



Searching for other worlds

Elizabeth Tasker



Sun



Mercury



Venus



Earth



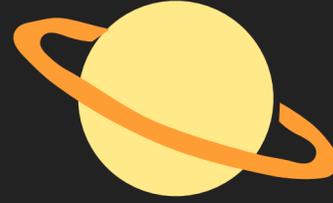
Mars



asteroid belt



Jupiter



Saturn



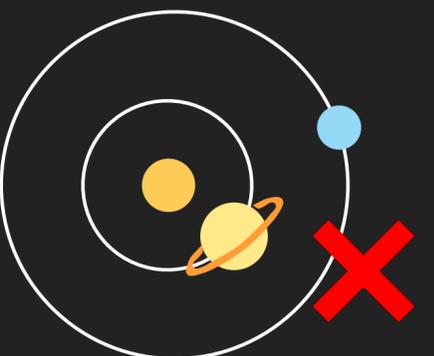
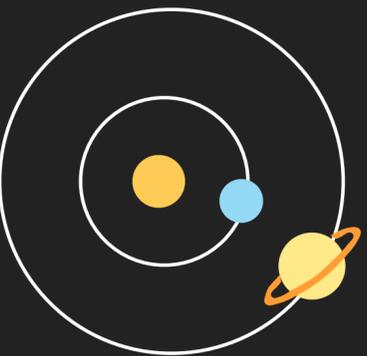
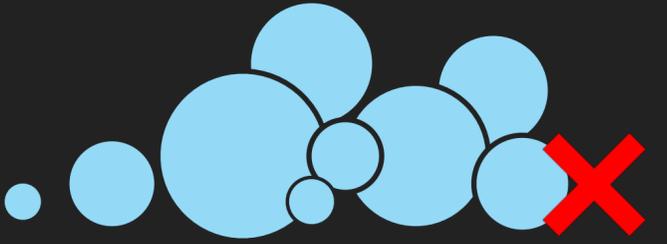
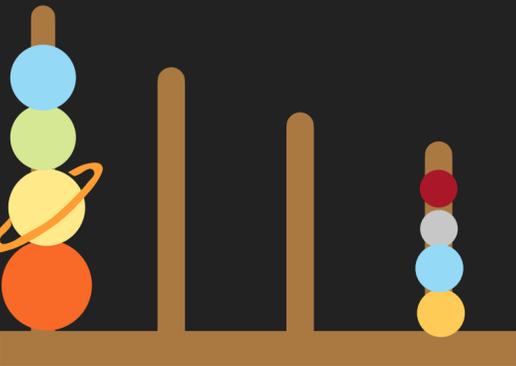
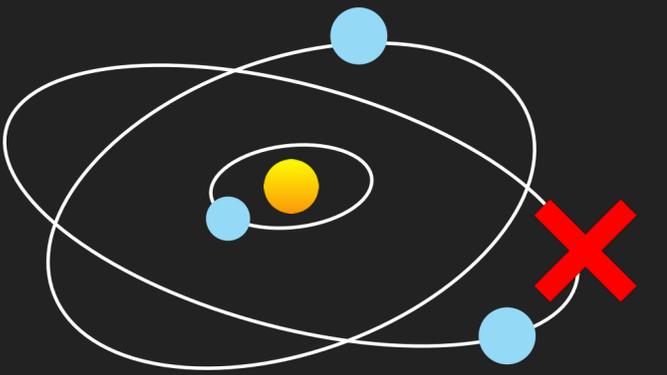
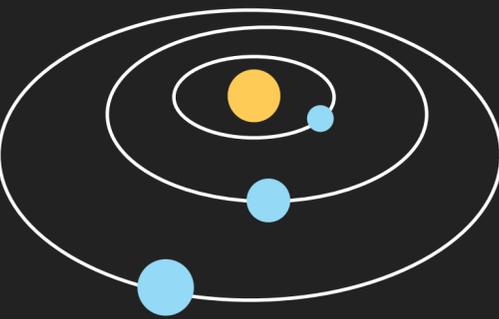
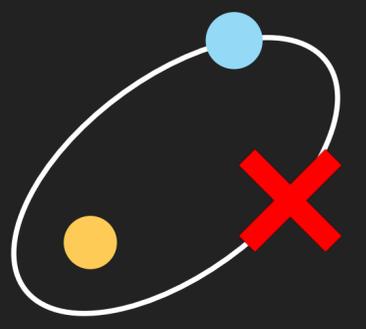
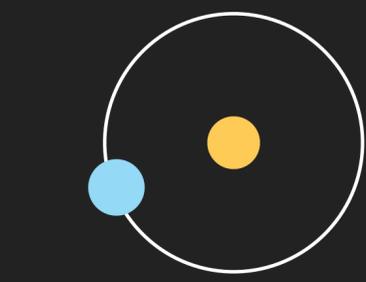
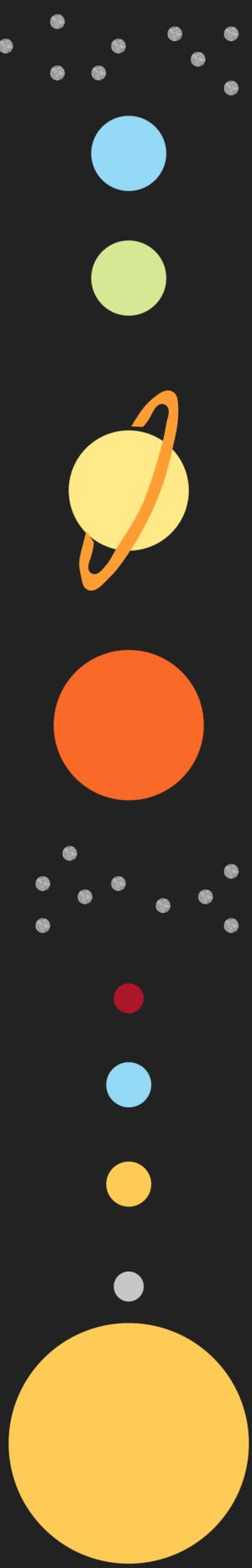
Uranus

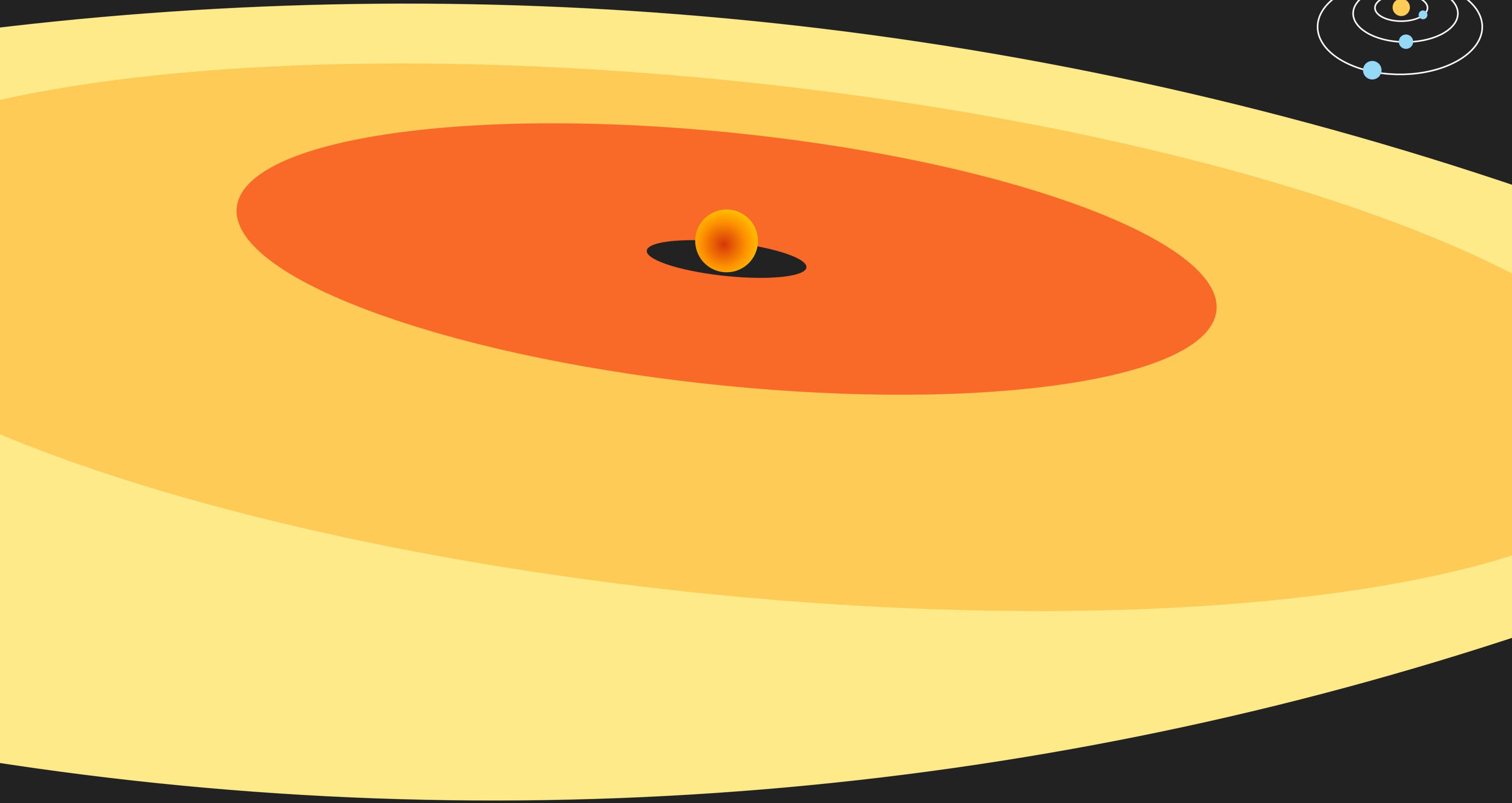
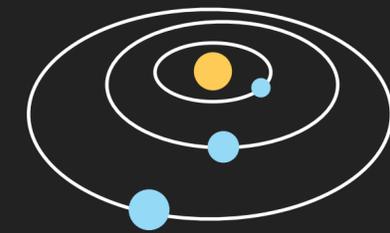


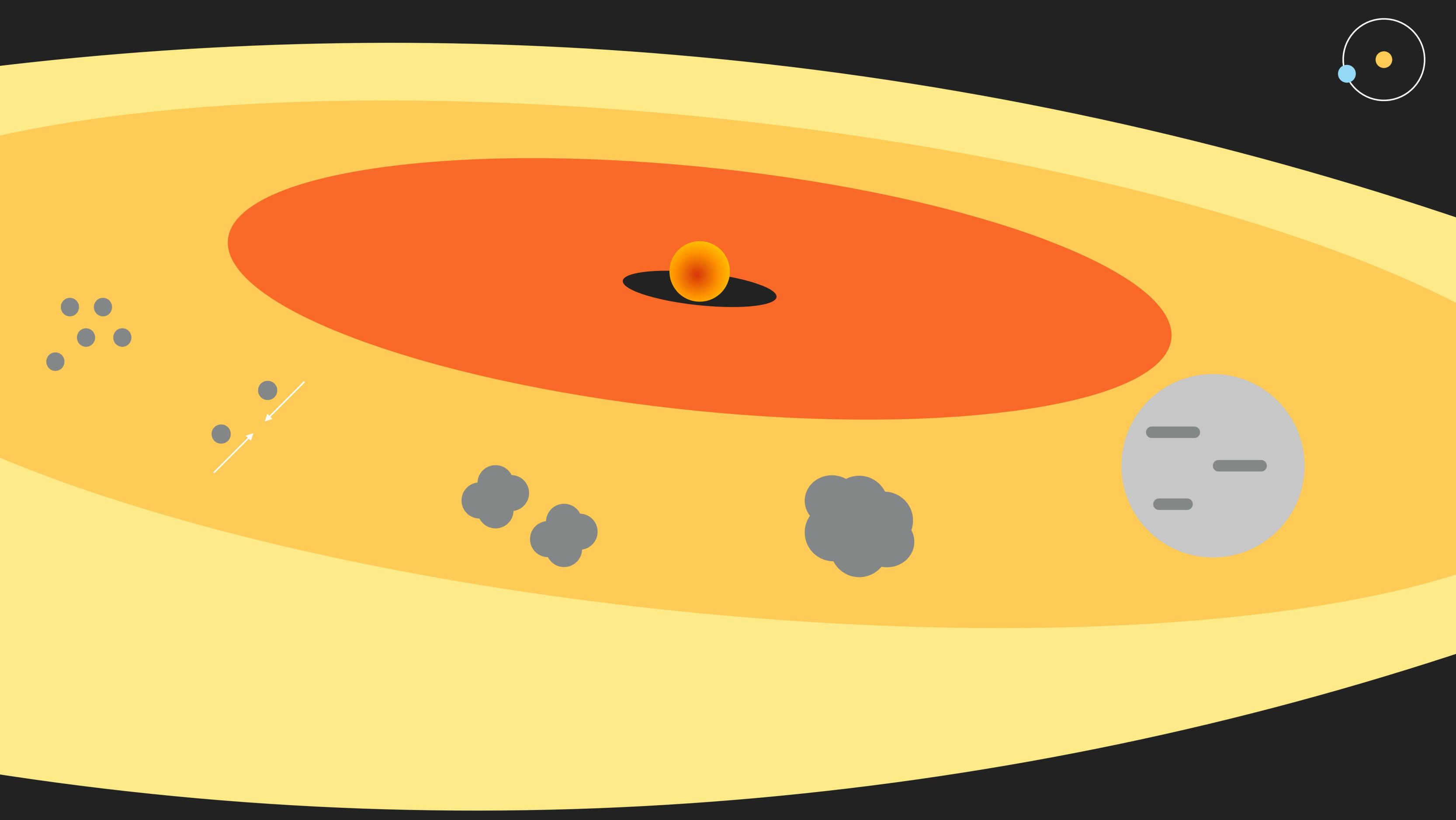
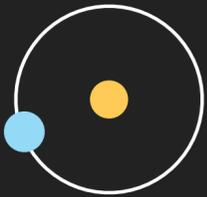
Neptune

