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Identifying Engine-Driven SNe: an Optimized Radio Follow-up Strategy

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10.00-10.15 **J. Michael Burgess**
GRBs, Spectral Width, and Fitting Emission Models

10.15-10.30 **Jean-Luc Atteia**
The maximum isotropic energy of GRBs

10.30-10.45 **Christopher Irwin**
X-Ray Flares During the Steep Decay Phase from High-Latitude Subjets

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A study of GRBs with low luminosity afterglows

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Magnetic fields in GRBs

12.00-12.15 **Paz Beniamini**
Constraints on millisecond magnetars as the engines of prompt emission in GRBs

12.15-12.30 **Christina Thöne**
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17.00-17.15 **Rosa Becerra**
COATLI and DDOTI, the new telescopes to catch transients

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GW measurements of the merger and kilonova properties of GW170817

10.00-10.15 **Nial Tanvir**
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The Environment of GW170817 on Sub-Parsec to Kpc Scales

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EM counterparts of compact object binary mergers

11.45-12.15 **Stephan Rosswog**
Multi-Messenger signals from GW sources

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12.30-12.45 **Ariadna Murguia-Berthier**
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Merging Black Hole Binaries as GW Sources

15.00-15.15 **Jeff Andrews**
Binary Population Synthesis with Markov-Chain Monte Carlo

15.15-15.30 **Tassos Fragos**
1D hydrodynamic simulations of the CE phase: the formation of binary compact objects

15.30-15.45 **Enrique Moreno Méndez**
The jet-accretion feedback during CE with a compact object

15.45-16.00 **Aldo Batta**
On the formation of rapidly rotating BHs in High Mass X-ray Binaries

16.00-16.15 **Alejandro Vigna Gomez**
GW sources and Galactic double neutron stars via isolated binary evolution

16.15-17.00 **Discussion**

17.00 **Farewell**

2 Invited Talks

The Evolution of Core-Collapse Supernova Progenitor Models

Matteo Cantiello - *CCA, Flatiron Institute & Princeton University*

I will review the current status of our understanding of massive stars evolution, emphasizing both recent progress and areas where we still lack a physical picture of the dominating processes at work. I will discuss possible ways to move forward, stressing the emerging synergies between theoretical and computational efforts, and the new observational probes.

The Diversity of thermonuclear transients

Ryan Foley - *University of California, Santa Cruz*

Short gamma-ray bursts

Wen-fai Fong - *Northwestern University*

The high energy universe as seen by HAWC

Magda Gonzalez - *Instituto de Astronomía, UNAM*

The High Altitude Water Cherenkov (HAWC) observatory is a wide field-of-view TeV instrument. It has been operating since March 2015 from the Volcano Sierra Negra in the State of Puebla, Mexico, at an altitude of 4100 m. above sea level. HAWC operates continuously over a 95% of the time and observes two thirds of the TeV sky. HAWC sensitivity peaks at energies between $2-10$ TeV which is close to an order of magnitude higher than IACTs, making their observations complementary. After more than 2 years of operation, HAWC has achieved its second steady source catalogue with both, previously known and new sources, the observation of extended sources and, a search for TeV transient and variable sources as well as follow-up alerts from other instruments such as Fermi, LIGO, etc., among other results. This talk will present recent highlights from the first years of HAWC operations.

Magnetic fields in GRBs

Jonathan Granot - *The Open University of Israel*

Magnetic fields likely play an important role in most aspects of the GRB phenomena, from the launching and acceleration of the relativistic outflow, through the jet dynamics and stability, to the energy dissipation, particle acceleration and the production of the radiation that we observe. I will review some of the recent progress in our understanding of the role of magnetic fields in GRBs.

Neutrinos from astrophysical sources

Dafne Guetta - *ORT-Braude*

One of the key goals in high energy astrophysics is to understand the formation and the dynamics of astrophysical jets and discover the sources of Ultra High Energy Cosmic Rays (UHECR). Cosmic Rays are extremely high energy charged particles that travel the universe at nearly the speed of light. Though they were discovered nearly a century ago, the research community is still puzzled by the origin of these high energy particles. Since neutrinos rarely interact, huge detectors covering an area of more than 1 km^2 are required to make a statistically significant measurement. The South Pole in Antarctica is the host of IceCube, the first 1 km^2 scale high energy neutrino detector that was completed in 2011. In this talk I will review the main mechanisms that may lead to the production of High Energy Neutrinos (TeV-PeV) from astrophysical sources. I will give an overview on the characteristic of these emissions and an estimate of the fluxes and rates that can be detected at the future and present neutrino telescopes. I will discuss the constraints given on these sources from the results of IceCube and future ultra high energy telescope ARA.

Models of tidal disruption events

James Guillochon - *Harvard University*

Stripped Core-collapse Supernovae

Alexander Heger - *Monash University*

It is the current paradigm that massive stars - if single, if of not too high initial mass, initial metallicity, or initial rotation - are expected to keep their hydrogen-rich outer layers until their death and the typical Type II supernovae - in their different varieties - results as the star dies. That is a lot of ifs. In practise, as you may guess, some, if not several, of these conditions may be violated for many stars. It now known that most massive stars live in close binaries, close enough to interact in their lifetime, transfer mass and angular momentum, or even lose the envelope due to interaction with the companion stars, e.g., in a common envelope phase. We also know that stellar rotation leads to mixing; for very rapid rotation the star may evolve chemically homogeneous during hydrogen burning, with significant mixing possibly lasting until helium burning - significantly shrinking or even entirely removing the hydrogen envelope. Lastly, massive stars also blow winds from their surface, more fiercely the more massive, more metal-rich, or more luminous the star is. All of this leads to a different set of supernovae classes: stripped supernovae. These may range from objects just above the critical mass for core collapse all the way to very massive stars exploding as pair instability supernovae or making intermediate-mass black holes; stripped stars are also prime candidates for long-duration gamma-ray bursts as they are can be more compact than stars with hydrogen envelope. In this talk I will attempt to give an overview of core collapse supernovae that have lost the hydrogen-rich envelope, with focus on the progenitors and their evolution.

Particle acceleration mechanisms

Grzegorz Kowal - *Universidade Cruzeiro do Sul, Brazil*

The first observations of high-energy radiation, commonly known as cosmic rays, took place over one hundred years ago. Soon after the discovery of cosmic rays, Victor Hess in 1912 confirmed with his observations, that they are mostly of galactic or extra-galactic origin. Their origin and nature, however, still puzzles the modern astrophysics and is considered one of the unresolved problems. In the first part of my talk I will briefly describe what we know about the properties of cosmic rays from observations and discuss the physical mechanisms, such as diffusive shock acceleration and turbulence, believed to be responsible for accelerating thermal particles to high energies. Finally, in the last part I will present the results of our studies on first-order Fermi acceleration by fast turbulent reconnection.

Relativistic jets in high energy transients

Pawan Kumar - *University Texas, Austin*

Long duration Gamma-ray bursts

Andrew Levan - *University of Warwick*

It is now 50 years since the discovery of the first gamma-ray burst (GRB) and 20 years since the identification of the first multi wavelength afterglow. While these decades of intensive study have unveiled the answers to many questions about the origins of GRBs, new observations have continued to provide surprises, and suggest new questions and directions. I will review progress in studies of the progenitors of long duration GRBs, and highlights of their use as cosmological probes. I will also outline the central questions relating to long GRBs today, including the nature of their central engines, their role as multi-messenger probes, and their use as lighthouses into the era of the first stars.

GRB-supernova association

Raffaella Margutti - *Northwestern University*

GW: observations

Nergis Mavalvala - *MIT*

Super luminous Supernovae

Paolo Mazzali - *Liverpool University*

Electromagnetic counterparts of compact object binary mergers

Rosalba Perna - *University of Stony Brook*

Mergers of two compact objects in a binary, in addition to being sources of gravitational waves, may also be accompanied by strong electromagnetic radiation. I will discuss the expectations for double neutron star and neutron star-black hole mergers, and the evidence that they may be associated with short Gamma-Ray Burts. I will then speculate on the novel possibility that electromagnetic signatures may be produced also in the merger of two black holes.

Fast Radio Bursts: Recent Discoveries and Future Prospects

Emily Petroff - *ASTRON*

Fast radio bursts (FRBs) are quickly becoming a subject of intense interest in time-domain astronomy. FRBs have the exciting potential to be used as cosmological probes of both matter and fundamental parameters, but such studies require large populations. Advances in FRB detection using current and next-generation radio telescopes will enable the growth of the population in the next few years. Real-time discovery of FRBs is now possible with a significant number of FRBs now detected in real-time. I will discuss the developing strategies for maximising real-time science with FRBs as well as the properties of the growing FRB population. I will also discuss upcoming efforts to detect FRBs across the radio spectrum using a wide range of new and refurbished radio telescopes around the world and how these discoveries can inform next generation surveys and pave the way for the enormous number of FRB discoveries expected in the SKA era.

Merging Black Hole Binaries as GW Sources

Fred Rasio - *Northwestern University*

I will review recent work making theoretical predictions for the properties and merger rates of black hole binaries detectable by LIGO and Virgo. In particular I will contrast the properties of GW sources formed through the evolution of massive binaries in the field to those of sources assembled dynamically through gravitational interactions in dense star clusters, and I will discuss the prospects for distinguishing between these two formation channels with upcoming LIGO/Virgo observations.

Multi-Messenger signals from gravitational wave sources

Stephan Rosswog - *Stockholm University*

The role of accretion disks in transient sources

Alexander Tchekhovskoy - *Northwestern University*

3 Contributed talks

Unified progenitor models for long-duration gamma ray bursts and Type I superluminous supernovae

David R. Aguilera Dena[1], Norbert Langer[1], Takashi Moriya[2], Abel Schootemeijer[1] - *1. Argelander Institute for Astronomy, University of Bonn, 2. Division of Theoretical Astronomy, National Astronomical Observatory of Japan*

We model the late evolution and mass loss history of rapidly rotating Wolf-Rayet stars in the mass range 5 $M_{\odot}$ - 100 $M_{\odot}$. Such stars, when they are hydrogen-free and contain little helium, represent the prime progenitor candidates for long-duration gamma-ray bursts, superluminous supernovae and broad-line Type Ic supernovae. We obtain corresponding models from simulating rapidly rotating quasi-chemically homogeneously evolving single stars. We find that such models with enhanced mixing retain very little helium and are compatible with Type Ic supernovae. The relatively long post-core helium burning time scale in our lower mass models ($M < 20\ M_{\odot}$) allows for angular momentum transport, leading to core angular momenta in the range expected for magnetar driven SLSNe. Due to their faster contraction, our more massive models retain core angular momenta suitable to produce long-duration gamma-ray bursts in the collapsar scenario. Due to the absence of a significant helium envelope, the rapidly increasing neutrino emission after core helium exhaustion in our models leads to an accelerated contraction of the whole star. This contraction induces a strong spin-up, and centrifugally driven mass loss at rates of up to $10^{-2}\ M_{\odot}$/yr. Since the angular momentum transport in our lower mass models enhances the envelope spin-up, they show the largest relative amounts of centrifugally enforced mass loss, i.e., up to 25% of the expected ejecta mass. Our massive models evolve into the pulsational pair-instability regime, where again large amounts of CO-rich matter may be ejected preceding an expected engine-driven Type Ic supernova. Signs of such mass loss should be observable at early epochs of the supernova explosion, and may be related to bumps observed in the light curves of SLSNe, or the massive circumstellar CO-shell deduced for some SLSNe.

Binary Population Synthesis with Markov-Chain Monte Carlo

Jeff Andrews[1], Tassos Fragos[2], Andreas Zezas[1] - *1. FORTH/University of Crete, 2. Geneva Observatory*

With the detection of merging stellar mass black hole binaries (BHBHs) by the Laser Interferometer Gravitational-Wave Observatory (LIGO), the study of binary stellar evolution transformed almost overnight. As traditionally employed, binary population synthesis codes interpreting these merging systems have dif- ficulty generating sufficient statistics because merging BHBHs are exceedingly rare; only a small fraction of simulated systems evolve into binaries similar to those observed. I will introduce a fundamentally new approach to studying stellar binary populations that employs a Markov-Chain Monte Carlo algorithm to efficiently explore the binary evolution parameter space. In addition to being substantially more efficient than traditional methods for studying high mass binaries, I will demonstrate how this technique seamlessly incorporates observational constraints and their corresponding uncertainties.

Finally, using this algorithm I will demonstrate what we can learn about the merging BHBHs detected by LIGO under the assumption that they were formed through classical binary evolution channels.

Progenitors of Type IIn SNe

Jennifer Andrews, Nathan Smith - *University of Arizona*

Approximately 8-9% of core collapse supernovae (CCSNe) show the presence of narrow (100 km/s) hydrogen emission lines in their spectra, due to the photoionization or shock heating of the surrounding, slow moving circumstellar medium (CSM). These CCSNe are classified as Type IIn and while they all have narrow emission lines, they are far from homogeneous. They vary in peak absolute magnitude and some exhibit bright hydrogen emission for years or decades after explosion. To date, no definitive progenitor scenario seems to exist for these interacting SNe, and it is likely that they can arise from a wide variety of progenitor masses and mass-loss histories. Red supergiants and yellow hypergiants will have slower wind velocities and lower mass-loss rates than luminous blue variables, creating very different explosion environments. Many SNe IIn also have asymmetric CSM, whether it be bipolar or in the form of a disc or torus. Through continuous optical monitoring of a sample of IIn SNe we have found that the addition of CSM asymmetry in Type IIn SNe allows for a continuum among the non-super luminous IIn, and opens the door for RSGs to be common progenitors for all but the brightest SNe IIn.

