THE RECURRENT NOVA CANDIDATE M31N 1966-08A = 1968-10C IS A GALACTIC FLARE STAR

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Rosino (1964, 1973) and Rosino et al. (1989) conducted a multi-decade (1955 – 1986) imaging survey for novae in M31 using the 1.22m reflector at the Asiago observatory, supplemented from 1973 onwards with observations from the 1.82m telescope at Mount Ekar. During the course of the survey, Rosino discovered a total of 142 nova candidates in M31. As described in Shafter et al. (2015), based on spatial coincidence, a total of six of these outbursts (R029 = M31N 1960-12a, R039 = 1962-11a, R048 = 1963-09c, R066 = 1966-08a, R079 = 1968-09a, R081 = 1968-10c) were found to be associated with 4 recurrent nova candidates (M31N 1960-12a = 2013-05b, M31N 1926-06a = 1962-11a, M31N 1963-09c = 1968-09a = 2010-10e = 2015-10c, M31N 1966-08a = 1968-10c).

Perhaps the most interesting of these eruptions is the last pair, M31N 1966-08a = 1968-10c (R066 = R081), which were observed on 12 August 1966 and 25 October 1968, respectively. Available observations restrict the duration of the eruptions to less than 2 days. Not only is the interval between eruptions (~ 2.2 yr) extremely short – shorter than any known recurrent nova with the exception of the remarkable system M31N 2008-12a with a ~ 1 yr recurrence time (e.g., see Darnley et al. 2017a,b; Henze et al. 2017, and references therein) – but unlike 2008-12a (where an eruption has been detected every year for the past 9 years), M31N 1966-08a was only seen in eruption twice in the past half century. It would be surprising if M31N 1966-08a were a recurrent nova in M31 or a foreground Galactic dwarf nova, as such systems typically remain near maximum light for several days, or more. Given that the object lies just $16'$ from the center of M31 in a region of the galaxy that is routinely monitored down to $m \sim 18$ by a number of amateur and professional astronomers alike, missing additional eruptions would be particularly unlikely. On the other hand, the less predictable and much shorter duration flares from dMe stars (hours) could have more easily escaped detection.

To explore the possibility that M31N 1966-08a might be a foreground Galactic flare star, we examined the deep photographic images of M31 from Massey et al. (2006). A stellar object, J004123.75+411459.6, with $V = 20.3$ and $U - B = 1.9$, $V - R = 1.5$, $R - I = 2.0$ was found just $0.8''$ south of the nominal position of M31N 1966-08a ($R.A. = 00^{\rm h}\ 41^{\rm m}\ 23.75^{\rm s}$, $Decl. = +41^\circ\ 15'\ 00.4''$). The star has also been detected in the infrared as 2MASS 00412375+4114596, with $J = 15.3$, $H = 14.9$, and $K = 14.4$ (Skrutskie et al. 2006). Given its proximity, we have assumed that this star is the progenitor of M31N 1966-08a and 1968-10c. The implied outburst amplitude of $\sim 3 - 4$ mag would be unusually low for a recurrent nova (without precedent, in fact), but not unprecedented for a dMe star, which can have flares of up to $5 - 6$ magnitudes (e.g., see Hawley & Pettersen 1991; Kowalski et al. 2010, for the bright flares in AD Leo and YZ CMi, respectively).

To confirm the flare star hypothesis, on 2017 Nov. 23.27 UT we obtained a spectrum of J004123.75+411459.6 with the LRS2 spectrograph on the Hobby-Eberly Telescope (HET). The spectrum, shown in Figure 1, is that of a classic dMe flare star. The strength of the TiO bandheads at ∼5430Å and ∼6150Å suggest a spectral type of approximately M3 (see Bochanski et al. 2007), and the visibility of the CaH feature at ∼6380Å suggests that the star is a dwarf, not a giant. Finally, we note that the measured emission-line Balmer decrement (Hα:Hβ) is ∼4.2, which is typical of dMe flare stars in quiescence.