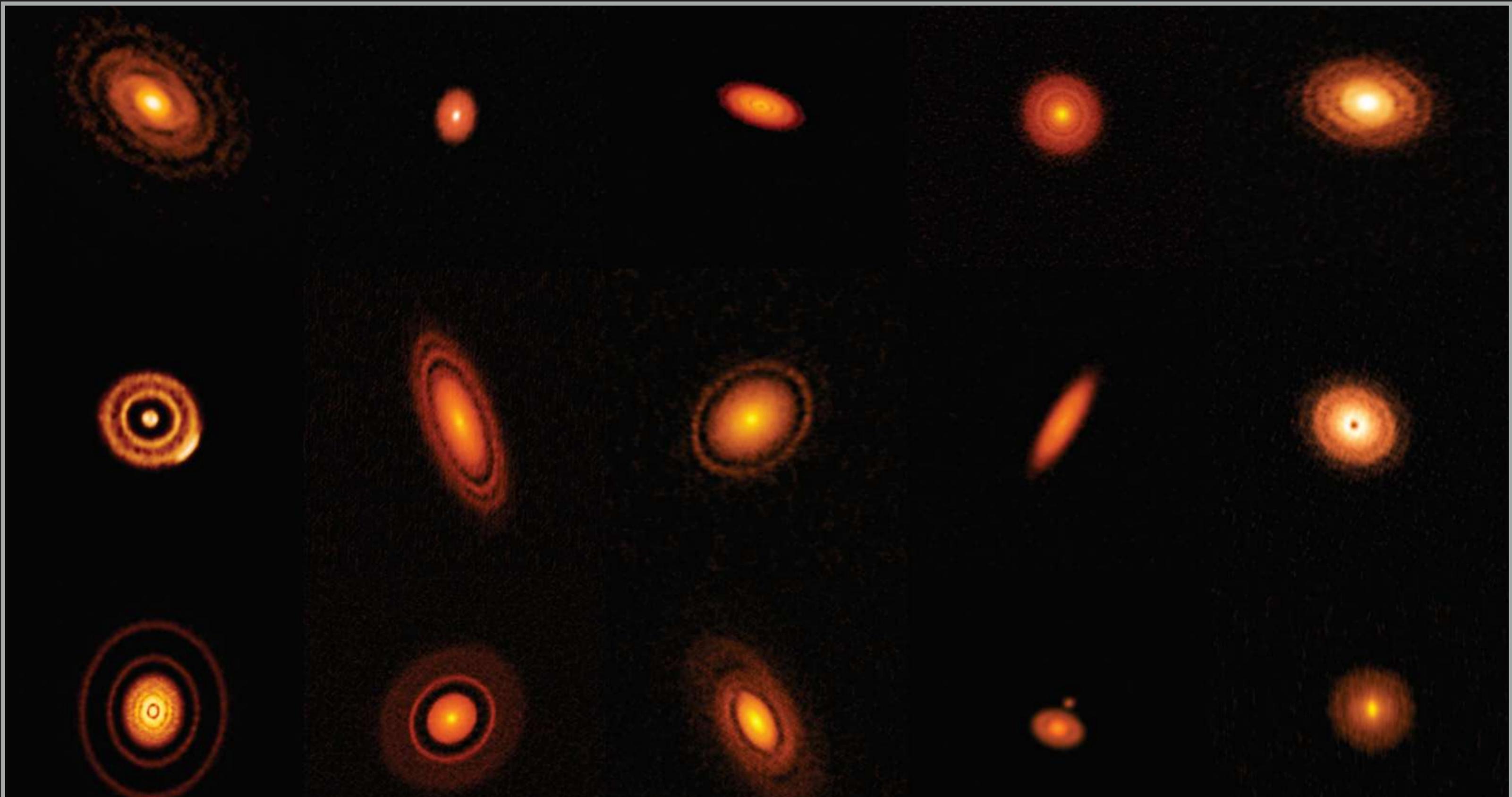


Kuiper belt

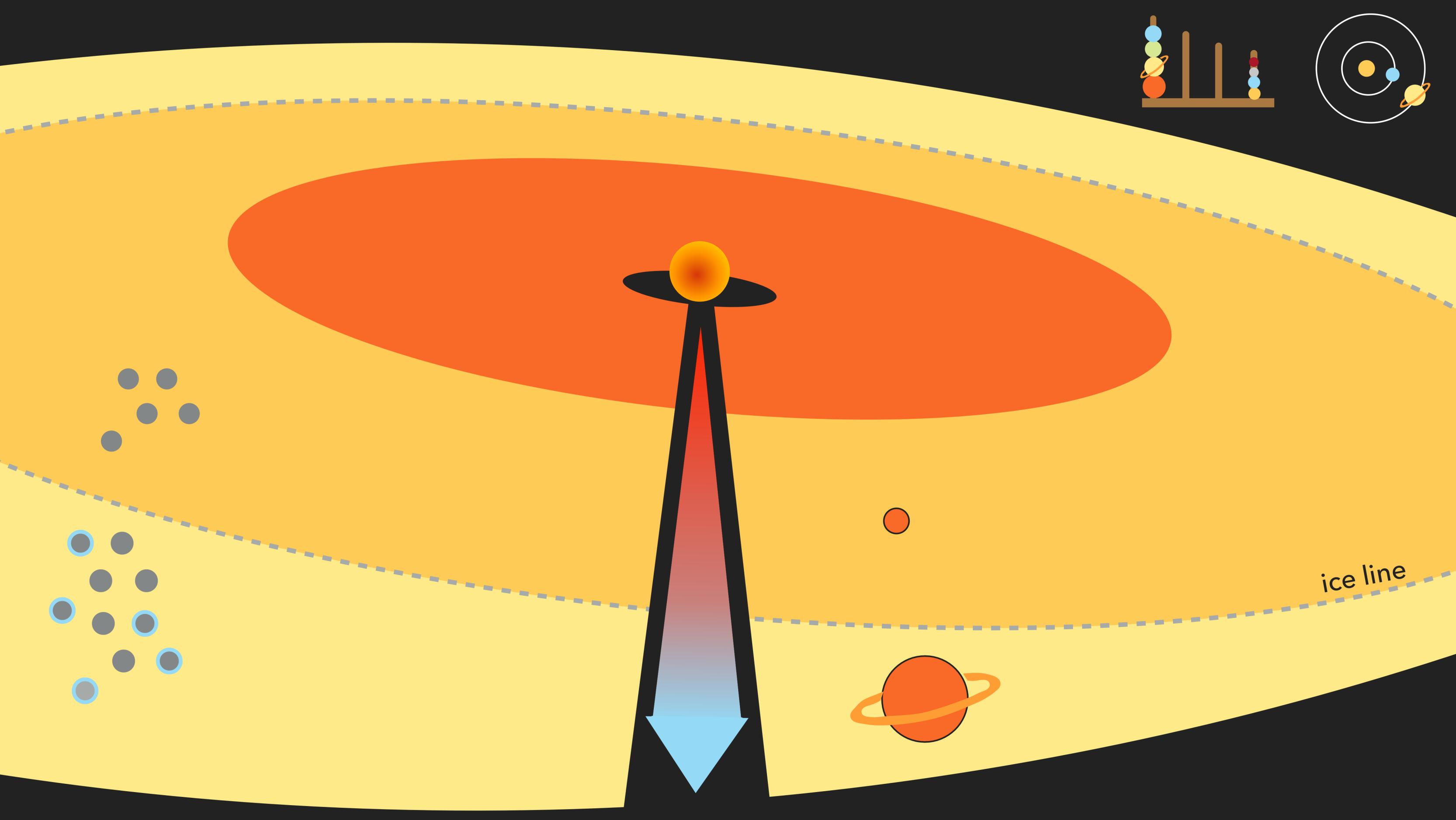






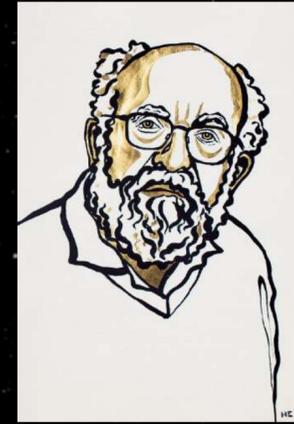


Planet forming discs with ALMA



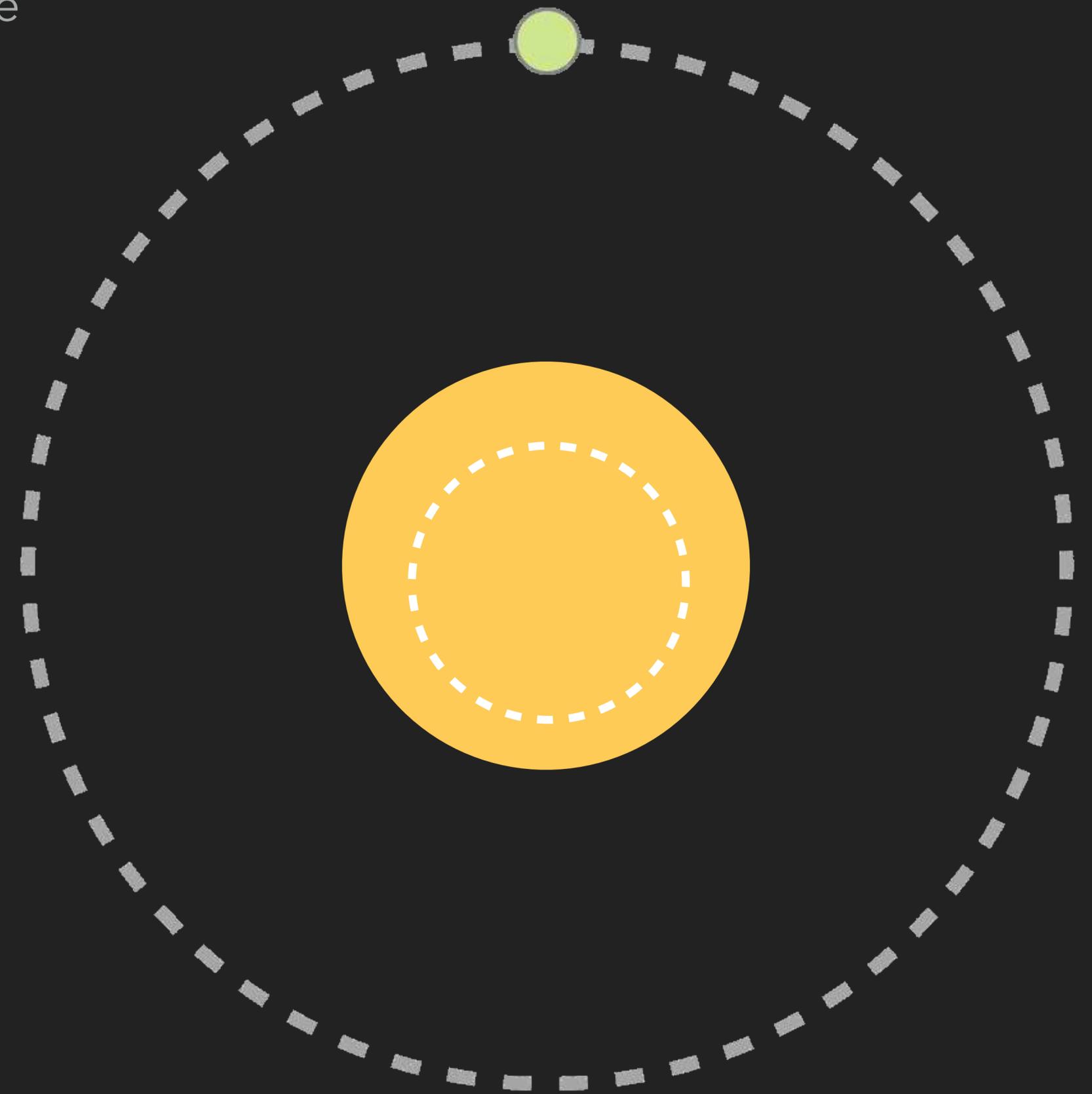
Nobel Prize in Physics 2019

Michel Mayor & Didier Queloz

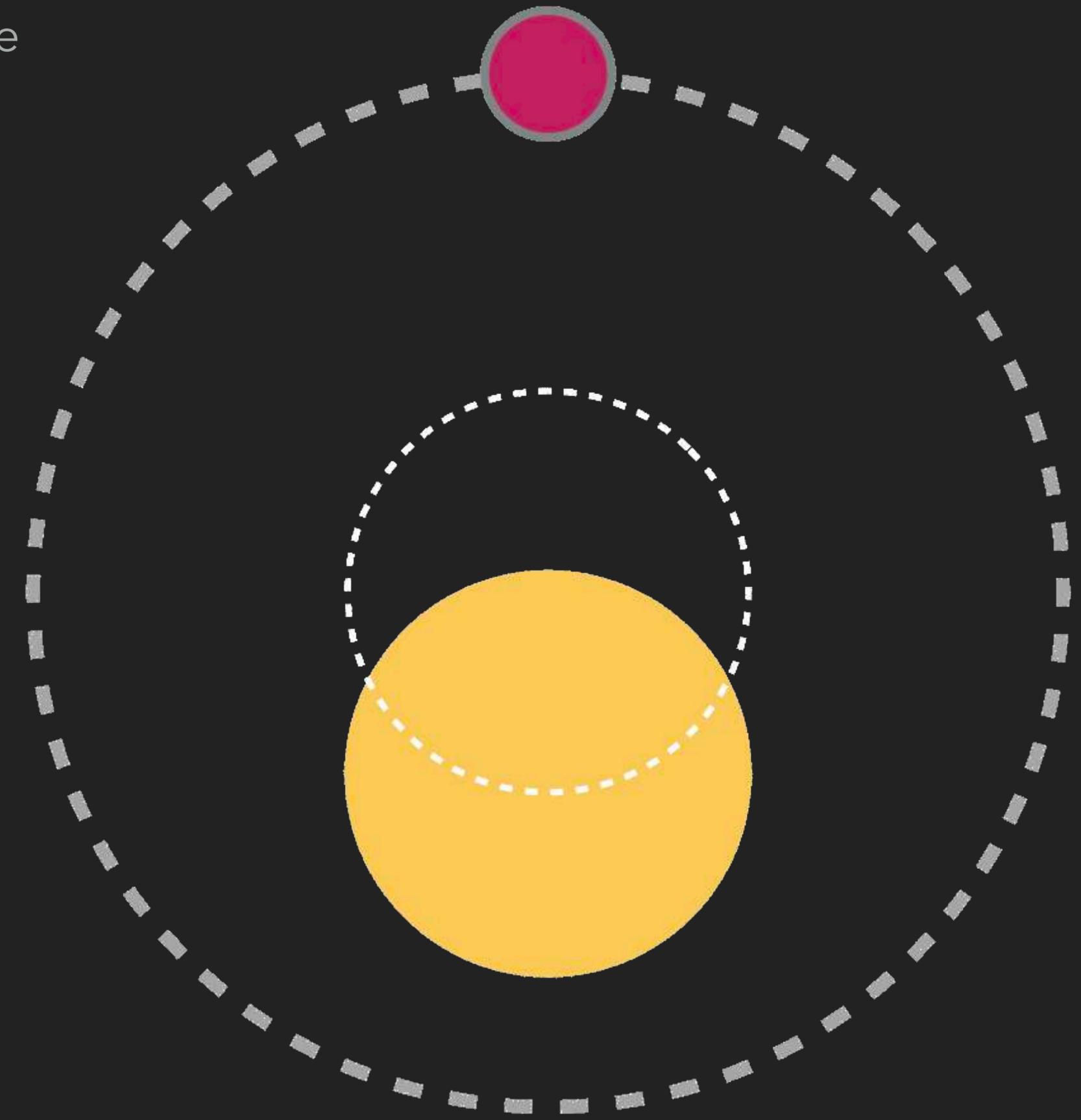


In 1995, the first exoplanet was discovered around a star like our Sun ... but it was weird.

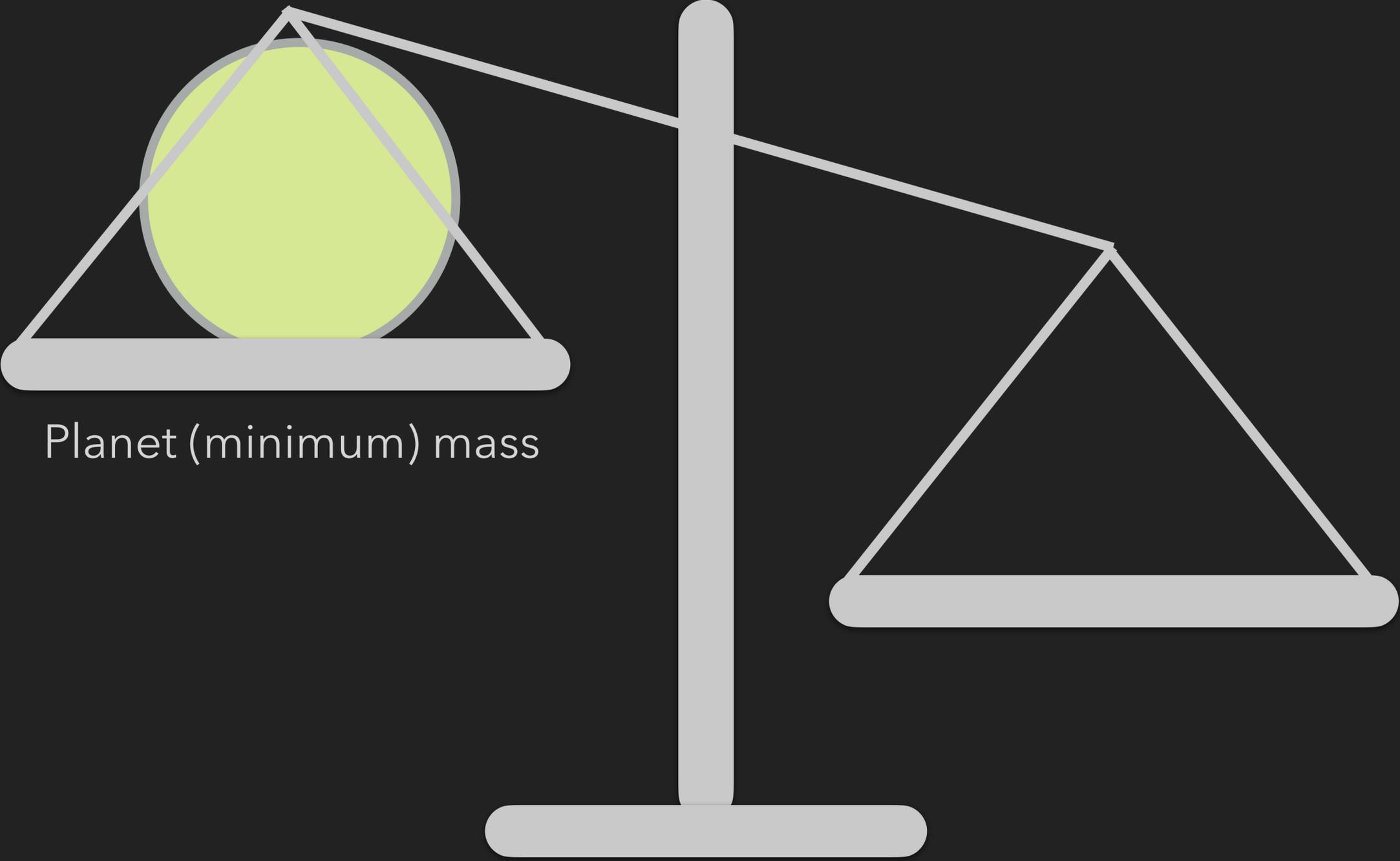
Radial velocity technique



Radial velocity technique

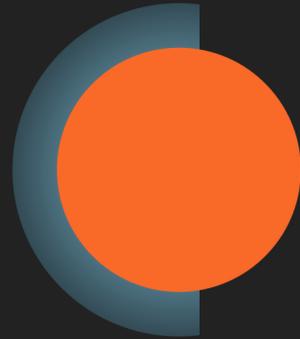
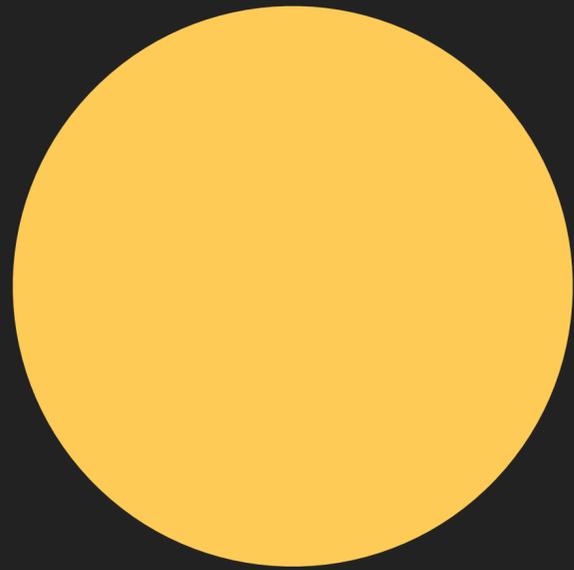


Radial velocity technique



Planet (minimum) mass

5% Earth - Sun



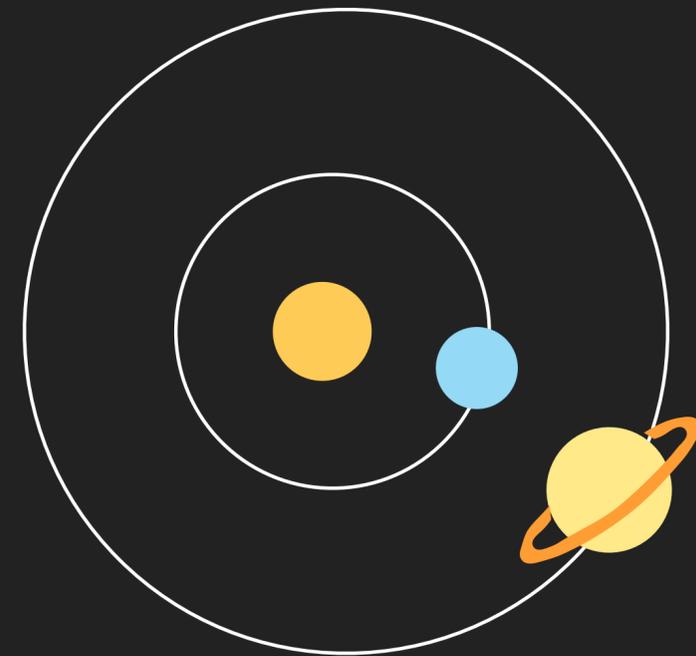
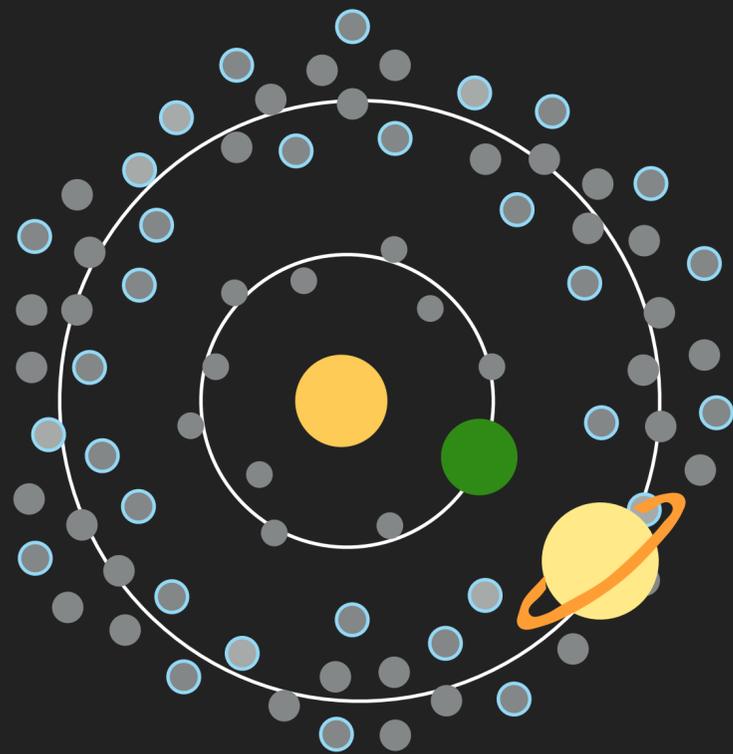
51 Pegasi b

~ Jupiter mass

Orbit 4 days

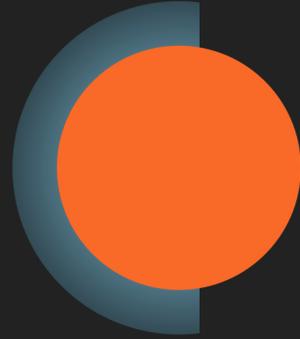
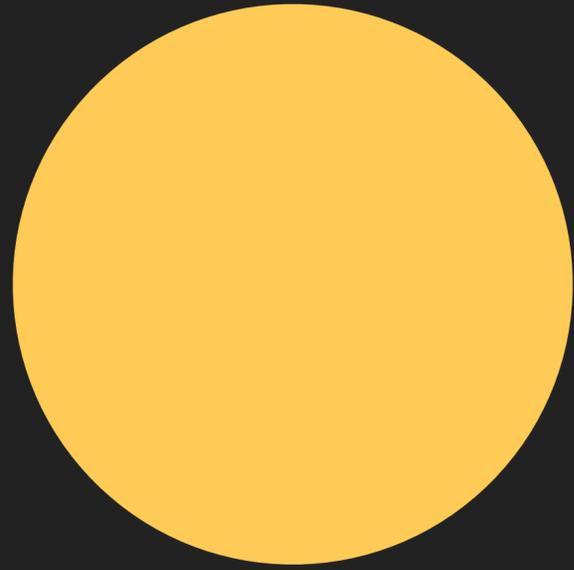


