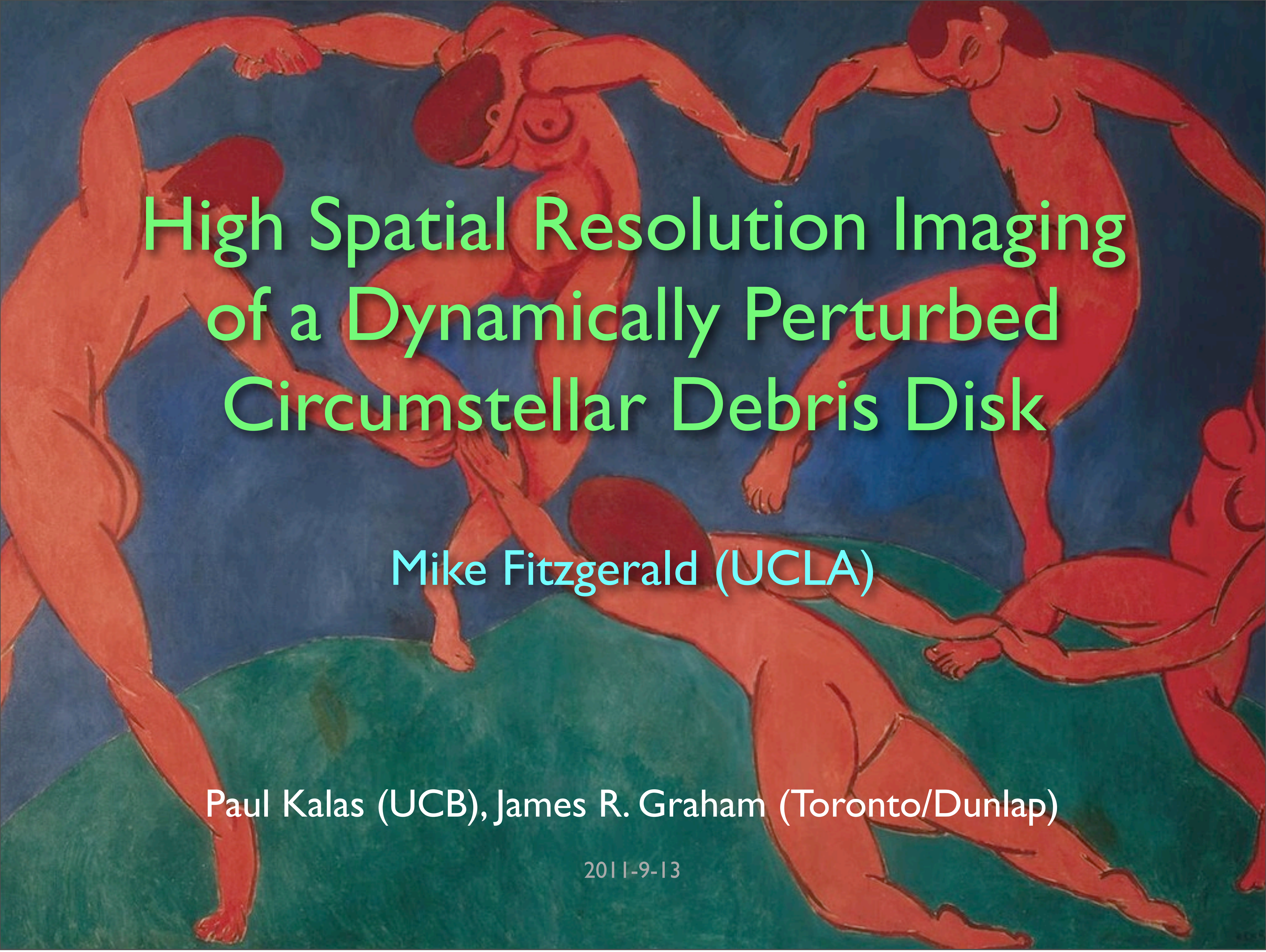


High Spatial Resolution Imaging of a Dynamically Perturbed Circumstellar Debris Disk

Mike Fitzgerald (UCLA)

Paul Kalas (UCB), James R. Graham (Toronto/Dunlap)

2011-9-13

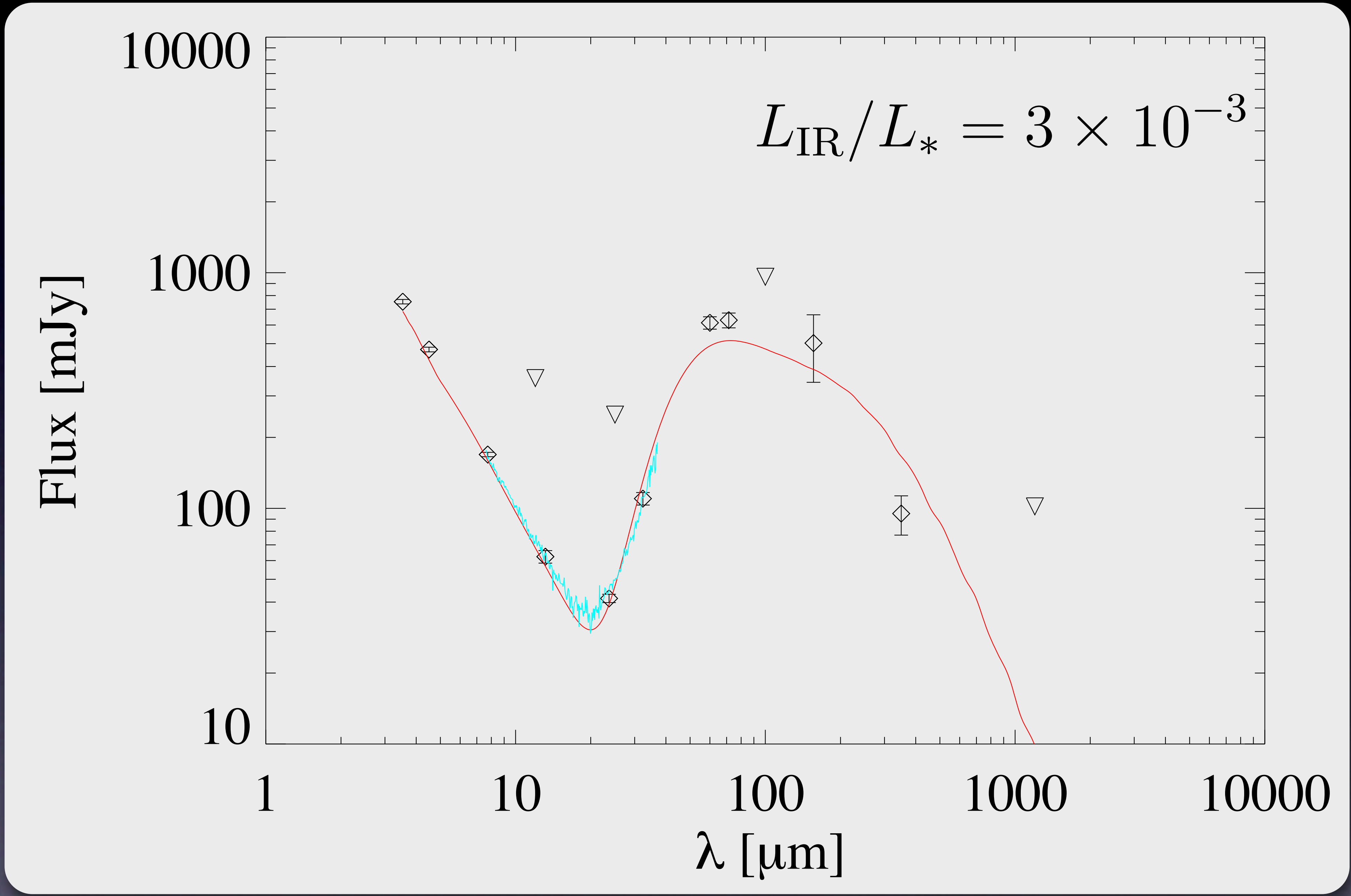
HD 61005

- G3/G5 V
- 35 pc
- 40 - 120 Myr

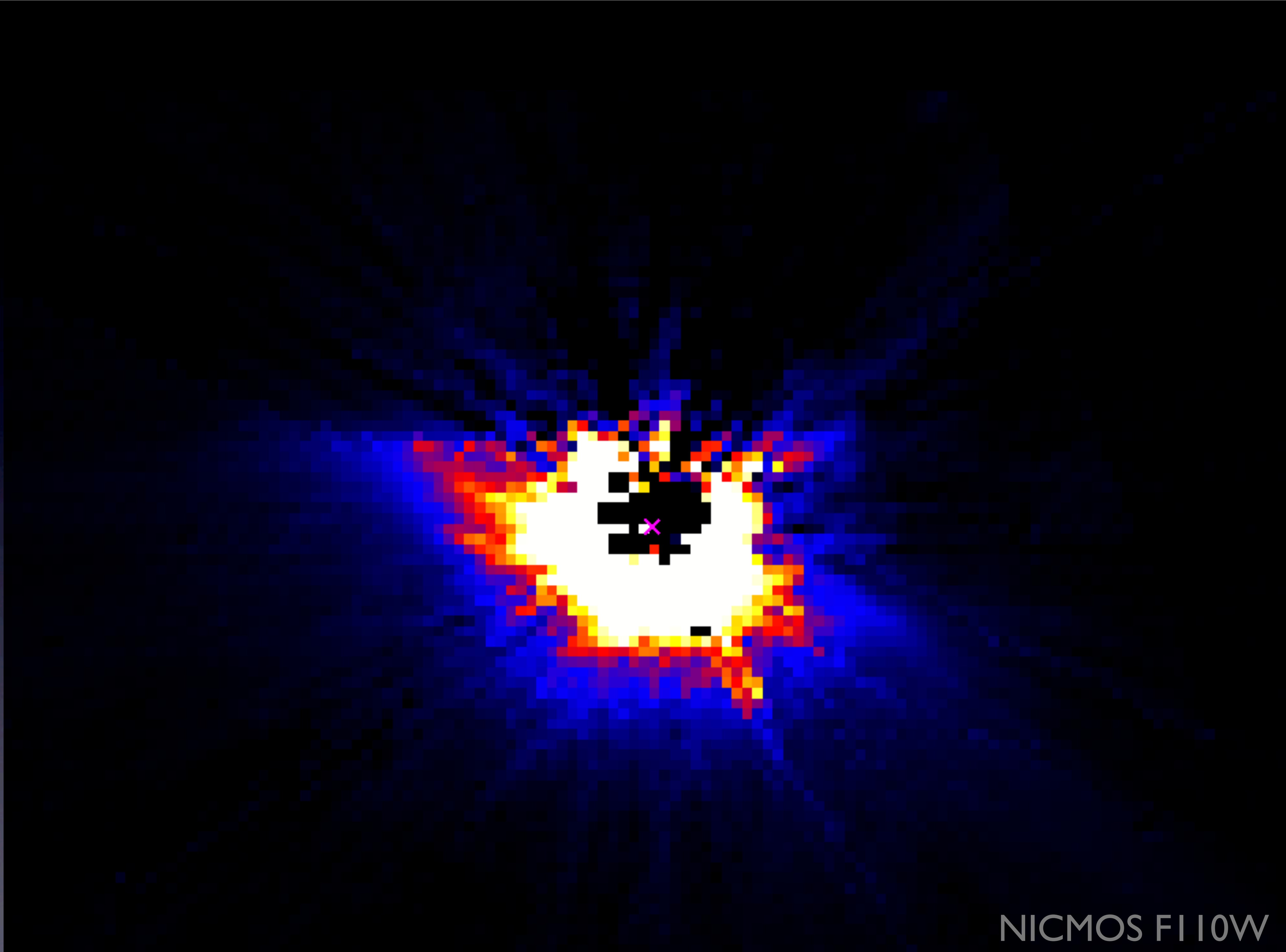
$T_* = 5500\,\mathrm{K}$

$L_* = 0.6\,L_\odot$

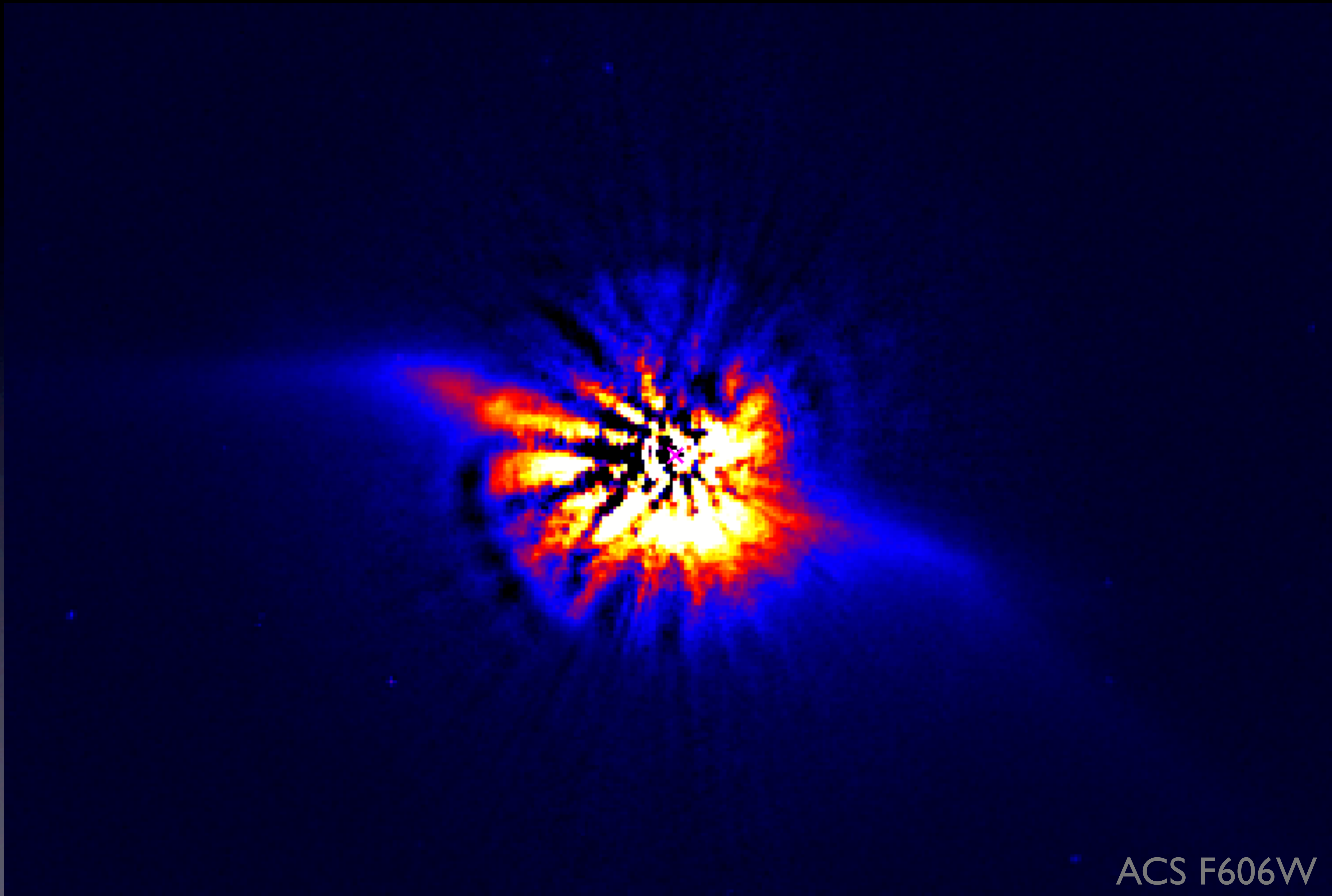
- Argus member? (Desidera et al. 2011)



Hillenbrand et al. (FEPS; 2008), Rocctagliata et al. (2009)



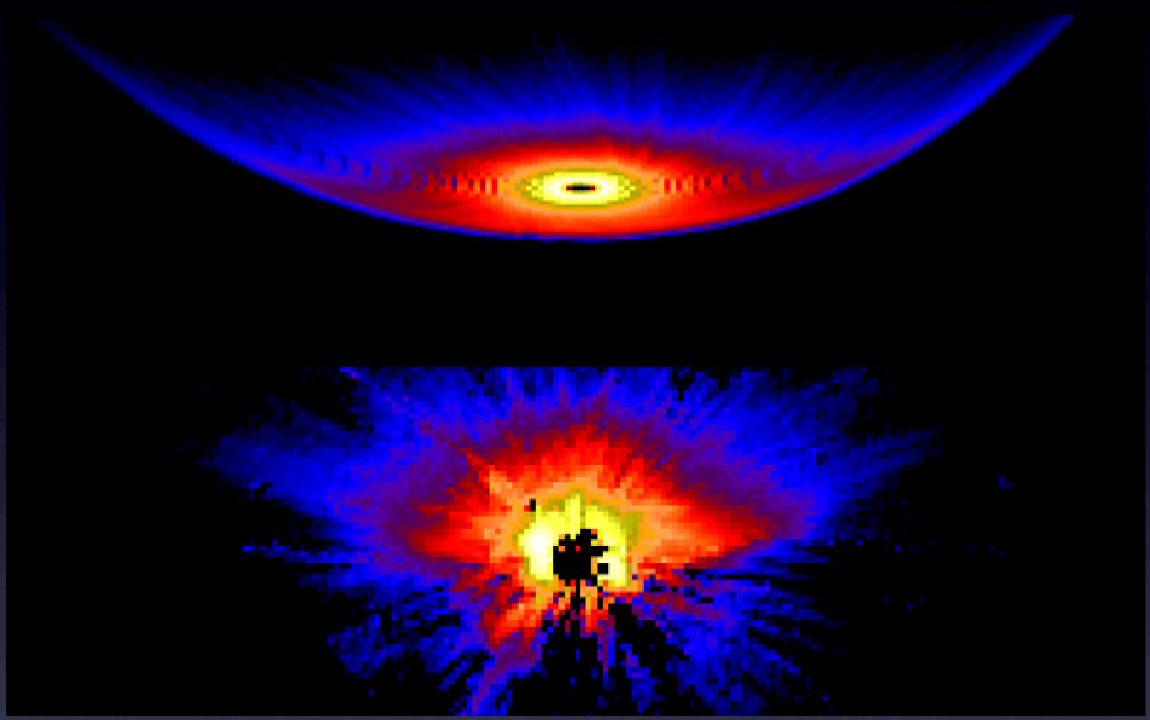
Hines et al. (2007)



Maness et al. (2009)

ISM Interaction?

