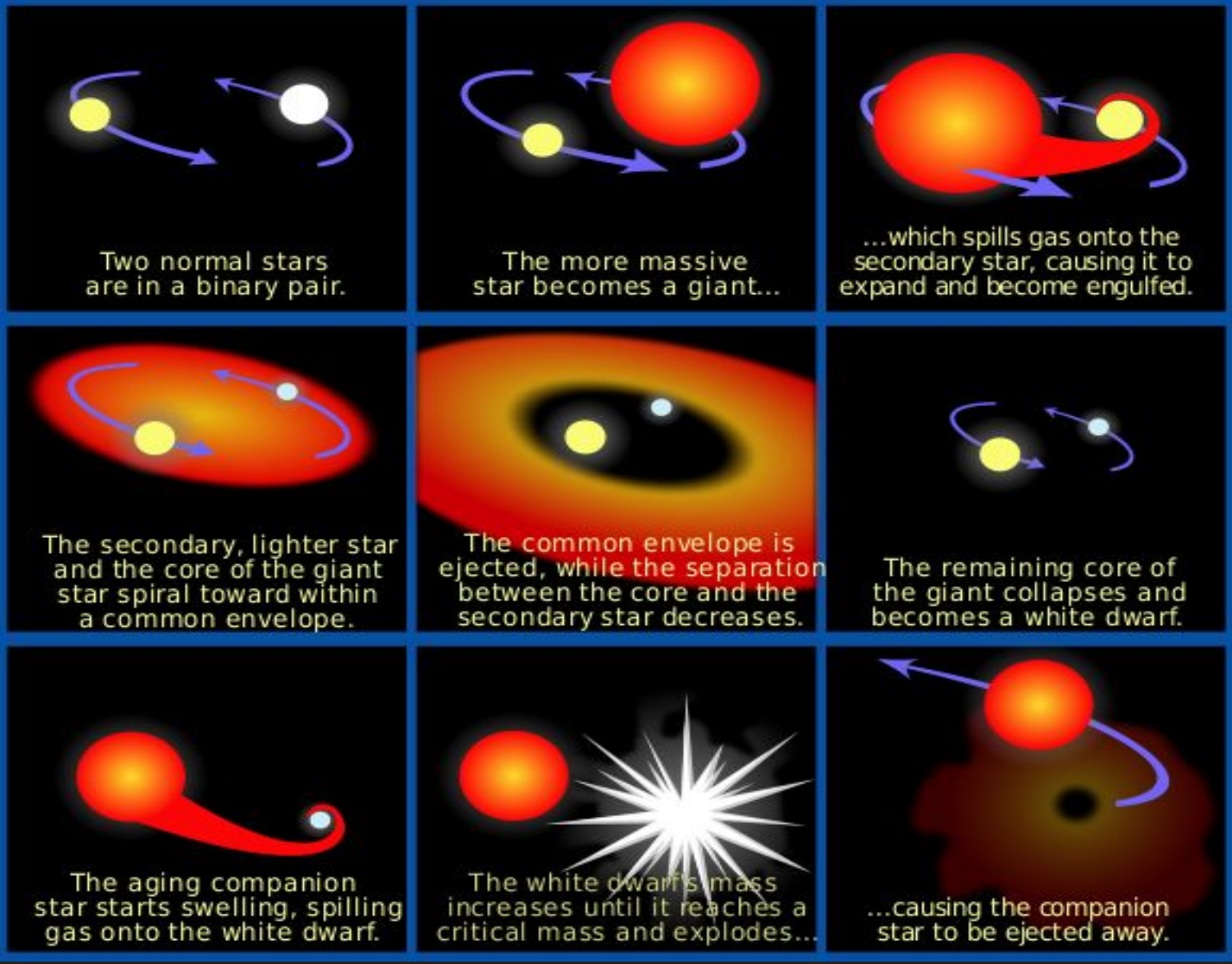
M31N 2008-12a

Observing a recurring nova in the Andromeda galaxy

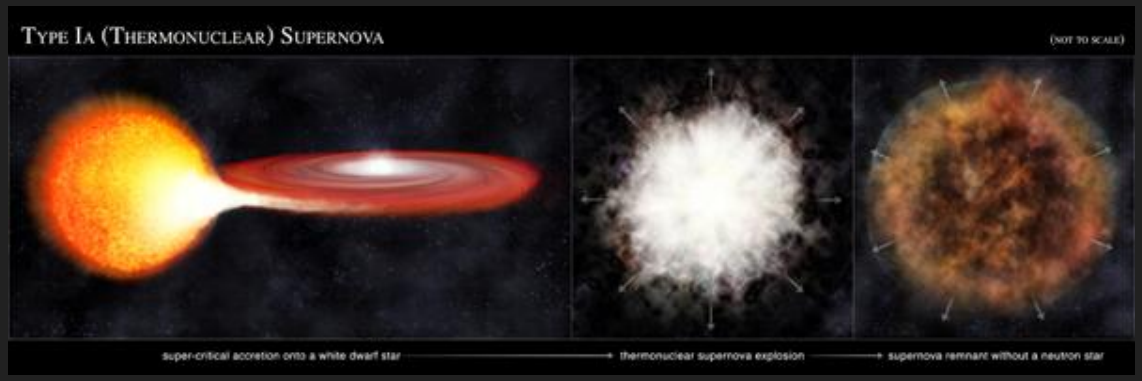
EVS2019 - Grimbergen, Belgium

The progenitor of a Type Ia supernova



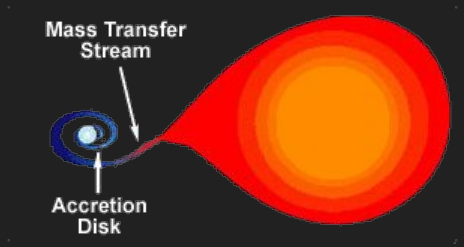
Type Ia supernova

- If mass is added to a white dwarf it will become hotter, smaller and heavier
- When the mass exceeds the critical limit of 1.4 solar mass it will explode as a type Ia supernova (thermonuclear runaway).
- This type is an important cosmic standard candle (assuming equal mass → equal luminosity).

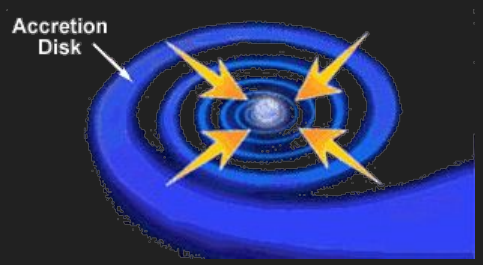


Nova Outburst(s)

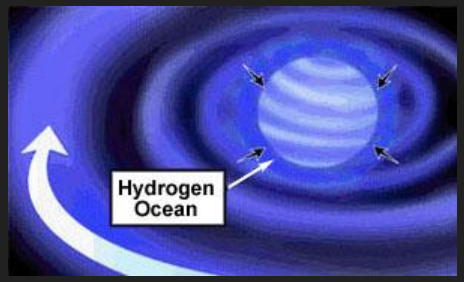
White dwarf accretes mass from the donor star as it fills its Roche lobe. Mass transfer stream flows through the Lagrange