40% Earth - Sun



Solar System

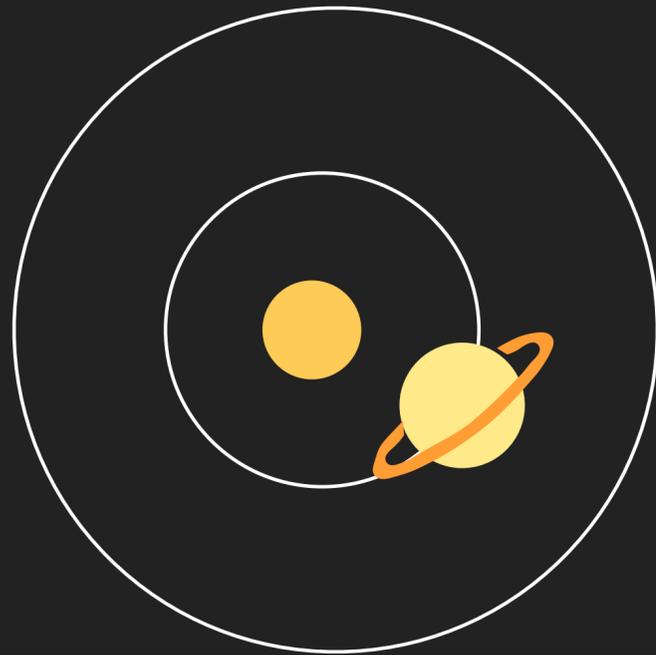
5% Earth - Sun



51 Pegasi b ~ Jupiter mass
Orbit 4 days



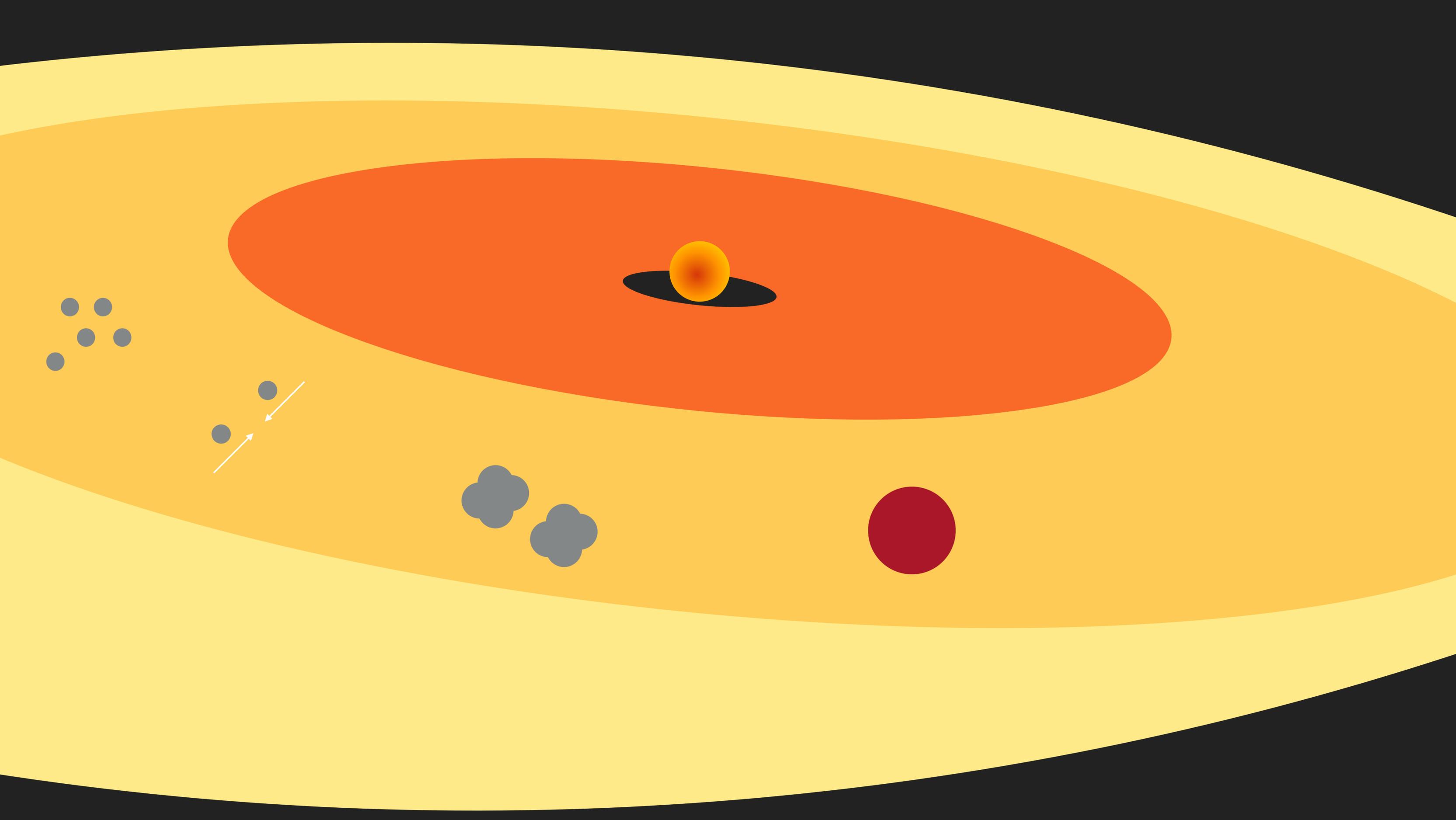
40% Earth - Sun

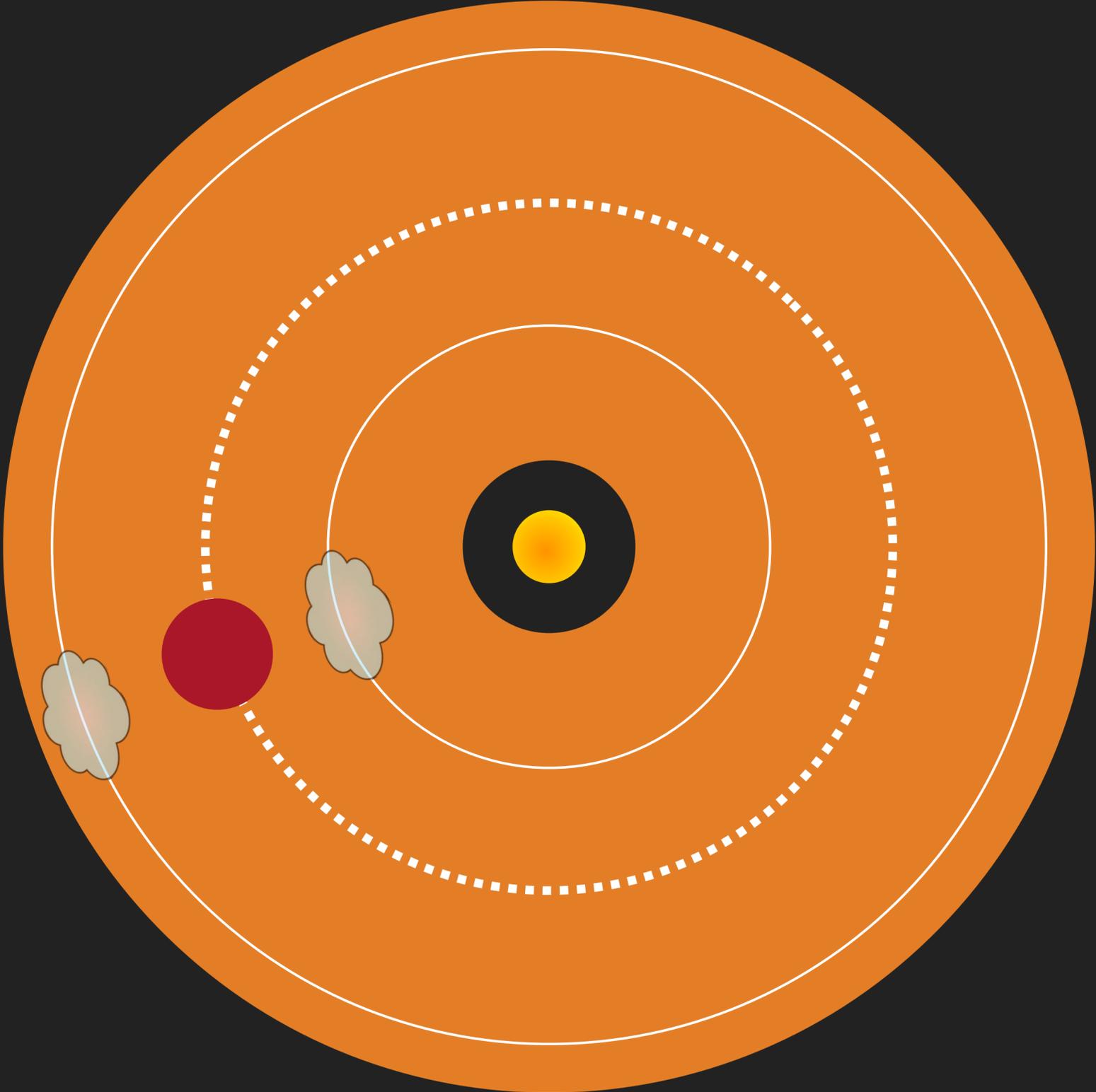


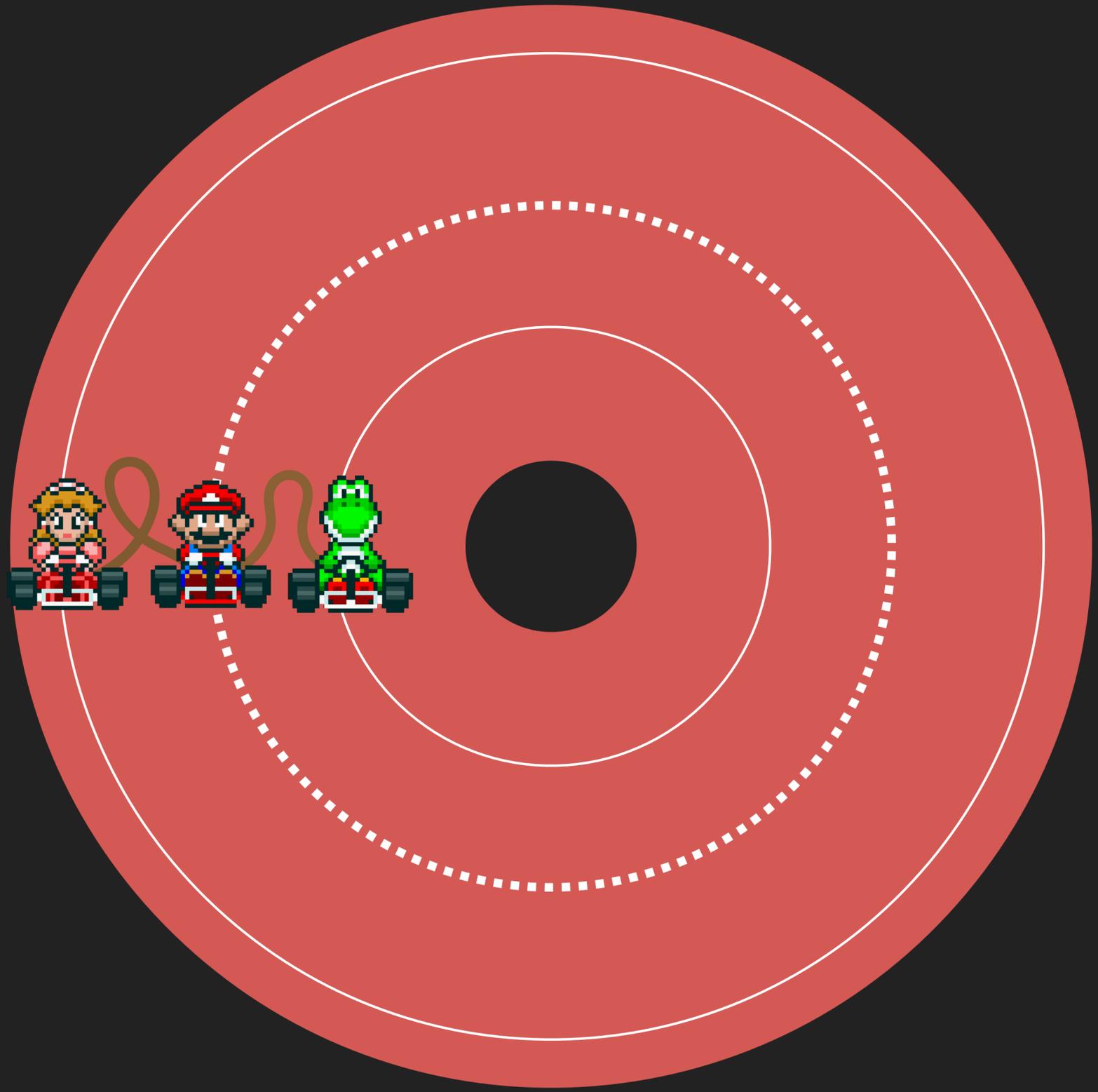
51 Peg System

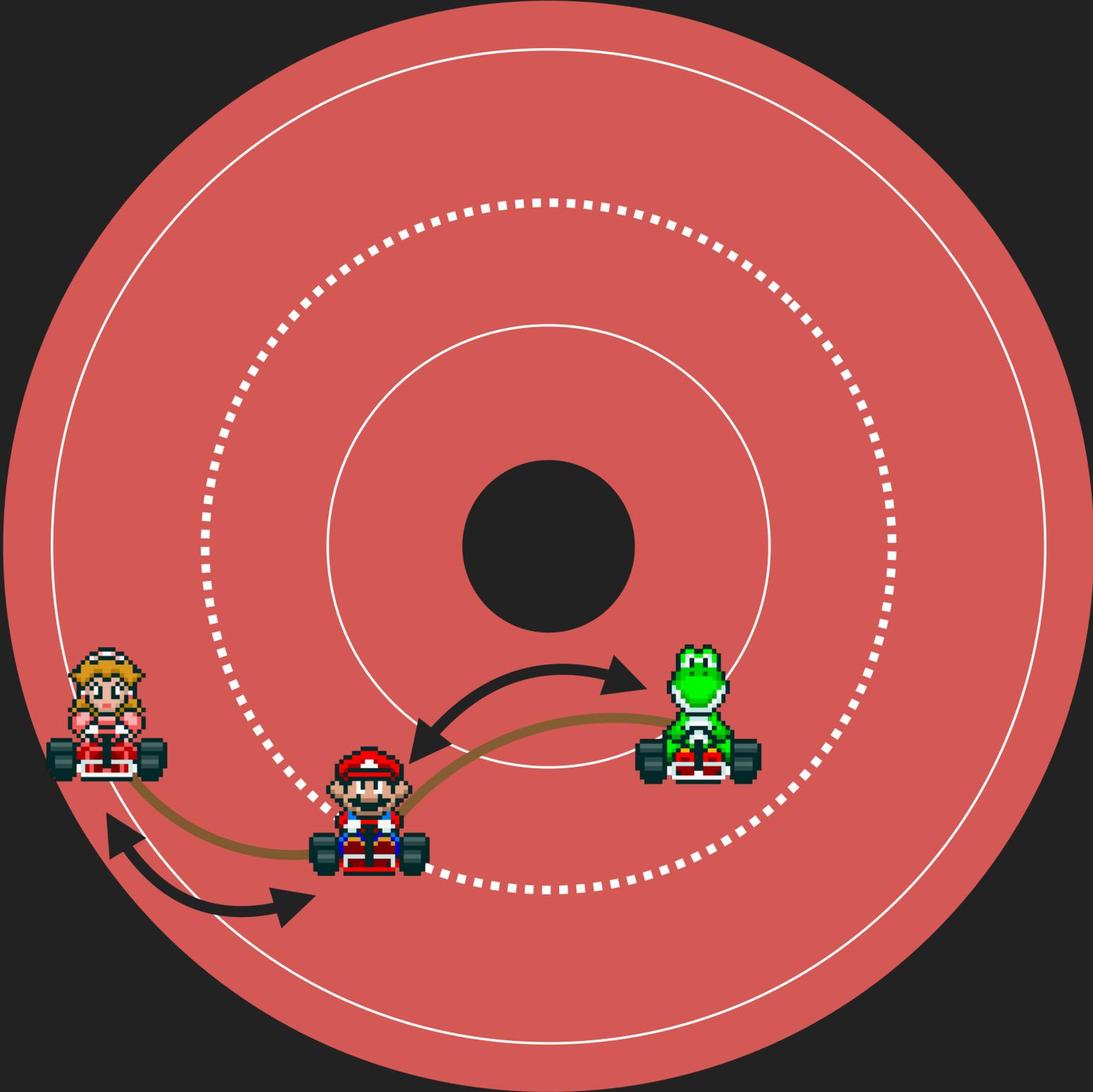
New class of planet:

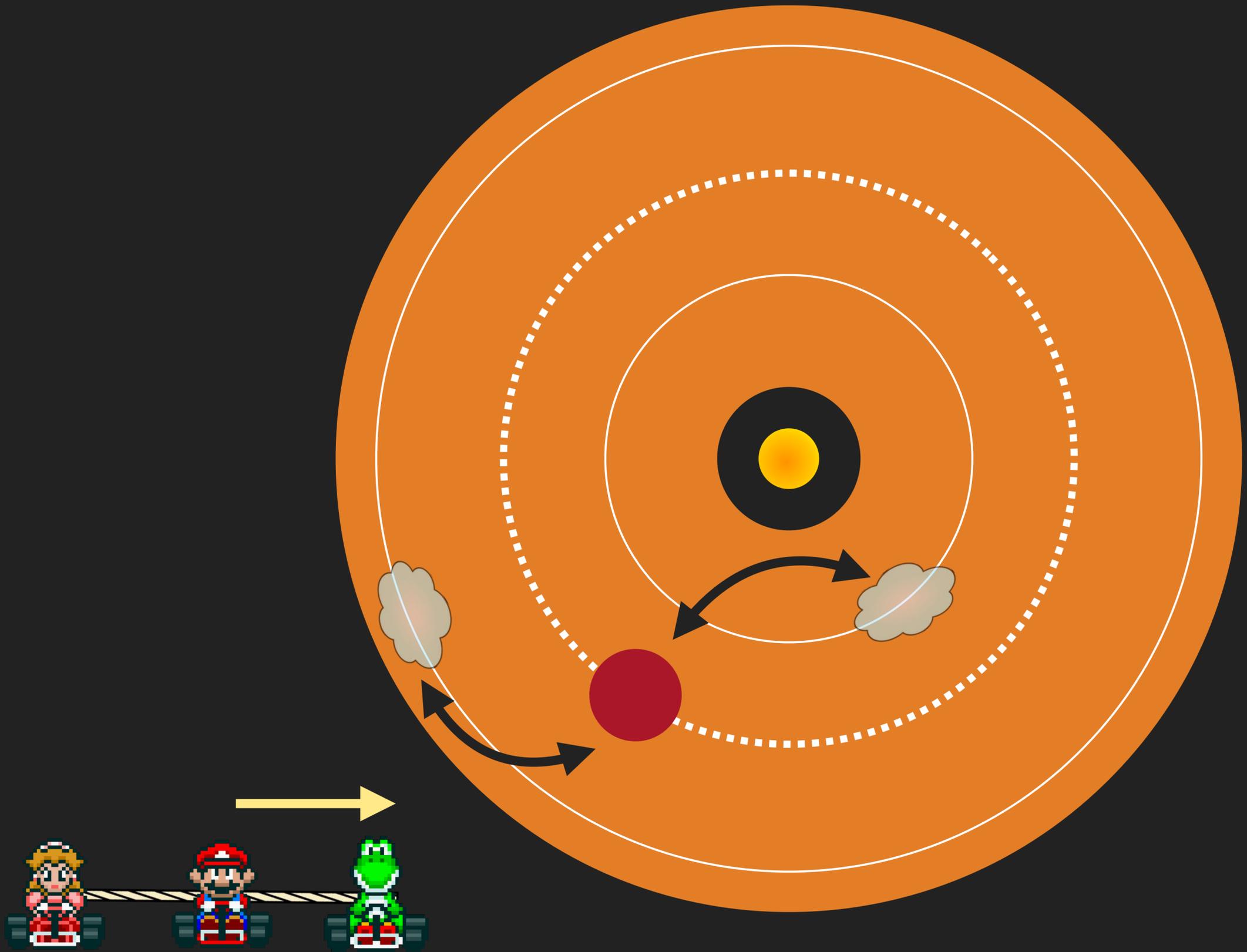
"Hot Jupiter"

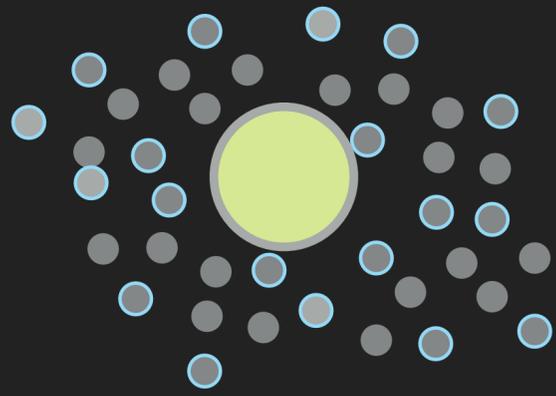






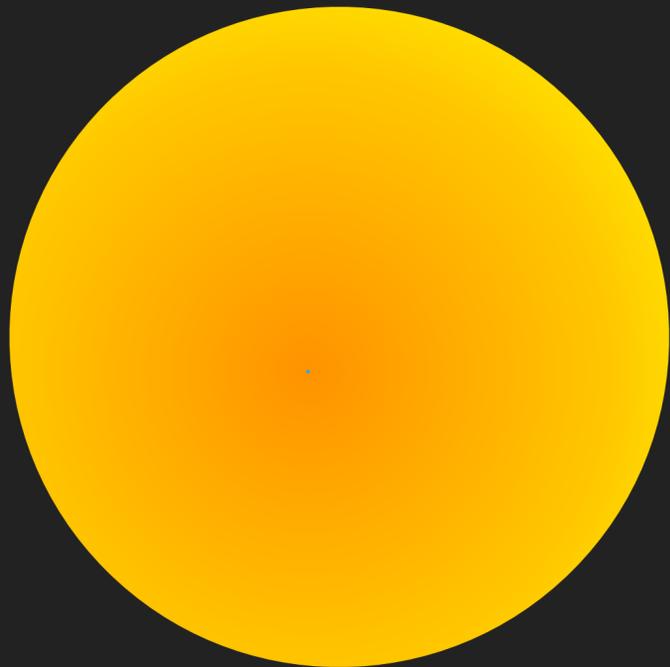
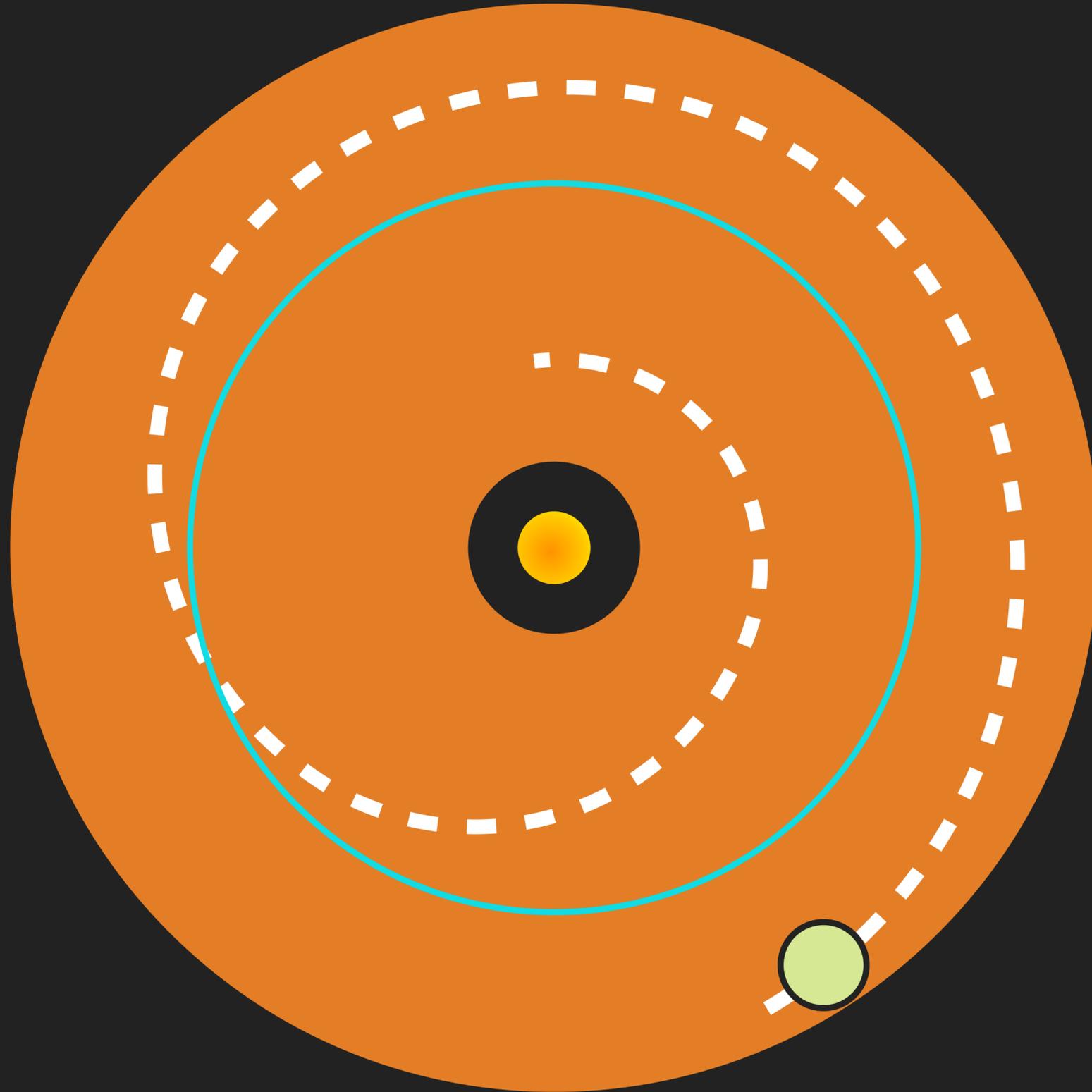






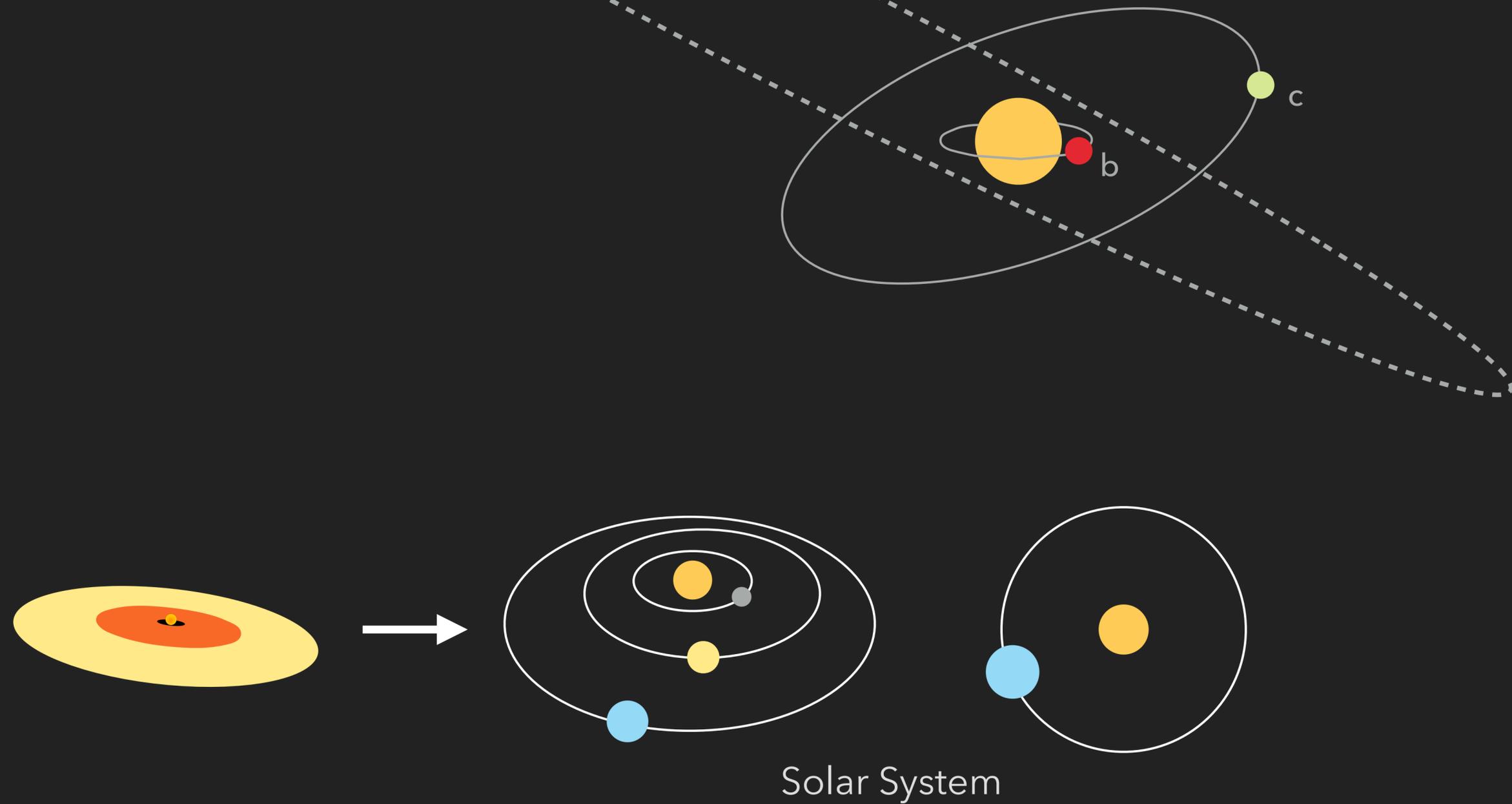
Planet can form
beyond the ice
line.

