Astronomers scan hundreds of stars for 'anomalous transits'

December 19 2023, by Andy Tomaswick

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Telescopes have been collecting copious amounts of data on exoplanets in recent years. One of the most common datasets tracks what are known as transits, when an exoplanet crosses in front of its host star and dims

the star's light slightly as it does so. The majority of exoplanets have been found this way, but other interesting details might be hidden in the data.

For example, what would it mean if the transits happened in a way that disagreed with typical Newtonian physics? One answer to that question is that there might be an intelligent force behind the discrepancy—and that's what a group of researchers at Breakthrough Listen began looking for in a paper recently published on the *arXiv* preprint server.

Technically, the researchers weren't looking simply at transits but at a data set called a lightcurve. These graphs track an object's brightness over time—transits usually are identified by a noticeable dip in a star's lightcurve.

But how a star's lightcurve is affected by a planet could vary in several ways. For example, the path might vary somewhat across the star's surface or at a slower speed on a second pass. Anomalies like that keep astronomers awake all night—to do their job, of course.

In their downtime, though, they might be dreaming about aliens. A technologically advanced civilization could modify its planet's lightcurve through gigantic thrusters or a similar colossal engineering project. In fact, the planet itself might be such an engineering project, such as a Birch world or other megalithic structure.

The way to track that down would be to try to determine if there were any such anomalous lightcurves that other physical phenomena couldn't explain. Unfortunately, after a preliminary search of the lightcurve data from Kepler, the answer seems to be "no."

That's not to say there weren't any anomalous signatures at all. There were, in fact, 228 exoplanetary systems that had an anomalous signal.

However, 10 of those systems couldn't nicely fit into the software model the researchers decided to know (known, interestingly, as Batman), leaving them with 218 candidate systems to check manually.

To make that daunting task more accessible, the researchers broke the anomalous signals into three different categories—transits that appeared to be "missing," transits that were deeper than expected, and transits that had significant transit timing variations (TTV)—i.e., the planet was either going faster or slower than it was when it was initially seen.

Breaking down the details of these 218 anomalous systems takes up the bulk of the paper. Still, the outcome of all that research is there aren't any transits that look to be clearly created by something that could be considered technological—what modern-day astronomers have come to call a technosignature.

This is still early days, though. So far, we've found 5,000+ exoplanets out of the billions that probably exist. Statistics is not really on our side for this one, and as such more data is needed. Sifting through that data using techniques like the one developed in this paper will be a focal point of astrobiologists and others interested in SETI for the next few decades. They certainly won't lack for data to scroll through, as more and more planet-hunting telescopes continually come online.

More information: Anna Zuckerman et al, The Breakthrough Listen Search for Intelligent Life: Detection and Characterization of Anomalous Transits in Kepler Lightcurves, *arXiv* (2023). DOI: 10.48550/arxiv.2312.07903

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