Properties of the parent population of merging SMBHs

Spatially Resolved spectroscopy: classification and properties

F. Mannucci

INAF - Osservatorio Astrofisico di Arcetri, Florence

M. Scialpi, G. Tozzi, C. Marconcini, L. Ulivi, Q. D'Amato, M. Ceci

L. Battistini, F. Belfiore, E. Bertola, C. Bracci, S. Carniani, E. Cataldi, A. Chakraborty, C. Cicone, A. Ciurlo, G. Cresci, A. De Rosa, E. Di Teodoro , A. Feltre, M. Fumagalli, M. Ginolfi, B. Hagedorn, R. Khatun, I. Lamperti, E. Lusso, A. Marconi, B. Moreschini, E. Nardini, M. Parvatikar , M. Perna, P. Rosati, P. Severgnini, J. Singh, A. Sonnenfield, C. Spingola, G. Venturi, C. Vignali, M. Volonteri, S. Yeh, M. V. Zanchettin

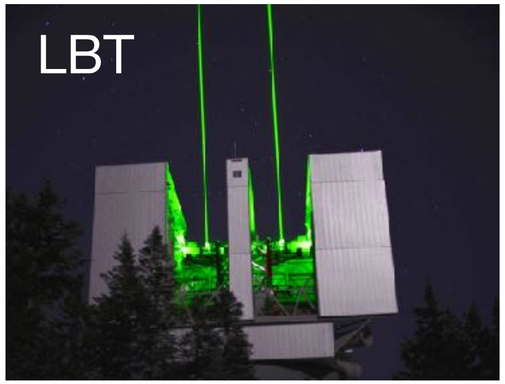
Spatially Resolved spectroscopy of Gaia selected sources

STIS
optical

OSIRIS
near-IR

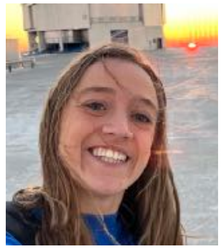
MUSE-NFM
optical

ERIS
near-IR



LUCI & SHARK
near-IR

G. Tozzi



M. Scialpi

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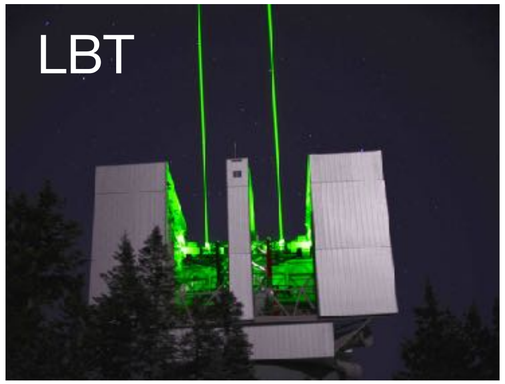

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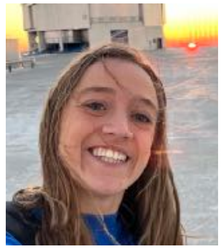

M. Scialpi

GTO
115hr

Spatially Resolved spectroscopy of Gaia selected sources

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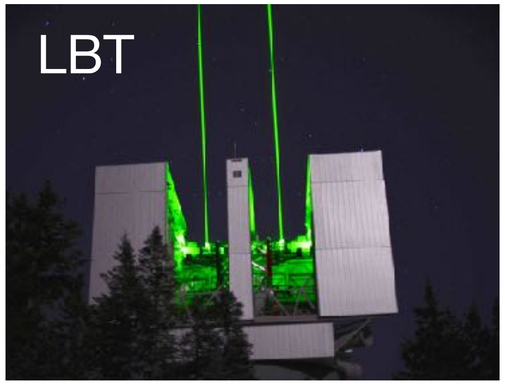
near-IR



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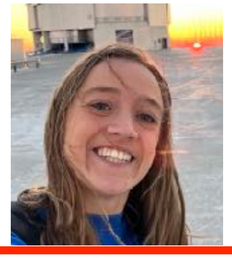


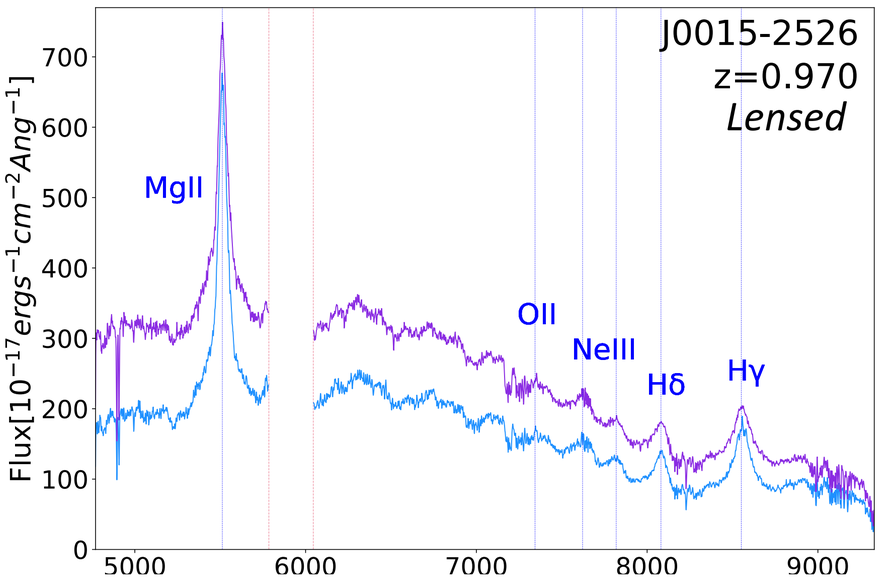
M. Scialpi

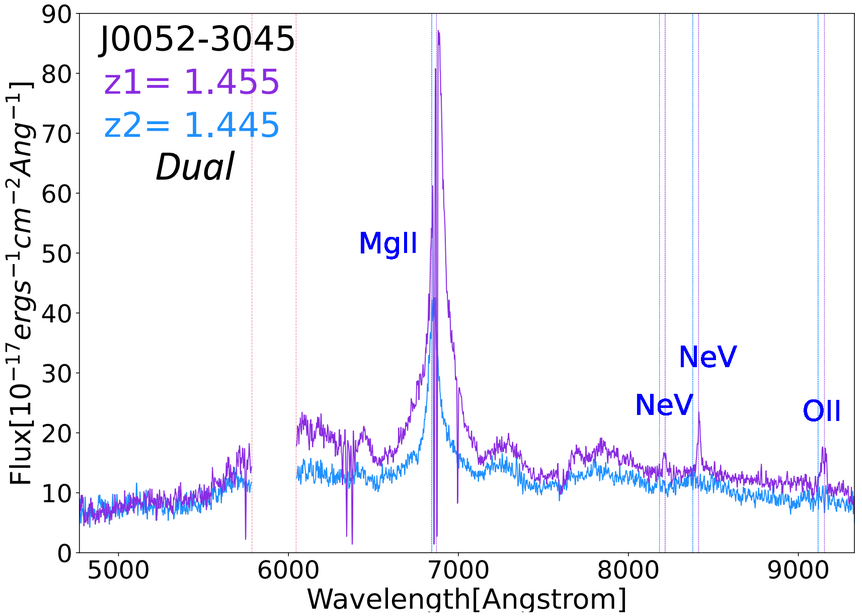
COSMIC DUETS

ESO
Large Program
150hr, 2 yrs
(just starting)