The maximum isotropic energy of gamma-ray bursts

J-L. Atteia[1], V. Heussaff [1], J.-P. Dezalay[1], A. Klotz[1], D. Turpin[1], A.E. Tsvetkova[2], D.D. Frederiks[2], Y. Zolnierowski[3], F. Daigne[4], R. Mochkovitch[4] - *1. IRAP, 2. Ioffe Institute, 3. LAPP, 4. IAP*

The most energetic gamma-ray bursts (GRBs) are remarkable sources releasing huge amounts of energy on short timescales. Their prompt emission, which usually lasts few seconds, is so bright that it is visible across the whole observable universe. We present a study of the bright end of the isotropic energy distribution of long GRBs. We use two samples of long GRBs with redshift detected by Fermi/GBM or Konus-Wind, two instruments which measure the spectral shape and the energetics of the prompt emission accurately. We focus on GRBs within a range of redshifts z = $1-5$, a volume that contains a large number of energetic GRBs, and we propose a simple method to reconstruct the bright end of the GRB energy distribution from the observed one. We find that the GRB isotropic energy distribution requires a strong cutoff above 13×10^{54} erg. We attribute this feature to an intrinsic limit on the energy per unit of solid angle radiated by gamma-ray bursts, possibly due to a modification of the geometry of the jet when large amounts of energy are released by the central engine.

The nature of the soft X-ray emission of tidal disruption events.

Katie Auchettl[1], James Guillochon[2], Enrico Ramirez-Ruiz[3] - *1. OSU, 2. Harvard, 3. UCSC*

If a star passes within the tidal radius of a supermassive black hole, it will be disrupted, and subsequently accreted, producing a luminous X-ray flare. Over the last few decades, a significant number of tidal disruption events (TDEs) have been discovered, however for only a handful of these events has the X-ray emission from these source been studied in detail. In this talk, I will present the results of a comprehensive, systematic study of the soft X-ray emission from arising from TDEs, while highlighting observationally how the X-ray emission from these events differ from those of AGN. In particular, I will show that the X-ray emission of a TDE evolves significantly with time and decays with power-law indices that are much shallower than the canonical -5/3. In addition, I will show that the long lifetimes of TDEs are consistent with what one would expect from a main sequence star being disrupted by a viscously slowed BH with mass $< 10^7$ $M_\odot$, while the isotropic luminosities of jetted and non-jetted events are separated by a reprocessing valley, which we suggest is naturally populated by optical/UV TDEs whose X-ray emission is being reprocessed into lower energies.

Toward a near-infrared SN Ia Cosmology

Arturo Avelino[1], Andrew Friedman, Kaisey Mandel, Robert P. Kirshner, Peter Challis - *1. CfA, Harvard*

Observations of type Ia supernovae (SN Ia) in the near infrared (NIR) are a promising way to construct an accurate cosmic expansion history to constrain the properties of dark energy. SN Ia are more nearly standard candles in NIR than in optical bands, while dust absorption is less of a problem at NIR wavelengths. This allows us to investigate the dark energy properties in a way that is less sensitive to systematic errors due to the variations in the intrinsic brightness of SN Ia or the properties of dust in their host galaxies. In this talk we present the analysis and Hubble diagrams from the Y, J, H, and Ks NIR light curves of a sample of SN Ia in the redshift range $0 < z < 0.04$ observed in optical+NIR bands. We found that the scatter in the Hubble-diagram residuals after accounting for peculiar-velocity and photometric uncertainties is as small as 0.05 magnitudes without applying any light-curve or host-galaxy dust correction. In contrast, fitting the optical light curves of exactly the same set of supernovae with the standard SALT and SNooPy light-curve shape corrections and corrections for host extinction, we found a scatter of 0.15 magnitudes after accounting for peculiar-velocity and photometric uncertainties as well. When nearby SN Ia are combined with distant SN Ia observed in the NIR by the RAISIN-1 and RAISIN-2 HST programs (GO-13046 and 14216), we expect accurate and precise measurements of extragalactic distances, cosmological parameters, and better constraints on the dark energy equation of state. This work is supported by the National Science Foundation grants AST-1516854 and AST-1211196.

On the formation of rapidly rotating BHs in High Mass X-ray Binaries

Aldo Batta[1], Enrico Ramirez-Ruiz[1], Chris Fryer[2] - *1. UCSC, 2. LANL*

High mass X-ray binaries (HMXRBs) like Cygnus X-1, host some of the most rapidly spinning black holes (BHs) known to date, reaching spin parameters greater than 0.84. However, there are several effects that can severely limit the maximum BH spin parameter that could be obtained from direct collapse, such as tidal synchronization, magnetic core-envelope coupling and mass loss. Here we propose an alternative scenario where the BH is produced by a failed supernova (SN) explosion that is unable to unbind the stellar progenitor. A large amount of fallback material ensues, whose interaction with the secondary naturally increases its overall angular momentum content, and therefore, the spin of the BH when accreted. Through SPH hydrodynamic simulations, we studied the unsuccessful explosion of a $8M_{\odot}$ pre-SN star in a close binary with a $12M_{\odot}$ companion with an orbital period of 1.2 days, finding that it is possible to obtain a BH with a high spin parameter (larger than 0.8) even when the expected spin parameter from direct collapse is 0.3. This scenario also naturally explains the atmospheric metal pollution observed in HMXRB stellar companions.

COATLI and DDOTI, the new telescopes to catch transients.

Rosa Becerra - *Instituto de Astronomía, UNAM*

COATLI and DDOTI are the new robotic telescopes in the OAN-San Pedro Martir, Mexico. COATLI, the acronym to Corrector Optica Activa Tilt al Lmite de difraccion, is a ϕ = 50 cm telescope with two channels which work in *griz* bands. It will have images with the best optical quality in the OAN. COATLI, has a fast equatorial mount , then, is able to point in any position with a distance larger than 60° from cenital angle with an accuracy of 60" in less than 10 seconds. This makes it an ideal instrument to study the prompt emission of GRBs in the optical. On the other hand, DDOTI Deca-Degree Optical Transient Imager is a wide-field robotic imager consisting of six 28-cm telescopes with prime focus CCDs mounted on a common equatorial mount. Each telescope has a field of view of 12 square degrees with 2 arcsec pixels. The main goal of DDOTI is the localization of the optical transients (GRBs and GWs).

Constraints on millisecond magnetars as the engines of prompt emission in gamma-ray bursts

Paz Beniamini[1], Dimitrios Giannios, Brian D. Metzger - *1. George Washington University*

We examine millisecond magnetars as central engines of Gamma Ray Bursts (GRB) prompt emission. Using the proto-magnetar wind model of Metzger et al. (2017), we estimate the temporal evolution of the magnetization and power injection at the base of the GRB jet and apply these to different prompt emission models to make predictions for the GRB energetics, spectra and lightcurves. We investigate both shock and magnetic reconnection models for the particle acceleration, as well as the effects of energy dissipation across optically thick and thin regions of the jet. The magnetization at the base of the jet, σ_0, is the main parameter driving the GRB evolution in the magnetar model and the emission is typically released for $100 \leq \sigma_0 \leq 3000$. Given the rapid increase in σ_0 as the proto-magnetar cools and its neutrino-driven mass loss subsides, the GRB duration is typically limited to ≤ 100 s. This low baryon loading at late times challenges magnetar models for ultra-long GRBs, though black hole models likely run into similar difficulties without substantial entrainment from the jet walls. The maximum radiated gamma-ray energy is $\leq 5\times10^{51}$ erg, significantly less than the magnetars total initial rotational energy and in strong tension with the high end of the observed GRB energy distribution. However, the gradual magnetic dissipation model (Beniamini & Giannios 2017) applied to a magnetar central engine, naturally explains several key observables of typical GRBs, including energetics, durations, stable peak energies, spectral slopes and a hard to soft evolution during the burst.

GRBs, Spectral Width, and Fitting Emission Models

J. Michael Burgess - *Max-Planck-Institut for extraterrestrische Physik*

The spectral width and sharpness of unfolded, observed GRB spectra have been presented as a new tool to infer physical properties about GRB emission via spectral fitting of empirical models. Following the tradition of the line-of-death, the spectral width has been used to rule out synchrotron emission in a majority of GRBs. This claim is investigated via examination of both cataloged GRB spectra as well as reanalyzed spectra leading to the introduction of another empirical characterization of the spectra: the data width. This new auxiliary quantity is a direct measure of the folded datas width. Examination of the distribution of data widths suggests that a large fraction of GRBs can be consistent with synchrotron emission. To assess this prediction, a sample of peak-flux GRB spectra are fit with an idealized, physical synchrotron model. It is found that many spectra can be adequately fit by this model even when the width measures would reject it. Thus, the results advocate for fitting a physical model to be the sole tool for testing that model.

Identifying Engine-Driven Supernovae: an Optimized Radio Follow-up Strategy

Dario Carbone, Alessandra Corsi - *Texas Tech University*

How exactly massive stars die is still an open question as the zoo of supernovae (SNe) explosions is very wide and variegate. The most extreme and rare type of supernova explosion is an engine-driven supernova associated with relativistic ejecta (gamma-ray burst; GRB), and bright radio emission. In the near future, several synoptic optical surveys (e.g., ZTF and LSST) will offer the unprecedented opportunity of discovering larger samples of the rarest forms of core collapses. Therefore, we need to have an efficient radio follow-up plan to detect and correctly identify engine-driven SNe, as well as promptly distinguish them from other types of radio bright (but non-relativistic) explosions such as e.g. CSM-interacting SNe. In this talk, I will present two new statistical methods that allow us to quantify the efficacy of radio follow-up strategies in detecting and classifying radio bright SNe, as well as potential off-axis GRBs. These methods allow us to optimize the follow-up so as to maximize either the detection probability in general, or the accuracy in identifying relativistic events in particular. I will conclude by providing an example follow-up strategy that correctly identifies most of the relativistic SNe, about half the CSM-interacting SNe, and about a third of the off-axis GRBs.

Spectropolarimetry of Supernovae Ia

Aleksandar Cikota, Ferdinando Patat - *ESO*

Spectropolarimetric observations of SNe Ia allow us to (i) study the geometry of the ejecta by observing the polarization of absorption lines, and (ii) study the dust along the line of sight to SNe Ia by observing the ISM continuum polarization. Understanding the effect of dust extinction on SNe Ia is essential for accurate measurement of cosmological parameters and the expansion history of the Universe. Different studies of the host galaxies dust extinction from SNe Ia yielded diverse values of the absorption to reddening ratio, R v , ranging from R v = 1 to R v = 3.5 (see e.g. Cikota et al. 2016). Studies of dust along the lines of sight of SNe Ia might lead to conclusions on the progenitor system, because the single degenerate (SD) and double degenerate (DD) models imply different circumstellar environments. Furthermore, studeis of line polarization of SNe Ia might imply different explosion scenarios. Polarization models of SNe Ia predict different polarization signatures for the violent merger scenario, compare to the double-detonation and delayed-detonation models (Bulla et al. 2015, 2016). We will discuss the peculiar continuum polarization profiles of SNe Ia sight lines, and present preliminary results extracted from our spectropolarimetric observations of a sample of $\sim$ 35 SNe Ia observed with VLT at more than 120 epochs in total.

Magnetic reconnection particle acceleration and gamma-ray emission around black hole sources

Elisabete de Gouveia Dal Pino - *Instituto de Astronomia, Geofisica e Ciencias Atmosféricas, Universidade de Sao Paulo*

Particle acceleration induced by fast magnetic reconnection in the surrounds of black holes and their relativistic jets may help to solve current puzzles specially related to the interpretation of the very high energy emission they produce. In this talk, I will discuss this process in the framework of these sources, showing our recent results of analytical and multidimensional numerical MHD simulations with test particles.

A study of GRBs with low luminosity afterglows

Hüsne Dereli - *INAF*

We present a sample composed of the 41 faintest X-ray afterglows of the population of long Gamma- Ray Bursts (lGRBs) with known redshift. We study their intrinsic properties (spectral index, decay index, distance, luminosity, isotropic radiated energy and peak energy), and their luminosity distribution functions to assess whether they belong to the same population as the brighter afterglow events. We find that these events belong to a population of nearby events, different from the general population of lGRBs. In addition, these events are faint during their prompt phase, and include the few possible outliers of the Amati relation.

OCTOCAM: Gemini's future multichannel imager and spectrograph, optimized for transient studies

Antonio de Ugarte Postigo - *Instituto de Astrofísica de Andalucía*

OCTOCAM is an 8-chanel imager and spectrograph capable of obtaining simultaneous imaging in g,r,i,z,Y,J,H, and Ks bands of a field of view of 180"x180". It will also perform long slit spectroscopy covering the range with a resolution of ∼4000. Finally by using state of the art detectors OCTOCAM from 3700 to 23500 A will be able to perform high-time resolution observations and minimize the dead time between exposures. In this talk I will present the project, which is currently in the preliminary design phase, and discuss its scientific potential for the study of the transient sky.

Search of very high energy emission to constrain the physics of GRBs

Simone Dichiara, Magda González, Nissim Fraija - *Instituto de Astronomía, UNAM*

The nature emission coming from gamma-ray bursts (GRBs) up to very high energy is far to be fully understood. Especially the study of their GeV-TeV component represent one of the most challenging and important task needed to unveil the physics of these peculiar events. We perform a search of TeV emission coming from a sample of GRBs detected by Fermi and Swift satellite. Using the data collected by the HAWC observatory we search for possible extended or delayed signal with respect to the prompt phase. Under the framework of the external shock model scenario, we use the flux upper limits derived for each event to constrain the microphysical parameters and the bulk Lorentz factor. Theoretical interpretation will be discussed and the parameter constrains will be presented under different assumptions.

The Environment of GW170817 on Sub-Parsec to Kiloparsec Scales

Wen-fai Fong - *Northwestern University*

GW170817 marks the first direct detection of a merger of two neutron stars from gravitational waves, followed by the detection of electromagnetic emission across ten orders of magnitude in wavelength. GW170817 was localized to NGC4993, a galaxy in our own cosmic neighborhood, allowing us to study the properties of the merger and its environment in unprecedented detail. Here, I discuss the environment of GW170817 on sub-parsec to kiloparsec scales. I will present radio and X-ray observations, which constrains the make-up of the local environment, as well as HST observations and archival data, which constraints the galaxy-scale stellar population. I also discuss the inferred properties of the environment in the context of cosmological short GRBs.

