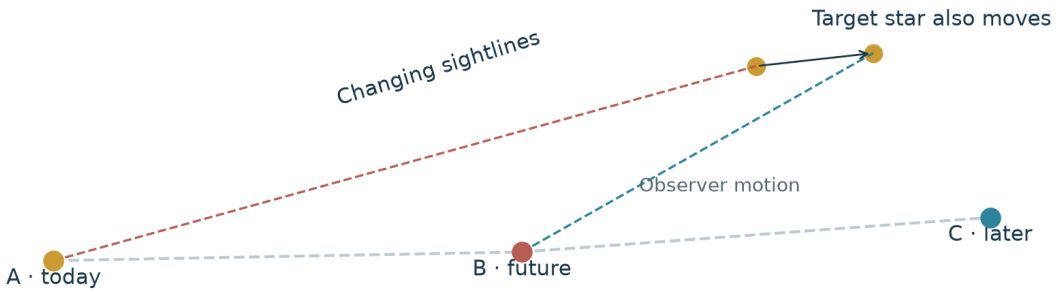
Does a moving viewpoint change the exoplanet sky?

Biswajit Jana | Finding Earth 2.0

The Moving Observer - discussion report brief | 24 October 2026

1. The original question

Finding Earth 2.0 began with a map of known exoplanet hosts. A catalogue snapshot prompted a broader question: as the Solar System moves from A to B and later C, while target stars also move, could changing sightlines make different planetary systems detectable? In particular, could a near-boundary system enter or leave transit visibility? The question extends beyond a century.



Schematic only: observer and target both move. A, B and C are observer epochs here, not the simulation's optional synthetic comparison stars. No positions or angles in this drawing are measured.

2. Geometry that makes the question testable

$$\mathbf{q}_i(t) = \mathbf{r}_i(t) - \mathbf{r}_{\mathrm{obs}}(t), \quad \hat{\mathbf{n}}_i(t) = \mathbf{q}_i(t)/|\mathbf{q}_i(t)|$$

$$\Delta\theta \simeq |\mathbf{v}_{\mathrm{rel},\perp}|\,\Delta t/D, \quad b = a\cos i/R_\star, \quad |b| < 1 + R_p/R_\star$$

$$P_{\mathrm{transit}} \simeq (R_\star + R_p)/a \simeq 0.47\% \quad \text{(Earth–Sun analogue)}$$

The observer position is the Solar position plus Earth's heliocentric offset. D is target distance; the transverse velocity is **relative to the observer**. The angular approximation requires a small change and nearly constant relative velocity. The transit condition assumes a circular planet orbit; inclination i is measured to the line of sight. The probability averages random orientations, not changing phases of a known planet.

Elapsed time	Solar travel at 233 km/s	Sightline change*
100 years	0.0777 light-years	20.6 arcseconds
10,000 years	7.77 light-years	0.573 degrees
100,000 years	77.7 light-years	5.73 degrees

*Illustrative linear estimate for transverse relative speed 30 km/s at initial distance 100 light-years. At 100,000 years the approximation is only an order-of-magnitude guide; a trajectory calculation is needed. These figures are not counts of new stars or planets.

The requested 100-light-year journey takes about 129,000 years. The long-clock model follows an idealized, nearly circular Solar orbit in a static, smooth axisymmetric potential. Evolution of the Galactic plane is omitted; the displayed warp does not drive the orbit.

From a question to a test

Independent research and simulation - seeking expert criticism

3. What has been calculated so far

Selected Gaia sample: 1,387 sources	Accessibility sum
2026 geometry; baseline thresholds	29.63207
2126 geometry; same thresholds	29.64118
2026 geometry; improved thresholds	102.72300

Century motion changes this direct-imaging accessibility score by about **0.03%**; the assumed instrument improvement has a much larger effect. The experiment inserts a hypothetical planet population and averages over isotropic viewing configurations. It **does not test transit-zone entry for known orbital planes**, nor predict discoveries or habitability. Some threshold choices reverse the motion effect.

4. What remains open

Transit visibility: which real systems, with constrained orbital planes, could cross a transit boundary as observer and host move? Radial-velocity amplitude also depends on viewing inclination through sin i, but a meaningful change must exceed instrumental and stellar noise.
Observing opportunity: do any target-priority gains survive binary dynamics, astrometric uncertainty, exposure times and a realistic survey schedule?
A probe left behind: which feasible second-observer trajectory would add useful geometry? A released probe inherits its velocity; a fixed Galactic marker is a hypothetical spatial reference, not a passive spacecraft.

5. Explore and reproduce

100 light-years: open the website's journey preview; the 10-second clip compresses about 129,000 years. Planets are unresolved and not extrapolated beyond their ephemeris range.
Sun & all planets: compare the Galactic and 98% co-moving frames; inspect the separate Earth-Moon close-up.
Space & Time: compare the 400 km and 20,200 km ideal Earth-orbit clocks. The report provides equations, inputs, CSV exports and limitations.

Limits and a request for guidance

The long-term Galaxy view is illustrative; its potential is not fitted to the latest rotation curve. Smooth density omits spiral-arm enhancements and does not forecast discovery counts. I am an independent researcher without a formal supervisor. I welcome corrections, relevant prior or follow-up work, and advice on the smallest scientifically useful next experiment.

Original note and selected foundations

Original two-page discussion note - preserved in full

Kaltenegger & Faherty (2021): changing Earth transit-zone membership

Bailer-Jones (2022): Gaia DR3 stellar encounters

Stark et al. (2024): HWO yield modelling

Simulation, full report and source:
biswajit1999.github.io/moving-observer/