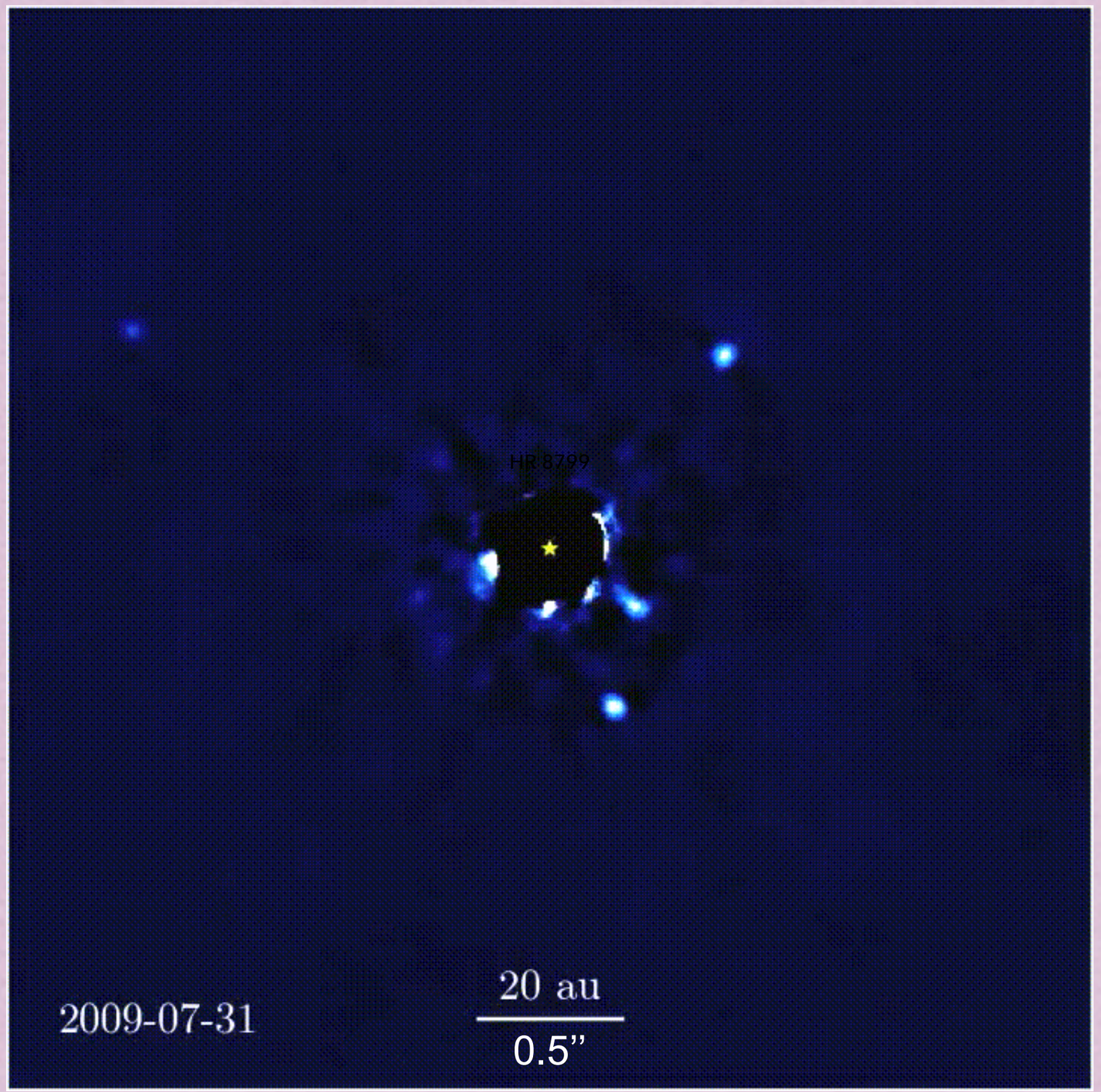
News and Reminders

Homework 1 is posted and is due Sep. 9.

