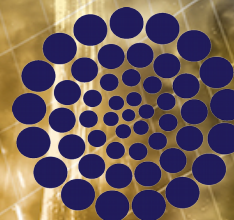


# Gravitational-wave sources and Galactic double neutron stars via isolated binary evolution

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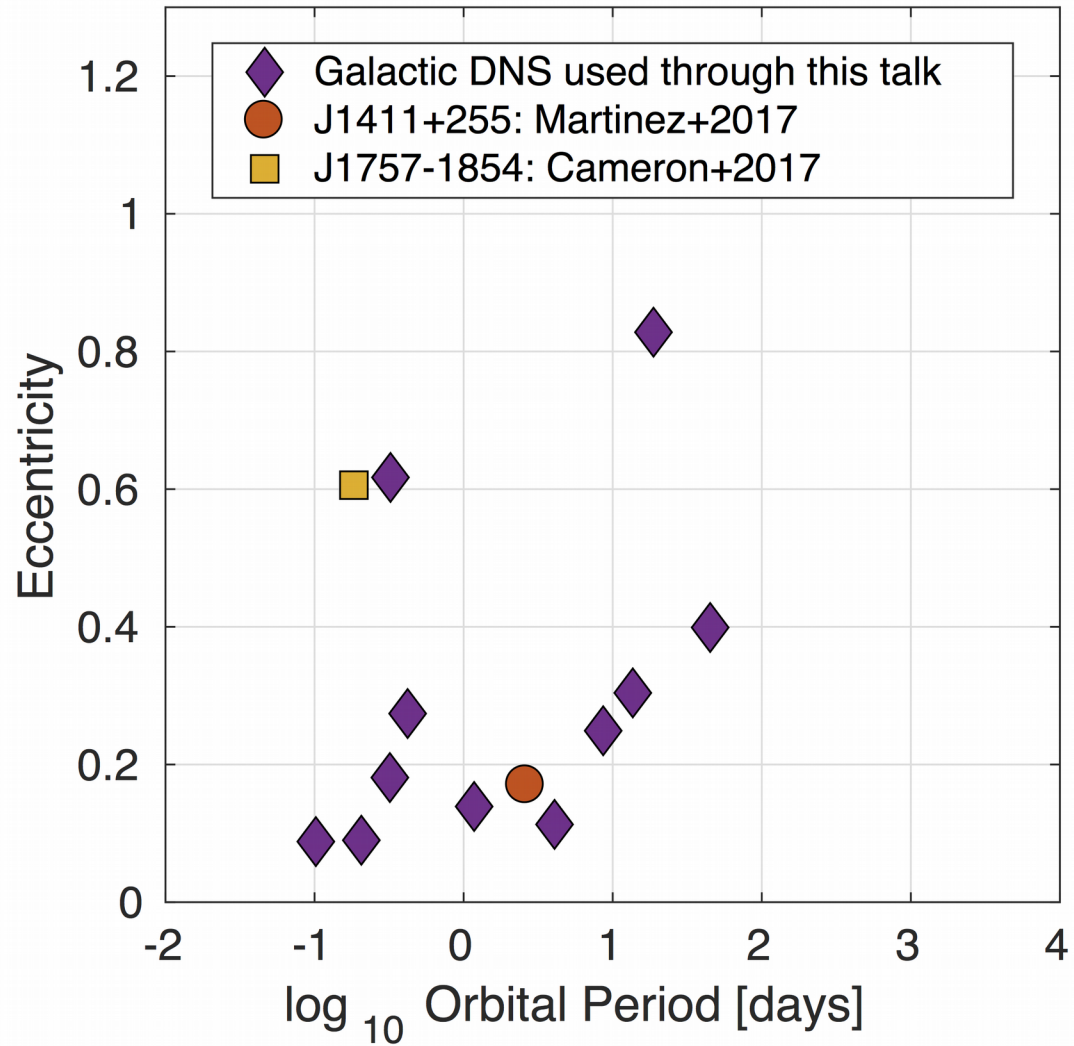
# Outline



- Galactic DNS
- COMPAS
- BBHs in Stevenson, **AVG**, et al. 2017 (old model)
- A Galactic-like DNS population (new model)
  - Bimodal kick distribution
  - Case BB mass transfer
- Old vs New model



