Observing Black Holes with LISA

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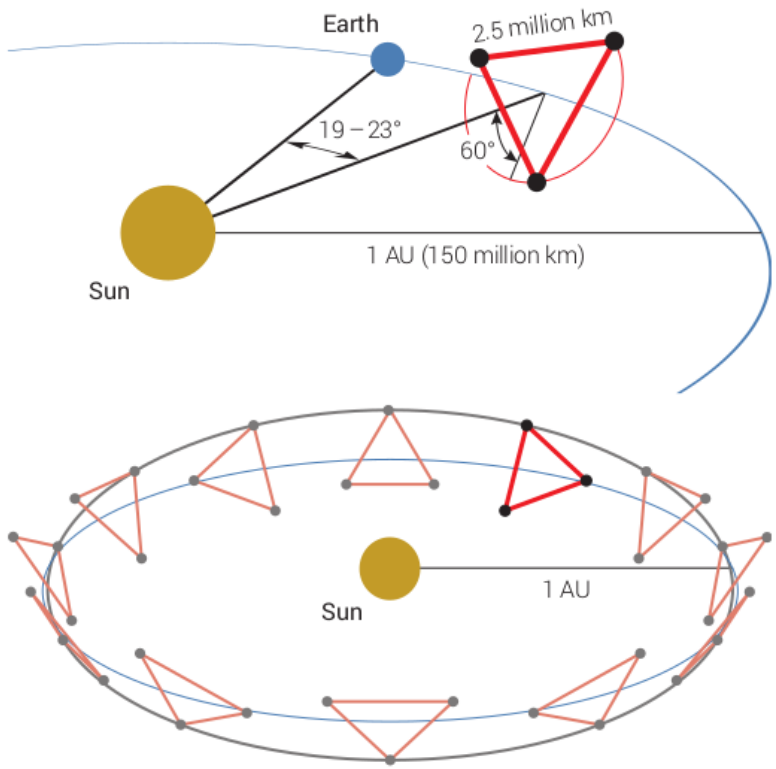
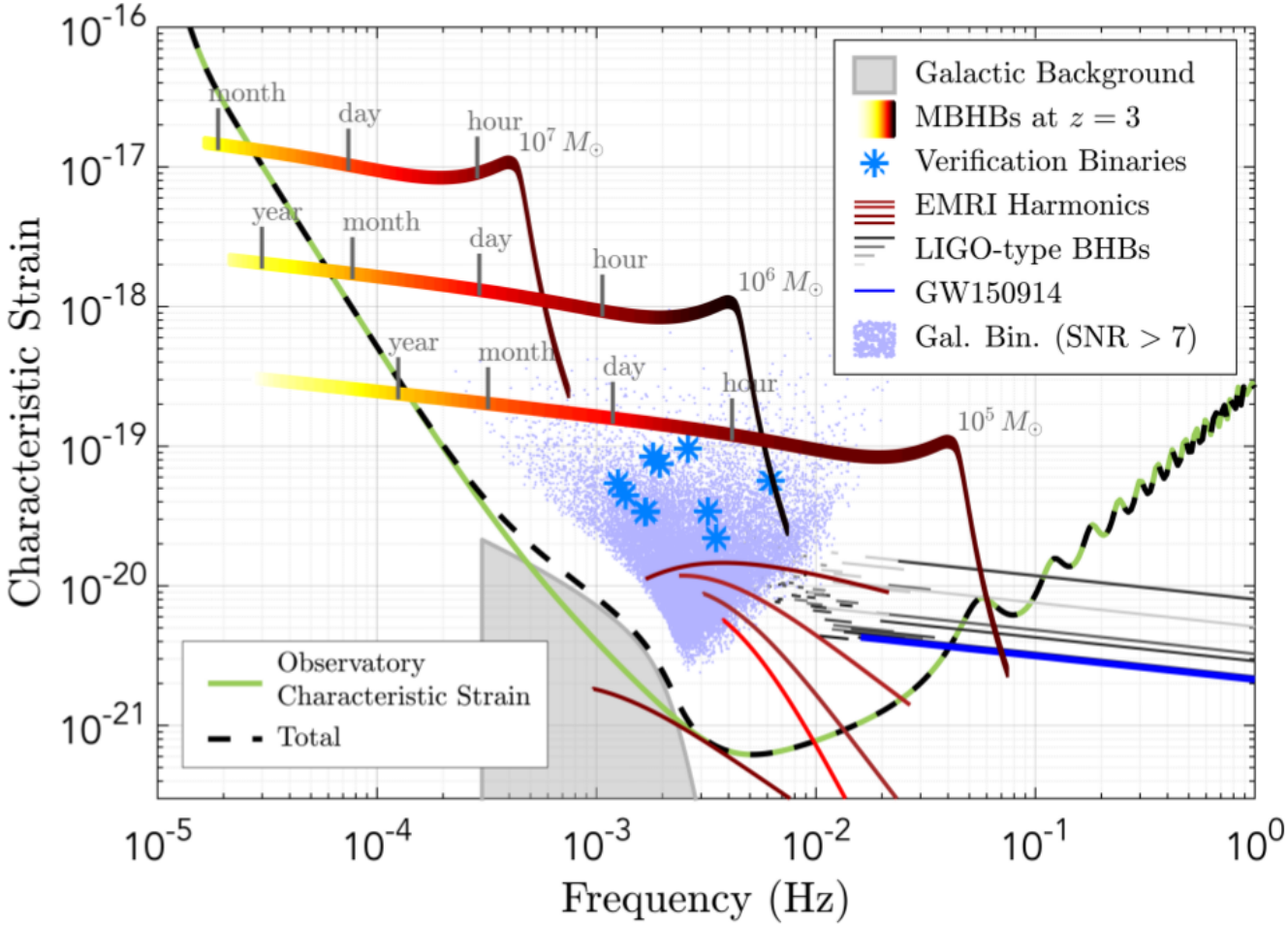
Outline

Orbits Sketch



[Image: K. Danzmann et al., LISA proposal, 2017]

Sensitivity



[Image: K. Danzmann et al., LISA proposal, 2017]