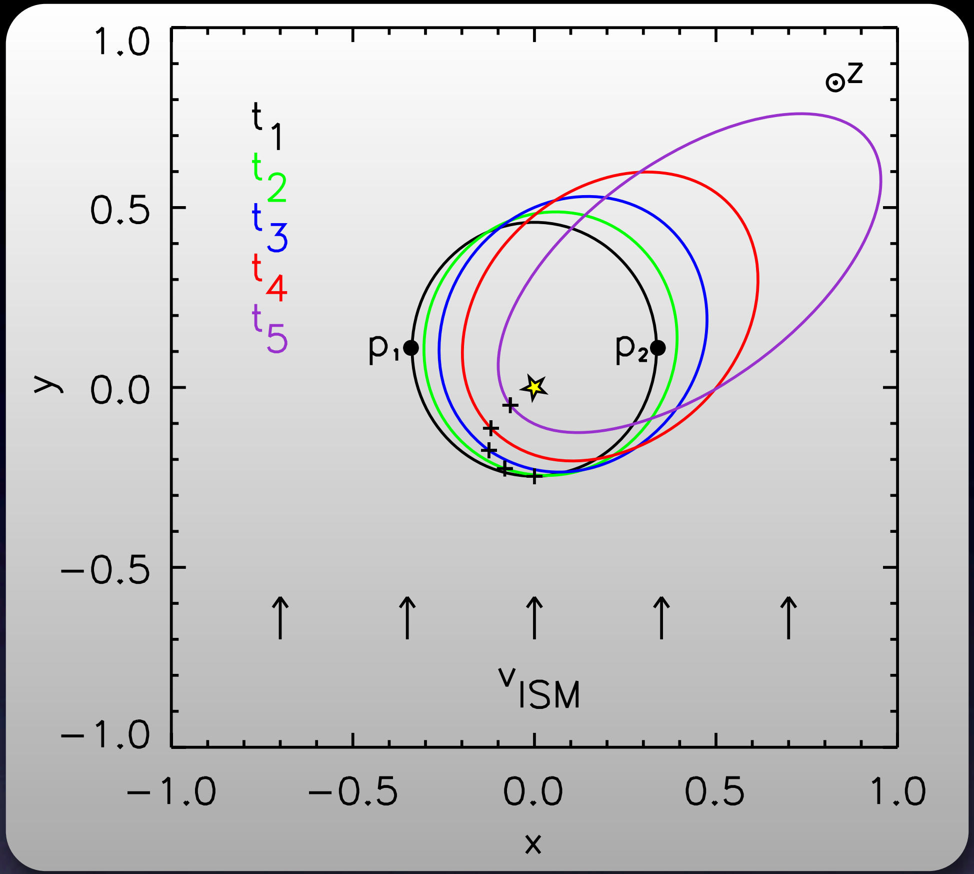
- blue colors → small grains
- interaction with cold, dense cloud?
    - stripping of bound grains
    - deflection of unbound grains
- Limit on Na I absorption below that expected for CNM cloud column density (Maness et al. 2009)

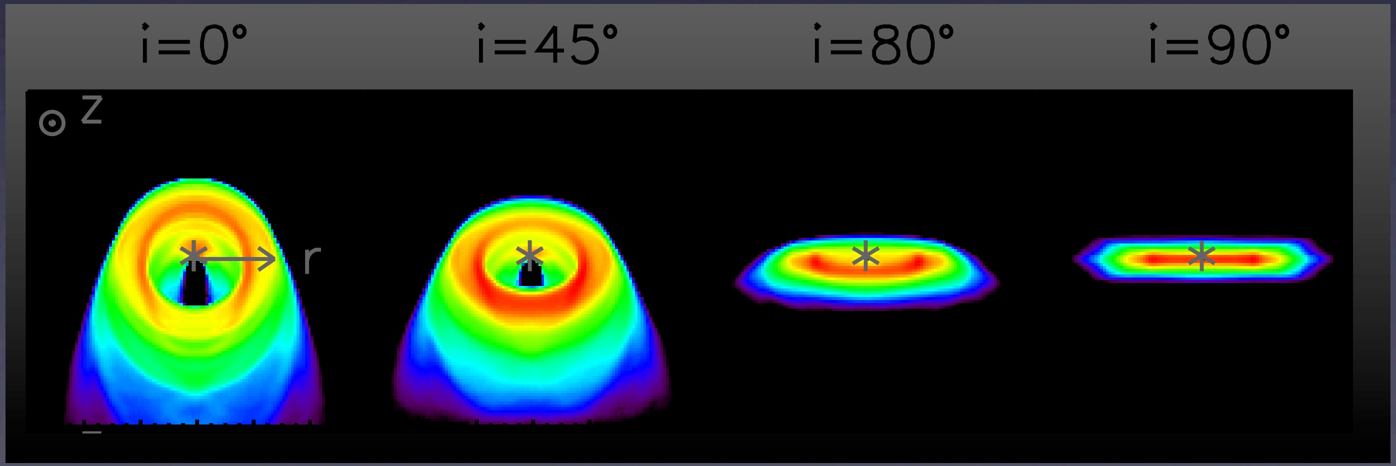


Debes et al. (2009)

ISM Interaction?

- warm, low-density cloud?
  - typical values for density and velocity are insufficient for stripping grains
  - secular perturbations by gas forces may play a role

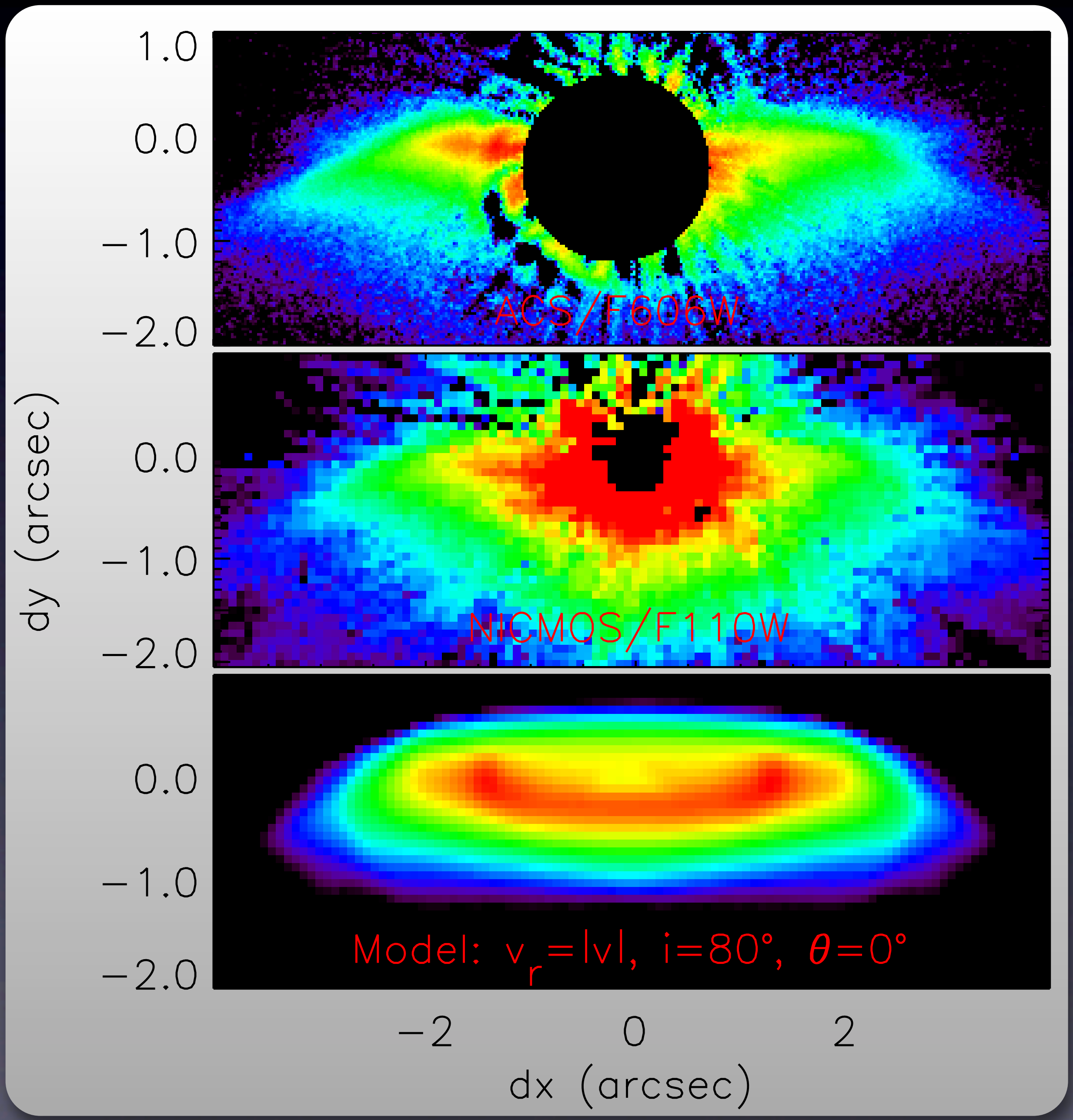




Maness et al. (2009)

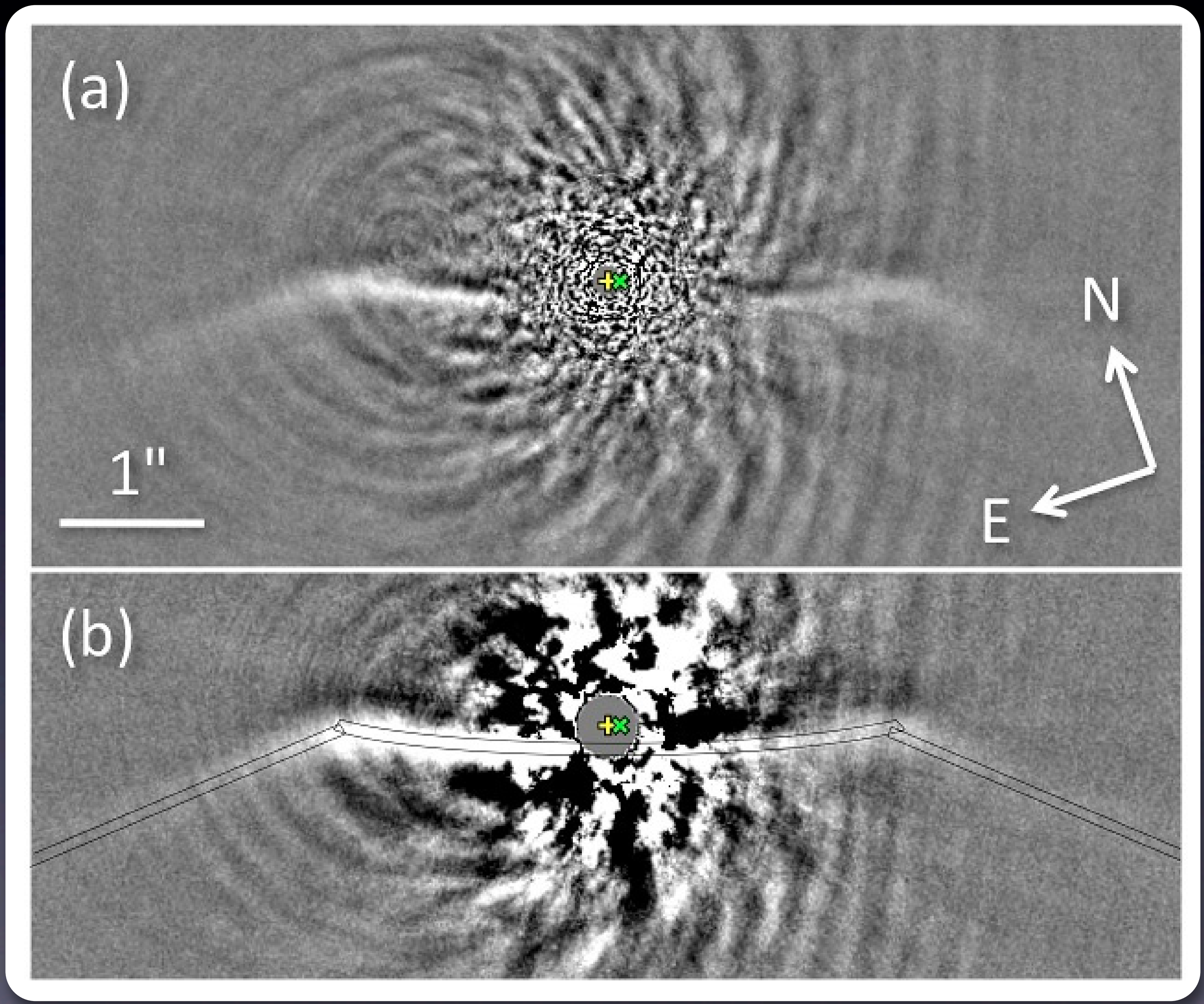
ISM Interaction?

