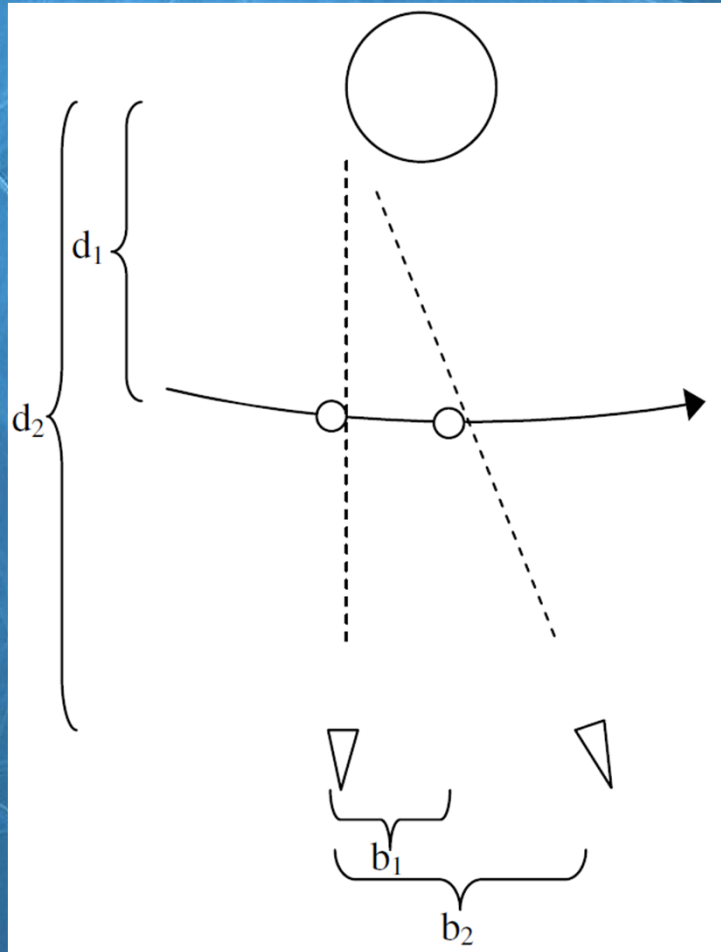


# On-sky Position Angles from Transit Timing

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# Introduction



• New observable from

• *from observing a  
separate (AU-scale)*

- Expected delay:

$$\Delta t_{\text{expect}} = \frac{b_1}{V} = \frac{b_1}{2\pi d_1 / P} = P \frac{b_2}{2\pi d_2}$$

- Parallax delay

# Non-Planar Geometry

- What if the orbital plain is tilted at angle  $l$

$$\Delta t_{\text{observe}} = \Delta t_{\text{expect}} \cos(l)$$

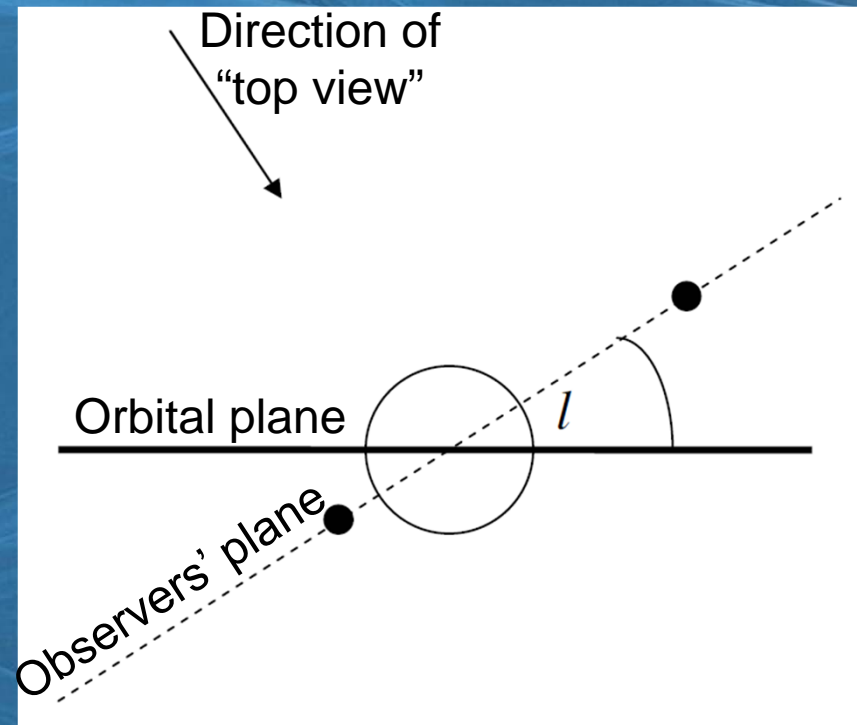
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- What if there are *two* transiting planets?