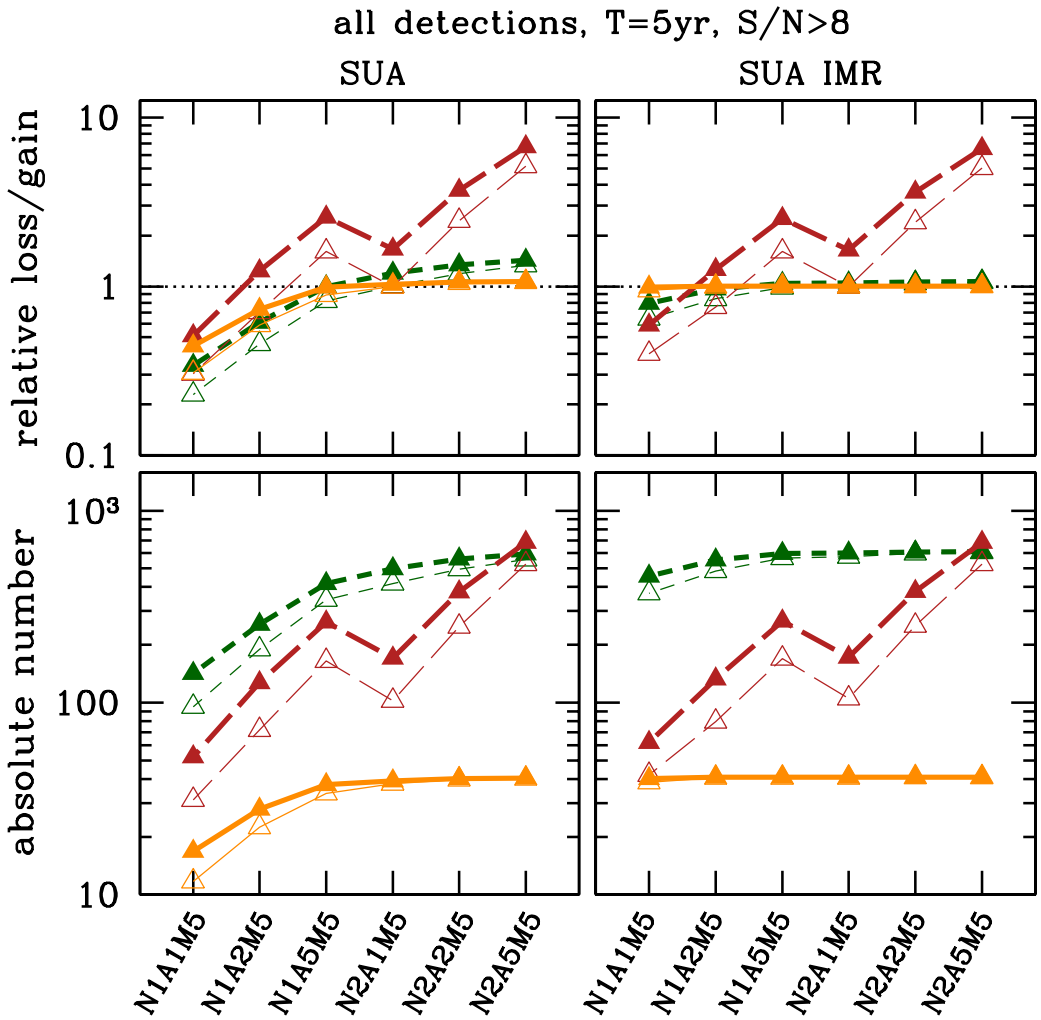
Supermassive Black Hole Binaries

Due to the length of its arms, LISA will be be most sensitive to the merger of black hole binaries with total mass $10^3 M_\odot \lesssim M \lesssim 10^7 M_\odot$.

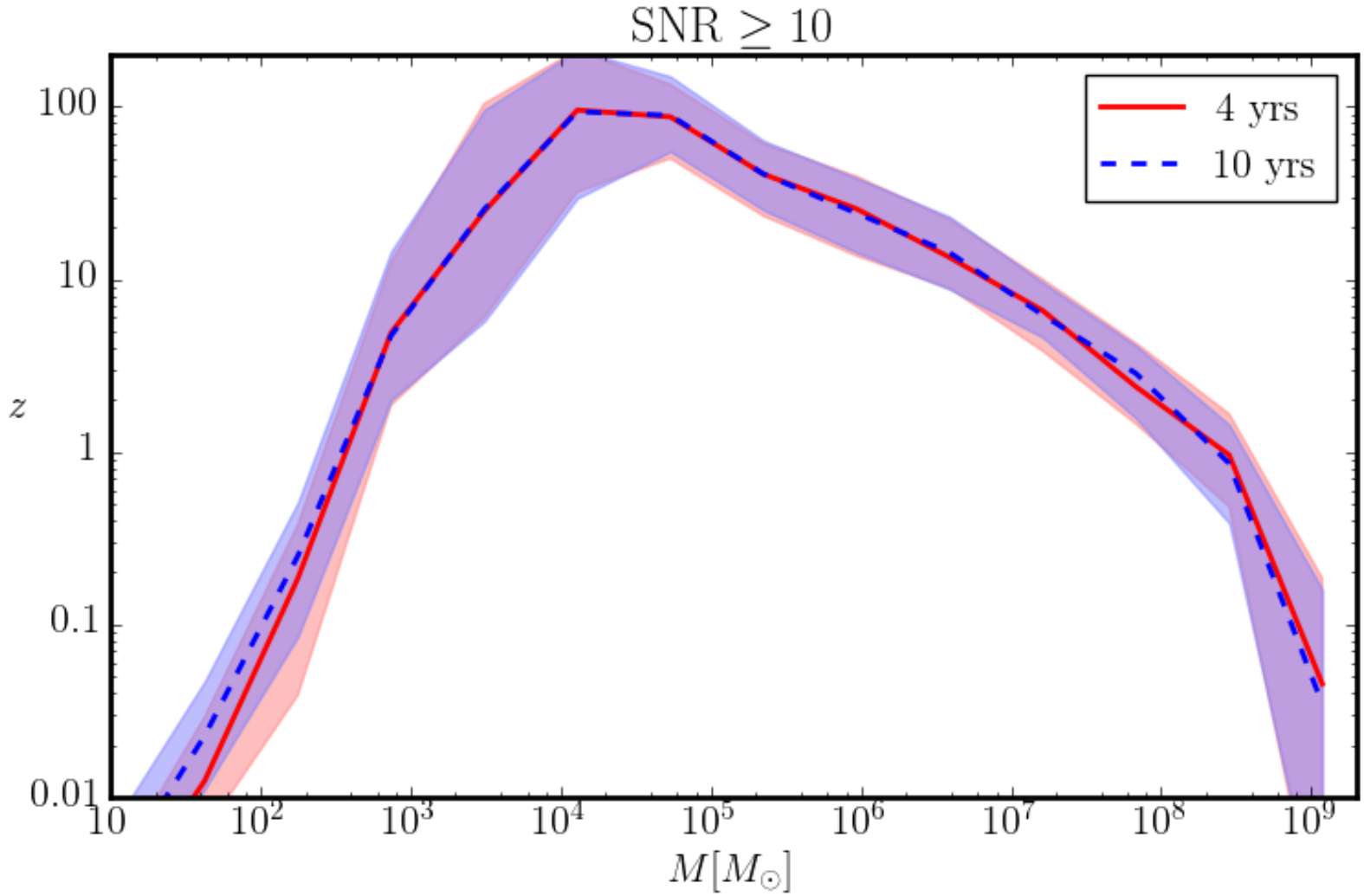
Observing SMBHBs will provide a window into galaxy evolution through the evolution of their central black holes.