# Observations of DNSs

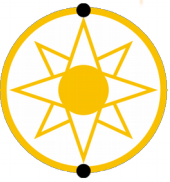




# COMPAS

<http://www.sr.bham.ac.uk/compas>

- Rapid population synthesis code (sub second)
- Isolated binary evolution



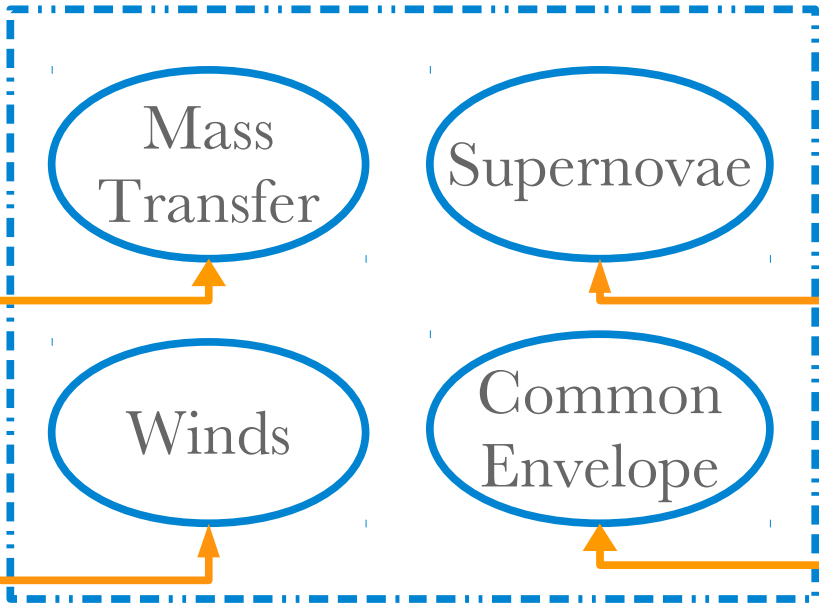
# Population Synthesis

Initial Distributions

$$\mathcal{P} (M_1, q_{ZAMS}, e, a)$$

$$f_a, \gamma, \text{Stability}$$

$$f_{WR, LBV}$$



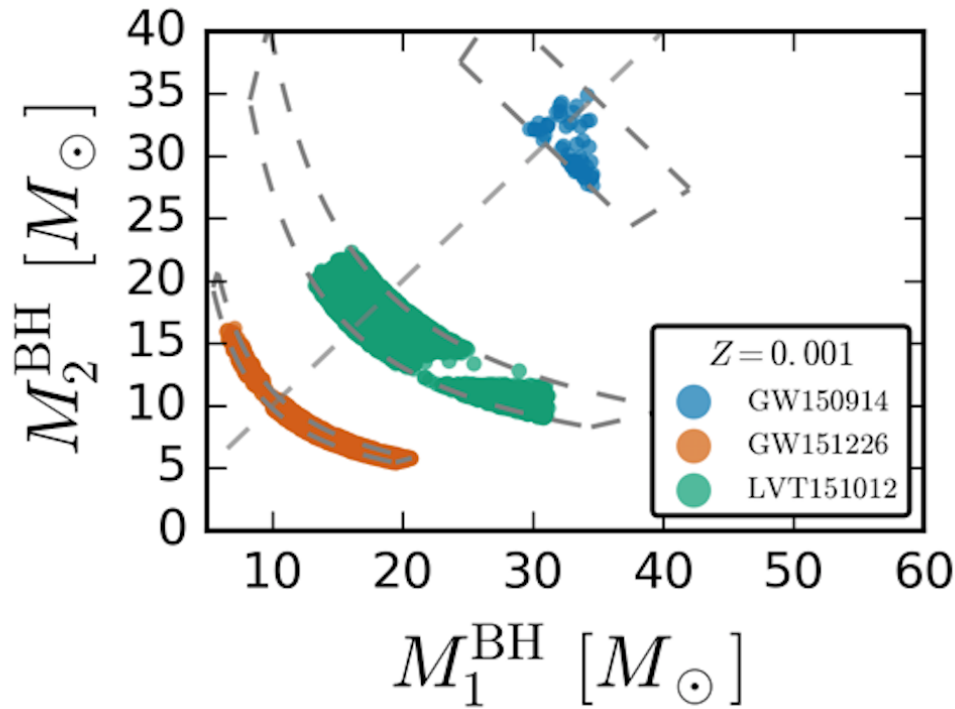
$$v_{\text{kick}} : \text{bimodal} \\ \text{Fryer+2012}$$

$$\lambda : \text{Nanjing} \\ \alpha=0.1$$

$$\mathcal{P} (M_{\text{chirp}}, q_{\text{DCO}}, e_{\text{DCO}}, a_{\text{DCO}})$$