point L1 as star evolves to a red giant and the orbit shrinks by gravitational radiation. Usually (not magnetic WD) the falling matter forms an accretion disk around the white dwarf.



As friction slows the matter in the disk it eventually falls on the white dwarf. On the surface of the white dwarf the matter forms an ocean of hydrogen.



The high gravity of the WD pulls the hydrogen to very high density and the high temperature eventually ignites the fusion. This will start a very fast rise of temperature and runaway chain reaction of thermonuclear fusion. **The explosion ejects matter from the white dwarf and the cycle starts over.**



The cycle becomes shorter and shorter if the WD gains mass.

M31N 2008-12a

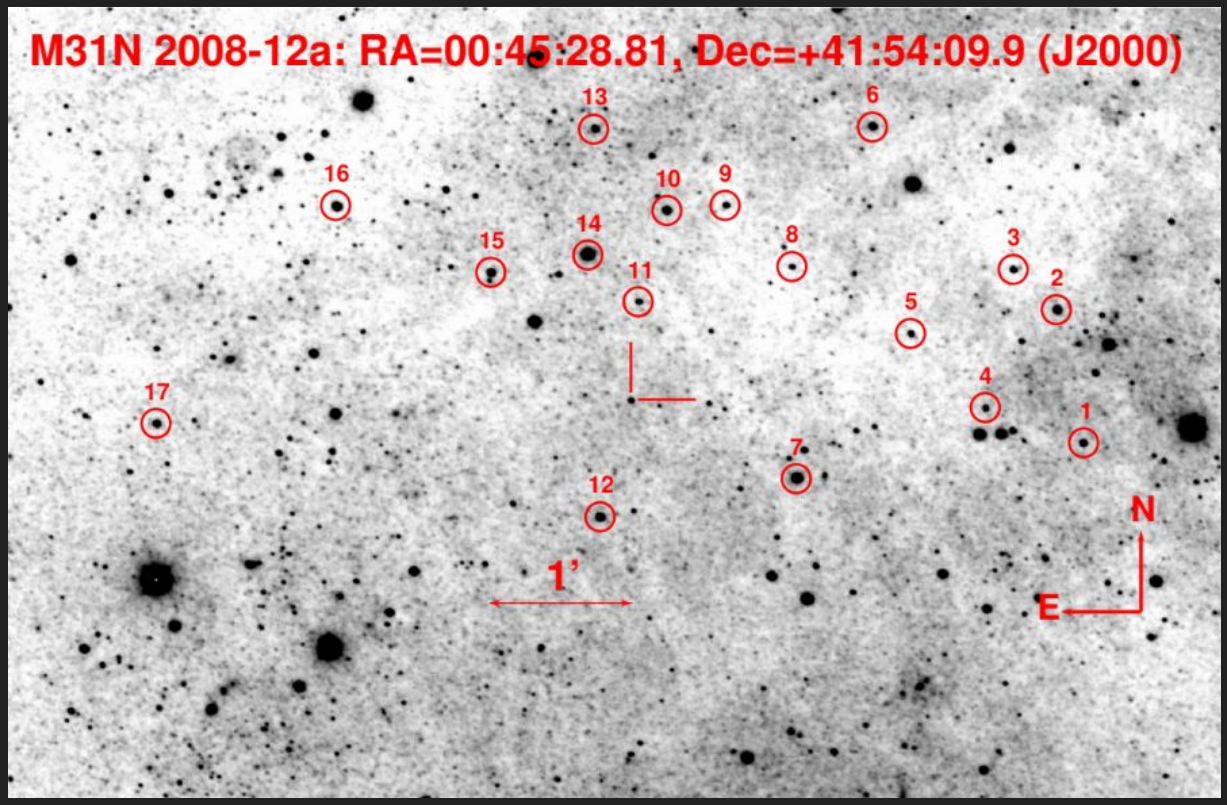
The fastest known recurring nova.