Migrate inwards
to become a
hot Jupiter.



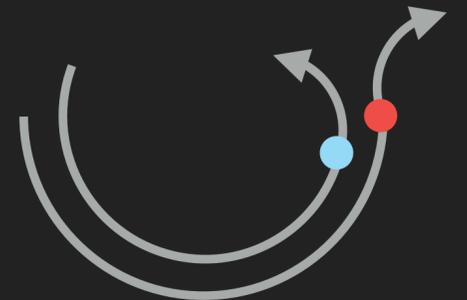
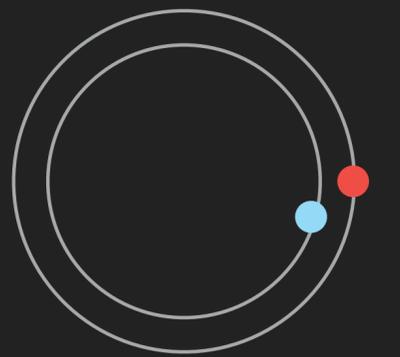
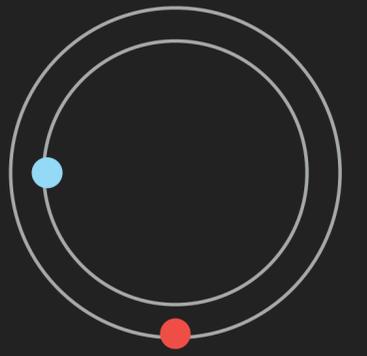
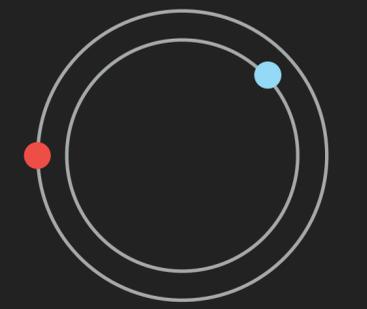
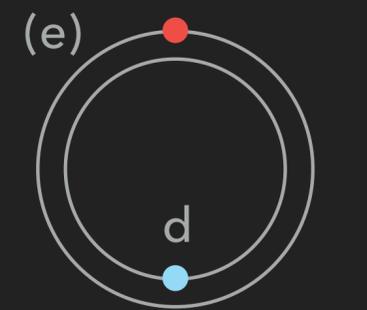
First multi-planet system discovered:

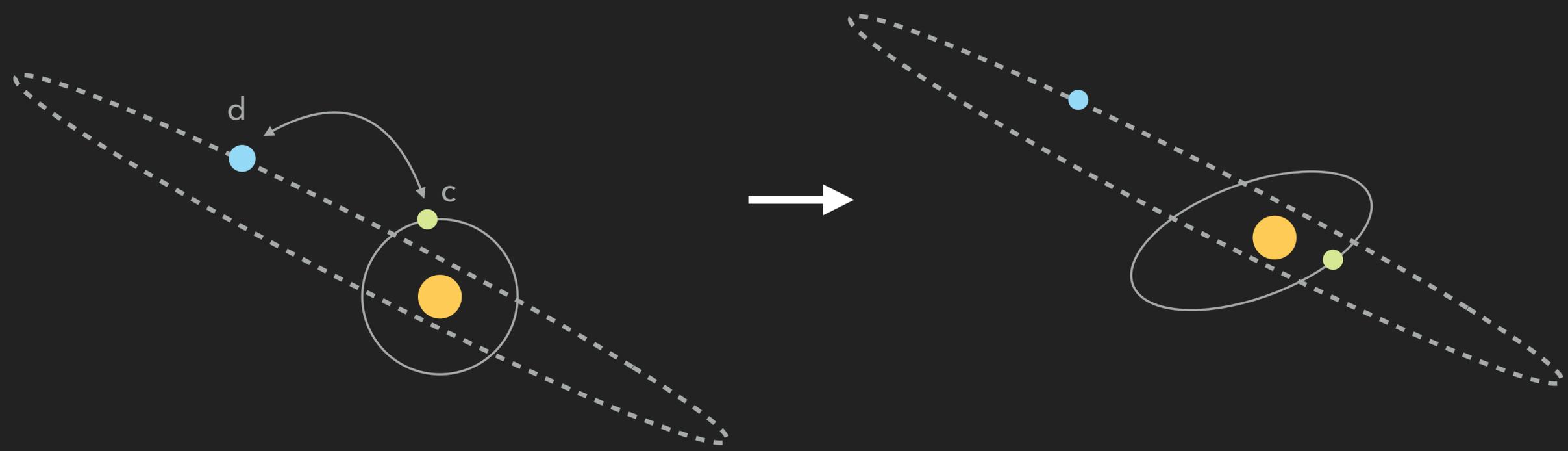
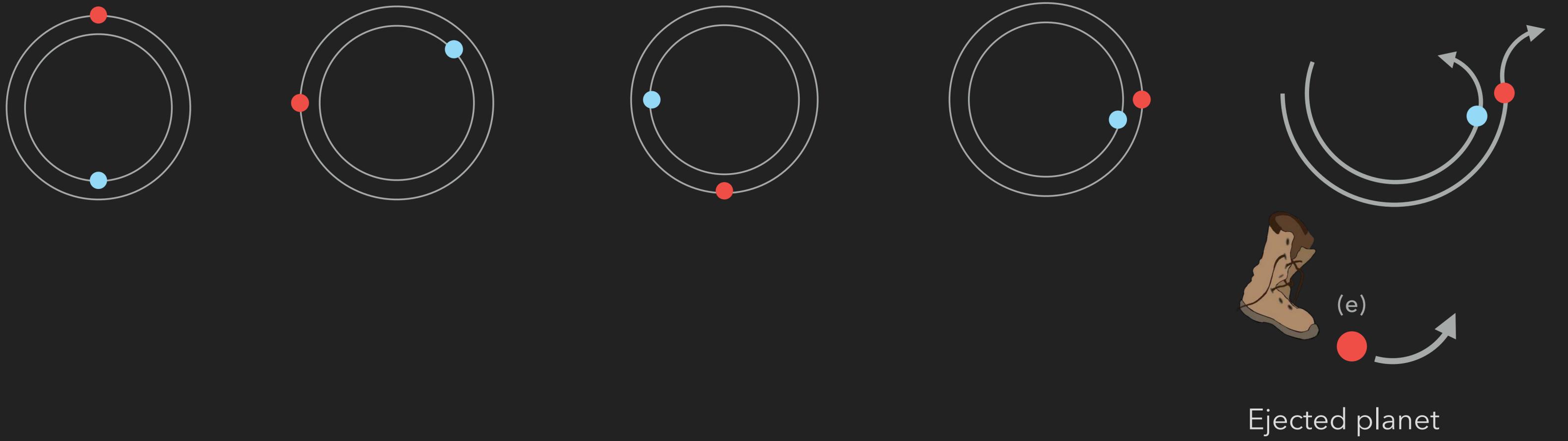
Upsilon Andromedae A

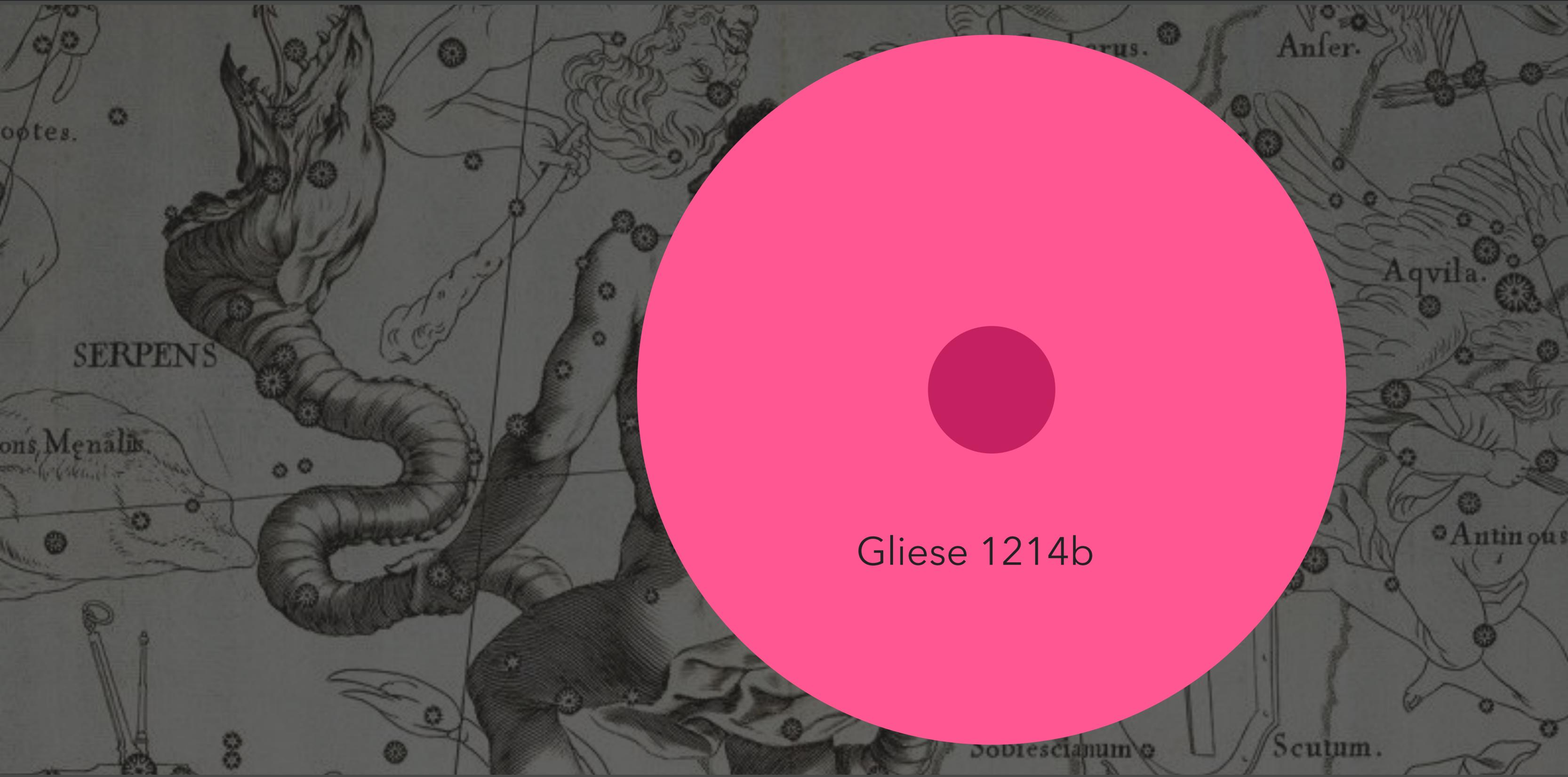


A Simulation of Planet-Planet Scattering in the Upsilon Andromedae Planetary System

Diameters of planets have been greatly exaggerated for visibility

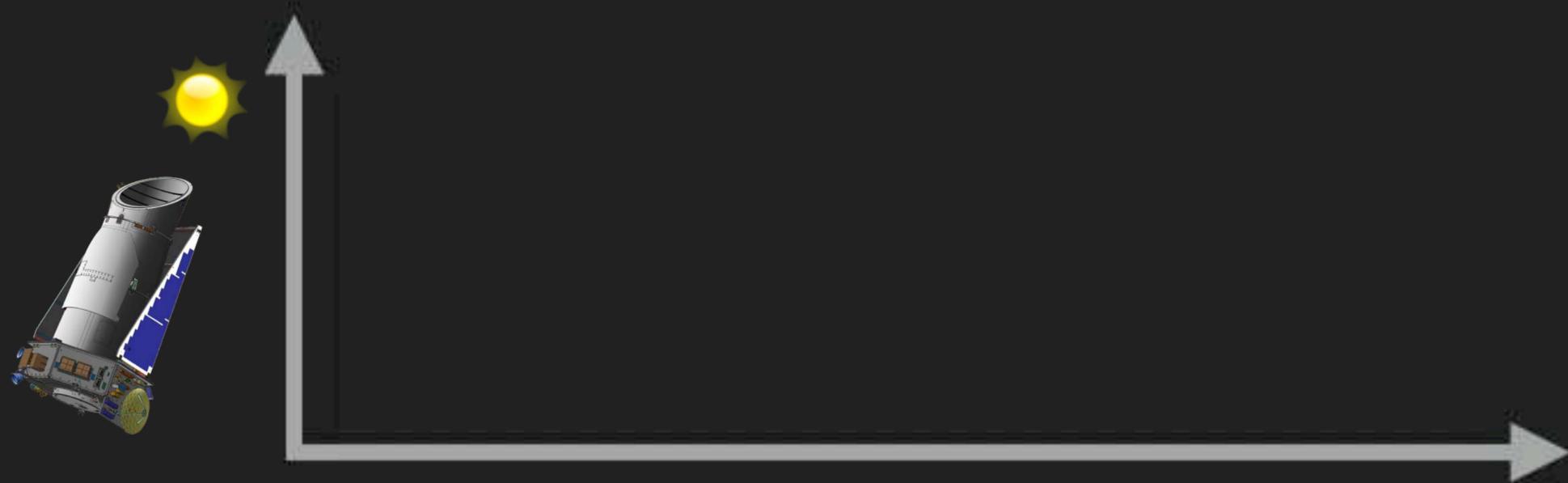
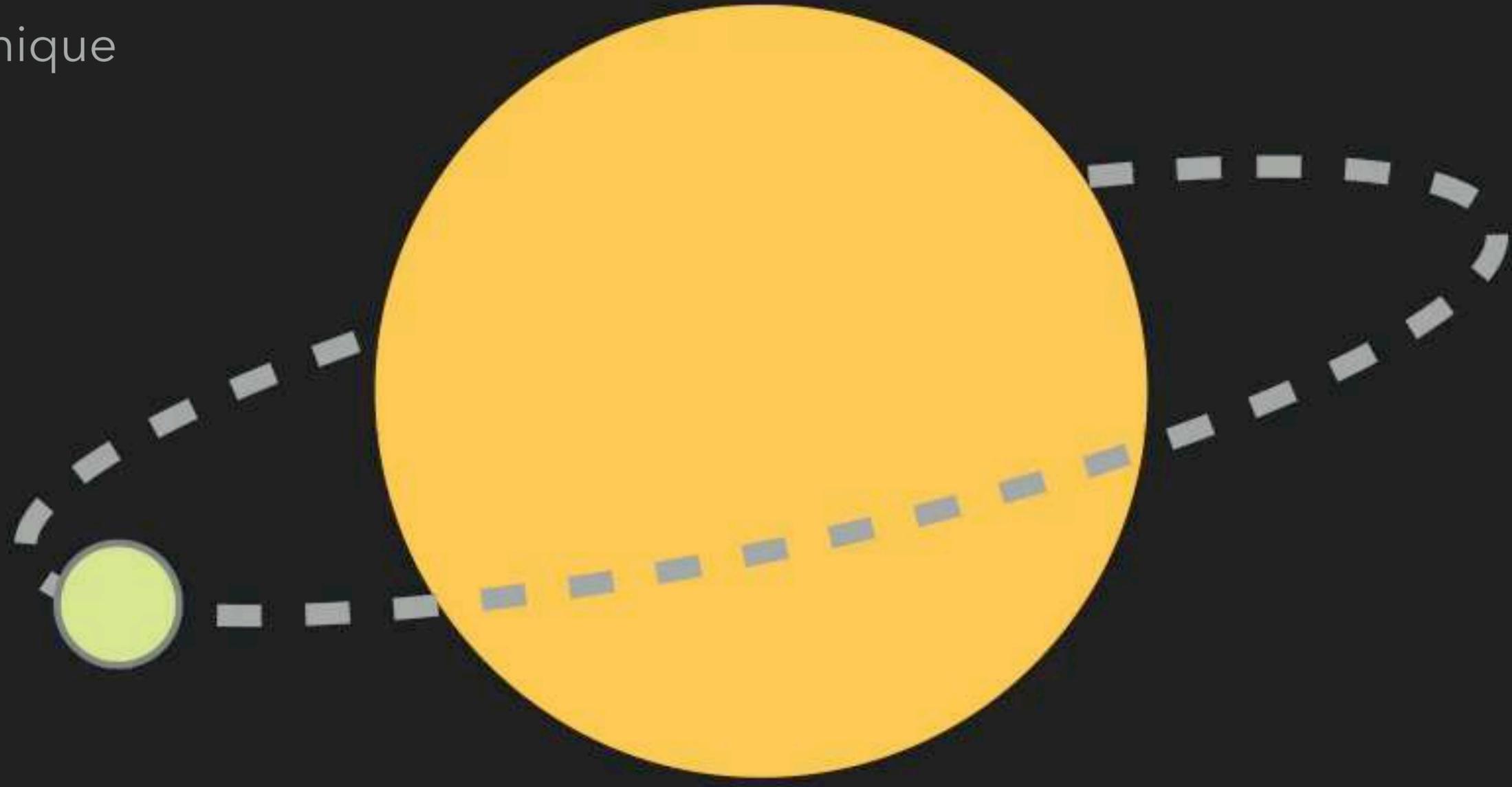


