NOVAE & SUPERNOVAE: SEARCH AND FOLLOW-UP OBSERVATIONS

Based on a talk at Clanfield, 2010 March 13

Guest Stars

For nearly 2000 years there were ‘Guest Stars’ occasionally seen appearing in the sky but no talk of supernovae or novae until the early 1920’s. The sudden appearance of a magnitude -8 star in Lupus in 1006, visible in daylight and followed with the naked eye for about two years, was meticulously recorded by the Chinese. Further guest stars appeared in 1054 (now the Crab Nebula remnant in Taurus), 1181 (Cassiopeia), 1572 (Cassiopeia), and 1604 (Ophiuchi). All this was before the use of the telescope on the night sky in 1609.

The Reverend Thomas Anderson went on in more modern times to find ‘new stars’ in Auriga (1892) and Perseus (1901) but these were fainter suggesting perhaps two categories of such events. This was confirmed with the earlier bright stars being supernovae in which a star destroys itself and the fainter ‘Anderson objects’ being novae when a white dwarf in a binary loads itself with material taken from its companion and forms a shell which is thrown off in an explosion but leaving the white dwarf intact.

UK Nova/Supernova Patrol formation

The UK Nova Patrol was started in 1976 by the late John Hosty and the present coordinator and early in 1977 John found a nova in Sagitta (HS Sge) visually with half a pair of 10x50B’s. Of the nine nova discoveries to date only the Sagitta object was found visually and the rest by photography/imaging. As most novae occur in the Milky Way, this was divided into 121, 10-degree zones and initially four areas allocated to those joining. Photography and later imaging via digital CCD cameras have opened this up to a wide variety of amateur astronomers. Surprisingly, within a few months, newcomers gradually memorise the stars in an area down to about magnitude 8, which helps to detect an intruder as it disturbs the patterns. Imagers can use the blinking technique with various software to rapidly view a master frame against the latest image where newcomers seem to flash on and off. Limiting magnitudes of 12 can be achieved within 10-20 secs but short exposures avoid serious trailing.

Practical nova exercise

A practical nova exercise was then conducted based on George Alcock’s discovery of a nova in Vulpecula in 1976 (NQ Vul). Actual images of 1976, before the nova and after, allowed participants to convince themselves that an intruder can be spotted. Additionally magnitude estimates were taken at discovery and later by attendees showing the object was caught on the rise and this showed that a group of observers whose results are averaged can produce magnitudes in close agreement with the discoverer.

Recurrent novae and classical novae near minimum

The classification of nova light curves by Cecilia Payne-Gaposchkin broadly showed three variations in decline from smooth linear decay, undulating activity in the transitional phase to a deep minimum before recovery and final smooth fade. Zwicky in 1936 proposed a 'life-luminosity relation' so that novae might be considered as standard distance candles though this proposal has never taken hold. Kasliwal (2010 Mar) proposed a new faint nova group found at Palomar. All this suggests standardisation of light curves is difficult and has been borne out by their wide variety as collected by the patrol often with some objects rising to a pronounced second maximum. There is a need for patrollers to help extend the fainter end of light curves especially using CCDs.

Progenitor searching is also needed and recently Ernesto Guido has submitted animated GIFs blinking between images of newly discovered novae and old professional survey pictures. KT Eri (nova 2009), the first found in that constellation, was identified with a magnitude 15 star.

Novae at minimum can also be studied by photometry and recent work by the author suggests several show variation at quiescence so more measurements are needed.

Additionally a recent paper by Brad Schaefer listed 10 recurrent novae where outbursts have occurred two or more times and recently U Scorpii was found in outburst by Angela Harris of USA after her dog barked and woke her up early morning leading to her use of the telescope! RS Oph and T CrB are always worth checking as they can become quite bright.

Search and Follow-up observations of supernovae

After adding supernova search to the patrol, initially under the supervision of Nigel Henbest, on 1996 October 23 Mark Armstrong discovered a supernova in NGC 673, the first ever found from the UK. The author enlisted the help of staff at the ESO to obtain a spectrum in confirmation. By 2010 February, Tom Boles had found 129, recently breaking Zwicky's record and, in addition to Mark's tally of 73, Ron Arbour has also found 22. All this work has been by regularly imaging large numbers of galaxies and blinking them against earlier masters and it is the checking which is particularly challenging. Consequently, unlike the binoculars needed for nova hunting, searches for supernovae require telescopes with large apertures, say 30-cm or greater, preferably by imaging though considerable success has also been achieved visually by Bob Evans of Australia for the brighter objects. For those without a telescope it may be possible to use a remote robotic such as the Bradford telescope in Tenerife especially for the much needed follow-up photometry.

As with novae, supernovae often do not follow a standard pattern. Type Ia involving a binary, have been used as distance candles based on comparing their absolute and apparent magnitudes with an adjustments for the speed of decline but many

show markedly irregular declines making this difficult. Other objects, such as SN 2009jf, seem to continue brightening well after discovery and yet others remain at standstill for a much longer time than expected. More help is needed again to extend these light curves to as faint a magnitude as possible.

Future of the Patrol

The search for novae and supernovae remains paramount and these aims offer potential patrollers the chance to use equipment ranging from modest binoculars (e.g. 10x50B or similar) to large aperture telescopes with imaging options.

However, in addition, follow-up observations of these objects are vital to investigate the myriad of light curve varieties. This may become especially important for supernovae as recent discussion suggests lack of spectroscopy might mean light curves become a major source for classification of supernova types.

Application forms to join any section of the patrol can be obtained from the undersigned.

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