Located in the Andromeda galaxy, M31.

M31N 2008-12a

Observed eruptions:

- 2008 Dec 26
- 2009 Dec 03
- 2010 Nov 20
- 2011 Oct 23
- 2012 Oct 19
- 2013 Nov 28
- 2014 Oct 03
- 2014 Oct 03
- 2015 Aug 28
- 2016 Dec 12
- 2017 Dec 31
- 2018 Nov 6



Intensive monitoring ongoing to detect the next outburst as early as possible.

Start of the observing campaign February 2016

Dear colleagues,

Thank you for participating in this global project to catch the next eruption of the remarkable M31 recurrent nova M31N 2008-12a and to confirm the predicted 6-months period! This email is to initiate the communication within the collaboration and to explain the notifications in case of discovery. If you have any questions don't hesitate to contact me.

Best regards,
Martin

My observing strategy

One data point per every clear & dark night using the remote operable 40 cm RC telescope of Hankasalmi observatory.

ACP with a script taking 20x60s unfiltered exposures.

Image stacking with MaxImDL.

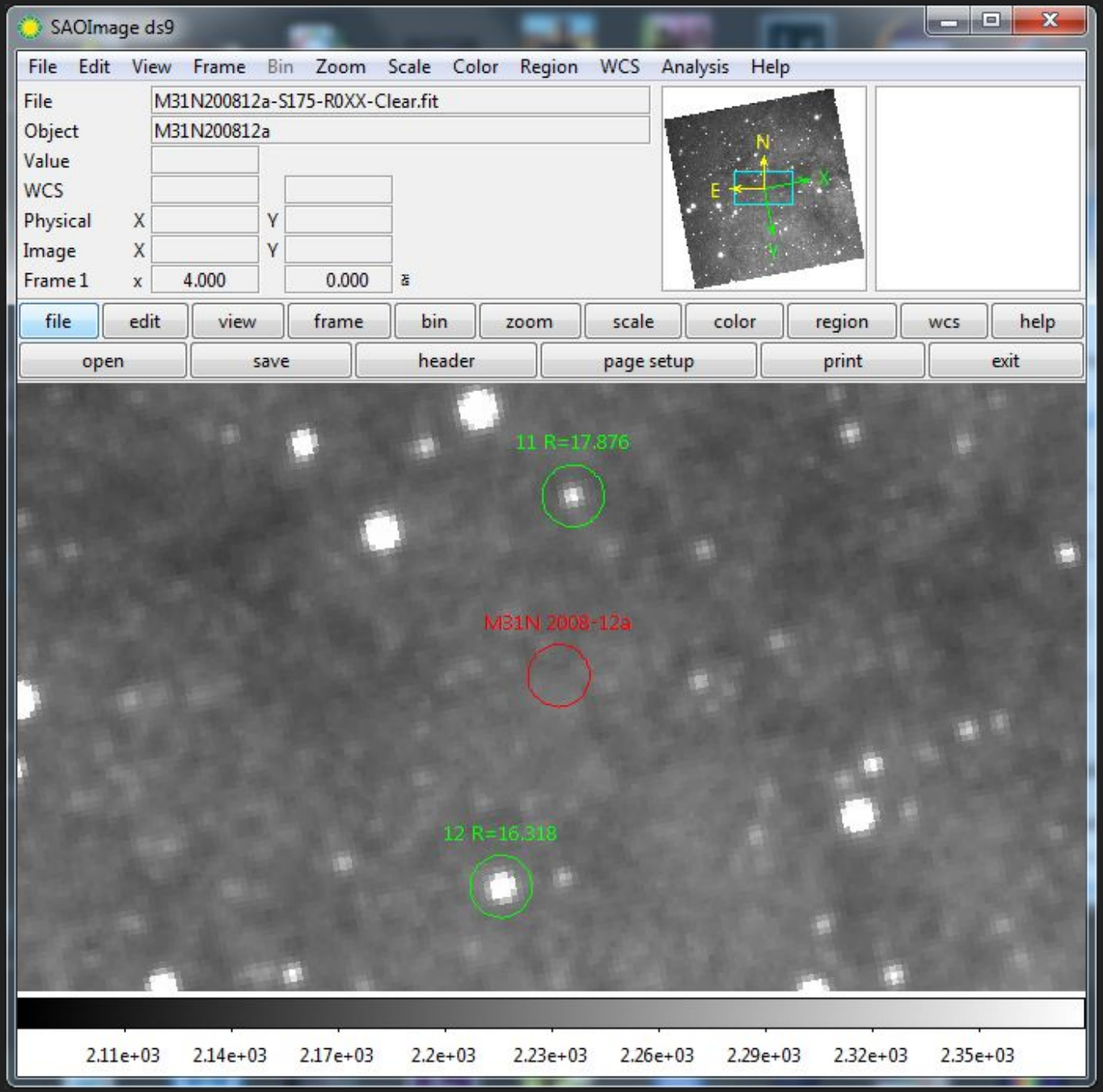
Photometry with a self made script.