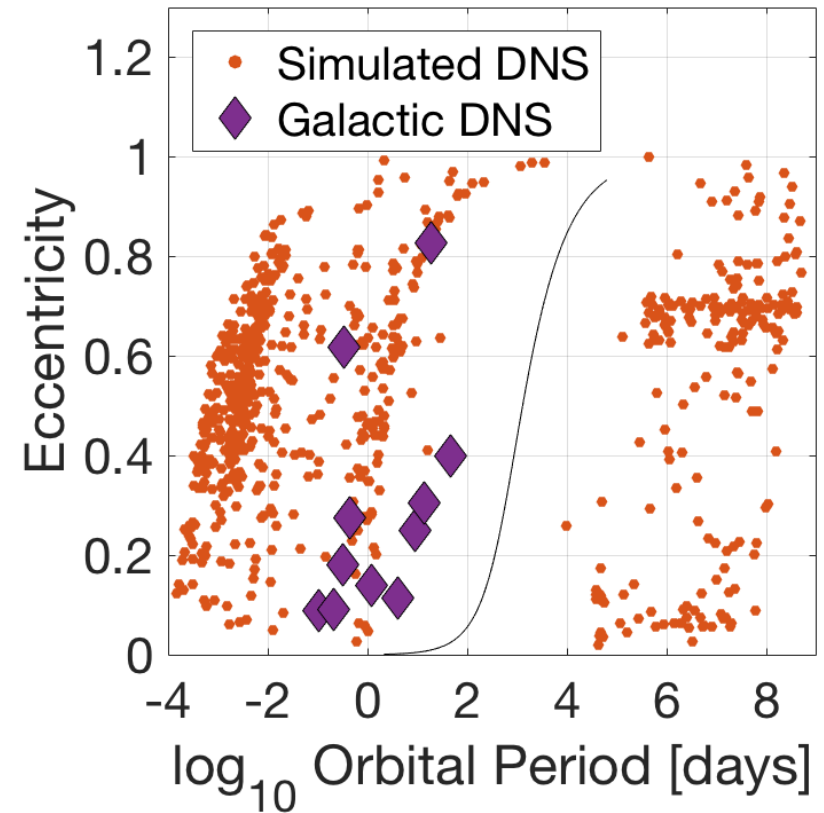
Final Distributions

# Gravitational-wave Sources

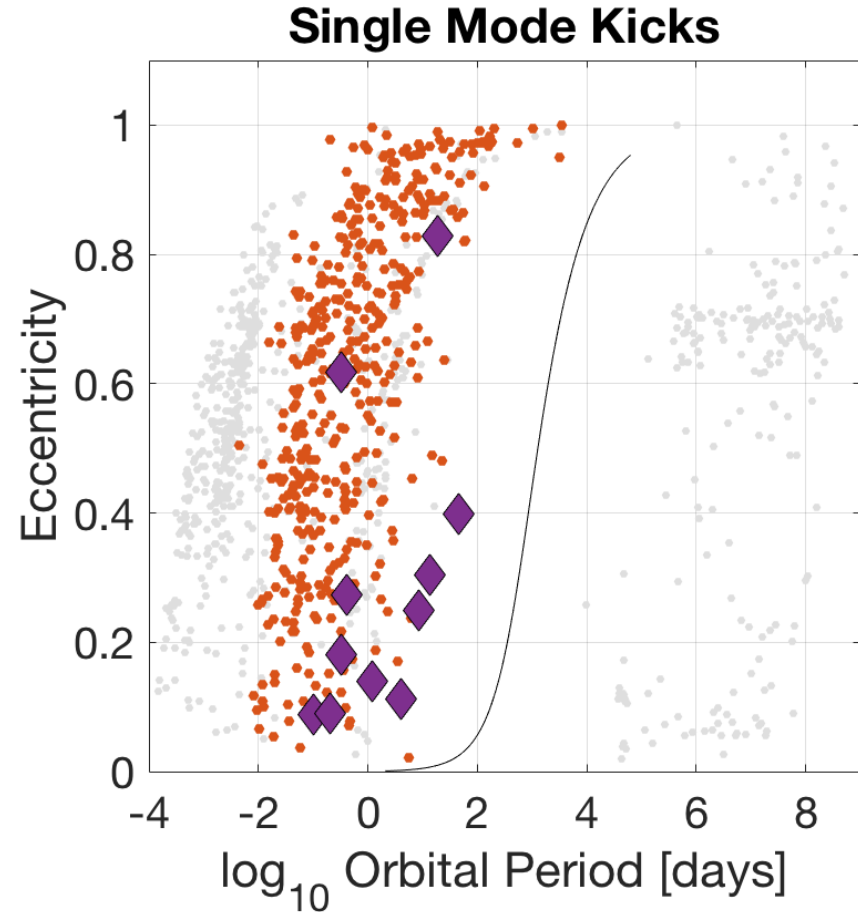
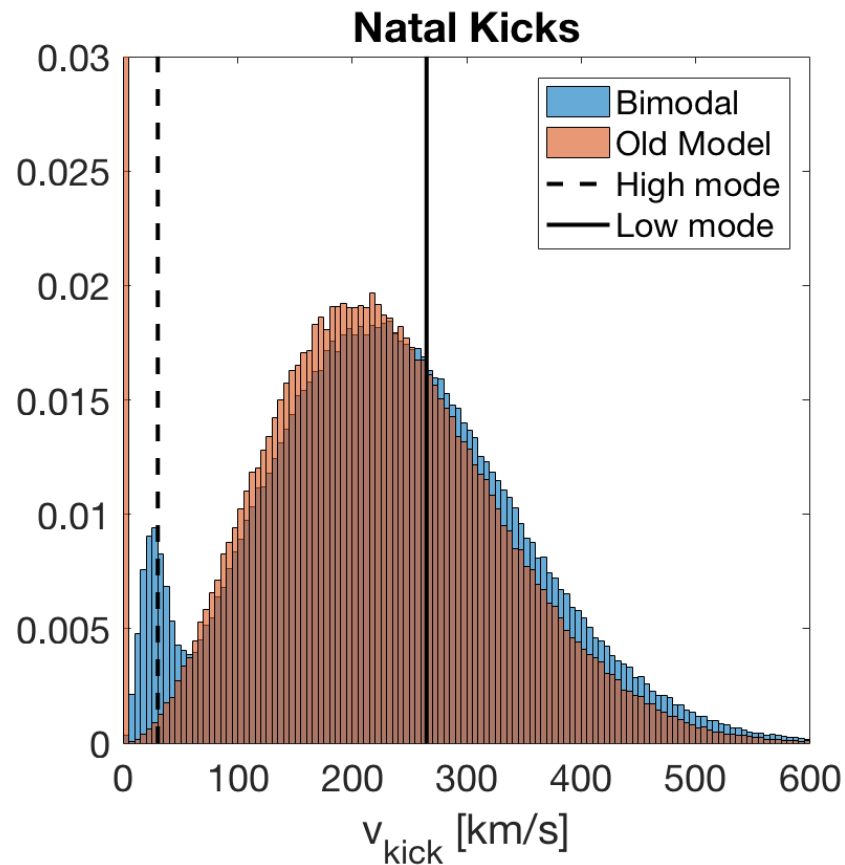


Stevenson, **AVG**+2017  
Old model

## Stevenson, **AVG**+2017 Old Model



# Natal Kicks Distribution



Old Model

$\sigma_{\text{CCSN}} = 265.0 \text{ km/s}$  (Hobbs+2015)

$\sigma_{\text{ECSN}} = 0.0 \text{ km/s}$  (Belczynski+2008)

