

Visualising Astronomy: “Other Worlds”

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Key Words

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The International Year of Astronomy 2009 celebrates the 400th anniversary of Galileo’s use of the telescope for astronomical observations; if you’re reading this, you probably know the story by rote, but bear with me...

The discovery of Jupiter’s moons ranks as one of the most famous revelations that Galileo announced in *The Starry Messenger*, and to illustrate his breakthrough, he embedded a sequence of images in the middle of the text (see Figure 1). The series of woodcuts shows these “little stars” moving from night to night, leading to the conclusion that Jupiter must have moons like our own — not one single companion, but four. At this point in the story, the reader is typically reminded that Galileo used the observation of the Jovian satellites to bolster arguments in favour of the heliocentric planetary system. All well and good.

But other debates raged at the time, and other questions occupied people’s attention. Is the Universe infinite or finite? What is the nature of the planets? Are there other worlds, with other beings? Questions not unlike those that occupy astronomers today! Johannes Kepler showed a much greater



Figure 1. Pages from Galileo’s *The Starry Messenger* show his depictions of the moons of Jupiter integrated into the text.

tendency to speculate on such topics than Galileo, and indeed, taken together, the two represent complementary perspectives on astronomy at the time. (More than a few

people have argued that 2009 should also receive recognition as the 400th anniversary of Kepler’s *New Astronomy*, a tome that offered significant advances in the theory

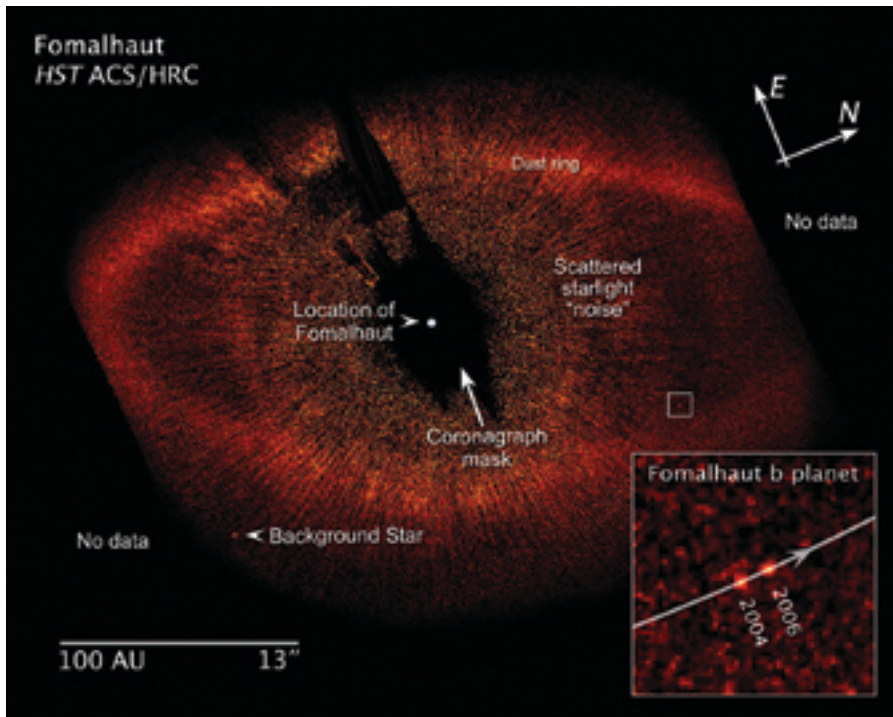


Figure 2. The Hubble Space Telescope image of Fomalhaut reveals an extrasolar planet observed directly in visible light.

and mathematics of astronomy. I'm inclined to agree with them, if not for the particular value of that work then for the general recognition of Kepler as an astronomical celebrity on par with his Italian counterpart.)