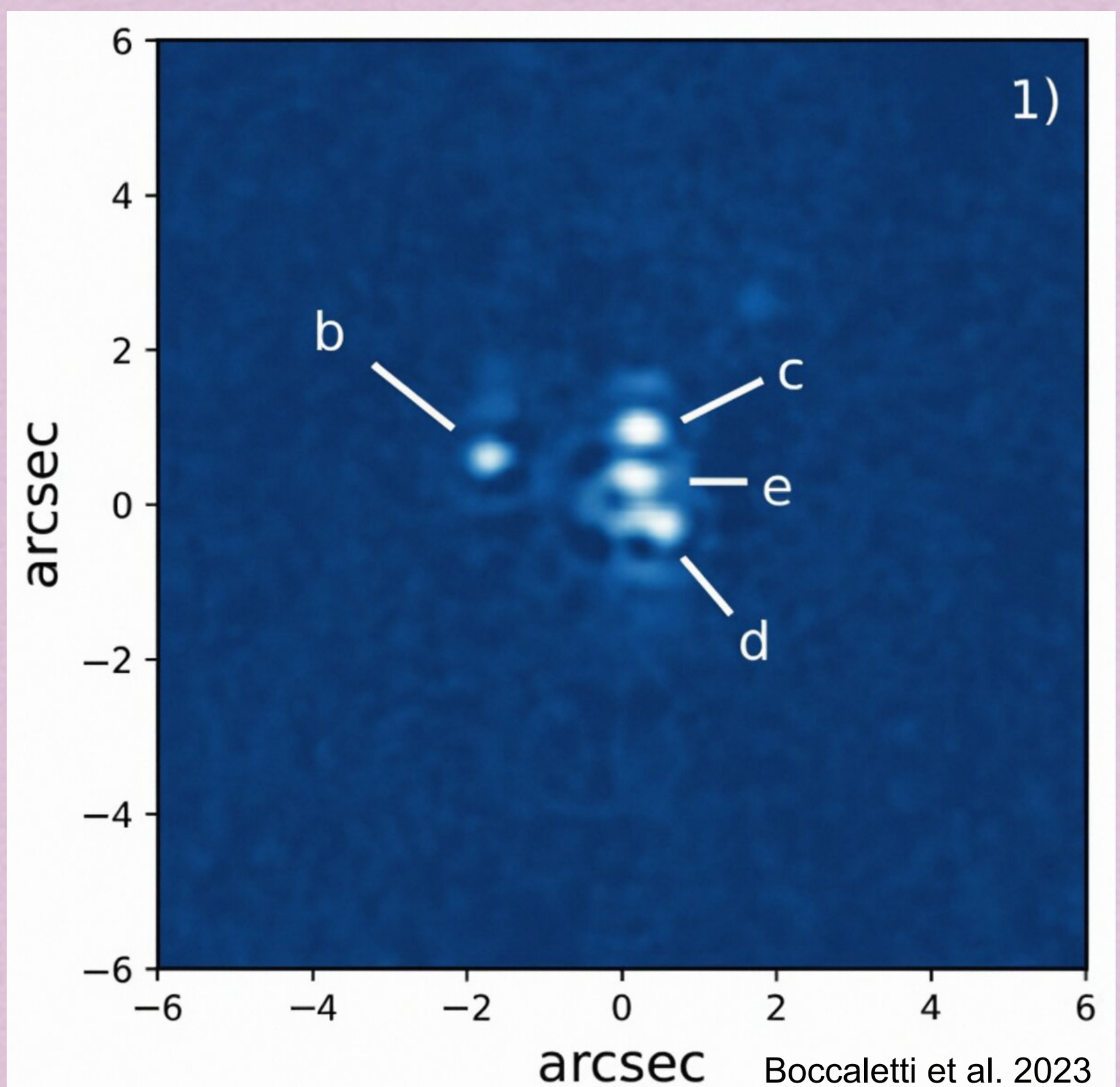
JC papers and dates so far - if you want to sign up for any of these, let me know **by Wednesday (9/4)**:

1) ***Sep. 16*** *- Evidence for Hidden Nearby Companions to Hot Jupiters*
2) ***Sep. 25*** *- Tilting Uranus via Spin-Orbit Resonance with Planet Nine*
3) ***Oct. 7*** *- Photochemically produced SO_2 in the atmosphere of WASP-39b*
4) ***Oct. 16*** *- Galileo Magnetometer Measurements: A Stronger Case for a Subsurface Ocean at Europa.*