- can approximate gross morphology, but not yet asymmetries
- collision time on order steady-state relaxation time
- no perturbations from planets



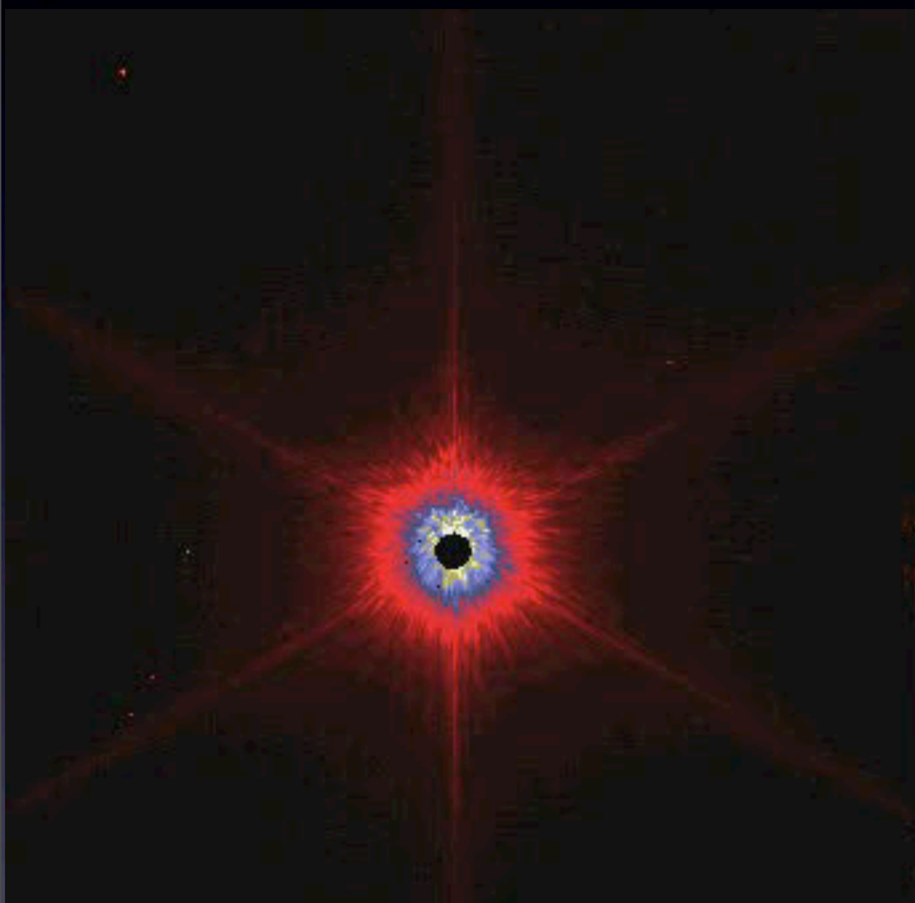
Maness et al. (2009)

Recent Observations

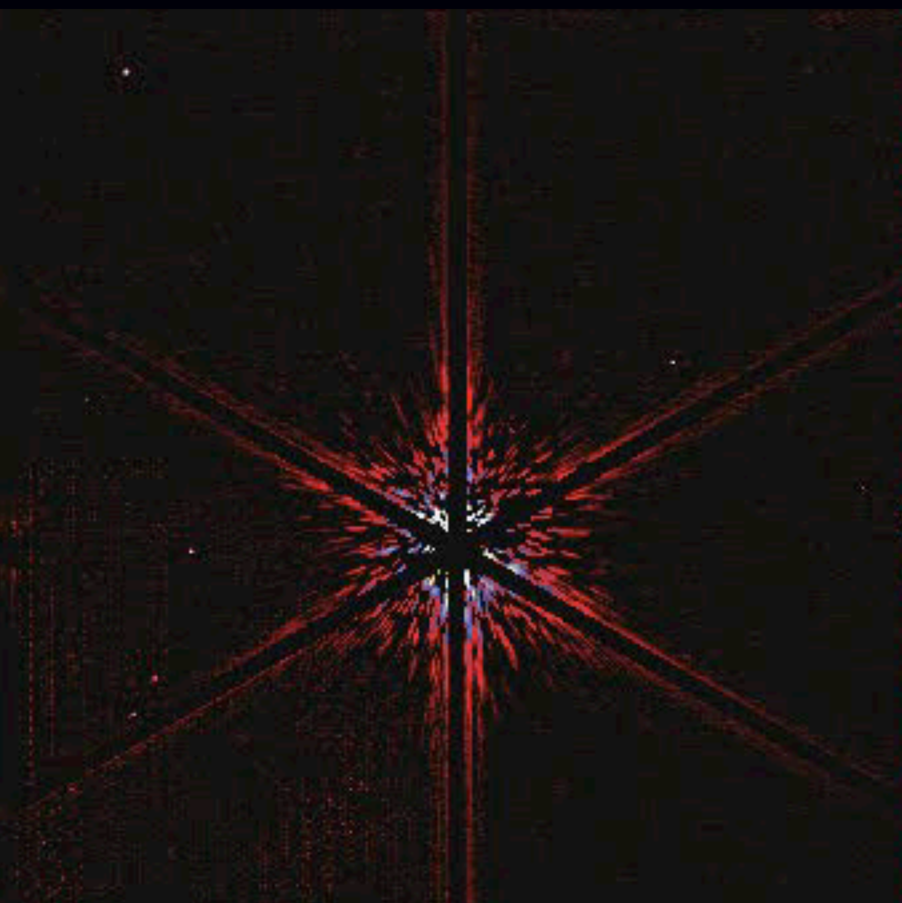


Buenzli et al. (2011)