Submission to the AAVSO database.

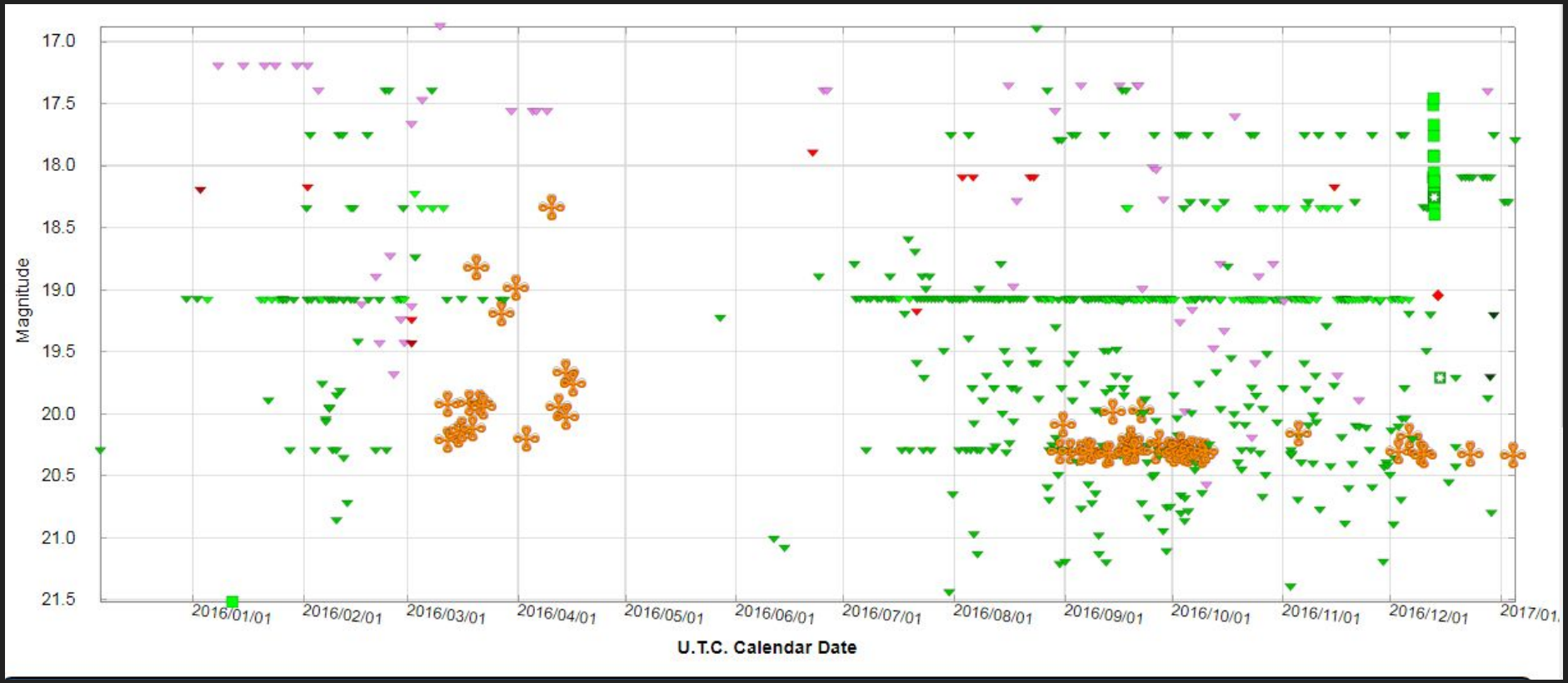
Visual examination with SAOImage ds9.

Email to the PI.