Direct Imaging - HR 8799 (30 Myr)

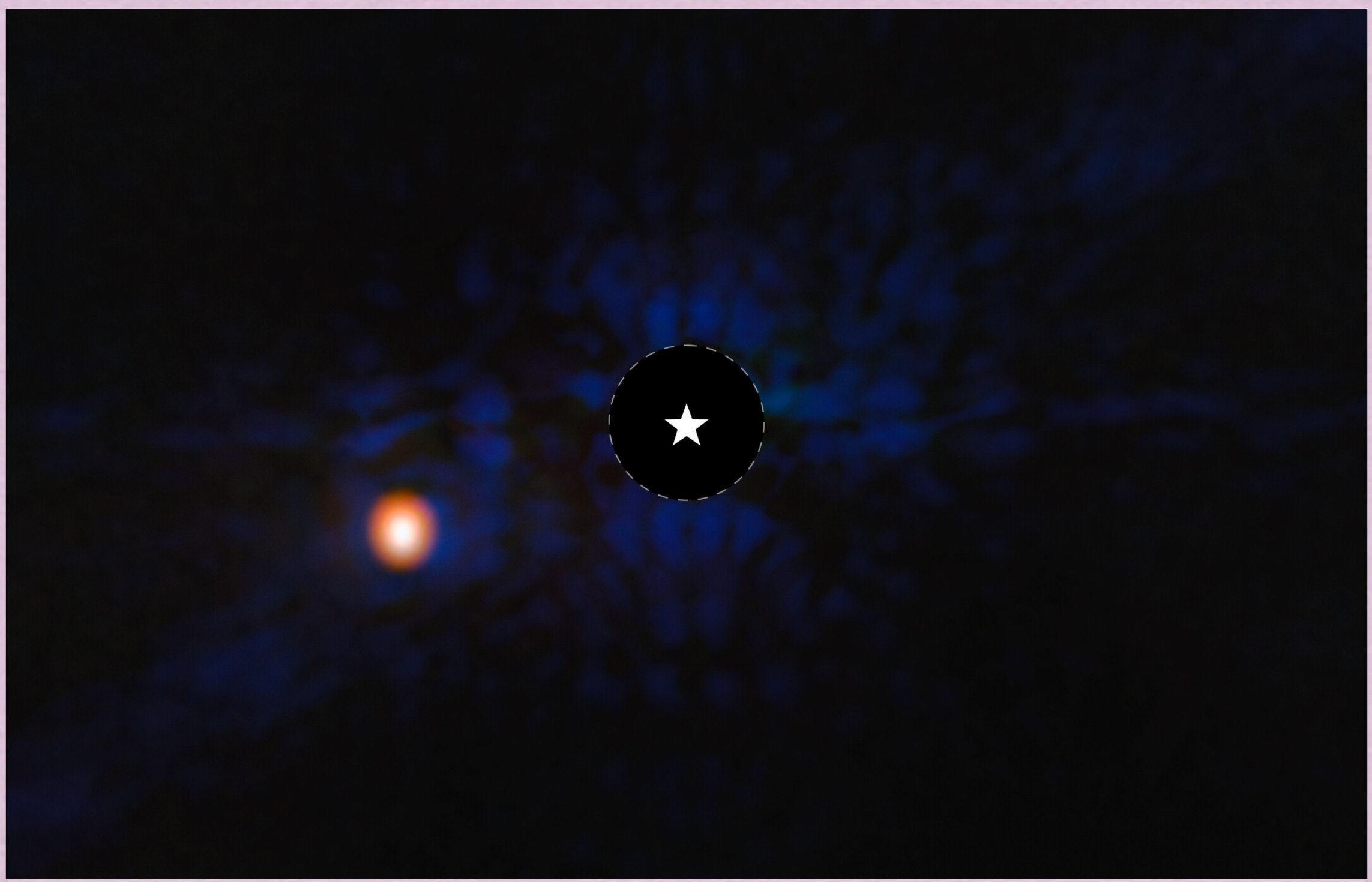


Direct Imaging - HR 8799 (30 Myr)



