USING OLD TRICKS TO DISCOVER NEW VARIABLE STARS

Daniel H. Kaiser
Crescent Moon Observatory
2631 Washington Street
Columbus, IN 47201

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Abstract

Using the nearly one hundred year old technique of comparing photographs of the same sky area taken on different dates, over three dozen previously unrecognized variable stars have been found. The necessary procedures to identify discoveries are discussed.

1. Introduction

Astrophotography was originally used in astronomy not only to record objects, but also as a method of discovery. Film will record large star fields for close examination. Photographs of the same field taken on different dates are compared, and any changes can be found by rapidly looking at first one photo and then the other. This is done with a device called a blink comparator. If an object was on one photograph but not the other, it would call attention to itself by apparently blinking on and off. An object would also blink if it had moved or changed in brightness. Many comets, novae, asteroids, and most variable stars have been discovered with this method.

I have been conducting my own photographic sky patrol from my backyard since 1986, and have found over three dozen previously unnoticed variable stars. The discovery process is in three stages: (1) taking patrol photographs; (2) comparing photographs; and then (3) identifying suspects.

2. Photography

The simplest astrophotography, piggyback astrophotography, is perfect for patrol work. Since we are talking about searching for objects with unknown locations, we need wide fields to search. A 35-mm camera piggybacked on a equatorial telescope works fine. I recommend a 50-mm to 135-mm lens, which gives good sky coverage without crowding. I use a 135-mm lens, which covers a 10 x 15 degree field. If the telescope is aligned and tracks well, no manual guiding is necessary.

It is necessary to center the camera on a repeatable spot. Since we intend to compare photos, orientation is important. For this reason, I believe barndoor-type trackers would not be suitable. A field shot in the eastern sky may not match up well with the same field photographed in the western sky. It is also important to take accurate notes. Number each roll and frame. Note the field being photographed, along with the double date and time (10/25-26/91, 02h 52m UT); using UT will eliminate confusion when communicating with observers in other time zones. Also record the lens, f-stop, and exposure, along with film type. I have made up a form so that I always remember to record everything, even if it is 2 A.M.

Take two frames of each star field. This is very important. ALWAYS two frames! Sequentially, not simultaneously! If you find something, but you have only one photo, are you sure it is real? Can you prove it? If you have two frames, you can. Save all of your patrol photographs. Photos from last night may not compare well with photos taken the night before or last week, but may match well with some taken last month or last year.

They may also contain information that you missed the first time around!

As for film, any slide film will do. Naturally, the finer-grained and faster films would be better. I use Ektachrome 400 color slide film. With 5-minute exposures, this will reach 10th magnitude and fainter. I like it because I can develop it myself, or have it done commercially. I have experimented with hypered Tech Pan 2415 black & white negatives mounted as slides. This shows promise, recording fainter stars with similar exposure times. Tech Pan is the preferred film of professionals. However, the Ektachrome 400 requires no special hypersensitizing equipment or handling. Since I make no prints, neither film requires a darkroom.

3. Comparing

There are several plans available for a home-built comparator, and it will not cost thousands of dollars. Ben Mayer's PROBLICOM (PROjection BLInk COMparator) (Mayer 1977) is made by using two slide projectors. Howard Lazerson designed a small electronic comparator (Lazerson 1994). Several comparators can be seen and are discussed in William Liller's book, *The Cambridge Guide to Astronomical Discovery* (Liller 1992). This book is highly recommended for anyone interested in the methods of astronomical discovery.

When one has built a comparator and has photos from several nights, blinking objects will be found. The problem will not be finding blinking objects. Rather, the problem will become identifying what has been found.

4. Identifying suspects

Don't expect to discover anything new right away. I said blinking objects will be found, not necessarily *new* blinking objects. My own patrol was almost a year old before my first discovery materialized.

Well, what will be found? It is a safe bet that if you have photos taken a month or more apart, you will find some previously discovered variable stars, maybe a bright asteroid, and probably an airplane or two. Satellites are a good possibility also.

To identify asteroids, one can wait a day or two and rephotograph the field to check for motion. Novae come out of nowhere and so will be on one night's photos but not on others. These were my original targets. Alas, I still have found none.

This leaves variable stars. Any systematic patrol will find lots of variable stars. I started looking for novae in 1986. When I found something blinking on my PROBLICOM, I would check the location of my blinker against the *AAVSO Variable Star Atlas* (Scovil 1990). It has most variable stars brighter than 10th magnitude identified. This identifies most finds. If my suspect was not in the AAVSO atlas, I would determine coordinates and then manually search the *General Catalogue of Variable Stars* (GCVS) (Kholopov *et al.* 1985), *The New Catalogue of Suspected Variable Stars* (NSV) (Kholopov *et al.* 1982), and the *Name Lists*, the periodic updates to the GCVS published in the *Information Bulletin on Variable Stars* (IBVS). Determining coordinates would sometimes require plotting known stars from the *SAO Star Catalog* (Haramandanis 1966) on graph paper and reading off the suspect's coordinates.

Fortunately, I have found a much faster method. Today when I find a suspect, I go to the computer. The commercial program GUIDE (Project Pluto, Ridge Road, Box 1607, Bowdoinham, ME 04008) has the SAO, GCVS, NSV, and the *Name Lists* on file. This program also contains the entire *Hubble Space Telescope Guide Star Photometric Catalog* (GSC)—over 15 million stars!—along with a list of over 5000 asteroids and about every other astronomical catalogue one could imagine. A search that formerly might require an hour and a half with graph paper and catalogues now takes less than 1 minute.

In just a few moments one can identify a blinking object as a known asteroid or known or previously suspected variable star. If it's not in GUIDE, one probably has a discovery! Of course there is the possibility that its discovery by someone else is so recent that it has not made it into GUIDE.

5. Conclusion

Systematically patrolling for discoveries requires dedication and perseverance. I have exposed over 180 rolls of film, which averages out to more than 4 rolls per discovery. It also can be fun, standing under the night-time sky, recording and bathing in starlight. Following up on the discoveries, determining periods, amplitudes, and types, has also been enjoyable. But that is another story.

If anyone has found something they are having difficulty identifying, feel free to contact me. Remember though, if you have a possible discovery, please make sure that you have two photos showing the suspect bright, and two showing it faint or absent. One photograph showing an unidentified starlike object is not enough. Confirmation is the key.

And remember what Ben Mayer once wrote: "A camera in its case, just like the hook in a tacklebox, will never produce a 'catch'; only if it is properly 'baited' and 'trolled in the ocean' can it reward the patient and persevering 'fisherman' with a record prize." (Liller and Mayer 1985).

References

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