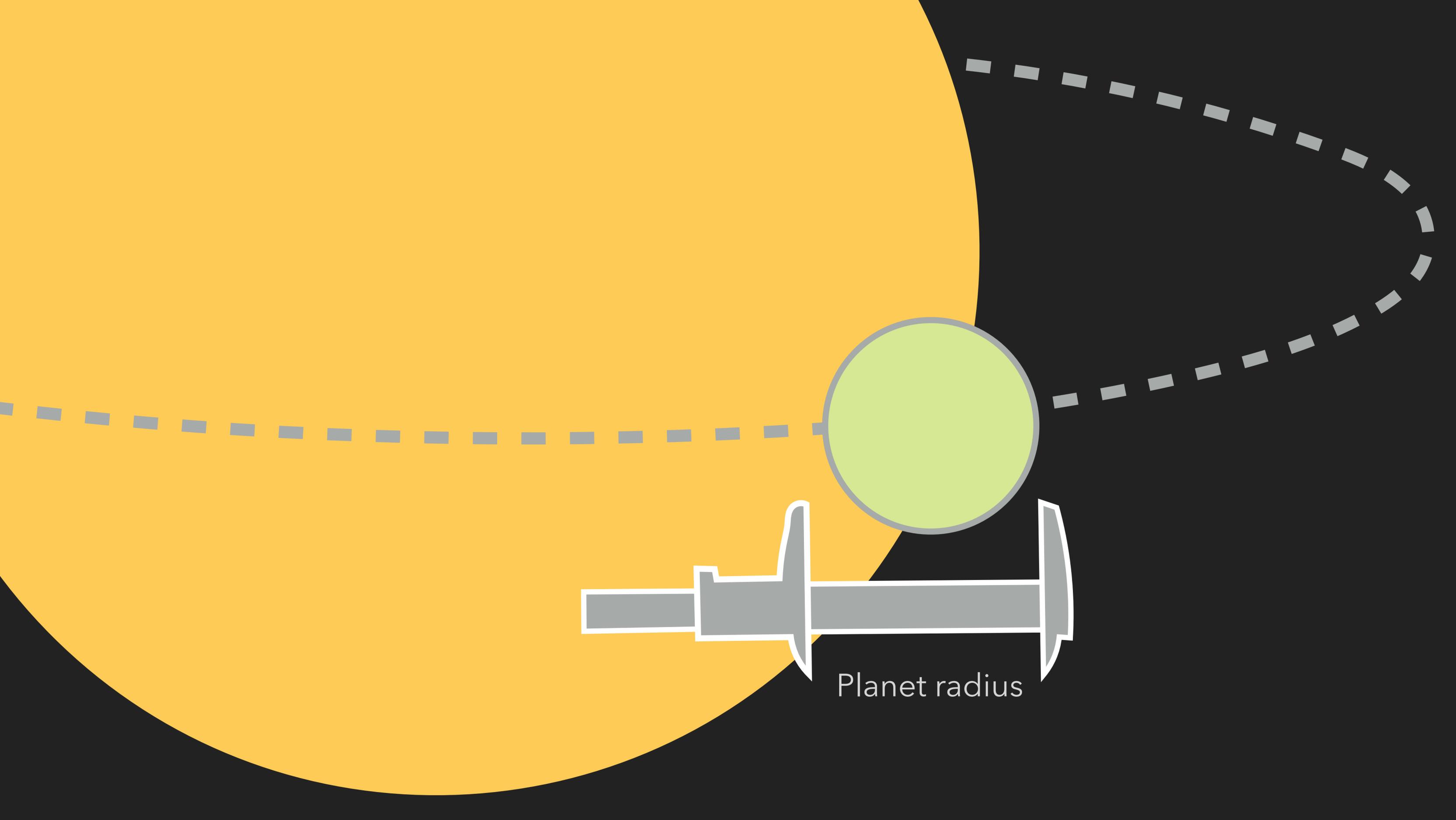




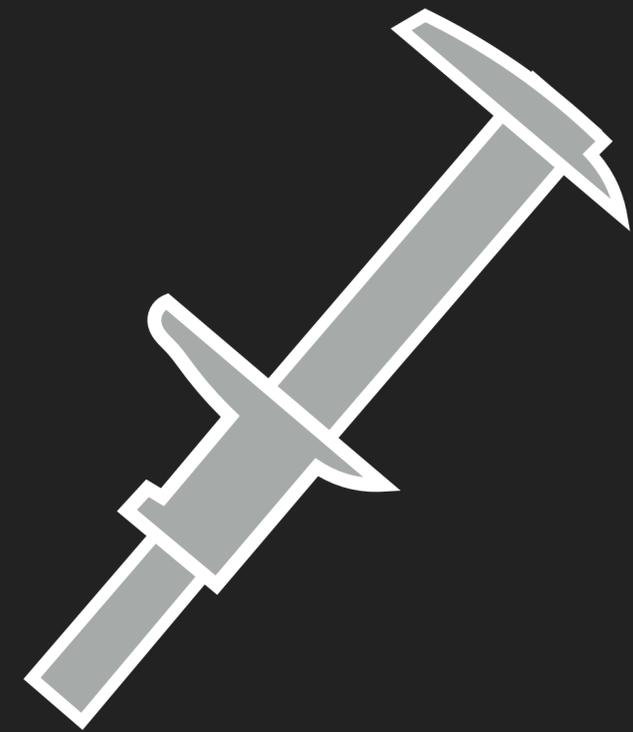
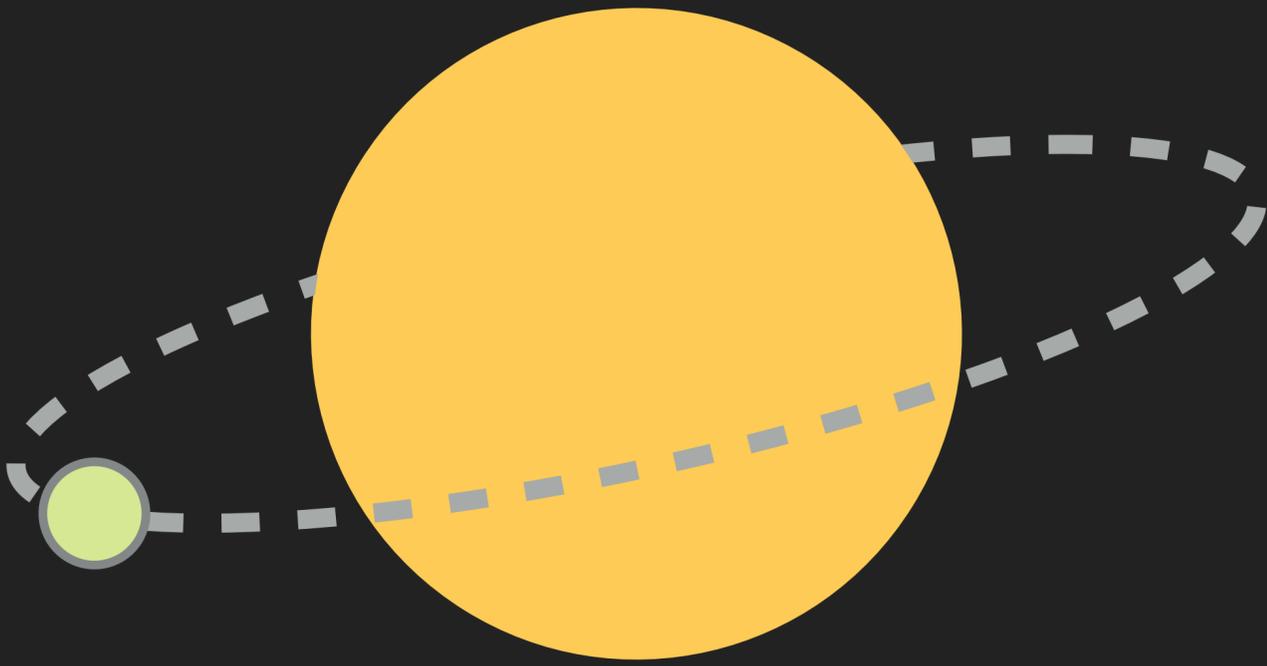
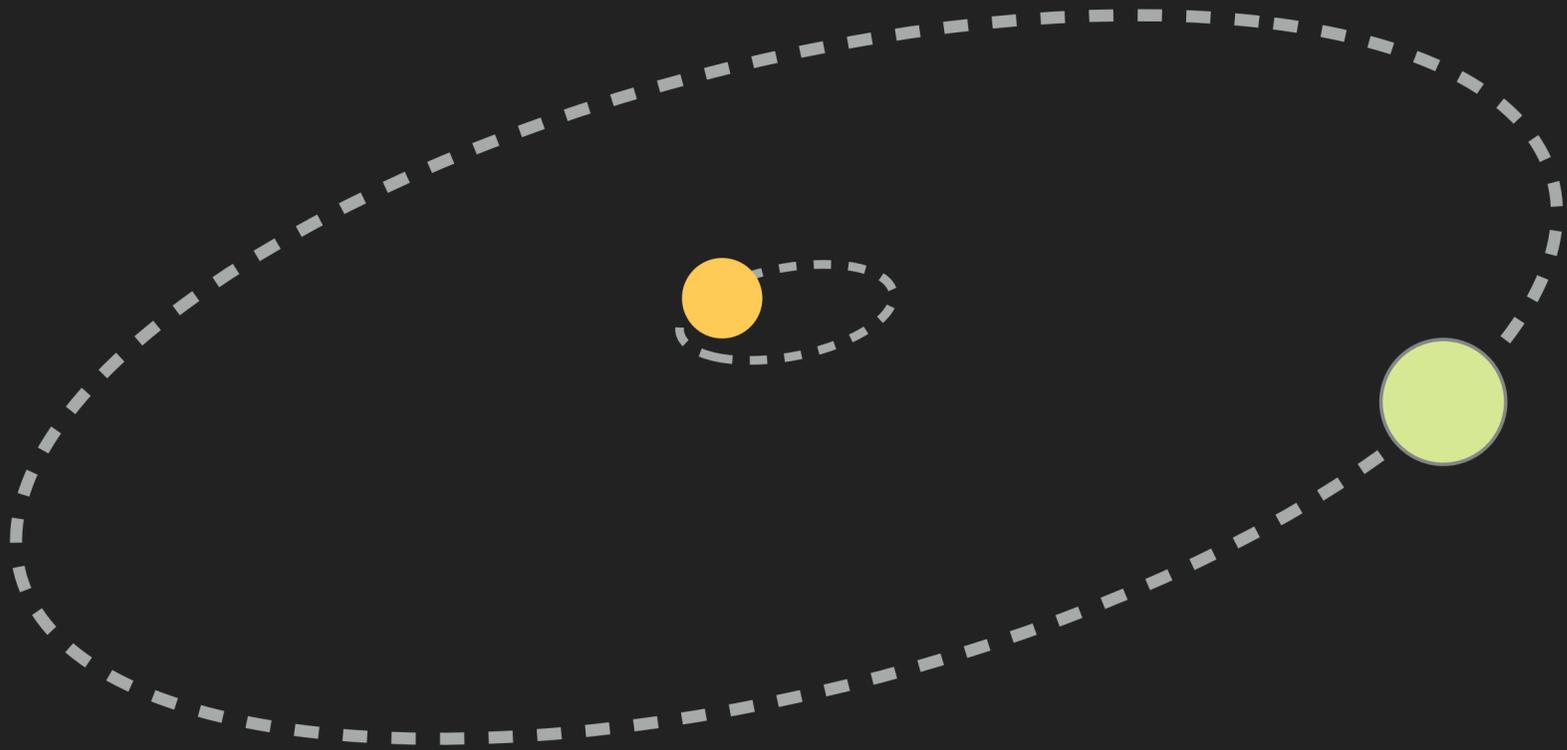
Gliese 1214b

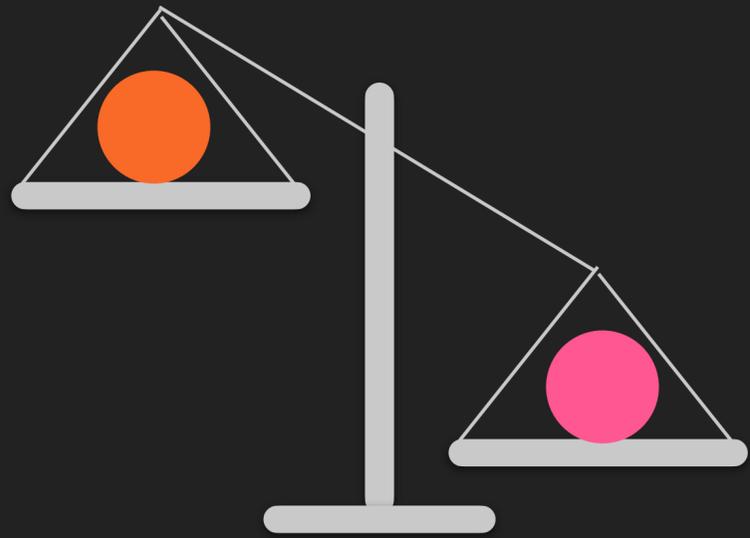
Transit technique



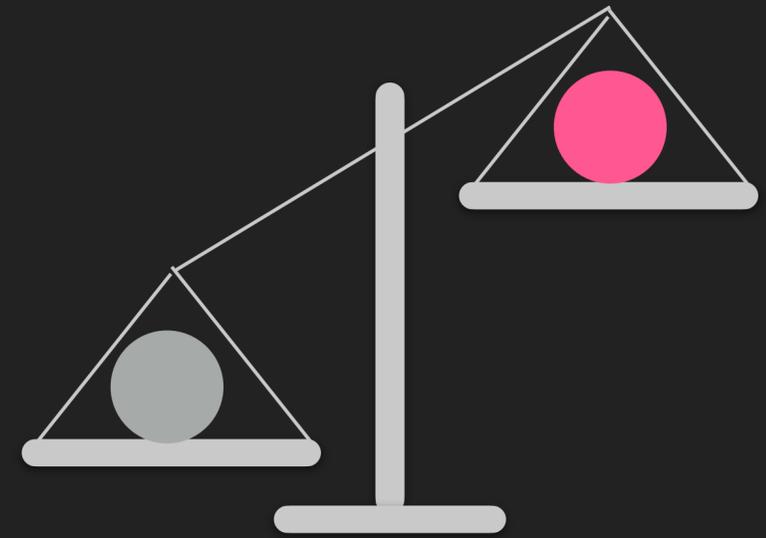


Planet radius



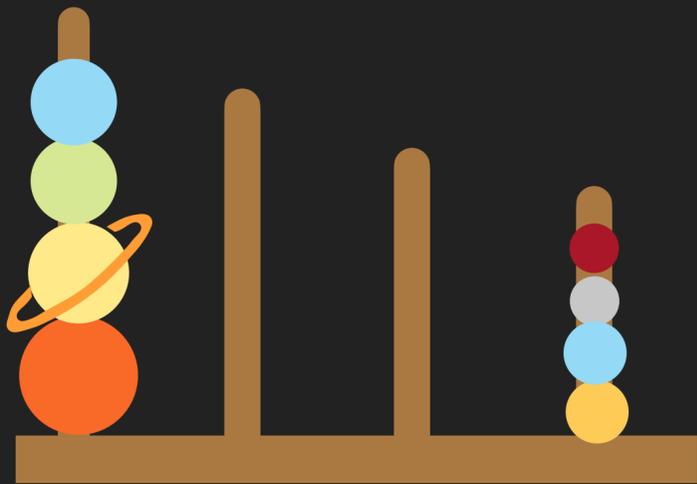


Too dense for a gas giant

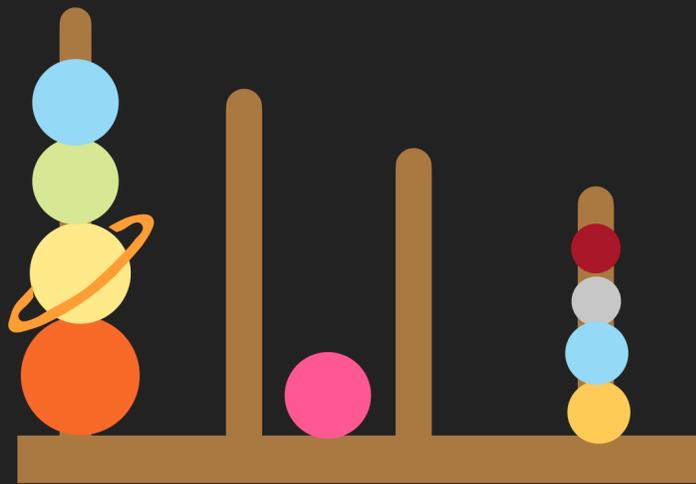


Too light for a rocky world





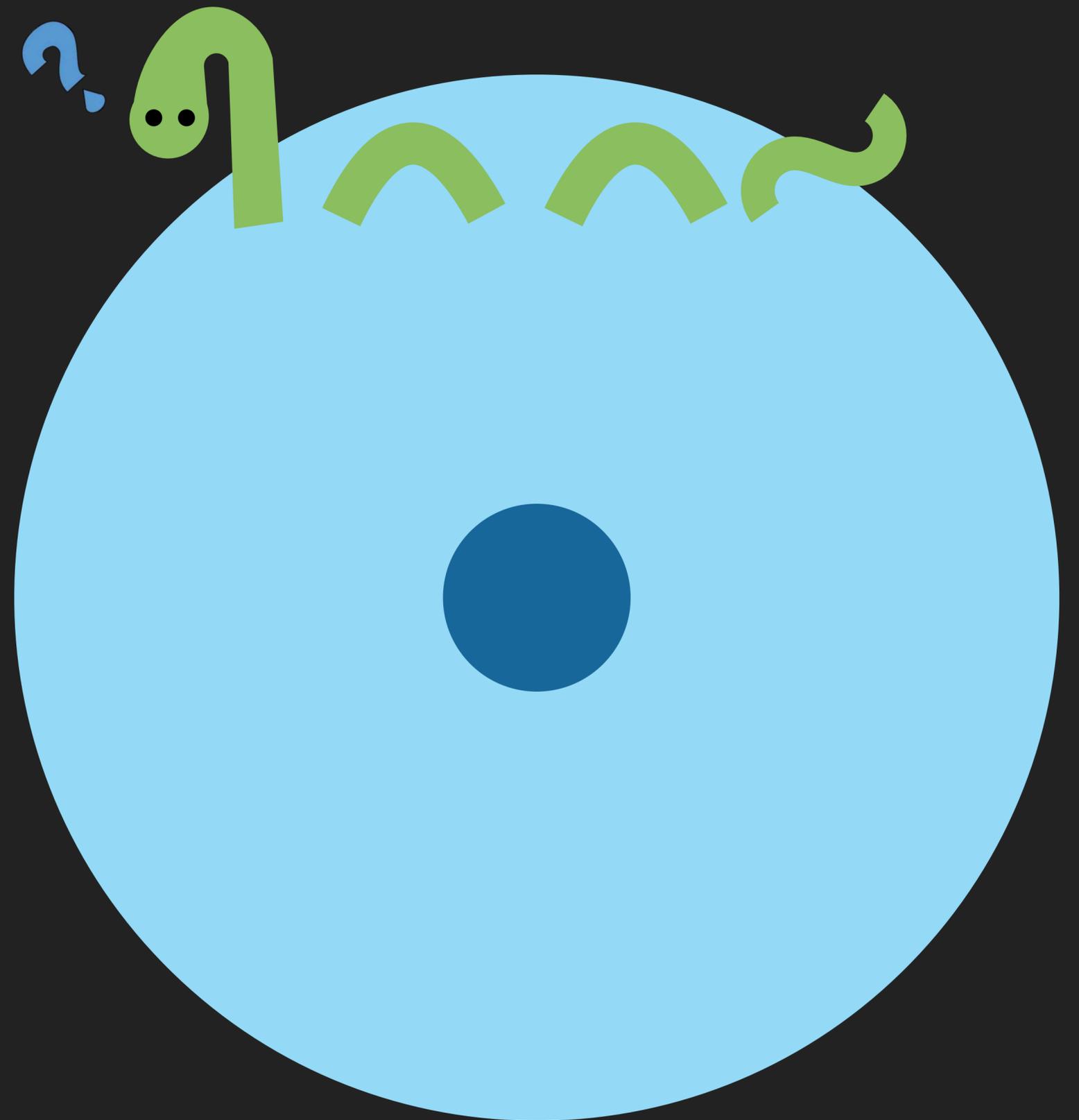
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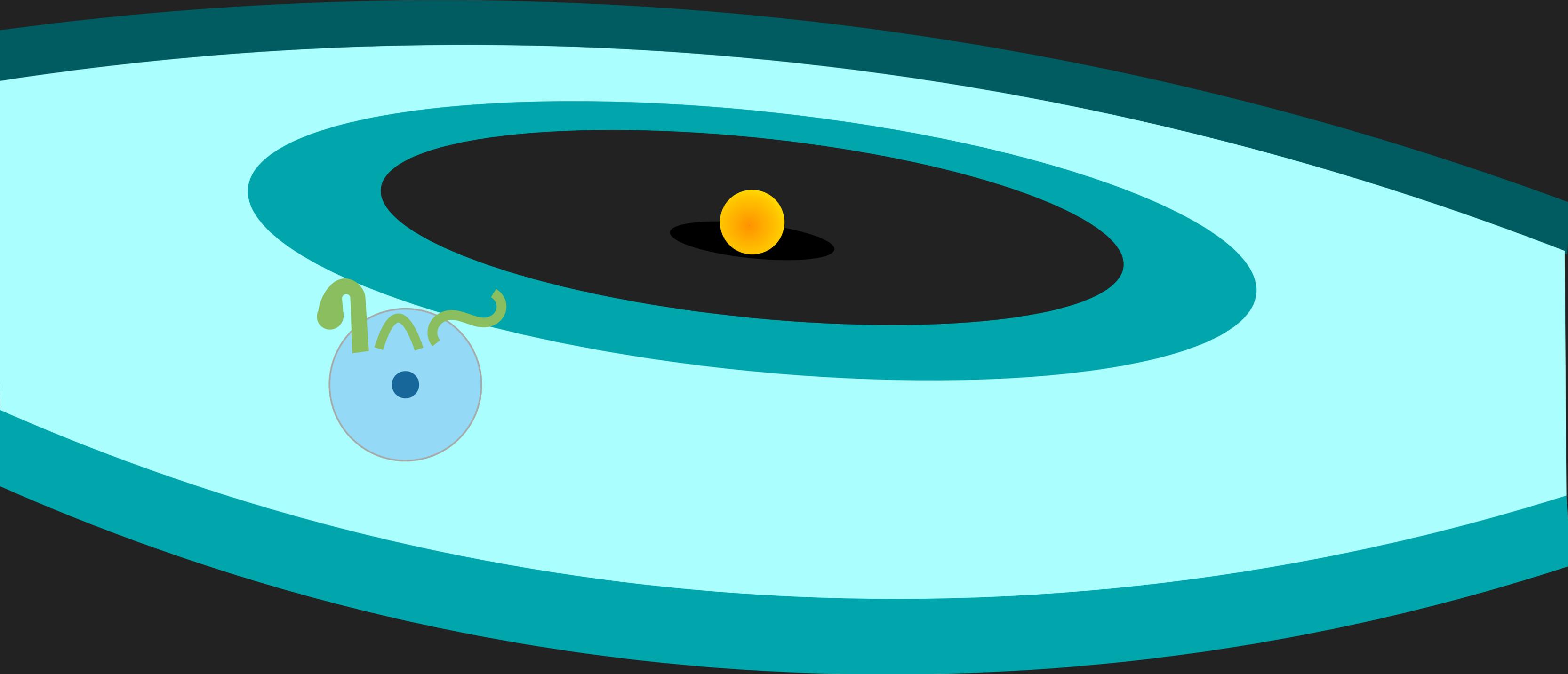


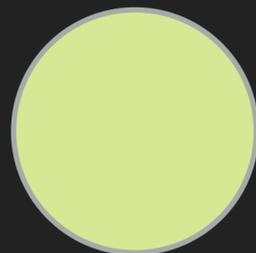
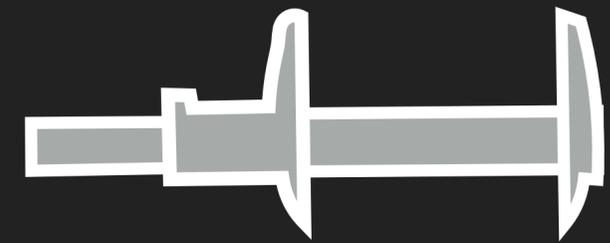
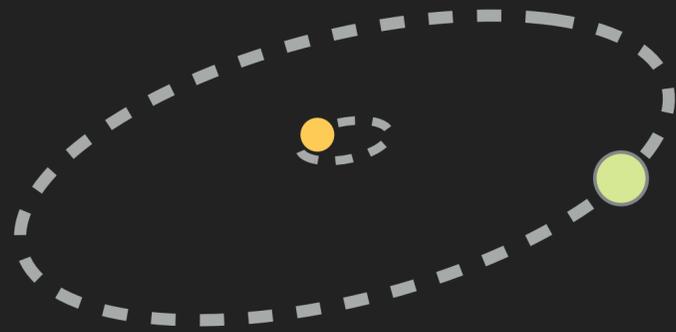
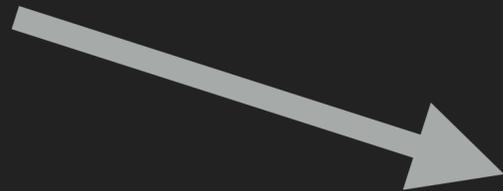
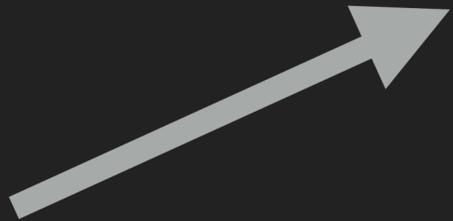
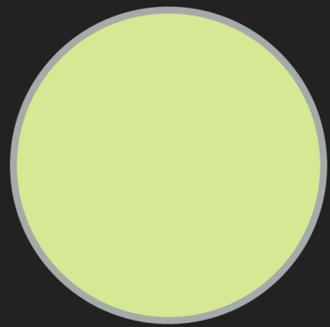
A water world?

Are water worlds
habitable?