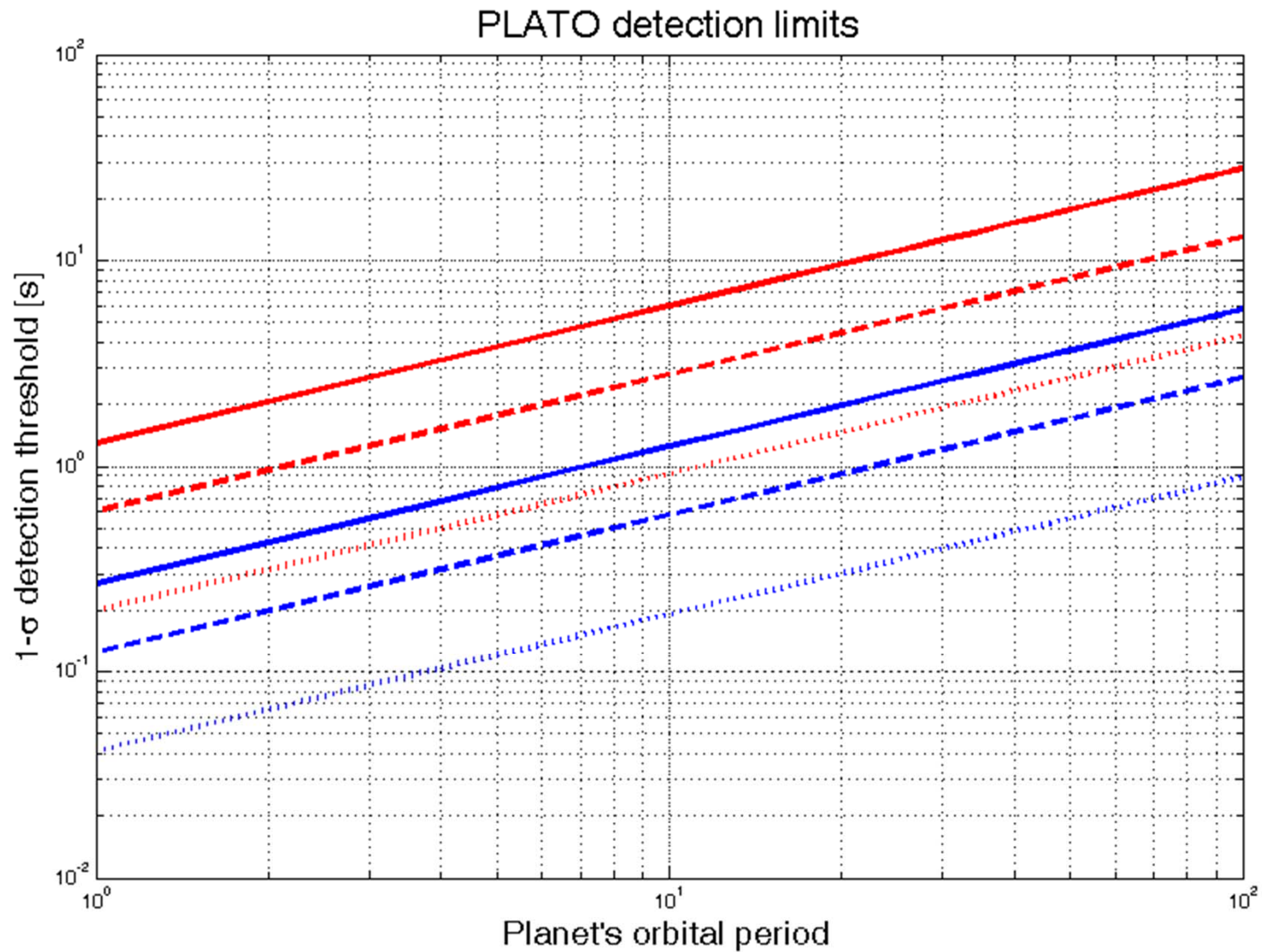
$$\begin{matrix} \cos(l_1) & \Delta t_1 & P_1 & b_{3,2} \\ \cos(l_2) & \Delta t_2 & P_2 & b_{2,1} \end{matrix}$$

- 

- Is this observable?  $\left[ \begin{matrix} P \\ d \end{matrix} \right] \left[ \begin{matrix} b_2 \\ AU \end{matrix} \right] \left[ \begin{matrix} d_2 \\ pc \end{matrix} \right]^{-1} [s]$



# And for PLATO?



# Some uses for the new observable

- Partial-plane direct imaging techniques.
- Variation of  $\cos(i)$  may allow inferring the existence of non-transiting planets.
- Connection with stellar companions
- ...

# Conclusions

- A fundamentally new observable from transit photometry.
- Some already-known planets may allow to measure  $\cos(i)$  in the near term.
- PLATO will allow to measure  $\cos(i)$  in large scale.

The background is a solid blue color with a complex, abstract pattern of white, glowing, and semi-transparent lines. These lines are curved and overlapping, creating a sense of movement and depth, similar to a network or a dynamic system. The overall effect is modern and professional.

# Thank you.