A HST Search for the Binary Secondaries of Nearby Stripped-Envelope Supernovae

Ori Fox - *STScI*

Stripped-envelope supernovae (e.g., SNe IIb, Ib, and Ic) refer to a subset of core-collapse explosions with progenitors that have lost some fraction of their outer envelopes in pre-SN mass loss. Mounting evidence suggests that the mass loss in a large fraction of these systems must be due to binary interaction instead of stellar winds from single stars. The progenitors of stripped-envelope SNe, however, remain relatively unknown and ambiguous. An unbiased, statistically significant sample of companion-star characteristics (including deep upper limits) from post-explosion imaging can constrain the binary fraction, which impacts our understanding of both single star and binary evolution models. To date, however, only two possible detections have been made: SNe 1993J and 2011dh. Over the past year, we have improved this sample with an HST WFC3/NUV survey for binary companions of three additional nearby stripped-envelope SNe: 2002ap, 2001ig, and 2010br. I will present a review of previous companion searches and results from our current HST survey, which include one detection and two meaningful upper limits.

1D hydrodynamic simulations of the common envelope phase: the formation of binary compact objects

Tassos Fragos - *DARK/CTA, NBI, University of Copenhagen*

To date, the common envelope (CE) phase remains vital in our understanding of a wide variety of astrophysical problems, including the formation of XRBs, double compact objects, short and long gamma-ray burst progenitors, and type Ia supernova progenitors. The recent detection of gravitational waves from coalescing binary black holes sparked a renewed interest in the CE phase as one of the proposed formation channels, namely the "classical" binary evolution channel, requires a CE phase that will eject the envelope of the second-born black hole progenitor and bring the first-born black hole and the stellar core of the second-born BH in a close orbit. In this talk, I will present new 1D hydrodynamic models, that include heat, radiation and angular momentum transport, of the inspiral of compact objects, black holes or neutron stars, in the envelopes of massive giant stars. These models self-consistently follow the inspiral of the compact object and the ejection of the common envelope, while they avoid the use of free parameters such as the infamous CE and ad-hoc definitions of the core-envelope boundary, and lead to physical predictions of the end-state of the common envelope phase. Finally, they are computationally efficient, in contrast to 3D simulation, allowing for broader parameter studies.

PeV Neutrino and UHECRs connexion around the Lobes of the nearest radio galaxies (Cen A and Cen B)

Nissim Fraija - *Instituto de Astronomía UNAM*

Ultra-high-energy cosmic ray (UHECR) detections could give an indirect signal of PeV neutrino emission. Recently, Pierre Auger observatory reported the distribution of arrival directions of the highest energy cosmic rays in 10 years of operations. The IceCube neutrino telescope reported the detection of 54 extraterrestrial neutrinos in the High-Energy Starting Events catalog. The highest-energy neutrino event (IC35) reported in this catalog had an energy of $\sim$2 PeV and was located centered at RA=208.40 and DEC=-55.80 (J2000). Being Centaurus A and Centaurus B the nearest radio-loud active galactic nuclei and ones of the best potential candidates for accelerating cosmic rays up to 10^{20} eV, we investigate the possible association of UHECRs with the lobes of these radio galaxies and also the conditions so that the PeV-neutrino event (IC35) reported in the HESE catalog by the IceCube Collaboration could be associated to UHECRs detected by PAO around the giant radio lobes.

Lessons from the short GRB 170817A and off-axis emission from GRB jets

Ramandeep Gill - *The Open University of Israel*

The first-ever gravitational wave (GW) detection of a NS-NS merger was also accompanied by an electromagnetic counterpart - the short-hard GRB (sGRB) 170817A. This provided the long-awaited ”smoking-gun” that binary NS mergers produce short GRBs. Many key lessons about the nature of the merger remnant as well as properties of the relativistic outflows that power sGRBs can be learned from the multi-messenger signals from this unprecedented event. In this talk, I will present several pieces of evidence which suggest that this sGRB was powered by a jet with an energetic narrow core and less energetic wings extending to larger angles, viewed off-axis from well outside of the core where the prompt emission was produced by material along our line of sight. To support this hypothesis, I will show light curves from numerical simulations of a relativistic jet viewed off-axis and compare them with multi-wavelength observations of this event, which also provide valuable information about the jet’s energy, the external density, and the shock microphysical parameters. The small delay (1.74 sec) between the GW chirp signal and the sGRB onset presents a rare opportunity to infer the nature of the remnant that formed promptly after the merger. I will argue that that a long-lived ($>$ 2 sec) massive neutron star remnant is highly unlikely, while a short-lived ($<$ 1 sec) hyper-massive neutron star that later collapsed to a black hole is somewhat preferred over a direct black hole formation.

An Early Blue Bump for SN 2017cbv and Implications for Progenitors

Andy Howell - *University of California, Santa Barbara*

We present very early, high-cadence photometric observations of the nearby Type Ia SN 2017cbv. The light curve is unique in that it has a blue bump during the first five days of observations in the U, B, and g bands, which is clearly resolved given our photometric cadence of 5.7 hr during that time span. We model the light curve as the combination of early shocking of the supernova ejecta against a nondegenerate companion star plus a standard SN Ia component. Our best-fit model suggests the presence of a subgiant star 56 RŁ from the exploding white dwarf, although this number is highly model-dependent. While this model matches the optical light curve well, it overpredicts the observed flux in the ultraviolet bands. This may indicate that the shock is not a blackbody, perhaps because of line blanketing in the UV. Alternatively, it could point to another physical explanation for the optical blue bump, such as interaction with circumstellar material or an unusual nickel distribution. Early optical spectra of SN 2017cbv show strong carbon

(C II 6580) absorption up through day -13 with respect to maximum light, suggesting that the progenitor system contains a significant amount of unburned material. These early results on SN 2017cbv illustrate the power of early discovery and intense follow-up of nearby supernovae to resolve standing questions about the progenitor systems and explosion mechanisms of SNe Ia.

X-Ray Flares During the Steep Decay Phase from High-Latitude Subjets

Christopher M. Irwin[1,2], Ehud Nakar[1], Tsvi Piran[2] - *1. Tel Aviv University, 2. Hebrew University of Jerusalem*

In addition to rapid variability during the prompt phase, many gamma-ray bursts show flaring in X-rays during the afterglow phase between 10^2 and 10^6 seconds. We discuss observational evidence suggesting two distinct types of X-ray flares: early flares that peak at t = $100 - 3000$ s, with a duration dt $\sim$ 0.2 t and a luminosity that tracks the steep decay phase of the afterglow; and late flares peaking after $\sim$3000 s, with dt$\sim$t and a shallower luminosity decay. Interestingly, we find that bursts with late flares tend to have irregular afterglows that lack a steep decay, hinting at a different physical origin for bursts with late flares. Motivated by several strong similarities between early X-ray flares and the pulses observed during the prompt phase, we consider a subjet model in which both the prompt pulses and the early X-ray flares are produced by emitters that move with a randomly oriented, relativistic comoving Lorentz factor within an expanding relativistic shell. By extending previous work on subjets to high latitudes (i.e., to viewing angles larger than the inverse of the bulk shell Lorentz factor), we are able to reproduce the observed duration and the average light curve of early flares, thereby constraining the shell and emitter properties. Our results are consistent with existing subjet models for the prompt emission, with both requiring the emitting material to have a Lorentz factor of a few tens in the comoving frame. While the high-latitude model provides a plausible explanation for early X-ray flares that links them to the prompt emission, a different physical mechanism, possibly related to late engine activity, must be responsible for flares observed long after the steep decay.

Accretion in GRB central engine

A. Janiuk[1], K. Sapountzis[1], K. Wojczuk[2] - *1. CFT PAS, 2. Warsaw University*

We study the structure and evolution of the accreting plasma in gamma ray burst central engines. The modeling is based on the general relativistic MHD simulations. The nuclear equation of state adequate for dense and degenerate plasma can be incorporated to the numerical scheme. Plasma is cooled by neutrinos and energy is extracted from the rotating BH by magnetic fields. We discuss our results in the frame of the observable GRBs, and speculate about the origin of variability in observed GRB emission. We also discuss the possible contribution of elements synthesized in the winds launched from GRB engine to the kilonova emission.

Tidal disruption events in the presence of pre-existing accretion disks

Adithan Kathirgamaraju, Rodolfo Barniol Duran, Dimitrios Giannios - *Purdue University*

Numerous tidal disruption event (TDE) candidates originating from galactic centres have been detected (e.g., by Swift and ASASSN). Some of their host galaxies show typical characteristics of a weak active galactic nucleus (AGN), indicative of a pre-existing accretion disc around the supermassive blackhole (SMBH). In this work, we develop an analytic model to study how a pre-existing accretion disc affects a TDE. We assume the density of the disc $\rho \propto R^{-\lambda}$, R being the radial distance from the SMBH and varying between 0.5 - 1.5. We show that interactions between the pre-existing accretion disc and the stream of the tidally disrupted star can cause a sudden drop in the rate of fallback of gas onto the SMBH. The interactions considered in this work are caused by shocks, Kelvin-Helmholtz instabilities and momentum imparted by the disc onto the stellar stream. These interactions could explain the steep cut-off observed in the light curve of some TDE candidates (e.g., Swift J1644 and J2058). With our model, it is possible to use the time of this cut-off to constrain some properties pertaining to the pre-existing accretion disc, such as and the disc viscosity parameter . Therefore, our theory enables us to use TDE observations to probe pre-existing accretion disks at sub-parsec scales. We demonstrate this by applying our theory to the TDE candidates Swift J1644, J2058 and ASASSN-14li. Our analysis favors a disc profile with 1 for viscosity parameters 0.01 0.1 for the Swift cases, and profiles of R^{-1} or steeper for the case of ASASSN-14li.

Optical discovery and follow-up of kilonovae

Charles D. Kilpatrick - *UCSC*

11 hours after the LIGO and Virgo collaboration detected GW170817, the first detection of gravitational waves from a binary neutron star merger, my team, the One-Meter Two-Hemisphere (1M2H) collaboration, discovered the optical counterpart Swope Supernova Survey 2017a (SSS17a). Within 24 hours of this discovery, follow-up observations spanning the electromagnetic spectrum confirmed that SSS17a was the counterpart to GW170817 and that it was a kilonova resulting from r-process material generated in the merger. I will discuss our observing strategy for finding SSS17a, which involved targeting high-mass galaxies within the LIGO/Virgo error volume and enabled rapid identification and follow up of the optical counterpart, including the only optical spectrum of a kilonova within 24 hours of merger. I will discuss application of this strategy to future gravitational wave sources, especially for more distant sources in an expanded LIGO/Virgo binary neutron star detection volume. Finally, I will discuss the optical and near-infrared properties of SSS17a, which involved a combination of both “blue” and “red” kilonova emission, which will inform the timescales and luminosities of sources for future GW-targeted kilonova searches.

The SVOM Gamma-ray Burst mission

C. Lachaud - SVOM consortium

Scheduled for a launch in 2021, SVOM (Space-based multi-band astronomical Variable Objects Monitor) is a Sino-

French space mission dedicated to the study of the transient sky, focusing on the Gamma-Ray Bursts (GRBs). The satellite payload encompasses a coded-mask telescope operating in the 4-150 keV energy range for real-time detection and localization of all known types of GRBs, a non-imaging gamma-ray monitor extends the GRB spectroscopy up to MeV energies, and two narrow-field follow-up telescopes to refine the GRB positions and to study their afterglow emission in the X-ray and visible bands.The pointing strategy of the satellite has been optimized to favor the detection of GRBs located in the night hemisphere, in order to enhance ground-based observations in the first minutes and to facilitate GRB redshift measurements by the largest telescopes. The SVOM ground segment combines a wide-field camera to catch the GRB prompt emission in the visible band and two robotic telescopes to measure the photometric properties of the early afterglow in the NIR/visible band. We will present the scientific objectives of the SVOM mission, the operations, the instruments and their expected performance for GRB studies. We will also outline the prospects for GRB science with SVOM in the context of the multi-wavelength and multi-messenger panorama for the next decade.

Numerical simulations of dynamics and radiation from gamma-ray bursts

Davide Lazzati - *Oregon State University*

Gamma Ray Burst (GRB) jets, their dynamical evolution, and their radiative properties are very complex. Arising from a compact engine, they propagate through a dense environment, and eventually radiate away their internal energy. The light we see is therefore a superposition of multiple radiation mechanisms and of emission from a range of zones with different physical conditions. Global numerical simulations of GRB Jets and radiation transfer through them are therefore an invaluable tool to disentangle the burst complexity and to test theories on the burst physical ingredients. In this talk I will present the results of a set of global hydrodynamic and Monte Carlo radiation transfer simulations of longand short-duration GRB jets. I will present synthetic light curves and spectra, with and without contribution from non-thermal particles and magnetic field. I will compare the results to individual burst observations as well as to ensemble correlations to tease out what radiation mechanisms and physical conditions explain the observations. I will finally discuss the prospect of using numerical simulations of this kind to predict the multimessenger signal from these events, especially from the case of short bursts, for which gravitational waves are expected and very high energy neutrinos might be detectable in favorable circumstances.

Radiation Mechanism of Fast Radio Bursts

Wenbin Lu, Pawan Kumar - *UT Austin*

Two general types of coherent emission mechanisms for fast radio bursts (FRBs) are considered maser and antenna mechanisms. We use the observed properties of FRBs to constrain the physical conditions needed for these two mechanisms. The most favorable case is curvature antenna mechanism near the surface of a magnetar.

A Circumstellar Shell around a Superluminous Supernova Revealed in a Light Echo

Ragnhild Lunnan[1], Claes Fransson[1], and the intermediate Palomar Transient Factory collaboration - *1. The Oskar Klein Centre & Department of Astronomy, Stockholm University, Sweden*

Superluminous supernovae (SLSNe) are a rare class of transients with peak luminosities 10-100 times those of normal core-collapse and Type Ia SNe, and whose progenitors and energy sources are still debated. Here, I will report on a surprising result from a late-time spectroscopic survey of SLSNe: the discovery of a shell of circumstellar material (CSM) around the SLSN, revealed by both absorption and subsequent re-emission in Mg II from the shell, in an echo of the SLSN light. The blueshift of the absorption lines allow us to measure the velocity of the CSM shell, while the time delay between the blueshifted and redshifted emission lines directly constrains the size of the shell. While pre-supernova mass loss is not uncommon in massive stars, this kind of observation is nearly unique, with the closest observed analogue being the ionization of the ring around SN1987A by the supernova flash. I will discuss both the circumstances that allowed us to observe it in this particular instance, and the implications for SLSN progenitors and mass loss mechanisms. In this case, the high shell velocity (3000 km/s) and implied time of the eruption (50 years prior to explosion) may point to a pulsational pair-instability origin.