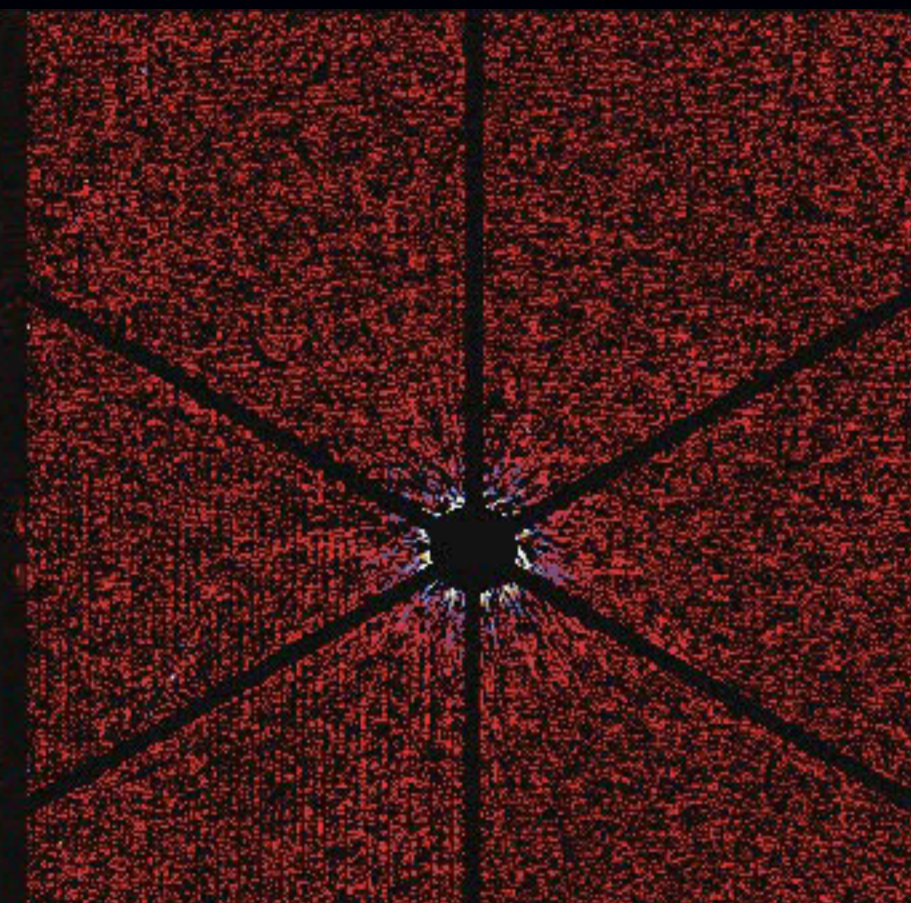
AO Roll Subtraction



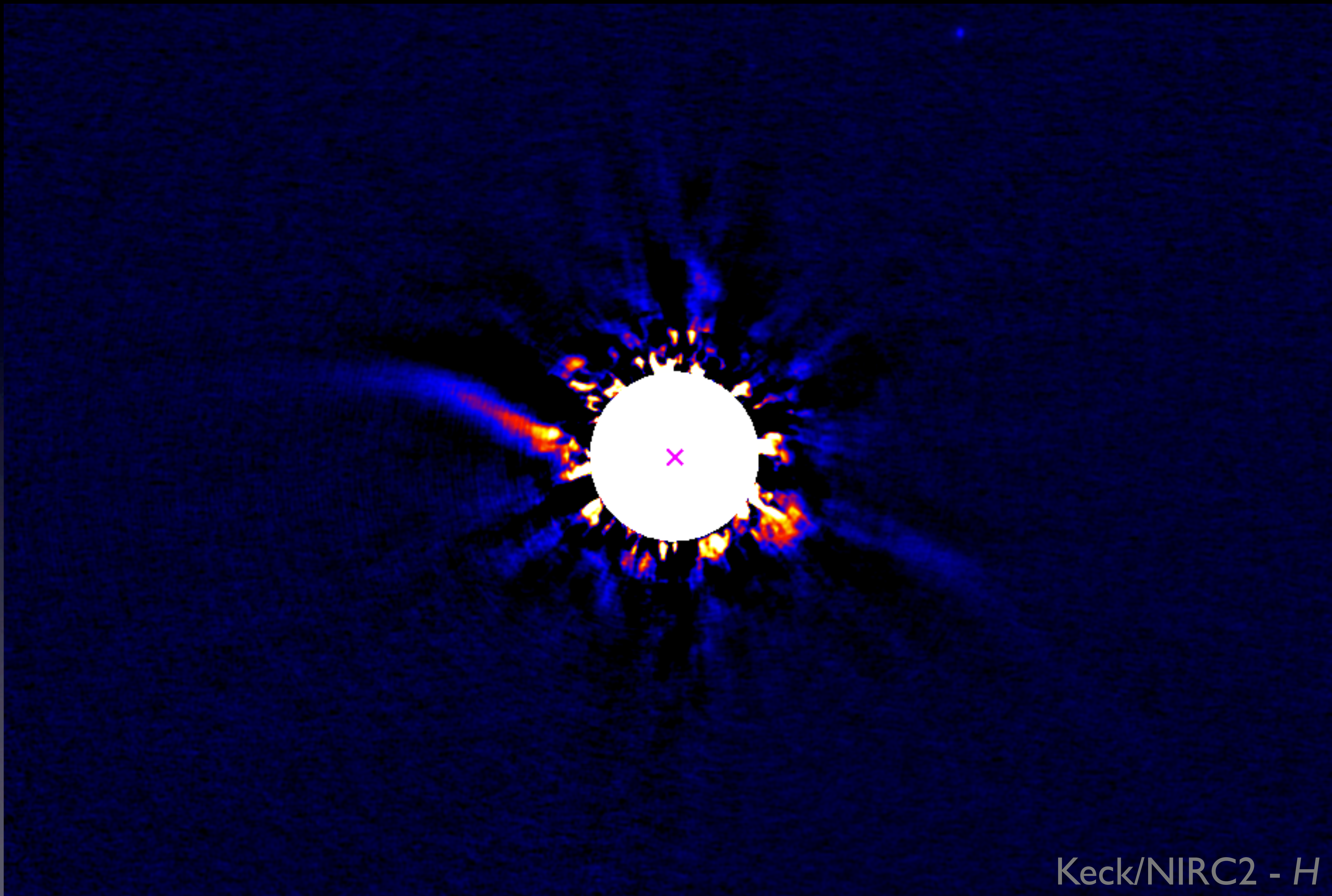
Original

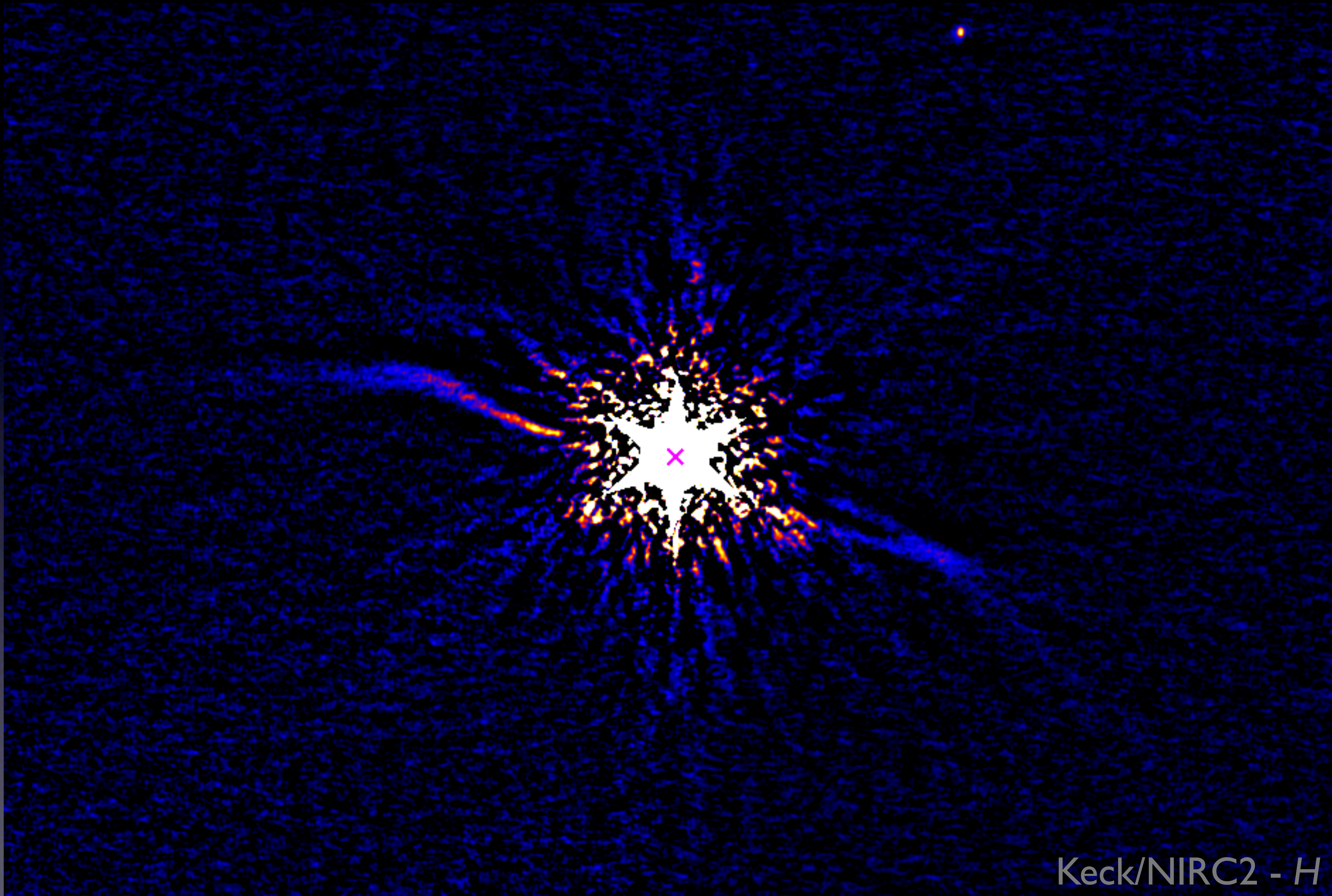


Filtered



Subtracted


Keck/NIRC2 - *H*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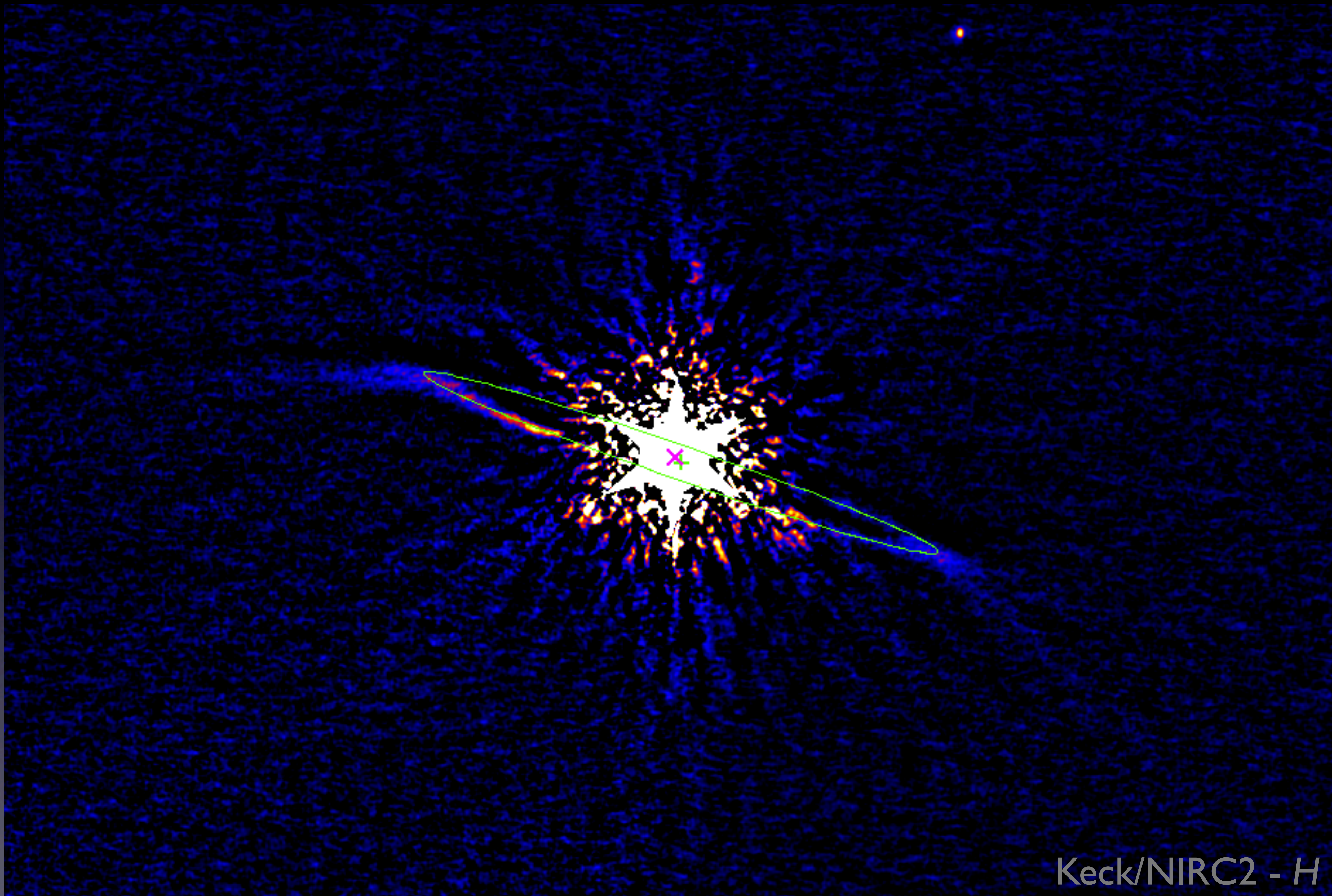
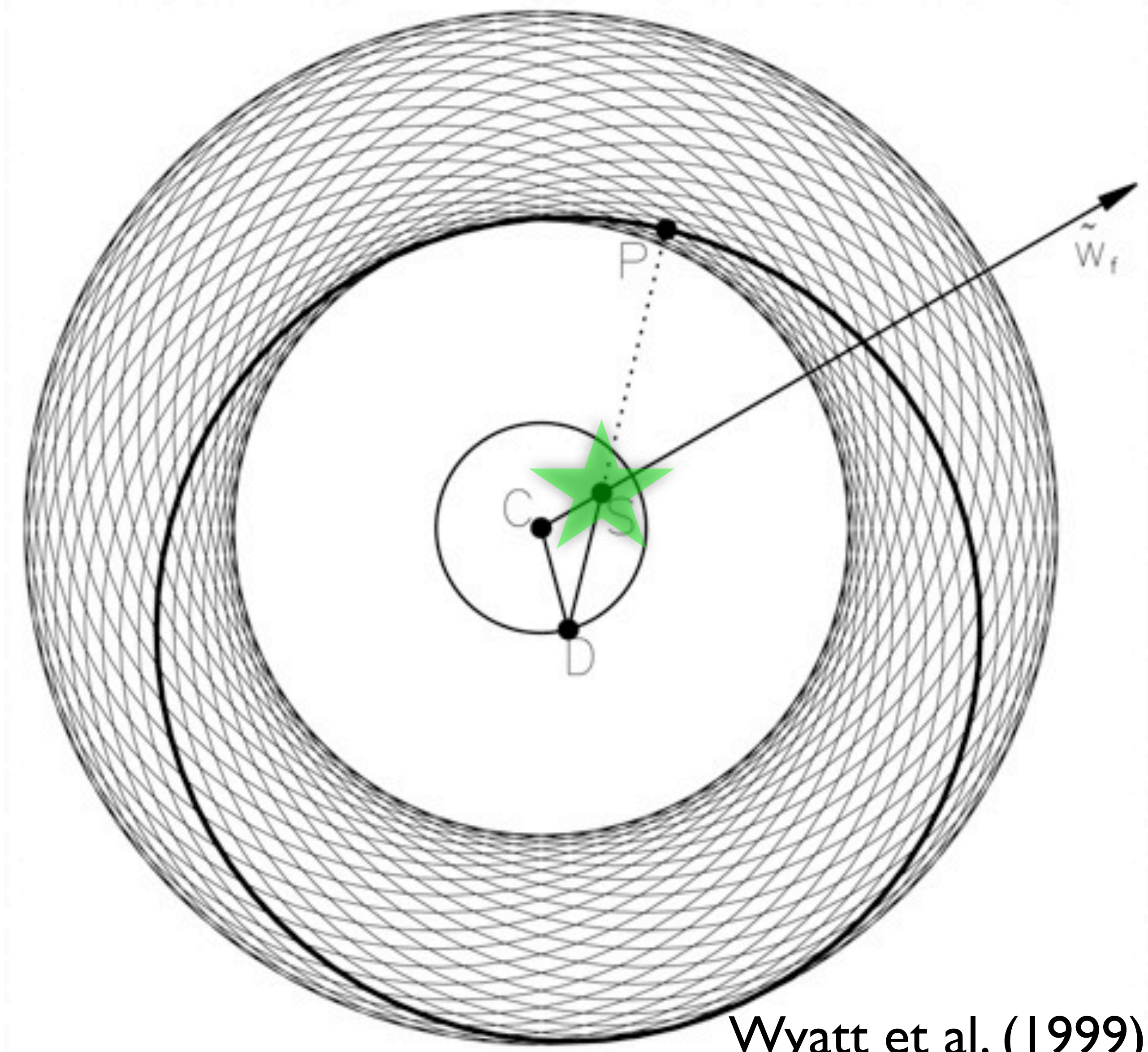

Keck/NIRC2 - *H*

Eccentric Perturber?

- Secular perturbations from a planet on an eccentric orbit can cause offset
- Deprojected offset is 18 AU for circle of radius 70 AU
- Can relative inclination be responsible for apparent “swept” structure?



Wyatt et al. (1999)

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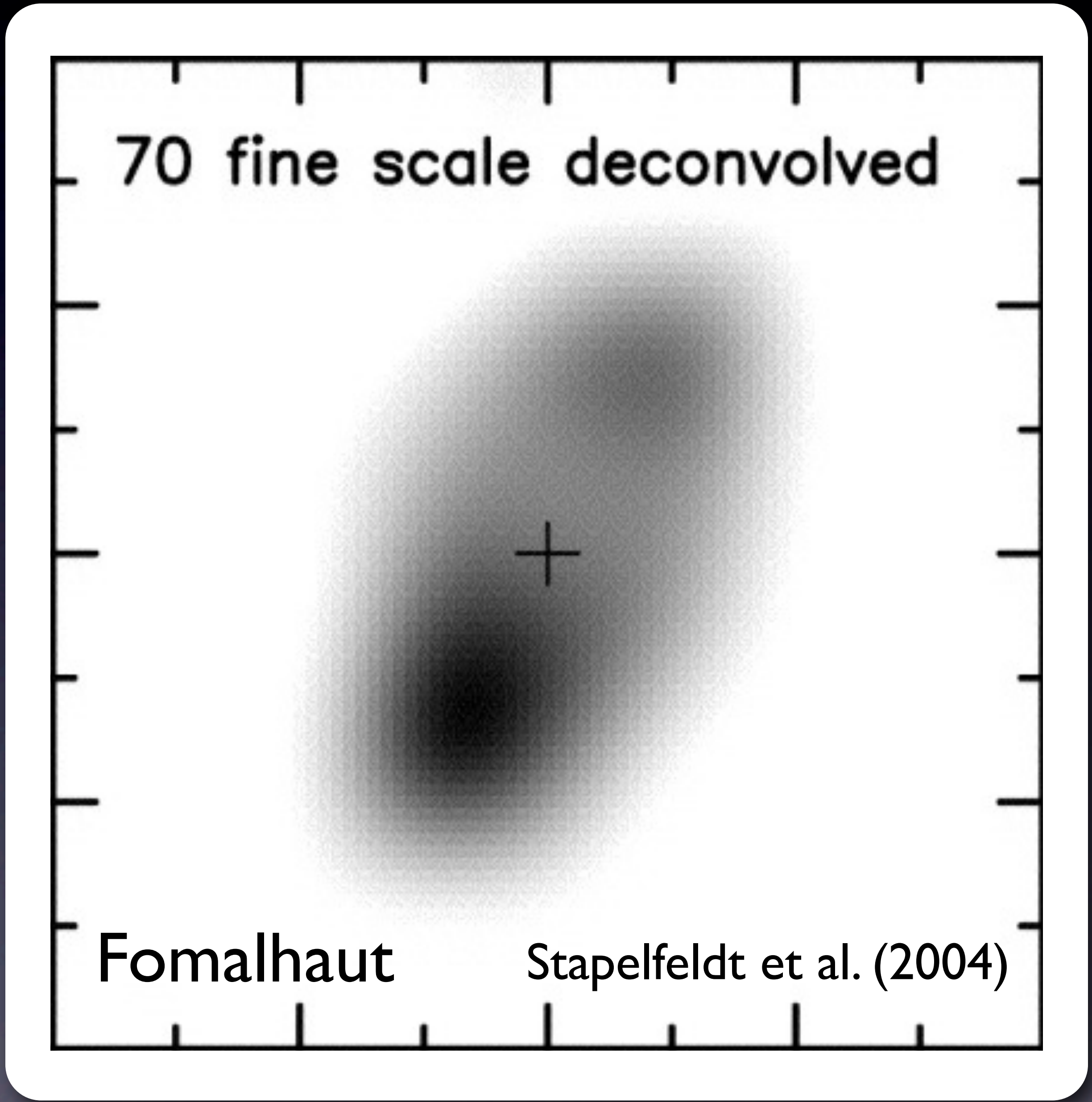

also e.g. Holland et al. (2003)

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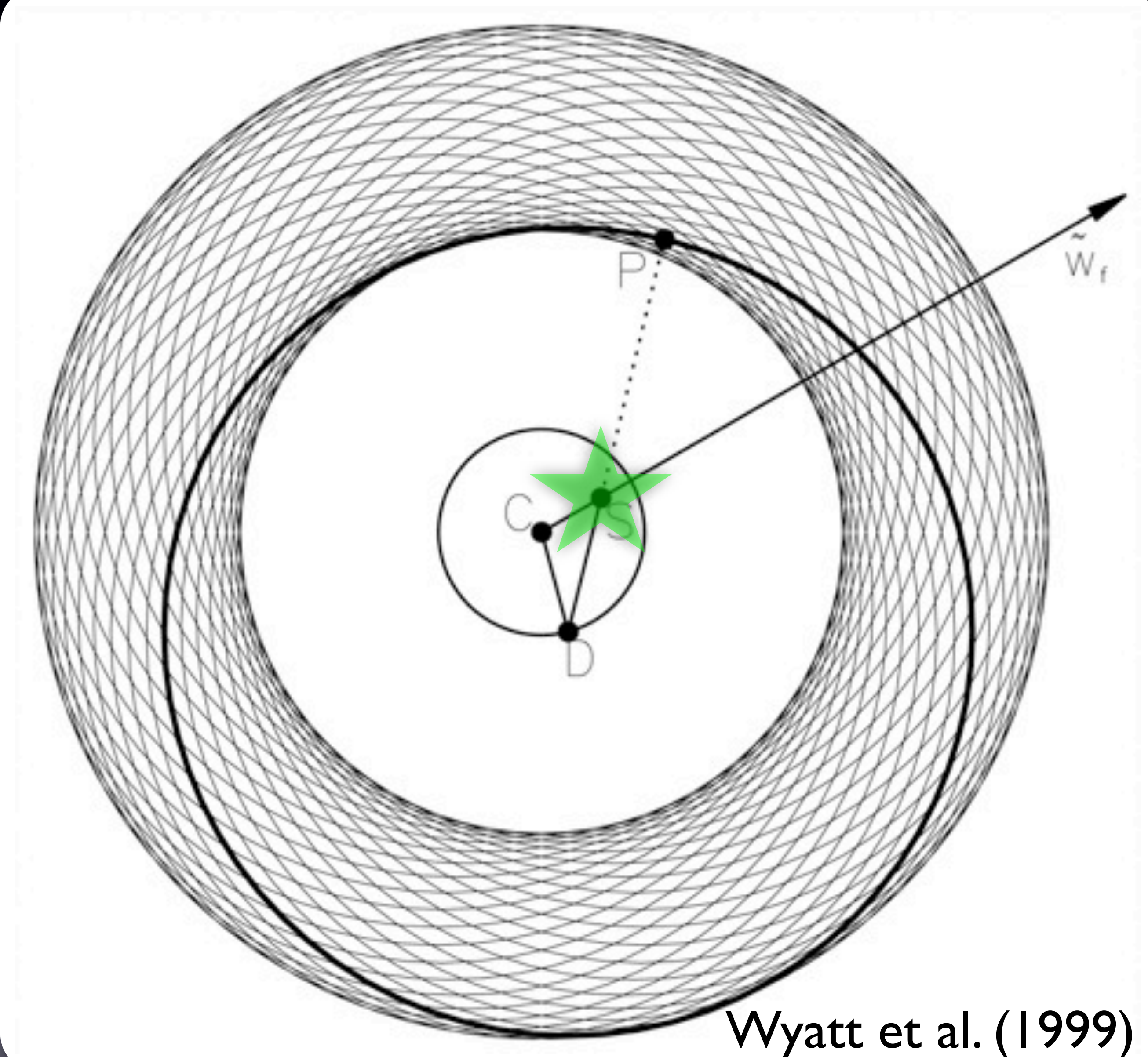

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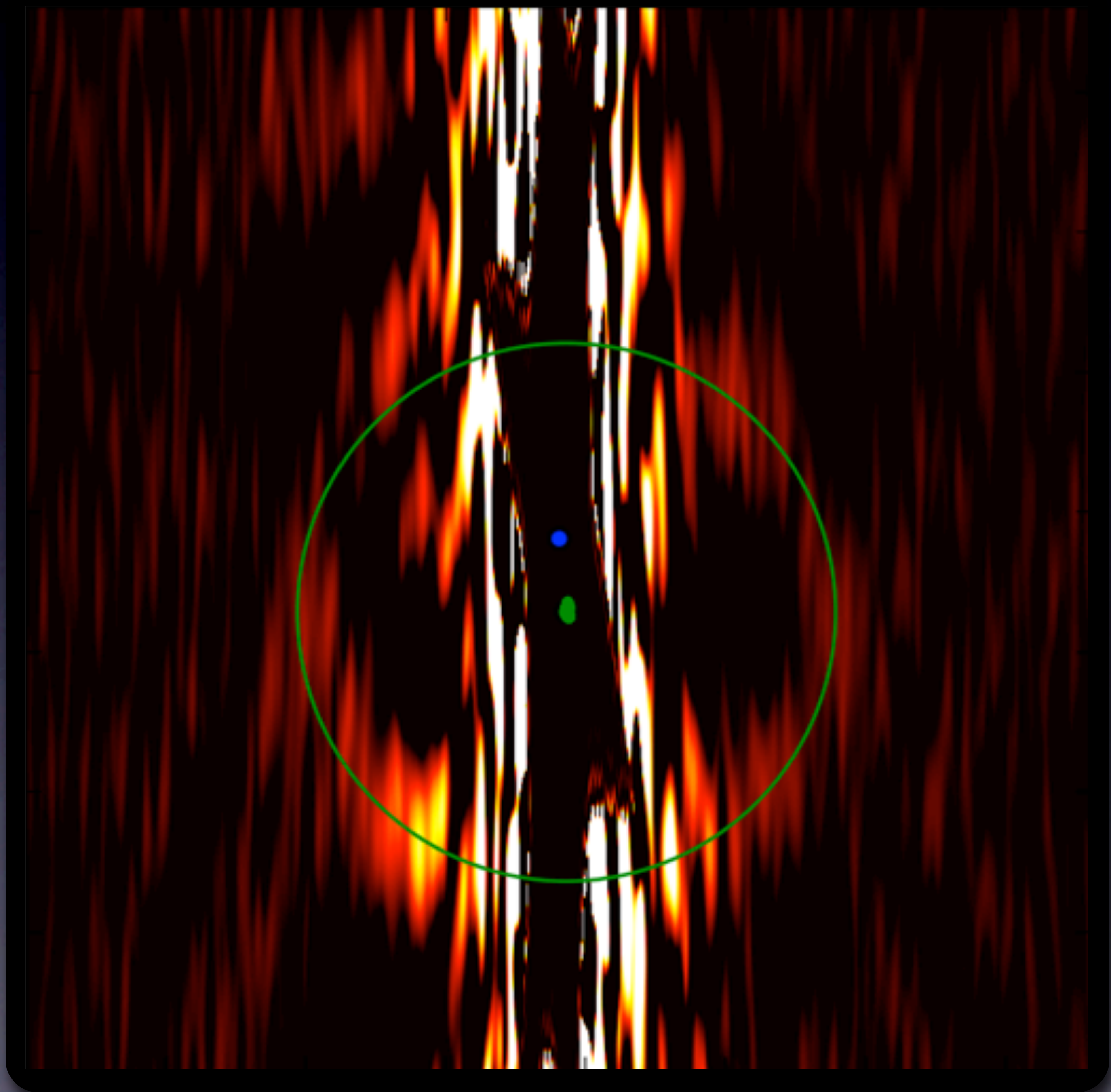