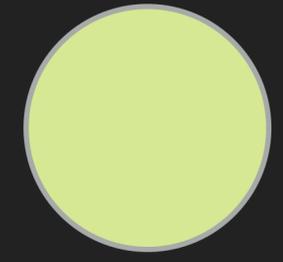
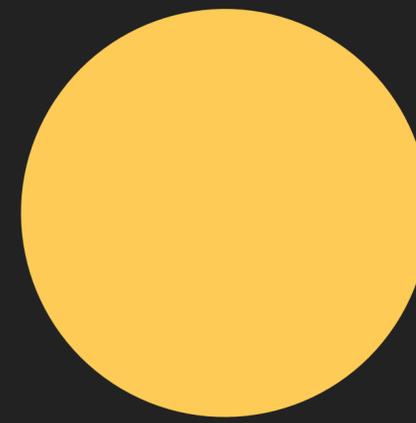


Habitable Zone





Amount of energy from star



T_{eq} ● -18°C

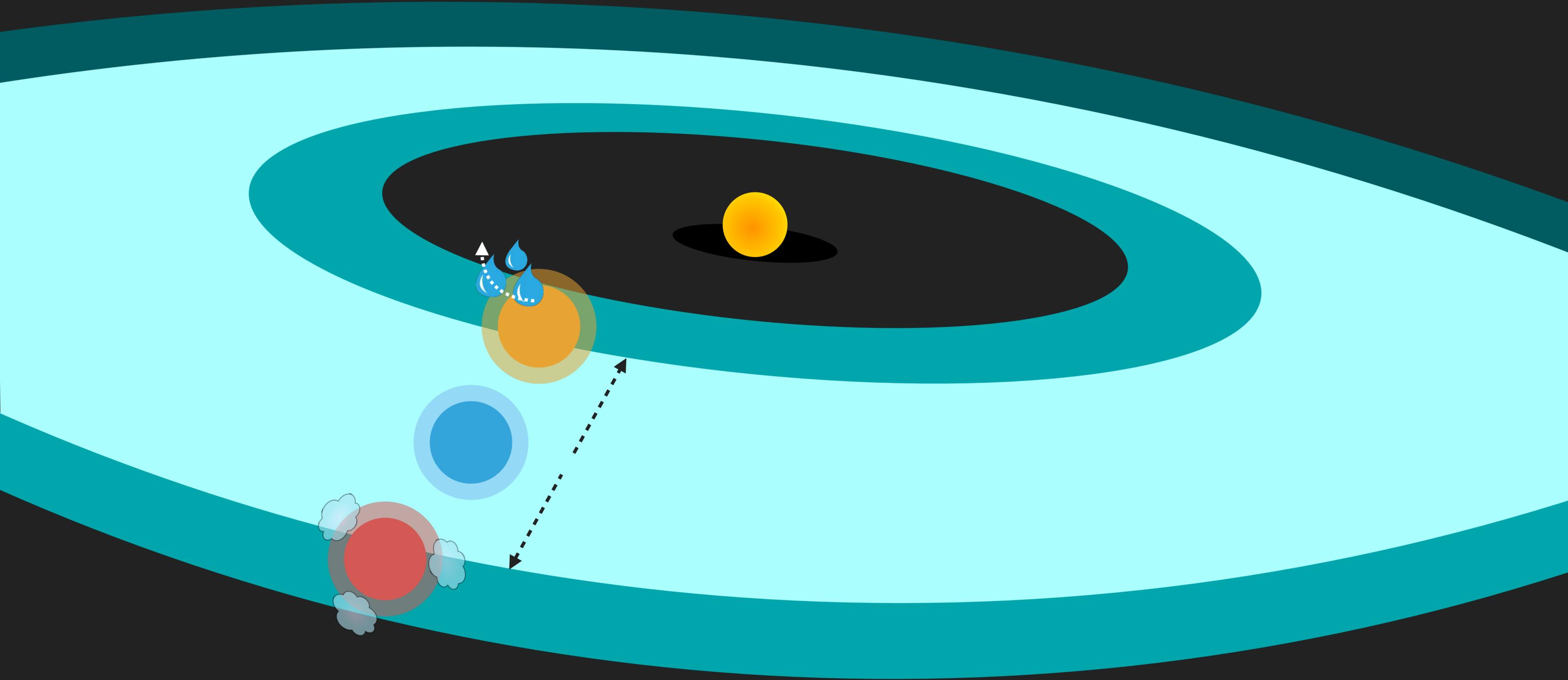
T_{s} ● 15°C

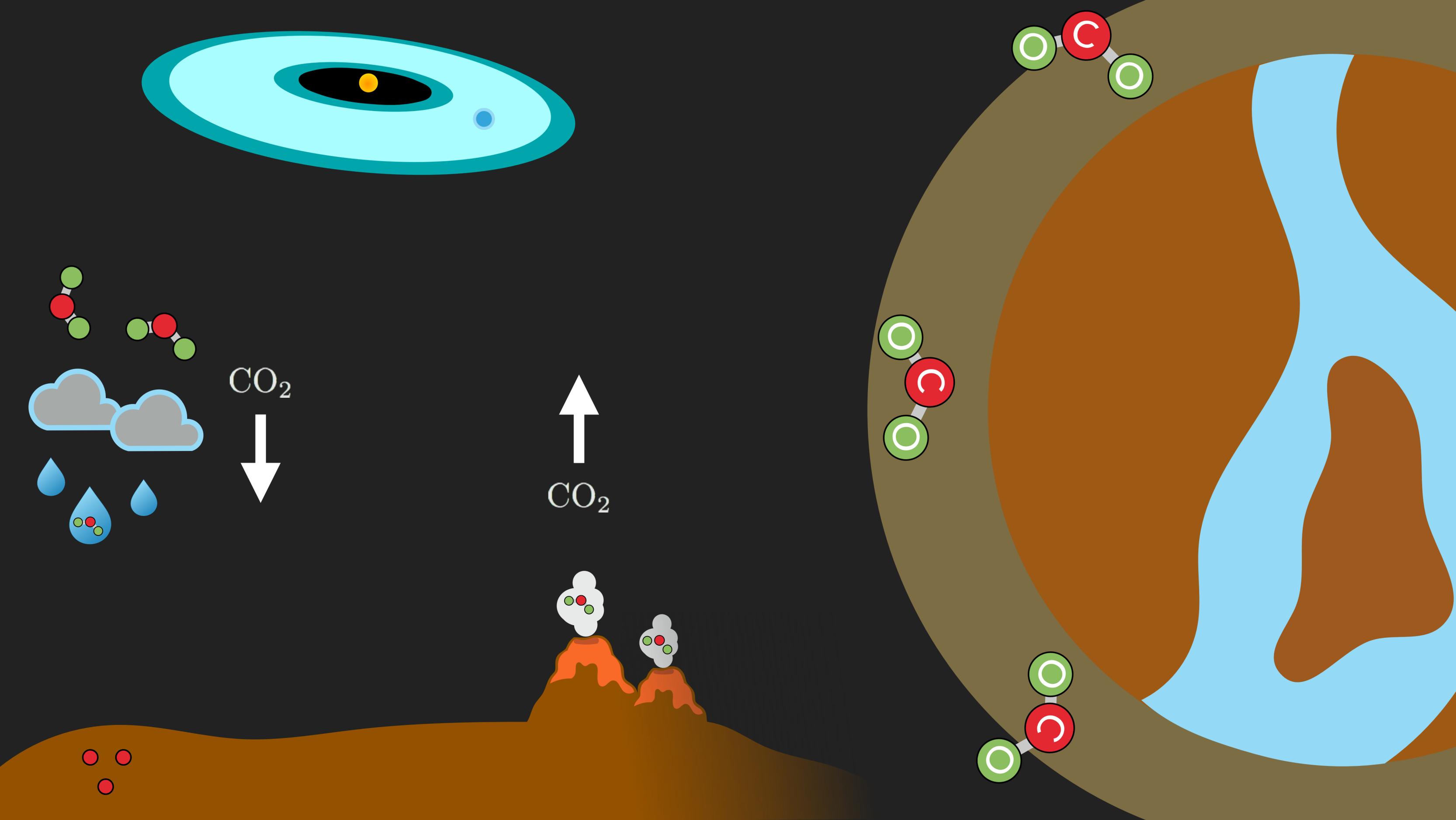
T_{eq} ● 27°C

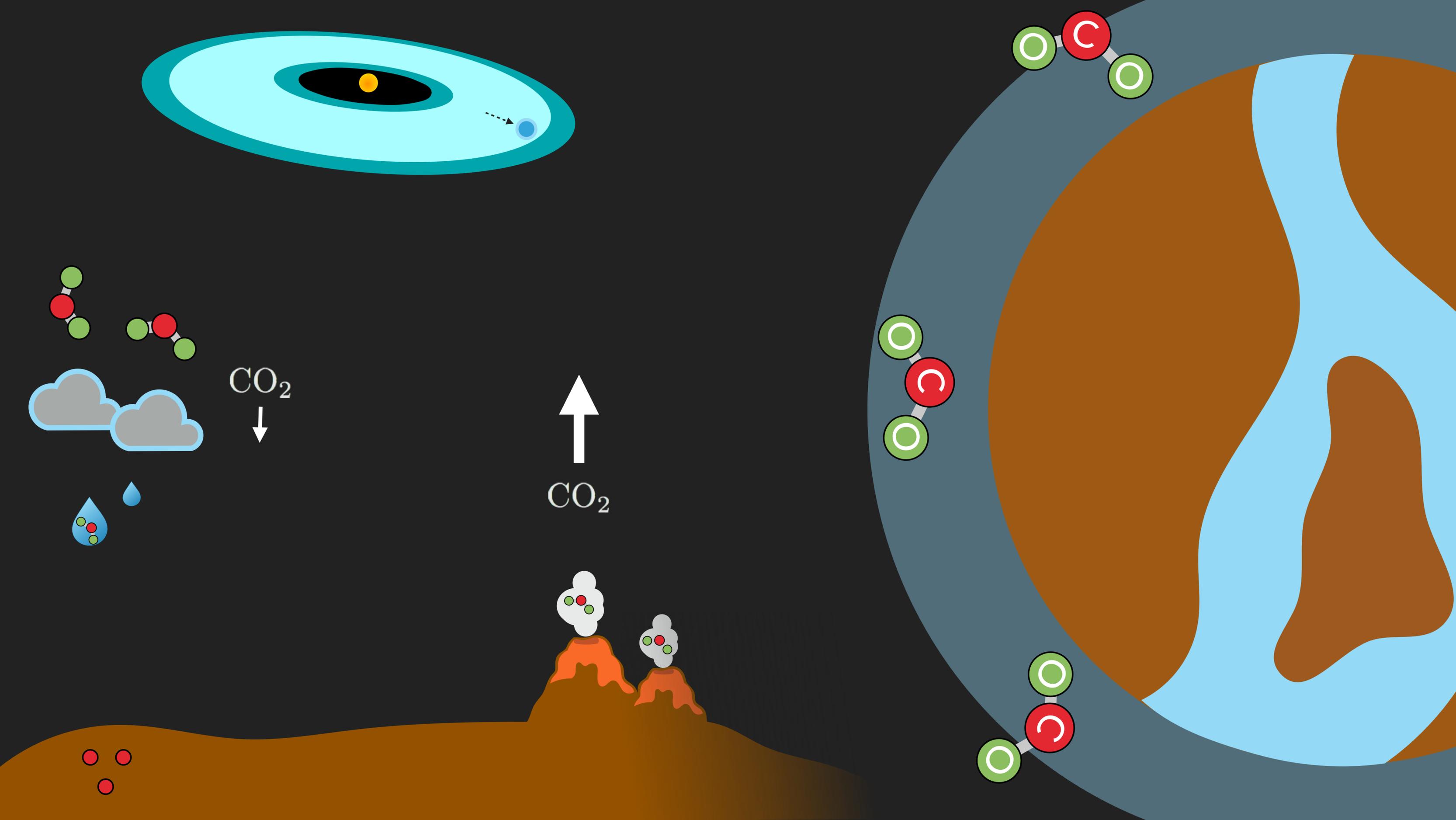
T_{s} ● 460°C

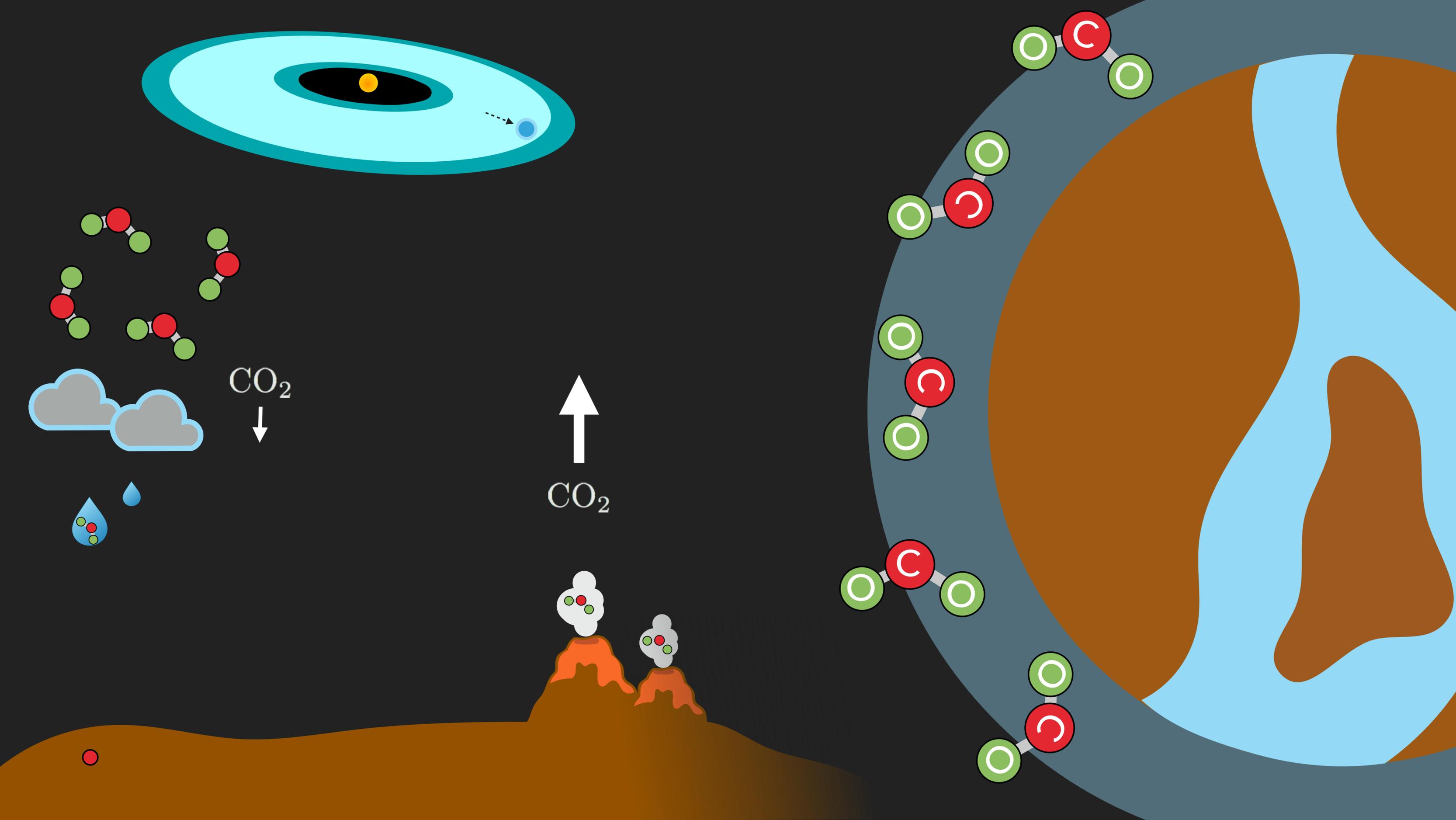
Venus from JAXA's Akatsuki

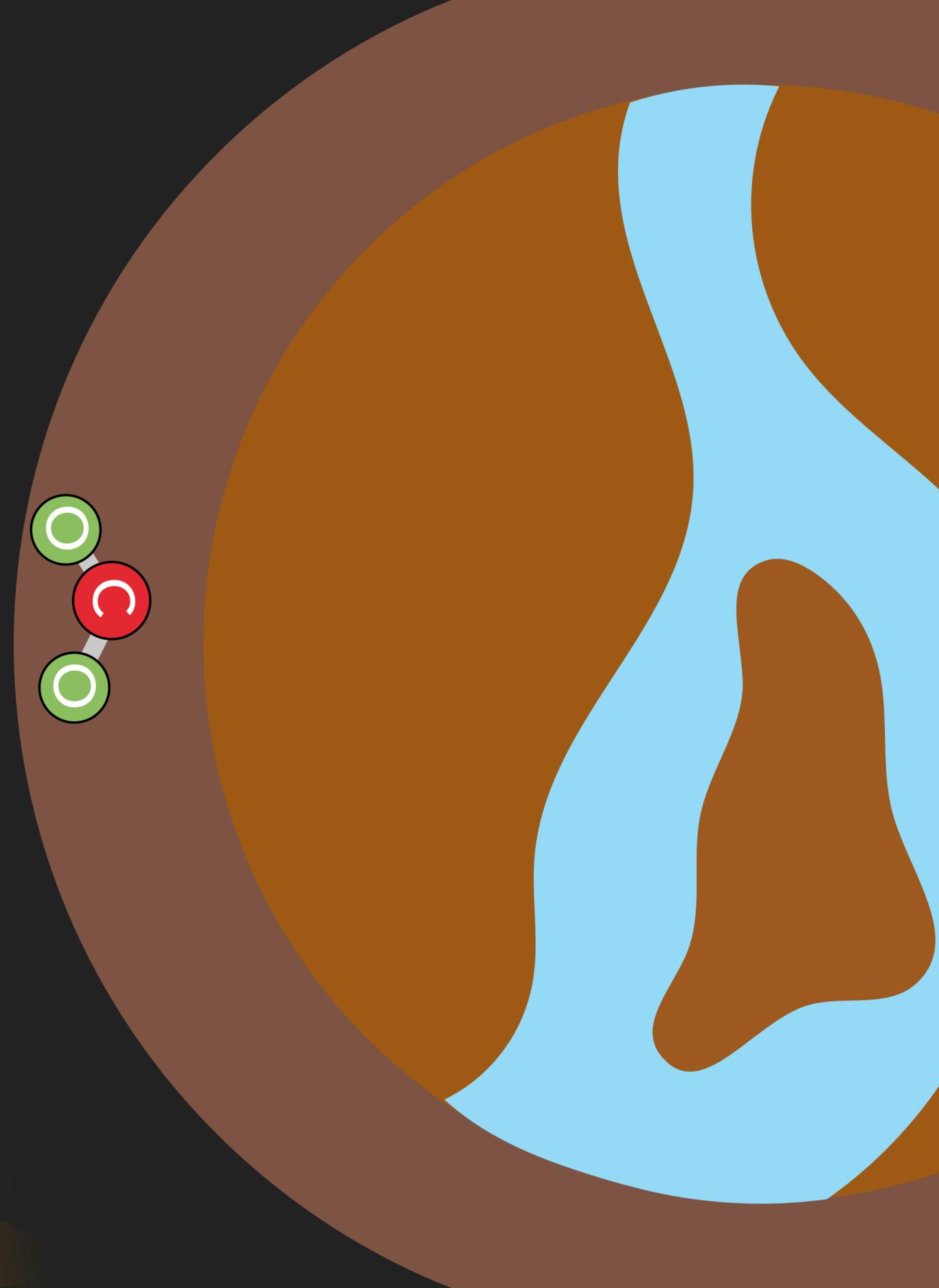
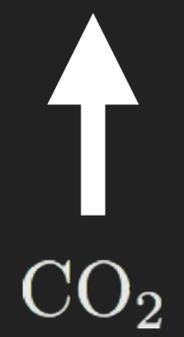
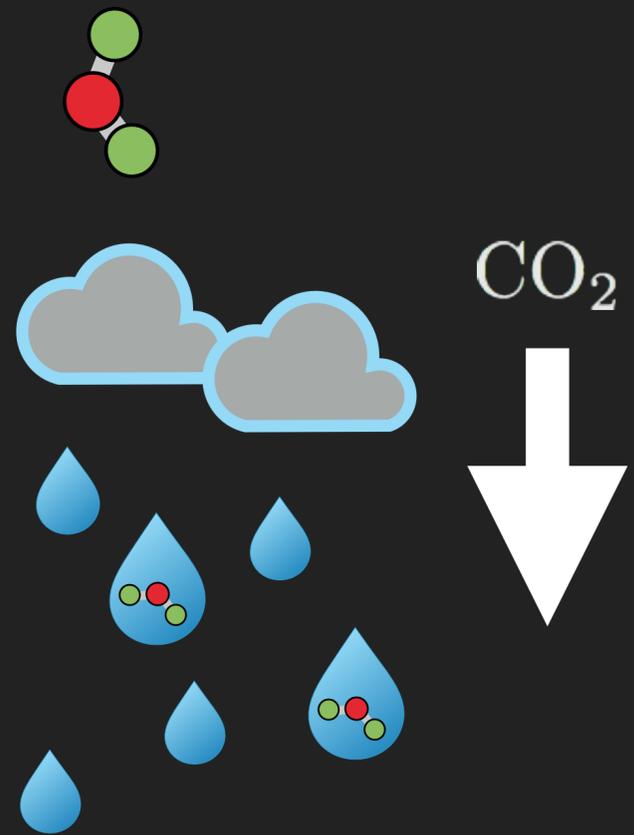
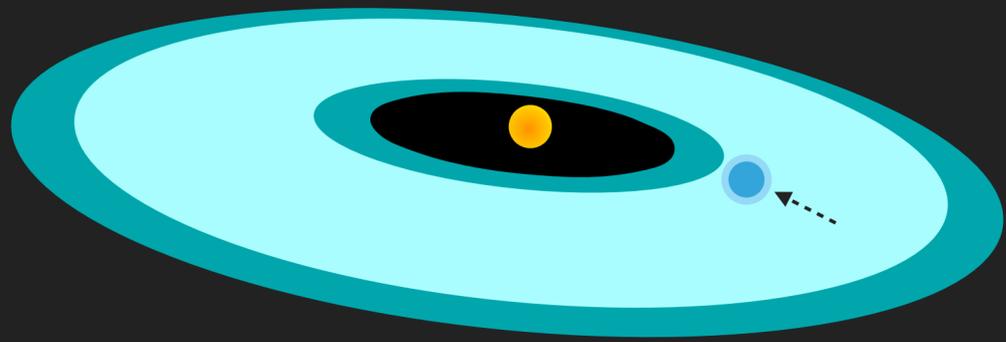
Habitable Zone limits are defined for the Earth

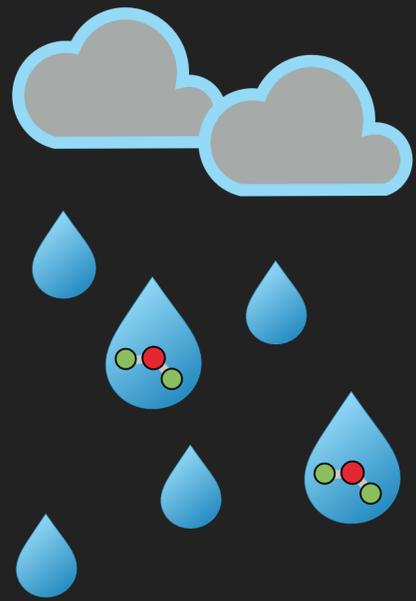
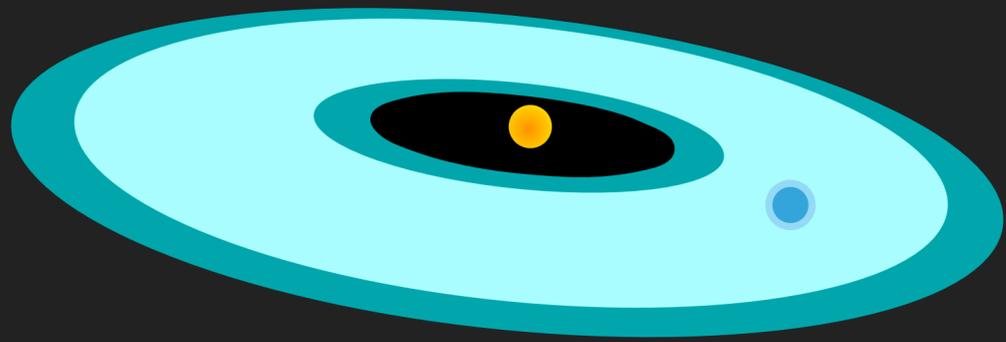