Weighing black holes with TDEs

Brenna Mockler[1], James Guillochon[2], Enrico Ramirez-Ruiz[1] - *1. UC Santa Cruz, 2- Harvard-Smithsonian Center for Astrophysics*

While once rare, observations of tidal disruption events are quickly becoming commonplace. To continue to learn from these events it is necessary to robustly and systematically compare our growing number of observations with theory. Here we present a tidal disruption module for the new Modular Open Source Fitter for Transients (MOSFiT) and the results from fitting 12 tidal disruption events (TDEs). Our model uses hydrodynamical simulations to generate accretion rates and passes these accretion rates through viscosity and light reprocessing modules to get theoretical light curves. It then uses an MCMC fitting code to compare these theoretical light curves with observations. This procedure provides a relatively robust method for measuring the masses of supermassive black holes because the shape of a TDE light curve depends strongly on the black holes mass. We find that the events we fit have black hole masses in the range from 1×10^6 1×10^8 $M_\odot$, and that the masses we derive are mostly consistent with other methods used in the literature. We also find that none of the events appear to show long viscous delays, supporting the theory that our current observing strategies are missing a significant fraction of viscously delayed events.

The jet-accretion feedback during common envelope with a compact object.

Enrique Moreno - *UNAM*

A large percentage of massive stars are part of a binary system which will interact. It is evermore clear that binary interactions are a very important, if not critical, ingredient in the formation of many transient phenomena, e.g., sort and long GRBs, GWs, SNe, HNe, kNe, etc. Thus, the importance of understanding the common envelope (CE) phase is hard to overstate. We study the interaction between a jet and a stellar envelope focusing in the particular cases where a giant star engulfs a compact object; we include the cases of a NS, as well as that of a BH. We further study the feedback between the jet-induced cocoon and the accretion rate. We discuss the implications this may have in partially or fully removing the CE. We find that the energy, luminosity, as well as the timescale, are in line with those of ultra-long GRBs. Thus, we suggest CE events of a red-giant or supergiant with a BH or NS are interesting candidates for this rare type of GRB, and/or an exotic, high-energy, transient.

Unraveling GW170817: shedding light on the neutron star binary merger

Ariadna Murguia-Berthier - *University of California, Santa Cruz*

LIGO recently discovered gravitational waves from a binary neutron star merger, mark- ing the beginning of a new era in high energy astrophysics. Aside from the gravitational wave signal, the event was serendipitously observed in the entire electromagnetic spectrum. In my talk I will argue the non-thermal processes that describe the nature of the relativistic ejecta can be probed by the γ-ray, X-rays and radio observations, while the thermal processes, originated in the decay of r-process elements from material torn from the system can be probed by the optical and infra-red observations. I will discuss how the prompt emission and multi-wavelength observations are consistent with a typical short γ-ray burst seen off-axis.

A Unifying Explosion Condition for Core-collapse Supernovae

J. Murphy, Q. Mabanta, J. Dolence - *Florida State University*

The fundamental challenge in core-collapse supernova (CCSN) theory is to explain why massive stars explode. We present a new integral condition for explosion that provides a deeper understanding of why stars explode. This explosion condition is a promising explodability measure for CCSN simulations. As a result, this condition provides a means to quantitatively explore which physical effects enable explosion. For example, using this condition, we show how turbulence enables core-collapse supernova explosions. An important result in core-collapse supernova (CCSN) theory is that spherically-symmetric, one-dimensional simulations fizzle, while multi-dimensional simulations explode. Recent multi-dimensional investigations suggest that turbulence eases the condition for explosion, but how has not yet been clearly defined. We develop a turbulence model for neutrino-driven convection, show that this turbulence model reduces the condition for explosions in concordance with multi-dimensional simulations, and identify which turbulent terms enable explosions. We find that turbulent ram pressure is not the dominant factor in reducing the condition for explosion. Instead, we find that there are many contributing factors, turbulent dissipation being the dominant.

Gravitational-wave measurements of the merger and kilonova properties of GW170817

Chris Pankow[1], Eve Chase, Scotty Coughlin, Monica Rizzo, Vicky Kalogera, Raffaella Margutti, Adam Miller - *1. CIERA / Northwestern University*

GW170817/GRB170817A was a watershed moment for multi-messenger astronomy and the astrophysics of neutron stars. In addition to the first discovery of a binary neutron star in gravitational waves and confirming the long-held association of short GRB with neutron star mergers, a wealth of observations of the post-merger dynamics in several electromagnetic bands has allowed a nearly full picture of the previously elusive phenomena of kilonova. This was enabled by the detection of the inspiral in gravitational waves, spurring a momentous effort to determine the properties of the pre-merger binary. I will describe the gravitational-wave measurement of the properties of the binary from its inspiral. Then I will explain how, in tandem with studies in numerical relativity, one can determine the properties of the kilonova which are consistent with those inferred from electromagnetic observations. In the future, this information can be synthesized with electromagnetic data to further constrain the neutron star equation of state as well as independently aid in observational campaigns for binaries detected in gravitational waves.

Blazars in outburst as probes of extragalactic jets formation and propagation

Elena Pian - *INAF, IASF Bologna & Scuola Normale Superiore, Pisa*

I will review the state of the art of blazar observations and model results in an attempt to identify the emission mechanisms and jets composition in these sources. Their relationship with other AGNs and the clues from multi-messenger information will also be covered.

The tidal disruption event ASASSN-14li and its host resolved with high-resolution radio observations

Cristina Romero Cañizales - *Núcleo de Astronomía, Universidad Diego Portales*

It is well established that the merger among gas-rich galaxies can trigger both starbursts and the onset of an active galactic nucleus (AGN). We present results on European very long baseline interferometry (VLBI) Network (EVN) observations toward PGC043234, a post-starburst galaxy which seems to be the remnant of a merger with current negligible star formation. This system recently hosted the tidal disruption event (TDE) ASASSN-14li. Our EVN observations have allowed us to resolve the system into two components 2pc apart. The components resemble a core-jet/outflow system, whose secondary component can be related directly to ASASSN-14li, if its motion is superluminal, or to a past AGN flare or TDE if its motion is subluminal. The exciting possibility exists that both components are instead a binary BH system. These possibilities will be tested in upcoming EVN observations, from which we will show preliminary results.

Interpreting the spectral properties of tidal disruption events

Nathaniel Roth[1], Daniel Kasen[2] - *1. University of Maryland, 2. UC Berkeley*

Wide-field optical surveys are detecting TDEs at optical wavelengths, but the origin of this optical emission remains poorly understood. Discriminating between various models for this emission requires careful analysis of the observed spectra, which display a large amount of diversity. I will present results from radiative transfer calculations designed to connect the underlying hydrodynamics of the disrupted star to what is observed, showing how the combined effects of electron scattering and gas kinematics can shape the line profiles. In particular, I will demonstrate how the line profiles from several TDE spectra can be interpreted as evidence for massive, radiatively launched outflows.

Emission from accelerating jets in GRBs

Felix Ryde, Christoffer Lundman, Zeynep Acuner - *KTH Royal Institute of Technology*

We will discuss the narrowest spectra expected from gamma-ray bursts. We will present an analytical function for the spectrum that is emitted from the photosphere of a radiation-dominated flow that is under acceleration and numerical spectra from photospheres occurring during the transition into the coasting phase of the flow. Using these spectral models, we reanalyse Fermi observations of GRB100507 and GRB101219 and show that the bursts can be fitted by the spectral models: For GRB101219 the spectrum is consistent with the photosphere occurring below or close to the saturation radius, while for GRB100507 the photosphere position relative to the saturation radius can be determined as a function of time. In the latter case, we find that the photosphere initially occurs in the acceleration phase and thereafter transitions into the coasting phase. We also find that this transition occurs at the same time as the change in observed cooling behaviour: the temperature is close to constant before the break and decays after. We argue that such a transition can be explained by an increasing mass outflow rate. Both analysed bursts thus give strong evidence that the jets are (initially) radiation dominated.

A Common Central Engine for Long-Soft Gamma Ray Bursts and Type Ib/c Supernovae?

E. Sobacchi[1,2], J. Granot[2], O. Bromberg[3], M.C. Sormani[4] - *1. Ben Gurion University of The Negev, 2. The Open University of Israel, 3. Tel Aviv University, 4. Heidelberg University*

Long-duration, spectrally-soft Gamma-Ray Bursts (GRBs) are associated with Type Ic Core Collapse (CC) Supernovae (SNe), and thus arise from the death of massive stars. In the collapsar model, the jet launched by the central engine must bore its way out of the progenitor star before it can produce a GRB. Most of these jets do not break out, and are instead choked inside the star, as the central-engine activity time, te, is not long enough. Modelling the long-soft GRB duration distribution assuming a power-law distribution for their central-engine activity times, $\sim$ t_e^{-a} for $t_e > t_b$, we have found a steep distribution (a$\sim$4) and a typical GRB jet breakout time of $t_b \sim 60$s in the stars frame (Sobacchi et al. 2017; arXiv:1705.00281). The latter suggests the presence of a low-density, extended envelope surrounding the progenitor star, similar to that previously inferred for low-luminosity GRBs. Extrapolating the range of validity of this power law below what is directly observable, to $t_e < t_b$, by only a factor of $\sim 4 - 5$ produces enough events to account for all Type Ib/c SNe. Such extrapolation is necessary to avoid fine-tuning the distribution of central engine activity times with the breakout time, which are presumably unrelated. We speculate that central engines launching relativistic jets may operate in all Type Ib/c SNe. In this case, the existence of a common central engine would imply that (i) the jet may significantly contribute to the energy of the SN; (ii) various observational signatures, like the asphericity of the explosion, could be directly related to jets interaction with the star.

Ultra-stripped Type Ic supernovae generating double neutron stars

Yudai Suwa[1], Takashi Yoshida[2], Masaru Shibata[1], Hideyuki Umeda[2], Koh Takahashi[3] - *1. YITP, 2. U. of Tokyo, 3. U. Bonn*

Double neutron star (NS) system is a strong source of gravitational wave and expected to be detected via gravitational waves near future. The event rate of double NS merger is still uncertain. However, since NSs are generated by supernovae (SNe), we would be able to give constraint on double NS merger rate with supernova observations. There are candidates of SNe generating double neutron star systems. They are called ultra-stripped SNe whose ejecta mass, O(0.1) $M_\odot$, is much smaller than that of canonical SNe, O(1) $M_\odot$, which would be a natural consequence of close binary interactions. In this talk, I will show explosion characteristics of ultra-stripped supernovae. As a first step, stellar evolutionary simulations of bare carbon-oxygen cores of mass from 1.45 to 2.0 $M_\odot$ are performed until the iron cores become unstable and start collapsing. Then, axisymmetric hydrodynamics simulations with spectral neutrino transport are followed. All models exhibit successful explosions driven by neutrino heating. The diagnostic explosion energy, ejecta mass, and NS mass are typically $\sim 10^{50}$ erg, ~ 0.1 $M_\odot$, and ~ 1.3 $M_\odot$, which are compatible with observations of rapidly evolving and luminous transient such as SN 2005ek. We also find that the ultra-stripped SN is a candidate for producing the secondary low-mass NS in the observed compact binary NSs like PSR J0737-3039. In addition, based on hydrodynamic simulations, we perform nucleosynthesis calculations that leads to trans-iron elements, and calculate light curves of consequent SNe.

Dynamical evolution of supernova ejecta powered by a central engine in multi-dimension

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One of the remarkable results of recent un-biased transient surveys is the discovery of superluminous super- novae, a special class of extremely bright supernovae. Hydrogen-poor superluminous supernovae are among the most mysterious, because of their still unknown energy source. A plausible scenario for the extreme brightness of hydrogen-poor supernovae assumes that the compact object (neutron star or black hole) left at the center of the supernova ejecta deposits additional energy in some way to give rise to bright emission. We have recently been working on multi-dimensional simulations of dynamical evolution of supernovae ejecta powered by the central energy source. When the total amount of the injected energy is much larger than the original kinetic energy of the supernova ejecta, the energy redistribution process in the ejecta associates with multi-dimensional turbulent motion and efficient mixing of the ejecta. We present recent results of our numerical calculations and discuss their implications for observations of hydrogen-poor superluminous supernovae.

Searching for signs of circumstellar interaction in supernovae: a mid-IR investigation

Tamas Szalai - *University of Szeged, Hungary*

Observing the interaction of supernova (SN) ejecta with the circumstellar matter (CSM) offers a chance to find answers to some open questions concerning the final stages of stellar evolution. In the cases of stripped-envelope (Type Ib/c and IIb) core-collapse SNe (SE CC SNe), both the transition to and the duration of the pre-explosional phases can be probed via revealing the mass-loss history of the progenitor. In thermonuclear explosions of C/O white dwarfs, called SNe Ia, the key-question is the presence of any CSM, which could serve as an evidence in a long-term debate about which fraction of Ia progenitor systems contain a non-degenerate, H-rich companion (known as single-degenerate scenario). In Type Ia or SE CC SNe, CSM interaction could lead to either an IR echo or dust formation that both induce late-time mid-IR excess. Recently, the Spitzer Space Telescope has been the most essential tool to detect mid-IR radiation of SNe and to follow the years-long evolution of these objects. Within the framework of targeted surveys, more than 200 SNe has been followed with Spitzer to date; however, there are even more SNe that have been captured during non-targeted surveys. Here we present the results of a comprehensive study based on archive Spitzer data of more than 900 Type Ia and SE CC SNe including 30 objects with previously unpublished detection in mid-IR. While some of the studied objects have quite interesting behaviour in mid- IR, only a small fraction ($< 10\%$) of the detected SNe shows clear signs of CSM interaction, in agreement with the results of other surveys carried out in different wavelength-ranges.