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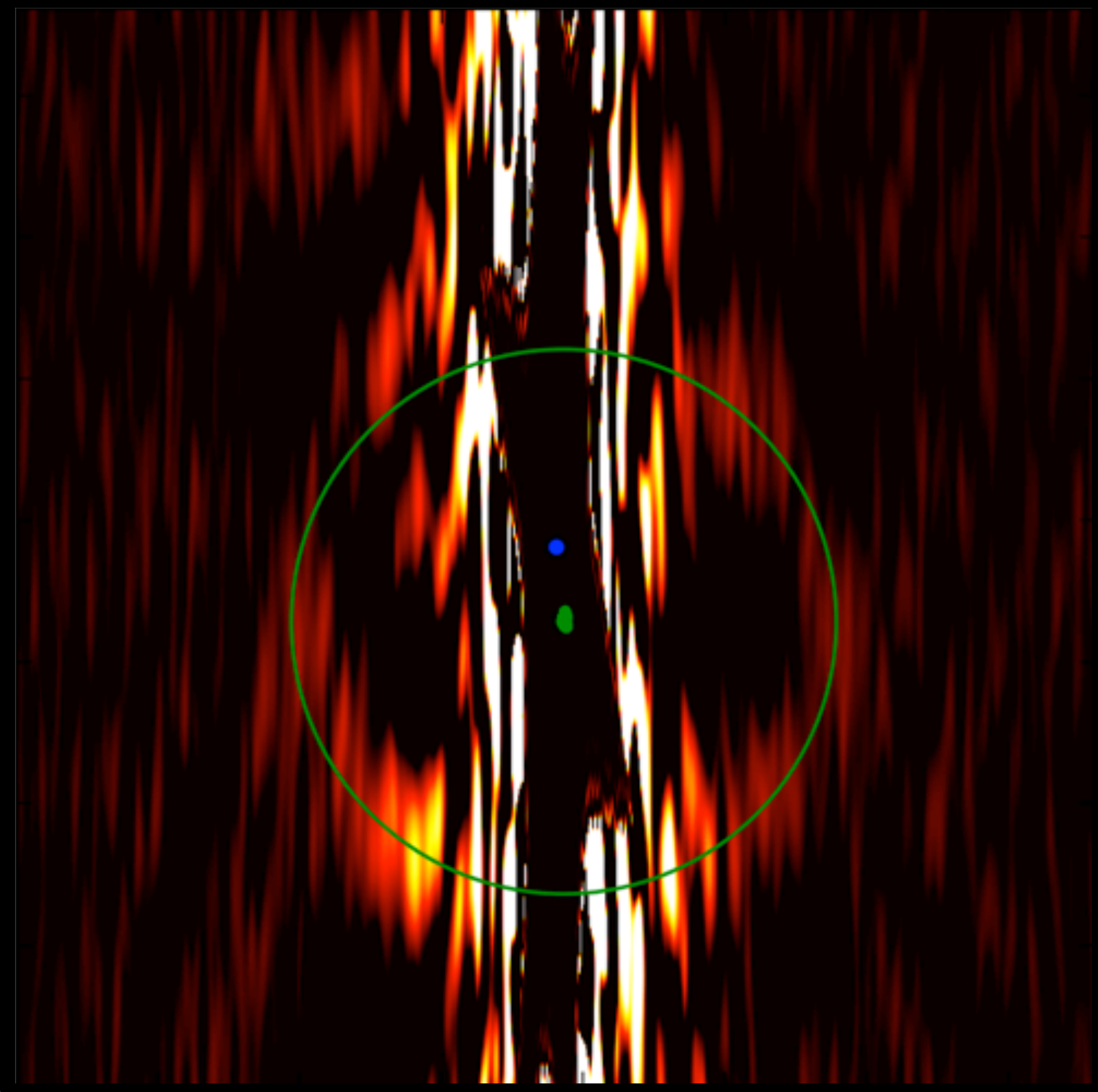

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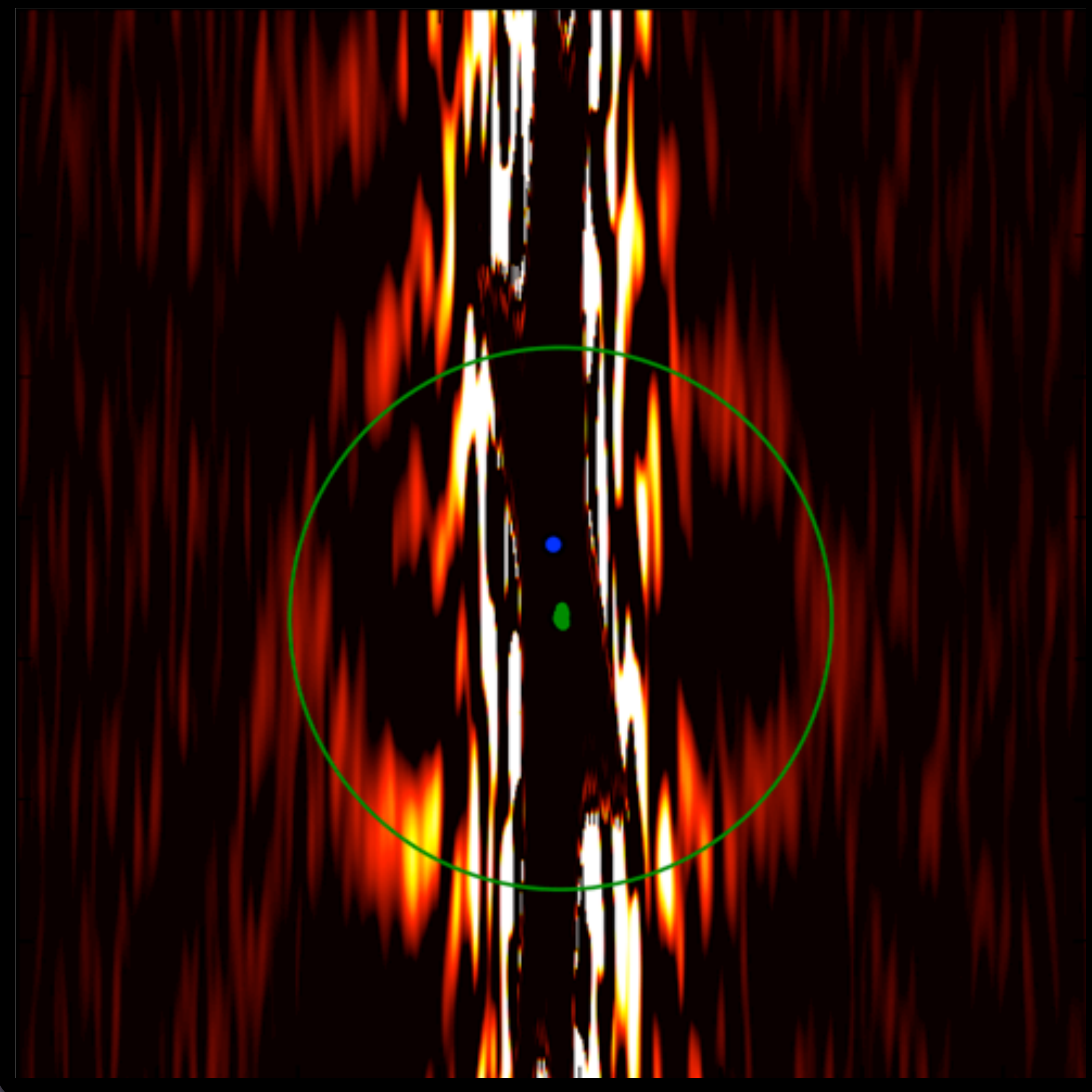

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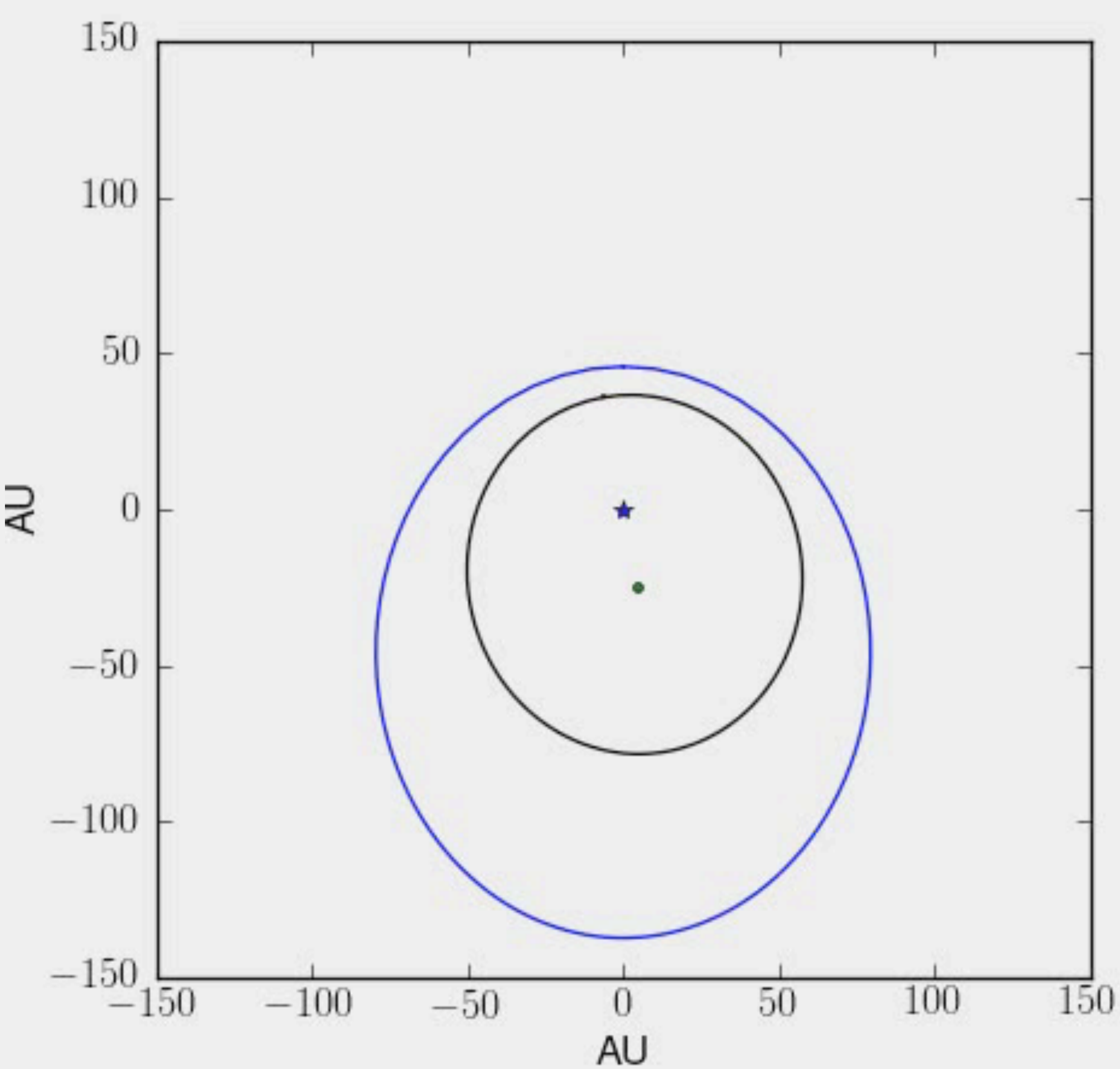