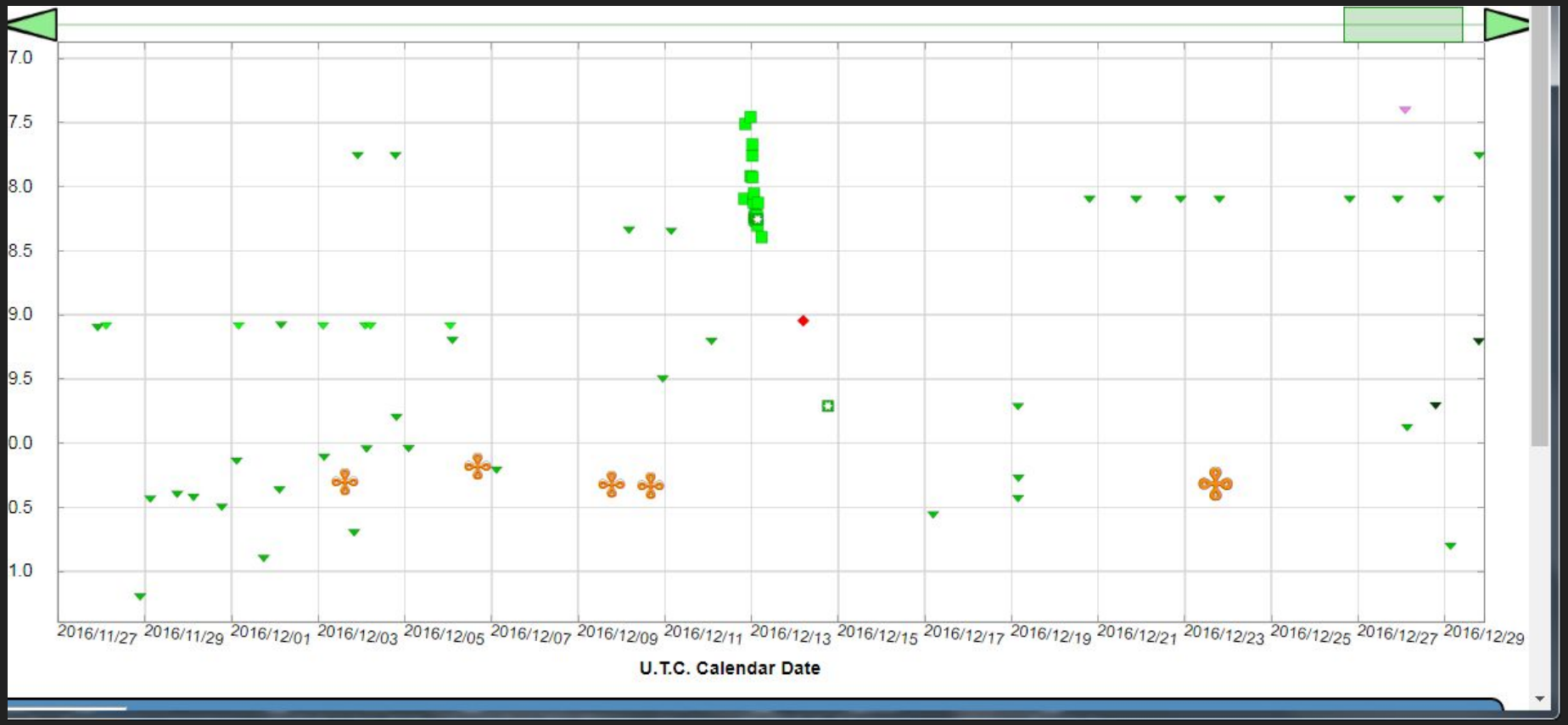
So far done 180 imaging runs.


SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File M31N200812a-S175-R0XX-Clear.fit
Object M31N200812a
Value
WCS
Physical X Y
Image X Y
Frame 1 x 4.000 0.000
N
E
X
Y
file edit view frame bin zoom scale color region wcs help
open save header page setup print exit
11 R=17.876
M31N 2008-12a
12 R=16.318
2.11e+03 2.14e+03 2.17e+03 2.2e+03 2.23e+03 2.26e+03 2.29e+03 2.32e+03 2.35e+03

AAVSO observations of 2016



Eruption Dec 12, 2016 !



Peculiar eruption in 2016

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BREAKING THE HABIT — THE PECULIAR 2016 ERUPTION OF THE RAPIDLY RECURRING NOVA M31N 2008-12a.

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Predicting the next eruption (Henze et al. 2017)