Kilonova/Macronova Emission from Neutron Star Mergers

Masaomi Tanaka - *National Astronomical Observatory of Japan*

Kilonova/macronova,optical and near-infrared emission powered by radioactive decays of r-process nuclei, is one of the most promising electromagnetic counterparts to gravitational sources. The opacity in the ejecta is a key factor to determine the emission properties, but lack of systematic atomic data limits our understanding. We recently performed new set of atomic structure calculations and performed detailed radiative transfer simulations with the new atomic data. For various element abundances, we study expected properties of kilonova/macronova emission, such as brightness, color, and timescale. We show that the presence of post-dynamical ejecta (e.g., viscosity-driven wind) can enhance optical brightness by > 2 mag, and that such emission reaches the observed magnitudes of 21.0 mag (100 Mpc) and 22.5 mag (200 Mpc) in optical, which can be detectable with 1m or 2m-class telescopes.

Observing kilonovae associated with compact binary mergers: lessons from GW170817

Nial Tanvir - *University of Leicester*

The electromagnetic detection of events that are also detected as gravitational wave (GW) sources has long been a "holy grail" of astrophysics, allowing, as it does, determination of redshifts, distance estimates and characterisation of galactic environments and linking these to source properties. This ambition was finally realised in August 2017 with the discovery of the binary neutron star merger GW170817 by LIGO/Virgo, and the subsequent detection of counterparts across the electromagnetic spectrum. I will review what we have learnt from this event, particularly regarding the UV/optical/IR kilonova emission, and consider implications for future studies.

Hydrogen-rich supernovae beyond the neutrino-driven core-collapse paradigm

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Type II supernovae (SNe) are the final stage of massive stars (above $\sim$8 $M_\odot$) which retain part of their hydrogen-rich envelope at the moment of explosion. They typically eject up to 10-15 $M_\odot$ of material, with energies of the order of 10^{51} erg and peak magnitudes of -17.5 mag. Although more luminous events are commonly discovered, their explosion energies are mostly in the range of a few times 10^{51} erg, explainable by neutrino-driven explosions and neutron star (NS) formation. We present our study of OGLE-2014-SN- 073, one of the brightest non-interacting Type II SN ever discovered, with an unusually broad lightcurve combined with high ejecta velocities. From our hydrodynamical modelling we infer a remarkable ejecta mass of 60 $M_\odot$, and a relatively high explosion energy of 12.4 x 10^{51} erg. We show that this object belongs, with a very small number of other hydrogen-rich SNe, to an energy regime that is not explained by standard core- collapse neutrino-driven explosions. We compare the quantities inferred by the hydrodynamical modelling with the expectations of various exploding scenarios, trying to explain the high energy and luminosity released. We find some qualitative similarities with pair-instabilities SNe, although a prompt injection of energy by a magnetar seems also a viable alternative to explain such extreme event. This is an object with no precedent in literature and it has the potential to stand as the archetypal of a new category.

Abundances and kinematics in GRB hosts in 3D

Christina Thöne - *HETH/IAA-CSIC*

Long GRBs are connected to massive star-formation and possibly require other special circumstances such as low metallicites, as has been claimed by progenitor modeling. GRB hosts are hence star-forming galaxies but most of these hosts remain unresolved due to their large distances. This also makes it difficult to determine whether the properties of the entire host reflect appropriately the properties at the GRB site. Here we present the most recent results from two samples of integral-field spectra of GRB hosts using FLAMES and MUSE that allow us to study those hosts at both high spatial and spectral resolution. In particular, we compare the properties of the GRB site with other regions in the host and its global properties to determine whether we can infer anything on the measurements of unresolved hosts on the properties of GRB progenitors. Although GRB sites are somewhat less extreme in terms of metallicity, age and star- formation than demanded by progenitor models, they tend to occur is the more extreme regions in their hosts. In addition, kinematical studies reveal frequent outflows and interesting kinematics even in the smallest GRB hosts. Finally, we will also put this into context of other massive stellar explosion hosts and their properties, in particular super-luminous SN hosts. Future facilities will soon allow us to extend these studies to higher redshift to study possible differences.

The first supernovae in the early Universe: radiation hydrodynamics simulations

Alexey Tolstov - *Kavli IPMU, The University of Tokyo*

Nowadays in the nearby Universe telescopes detect about 10 supernovae (SNe) per day. All these SNe lead to the formation of metal-rich stars in billions of years after the explosion. In the coming years in the distant Universe or metal-free gas pockets we expect the detection of the first SNe. Their progenitors are zero-metal, compact stars and the explosion leads to the formation of metal-poor stars in next generation. The first SN explosions have strong dynamical, thermal, and chemical feedback on the formation of subsequent stars and evolution of galaxies. The question is how to identify first SNe? How do they explode? Using the observed abundance patterns of the metal poor stars we perform numerical simulations to find the difference between the first and normal SNe. We find that first SNe are usually bluer, shorter and fainter. The peculiarities of the color evolution can be used as easy-to-use indicator of the first SNe by current and future surveys.

Tackling the origin of GRBs and SLSNe through the study of their host galaxies

S.D. Vergani - *CNRS, Paris Observatory*

Despite their extremely powerful explosions, our knowledge on the progenitors of LGRBs and SLSNe remains very poor. Indeed, massive stars can end their lives in very different ways. Mass, binarity, metallicity, rotation rate, mass-loss and magnetic fields play critical roles in determining the final fate of a star. In most cases it is not possible to have direct observation of the star before its explosion, making the progenitors of different classes of cosmic explosions still unknown. This is the case for LGRBs and SLSNe. Indirect information on the progenitor star conditions of both phenomena can be inferred by the study of the properties of their host galaxies. I will present the results of our recent studies which took advantage of both photometry and spectroscopy of carefully selected samples of SLSN and LGRB host galaxies, as the Swift/BAT6 complete sample of LGRBs up to $z\sim3$. I will show in particular which are the implications of our results on the properties of the progenitor stars of both classes of objects (binarity, metallicity, masses,...), that can be tested by theoretical progenitor models.

Gravitational-wave sources and Galactic double neutron stars via isolated binary evolution

A. Vigna-Gómez[1], J. Barrett, I. Mandel, C. Neijssel, S. Stevenson - *University of Birmingham*

Advanced LIGO has detected gravitational waves from three binary black holes mergers, GW150914, GW151226 and GW170104, as well as the statistically less significant binary black hole merger candidate LVT151012. These new gravitational wave source join the population of known double compact objects, which also include Galactic double neutron stars. I will show how isolated binary evolution is able to explain the population of double compact objects using the rapid population synthesis element of the COMPAS suite. I will discuss how can we use observations of double compact objects to understand the life and death of binary stars.

Discovery of the X-ray Counterpart to GW170817.

Alan Watson - *Instituto de Astronomía, UNAM*

The discovery of GW170817 by LIGO/VIRGO has ushered in a new era in relativistic astrophysics with the simultaneous detection of the associated electromagnetic counterpart in GRB170817A. We report our discovery of the X-ray counterpart with Chandra and multi-wavelength modeling of the source, consistent with the GW picture of the merger of two neutron stars which produced a short gamma-ray burst viewed off-axis and an associated kilonova resulting from the ejection of neutron-rich matter and the subsequent nucleosynthesis. Taken as a whole, this rich data set confirms the long-held idea that compact object mergers do indeed power short GRBs, while providing unique insight into the creation of heavy elements in the universe and the evolution of massive stars.

The Three-dimensional Expansion of the Ejecta from Tycho's Supernova Remnant

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We present the first 3D measurements of the velocity of various ejecta knots in Tychos supernova remnant, known to result from a Type Ia explosion. Chandra X-ray observations over a 12 yr baseline from 2003 to 2015 allow us to measure the proper motion of nearly 60 tufts of Si-rich ejecta, giving us the velocity in the plane of the sky. For the line-of-sight velocity, we use two different methods: a nonequilibrium ionization model fit to the strong Si and S lines in the 1.2-2.8 keV regime, and a fit consisting of a series of Gaussian lines. These methods give consistent results, allowing us to determine the redshift or blueshift of each of the knots. Assuming a distance of 3.5 kpc, we find total velocities that range from 2400 to 6600 km s^{-1}, with a mean of 4430 km s^{-1}. We find several regions where the ejecta knots have overtaken the forward shock. These regions have proper motions in excess of 6000 km s^{-1}. Some SN Ia explosion models predict a velocity asymmetry in the ejecta. We find no such velocity asymmetries in Tycho, and we discuss our findings in light of various explosion models, favoring those delayed-detonation models with relatively vigorous and symmetrical deflagrations. Finally, we compare measurements with models of the remnants evolution

that include both smooth and clumpy ejecta profiles, finding that both ejecta profiles can be accommodated by the observations.

Supernova Archaeology: Unveiling the origin of Type Ia supernovae

Tyrone E. Woods - *Monash University*

About half of the iron in our blood was born in the thermonuclear explosion of a white dwarfa Type Ia supernova (SN Ia). However, we still do not know why a white dwarf would undergo such an explosion. Evolutionary models can be grouped into either accretion or merger scenarios, with accretion models typically implying a hot, luminous phase prior to explosion. These objects are significant sources of ionizing radiation; therefore, the environment surrounding SN Ia progenitors as well as nearby remnants should be strongly ionized, and traced by faint nebular emission. Such relic nebulae should extend out to dozens of parsecs and linger for roughly 100,000 years. Here we report deep upper limits which rule out accreting, nuclear-burning white dwarfs as the progenitors of several young SN Ia remnantsin particular, that of Tychos supernovaas well as in older stellar populations.

4 Posters

Study of the PeV Neutrinos, γ-Rays and UHECRs around the lobes of Centaurus A

Edilberto Aguilar Ruíz - *Instituto de Astronomía, UNAM*

Ultra-high-energy cosmic ray (UHECR) detections could give an indirect signal of PeV neutrino emission. Recently, Pierre Auger observatory reported the distribution of arrival directions of the highest energy cosmic rays. These events were collected in 10 years of operations with declinations between -90° and +45°. The IceCube neutrino telescope reported the detection of 54 extraterrestrial neutrinos in the High Energy Starting Events catalog. The highest-energy neutrino event (IC35) reported in this catalog had an energy of 2004 TeV and was located centered at RA=208.4° and DEC=-55.8° (J2000). Being Centaurus A the nearest radio-loud active galactic nucleus and one of the best potential candidates for accelerating cosmic rays up to $\sim 10^{20}$ eV, we show that UHECRs with E $>$ 58 EeV around the direction of Centaurus A (15° radius) could be accelerated inside the giant lobes. These comic rays unavoidably interact with external radiation fields and ambient gas whereas they propagate through the lobes and their paths to Earth. We show that the proton luminosity extrapolated at 1 TeV contributes to the faint γ-ray fluxes reported by Fermi Collaboration. Using the buoyancy ages of the giant radio lobes instead of their spectral ages, and those UHECRs in the direction of the IC35 event, we found that the IC35 event cannot be generated inside the giant lobes. Additionally, considering the closest Galaxies around Centaurus A and the hadronic interactions in their paths to Earth, we found that IC35 event could be created in this environment.

Deeper Wider Faster: proactive observations to chase the fastest bursts

Igor Andreoni - *Swinburne University of Technology*

The seconds-to-hours transient time domain is widely unexplored and includes events resulting from a variety of physical mechanisms such as supernova shock breakouts, kilonovae, dark gamma-ray bursts, fast radio bursts and gravitational wave event counterparts. I will present the Deeper, Wider, Faster (DWF) program designed to probe the fast transient Universe. DWF is an Australian based multi-facility, multi-wavelength program that coordinates simultaneous observations with the Parkes, Molonglo, and ATCA telescopes (radio), the DECam imager and REM telescopes (optical/IR), and the NASA Swift satellite BAT, XRT and UVOT (gamma-ray, x-ray, and UV/optical). Our custom real-time data analysis pipeline allows rapid spectroscopic and photometric follow-up of interesting sources with small to big telescopes including Gemini, SALT, and possibly VLT and Keck.

Gammay-ray bursts and broad-lined Ic supernovae from a single central engine.

Jennifer Barnes[1], Paul Duffel[2], Dan Kasen[2], Maryam Modjaz[3], Federica Bianco[3], Yuqian Liu[3], Andrew MacFadyen[3] - *1. Columbia University, 2. UC Berkeley, 3. New York University*

While the unusually high velocities (~ 0.1 c) and correspondingly high kinetic energies observed in an intriguing subset of Type Ic supernovae established the broad-lined c supernova (SN Ic-bl) subclassification on empirical grounds, the central engine model capable of self-consistently generating these extremely energetic explosions remains an outstanding question. A clue to the explosion mechanism may lie in the fact that all supernovae that accompany long-duration gamma-ray bursts belong to the Ic-bl class. This study uses a combination of two-dimensional relativistic hydrodynamics and radiation transport calculations to demonstrate that the central engine responsible for long gamma-ray bursts can also trigger a SN Ic-bl. We find that a reasonable gamma-ray burst engine injected into a stripped Wolf-Rayet progenitor produces a relativistic jet with energy ~ 1 foe, as well as a SN whose synthetic light curves and spectra are fully consistent with observed SNe Ic-bl during the photospheric phase. I will discuss our engine and progenitor model, review the hydrodynamical and radiation transport calculations we employ, and discuss the resulting photometry, including the effects of viewing angle on the SN's radiative signature.

Model for the delayed GeV gamma-ray emission from Gamma-ray Bursts

Wlodek Bednarek, Julian Sitarek - *University of Lodz*

We propose that delayed hard GeV gamma-ray emission observed from long Gamma-ray Bursts (GRBs) can be produced when the hyper-relativistic jet encounters the radiation of stars, within the stellar cluster, which happens to be immersed in the jet. The hard X-ray to soft gamma-ray radiation from the jet, heats the surfaces of encountered stars to temperatures above those expected from nuclear burning. Then, relativistic electrons in the jet can efficiently Inverse Compton up-scatter stellar radiation to the GeV energies. We have performed numerical calculations of the gamma-ray spectra produced in the IC e-p pair cascade initiated by relativistic electrons in a dense stellar radiation field. The gamma-ray spectra produced in such scenario form additional component in the GRB spectrum which is delayed in respect to the main emission, coming from the central part of the GRB engine, since stars can be encountered up to a parsec distance scale from the GRB. Such mechanism is discussed for the delayed GeV emission recently observed from the powerful GRB 130427A.