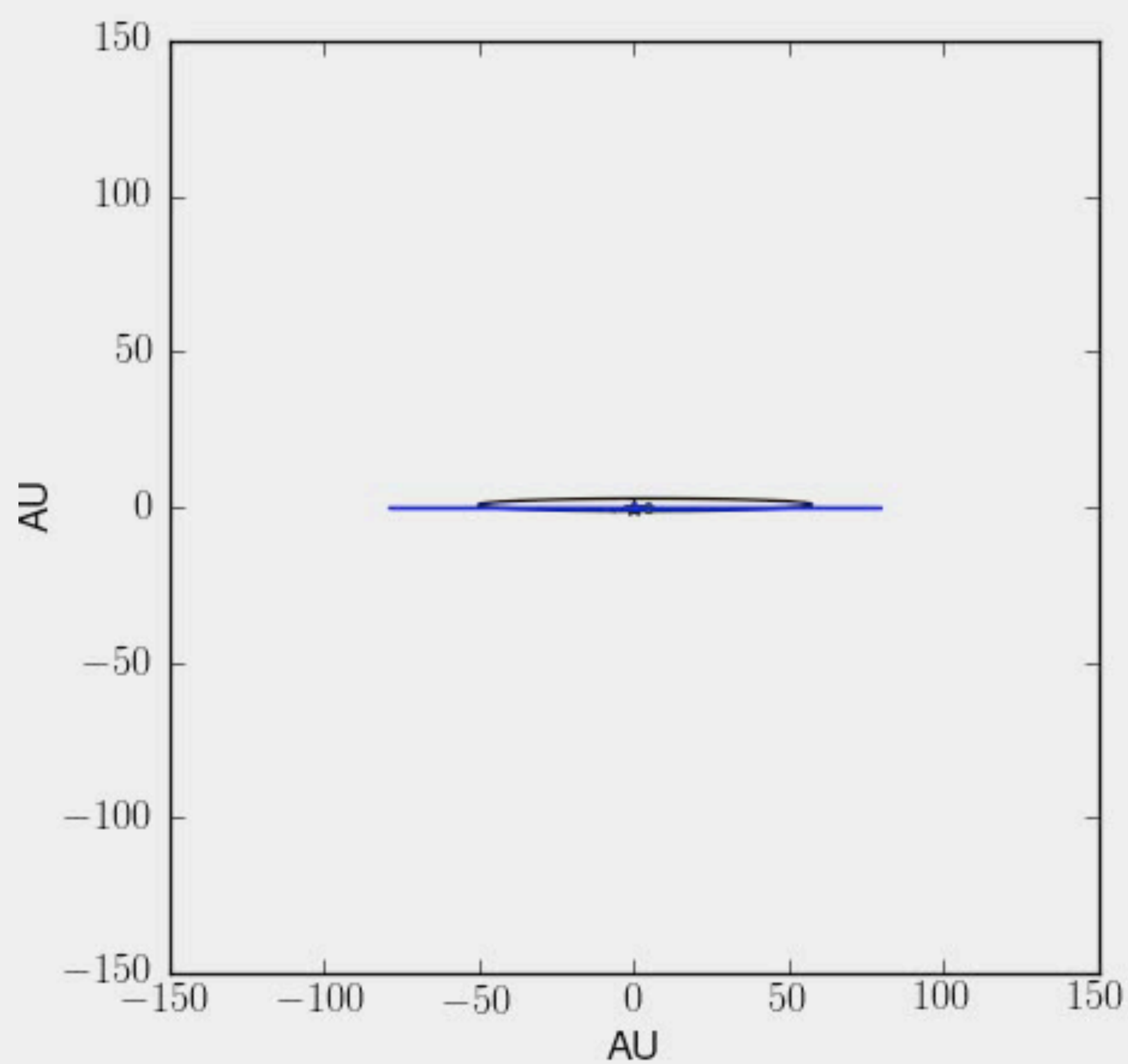

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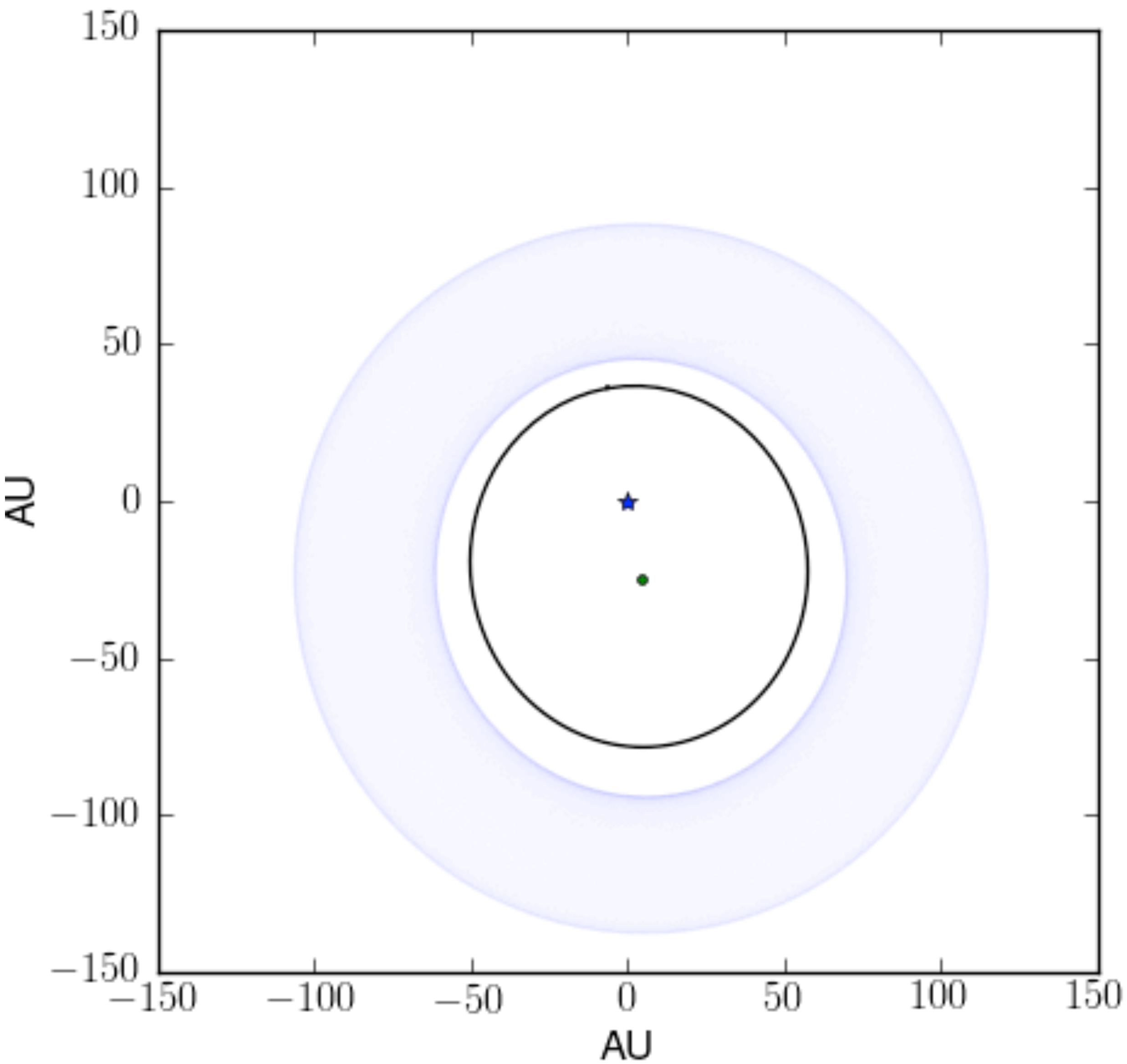

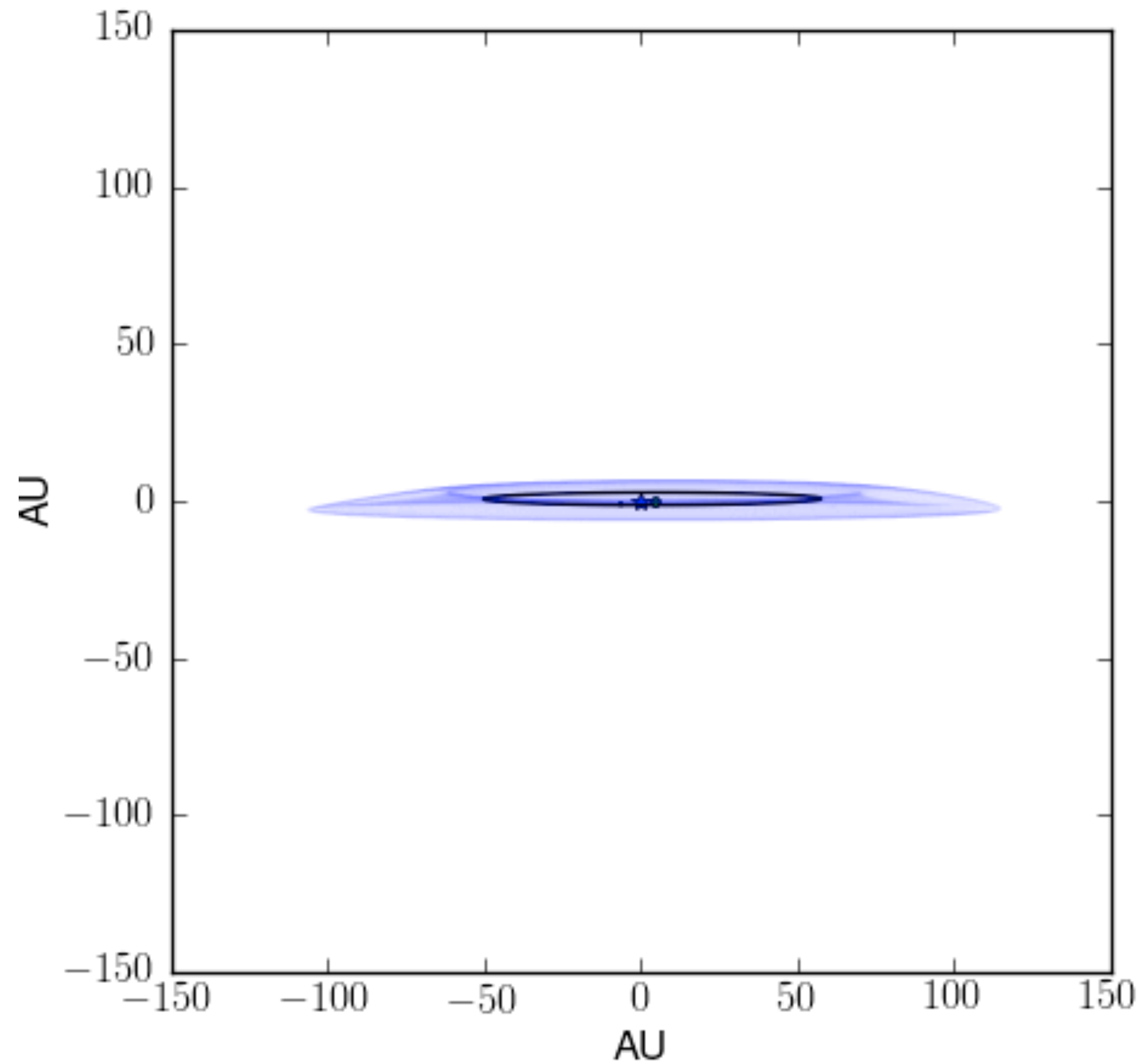

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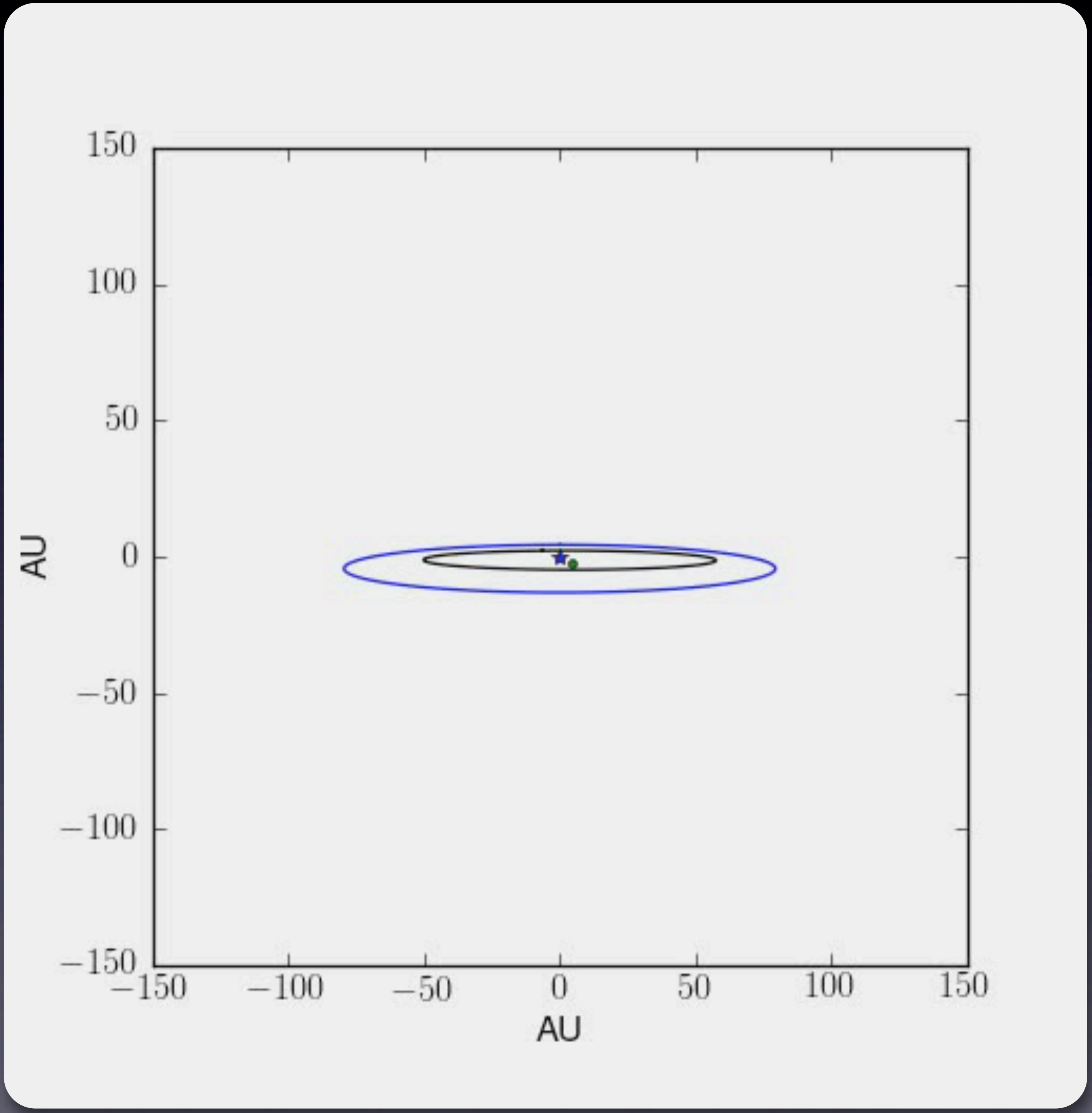

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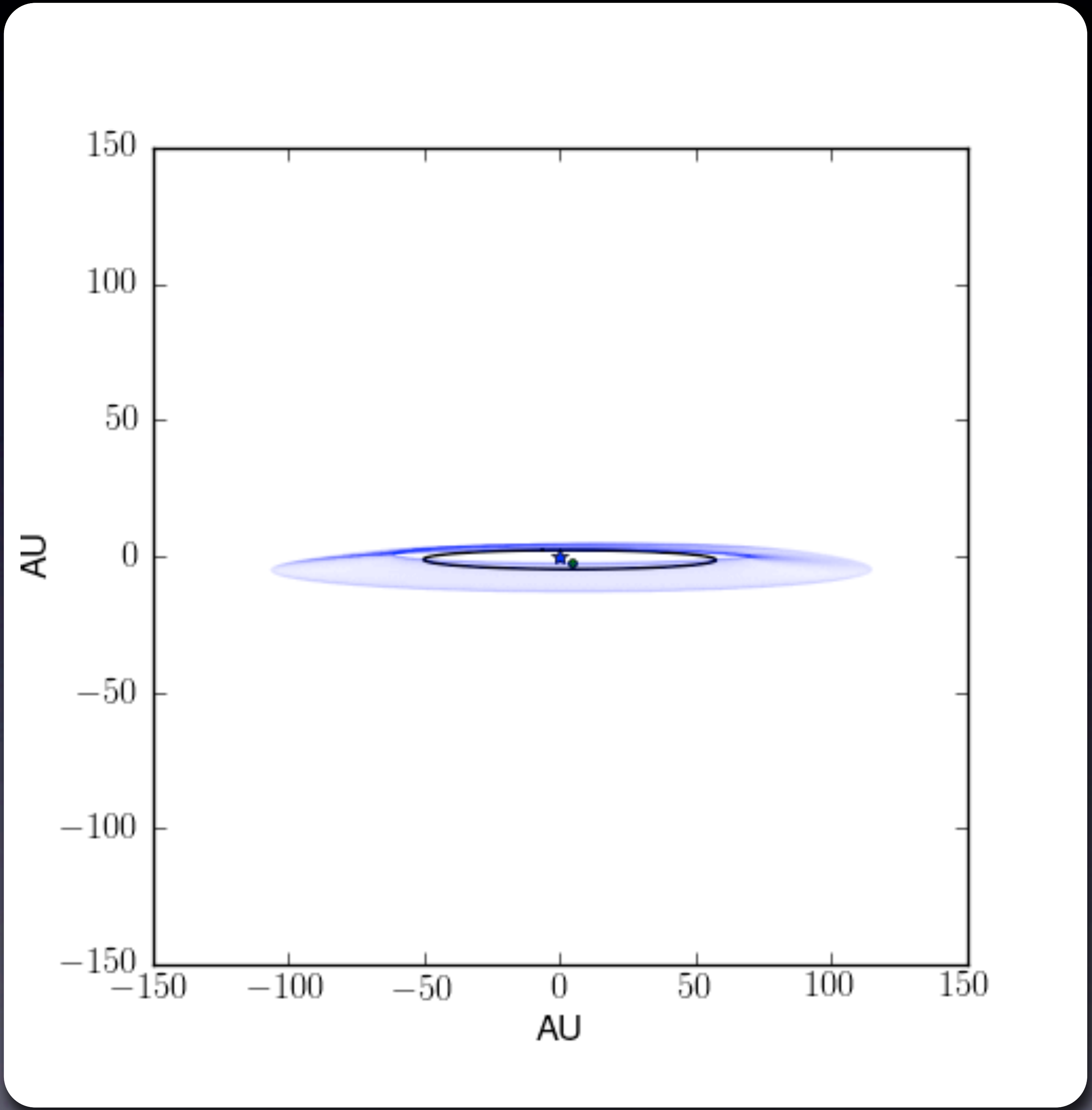