Measuring their masses and spins will give valuable astrophysical information, and measuring the ringdown radiation of the remnant black holes will provide important tests of gravity.

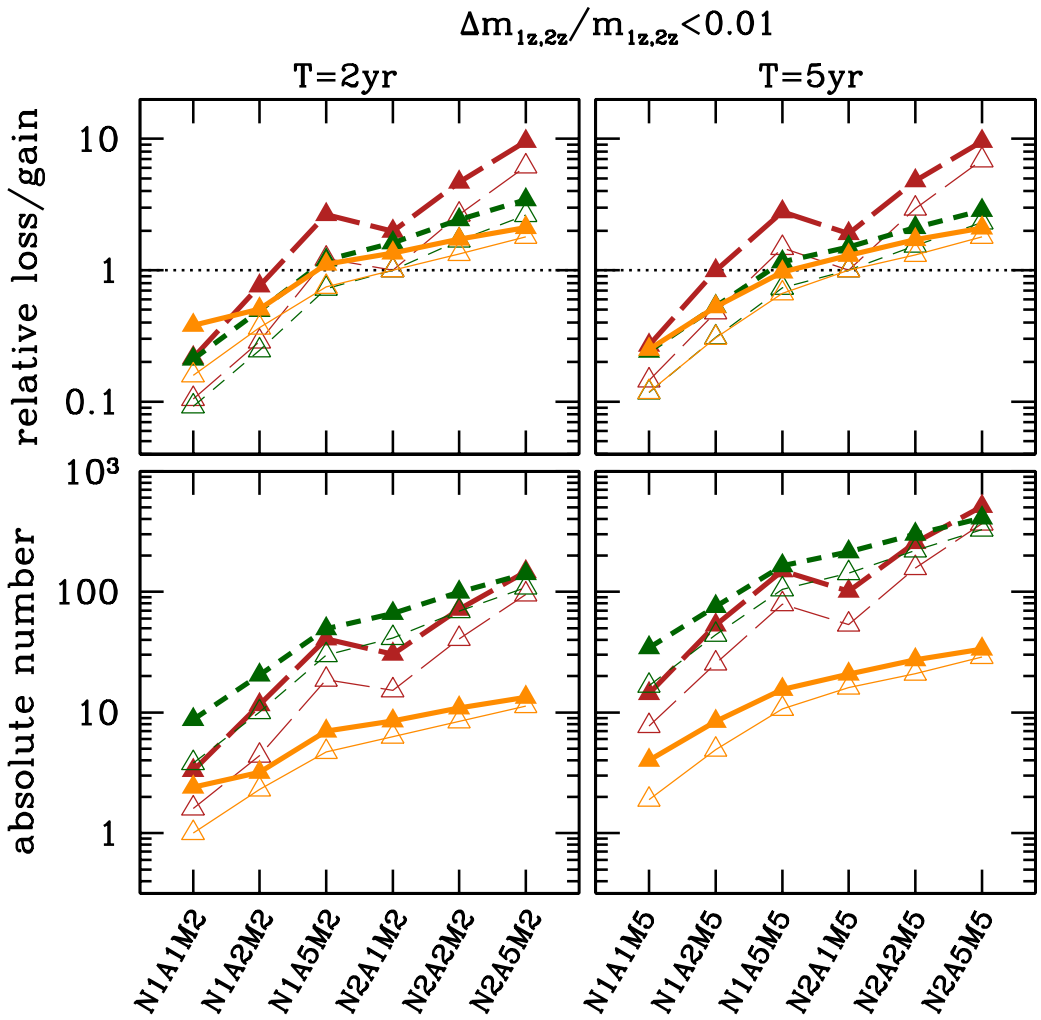
Detections from astrophysical populations