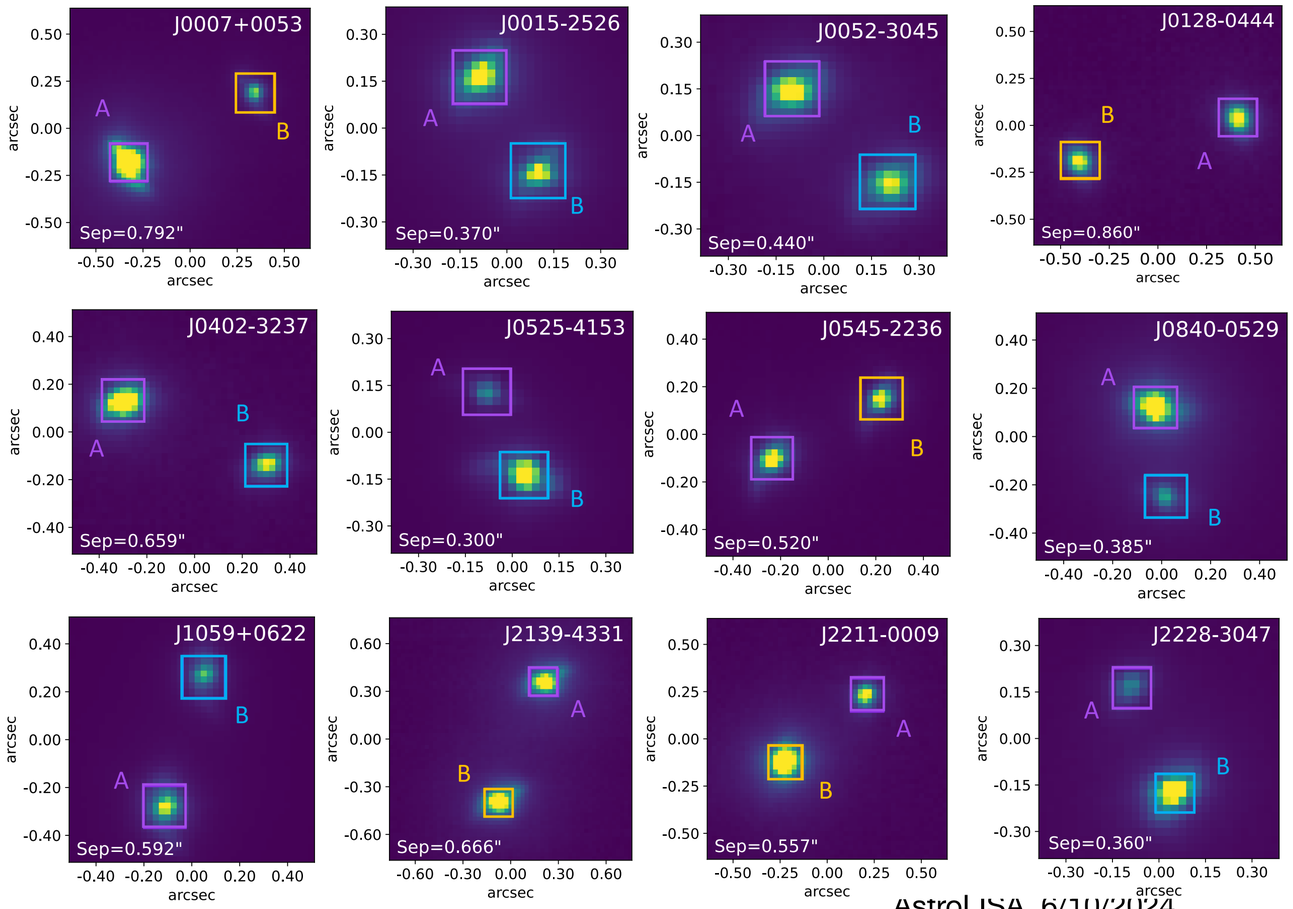
GTO
115hr

Spatially Resolved spectroscopy of Gaia selected sources

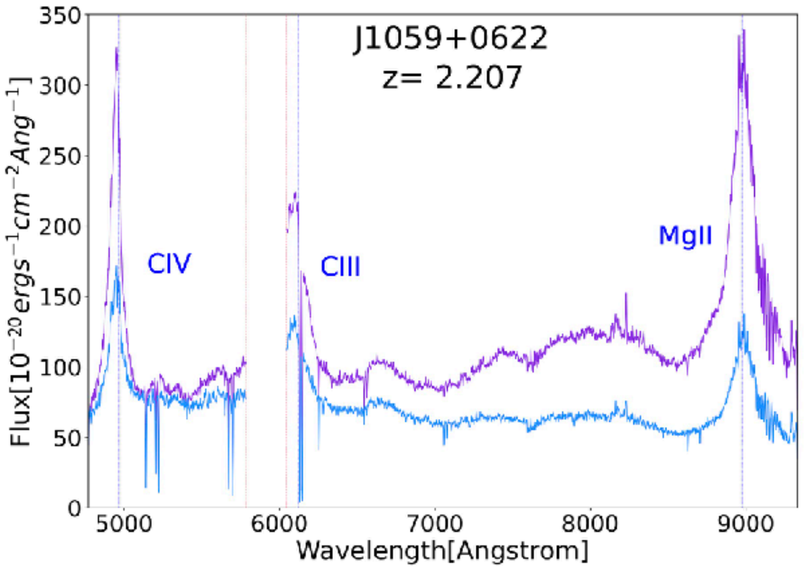


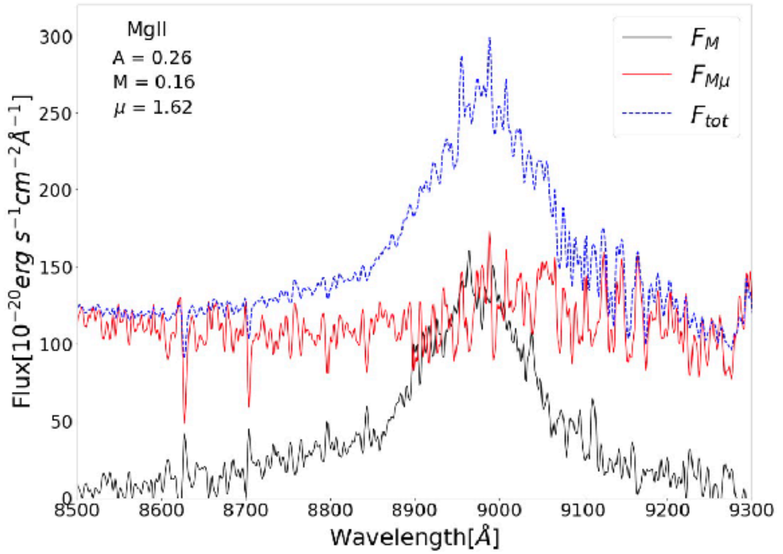


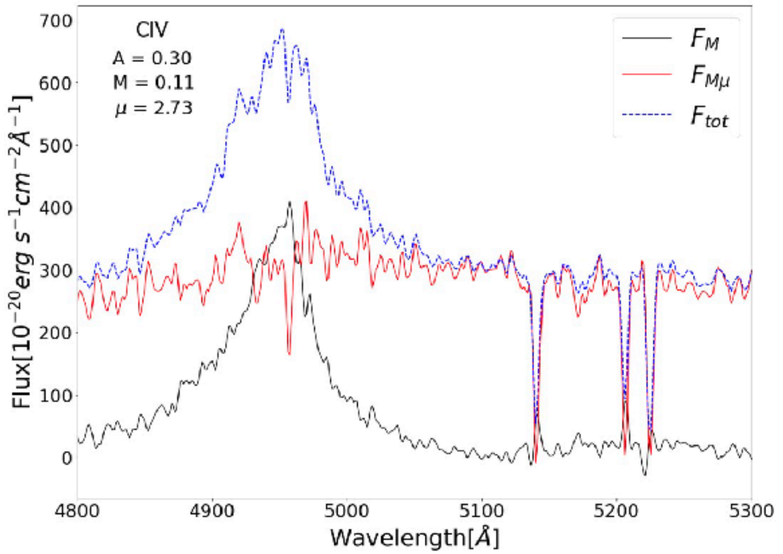
Scialpi+24



Lensed/duets classification and micro-lensing







- Contribution by micro-lensing
- Difference between continuum, broad-, and narrow-lines

$$F_1 = M \times F_M + M \times \mu \times F_{M\mu}$$

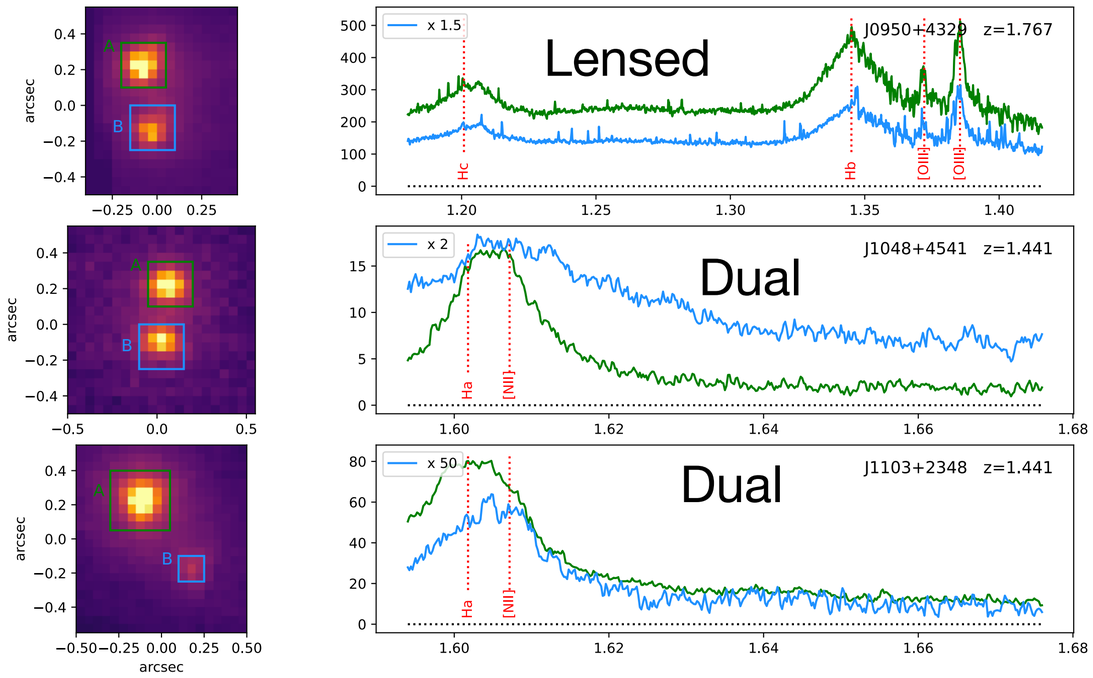
$$F_2 = F_M + F_{M\mu}$$

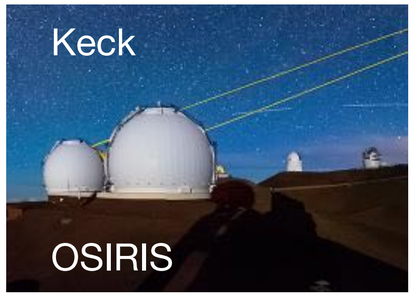
Observed spectra

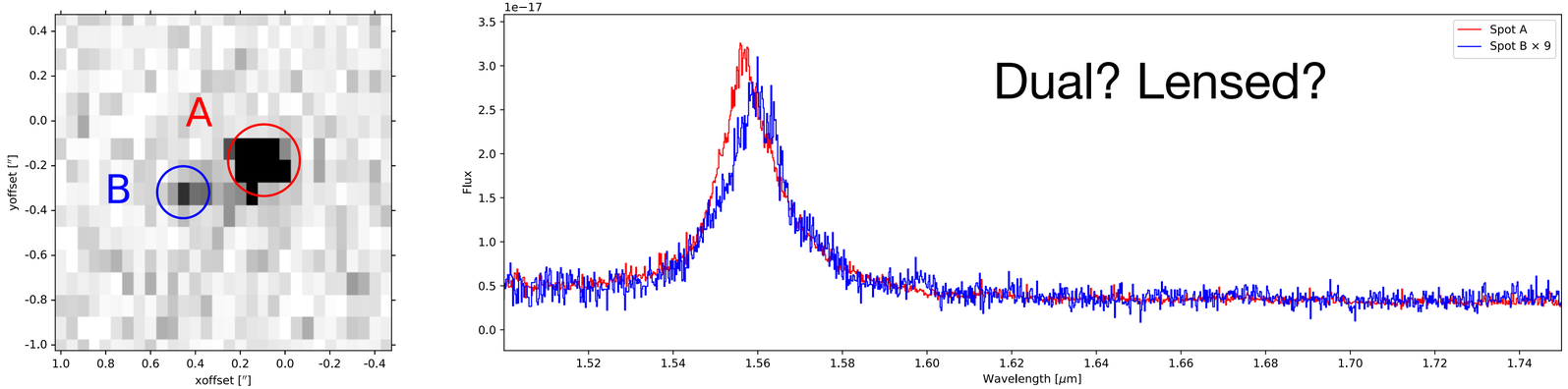
macro-lens only

macro and micro -lens

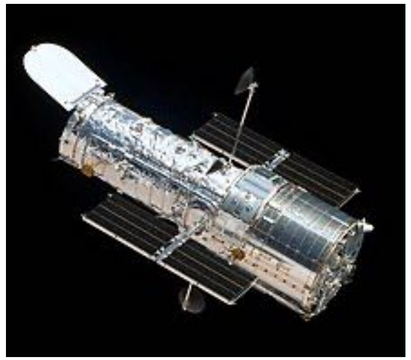
Spatially Resolved spectroscopy of Gaia selected sources