Radiative striped wind model for gamma-ray bursts

Damien Bégué - *MPE*

In my talk, I will revisit the striped wind model in which the wind is accelerated by magnetic reconnection. In our treatment, radiation is included as an independent component, and two scenarios are considered. In the first one, radiation cannot stream efficiently through the reconnection layer, while the second scenario assumes that radiation is homogeneous in the striped wind. We show how these two assumptions affect the dynamics. In particular, we find that the asymptotic radial evolution of the Lorentz factor is not strongly modified whether radiation can stream through the reconnection layer or not. On the other hand, we show that the width, density and temperature of the reconnection layer are strongly dependent on these assumptions. We then apply the model to the gamma-ray burst context and find that photons cannot diffuse efficiently through the reconnection layer below radius $r_D \sim 10^{10.5}$ cm, which is about an order of magnitude below the photospheric radius. Above r_D^A, the dynamics asymptotes to the solution of the scenario in which radiation can stream through the reconnection layer. As a result, the density of the current sheet increases sharply, providing efficient photon production by the Bremsstrahlung process which could have profound influence on the emerging spectrum. This effect might provide a solution to the soft photon problem in GRBs.

Thermal Evolution of Neo-Neutron Stars

Mikhail Beznogov, Dany Page - *Instituto de Astronomía, UNAM*

A neo-neutron star is the next step after the proto-neutron star phase. After the birth of the star it begins when neutrinos are free to escape and the crust of the neutron star is forming. Super-Eddington luminosities are still present for some time. We present models of the outer layers, the envelope, of these stars to study how long the super-Eddington phase lasts. A neo-neutron star produced in a core collapse supernova is not observable but one produced by a binary merger, likely associated with a short gamma-ray burst, may be observable for some time while the super-massive neutron star is supported by fast rotation.

Explaining GRB prompt emission spectrum with photospheric emissionExplaining GRB prompt emission spectrum with photospheric emission

Mukul Bhattacharya[1], Pawan Kumar[2] - *1. Department of Physics, University of Texas at Austin, 2. Department of Astronomy, University of Texas at Austin*

We study the sub-photospheric Comptonization of fast cooled synchrotron photons while the electrons and protons are accelerated to relativistic energies by repeated dissipative events. Unlike previous simulations, we implement realistic photon to electron number ratio $\sim$1e5 in addition to incorporating continuous energy transfer to electrons through Coulomb collisions. Using our Monte-Carlo code, we have successfully generated the observed photon spectrum for electrons accelerated to highly relativistic energies with Lorentz factor $\sim$100 by $\sim$40 dissipative events starting from moderate values of optical depth $\sim$20. We find that the shape of the photon spectrum is independent of the initial photon energy distribution and baryonic energy content of the jet, as expected.

Ultraviolet-Optical-Infrared Aggienova Templates of Explosive Transients

Peter J. Brown - *Texas A&M University & Mitchell Institute for Fundamental Physics and Astronomy*

The Swift satellite has made ultraviolet and X-ray observations of over 500 supernovae and other transients. The photometry for over 200 supernovae is already available from the Swift Optical Ultraviolet Supernova Archive. We use this photometric database to characterize the behavior of different supernova types and the increased variety in the ultraviolet. We combine the multi-epoch photometry with ground-based optical and near-infrared observations and spectral templates to create spectrophotometric templates. These better represent the ultraviolet and cover a larger sample of subtypes than previously possible and can be used to predict the brightness of these explosive transients out to cosmological distances where the rest-frame ultraviolet is redshifted into the optical and infrared.

Spectral, Timing and Polarization properties of GRB 160509A & GRB 160802A: a tale of two GRBs with polarization measurements by AstroSat/CZTI

Vikas Chand - *Tata Institute of Fundamental Research, Mumbai, India*

The bright GRBs 160509A and 160802A are observed in both Fermi and AstroSat/CZTI. We analyze these GRBs for temporal, spectral and polarization properties of the prompt emission. In GRB 160509A, the LAT high energy (LAT-HE) emission (*gt* 100 MeV) is highly correlated to its counterpart at immediate low energies. The single pulse as seen in the main burst at its low energies can be resolved into two separate pulses at the high energies. This main episode of the burst is followed by a precursor. The precursor has a thermal spectra which smoothly evolves during the main episode. The spectrum of the main burst shows a cut-off at an energy that falls in the window 30 MeV - 150 MeV. The LAT-HE emission can be separated into two temporal and spectral components. Further, a high degree of polarization (96 $\pm$ 40%) is also detected for this GRB from the Compton double scattering events during the main burst. The top-hat like spectrum, the existence of a high energy emission that can extend from a few hundred MeVs to GeVs, a sub-dominant thermal component, the clues from afterglow emissions (a reverse shock) and the existence of high polarisation are incompatible with the existing mainstream models of the GRBs. GRB 160802A is surprisingly faint at *leq* 2 MeV energies. In the time resolved spectroscopy of this GRB, we found that low energy index of Band function crosses the synchrotron line of deaths for cooling. This is a well known severity of the GRB spectral models. The availabilty of the AstroSat/CZTI observation forms an opportunity to study polarisation of such GRBs. Surprisingly, the polarisation for this GRB is also high and well constrained (polarization fraction 85 $\pm$ 29 %).

Pulsars in the Galactic Center

Ian Christie[1], Maria Petropoulou[1], Petar Mimica[2], Dimitrios Giannios[1] - *1. Purdue University, 2. University of Valencia*

The discovery of radio pulsars within the inner most pc of our Galactic Center (GC) poses a unique challenge for both observational and theoretical astrophysics. These objects are highly sought after for their potential as probes of Sgr A*, the compact radio source associated with the supermassive black hole (SMBH) in our GC, as well as interpreting the surrounding interstellar medium. Despite numerous searches, the only detected pulsar residing in the GC is a magnetar located 0.1pc from the SMBH. The presence of a pulsar population can be revealed by their interactions with the gas surrounding Sgr A* and its accretion disk which results in the relativistic winds of the pulsars being terminated by a strong shock. Relativistic electron-positron pairs, accelerated at the shock front, can enter the disk while cooling via synchrotron radiation, thereby producing a non-thermal, year-long X-ray flaring event and a substantial contribution to the GHz radio emission. Here, I will present X-ray and radio light curves, produced from a fiducial population of pulsars interacting with Sgr A*s accretion disk, and compare against X-ray and GHz observations of Sgr A*. I will also discuss the impact of the pulsar population on the dynamics of the accretion flow itself.

iPTF14gqr: A hot and fast ultra-stripped supernova in the outskirts of its host

K. De [1], M. M. Kasliwal[1] - *1.Caltech (on behalf of the larger iPTF and GROWTH collaborations)*

Early observations of young supernovae (SNe) provide vital information on the structure and immediate environment of the progenitor, and have greatly improved our understanding of the pre-explosion evolution of massive stars. In this paper, we present the intermediate Palomar Transient Factory discovery and multi-wavelength follow-up observations of a fast type Ic SN, iPTF 14gqr. Discovered in the far outskirts (projected offset $\sim$ 30 kpc) of a tidally interacting spiral galaxy, the transient exhibits a double peaked light curve composed of a rapid ($\sim$ 1 day) first peak and a longer timescale ($\sim$ 7 days) second peak. With rapid spectroscopy initiated within a few hours of discovery, we find the early spectra to be composed of featureless blue continua superimposed with flash ionized lines of He and C, making this the first Type I SN for which such features have been detected. The photometric and spectroscopic evolution of the main (second) peak of the light curve suggest a low Ni mass, ejecta mass and explosion energy of $\sim 0.03\ M_\odot$, $\sim 0.17\ M_\odot$ and $\sim 10^{50}$ ergs respectively. The first peak can be well modeled by shock cooling emission from an extended progenitor envelope, which along with modeling of the early flash ionized spectra, suggest that the progenitor was surrounded by a He rich envelope with mass of $\sim 0.01\ M_\odot$ and radius of $\sim 10^{14}$ cm. Deep spectroscopic limits on the presence of star formation at the location of the transient argue against in-situ formation of the progenitor, and suggest that it was likely ejected from the host galaxy, possibly due to a preceding SN explosion in a binary system or due to tidal interactions of the host galaxy. Taken together, all derived parameters point to iPTF 14gqr as being perhaps the first confirmed ultra-stripped Type Ic SN candidate, that are suggested to be progenitors of the crucial double neutron star system targets of current and future gravitational wave observatories.

Effects of the Common Envelope Phase on Binary Black Hole Evolution

Rosa Wallace Everson[1,2], Phillip Macias[1,2], Morgan MacLeod[2,3], Andrea Antoni[1,2], Enrico Ramirez-Ruiz[1,2] - *1. Department of Astronomy & Astrophysics, University of California, Santa Cruz, 2. Niels Bohr Institute, University of Copenhagen, 3. School of Natural Sciences, Institute for Advanced Study, Princeton*

The detection of gravitational wave signals from binary black hole (BBH) mergers in recent years has raised pressing questions about the formation and characteristics of these systems. In order for BBHs produced in the traditional formation channel to merge in a Hubble time, the pair must undergo a common envelope (CE) phase to dramatically reduce the separation distance of the progenitors prior to CE ejection. Recent work on the CE phase has shown that

density gradients in the envelope material produce a significant departure from drag and accretion rates of the embedded compact object as predicted by Hoyle Lyttleton accretion formalism; these effects, in turn, have implications for mass and angular momentum transfer between the donor star and compact object. Using a range of simplified progenitor systems in which a massive, stellar-mass black hole (BH) dynamically inspirals through the envelope of a giant stellar companion, we examine these CE effects on the final mass and spin of the BHs in the resulting binary.

Stripped envelope supernovae discovered by the (i)PTF

Christoffer Fremling - *CalTech*

We present a spectral analysis of all stripped-envelope SNe discovered by the PTF and iPTF collaborations. We find SNe Ic to have stronger and faster oxygen absorption features in their spectra compared to SNe IIb and Ib. This is inconsistent with low-mixing models for SNe Ic, where helium could be hidden due to it not being nontheremally excited. Instead, we propose that SNe Ic lose helium due to stellar winds or binary interactions, and do not hide it. SNe Ib are faster compared to SNe IIb in their helium absorption lines, consistent with SNe Ib lacking significant hydrogen envelopes.

Search of late time emission from GRB 170817A

Edwin Antonio Galván - *Instituto de Astronomía UNAM*

The discovery of the gravitational wave GW170817 marks the beginning of a new era for multi-messenger astrophysics. It was originated from a merger of 2 neutron stars at 40 Mpc from us. Electromagnetic counterparts of this merger are observed at different wavelength with emission starting from 2 second up to several days after the gravitational wave detection. Fermi/GBM firstly identified the gamma ray counterpart classified as a short gamma-ray burst (GRB) called GRB 170817A. This source starts to emot in X-rays and in radio 9 and 15 days after, respectively. We use the High Altitude Water Cherenkov (HAWC) gamma-ray observatory, installed at an altitude of 4100 m asl in the state of Puebla (Mexico) to look for possible emission in the TeV range at early and late times. We report the results of this analysis providing the significance of the signal for each transit of the source inside the field of view of HAWC up to 20 days after the detection. No significant flux is observed during this period. Our upper limits indicates that the off-axis scenario is the most reliable one to explain the emission coming from this peculiar event.

What's powering the magnetar wind nebula around Swift J1834.9-0846?

Ramandeep Gill[1], Jonathan Granot[1], Ramandeep Gill[1], George Younes[2], Joseph Gelfand[3], Alice Harding[4], Chryssa Kouveliotou[2], and Matthew Baring[5] - *1. The Open University of Israel, 2. The George*

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Magnetars are a small class of slowly-rotating (P 2-12 s) highly magnetized (surface dipole fields $\sim 10^{14} - 10^{15}$ G) neutron stars that show a variety of bursting activity, powered by the decay of their super-strong magnetic field. While many rotation-powered pulsars are surrounded by a pulsar wind nebula (PWN) powered by their spin-down MHD wind (the prime example being the Crab nebula), only now has the first-ever magnetar wind nebula (MWN) been discovered in X-rays, around Swift J1834.9-0846. We have analyzed the internal structure, dynamics, and global energetics of this system in detail to see what can be learned from it.

In this talk, I will argue that unlike normal PWNe this MWN cannot be powered by its spin-down MHD wind alone. I will show that a considerable contribution to the MWN energy should come from a different source, most likely sporadic outflows associated with the magnetar's bursting activity. I will further argue that such outflows in this case cannot be powered by the decay of the surface dipole field alone and are most likely supported by the decay of the much stronger internal field. Akin to PWNe, MWNe may serve as a calorimeter, and provide a new and robust estimate for the magnetar's long-term mean energy output rate in outflows.

Authors: Jonathan Granot (1), Ramandeep Gill (1), George Younes (2), Joseph Gelfand (3), Alice Harding (4), Chryssa Kouveliotou (2), and Matthew Baring (5)

Optical polarimetry and photometry of GRBs with RINGO2

A. Gomboc - *University of Nova Gorica, Slovenia*

We present a catalog of early-time ($\sim 10^2$ - 10^4 s) photometry and polarimetry of all GRB optical afterglows observed with the RINGO2 imaging polarimeter on the Liverpool Telescope. We discuss the results for the sample in the context of the reverse- and forward-shock afterglow scenario, and show that GRBs with detectable optical polarization at early time have clearly identifiable signatures of reverse-shock emission in their optical light curves. This supports the idea that GRB ejecta contain large-scale magnetic fields, and it highlights the importance of rapid-response polarimetry.