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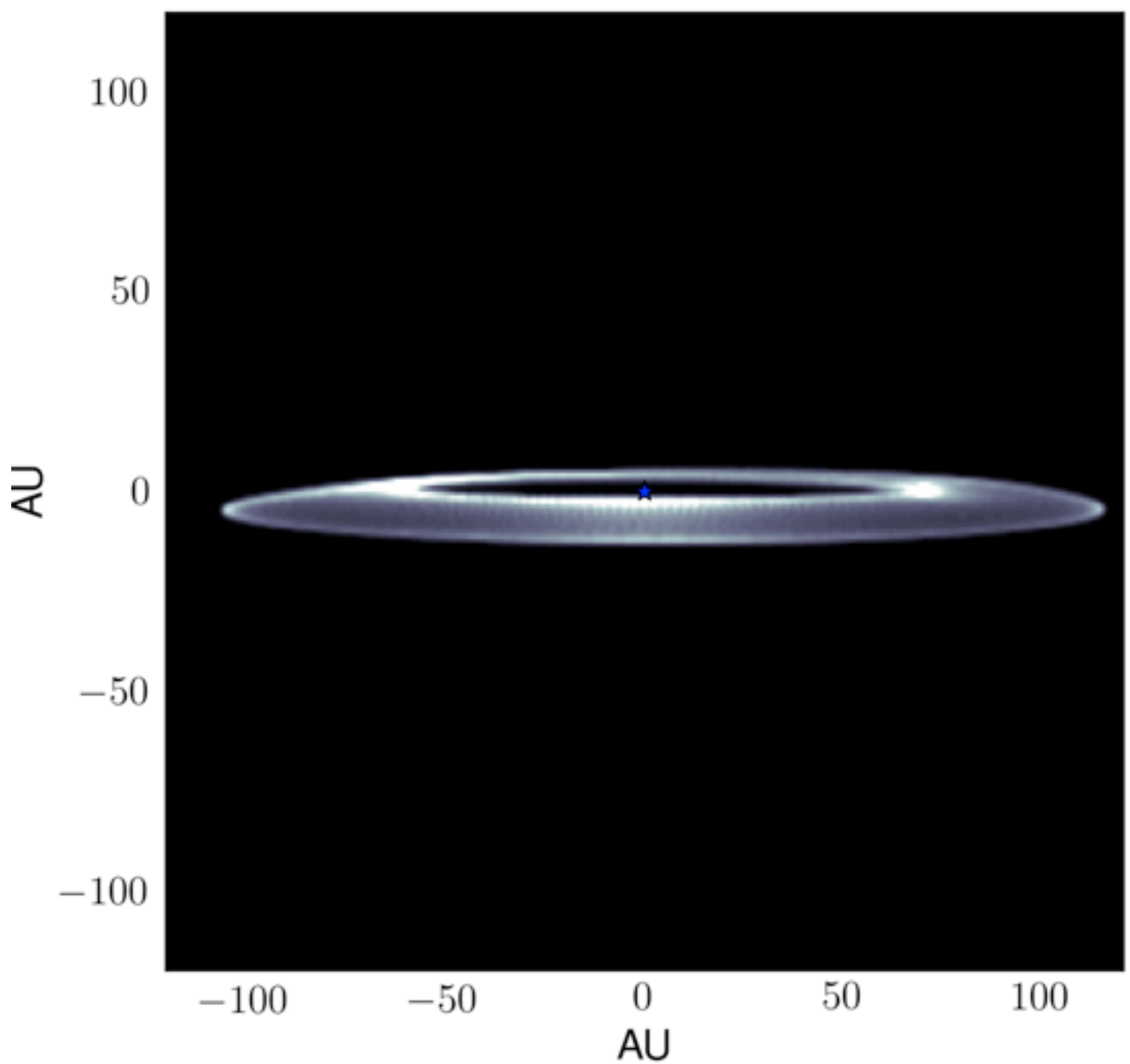
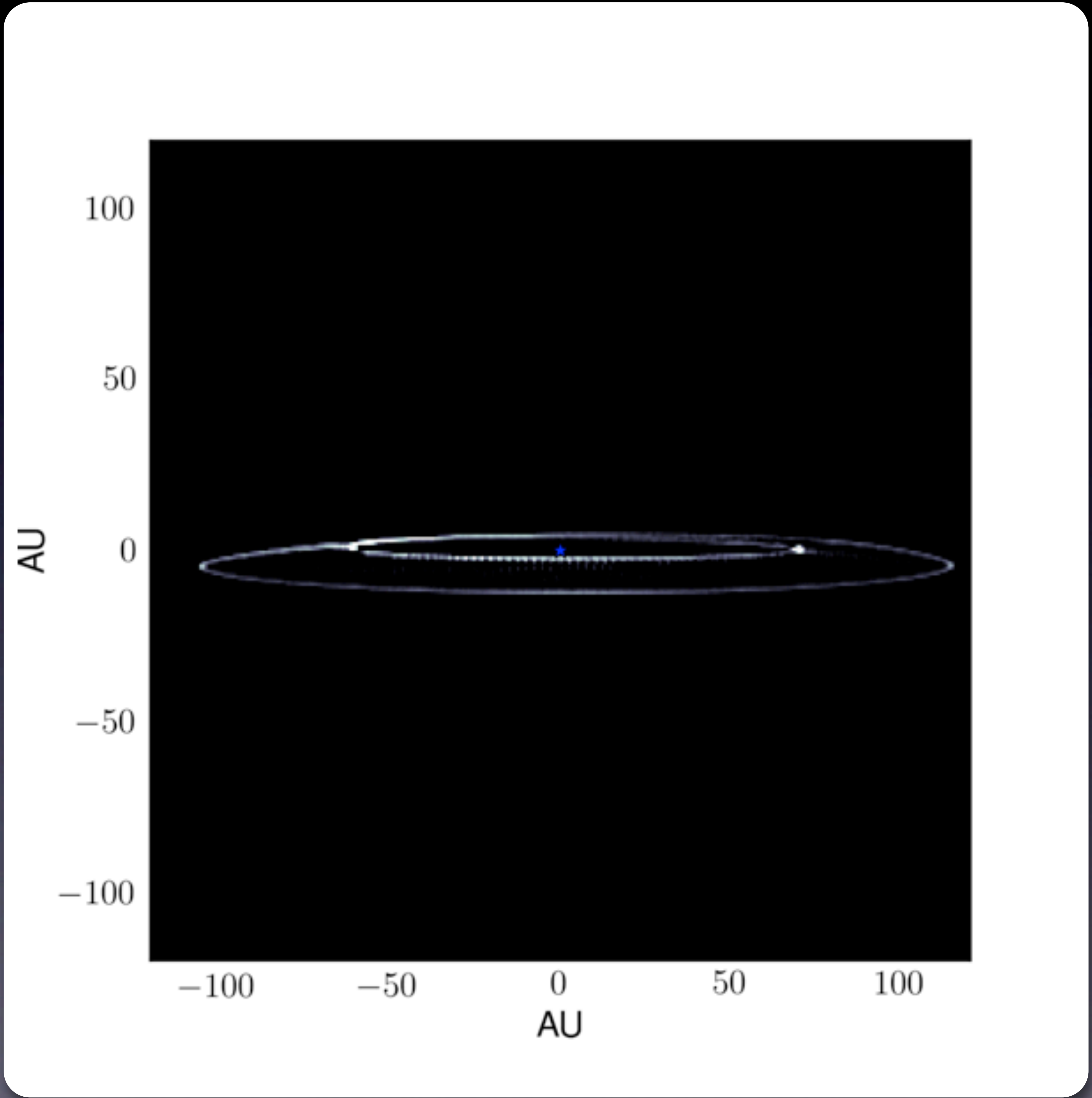
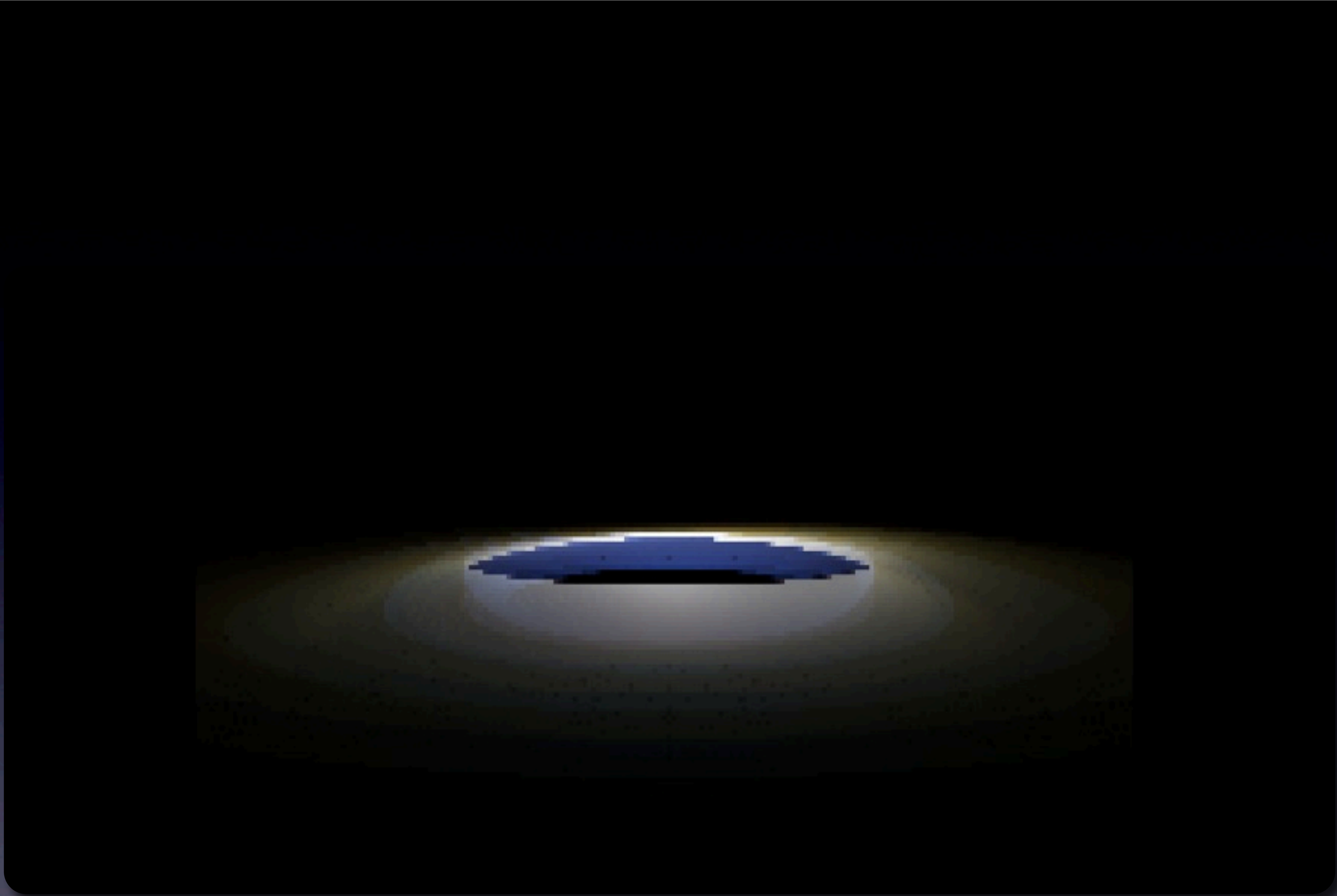
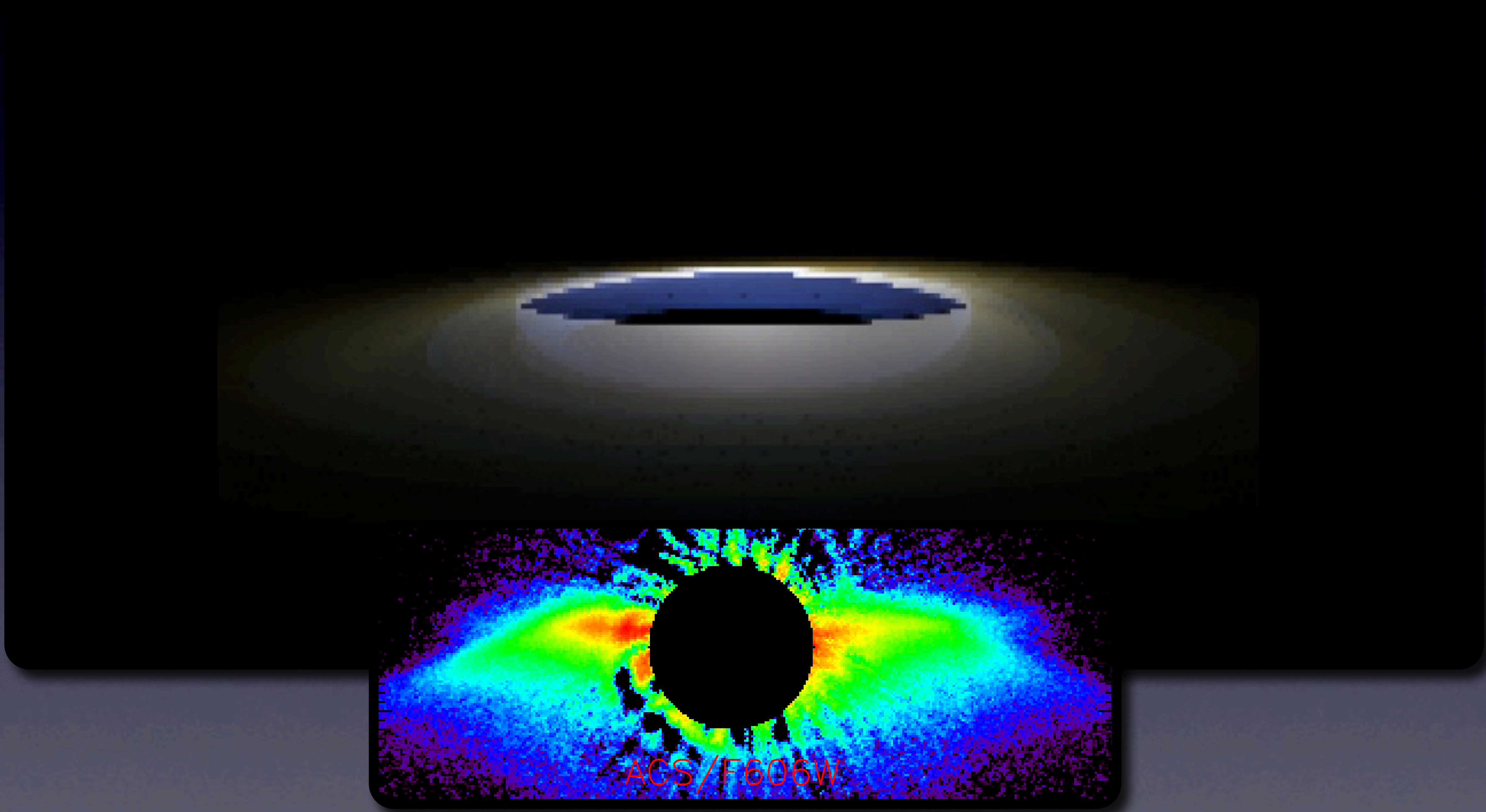


Eccentric Perturber?






ACS/F606W

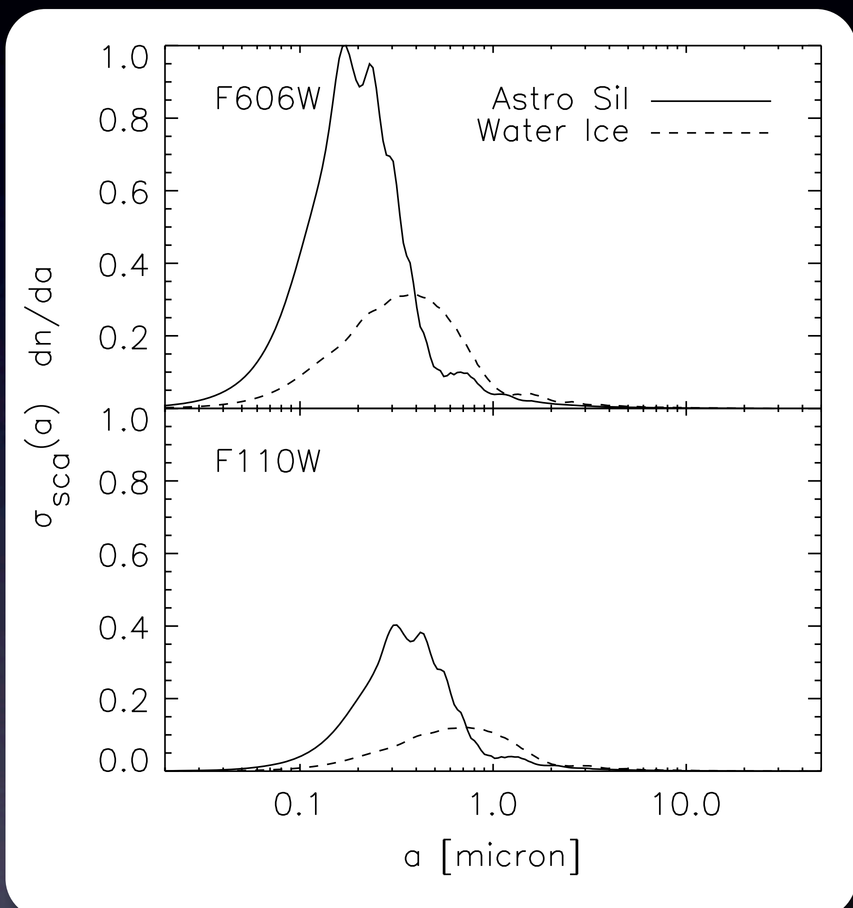
- We have resolved scattered light from the HD 61005 debris disk with Keck II adaptive optics