Fiducial

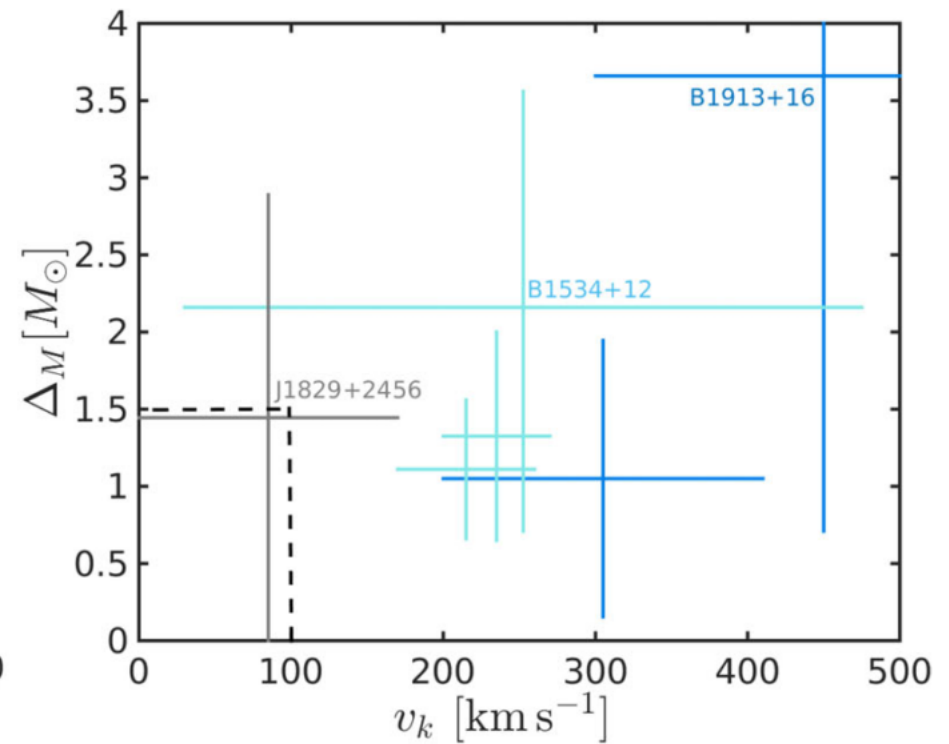
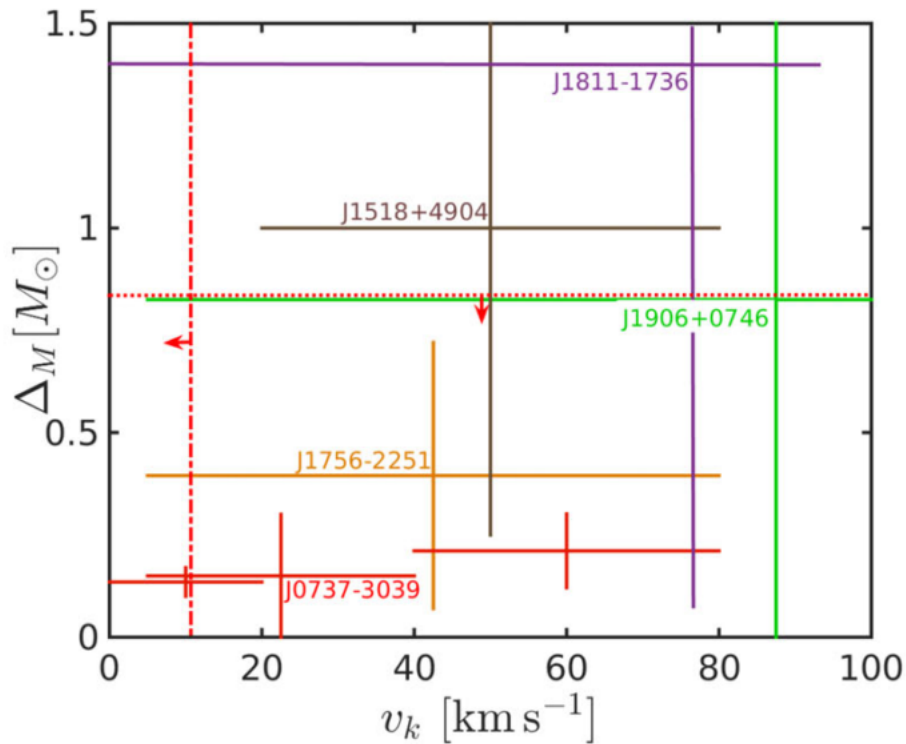
$\sigma_{\text{CCSN}} = 265.0 \text{ km/s}$  (Hobbs+2015)

$\sigma_{\text{ECSN}} = 30.0 \text{ km/s}$  (Podsiadlowski+2004)

