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# GSC 2139 2190 IS A SLOWLY CHANGING BE VARIABLE AND NOT A HOT LOW MASS POST ASYMPTOTIC GIANT BRANCH STAR

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GSC 2139 2190 ($\alpha_{2000} = 19^{\rm h}42^{\rm m}05\overset{\rm s}{.}5$; $\delta_{2000} = +23°18'59''$, Wyn Evans, 2003) is characterized in Gauba et al., (2003), following somewhat on earlier work, as being a possible hot low mass post asymptotic giant branch (post AGB) star of the pre planetary nebula ilk, based on its early spectral class (it is the OB star LS II +23 17; Stock et al., 1960), $H\alpha$ emission (HBHA 0038-54; Kohoutek and Wehmeyer, 1999) and supposed association with the adjacent infrared source IRAS 19399+2312's (Joint IRAS Science Working Group 1988) spectral distribution. The IRAS object may also be MSX5C_G059.3036+00.0819 (Egan et al., 1999).

During follow up work upon a list of prospective variable stars earmarked by T. Droege (2003) as part of his TASS Mk IV camera all sky survey (`http://www.tass-survey.org`), the distinct nature of this object from the usual 'run of the mill' variables was immediately apparent.

Utilising data for the object gleaned from the TASS Mk IV online database (Sallman and Droege, 2003+) it can be seen that it is indeed variable, showing a slow secular descend on the whole, and is nicely confirmed by ASAS3 data (Pojmanski, 2003+) both in general trend and at points of overlap, as well as during a small 'spike' event. This discovery of variability within this object in this way led to the current work. The data is repeated here as Figure 1.

Low amplitude, nonperiodic, variation over long intervals for luminous post AGB stars is not unprecedented in the literature (eg HD 213985 , Waelkens et al., 1987), so at first sight it seems that another candidate such object has been discovered.

However, several strong pieces of contradictory evidence go against this interpretation. The first area of uncertainty is the association of this star with the stated IRAS and MSX5C sources. Although these objects often have worse positional errors than the internal ones quoted in the catalogue, there are many other stars in this crowded Galactic area that could just as easily be associated with them. Indeed, it is not even certain if the infrared sources are the same as each other, and there is half the distance between their catalogue positions than either has to GSC 2139 2190. Further, the MSX5C source is only visible to band A of that experiment, usually interpreted as due to silicon emission, as can be found associated with evolved red giants.

In this context, the 2MASS $J-K_s$ colour of GSC 2139 2190 is given as +0.28, whereas there are several stars more adjacent to the IRAS and MSX5C source more than red enough in $J-K_s$ colour to be red giants. Further still, Reed B. Cameron (1998) gives

GSC 2139 2190 as having $U - B = -0.20$ and $B - V = +0.78$ for this star. Utilising the dereddening parameter $Q = (U - B) - 0.645(B - V)$ (Heintze, 1973), $Q$ is –0.70, equivalent to spectral type B2, which agrees well with the listed spectral type of B1 III (eg Gauba et al., 2003), although B1 IIIe would be more appropriate given by Kohoutek and Wehmeyer (1999). This suggests an approximate $E(B - V)$ of $\tilde{}1^{\rm m}$ for this early B star, suggesting that the difference between this object's $J - K_s$ colour and the $J - K_s$ colour for an early B star, a difference of about $0\overset{\rm m}{.}4$ numerically, can be comfortably attributed to reddening (given the lesser extinction rate at $J - K_s$ than $B - V$). Thus it seems unlikely for a star with no near infrared excess of any kind around the 2.2$\mu$m mark to be the same object as the approximately 10$\mu$m band A source in MSX5C, or the longer infrared wavelength's IRAS source.

The more telling point, however, is that this object cannot be a Population II Halo object presently lying coincident upon the Galactic Plane simply by the fact that, despite its position away from the main body of stars, it is a physical member of the open cluster NGC 6823, thus making it an evident Population I object. Strangely, this point is missed in SIMBAD, where the star is listed as two separate, unlinked, objects at the same position (ALS 10422 and NGC 6823 208), although both these objects' positional and photometric details make it quite evident that they are the same.

The association of this object with NGC 6823 (itself associated with the OB association Vulpecula OB1) based on proper motion consideration was first noted in Erickson (1971), and can be readily confirmed by comparison of the proper motions of the brightest OB stars central to the open cluster with that of GSC 2139 2190 using the latest UCAC2 values (Zacharias et al., 2003).