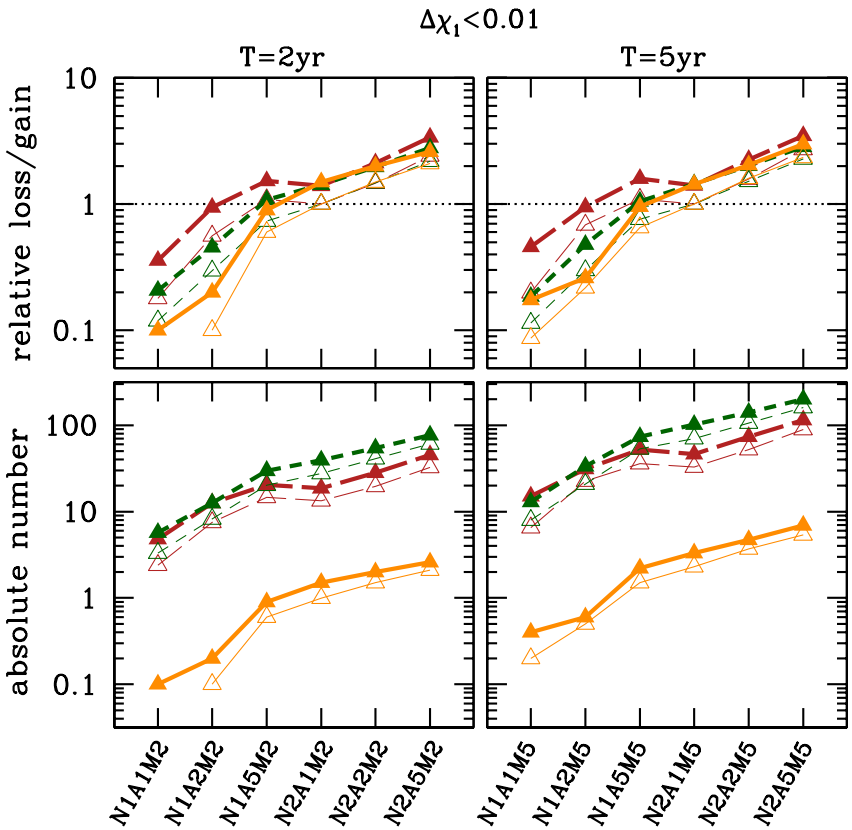
Horizon distance

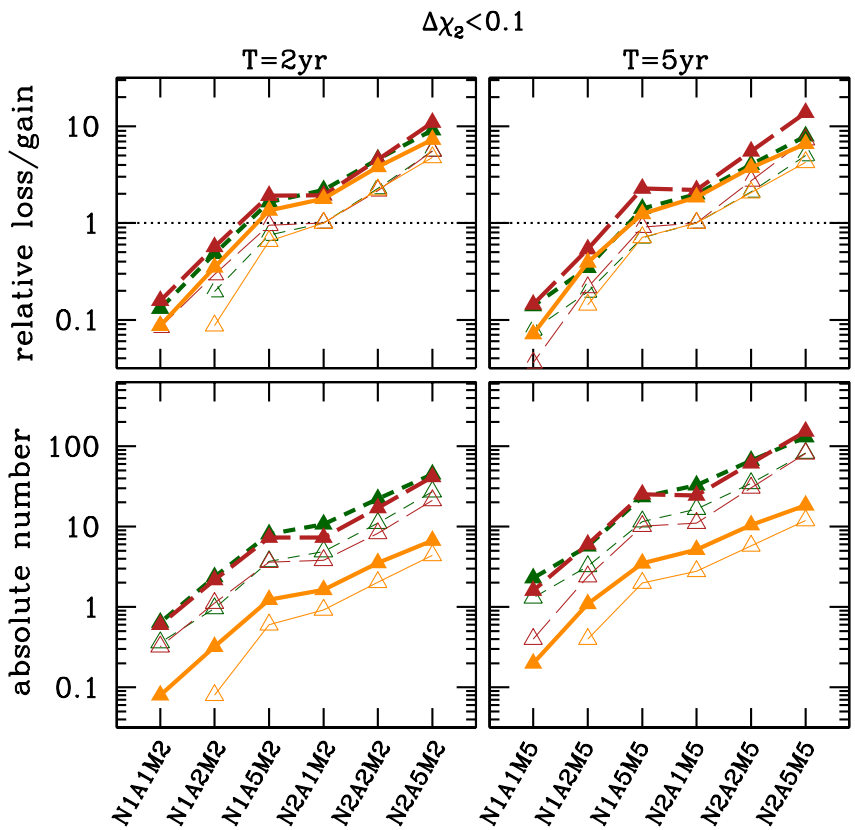


Mass measurement

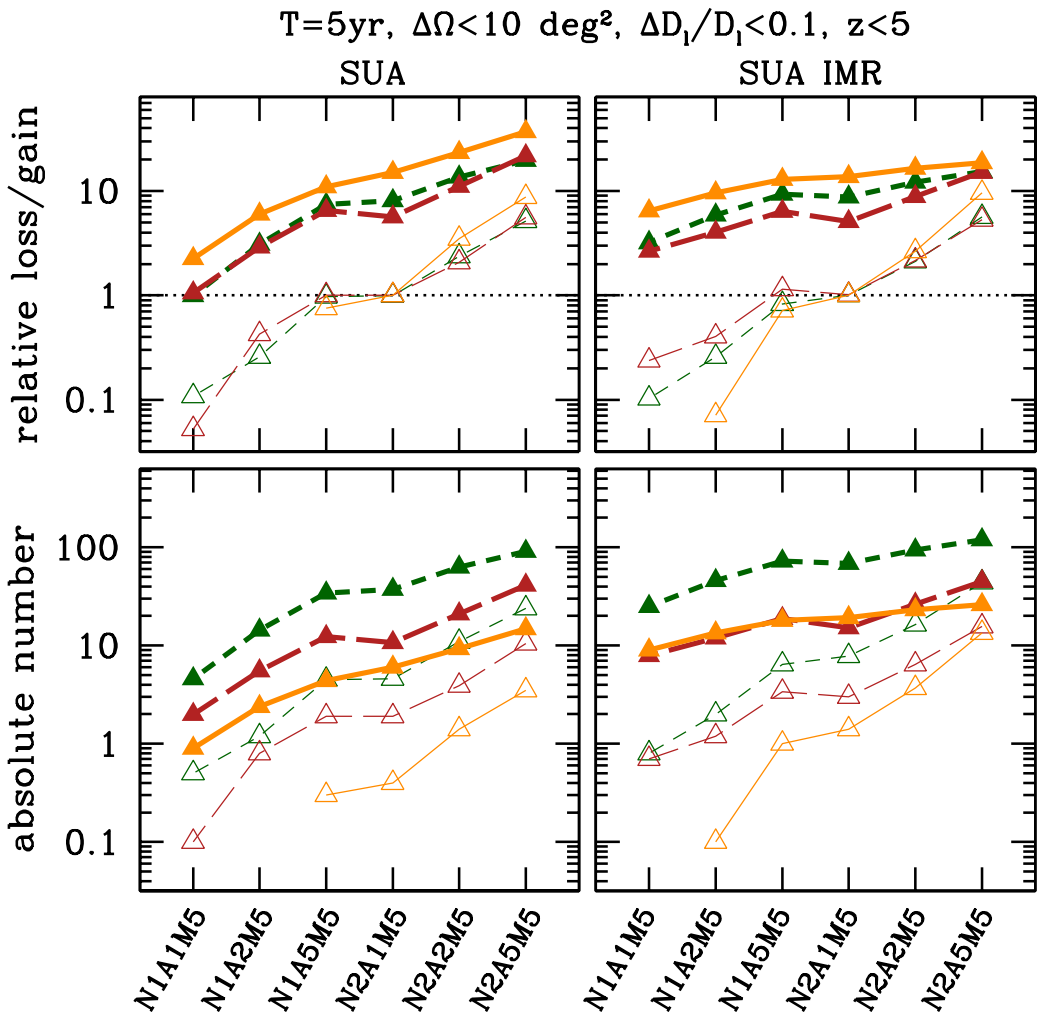


Spin measurement