Boccaletti et al. 2023

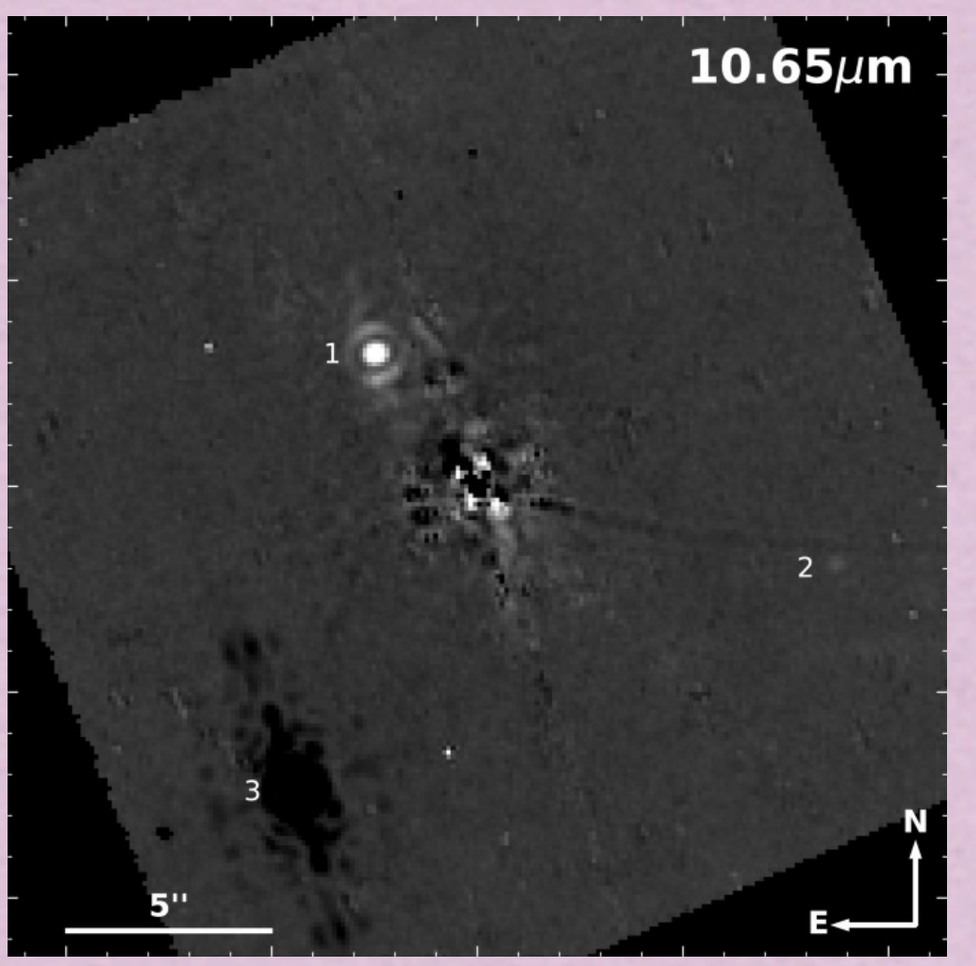
Direct Imaging - Eps Ind b (3.5 Gyr)