A simple independent check on this can be given via the objects spectral type and the $B - V$ of +0.8 (above) of this star being taken as giving $E(B - V)$ of 1.1, for a B1 giant which should have a $B-V$ of –0.3. Using the widely accepted relation of $A_v = 3.3E(B-V)$ gives $A_v = 3.6$, and using that as a correction to the distance modulus, i.e. $m - M - A_v$, taking the absolute magnitude of a B1 giant as being –4.4 (Jaschek and Jaschek, 1987), and representing the apparent $V$ magnitude by 10.2, being the median of the $V$ data in Figure 1, gives a distance modulus $m - M - A_v$ of 11.0, comparing well with the value of 11.5 given by Humphreys and McElroy (1984) for Vulpecula OB1.

GSC 2139 2190 is therefore a spectroscopic type Be star of GCVS variability type BE.

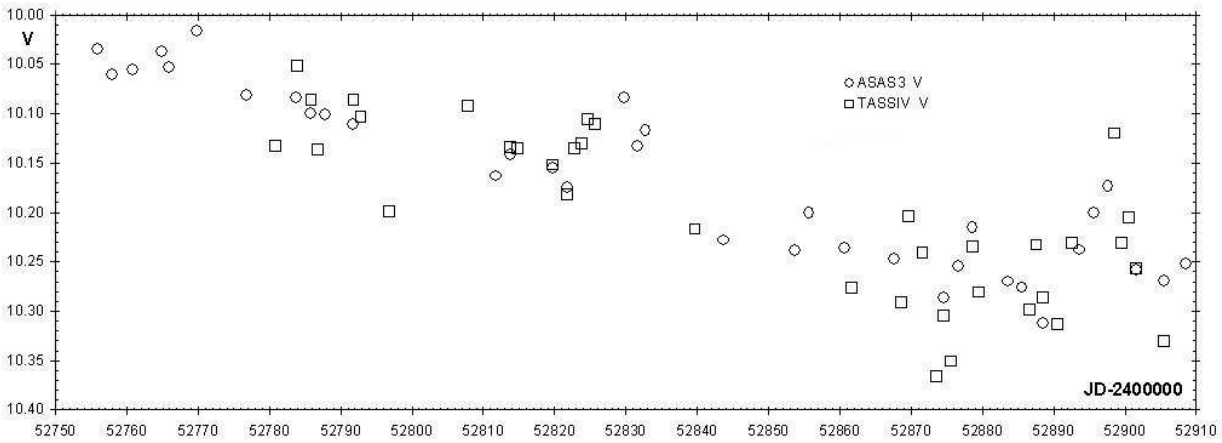


**Figure 1.** TASS Mk IV (squares) and ASAS3 (circles) V observations of GSC 2139 2190.

GSC 2139 2190 shows low amplitude variability on the time scale of hundreds of days, with at least one instance of a 0.1 $V$ spike on a much shorter time scale. Although the literature suggests that this is a Population II Halo object, specifically a hot low mass protoplanetary nebula forming post asymptotic giant branch star, it is in fact a Population I Thin Disk object within an OB Association and a member of an open cluster. Given that high Galactic latitude Be stars are not unknown, and in fact are relatively common (usually being considered as 'runaway' objects expelled from binaries born in star forming regions), and that it seems the light curves of variable candidate post AGB and protoplanetary nebulae stars (ppn) are indistinguishable by morphology, re-examination of candidate hot low mass post AGB stars may be in order, to ensure their nature is assessed correctly. Formerly, theory led examinations of objects that have been published in the literature, including the star researched here, found evidence confirming GSC 2139 2190 as likely a candidate hot low mass post AGB / ppn star, whereas when the star was examined for its own sake in an object led appraisal, stimulated by a happenstance discovery of variability during an observational survey, its true nature and environment were readily evident.

It is also to be remembered, as noted by the CDS themselves, that SIMBAD is primarily a device for integrating catalogues. This does not necessarily assure that the data within the catalogues therein, nor the cross-relationships derived therefrom, are authoritative. There is no indication that the nearby IRAS and/or MSX5C sources are any more likely to relate to GSC 2139 2190 than any other object in the field.

A detailed spectroscopic analysis of the star would go far in clarifying and confirming the issue.

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