Citizen Science Using Remote Telescopes

Part One: Variable Stars

Amateur astronomers have a huge role to play when it comes to citizen science. However, we don't all have the high-end equipment to involve ourselves in the best opportunities. Remote telescopes offer a solution that may work for you. One definition of a remote telescope is “Go-To Telescopes where the observer is not responsible for maintenance and operation of the telescope”. However, the observer is responsible for the selection, definition, and timing of the observation, and the exposure times, cadence, filters, and processing used to create the final images. They are also responsible for measurements such as astrometry (position), photometry (brightness) and other useful data.

R-COP at Perth Observatory

There are remote telescopes available on a commercial basis, and others available as part of research partnerships. By using remote telescopes, we can add to the knowledge base of astronomy and reach that goal without significant expense on our own part. For this first article, I will discuss below a few examples of one of the major ways to get involved – observing, measuring, and reporting variable stars.

Variable Stars

Variable stars provide several ways to perform citizen science. Measuring variability has taught us the inner workings of stars, set stellar and galactic distances, and helped explain how stars

form and die. Some of the best-known targets can be seen naked eye or with a small telescope, such as tracking the variability of long period variables (Mira), eclipsing binaries (Algol), Cepheid variables (Delta Cephei) etc. You may wish at some point to find dimmer and more challenging targets, such as young stellar objects, novae, and spectroscopy. All these things can be done using remote telescopes, and the findings reported to the American Association of Variable Star Observers (AAVSO). Each week, I get a report of who used my observations, and why:

Date	Star name	# obs.	User	Purpose
2022-07-31	MIRA	38	Stu	Analysis
2022-08-01	NOVA PER 2020	4	Pro	Analysis
2022-08-02	EPS AUR	27	Stu	Education
2022-08-03	RS OPH	1	Pro	Figure
2022-08-03	RS OPH	5	Pro	Figure
2022-08-04	EX LUP	18	Stu	Analysis
2022-08-06	R AQL	4	Am	Analysis

Supporting Hubble Missions

One exciting offshoot of this is to provide ground support of missions done by Hubble Space Telescope. The science being done by HST may be adjusted based on this ground support, with changes made or even rescheduling the HST observations based on findings by amateurs. In some cases, a star may be best observed when brightest, or it may have to be delayed if a flare up occurs. Often, the request is for multiband (B,V,R,I) imagery and even spectroscopy. In all cases, the requests are time sensitive.

Don't Stop Helping Hubble!

The AAVSO publishes alert bulletins on upcoming missions that need observations of certain variable stars to support an upcoming or ongoing Hubble mission. The bulletins provide details on the star, the timing, the filters requested, and even have some background on what the observation is about. I've been fortunate enough to get involved in some of them, including the recent ones below:

ALERT	DATE	STAR	MY OBS	REASON
779	6/7/2022	U Sco	11	Recur Nova
780	6/14/2022	IM Lup	19	HST
780	6/14/2022	RX J1556.1-3655	12	HST
780	6/14/2022	Sz100	14	HST
780	6/14/2022	Sz104	11	HST
781	6/14/2022	V0415 Mus	31	Nova
782	7/5/2022	V908 Sco	9	HST
783	7/5/2022	V485 Aqr	1	HST
788	8/1/2022	RU Lup	7	HST