Investigating the Violent Universe with THESEUS

Diego Götz[1], L. Amati, P. O'Brien, C. Tenzer, E. Bozzo - *1. CEA Irfu - Dèpartement d'Astrophysique (on behalf of the THESEUS consortium)*

The Transient High Energy Sky and Early Universe Surveyor (THESEUS) is an ESA M5 candidate space mission (scheduled for 2029), whose goal is to increase our knowledge on transient high energy sources over the entire comic history. In particular THESEUS will make use of Gamma-Ray Bursts as beacons to investigate the early Universe up to the re-ionisation era, and at the same time it will perform an unprecedented deep monitoring of the X-ray transient Universe allowing THESEUS to play a prominent role in time domain and multi-messenger astronomy. THESEUS will carry a suite of high-energy telescopes (based on focussing "Lobster Eye" and coded mask techniques) capable of a wide and deep monitoring in a broad energy range (0.2 keV - 20 MeV) and a follow-up NIR (0.7-1.8 microns) telescope with moderate spectroscopic capabilities for immediate transient identification and redshift measurement. We will present the complete THESEUS science case, its mission profile, as well as the three instruments (the Soft X-ray Imager, the X-Gamma ray Imaging Spectrometer and the Infra-Red Telescope) we designed in order to reach them.

Accretion of winds onto black holes in 3D

Francisco S. Guzmán - *Universidad Michoacana de San Nicolás de Hidalgo*, Miguel Gracía-Linares

We present the accretion of neutral and magnetized supersonic winds onto a rotating black hole in three dimensions. We select representative spin-wind orientations in order to illustrate its effects on the evolution and morphology of the shock cone with no symmetries. The most important finding in the magnetized case (MHD), unlike the purely hydrodynamical scenario (HD), is the formation of rarified spots where the magnetic field pressure dominates with $\beta < 1$. In these rarified spots, in the case of a winds perpendicular and diagonal to the spin of the black hole, whirlpools are formed within the shock cone. We also study the subsonic case and present the dynamics near and around the black hole of the gas in the HD case and the plasma in the MHD case. In this analysis we solve the fluid and plasma equations for the matter on top of the background space-time of a black hole described in penetrating coordinates, which allows one to track down the accretion process all the way through the black hole's event horizon.

Gravitational Waves from Accreting Neutron Stars in the Common-Envelope Phase

A. Miguel Holgado[1,2], Paul M. Ricker[1,2], Eliu Huerta[2] - *1. Department of Astronomy, University of Illinois at Urbana-Champaign, 2. National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign*

The common envelope phase is a likely formation channel for close binary systems containing compact objects, which may eventually lead to gravitational-wave sources and/or high-energy electromagnetic transients. Neutron stars in common envelopes accrete at a fraction of the Bondi-Hoyle-Lyttleton accretion rate, since the stellar envelope is inhomogeneous, but may still be able to accrete at hypercritical rates (though not enough to become black holes). We show that common envelope systems consisting of a neutron star with a massive primary may be gravitational wave sources detectable in the advanced LIGO band as far away as the Magellanic Clouds. From the range of possible accretion rates relevant to common envelope evolution, we find that these systems may be significantly louder gravitational wave sources than low-mass X-ray binaries like Sco X-1, which are currently the target of directed searches for continuous gravitational waves. We also find that their strain amplitude signal may allow for novel constraints on the orbital separation and inspiral timescale in common envelopes when combined with pre-common envelope electromagnetic transient observations.

Off-axis short GRBs from structured jets as counterparts to GW events

Adithan Kathirgamaraju - *Purdue University*

Binary neutron star mergers are considered to be the most favorable sources that produce electromagnetic (EM) signals associated with gravitational waves (GWs). They are also the likely progenitors of short duration gamma-ray bursts (GRBs). The brief gamma-ray emission (the prompt GRB emission) is produced by ultra-relativistic jets, as a result, this emission is strongly beamed over a small solid angle along the jet. It is estimated to be a decade or more before a short GRB jet within the LIGO volume points along our line of sight. However, we argue that for a realistic jet model, one whose luminosity and Lorentz factor vary smoothly with angle, the prompt signal can be detected for a significantly broader range of viewing angles. This can lead to an "off-axis" short GRB as an EM counterpart. Our estimates and simulations show, that with the aid of the temporal coincidence from a LIGO trigger, it is feasible to detect these "off-axis" short GRBs, even if the observer is substantially misaligned with respect to the jet.

CSM Interaction and Dust Formation in SN2010jl

Kelsie Krafton - *Louisiana State University*

The origin of dust in galaxies less than 1 billion years old has remained an unsolved mystery for over a decade. One proposed solution is dust produced by core collapse supernovae. Theorists have shown that 0.1-1$M_\odot$ of dust must be produced per supernova for this to work as an explanation for the dust in young galaxies. SN 1987A has produced 1$M_\odot$ of dust since its detonation. However, most supernovae have been found to only produce $10^{-4} - 10^{-2}M_\odot$ of dust. The energetic Type IIn SN 2010jl is located in UGC 5189, in a dense shell of CSM. As dust condenses in the SN ejecta, we see, (1) a sudden decrease in continuum brightness in the visible due to increased dust extinction, (2) the development of an infrared excess in the SN light curve arising from dust grains absorbing high-energy photons and re-emitting them in the infrared, and (3) the development of asymmetric, blue-shifted emission-line profiles, caused by dust forming in the ejecta, and preferentially extinguishing redshifted emission. A dense CSM may increase the dust production by supernovae. We observe signs of strong interaction between the SN ejecta and a dense CSM in SN 2010jl. SN 2010jl has been a source of much debate in the CCSN community, particularly over when it formed dust and how much dust it formed. The light curve shows strong signs of dust formation after 260 days. Arguments over these subjects have been based on the evolution of the light curve and spectra. We present new optical and IR photometry, and spectroscopy of SN 2010jl over 2000 days. We estimate dust masses using the DAMOCLES and MOCASSIN radiative transfer codes.

Tidal Disruptions of Stars with Realistic Structures and Compositions

Jamie Law-Smith[1], James Guillochon[2], Enrico Ramirez-Ruiz[1] - *1. UC Santa Cruz, 2. Harvard*

A detailed theoretical understanding of tidal disruptions, coupled with high-resolution observations, can help us understand the properties of massive black holes and nuclear stellar populations, the physics of super-Eddington accretion, and the dynamical mechanisms operating in galactic centers. I will present the first simulations of tidal disruptions of stars with realistic structures and compositions. We calculate the signatures of the disruption of stars of a range of masses and ages, and track the composition of the debris that falls back onto the black hole. I will present new predictions from these simulations, and place our results in the context of current observations.

Analysis of the co-spatial and temporal correlation of gamma ray bursts with high-energy neutrinos

Kin Lopez Mendoza - *Instituto de Astronomía UNAM*

The IceCube Collaboration initially reported on the detection of 54 extraterrestrial neutrinos in the TeV-PeV energy range. The reconstructed neutrino events were obtained during three consecutive years of data collection, from 2010 to 2013. Currently, although it has been discussed that these events have an extra galactic origin, they have not been correlated with any known source. Therefore, in this work a comprehensive correlation analysis of these 54 high-energy neutrinos with GRB data of BAT, XRT and UVOT onboard SWIFT space laboratory and the LAT and GBM instruments onboard FERMI was done. Additionally, a theoretical model to relate these events is presented.

Is the Macronova (Kilonova) in GW170817 Powered by the Central Engine?

Tatsuya Matsumoto[1], Yuto Teraki[2,3], Kunihito Ioka[2] - *1. Kyoto University, Japan, 2. Yukawa Institute for Theoretical Physics, Japan, 3. National Institute of Technology, Asahikawa College, Japan*

The gravitational wave event GW170817 from a binary neutron star (NS) merger is accompanied by electromagnetic counterparts, and the optical and near-infared emission is called a macronova (or kilonova). Although the radioactivity of synthesized r-process elements is widely discussed as an energy source, it requires a huge ejecta mass from the NS merger. We discuss a macronova powered by the central engine activities, and show that the engine model allows much broader parameter spaces, in particular smaller ejecta mass ($\sim 10^{4}$ 0.01 $M_{\odot}$) than the r-process model. The blue macronova is naturally explained by a cocoon powered by the jet from a black hole, while the red macronova by the merger ejecta heated by X-rays from the fall-back matter, which is very similar to the X-ray excess observed in GRB 130603B with the right power-law slope of the energy injection. On the other hand, we clarify that the r-process elements are required as the opacity source to reproduce the long duration of the red macronova. Early or late multi-wavelength observations are useful for revealing the central engine of short gamma-ray bursts and the r-process nucleosynthesis.

Nonlinear Stability of Kerr Black Holes with Massive Boson Hair

Jonah Miller - *Los Alamos National Laboratory*

Light massive bosons emerge naturally from quantum chromodynamics and Kaluza-Klein compactifications of anti-symmetric tensor fields in higher dimensional models. These boson fields can superradiantly scatter off of a spinning black hole, and the resulting dynamics are a proposed source of monochromatic gravitational waves. Axisymmetric black hole spacetimes with massive boson hair—evasions of the no hair theorems—were recently discovered. A key condition for the existence of these solutions is that the system must be at the threshold of superradiance. This suggests that these stationary solutions might be the end-result of the superradiant instability. We numerically study the stability of these solutions against perturbation and thus probe the dynamics of these systems.

Thermal Neutrino opacity within the wind medium generated by a binary neutron star merger

Gibran Morales Rivera - *Instituto de Astronomía UNAM*

The recent GW170817 event constitutes the first Gravitational Wave detection with LIGO and Virgo collaboration and its electromagnetic multiwavelength counterpart detected with many space and ground-based telescopes, confirming the Binary Neutron Star merger scenario as the progenitor of short Gamma-Ray Bursts. No MeV-EeV neutrino emission in directional coincidence with the host galaxy NGC4993 was detected with ANTARES, IceCube and Pierre Auger collaborations. In this work, we estimate the neutrino opacity of the stellar winds surrounding the central engine of this merger in both magnetically-driven (NS-NS) and neutrino-driven (NS-BH) wind scenario. We found that whereas MeV neutrinos leave the central engine isotropically due to a neutrino-driven wind, these neutrinos due to magnetically-driven wind can only be detected at viewing angles less than 45 degrees. Using these results we show an effective criterion to determine which is the most plausible progenitor of sGRBs based on the line of sight of these events.

Obtaining gravitational waves emitted by a black hole interacting with accretion discs

Claudia Moreno - *Universidad de Guadalajara* Darío Nuñez, Universidad Nacional Autónoma de México
Mauricio Antelis, Tecnologico de Monterrey

We investigate the physical consequences of the interaction between a black hole and scalar and electromagnetic fields halos in terms of gravitational waves (GW) by solving Teukosky's master equation with sources. The black hole is taken as a static and spherically symmetric gravitational source; we work within the test field approximation, considering that the field lives in the curved space-time outside the black hole. We analyze the scalar, electromagnetic and gravitational waves as well as the quasinormal modes emitted by this system.

Ultra-stripped supernovae leading to coalescing double neutron stars

Takashi Moriya - *National Astronomical Observatory of Japan*

If a supernova progenitor is in a close binary system with a compact star like a neutron star, it can lose significant amount of its mass before the explosion. Such supernovae are called "ultra-stripped" supernovae. They only eject $\sim$0.1$M_\odot$ with the ^{56}Ni mass of $\sim$0.01$M_\odot$. Because of the small ejecta mass, such supernovae may be a major path to make coalescing double neutron stars that will be detected in gravitational observatories. We followed the evolution of ultra-stripped supernova progenitors until core collapse and investigated their light-curve and spectral properties. We found that their light curves typically peak at around 10^{42} erg/s or -16 mag with the rise time of 5-10 days. By comparing synthesized and observed spectra, we found that SN 2005ek, some of so-called calcium-rich gap transients, and SN 2010X may be ultra-stripped supernovae. If these supernovae actually lead to the formation of coalescing double neutron-star systems, about 1% of core-collapse supernovae are likely to make such systems. Future detections of coalescing double neutron stars can test if the ultra-stripped supernovae are the major path to form coalescing double neutron stars.

Comparison of early- and late-time light curve fits of stripped-envelope supernovae

A. P. Nagy - *University of Szeged*

Stripped-envelope (Type Ib/c) supernovae form a special group of core-collapse SNe, because their progenitor lost the H and He layers during the presupernova evolution. Due to their complex physical nature, theoretical models are essential to understand better the physics of this kind of exploding stars via the analysis of their emitted radiation. One possibility to model the light curve of stripped-envelope SNe is the construction of a simplified semi-analytic model, which can be used for getting order-of-magnitude estimates of the basic physical properties. As previous studies (e.g. Clocchiatti & Wheeler, 1997, ApJ, 491, 375; Wheeler et al., 2015, MNRAS, 450, 1295) revealed, there are some discrepancies between the physical parameters derived from early- and late-time light curve fits. The aim of the present study is to improve the light curve fits in order to ease the tension between the estimated physical parameters. First, we consider the effect of poor light curve sampling, which may result in large offsets in explosion date as well as the slope of the late-time light curve. Next, we examined the frequently used assumption that the R-band light curve is a good approximation of the true bolometric light curve. Our results show that this approximation has limitations, because the slope of the light curve tail slightly depends on the filter used, which can strongly influence the derived masses. Finally, we analyze the effect of gamma-ray and positron trapping, that play an important role in forming the shape of the late-time light curve of stripped- envelope supernovae.

Systematic light curve fits to superluminous supernovae: insights from the full literature sample

James Guillochon - *Harvard-Smithsonian Center for Astrophysics*

I will present the findings from a study analysing 38 superluminous supernovae (SLSNe), comprising virtually all spectroscopically confirmed events with published light curves. Assuming magnetar central engines, we fitted the multi-band photometric evolution with our new public light curve code, MOSFiT, to derive posterior distributions for key parameters such as ejecta mass, spin period and magnetic field. We show that while SLSN light curves are diverse, the relevant magnetar parameter space is well constrained by current data. The ejecta masses and spin periods, along with the observed SLSN rate and preference for dwarf galaxies, may be used to place interesting constraints on the progenitor stars. (Nicholl, Guillochon and Berger, https://arxiv.org/abs/1706.00825)

Exploring the behaviour of long gamma-ray bursts with an intrinsic multi-wavelength afterglow correlation

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We present a correlation observed in both the optical/UV and X-ray afterglows of long duration Swift Gamma-ray Bursts (GRBs), between the initial luminosity (measured at restframe 200s) and average afterglow decay rate. This correlation does not depend on the presence of specific light curve features, and is potentially applicable to all long GRB afterglows. We explore how the correlation decay parameters from the optical/UV and X-ray bands relate to each other and to the prompt emission phase. We will also investigate the implications and test whether the standard afterglow model is consistent with the observations.

