Astro Dynamics

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• For those of us active in visual astronomy and/or astrophotography, one of the biggest downsides of the hobby is that after a few years one has seen/photographed essentially all of the interesting things in the night sky.

• So, the question becomes... Should I find something within astronomy that keeps me interested, or is it time to find another hobby to spend my time on?

• I would recommend going with the first option. Within that option, I can identify a few specific directions one can pursue:
  1. Buy better equipment and/or take much longer exposures.
  2. Travel to the southern hemisphere where there’s a huge number of cool astro things that we can’t see from up here in the north. Or, ...
  3. Simply revisit things you’ve already seen/imaged and hope to find that something has changed.

• The first two answers are the most commonly pursued directions. In this talk, I will elaborate on the third direction.
Supernovae – The Whirlpool Galaxy
Supernova Remnants – The Crab Nebula
There are two interesting things to observe in the animation:

1. The Crab Nebula’s size varies. It’s bigger in the 2019 image.

2. The bright star in the upper right part of the image seems to be moving.

Let’s focus on the varying size of the nebula. It’s expanding because this nebula is the remnant of a supernova explosion that took place in the year 1054 (almost one thousand years ago).

After a careful analysis, it appears that the nebula in 2019 is 1.288% larger than it was back in 2006.

Here’s an animation in which the 2006 picture has been enlarged by a factor of 1.288% (the stars appear to move but the nebula doesn’t vary)…
There were 4533 days between the two exposures. In years, that’s \( \frac{4533}{365.25} = 12.41 \).

If we denote the expansion factor by \( x \) and we assume a constant linear rate of expansion, then the formula for computing the date at which the supernova explosion took place is

\[
\text{date} = 2007 - \frac{12.41}{x}
\]

Plugging in the value \( x = 0.01288 \), we get an estimate of the date for the supernova:

\[
x = 0.01288 \implies \text{date} = 1043
\]

I recomputed the estimate by subsampling the measurements 34 different ways. Here’s the histogram showing the range of dates obtained:
Histogram of Crab Nebula's Supernova Date
Future Supernovae? – Betelgeuse
Betelgeuse
Betelgeuse

![Graph of Betelgeuse's spectrum on March 15, 2020](image-url)
Proper Motion – Barnard’s Star
The measured parallax is $0.5478$ arcsecs. Corresponds to a distance of $5.97$ lightyears.
M27 – The Dumbbell Nebula
Dumbbell Nebula

I uploaded the image from 2016 into https://astrometry.net to look up the exact coordinates of this picture.

I then used Cartes du Ciel (aka SkyCharts) to determine the precise RA and DEC of the variable object.

I uploaded the RA and DEC into the Simbad website and found that it is a Mira variable star.

It's V571 Vul in the Variable Star catalog and is also listed as a variable star in the Gaia DR2 catalog (number 1827257659609857072).

It was discovered to be a variable star only about 30 years ago...
Dumbbell Nebula

It was discovered by Leos Ondra in the spring of 1991 while looking at the covers of two astronomy magazines...
M13 – The Great Globular Cluster
Date: 20:18-22:22 EDT, Sept. 4, 2018
Telescope: 10” Ritchey-Chretien at f/9
Mount: Takahashi NJP equatorial mount
Camera: Starlight Xpress Trius SX-694
Filters: L (6 min), R (8 min), G (6 min), and B (6 min)
Exposures: 20 seconds, unguided
Seeing: Best Frame: FWHM = 0.98 arcsec
       Stacked Image: FWHM = 1.18 arcsec
Processing: log stretch, unsharp mask
M13 – The Great Globular Cluster
M13’s Gaia Stars
HR Diagram Based On My Image

Hertzsprung-Russell Diagram for M13
M15 – Another Great Globular Cluster
M15 – Another Great Globular Cluster
We Want Your Feedback

The AAAP would like to hear feedback from you regarding *Zoom – The Experience*.

To provide your feedback, send an email message to

meetfeedback@princetonastronomy.org
Questions?