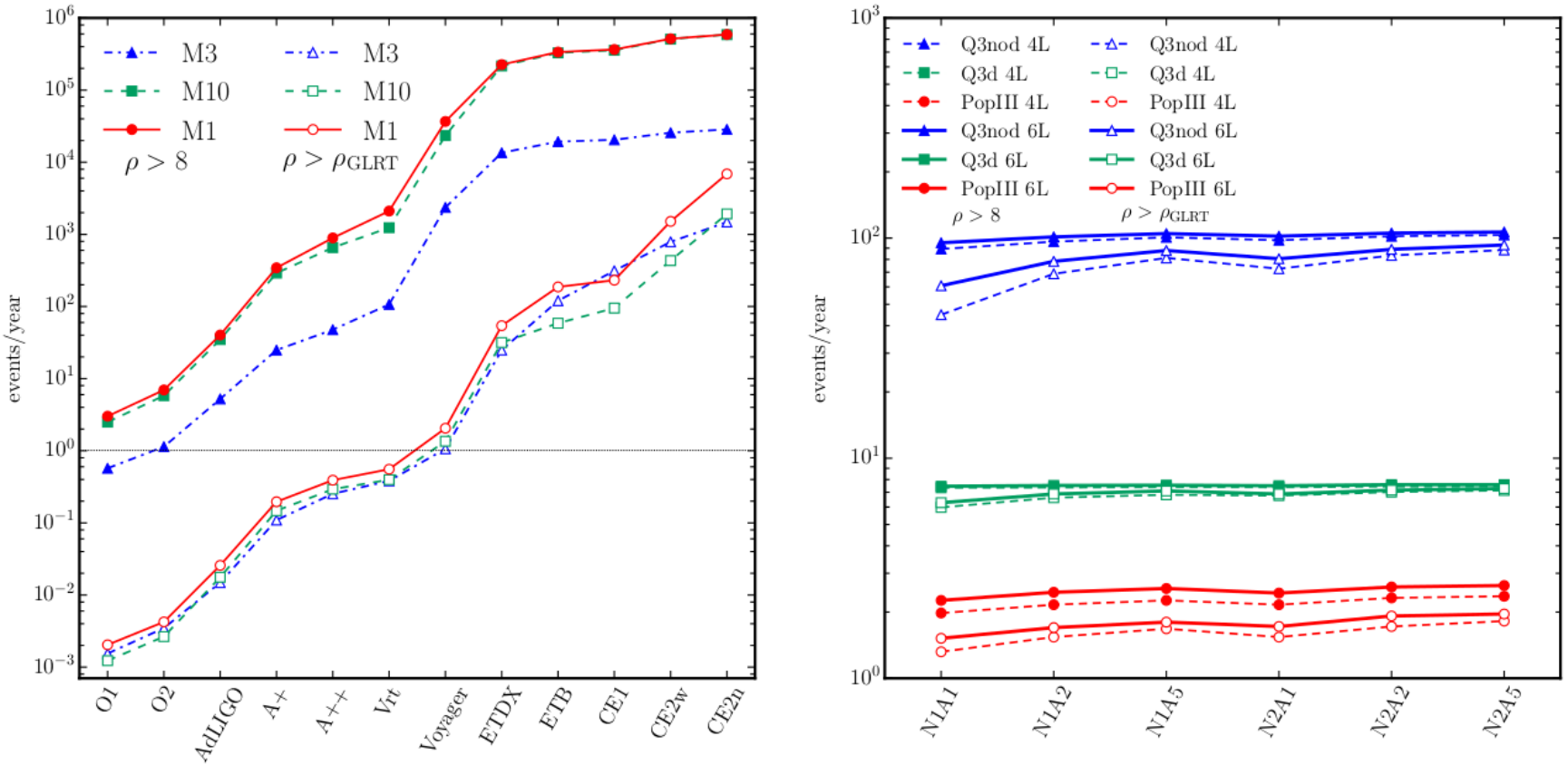




Potential counterparts population



Ringdown measurement



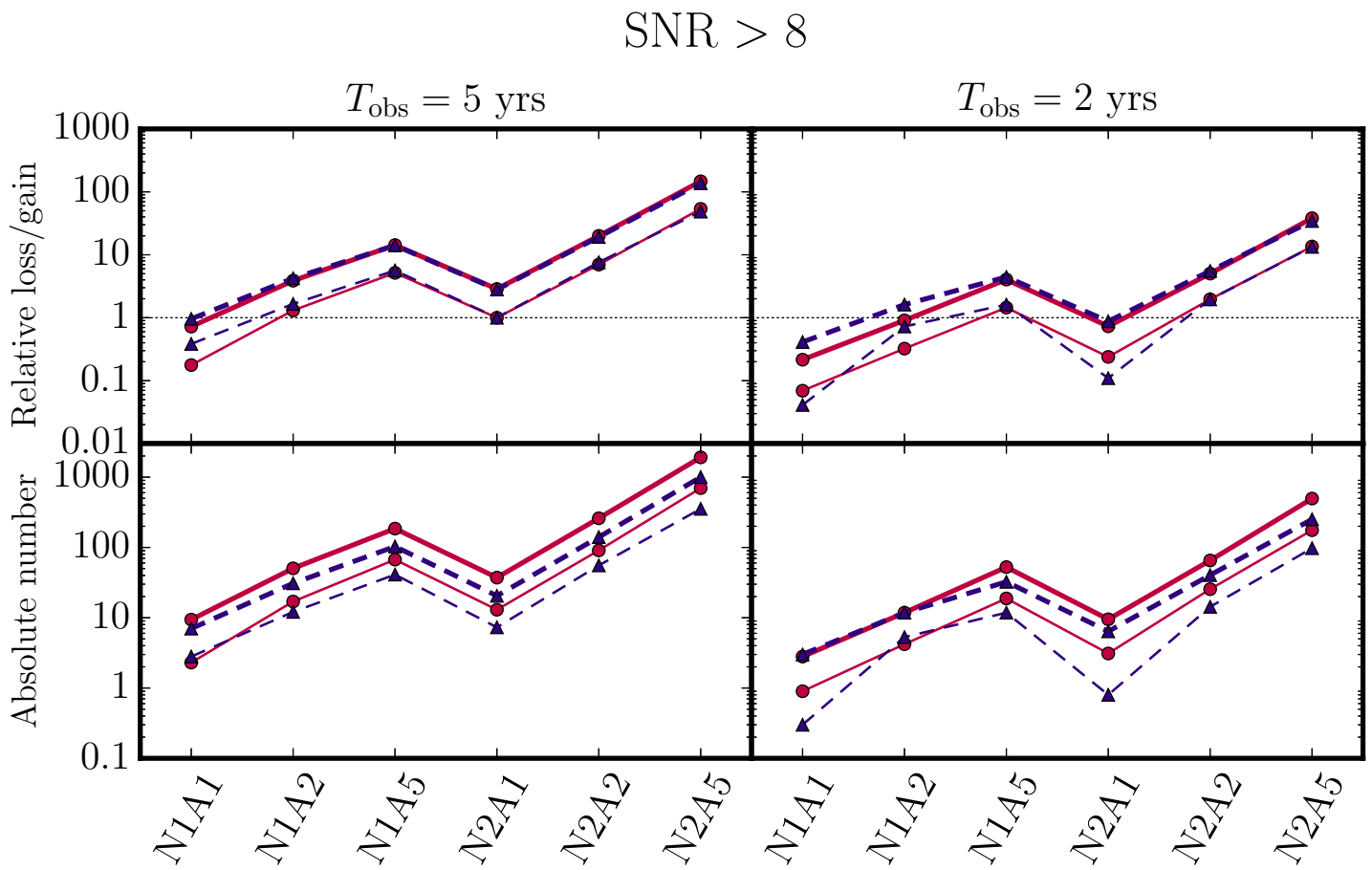
[Image: E. Berti et al., Phys. Rev. Lett. 117, 101102 (arXiv:1605.09286)]