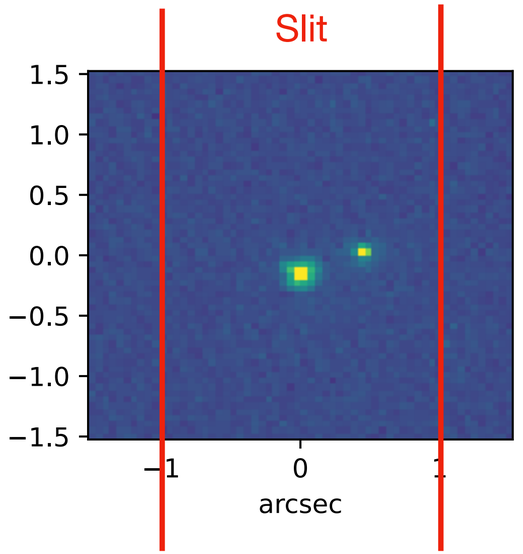




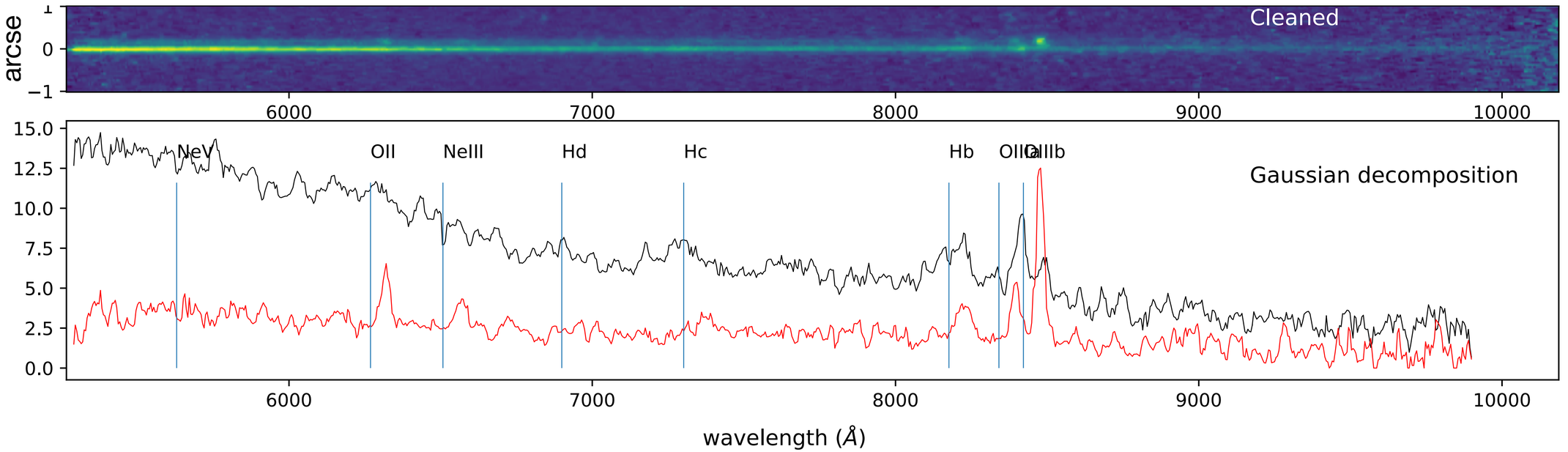
Spatially Resolved spectroscopy of Gaia selected sources



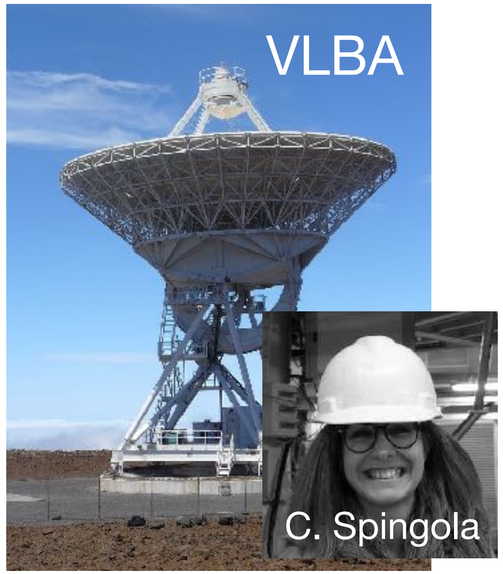
Cycle 31project, PI: G. Tozzi
16 GMP targets, 12 observed
unknown relative positions
STIS, 2" slit
2 orbits each

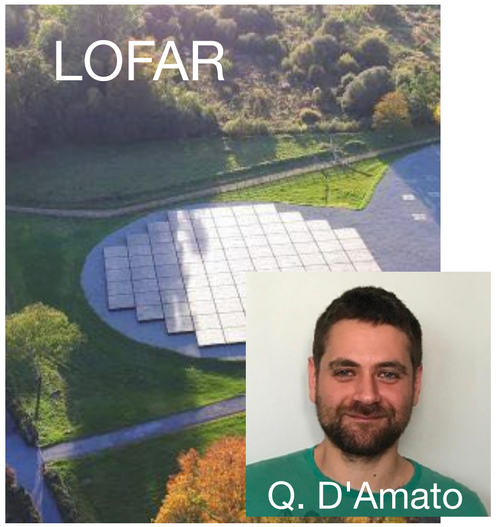


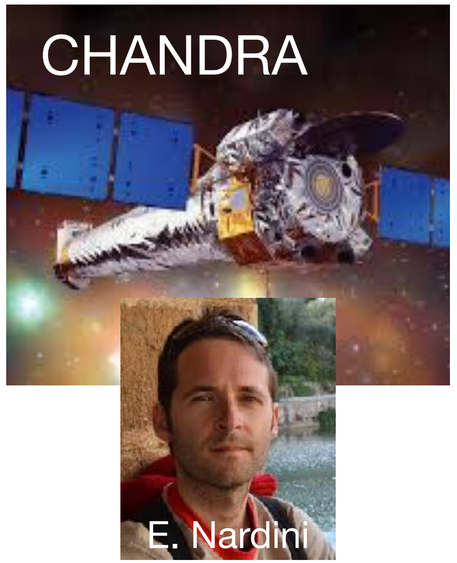
z=0.69



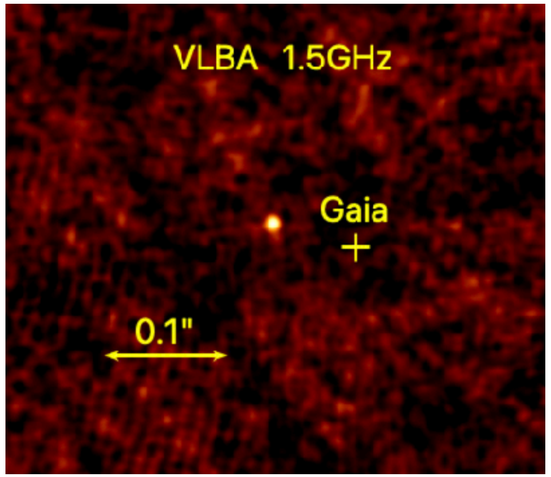
3 Observations - Multi-wavelength follow-up

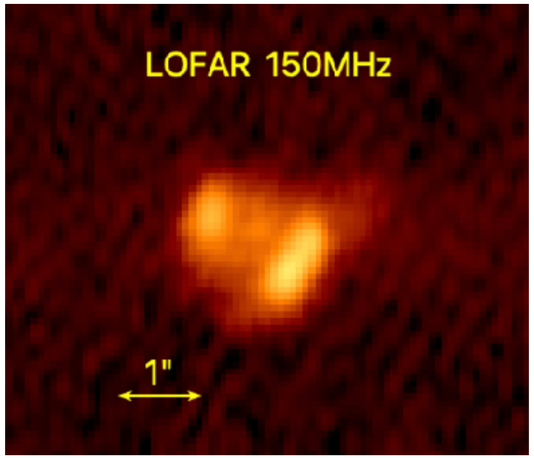


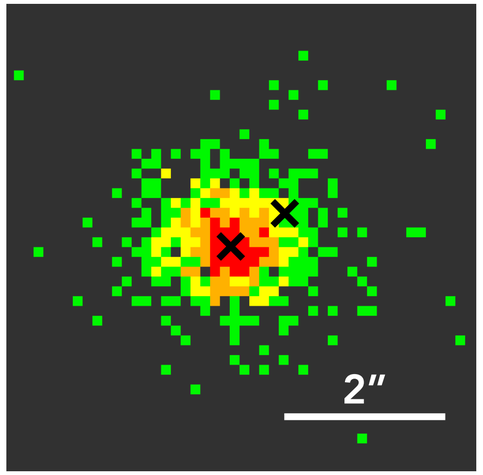


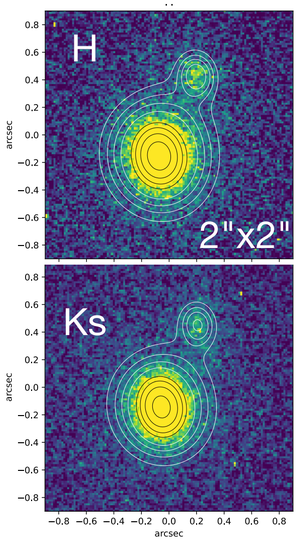


(also selection)