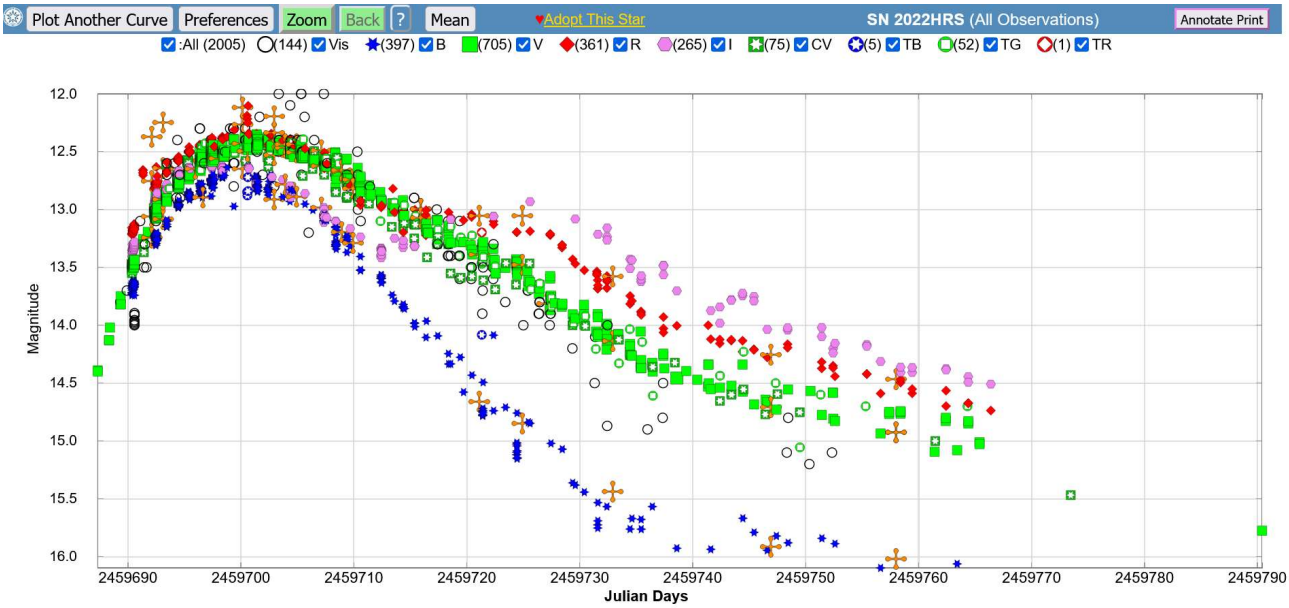
Note: if you want to look up any of my observations on the AAVSO website, my ID is YBA

Extragalactic Supernovae

Another exciting way to observe variable stars are the extra galactic supernova (EGSN). The Milky Way just won't give us a supernova since the invention of the telescope, but we have developed the equipment to see several a year in other galaxies. One famous one this year (SN 2022rms) occurred in NGC 4647; a galaxy right next to Messier 60.

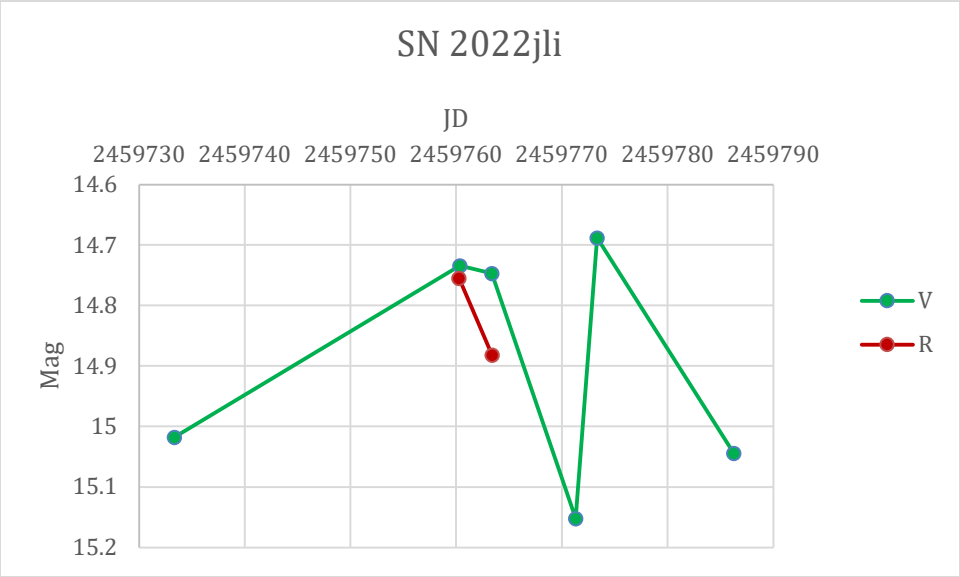
Image by Author

Not only was the supernova brighter than its host, but the location made it easy to observe. I touched on that in a short article earlier this year, and one of my friends in the Astronomy Club of Tulsa, Stan Davis just wrote a great article on his observations of it (using his own equipment). The latest light curve looks like this (with my observations as crosses):



There have been other EGSN this year that I've been able to observe including SN 2022jli in NGC 157. Although poor weather limited the number of observations, I was able to see the double peak indicative of a Type Ic supernova. I'm not claiming to have identified it as such, but it was nice to see this [verified by others using its spectrum.]

