

1 **Heavenly Lines:**

JavaScript-Generated Astrolabes for Celestial Navigation on Faraway Worlds

- 5 **An astrolabe is a sophisticated instrument used to measure the altitude of celestial bodies above the horizon.** Serving across Classical Antiquity, the Islamic Golden Age, the European Middle Ages, and the Age of Discovery as an analog calculator for identifying stars and planets, determining local latitude from time (and vice versa), and performing surveying and triangulation, it functioned as both an observational tool and a computational device.
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- 15 **The first universal astrolabe was invented by Abu Ishaq Ibrahim al-Zarqālī (b. 1029).** His “Tablet of al-Zarqālī” projected both the equatorial and ecliptic coordinates onto a vertical plane intersecting the celestial sphere at the solstices, enabling use at any latitude. Known in Europe as “Saphea Azarchelis,” it entered university curricula by the late 15th century.
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- 25 Trained as a metalsmith, al-Zarqālī refined trigonometric tables, calculated the ecliptic’s obliquity, and mapped stereographic projections. **Remarkably, he described planetary orbits as elliptical centuries before Kepler.** Copernicus cited him in “De Revolutionibus,” and Chaucer noted the practical importance of astrolabe skills in his treatise on the instrument.
- 30 **Inspired by al-Zarqālī, I generated astrolabes for eighteen celestial bodies, applying NASA data to capture their variations in axial tilt, orbital period, and rotational period.** Developed during my MIT Fellowship in the seminar “Recreate Experiments from History,” these digital instruments were sketched in p5.js, a JavaScript library for creative coding.
- 35 **This exploration demonstrates that astrolabes can provide navigational and temporal orientation beyond Earth, underscoring the enduring ingenuity of al-Zarqālī’s invention.**

40 Gary James Stilwell
 garystil.io@gmail.com
<https://astrolabe-sketches.space>