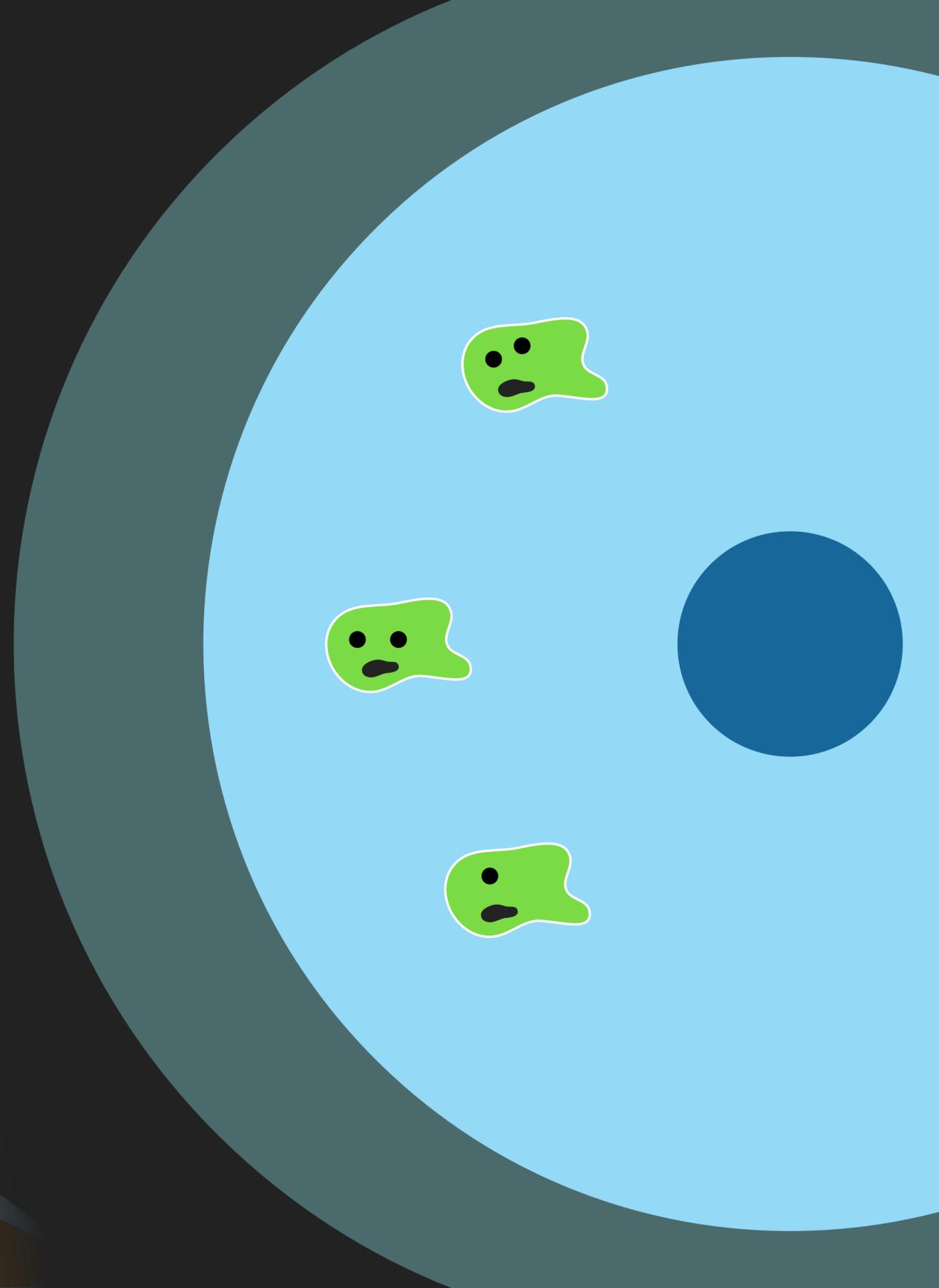
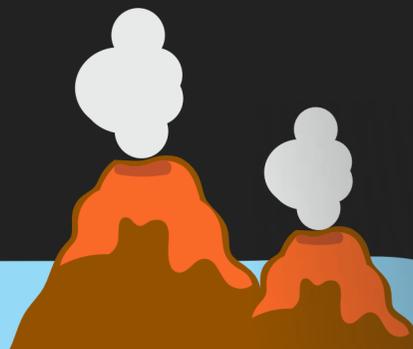


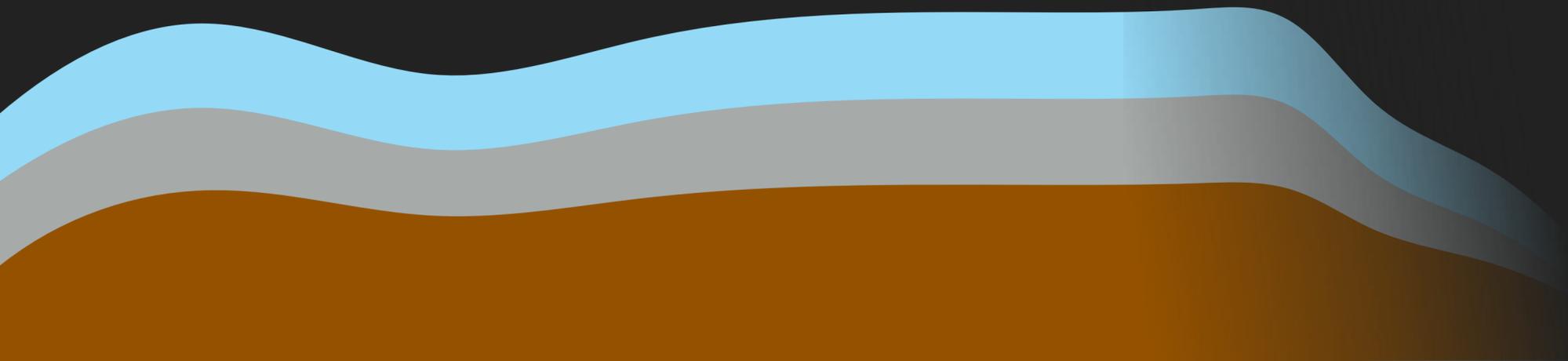
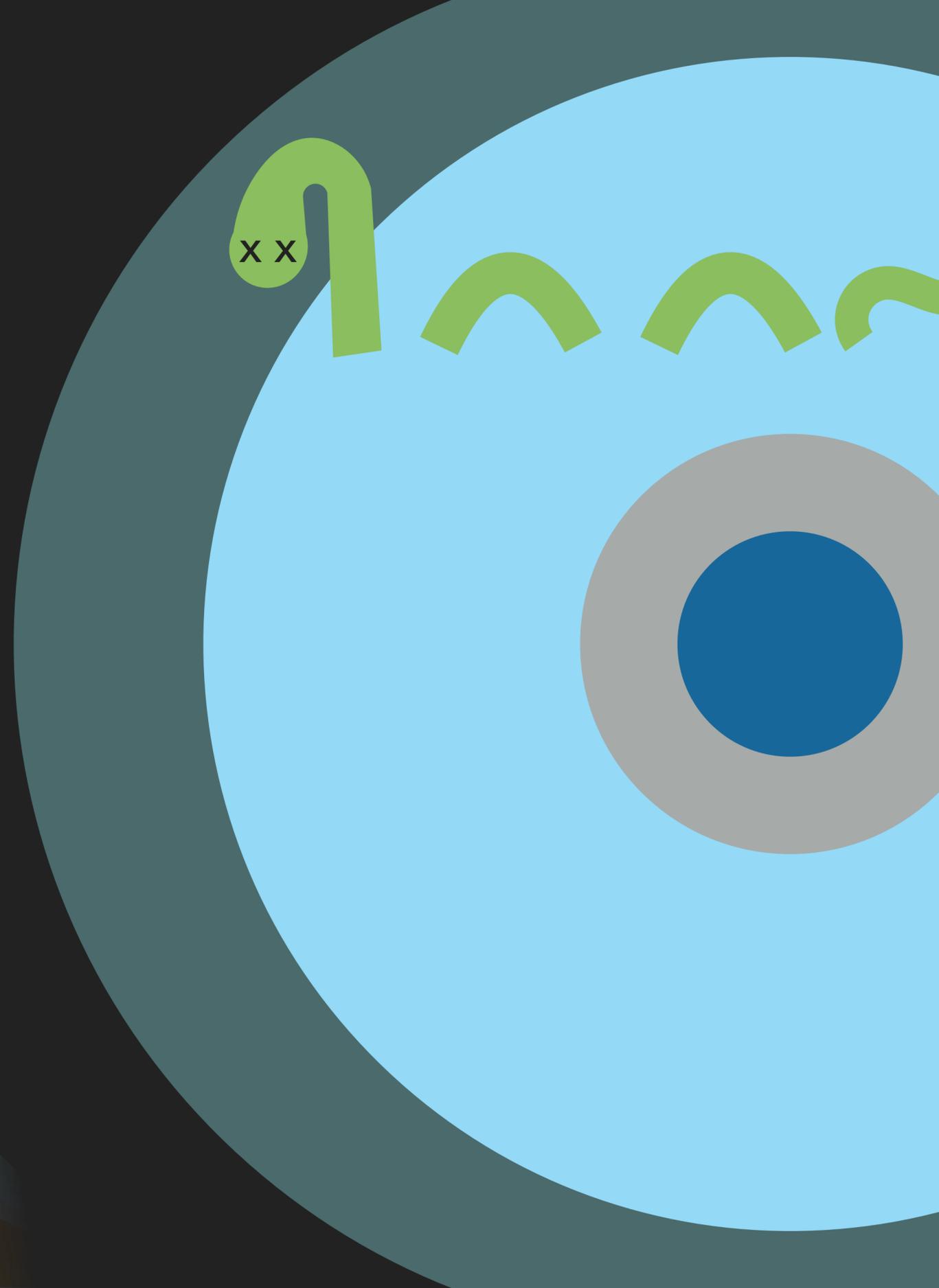
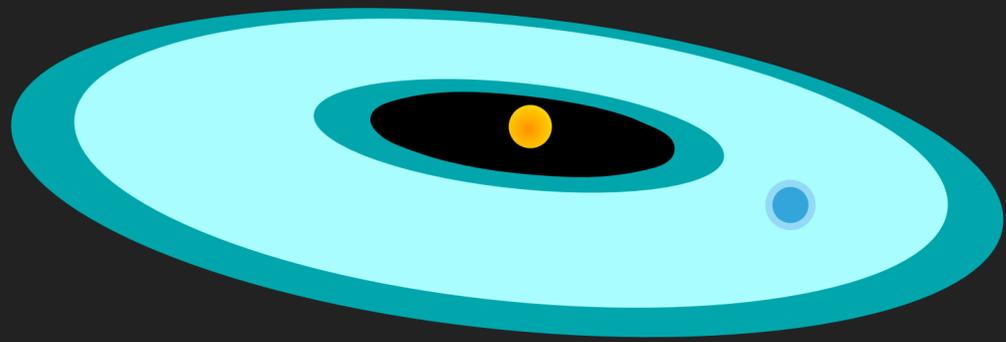


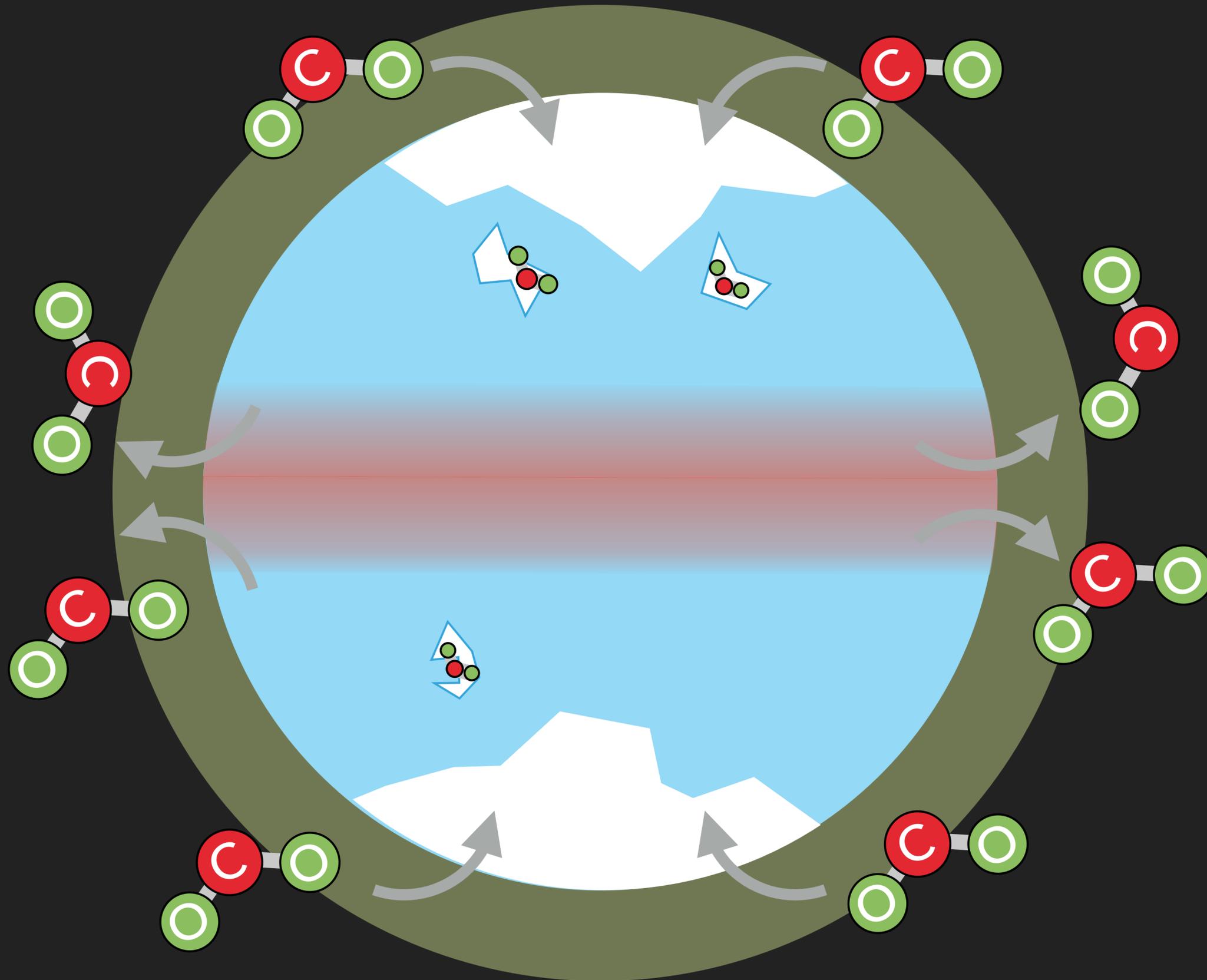


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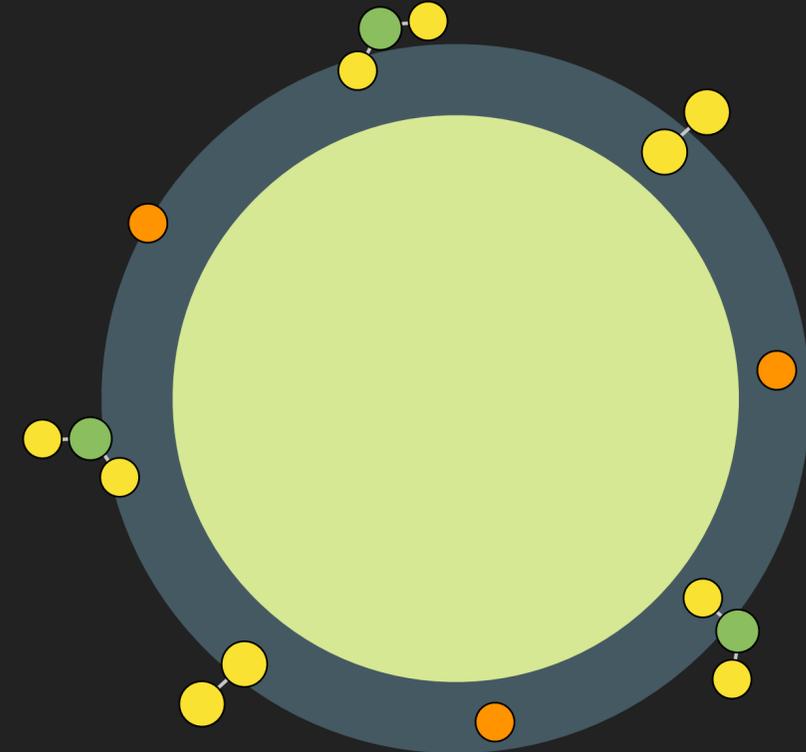
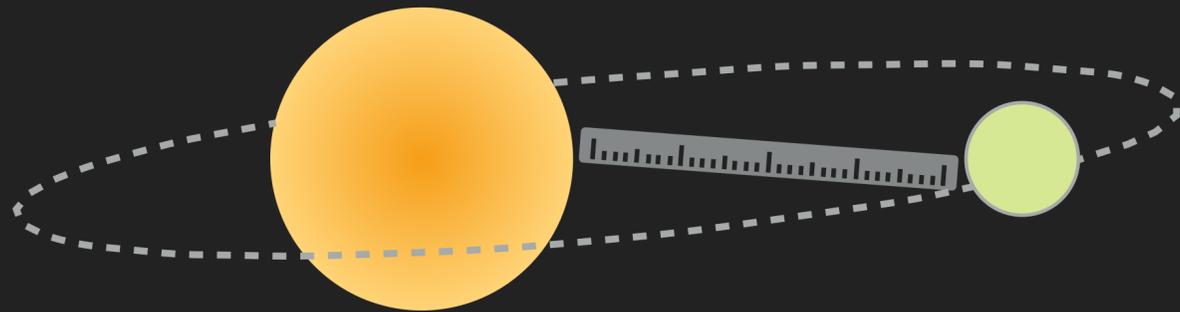
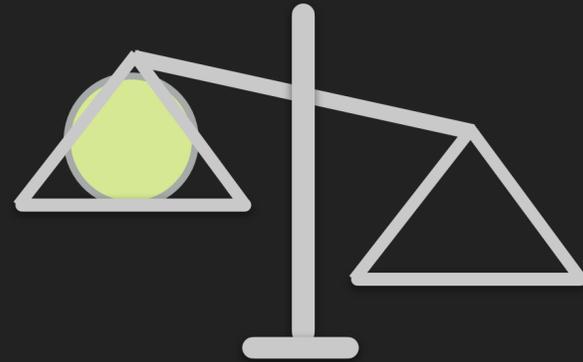
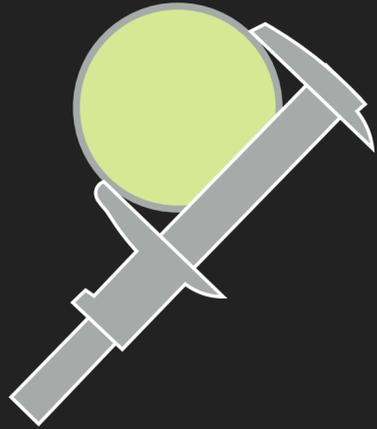
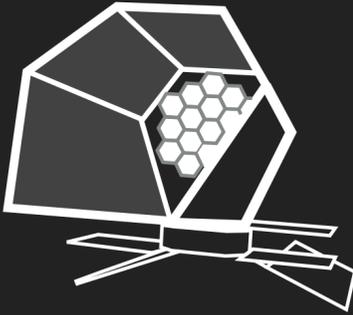
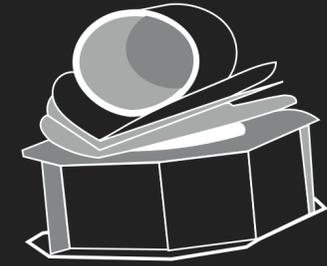
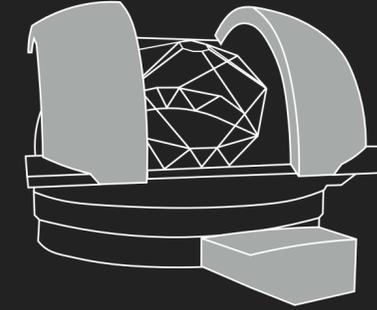
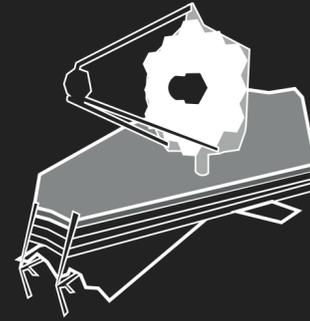
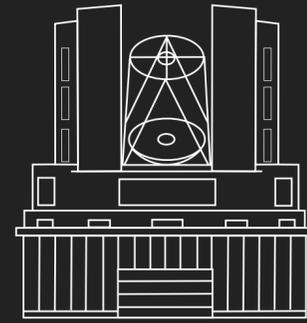
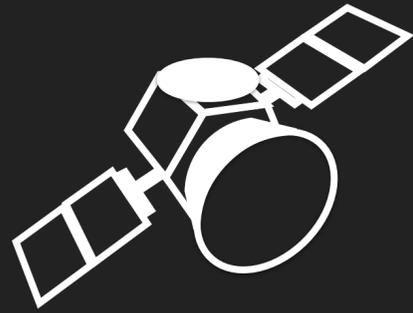