Results 2 - Confirmed duets

- 53 observed (45 analyzed)
- ~220 approved in 2 yrs

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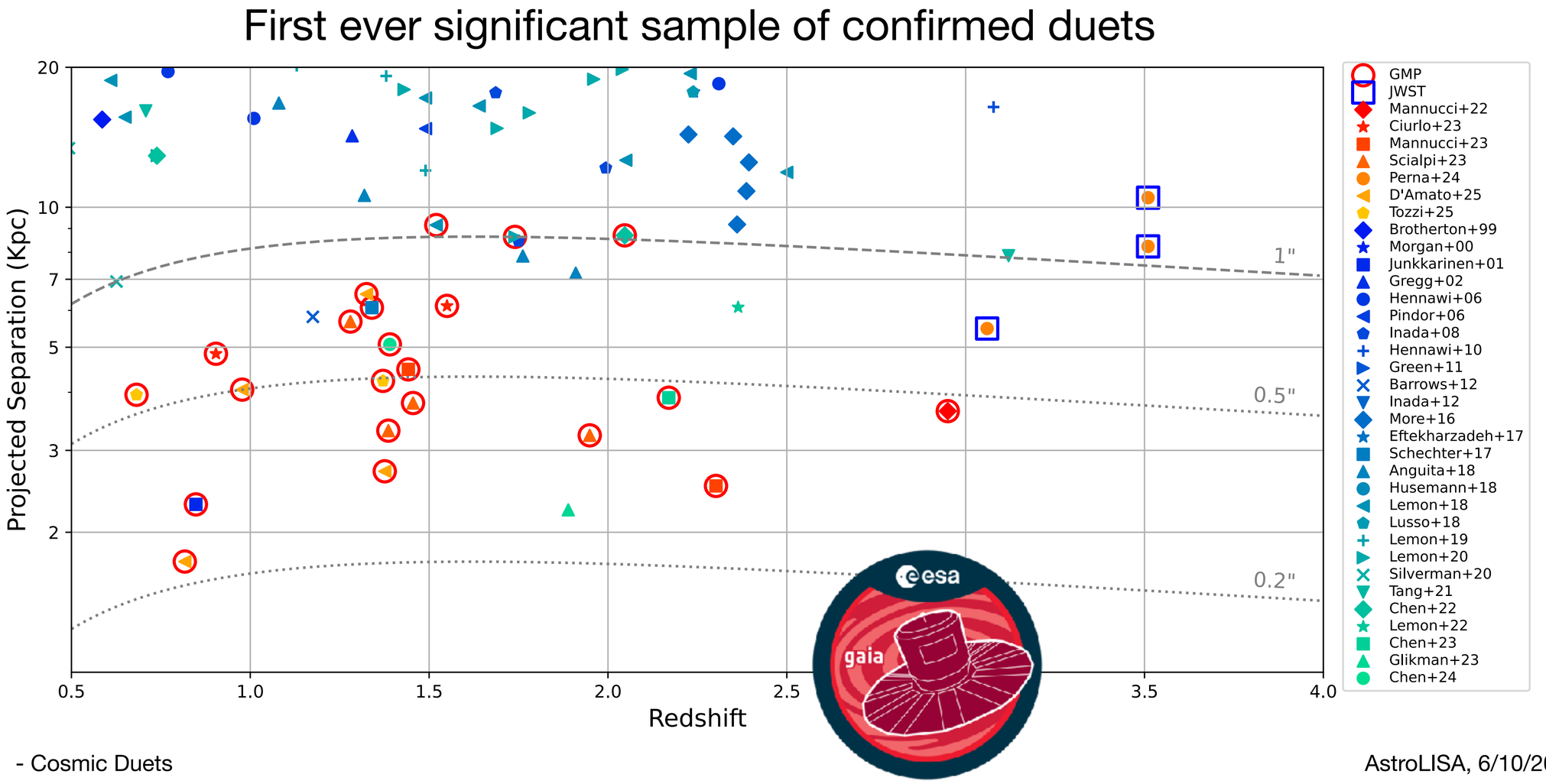
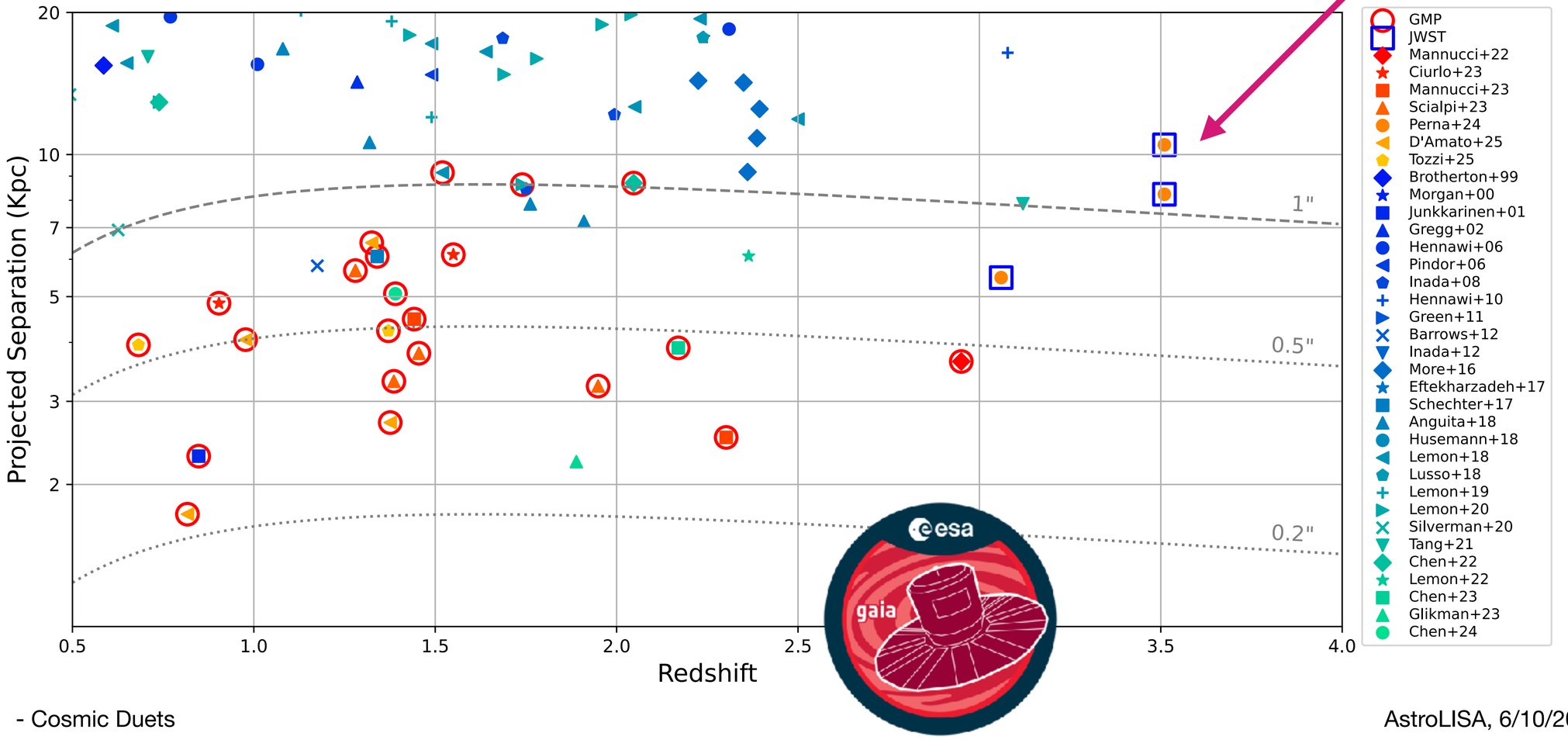


Results 2 - Confirmed duets

- 53 observed (45 analyzed)
- ~220 approved in 2 yrs

Perna+24

First ever significant sample of confirmed duets



Comparison with models

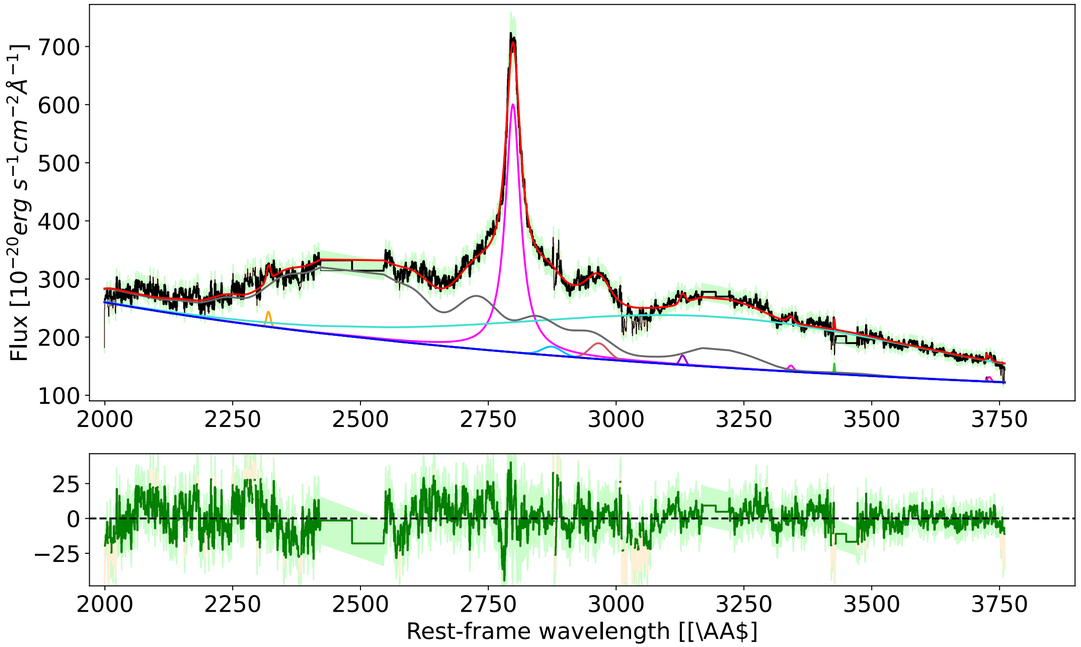
Quantity
BH masses distribution
Mass ratios
Bolometric luminosities
Luminsity ratio
L_eddington
Separation distribution
Lensed fraction
Dual fraction
Extinction distribution
Host properties
.....

