

# Detection of IMBHs with the ET and other advanced ground-based GW observatories: A biography of a binary of black holes, from birth to death

**Pau Amaro-Seoane, Lucía Santamaría**

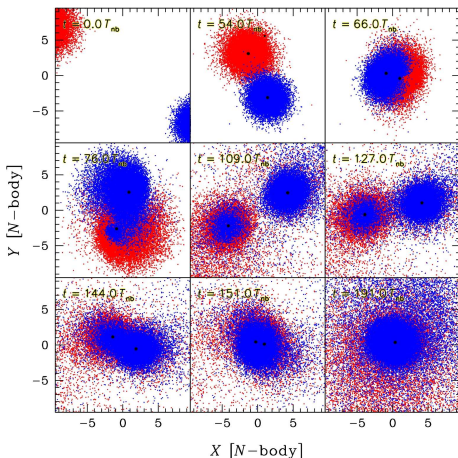
(Albert-Einstein-Institut Potsdam, Germany)

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# Do IMBHs exist?

- Formed after collapse of a Very Massive Star
- Double-cluster channel: in systems of two grav.-bound clusters, IMBHs sink down to the centers
- Single-cluster channel: in clusters with a fraction of primordial binaries  $> 10\%$  two IMBH might form



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# Event rates of IMBH binaries for AdvLIGO and ET

For Advanced LIGO:

$$\Gamma_{\text{Adv. LIGO}}^{\text{total}} \in [(0) 11, 300] \text{ yr}^{-1}.$$

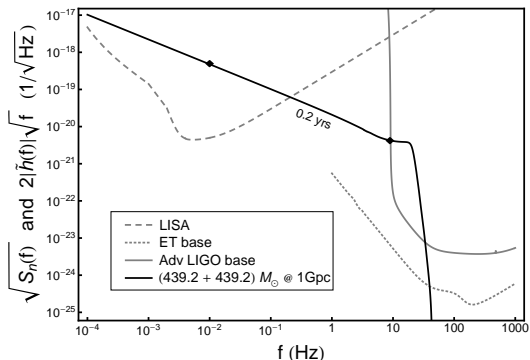
For the ET:

$$\Gamma_{\text{ET}}^{\text{total}} \in [(0) 4000, 6 \cdot 10^4] \text{ yr}^{-1}$$

This numbers are encouraging enough to address the problem of GW detection and characterization of IMBH systems with AdvLIGO and **the ET**

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# LISA and Ground-based detectors

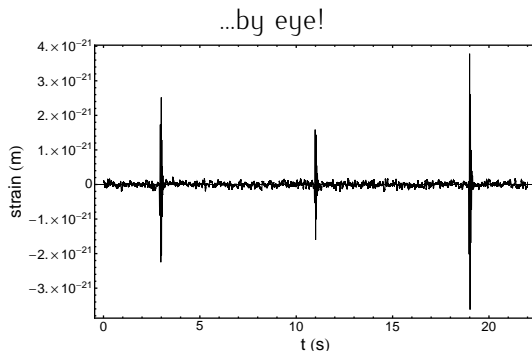


IMBHs with masses of hundreds of  $M_\odot$  could be seen by  
*both* LISA and the ET...

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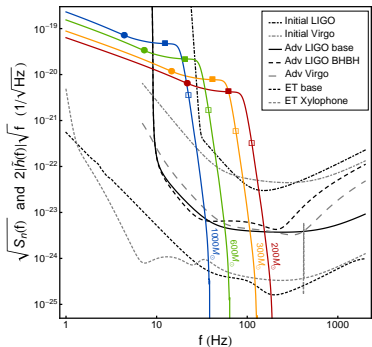
# LISA and Ground-based detectors

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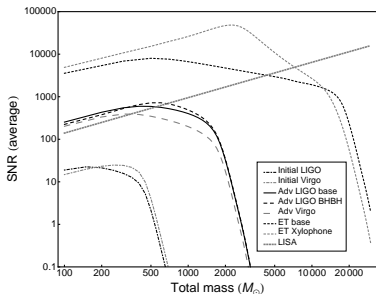


IMBHs of masses  $400 M_{\odot} \leq M_{\text{total}} \leq 700 M_{\odot}$  and random orientations at 1 Gpc of the Advanced LIGO.  
The ET will see these signals with an even larger SNR.

# Expected Signal-To-Noise Ratios



IMBH binaries with total mass 200, 300, 600 and 1000  $M_{\odot}$



Sky-averaged SNR at 100 Mpc vs total mass of the system

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## Conclusions

- ▶ IMBH detection would be of extreme important for theoretical astrophysics
- ▶ Possible formation channels for IMBH binaries in clobular clusters lead to non-negligible event rates for AdvLIGO and especially for the ET
- ▶ LISA will only see the inspiral stage, for IMBH binaries merge outside its band
- ▶ Large SNR events will be associated to the merger and ringdown of IMBH systems within the sensitivity bands of future-generation GW interferometers
- ▶ Prospects for detection and characterization of IMBH binaries with the ET look very encouraging