In summary, given the brevity of the two observed outbursts, the relatively low outburst amplitude, and especially the spectrum of the quiescent optical counterpart, we conclude that M31N 1966-08a = 1968-10c is not a recurrent nova in M31 nor a Galactic dwarf nova, but rather a Galactic dMe flare star projected against the Andromeda galaxy.

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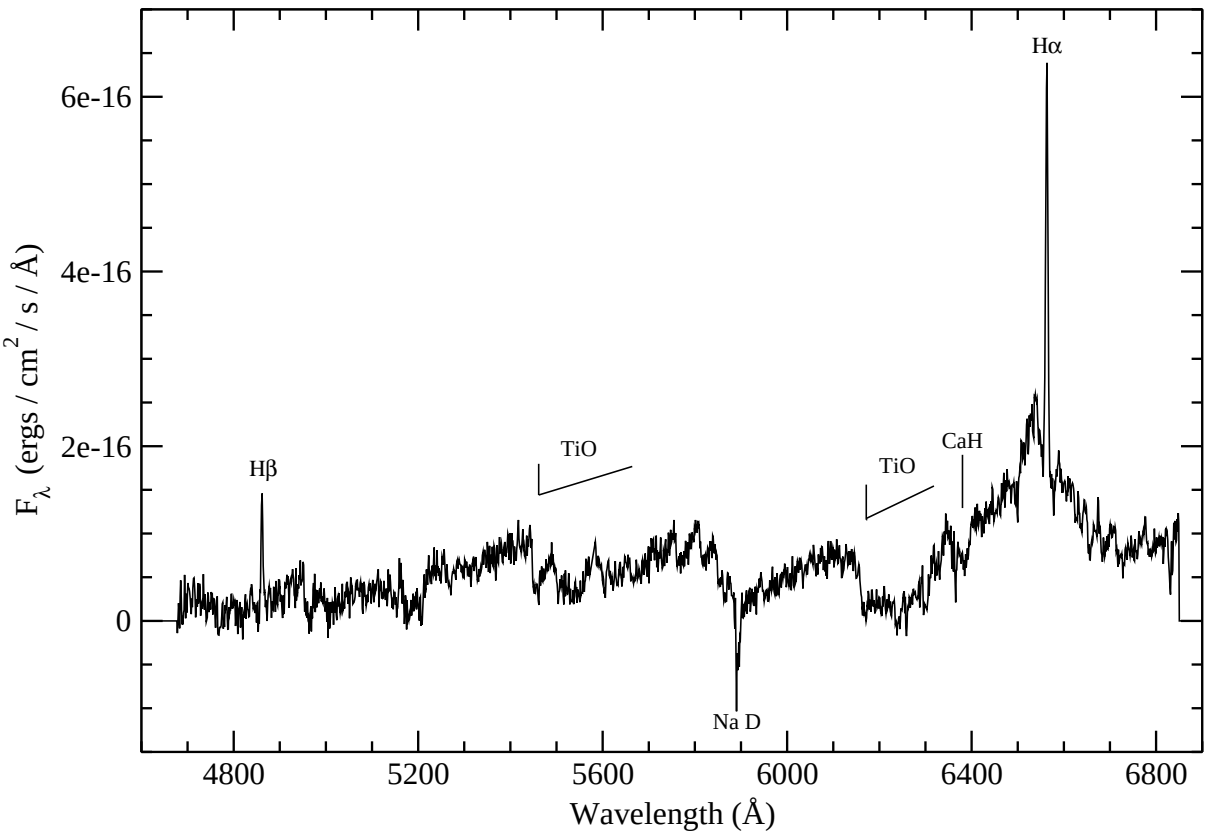

Figure 1. The HET spectrum of the quiescent counterpart of M31N 1966-08a, J004123.75+411459.6 (the absolute flux calibration is approximate). The spectrum is typical of a dMe flare star, displaying strong TiO bandheads at ∼5430Å and ∼6150Å, along with narrow Balmer emission lines. Detection of the CaH absorption feature at ∼6380Å suggests that the star is a dwarf.

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