Wide range of predictions

Limitations:

1. Data: still few observed systems
2. Models:
   - not enough resolution (unreliable for sep<7kpc)
   - not enough volume (only faint systems)
   - same selection as observations (GMP: G<20.5)

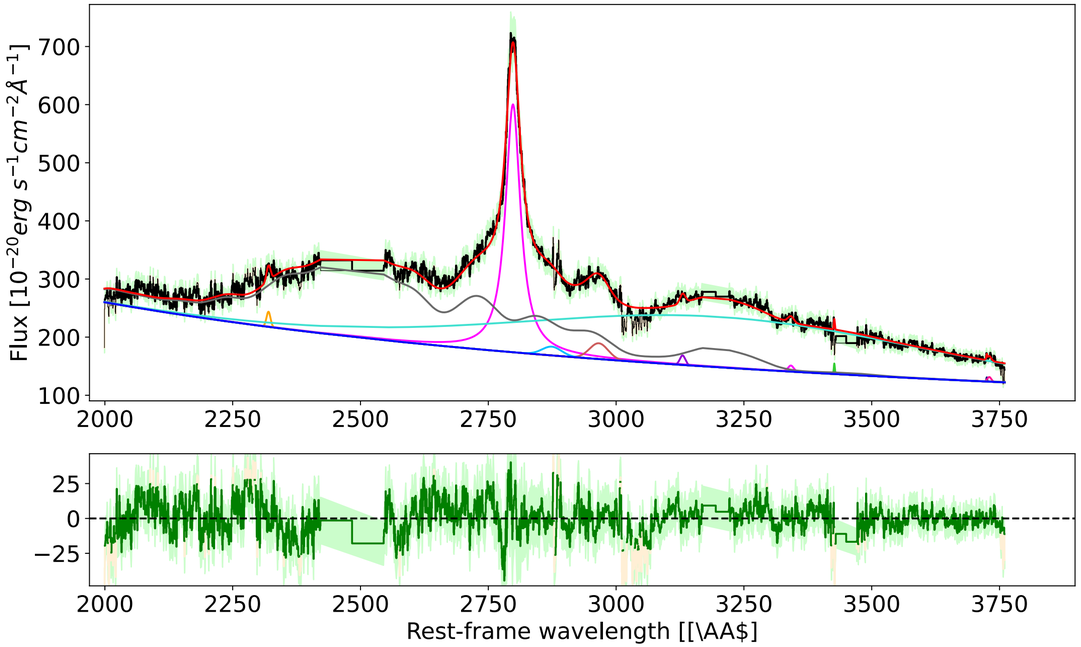
Comparison with models: BH mass



BH mass from luminosity and line width

accurate spectra fitting

Comparison with models: BH mass



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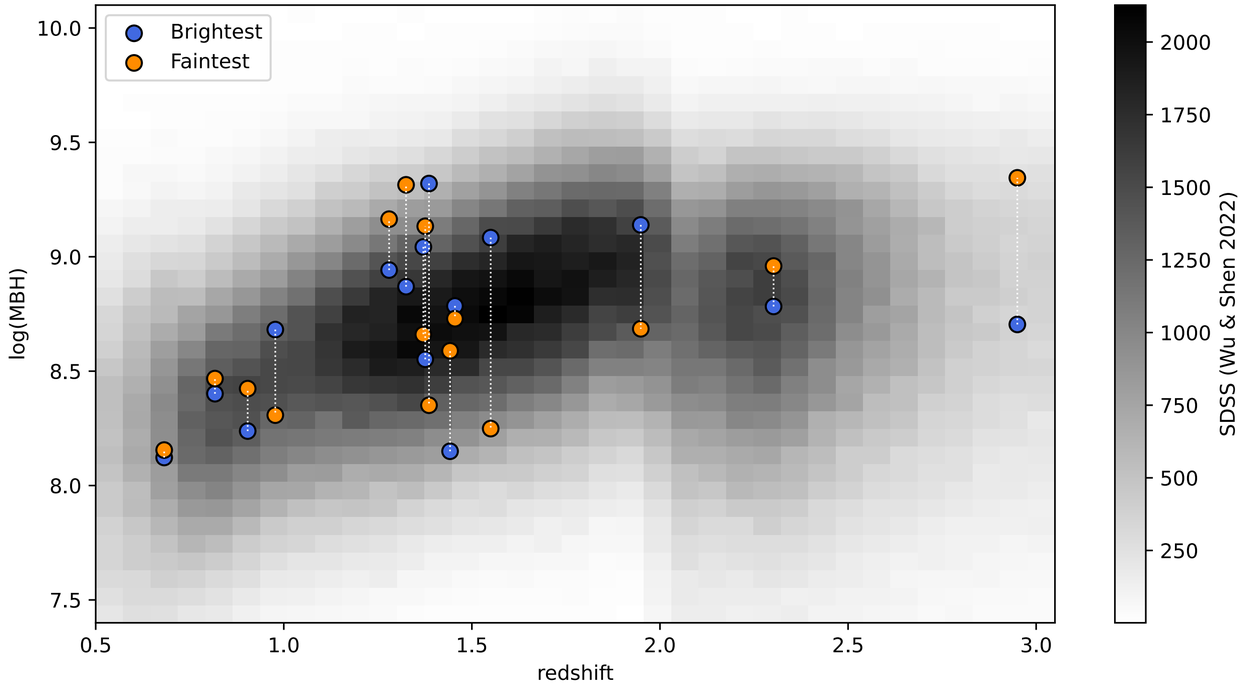
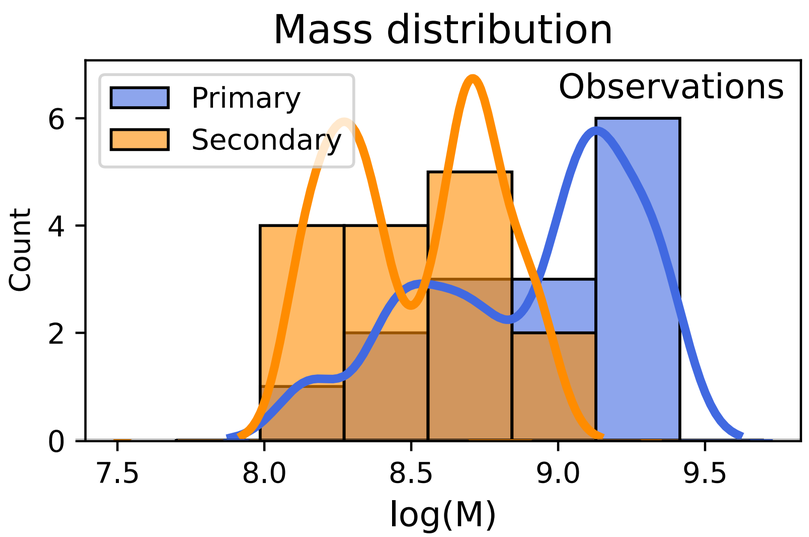
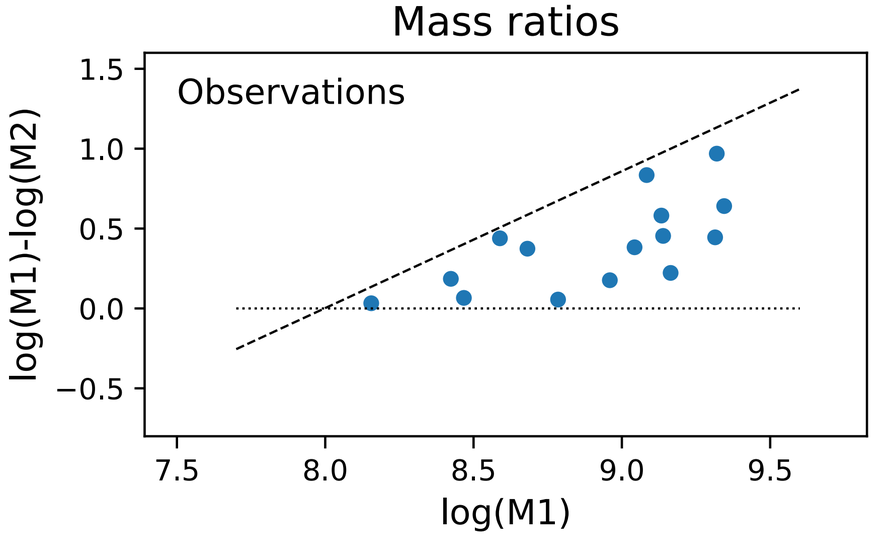


Distribution similar to SDSS

Comparison with models: BH mass

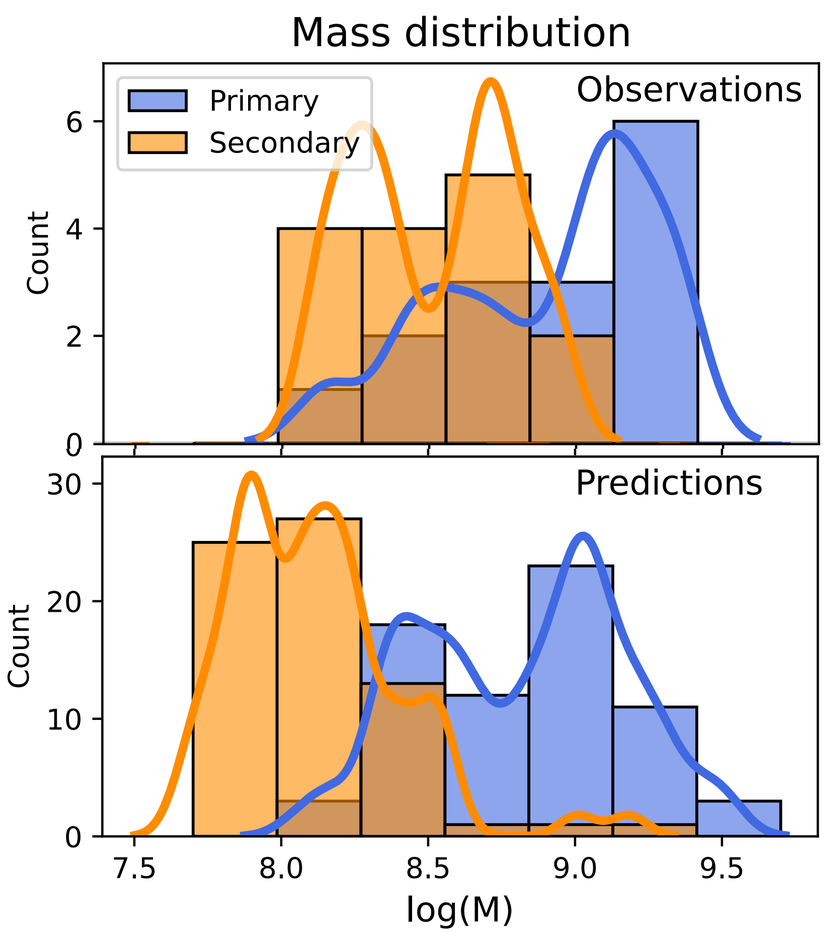
VERY PRELIMINARY!