Matthews et al. 2024

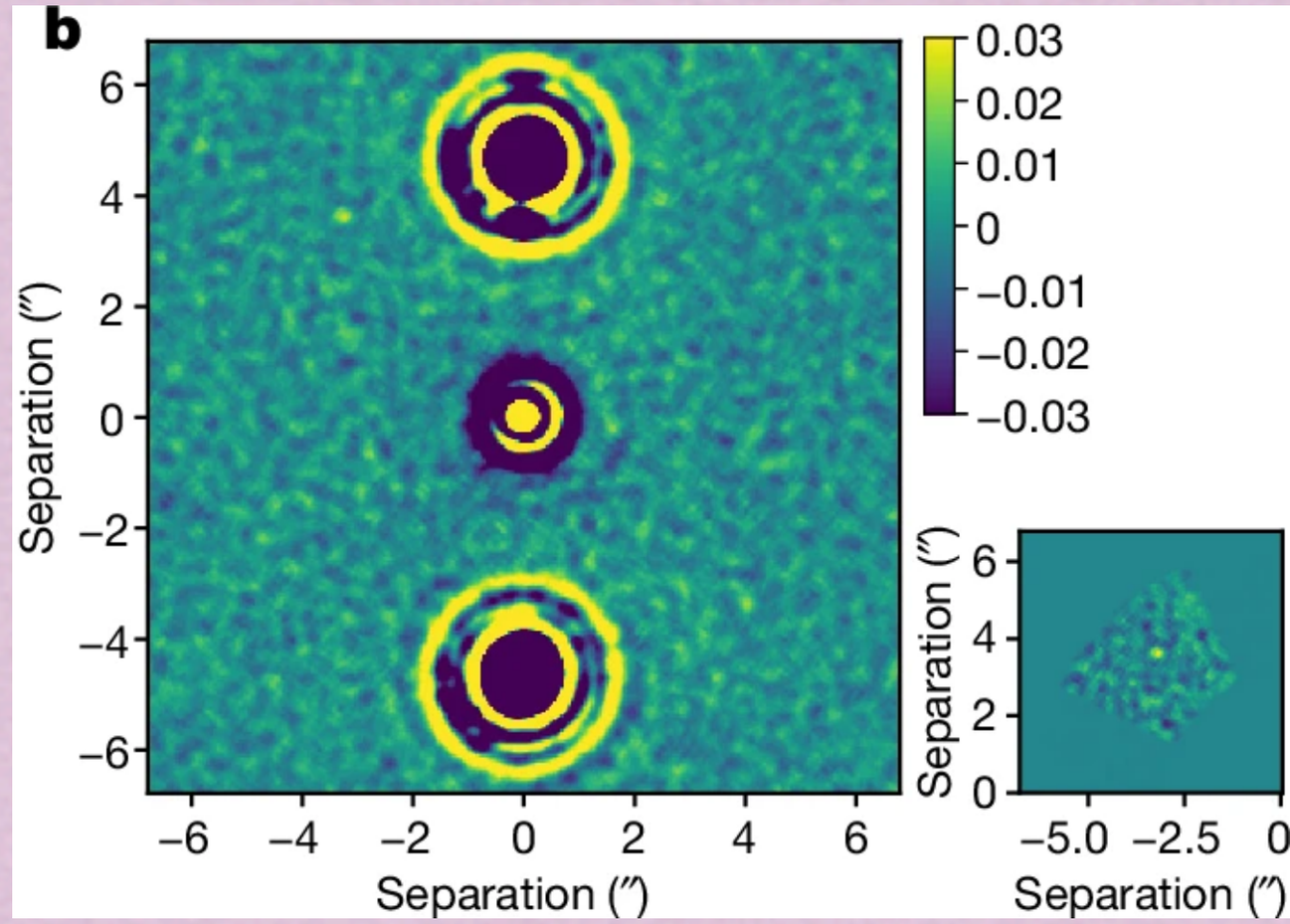
Direct Imaging - Eps Ind b (3.5 Gyr)