$\sigma_{\text{USSN}} = 30.0 \text{ km/s}$

● Old Model  
● Simulated DNS  
◆ Galactic DNS

# Natal Kicks Distribution: Bimodality



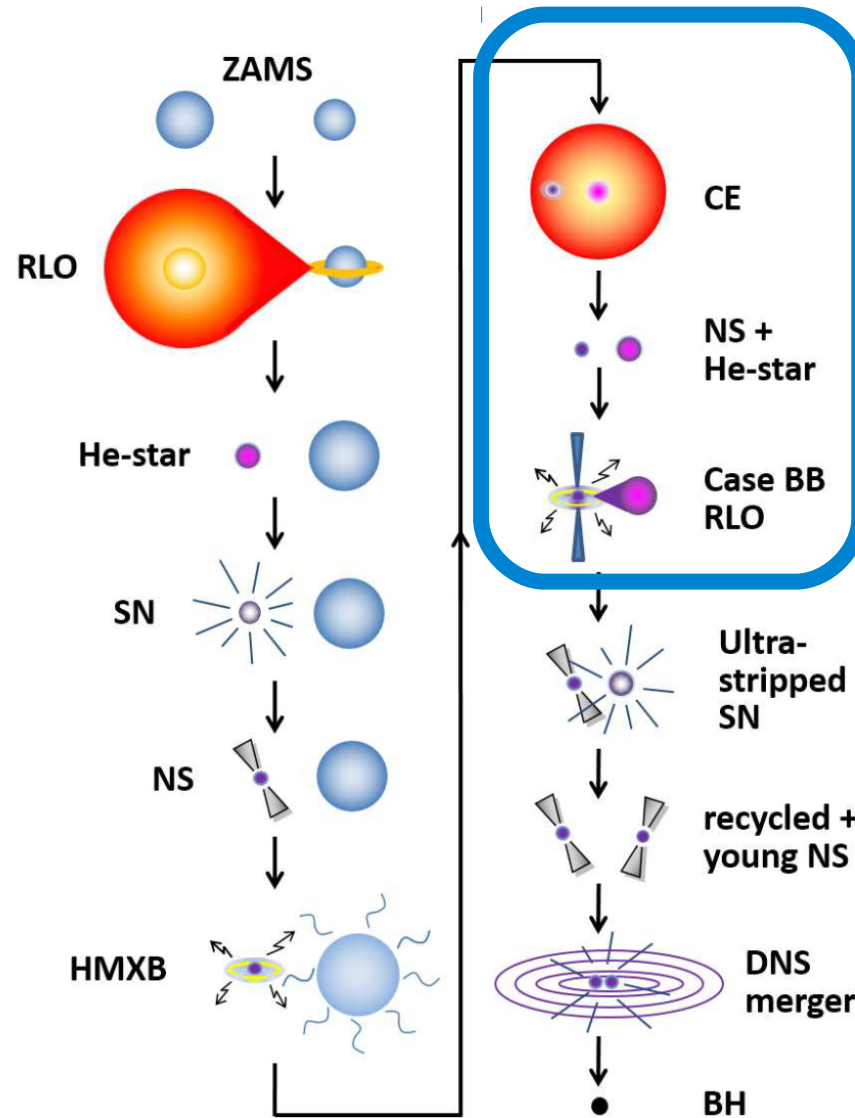
Beniamini & Piran 2016.

See also: Pfhalt+2002a, Podsiadlowski+2004 and Schwab+2010.