The Role of Metallicity in Supernova Evolution

Dan Patnaude - *Smithsonian Astrophysical Observatory*

Surveys of nearby galaxies have thus far turned up scant evidence for young, evolving supernova remnants. This is in contradiction with the expected supernova rate of 1 event per century. A possible reason for the lack of young SNR is the metallicity of the host environment. In the case of low metallicity, the progenitor will not deposit much mass into the CSM, as the line driven winds are expected to be weak. When the progenitor explodes, it will remain in nearly free expansion, resulting in a low surface brightness remnant. In contrast, a higher metallicity will result in rapid evolution of the remnant into the Sedov phase. Here we present new models for the evolution of supernovae in high and low metallicity environments. We discuss the role that the metallicity has on the remnant dynamics and spectral qualities.

Supernova rates from the SUDARE survey.

G. Pignata[1], E. Capellaro[2], M. Botticellla[3], A. Grado[3] -*Universidad Andrés Bello, 2. INAF, Osservatorio di Padova, 3. INAF, Osservatorio di CapodiMonte*

Supernova (SN) rates as a function of cosmic time and their link with the properties of the galaxy parent population is a powerful tool to investigate the nature of progenitor stars and to shed light on the origin of SN diversity. I will present Supernova rates per unit volume and per unit of mass computed from the data collected by the Supernova Diversity and Rate Evolution (SUDARE) experiment. We monitored the Cosmic Evolution Survey (COSMOS) and Chandra Deep Field South (CDFS) fields in the g, r, i filters with the VLT Survey Telescope (VST) between 2011 and 2015. I will also show the correlation between the rates of SNe of different type and the main parameters of the host galaxies.

Search for particular properties of long GRBs at high redshift

G. Pizzichini - *INAF/IASF Bologna*

I shall report on an until now unsuccessful search for properties belonging only to high redshift GRBs.

The Expansion of the SMC SNR 1E 0102.2-7219

Paul Plucinsky[1], Long Xi[2], Terrance Gaetz[1] - *1. SAO, 2. IHEP,CAS*

1E 0102.2-7219 (hereafter E0102) is the X-ray brightest supernova remnant (SNR) in the Small Magellanic Cloud. E0102 exhibits a mostly spherical symmetric morphology in the X-ray band, with a bright ring of ejecta emission interior to a mostly filled shell. The X-ray spectrum of E0102 is dominated by strong lines of O, Ne, and Mg, with little or no Fe emission. E0102 is one of a handful of "O-rich" SNRs and is the result of the core collapse supernova. The age of the remnant has been estimated to range between 1,000 and 2,000 yr. E0102 is routinely observed by the Chandra X-ray Observatory as a calibration source. Exploiting Chandra's superb angular resolution, we have measured the expansion of the outer blastwave using these observations at different epochs. Hughes et al. 2000 used one of the first Chandra images of E0102 to compare to archival images of E0102 from the Einstein Observatory and the ROSAT satellite to derive an expansion rate of 0.10% per year and a shock velocity of 6000 km/s. This relatively high shock velocity was apparently inconsistent with the temperature of 0.75 keV derived from the X-ray spectra. Hughes et al. suggested that a possible explanation was that a large fraction of the energy of the shock was going into the acceleration of cosmic rays. Restricting our analysis to include only Chandra observations of the blastwave, we find a significantly lower expansion rate of 0.032

γ-Ray emission in supernova remnants

Isidro Ramirez Ballines, Jorge Reyes Iturbide, Margarita Rosado - *Instituto de Astronomía, UNAM*

The γ-rays are results of the interaction of high energy particles acellerated for the shock waves of the Supernova Remnants (SNRs) with interstellar medium. It has been commonly assumed that 10

Inspiral and Ringdown Analysis of the LIGO Data From a Binary System of Black Holes.

Kenia Joseline Ramírez Millán, Claudia Moreno - Departamento de Matemáticas, Centro Universitario de Ciencias Exactas e Ingeniería, Universidad de Guadalajara, México

Recent direct detections of gravitational waves (GW) from coalescing binary black holes systems open a new era in the observational astronomy, as well as in experimental verifications of the theories of gravity. The detection of the GW events GW150914, GW151226 and GW170104 made by LIGO are a fascinate discovery that required three fundamental developments: (i) theoretical and numerical solutions of the Einstein's equations; (ii) the ground-based detector Laser-Interferometer Gravitational-Wave Observatory (LIGO) and (iii) computational models and data analysis algotithms. In this work,we will focus in the analytical model of the (i) and (iii) phases in black hole binaries: the phase (i) leads us to understand how the system works in the inspiral phase and how it produces GW. Late, we analyze the ringdown phase (iii) and be able to apply digital signal processin using machine learning and data science techniques, whose aim is to pull out gravitational waveforms from the noisy measurements provided by ground-based detectors and to estimate the physical parameters of the sources responsible of the detected signals.

A Fast-Evolving, Luminous Transient Discovered by K2/Kepler

Armin Rest - *STScI*

For decades optical time-domain searches have been tuned to find thermonuclear explosions (type Ia supernova) which rise to maximum light in two to three weeks and fade over months. Recently, supernova searches have improved their cadences and a handful of fast-evolving luminous transients (FELTs) have been identified. FELTs have peak luminosities comparable to type Ia supernovae, but rise to maximum in $<$ 10 days and fade from view in ¡ month. Here we present the most extreme example of this class thus far, KSN2015K, with a rise time of only 2.2 days and a time above half-maximum of only 6.8 days. Possible energy sources for KSN2015K are the decay of radioactive elements, a central engine powered by accretion/magnetic fields, or hydrodynamic shock. We show that KSN2015K's luminosity makes it unlikely to be powered by radioactive isotopes, and we find that the shock breakout into a dense wind energized the transient.

Evolution of jets driven by relativistic radiation hydrodynamics as Long and Low Luminosity GRBs

F. J. Rivera-Paleo and F. S. Guzmán - *Universidad Michoacana de San Nicolas de Hidalgo*

We carry out an analysis of three-dimensional numerical simulations of jets modeled with Relativistic Radiation Hydrodynamics (RRH), that evolve on two environments: i) a stratified surrounding medium and ii) 16TI progenitor model. We consider particular processes of interaction between the fluid and radiation, specifically, Bremsstrahlung emission and Thomson scattering. In this simulations, we assume initially, that the radiation field and matter are in local thermal equilibrium, which is broken immediately after initial time. We explore a variety of initial conditions, with different radiation energy densities and Lorentz factors of the beam, in particular, mildly and ultra-relativistic jets, together with hydrodynamical and radiation pressure dominated scenarios. In order to investigate the impact of the radiation field on the evolution of the jets, we compare our results with purely hydrodynamical jets. Comparing among jets driven by RRH, we find that radiation pressure dominated jets propagate faster than gas pressure dominated ones. Finally, we construct the luminosity Light Curves (LCs) associated with all these cases. The construction of LCs is natural in the model, because the radiation is fully coupled to the hydrodynamics equations during the evolution. The LCs measured on the stratified surrounding medium are of the same order of magnitude as the gamma-ray luminosity of typical Long Gamma-Ray Bursts, that is, $10^{50} - 10^{54}$ erg/s, whereas, the LCs measured on the massive stellar envelope are of the order range of magnitude $10^{46} - 10^{48}$ erg/s, resembling a typical event of low-luminosity GRBs.

Prototype detector of gravitational waves by laser interferometry

Ramón Daniel Rodríguez Soto[1], Claudia Moreno González[1], Javier Mauricio Antelis Ortiz[2] - *1. Universidad de Guadalajara, 2. Instituto Tecnolgico y de Estudios Superiores de Monterrey*

The gravitational waves (OG) derived from the linearized theory of General Relativity (RG) proposed by Albert Einstein in 1916, are space-time perturbations generated by oscillating massive objects. The scientific community around the world has made significant progress to verify experimentally the analytical and physical implications resulting from GR theory. Last year, these efforts resulted in the detection of OG generated during the merger of two black holes. This was made possible by OG detectors based on interferometers based on the configuration of the Michelson interferometer, due to the geometric forces produced by OG, and their high sensitivity to phase difference caused by changes in light path travel in their arms. We constructed a prototype OG detector based on the Michelson configuration with rigid arms of 0.5 m long, where we recreated the effect of OG focusing on the prototype, through motorized platforms programmed from a known OG that linearly move the Mirrors of the interferometer arms. By means of a photodetector acquiring the data of the changes of intensity and through these the OG was rebuilt. This work presents the results obtained in the construction of the prototype OG detector by means of laser interferometry that communicates the design principles of the LIGO Observatory.

Strange star - strange planet coalescing binary systems - Their importance as a source of gravitational waves and the possible electromagnetic counterpart

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Theoretical physicist have predicted that compact binary systems are the most important sources of Gravitational Waves (GW). Even thoug binary systems of Neuntron Star (NS) and Black Holes (BH) are the most favoured Strange Star (SS) systems have also being considerated as candidates. In this work we present the GW sign of a SS-Strange Planet system and with some prediction about the energies expected in the EM counterpart considering an external shock model.

A supervised learning approach to estimate parameters of binary black-holes from gravitational waves

Alberto Santos M.[1], Javier M. Antelis[1], Claudia Moreno[2] - *1. Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Guadalajara, 2. Centro Universitario de Ciencias Exactas e Ingenierías*

In sixteen months the LIGO (Laser Interferometer Gravitational-wave Observatory) has reported three direct detections of gravitational waves (GW) from binary systems which suggests that the merger of two black holes is more frequent than we expected. Detection of GWs consists of measuring and identifying small deformations of the space-time (i.e., strain) that are produced by astronomical massive objects. The inverse problem in GWs consists on identifying the astrophysical source parameters, e.g., mass ratio, spin, distance, orbital phase, among others. This work proposes to estimate the mass ratio of colliding binary black-holes (BBH) using an artificial neural network (ANN) algorithm which is trained with a waveform dataset created from numerical relativity. A systematic evaluation with different architectures of feedforward-nets and deep neural networks was made to assess the algorithm performance. Preliminary results indicate a mean square error (MSE) of 0.2 solar masses in the estimations and a correlation coefficient of 0.85 between the estimations and the parametrical data. We conclude therefore that it is possible to use a supervised learning approach to estimate parameters of BBH from GW waveforms.

Can we constrain Black Hole Spin in Field Binaries?

Sophie L. Schroder[1], Aldo Batta, Enrico Ramirez-Ruiz - *1. Dark Cosmology Center, Niels Bohr Institute, University of Copenhagen*

In the classical scenario, the merger of the black hole binary that was detected as GW150914 must have come from the direct collapse or ”failed” supernova explosion of two stars in an isolated binary system that underwent more than one mass transfer episodes. Through SPH simulations we explored different scenarios of the formation of the second BH, where a WR star suffers either a mild supernova explosions or a direct collapse, resulting in the formation of a massive BH but with considerably different spins depending on strength of the supernova.

Modelling the progenitors of accretion-induced collapse

Josiah Schwab[1], Lars Bildsten[2], Eliot Quataert[3] - *1. Department of Astronomy and Astrophysics, University of California, Santa Cruz, 2. Kavli Institute for Theoretical Physics and Department of Physics, University of California, Santa Barbara, 3. Physics Department and Astronomy Department and Theoretical Astrophysics Center, University of California, Berkeley*

We study the evolution of accreting oxygen-neon white dwarfs (WDs) towards accretion-induced collapse (AIC). We demonstrate the importance of Urca-process neutrino cooling in these objects. We show that MESA models with lower temperatures at the onset of electron captures on 24Mg develop convectively unstable regions, even when using the Ledoux criterion. We discuss the challenges in modeling these convective regions and outline the potential effects of this convection on the subsequent WD evolution. This an important step in producing more realistic progenitor models for studies of the signature of AIC.

Accretion and ejection in X-ray binaries of Population III

P. Sotomayor Checa[1], G. E. Romero[1,2] - *1. Facultad de Ciencias Astronmicas y Geofsicas - Universidad Nacional de La Plata, Argentina, 2. Instituto Argentino de Radioastronoma, Argentina*

We present the first results obtained in the elaboration of a complete model of a microquasar where the donor star is from Population III. These stars do not have stellar winds so we consider that the mass loss is due exclusively to matter overflowing the Roches lobe towards the compact object, a maximally rotating black hole. The rate of accretion should be extremely super-Eddington, with an intense mass loss from the system in the form of winds and jets. We calculate the relativistic particle content of the jet and the corresponding spectral energy distribution (SED) considering a lepto-hadronic model. Prospects for the cosmological implications of these objects are briefly discussed.

Oblate Supernova Explosions Aided by Rotation

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We report results from a series of three-dimensional (3D) rotational core-collapse simulations for 11.2 and 27 M stars employing neutrino transport scheme by the isotropic diffusion source approximation. By changing the initial strength of rotation systematically, we find a rotation-assisted explosion for the 27M progenitor, which fails in the absence of rotation. The unique feature was not captured in previous two-dimensional (2D) self-consistent rotating models because the growing non-axisymmetric instabilities play a key role. In the rapidly rotating case, strong spiral flows generated by the so-called low T/—W— instability enhance the energy transport from the proto-neutron star (PNS) to the gain region, which makes the shock expansion more energetic. The explosion occurs more strongly in the direction perpendicular to the rotational axis, which is different from previous 2D predictions.

The effects of initial conditions on the dynamics of GRB jets and their afterglow emission

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Simulating a GRB jet is a single run all the way from its launching at the central source is very challenging numerically. Therefore, the GRB jet dynamics during the afterglow stage is usually simulated directly by assuming some initial conditions. So far most numerical simulations have used a conical wedge from the Blandford-McKee (1976) spherical, ultra-relativistic self-similar solution. However, not necesserely such a spherical solution is an attractor for general non-spherical initial conditions, and an initial non-sphericity can persist as long as the jet remains relativistic. In this work we explore the effects of replacing a conical wedge by other options.