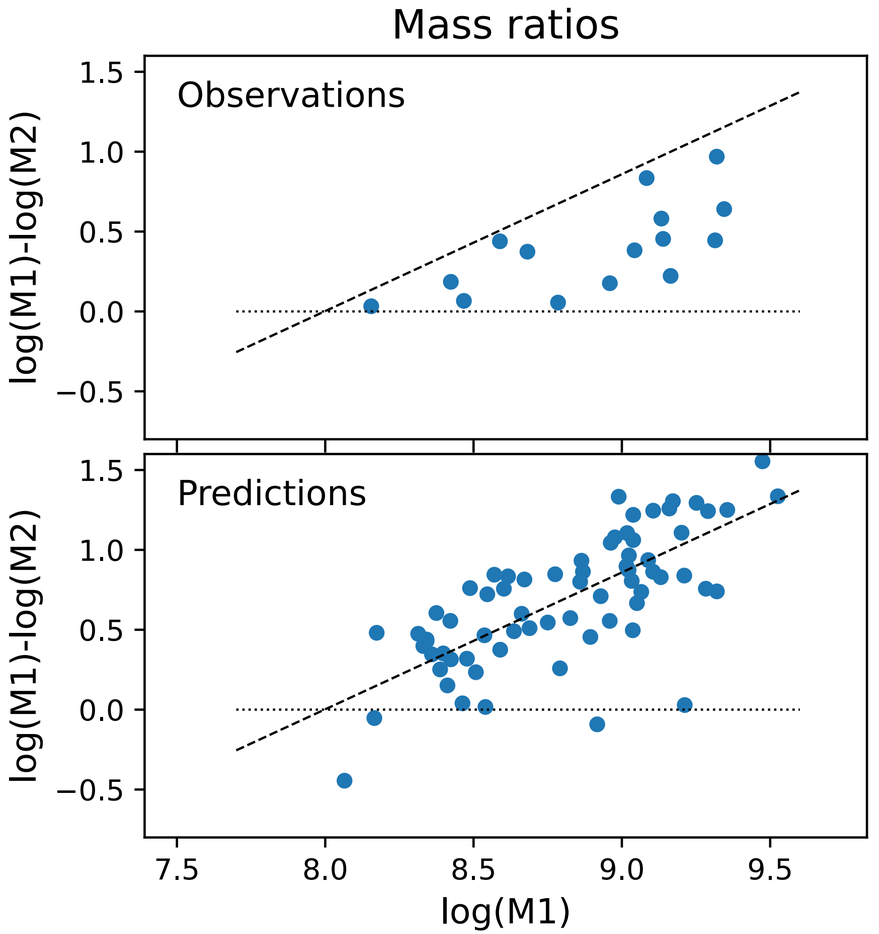




Comparison with models: BH mass

VERY PRELIMINARY!





L-Galaxies

Henriquez+16,20
Izquierdo-Villalba+22,23,24

selection G<20.5

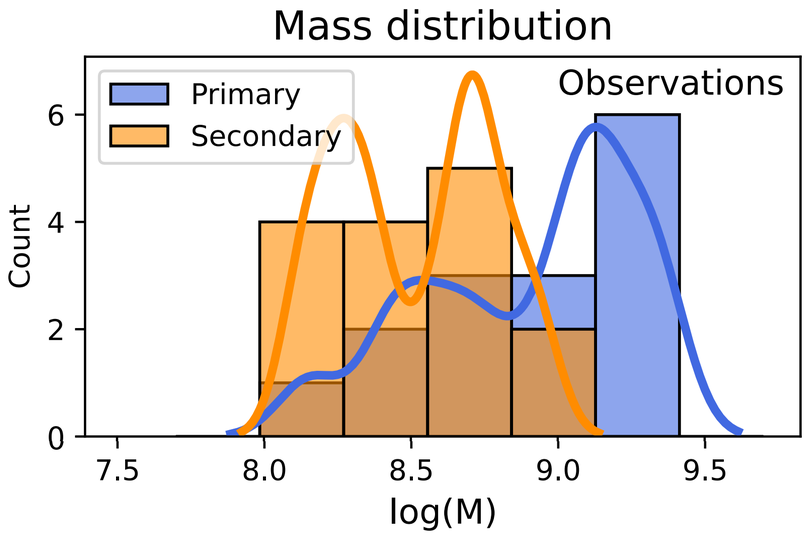
Primary: good match

Secondary: higher observed mass, more similar masses

Comparison with models: BH mass

VERY PRELIMINARY!

Masses in PTA range.....

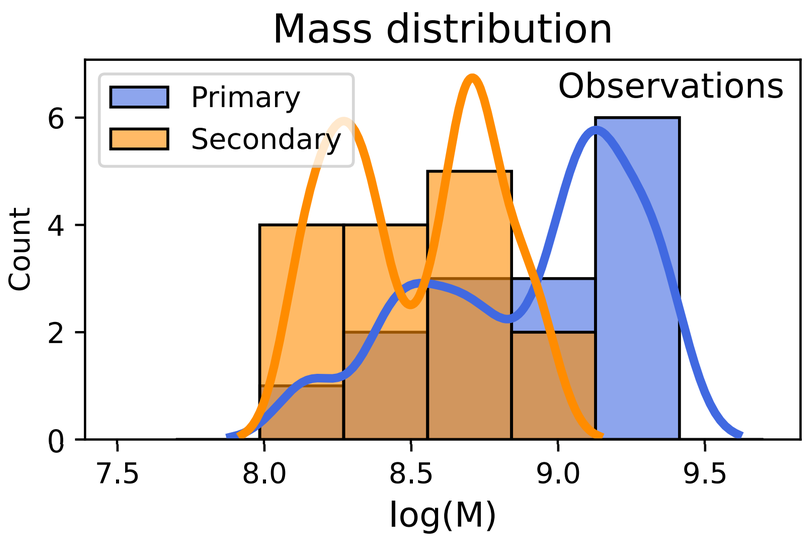


Comparison with models: BH mass

VERY PRELIMINARY!

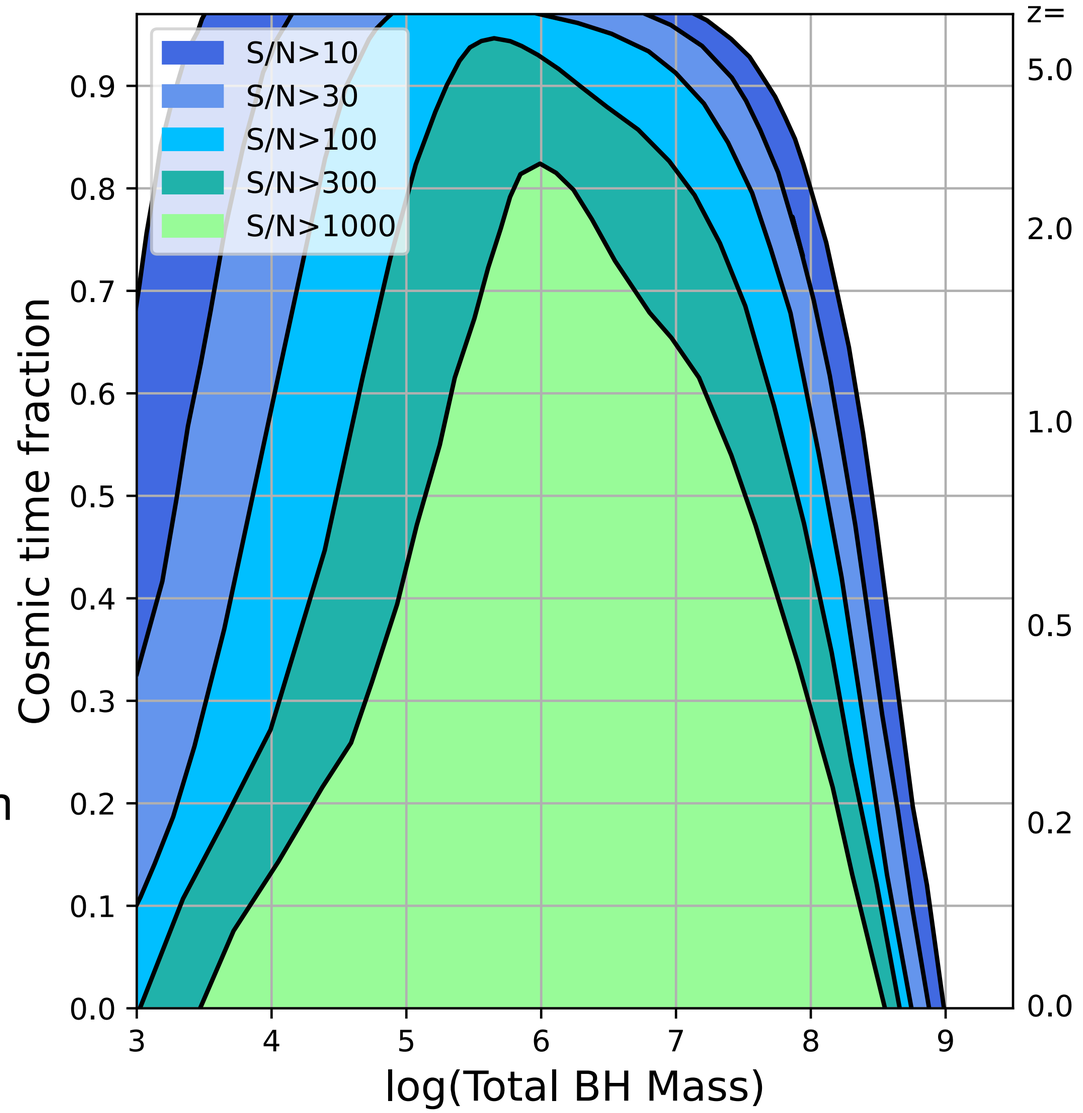
but relevant to LISA!

Masses in PTA range.....



