

# Is there evidence for a intermediate mass black hole (IMBH) from Stellar Orbits?

## Constraining a 5th force and an IMBH at the Galactic center using stellar orbits

### MOTIVATION

- Stars close to the central black hole is sensitive to fundamental physics
- 28+ years of orbital data gives us an opportunity to test exotic models

### MODELS & METHODS

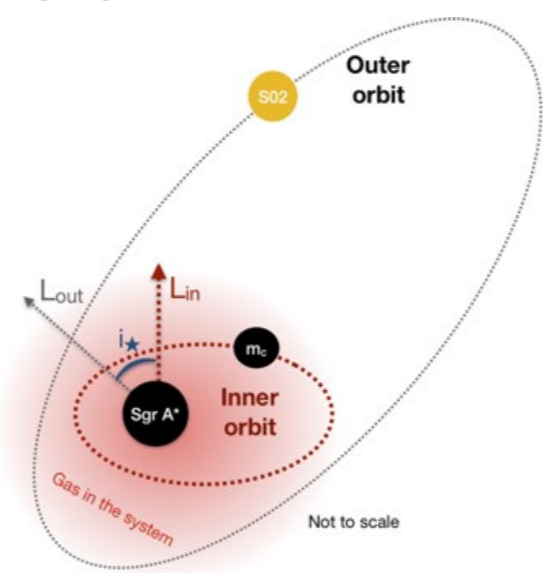
- Two models tested:

1) 5<sup>th</sup> force model:

Additional Yukawa Force:

$$V(r) = -\frac{GM}{r}(1 + \alpha e^{-r/\lambda})$$

2) IMBH model: Close companion within 100 AU which the s-stars orbit:



### DATA

- Only stars with > 40% orbital phase coverage used.
- Three stars simultaneously fitted: S0-2, S0-8, S0-38

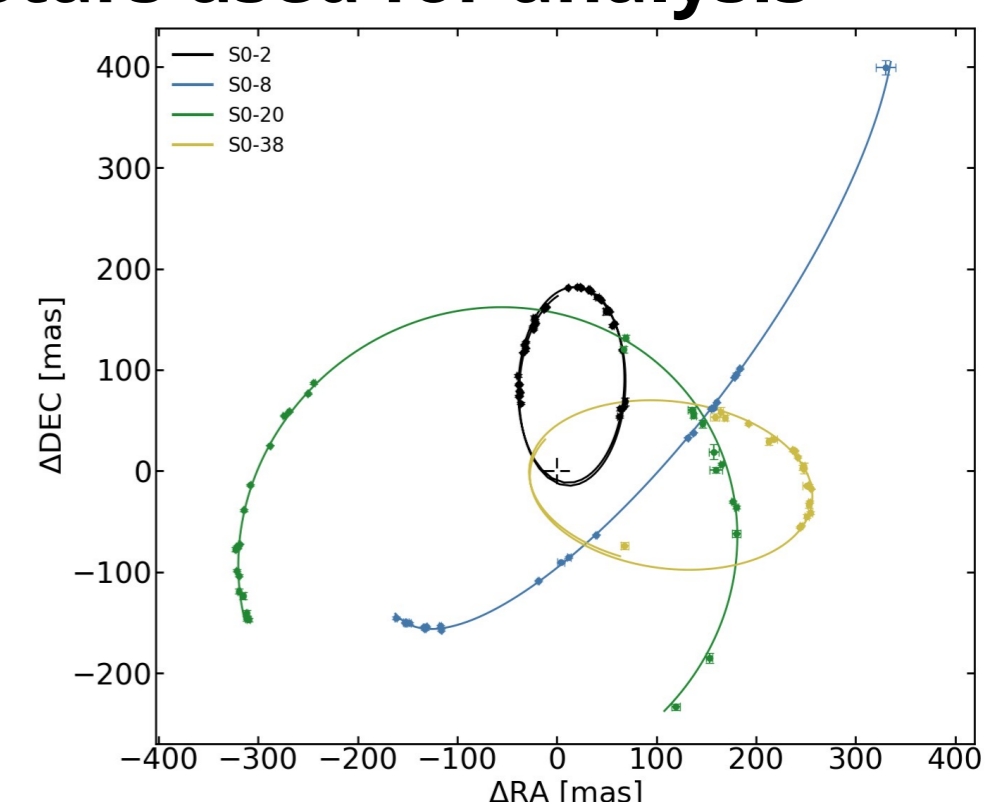
### RESULTS & DISCUSSION

- One star (S0-2) dominates the analysis
- No clear statistical preference for the IMBH or 5<sup>th</sup> force models. Only upper limits are presented.
- IMBH 95% upper limits:  
M(a=10AU) < 48000  
M(a=100AU) < 2500
- 5<sup>th</sup> force 95% upper limits:  
 $\alpha(\lambda=2200\text{AU}) < 0.01$   
 $\alpha(\lambda=4700) < 0.002$