Stellar Mass Black Hole Binaries

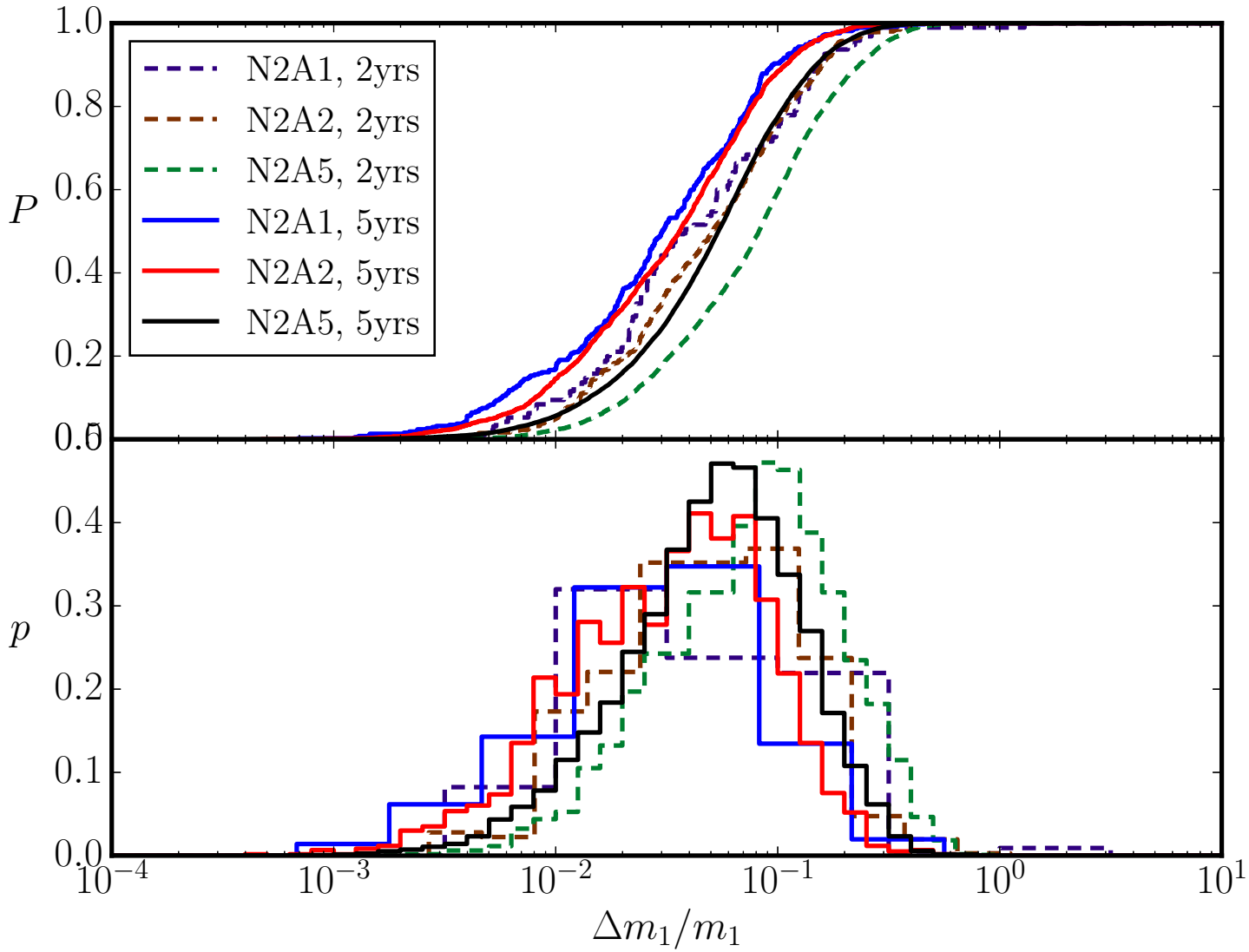
LISA will be able to see the early inspiral of the heavier sources for ground detectors.

It will provide a complementary measure of their parameters, and will be sensitive to sources at lower frequencies, where more binaries are radiating.

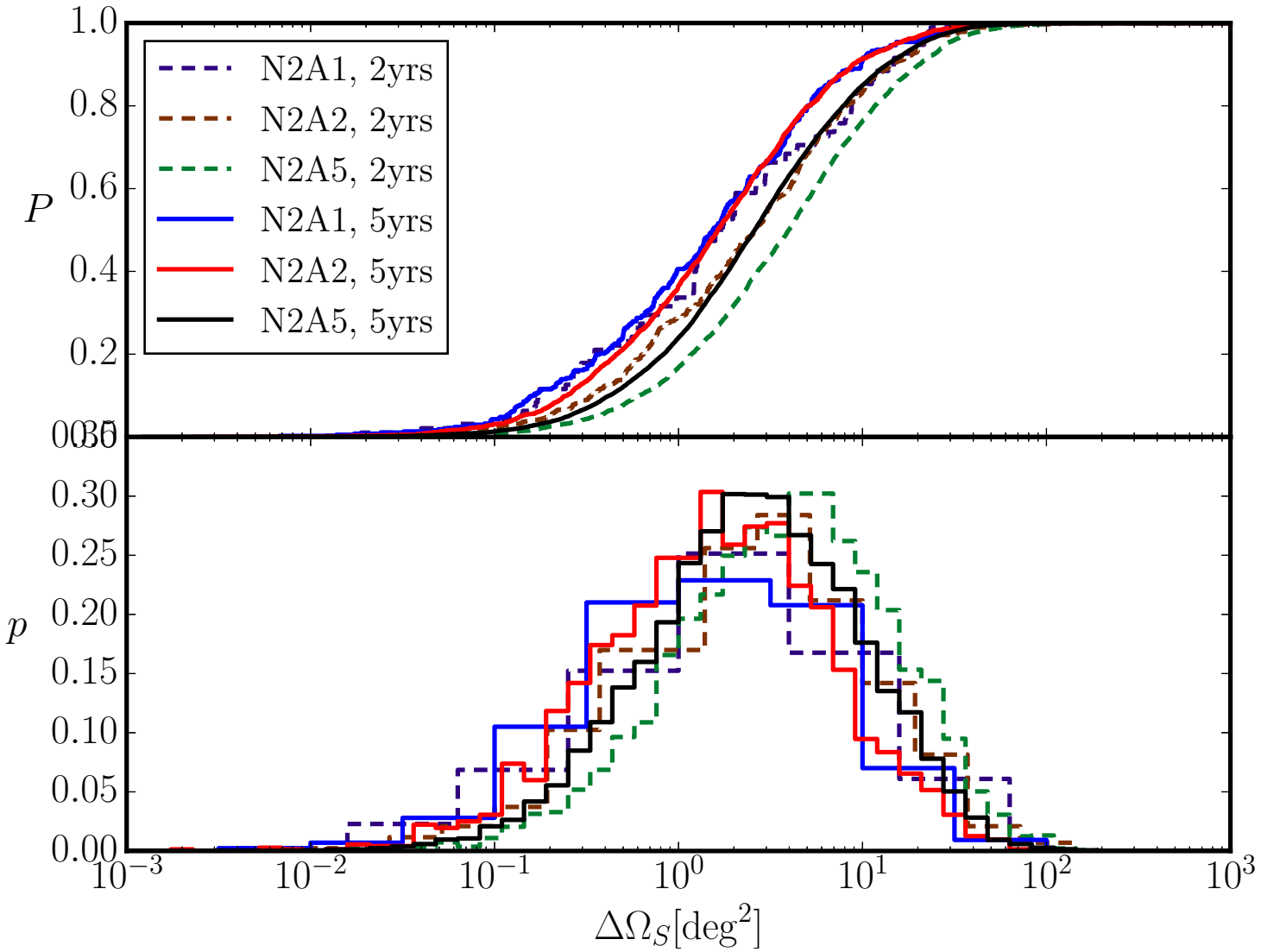
Detections from astrophysical populations