Adapted from Colpi+24

M2/M1=0.5



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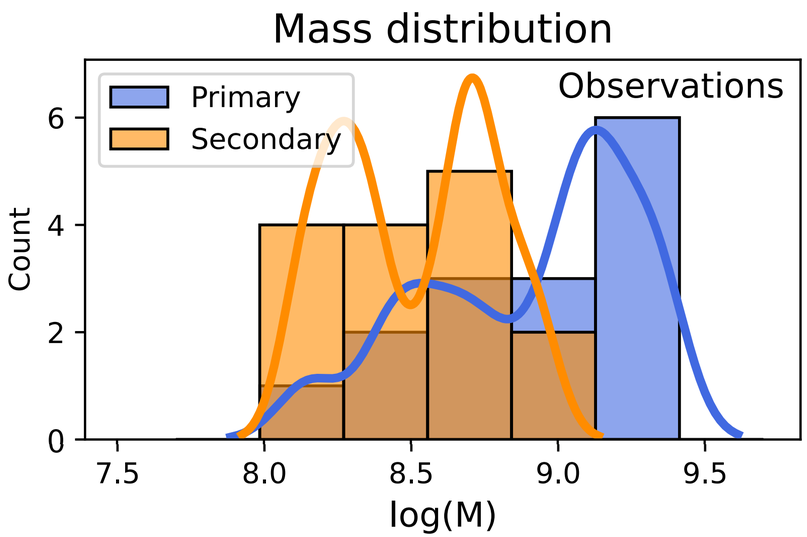

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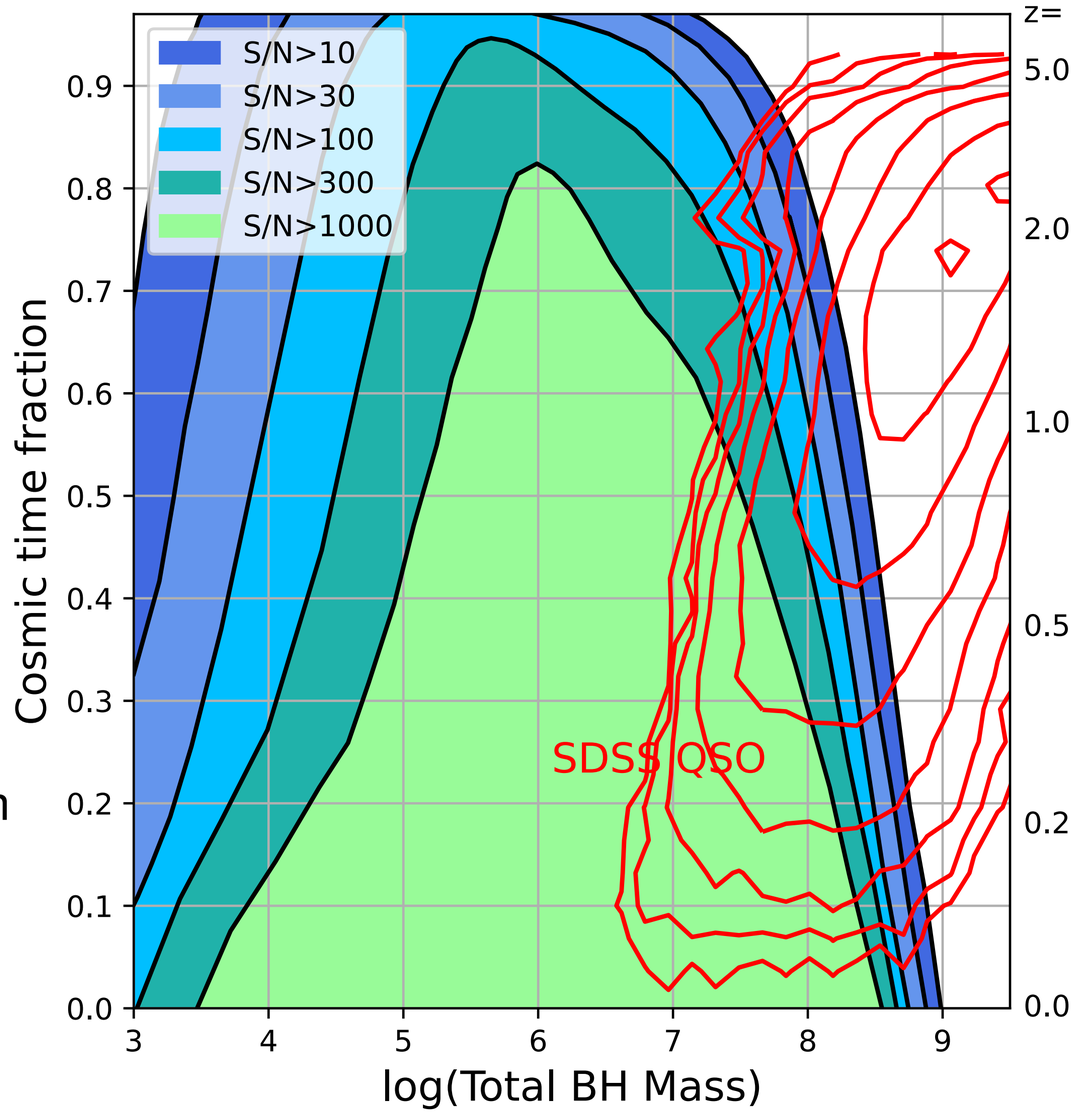
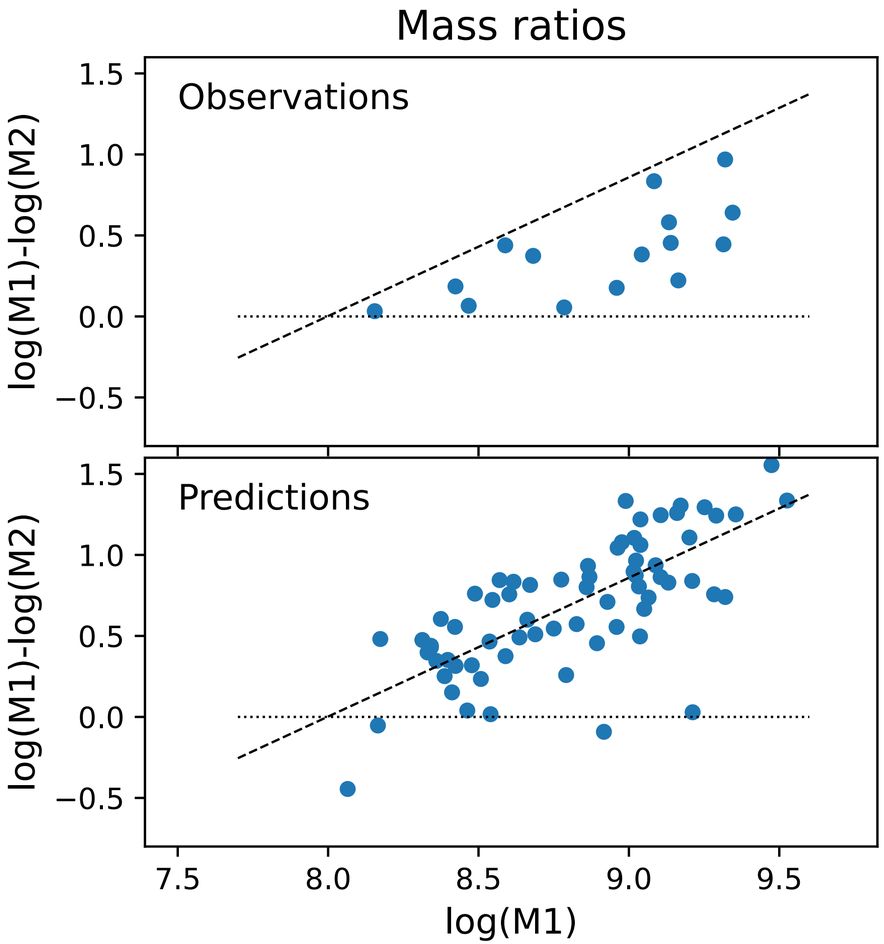


Comparison with models: BH mass

VERY PRELIMINARY!