Image by Author



Active Galactic Nuclei

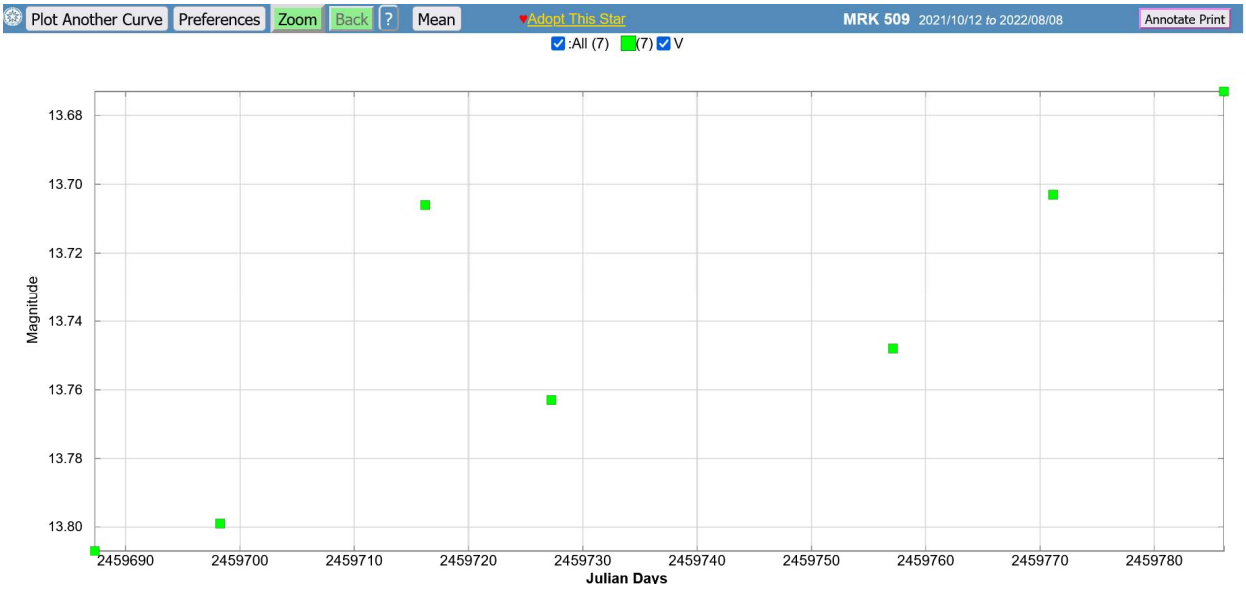
There is also a group of variables known as active galactic nuclei which are not the same as EGSNs but indicative of variability in the nucleus itself. This group includes objects such as quasars, blazars, BL Lacerta objects, and more:

Features of different types of galaxies

Galaxy type	Active nuclei	Emission lines		X-rays	Excess of		Strong radio	Jets	Variable	Radio loud
		Narrow	Broad		UV	Far-IR				
Normal (non-AGN)	no	weak	no	weak	no	no	no	no	no	no
LINER	unknown	weak	weak	weak	no	no	no	no	no	no
Seyfert I	yes	yes	yes	some	some	yes	few	no	yes	no
Seyfert II	yes	yes	no	some	some	yes	few	no	yes	no
Quasar	yes	yes	yes	some	yes	yes	some	some	yes	some
Blazar	yes	no	some	yes	yes	no	yes	yes	yes	yes
BL Lac	yes	no	no/faint	yes	yes	no	yes	yes	yes	yes
OVV	yes	no	stronger than BL Lac	yes	yes	no	yes	yes	yes	yes
Radio galaxy	yes	some	some	some	some	yes	yes	yes	yes	yes

Source: Wikipedia

These usually have AAVSO identifiers and can be easily reported, although many of them are faint and require larger scopes and/or long exposures. One good example is Mrk509; I have shown my recent reporting as a light curve below:



Of course, these objects and many others can also be observed remotely using radio telescopes, though use of those instruments is often more difficult to acquire.

Next Article

In the next article (Part 2) I will review how remote telescopes can help track and identify minor planets of all kinds for several different uses by science. I will also discuss tracking lost spacecraft and the debris in high orbit that may pose issues for spaceflight. And remember those comets you never got to see? Image them remotely, and you can help by reporting that data too.

Acknowledgement and Thanks

Most of the citizen science work I've done over the last six years has been with the use of a telescope at the Perth Observatory in Western Australia. They have been highly supportive of all my efforts and continue to help me and their other research partners throughout the world to add to our knowledge of the universe.

References:

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