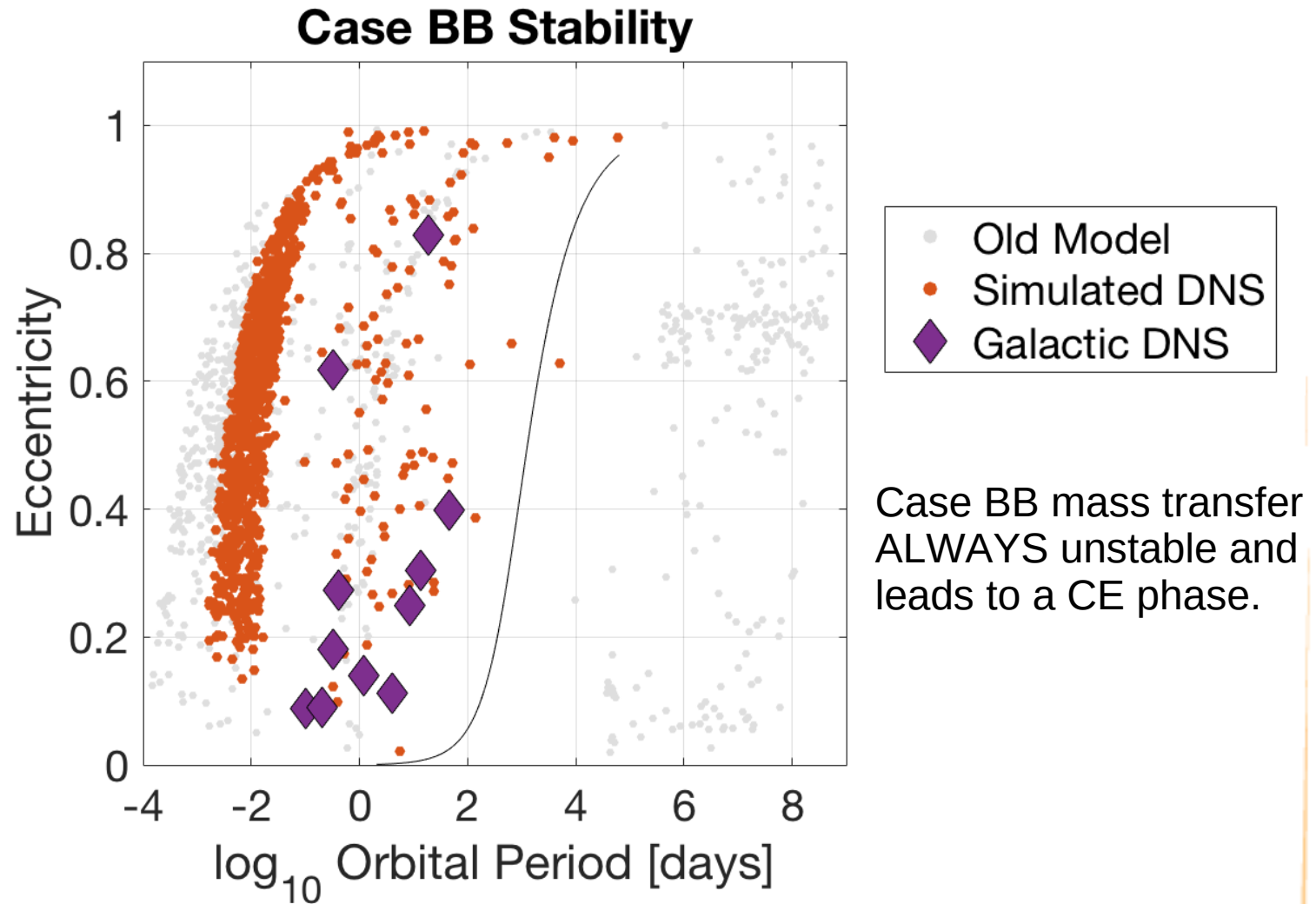
# Case BB Mass Transfer



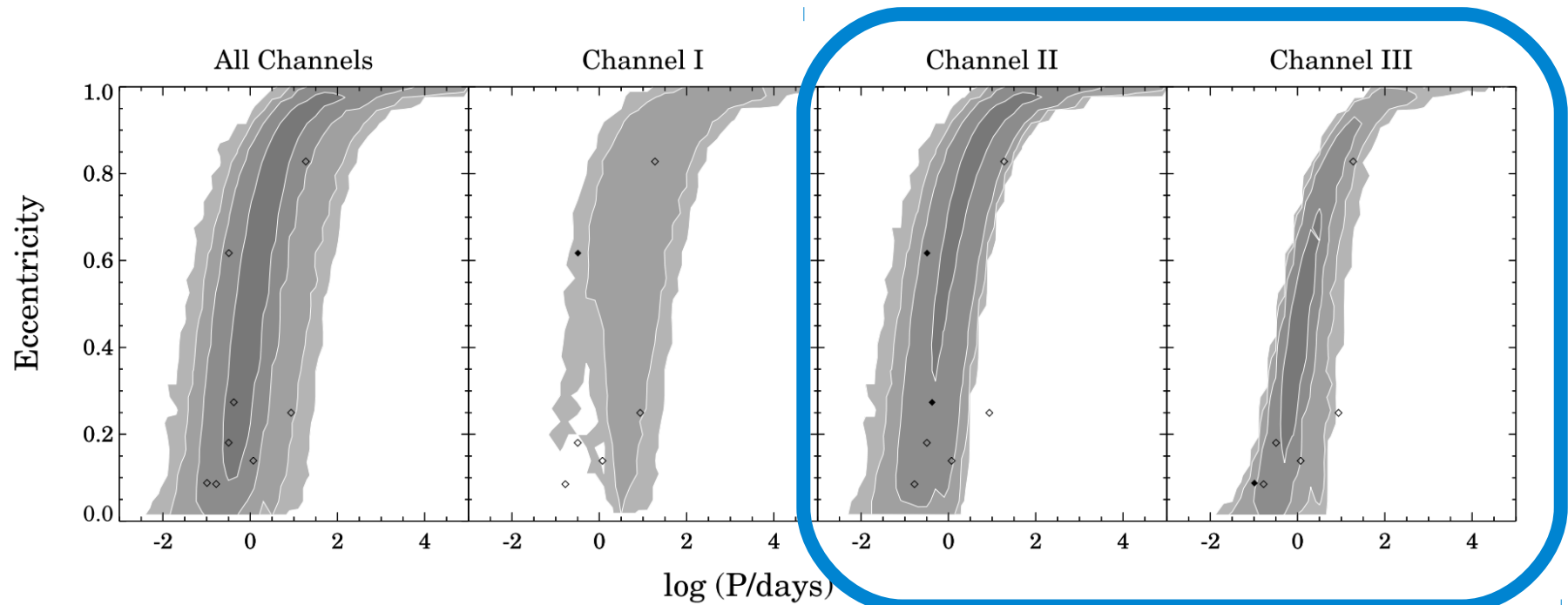
“... case BB (the star fills its Roche lobe after helium core burning is terminated, but before the ignition of carbon).”

Dewi & Pols 2003

# Case BB Mass Transfer



# Case BB Mass Transfer: usually stable

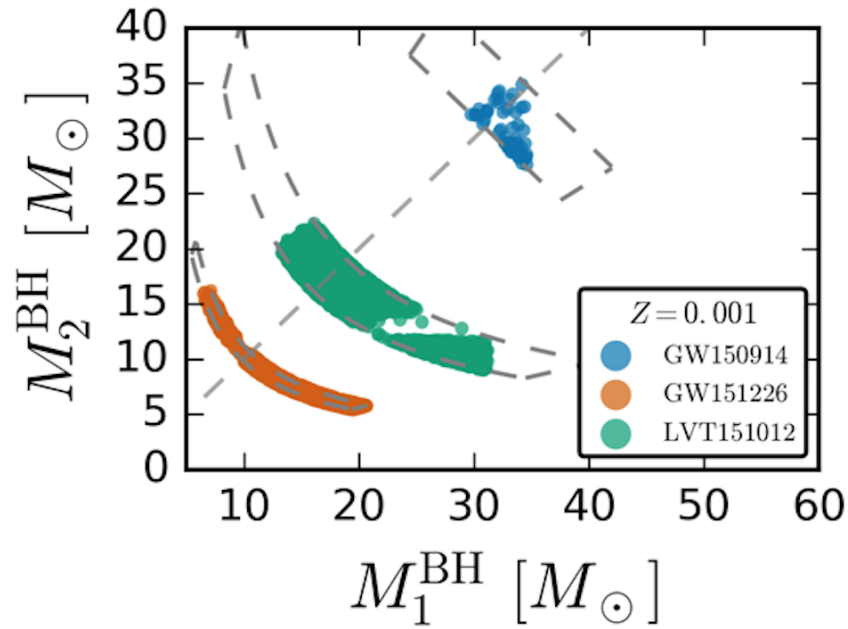


**Figure 1.** DNS population of Model 1, our reference model, is split into evolutionary histories. The first panel includes the whole simulated population and the eight DNSs (open diamonds) in Table 1. The other three panels split the population into the three evolutionary channels defined in Section 3.1. The DNSs J0737–3039, B1913+16, and B1534+12 are indicated by solid diamonds within their evolutionary channel restrictions described in Section 3.2. The four contours correspond to the 68.3%, 95.45%, 99.7%, and 99.994% confidence levels, normalized to the full population.