Matthews et al. 2024



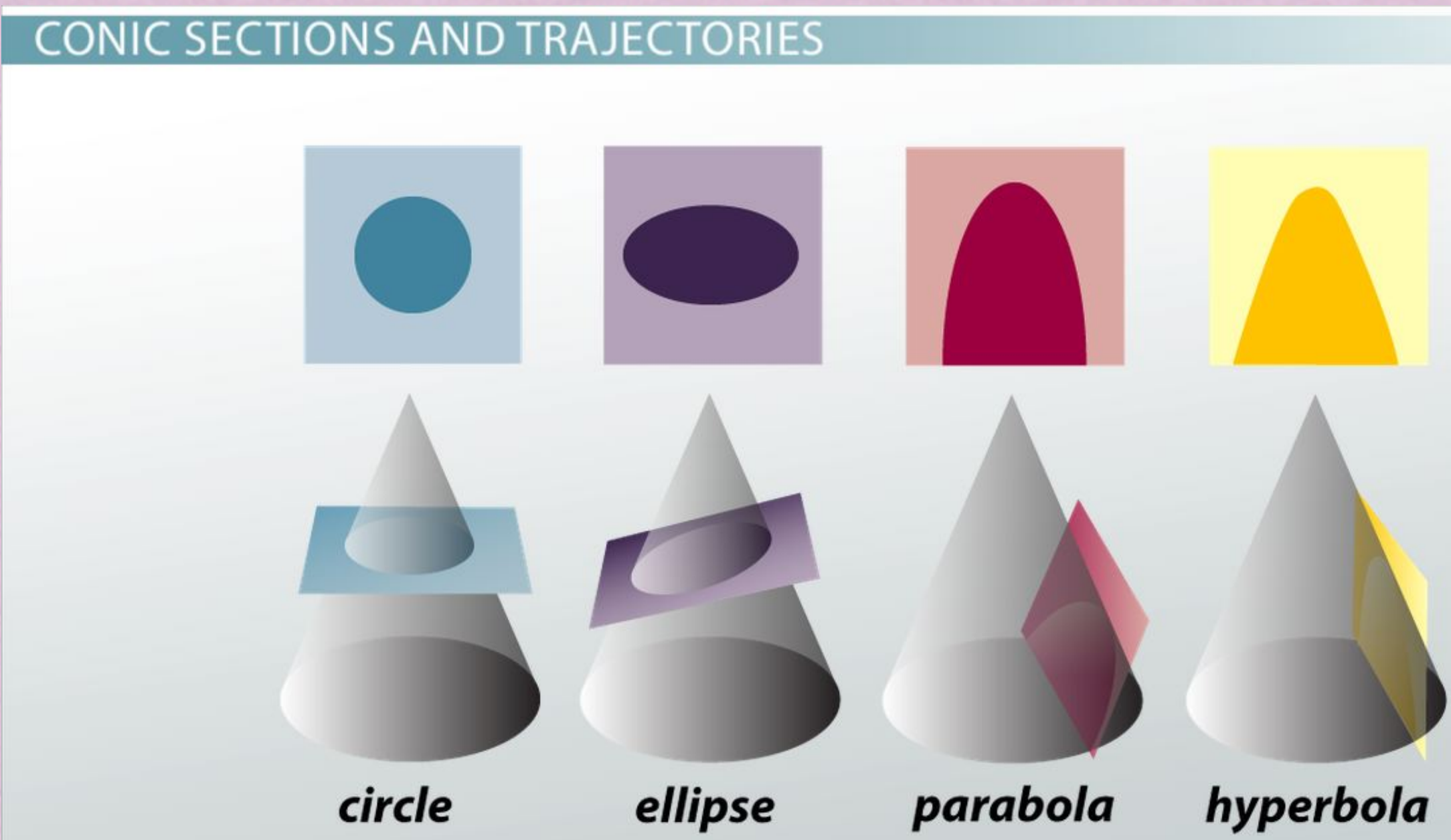
15 AU

JWST MIRI



VLT VISIR/NEAR

Bound and Unbound Orbits



Bound and unbound orbits:

conic sections slide

centripetal force: to keep object in circular orbit

$$\vec{F}_c = \mu n^2 \vec{r}$$

n = mean motion / average angular speed

$$= \mu \left(\frac{2\pi}{P}\right)^2 \vec{r}$$

$$= \mu \frac{4\pi^2 V_c^2}{4\pi^2 r^2} \vec{r} = \boxed{\frac{\mu V_c^2}{r} \hat{r}}$$

K.E. = P.E.

K.E. first, V_c first

$$\frac{\mu_r V_c^2}{r} \hat{r} = \frac{G m_1 m_2}{r^2} \hat{r}$$

$$\text{so } V_c = \sqrt{\frac{G}{r}(m_1+m_2)} = \sqrt{\frac{G\Pi}{r}}$$

$$P.E. = -\frac{G\Pi \mu_r}{r}$$

$$\text{so } E = \frac{1}{2}\mu_r V_c^2 - \frac{G\Pi \mu_r}{r}$$

$$= \frac{\mu_r}{r}\left(\frac{1}{2}G\Pi - G\Pi\right) = -\frac{1}{2}\frac{G\Pi \mu_r}{r}$$

for circ. orbits where r = a

$E > 0 \Rightarrow$ K.E. > P.E. $\Rightarrow$ unbound (hyperbola)
$E < 0 \Rightarrow$ K.E. < P.E. $\Rightarrow$ bound

$E = 0 \Rightarrow$ parabola – unstable