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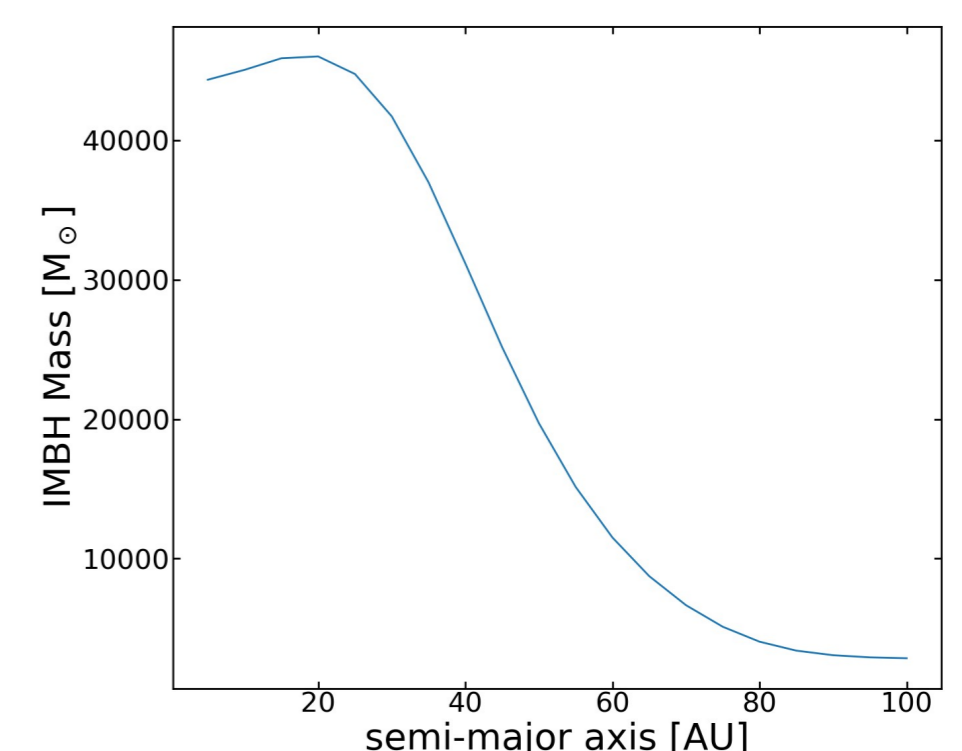
## FIGURES

### Stars used for analysis



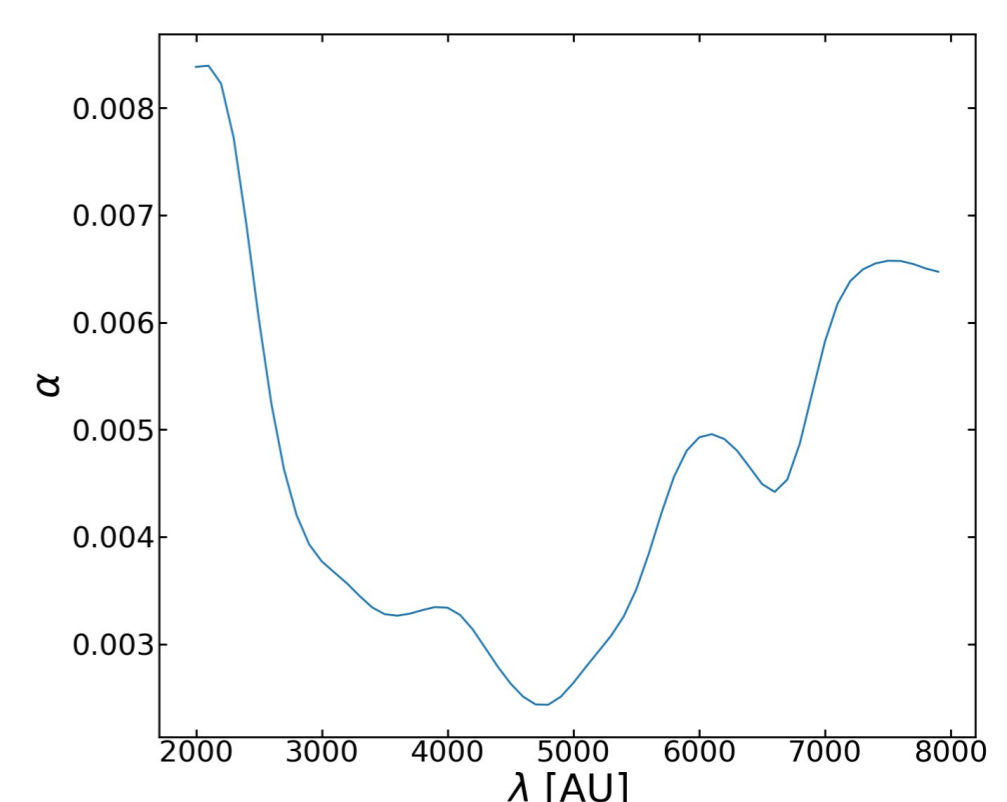
X and Y on-sky position of the stars used in this analysis (excluding S0-20)

### IMBH Mass limits



95% Upper credible level for the mass of an intermediate mass black hole companion mass given semi-major axis.

### 5<sup>th</sup> force limits



95% Upper credible level for a given a scale,  $\lambda$  for the 5<sup>th</sup> force model.



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