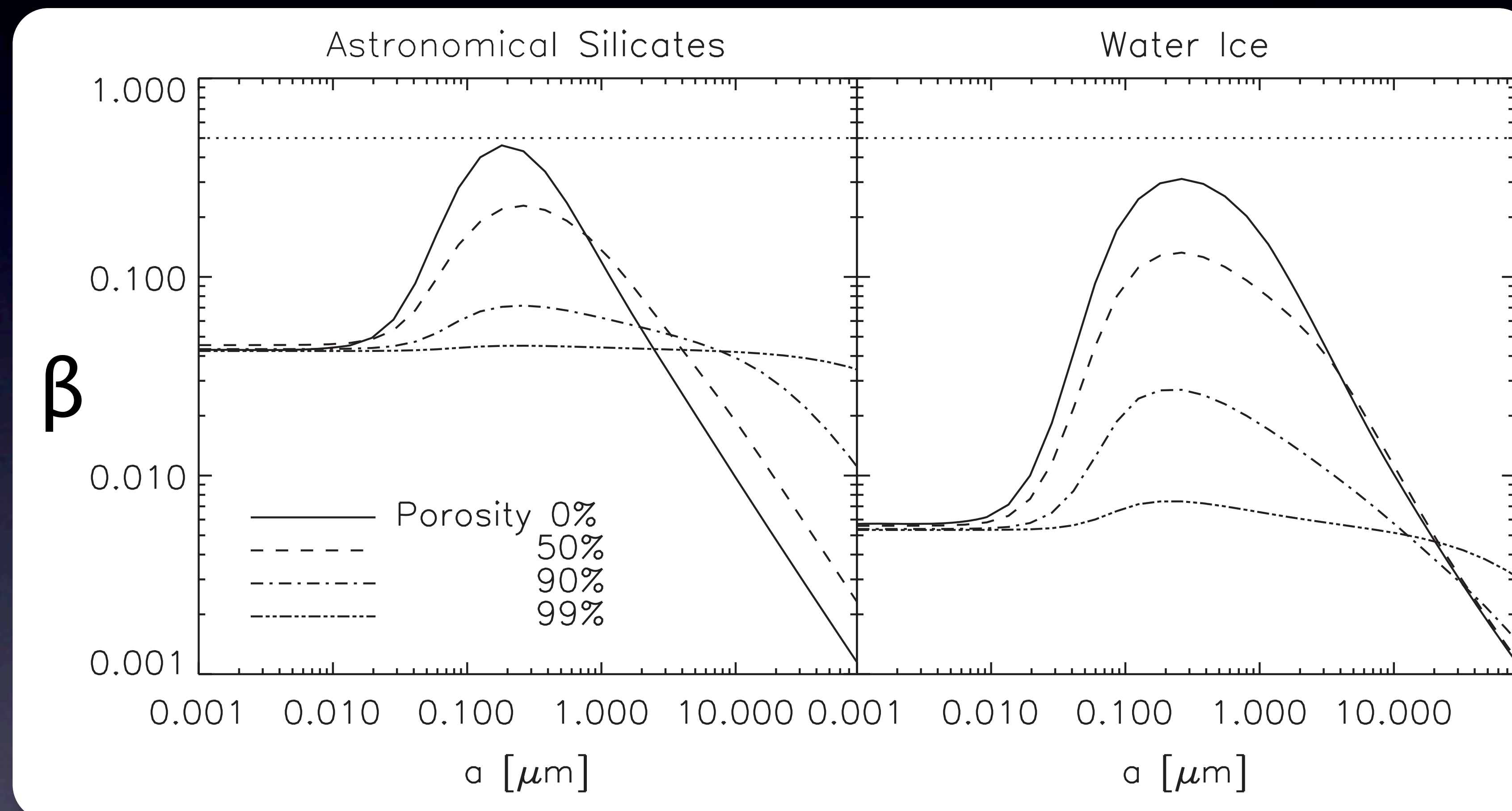
- Single perturber can produce a morphology consistent with an offset and 'swept' wings

- Secular perturbation timescale must be less than collision time (~5000 yr) – degeneracy in M_p, a_p, e_p

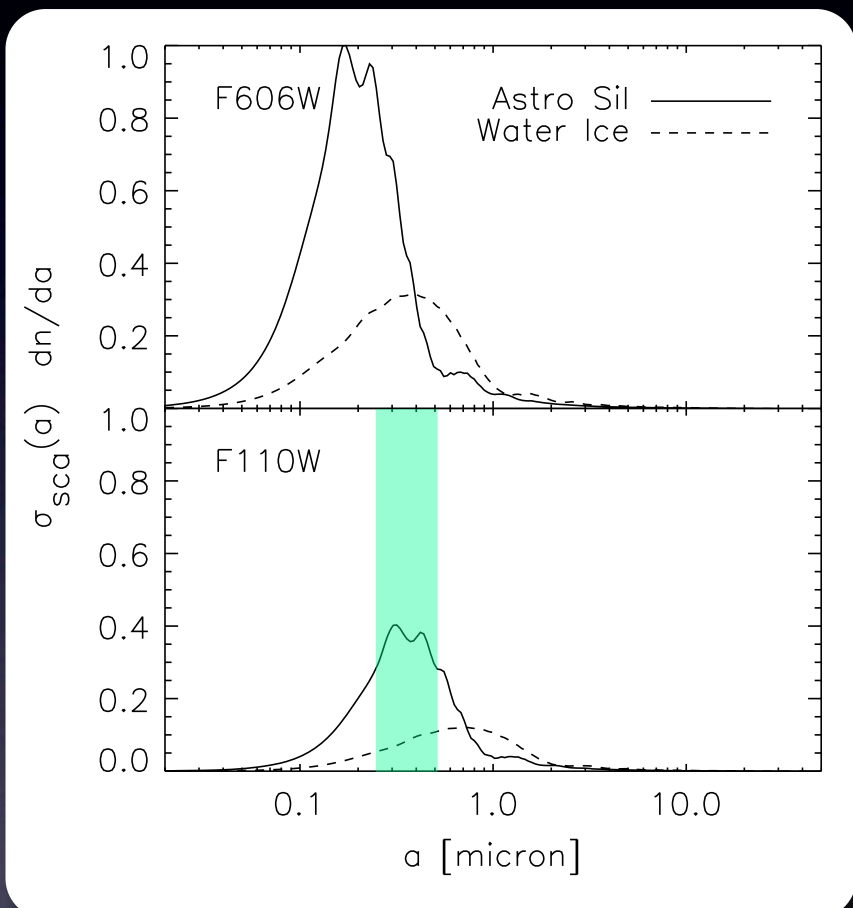
- Scattered-light contribution from grains with similar β

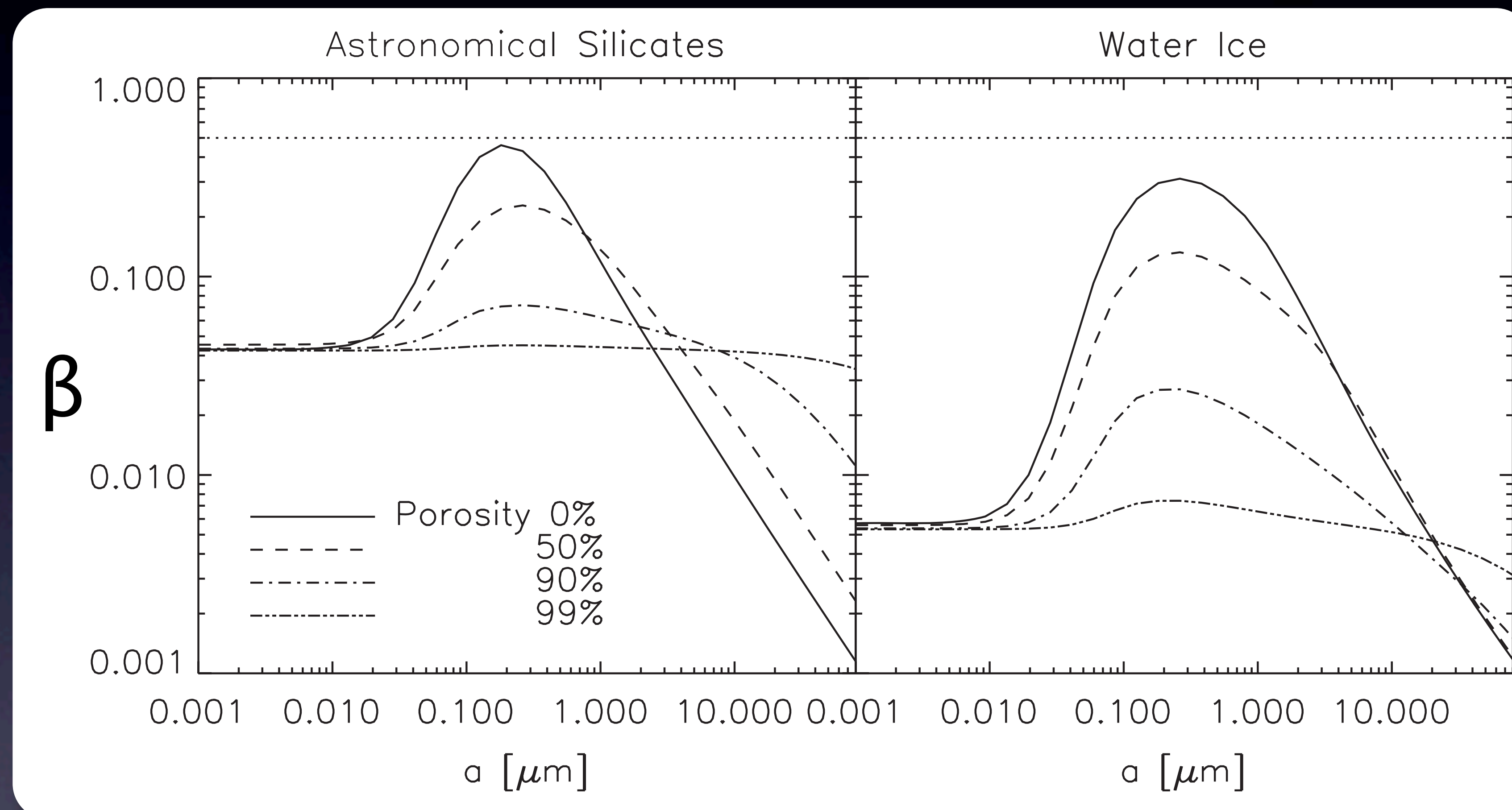
- Test hypothesis with direct detection planet search using next-generation instruments (e.g. GPI)





Maness et al. (2009)





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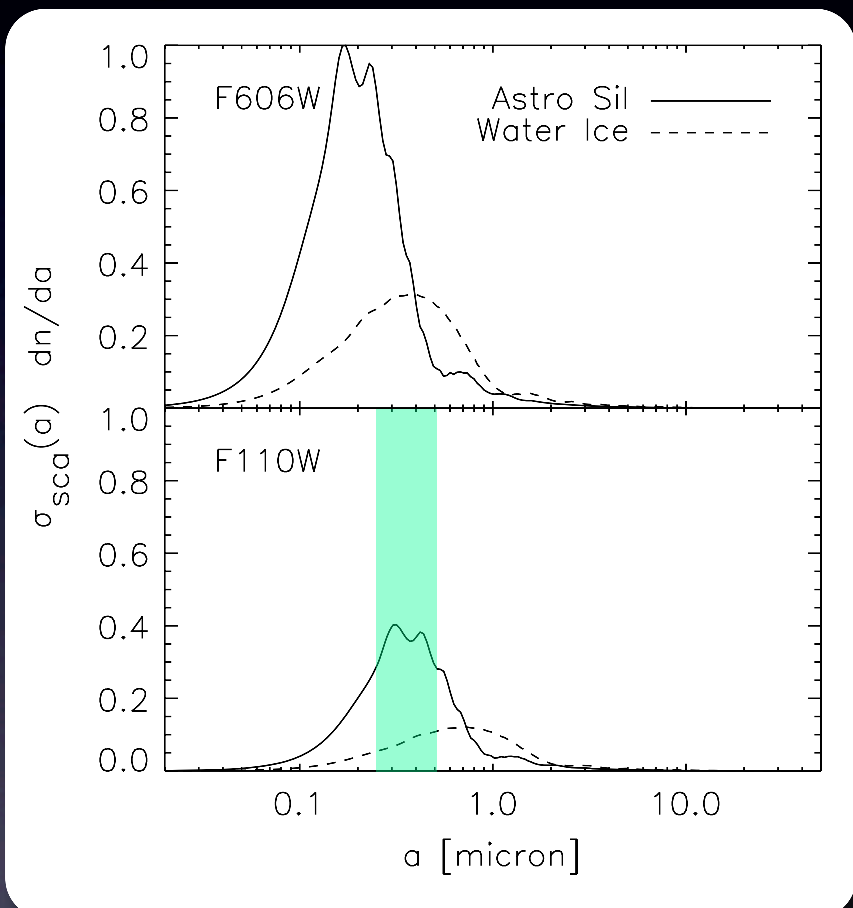

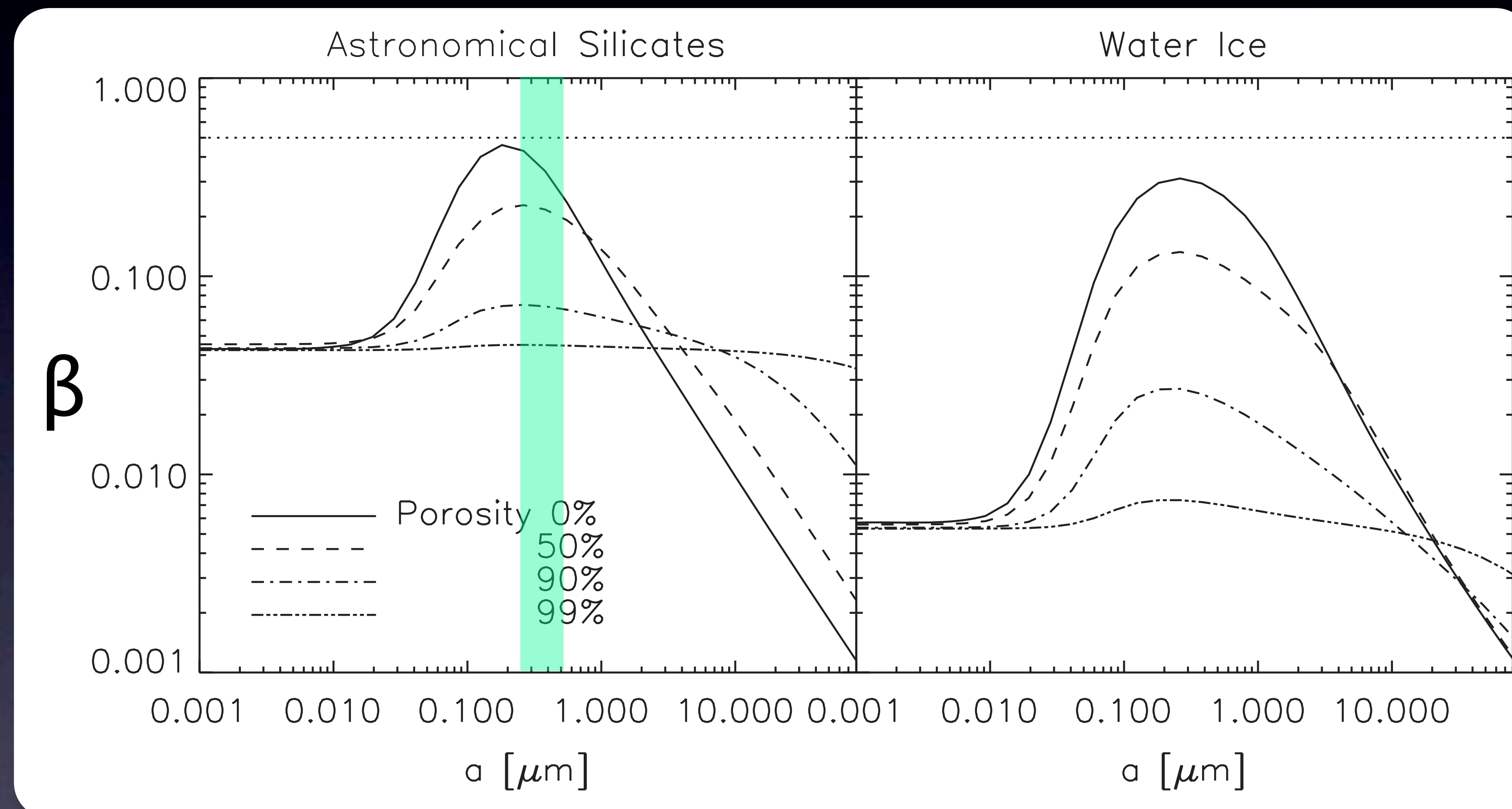

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