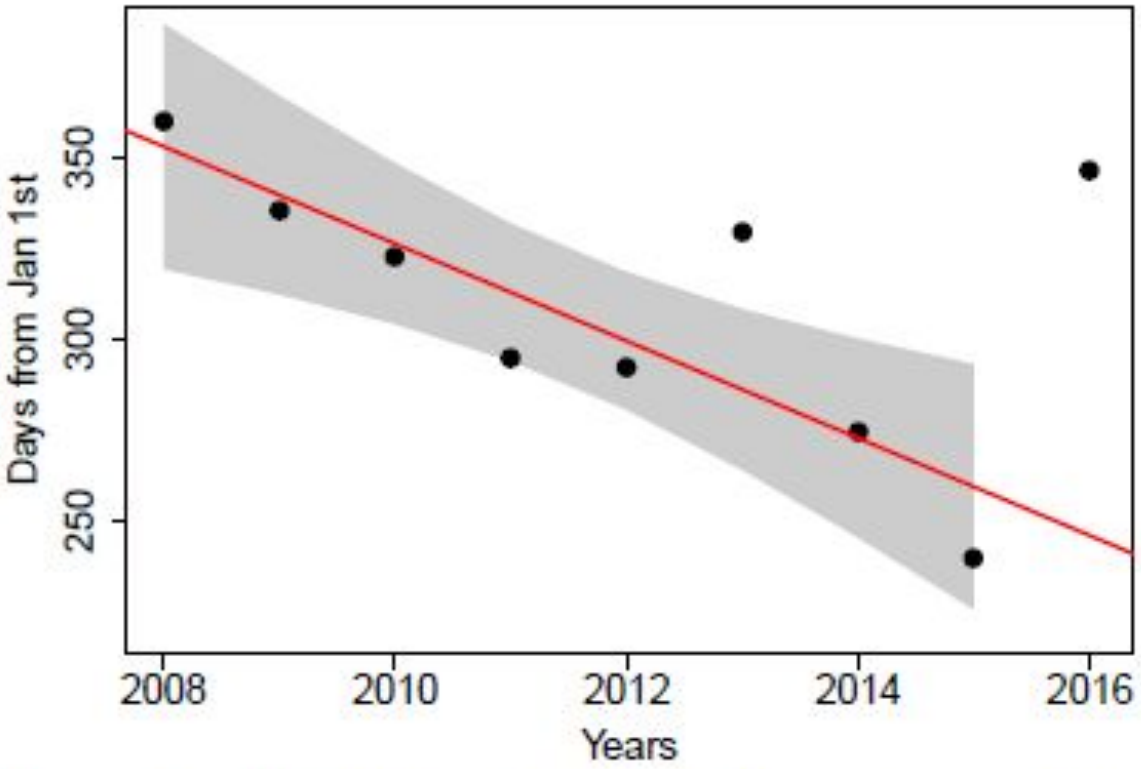
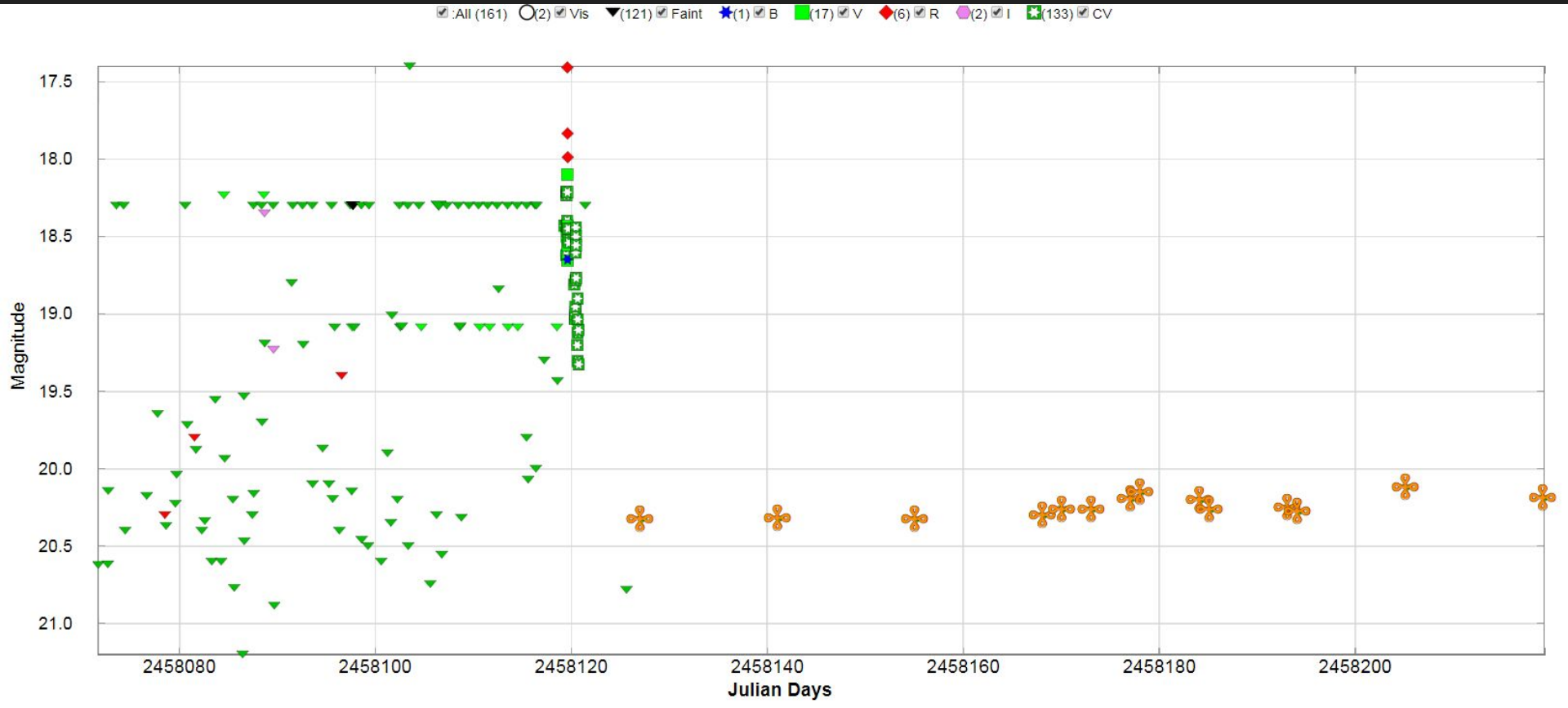