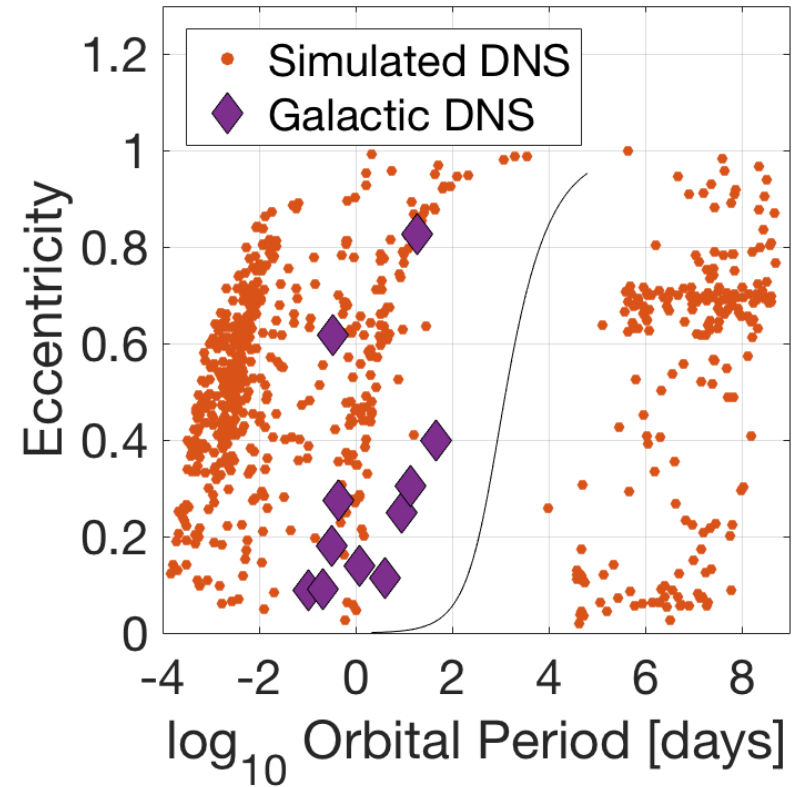
Andrews+2015.

See also: Dewi & Pols 2003, Tauris+2015

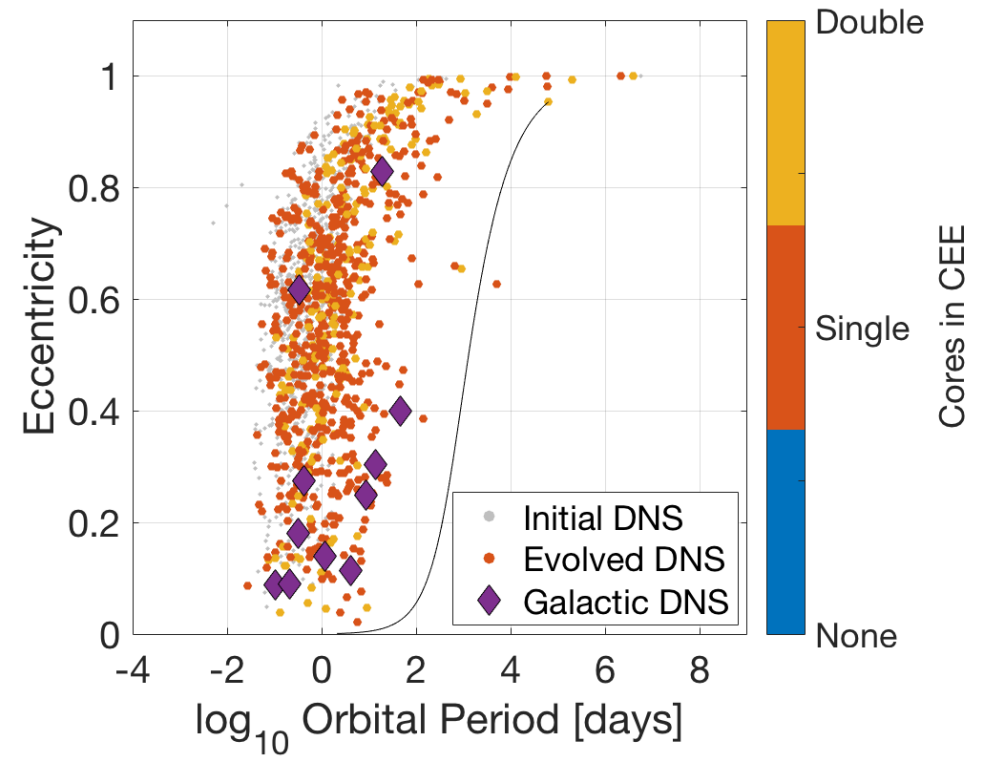
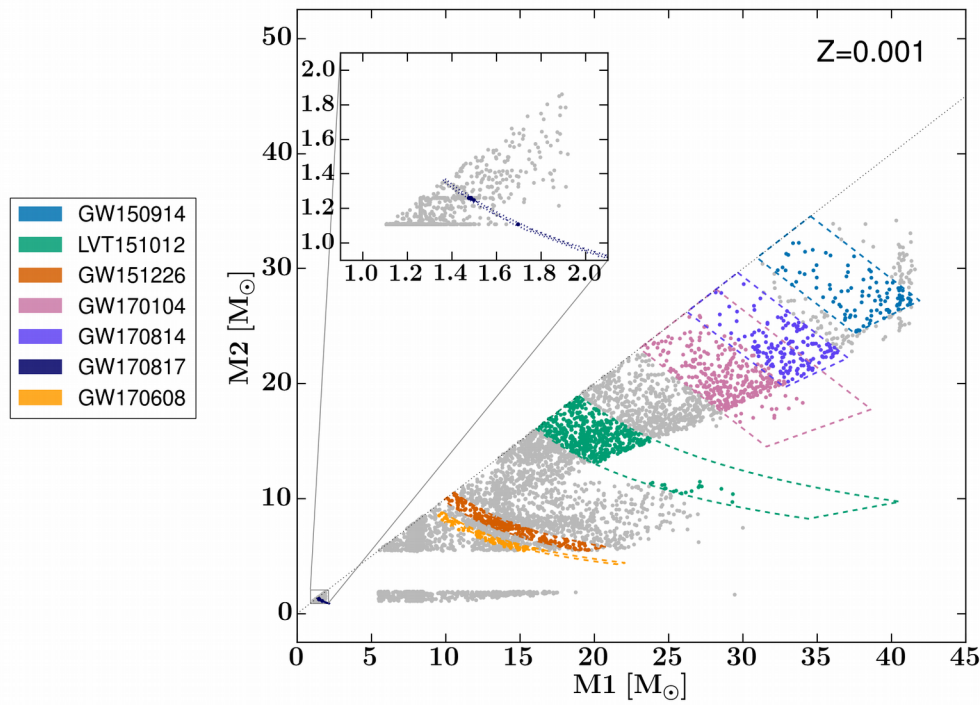
# Old Model