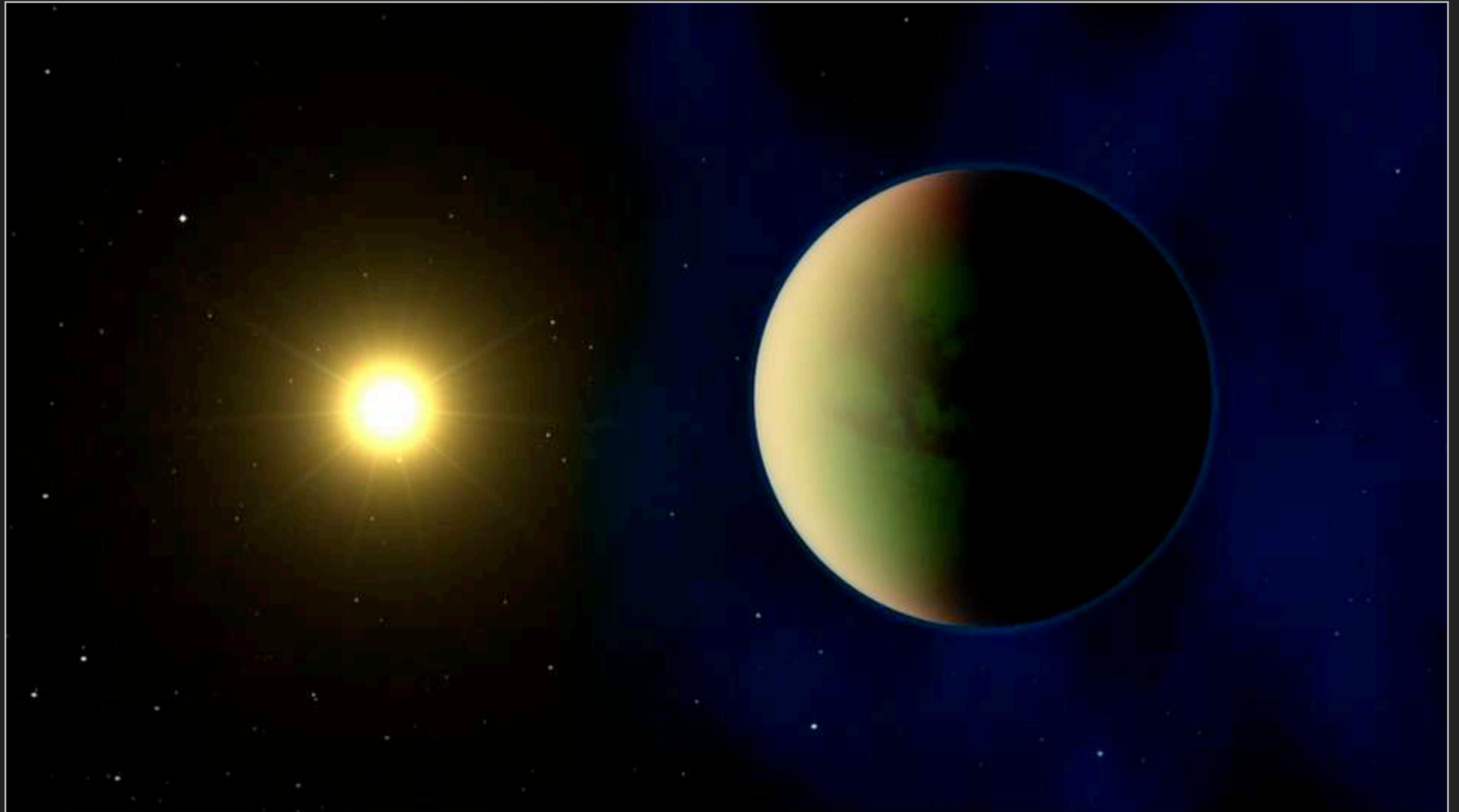




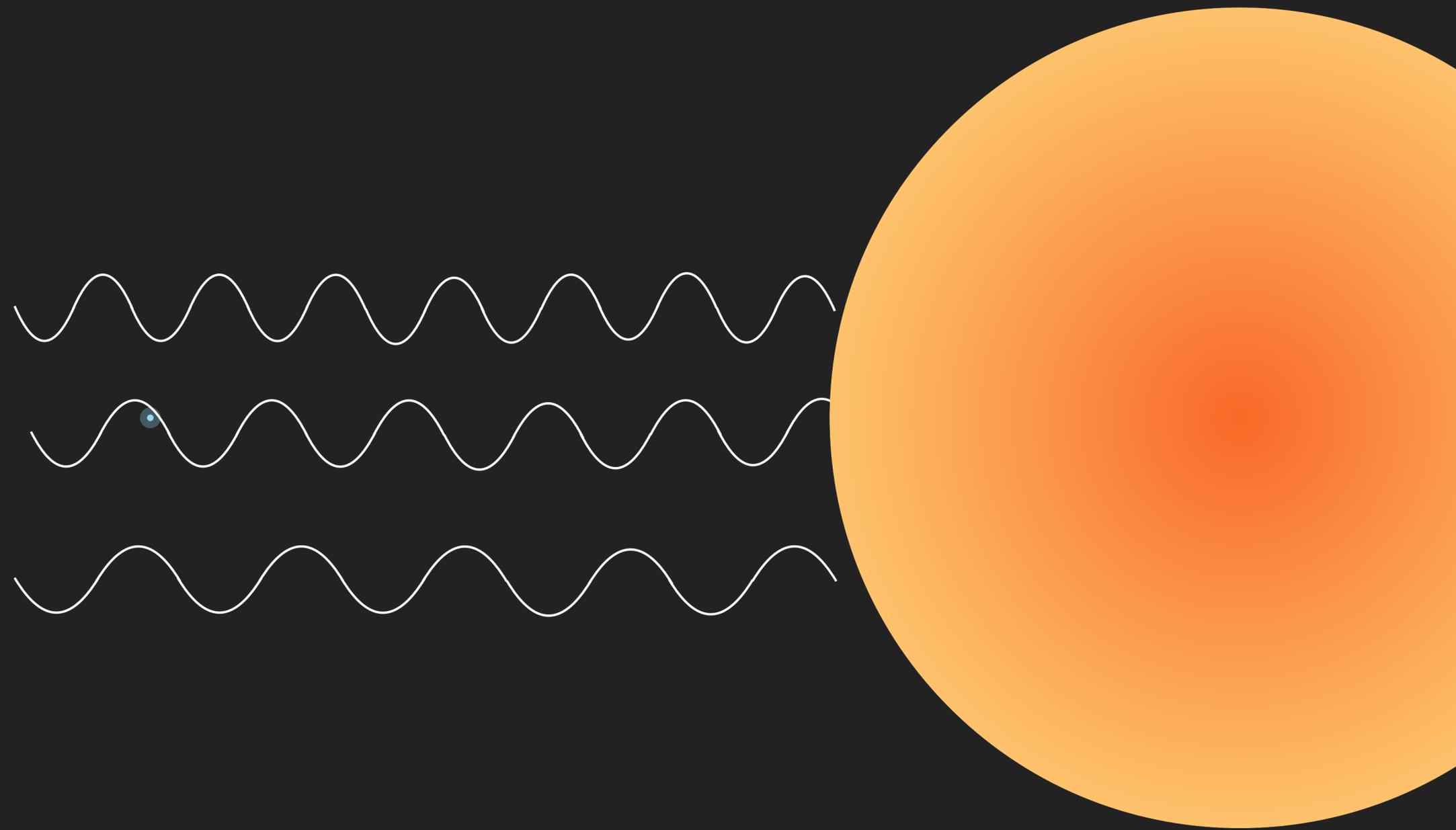
detection era

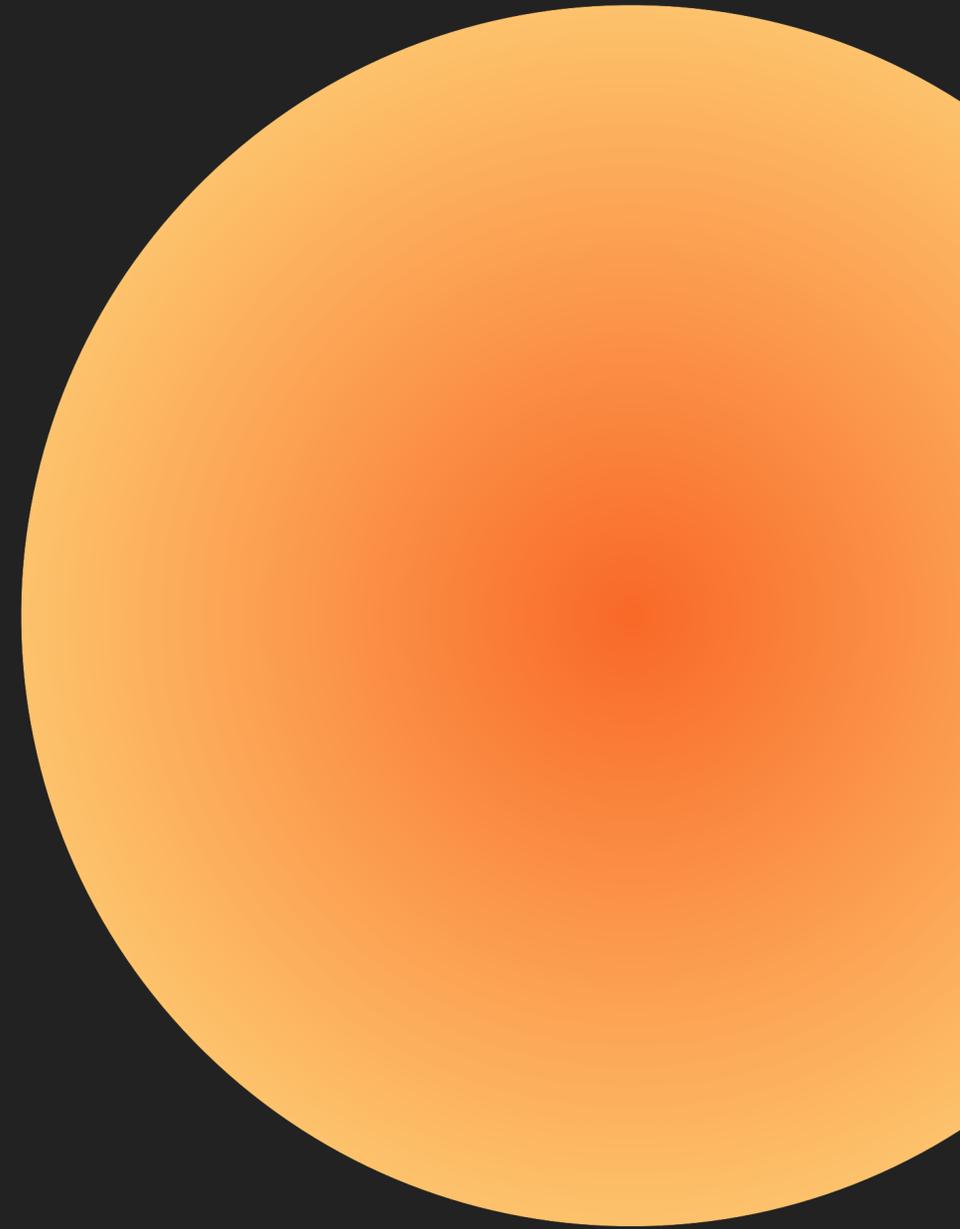
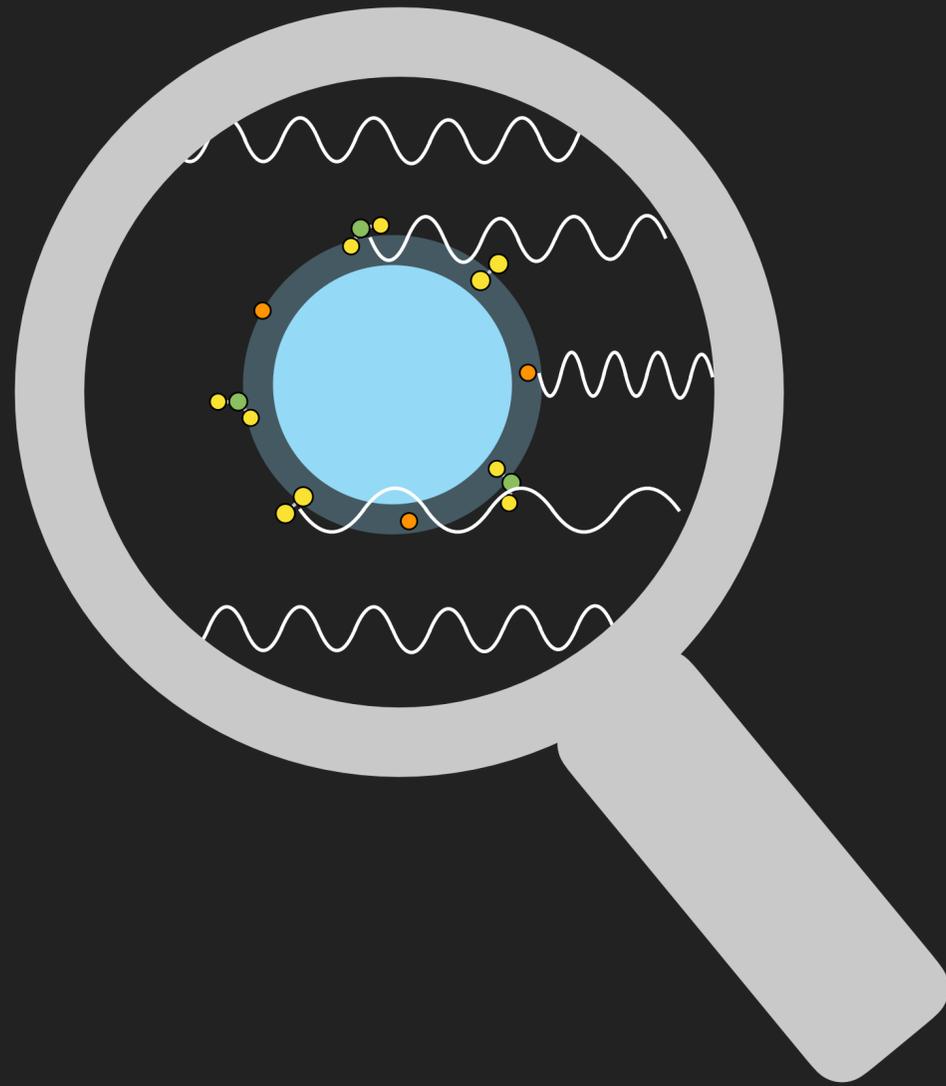
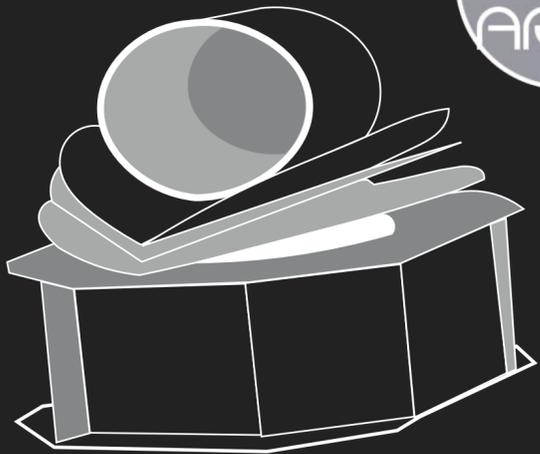
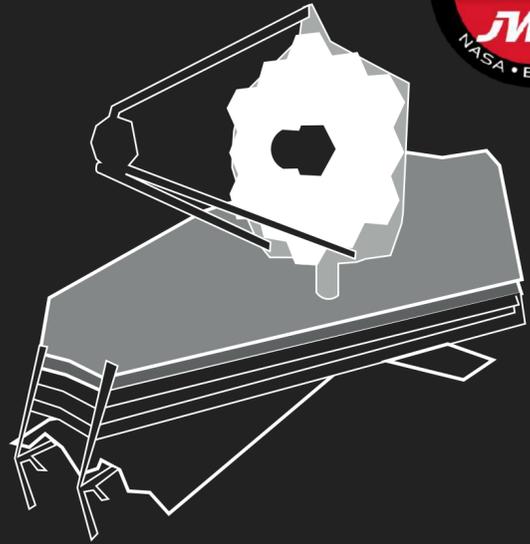
characterisation era





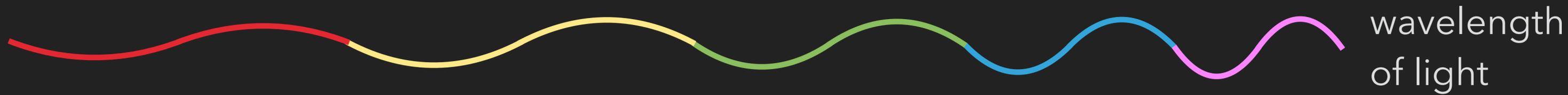
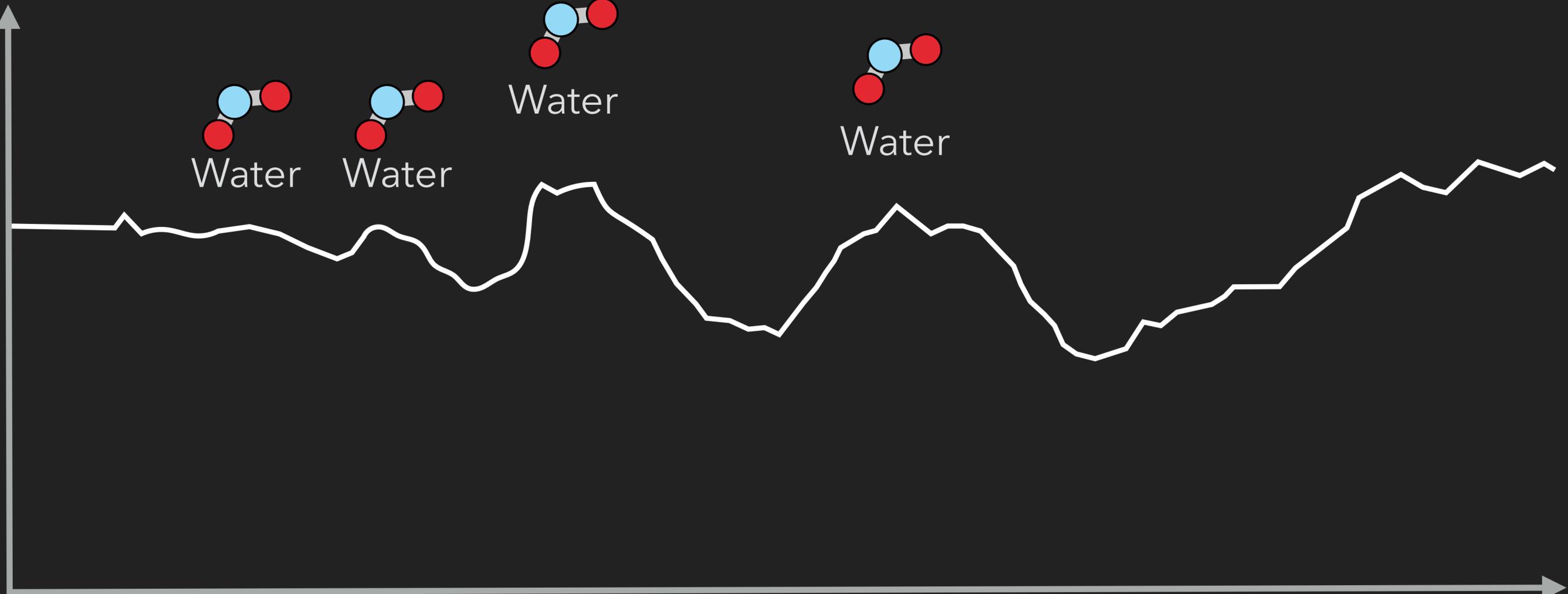
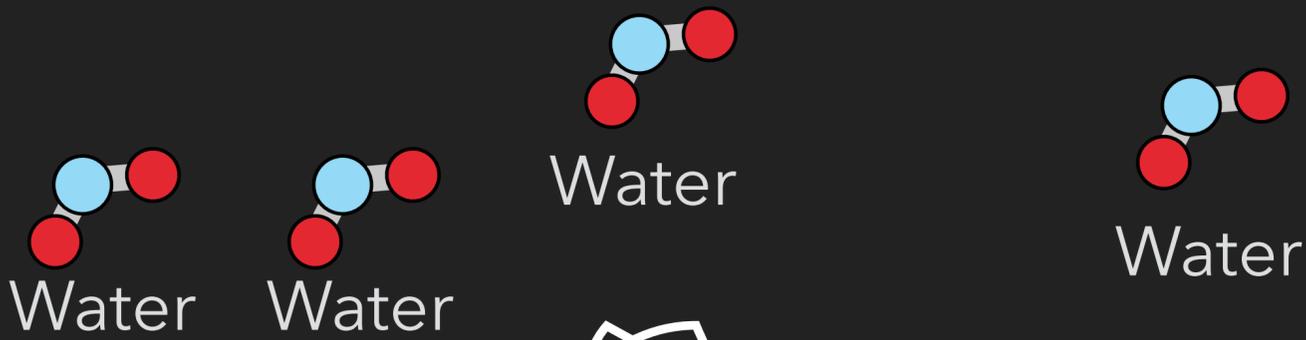
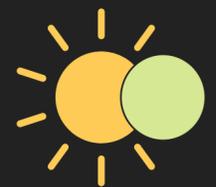
Transmission spectroscopy





Spectrum (transmission spectrum)

Amount of
Light blocked

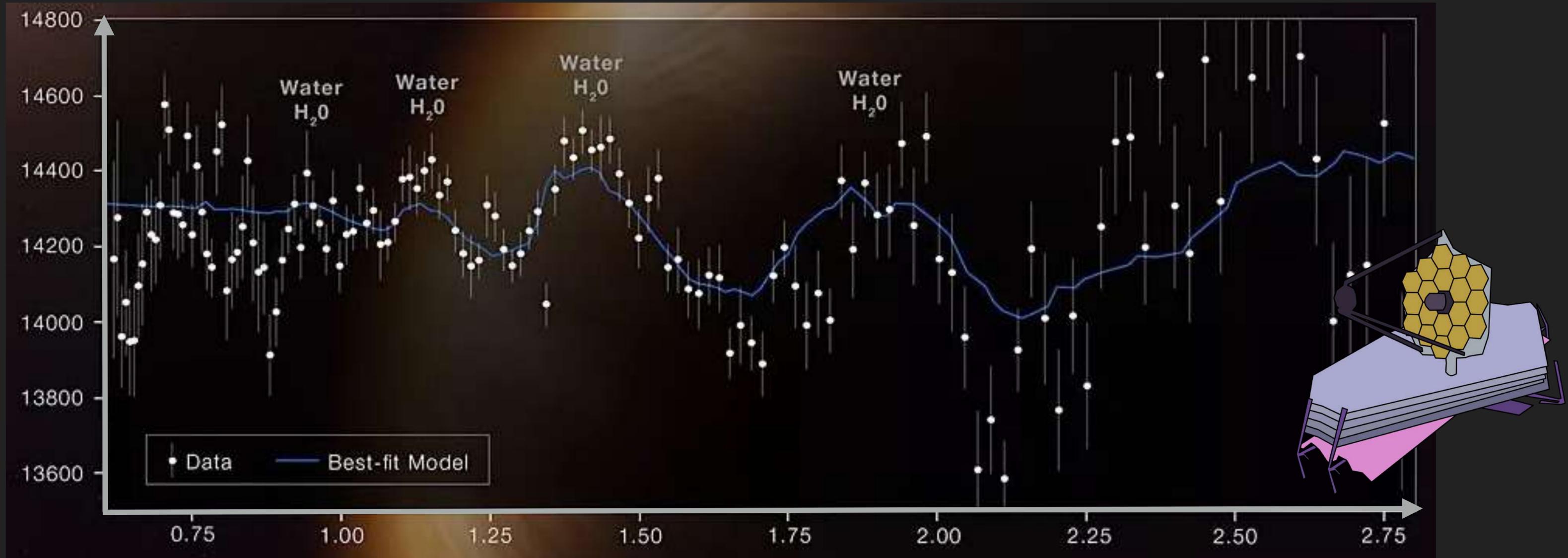


wavelength
of light

Spectrum (transmission spectrum)

Amount of
Light blocked
(parts per million)

WASP-96b



wavelength of light (microns)



<https://youtu.be/dUBxcVoKrD0?si=LGUyfO0GMTPAIh->