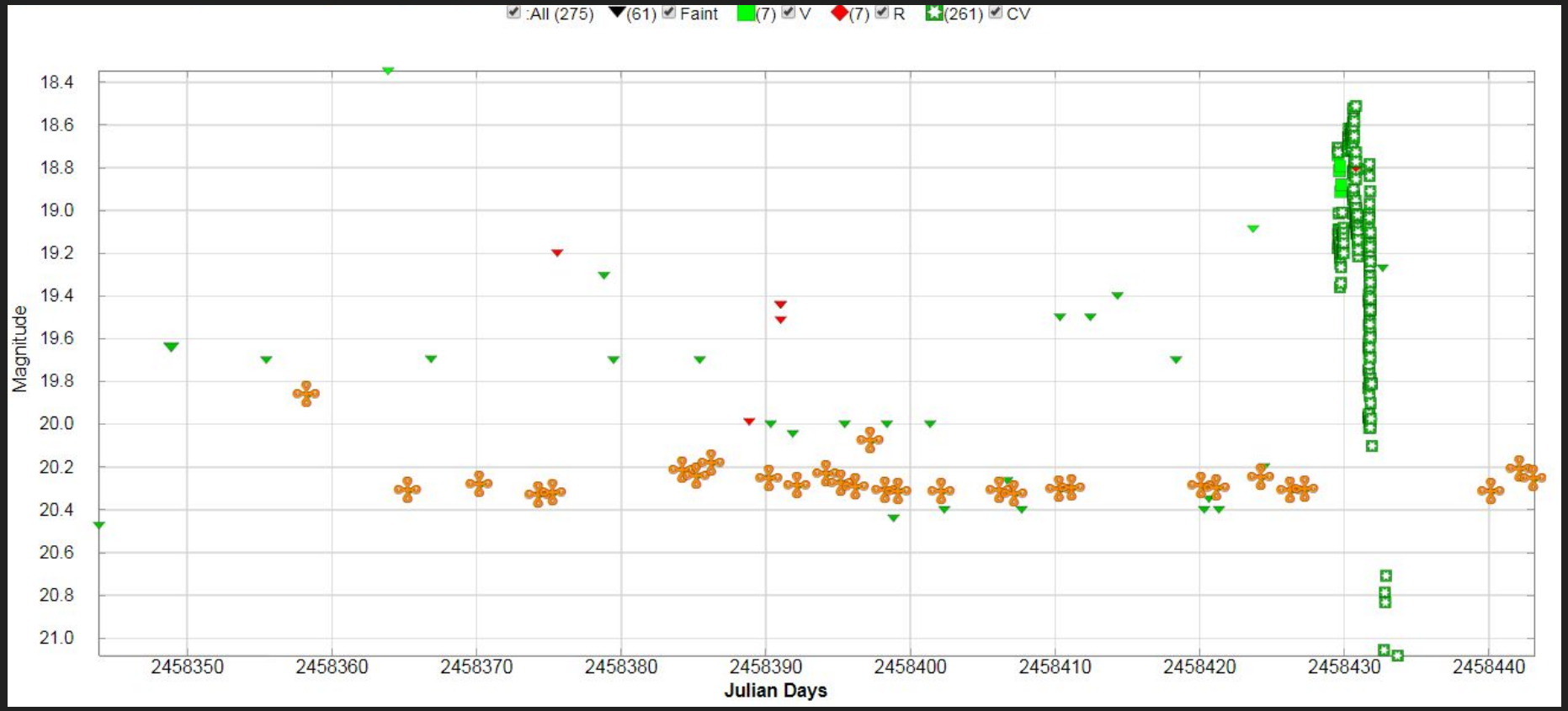


