Discovering a binary asteroid
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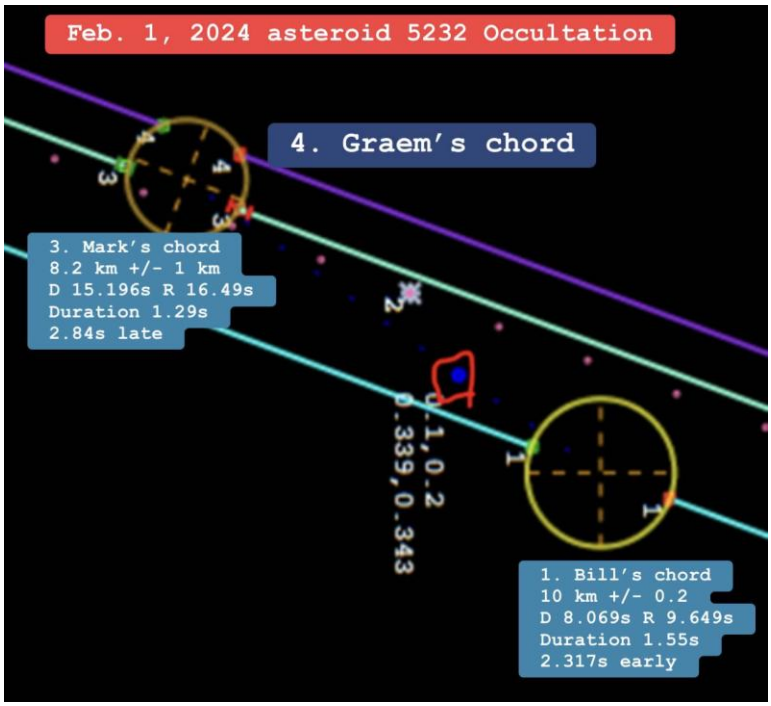
Amateurs can still make new discoveries in the JWST era

Since the first humans appeared, the beautiful night sky with sparkling starlight must have made our ancestors wonder about its beauty and mysteries. Astronomy was said to be the oldest science, and remains one of those rare fields in science that amateurs could still make contributions and discoveries. While we amateurs are enjoying the stunning photos bought back from space telescopes, first from Hubble and then the JWST, is there still anything left for amateurs to contribute in the age of these powerful space telescopes?

I first tried asteroid occultation during university in Edmonton during the early ’80s. All those first few attempted had failed miserably. Forty years later I returned to Calgary and picked up this old hobby again. After a year of trial and error, on the fateful night of February 1, 2024, RASC Calgary Centre members Graem Schmidt and Mark Simpson—who invented ASTRID (see below)—and I observed asteroid 5232 (Jordaens) occulting a magnitude 10 star with only 40 minutes advance notice. Noting the large difference in occultation time and other analysis, asteroid 5232 was found to be a binary asteroid indeed, just hours after the occultation was done.



There are a number of difficulties with asteroid occultation observations. They include large prediction error, adequate communication, keeping accurate time, and finding the often quite dim target star. Asteroid occultation has always been a less travelled road for amateur astronomers. Until a few years ago, only an estimated 5,000 observers had ever practised it. Until about a decade ago, the position in both the target stars and asteroid were about as good as 0.5 arc second and it produced a projection uncertainty of 500 kilometres on Earth, making it a difficulty for observers to place themselves at the right place. Also before the Internet age, making last minute path prediction correction had been difficult. Also every target stars looks alike (they are all pinpoints). Identifying the correct target star is not as easy as observing planets and deep sky objects. It is not uncommon for a beginner to observe the wrong star. And in the wilderness, it is not easy to obtain time signal better than one second.

The scientific benefits of asteroid occultation observations are many. With a successful occultation observation, the uncertainty of an asteroid position could be reduced from about half an arcsecond to a few thousandths of an arcsecond. This can help refine asteroid orbit calculations, provide accurate data to plan a spacecraft's flight path, determine the shape of the asteroid or if it is a binary, determine if it has satellites, or discover if the occulted star is a binary that is too close to be optically resolved.

A critical part of the success is ASTRID (ASTRonmy Imaging Device) invented by Mark Simpson. It is an integrated device that puts the CCD detector, electronics and software program in a single unit, which greatly improves the operation for asteroid occultation observation. It provides a time stamp with microsecond accuracy, and its prepoint function makes possible deploying multiple stations to gain more information on the asteroid profile. For ease-of-use, there is a polar alignment routine and a target identifying subprogram.

We used ASTRID to make our observation of asteroid 5232 on February 1, 2024. That evening, Mark noticed that an occultation by the asteroid would be shortly visible in Calgary. In spite of unfavorable factors like the short deployment time, we were able to set up at the edge of the prediction path, while the sun was still setting and sky was cloudy. An in-depth analysis of our results eliminated the possibility of the occulted star being a double and led to the discovery of the binary nature of asteroid 5232. This type of observation shows that with the right tools, an amateur with a modest telescope can still make a meaningful contribution to science.