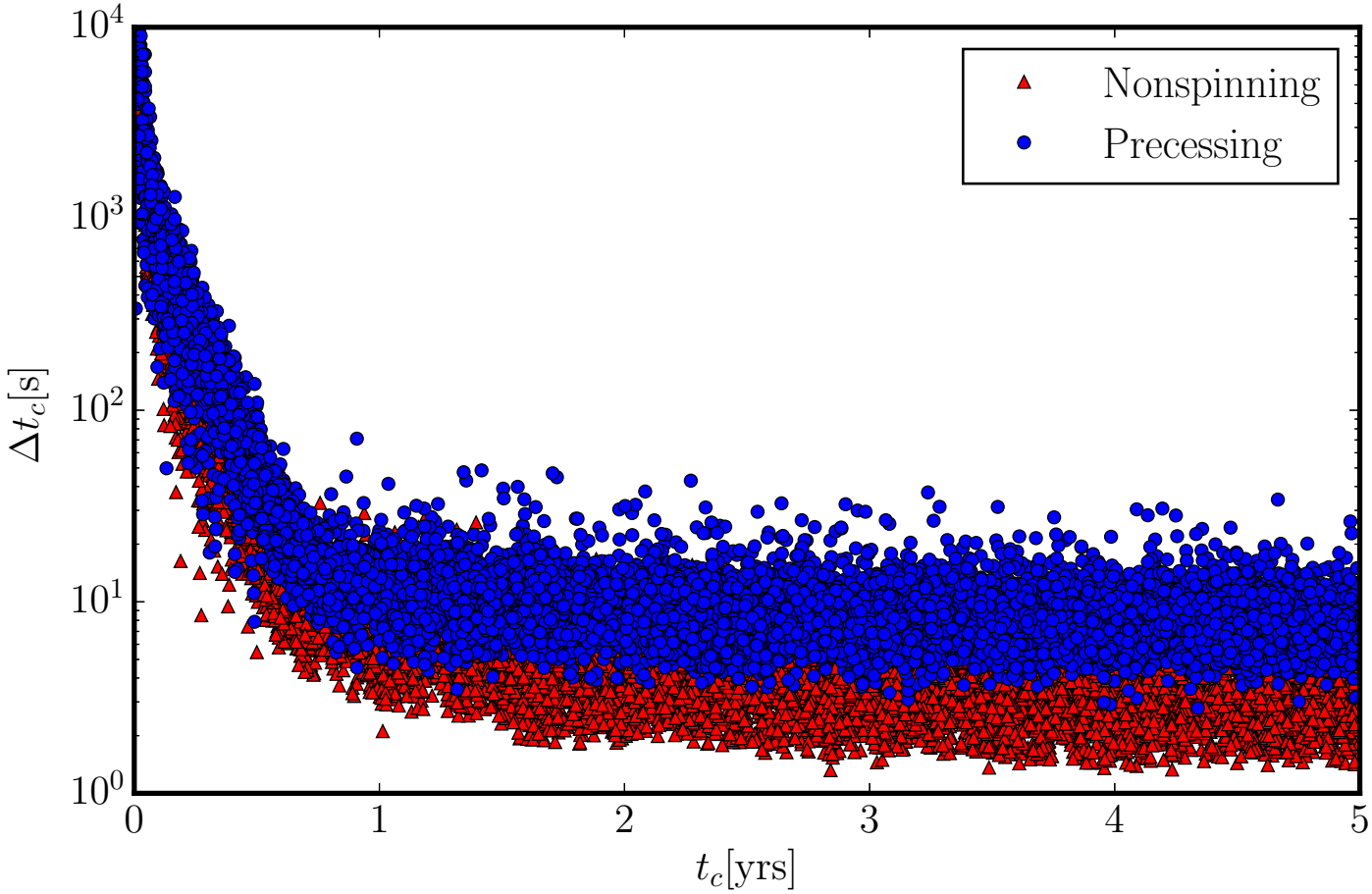
Overall mass estimates



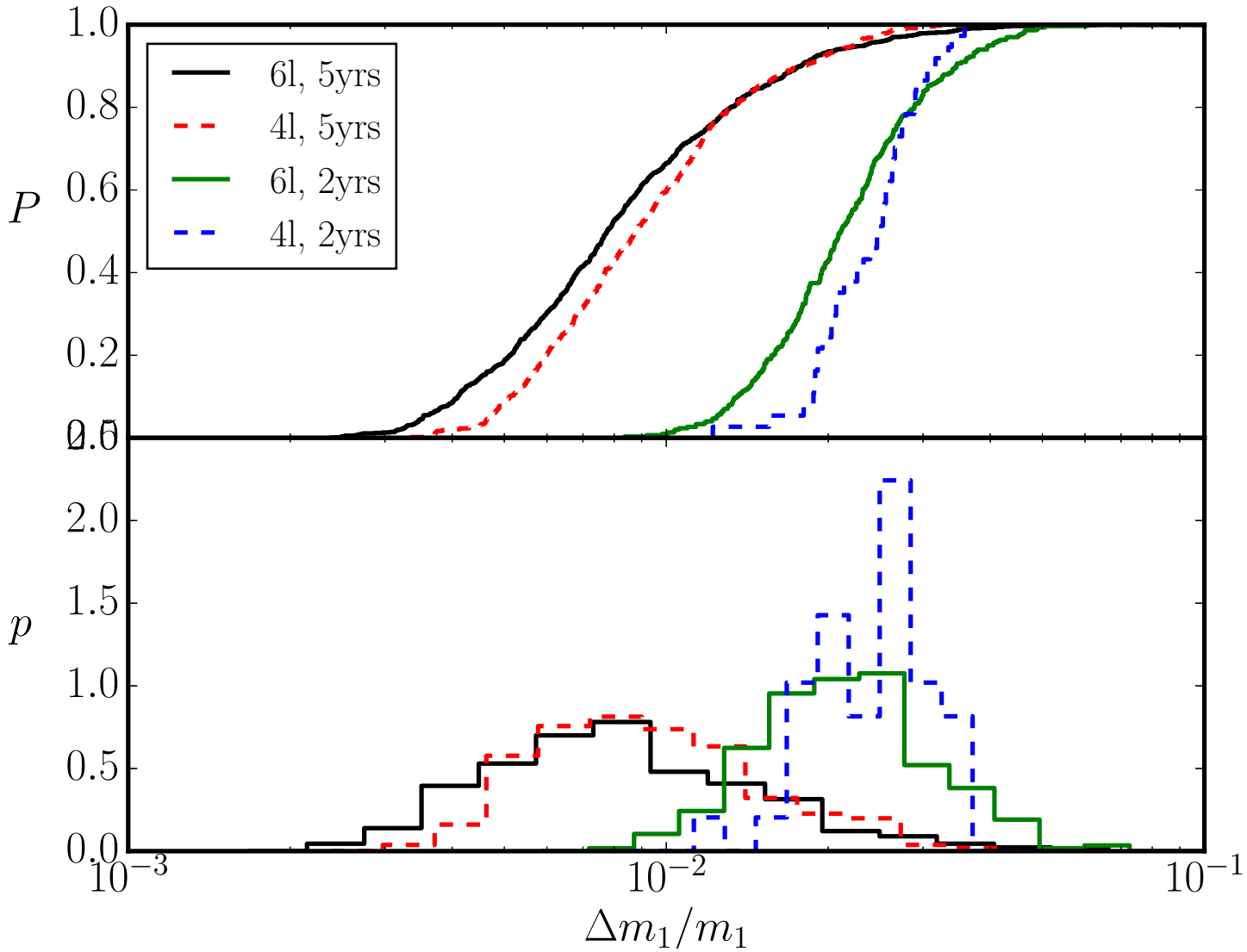
Overall sky localization



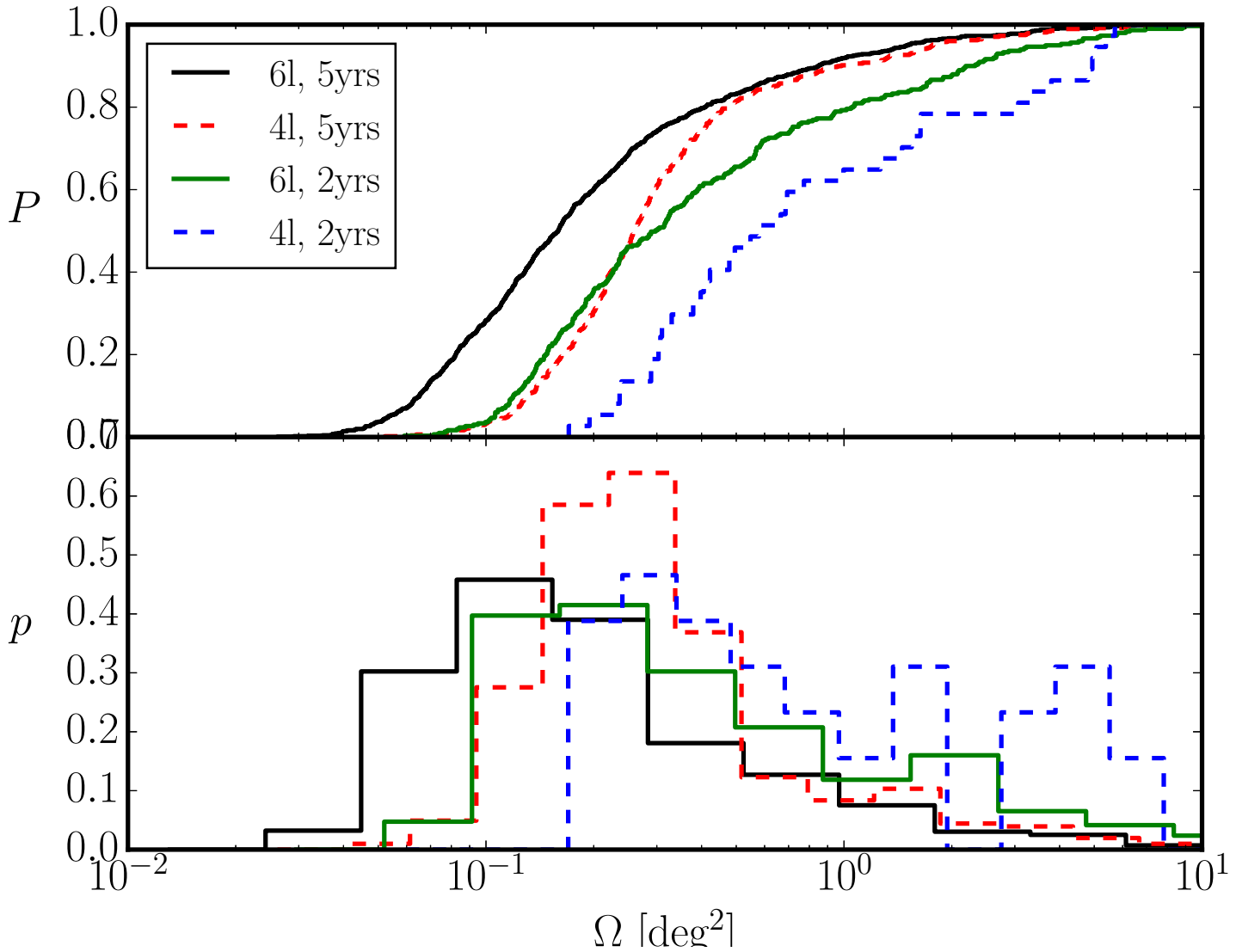
Merging systems: time to merger estimates



Merging systems: mass estimates



Merging systems: sky location estimates



Conclusion

The prospects for LISA science are very promising.

Tens to several hundreds of supermassive black hole mergers are expected, and will help constrain binary formation mechanisms.

Parameter estimation will bring provide very interesting data both astrophysically and theoretically.

Hundreds to a thousand stellar mass black hole binaries are expected to be detectable, among which tens to a hundred will be merging during the mission lifetime.

Parameter estimation will be complementary to that of ground-based detectors, providing competitive mass and sky location estimates.