Comparison with models: BH mass

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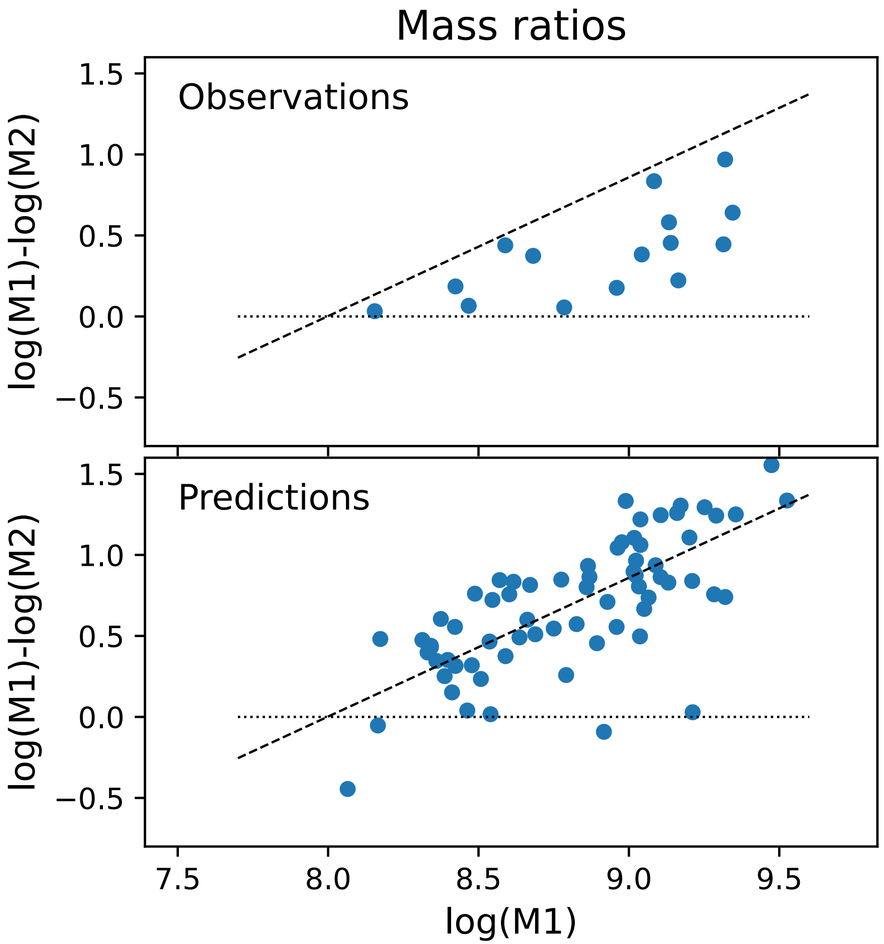
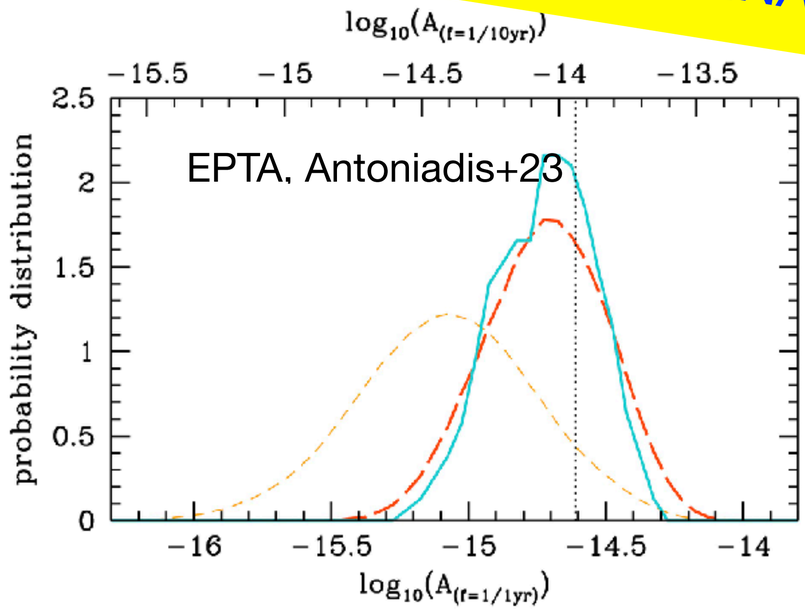
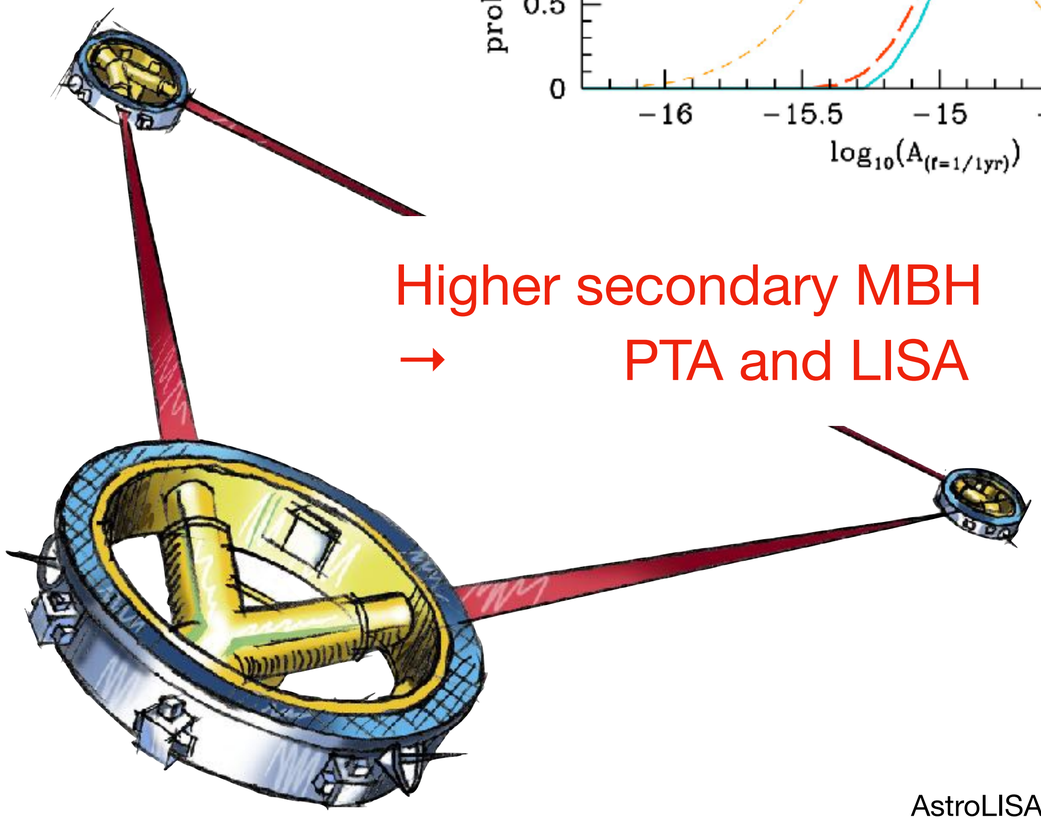






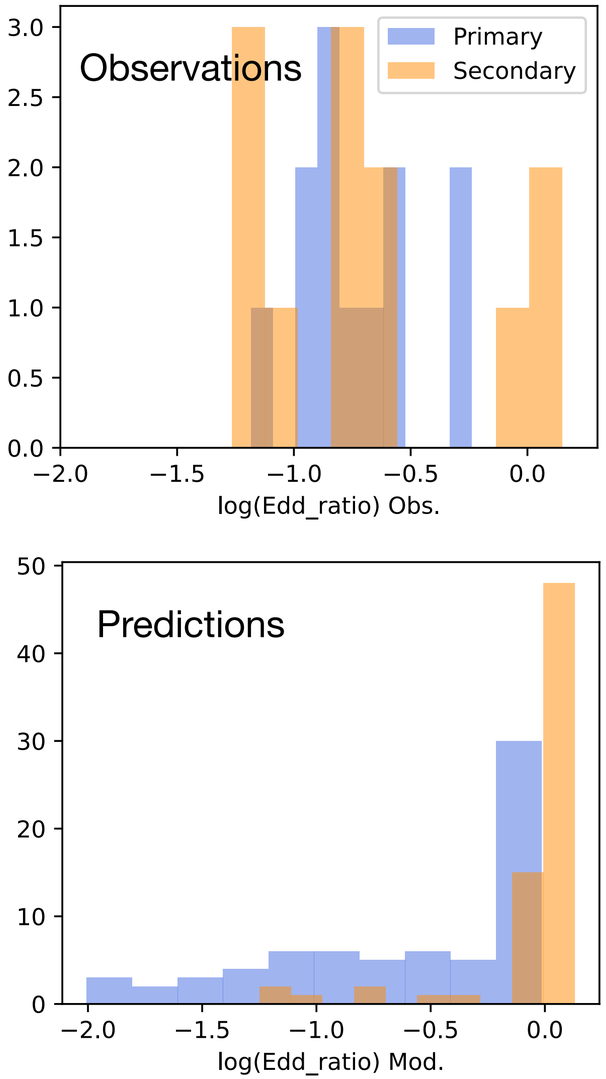
Higher secondary MBH
→ PTA and LISA

Comparison with models: Ledd

VERY PRELIMINARY!

Much larger distribution predicted

Similar for the primary
Predicted to be higher for the secondary



Future and Conclusions

- Using 13 telescopes to assemble the first significant sample of confirmed duets
- Working on testing model predictions
- Better LISA event rate predictions soon

significant tests to predictions

Quantity
BH masses distribution
Mass ratios
Bolometric luminosities
Luminsity ratio
L_eddington
Separation distribution
Lensed fraction
Dual fraction
Extinction distribution
host properties
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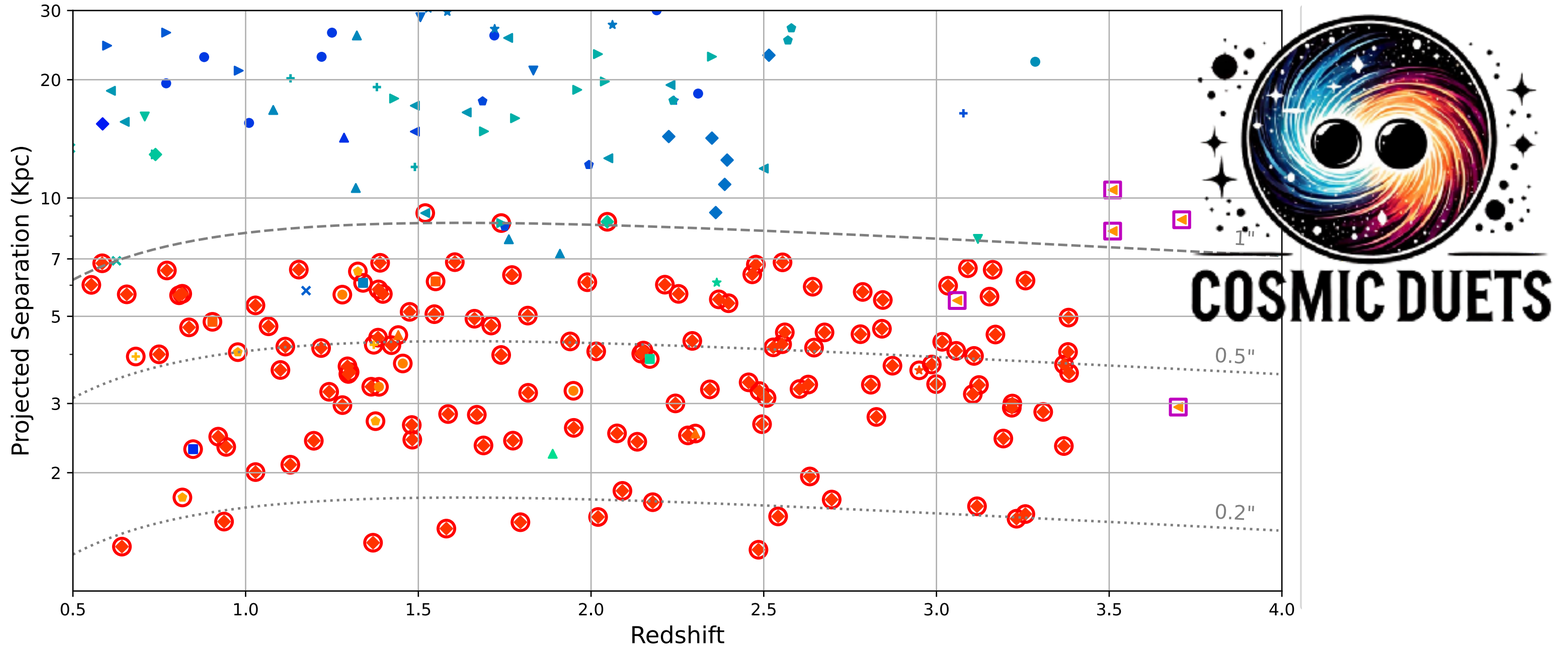
Future and Conclusions

- Using 13 telescopes to assemble the first significant sample of confirmed duets
- Working on testing model predictions
- Better LISA event rate predictions soon

in ~2 years from now.....



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