Stevenson, AVG+2017  
Old Model

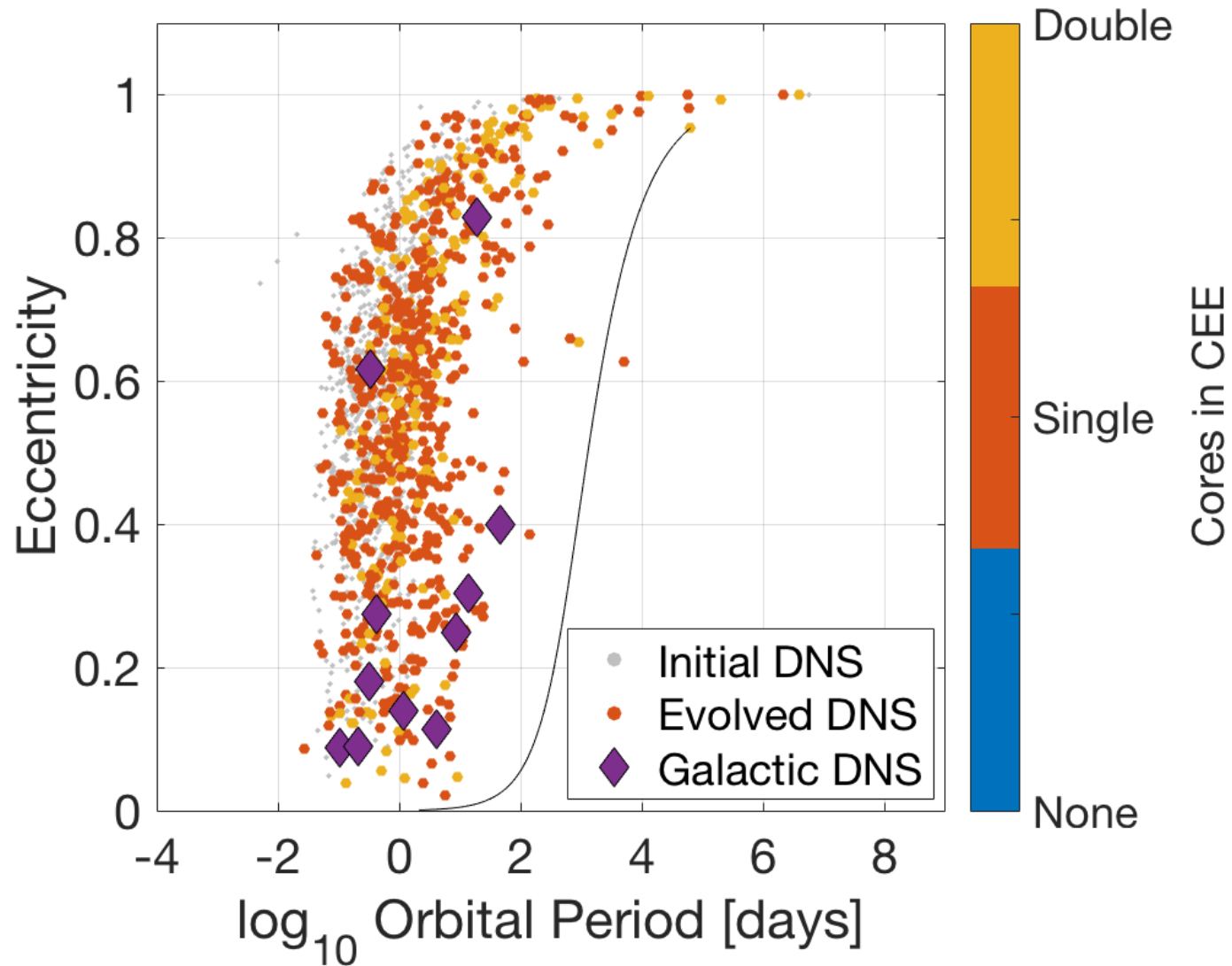


# New Model





# DNS Fiducial Model





# Conclusions

- BBHs in Stevenson, **AVG**, et al. 2017 (old model)
  - Good for BBHs **not** for BNSs
- **AVG** in prep (new model)
  - Good for BBHs **and** BNSs
- Personal interests (uncertainties):
  - Case BB mass transfer (stability)
  - NS remnant masses
- Future work:
  - Merger rates (soon)
  - Selection effects (not soon)