In response to Galileo's observations, Kepler wrote: "[Giordano Bruno and others] thought that other celestial bodies have their own moons revolving around them, like our earth with its moon... Moreover, they supposed it was the fixed stars that are so accompanied... Now the weakness of his reasoning is exposed by your observations. In the first place, suppose that each and every fixed star is a sun. No moons have yet been seen revolving around them. Hence this will remain an open question until this phenomenon too is detected by someone equipped for marvellously refined observations..."

Who would have guessed that we'd need to wait nearly four centuries for that open question to be resolved?

Over the last decade, marvellously refined observations have revealed the existence of hundreds of such "moons" orbiting other fixed stars... Observations the likes of which Kepler could never have conceived, relying on physical effects (spectroscopy, gravitational lensing) about which he knew nothing. But that remarkably straightforward observation eluded us: an image of another planet, simple reflected light from a distant point in orbit around another star.

In November 2008, two research groups announced independent observations of two

extrasolar planetary systems — one planet orbiting the star Fomalhaut (Figure 2) and three more revolving around the much less familiar HR 8799 (Figure 3). Much enthusiastic reporting and blogging ensued. We already know that such planets orbit other stars, so why do we get so excited about a couple of pictures?

Part of the accomplishment lies in the promise it holds for future developments — in particular, acquiring spectra and gathering astrometric data that could yield additional information. But of course, we already have spectra for a few planets, and we can even determine the size of transiting exoplanets. The excitement that surrounds the new pictures goes beyond their scientific merits.

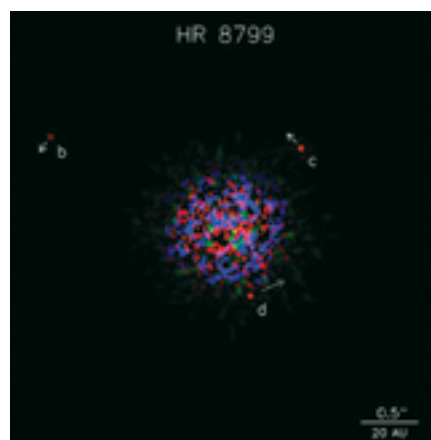


Figure 3. The Keck Observatory used adaptive optics in the near infrared to observe three planets orbiting HR 8799.

Like investigators at a crime scene, we want a snapshot. As Susan Sontag wrote, "Photographs furnish evidence. Something we hear about, but doubt, seems proven when we're shown a photograph of it." Somehow, these digital images are more real to us than the reams of spectra that have been collected on extrasolar systems thus far. A dip in brightness as a transiting planet dims the light of its parent star isn't as real as a snapshot of a tiny dot moving — not from night to night, but from year to year — around another sun. Even in an era of Photoshop and special effects, we accept some photographs as evidence.

Of course, Galileo didn't have recourse to photography (or digital imagery). His tiny woodcuts, dotting his text like frames from an animated film, had to suffice for presenting evidence to his readers. But his images and his eyes could be distrusted. After extolling (with typical verbosity) Galileo's virtues as a scientist, Kepler writes: "Shall he with his equipment of optical instruments be disparaged by me, who must use my naked eyes because I lack these aids. Shall I not have confidence in him, when he invites everybody to see the same sights, and what is of supreme importance, even offers his own instrument in order to gain support on the strength of observations? [...] Consequently I have no basis for questioning the rest of your book and the four satellites of Jupiter."

Criteria for evidence have changed over 400 years, but each generation holds to oddly image-based standards. If any observations qualify as "marvellously refined", the Hubble and Keck accomplishments should, alongside Galileo's pioneering efforts. Beyond the technological differences, the other worlds we discover seem to gain meaning through visual representation. Seeing is, perhaps, believing?

Notes

¹ Kepler, Johannes, *Conversation with the Sidereal Messenger*, as quoted online at <https://eee.uci.edu/clients/bjbecker/ExploringtheCosmos/week4e.html>

² Sontag, Susan 1977, *On Photography*, New York: Farrar, Straus and Giroux, p5, cited not so much for the perspicacity of this observation as for the general value of the work in stimulating thinking about the use of imagery in communication.

³ Kepler 1610, *op. cit.*

Biography

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