Figure 14. Distribution of eruption dates (in days of the year) over time since 2008. The red line is the best fit for the *2008-2015 eruptions* (cf. DHB16). The gray area is the corresponding 95% confidence region. The uncertainties of the estimated dates are smaller than the symbol size.

AAVSO observations of the 2017 eruption (Dec 31)



AAVSO observations of the 2018 eruption (Nov 6)



Last observations

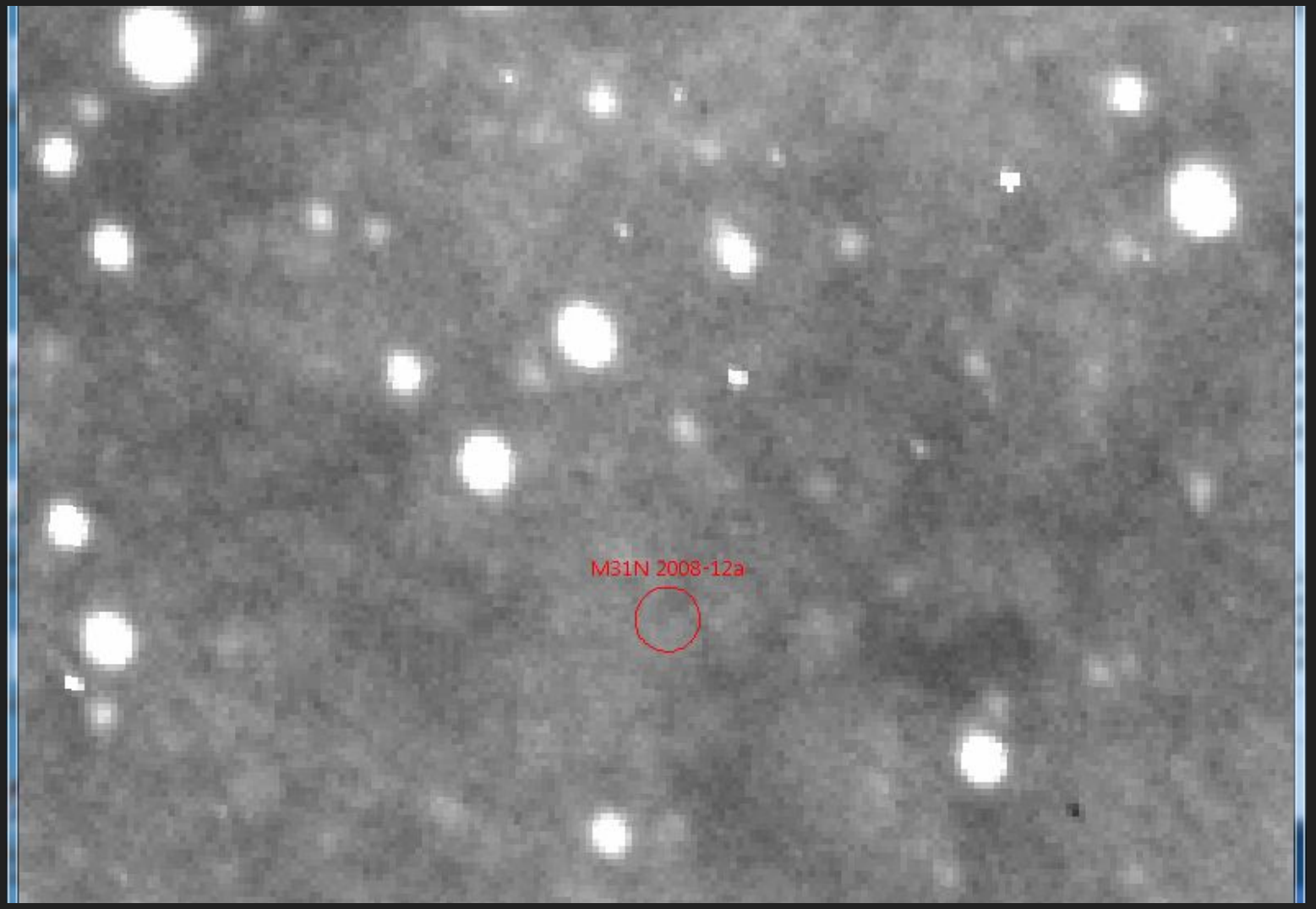
WebObs Search Results

Showing *1,354* observations for *M31N 2008-12a* from *19* observers

■ Plot a Chart ■ Generate a Light Curve ■ Search VSX

Star	JD	Calendar Date	Magnitude	Error	Filter	Observer	Collapse All Expand All
M31N 2008-12A	2458700.89630	2019 Aug. 05.39630	<20.569	0.271	R	COO	Details...
M31N 2008-12A	2458698.98796	2019 Aug. 03.48796	<20.559	0.209	R	COO	Details...
M31N 2008-12A	2458691.93865	2019 Jul. 27.43865	<20.7	0.303	CV	COO	Details...
M31N 2008-12A	2458655.839955	2019 Jun. 21.33996	<18.349	0.066	V	HBB	Details...
M31N 2008-12A	2458637.889433	2019 Jun. 03.38943	<19.087	0.279	V	HBB	Details...
M31N 2008-12A	2458577.29706	2019 Apr. 03.79706	<20.140	0.091	CV	OAR	Details...
M31N 2008-12A	2458569.31066	2019 Mar. 26.81066	<20.374	0.070	CV	OAR	Details...
M31N 2008-12A	2458555.24987	2019 Mar. 12.74987	<20.279	0.076	CV	OAR	Details...
M31N 2008-12A	2458548.23310	2019 Mar. 05.73310	<20.293	0.077	CV	OAR	Details...
M31N 2008-12A	2458536.20068	2019 Feb. 21.70068	<20.294	0.079	CV	OAR	Details...
M31N 2008-12A	2458532.24711	2019 Feb. 17.74711	<20.063	0.081	CV	OAR	Details...
M31N 2008-12A	2458531.31444	2019 Feb. 16.81444	<20.100	0.085	CV	OAR	Details...
M31N 2008-12A	2458527.28407	2019 Feb. 12.78407	<20.246	0.080	CV	OAR	Details...
M31N 2008-12A	2458519.26718	2019 Feb. 04.76718	<20.326	0.077	CV	OAR	Details...
M31N 2008-12A	2458516.28226	2019 Feb. 01.78226	<20.216	0.087	CV	OAR	Details...
M31N 2008-12A	2458511.21019	2019 Jan. 27.71019	<20.284	0.078	CV	OAR	Details...
M31N 2008-12A	2458508.26723	2019 Jan. 24.76723	<19.970	0.096	CV	OAR	Details...
M31N 2008-12A	2458496.37742	2019 Jan. 12.87742	<19.919	0.110	CV	OAR	Details...
M31N 2008-12A	2458495.41547	2019 Jan. 11.91547	<20.231	0.096	CV	OAR	Details...
M31N 2008-12A	2458477.24	2018 Dec. 24.74000	<19.1	—	CV	SFY	Details...
M31N 2008-12A	2458464.582654	2018 Dec. 12.08265	<19.087	0.611	V	HBB	Details...
M31N 2008-12A	2458459.660977	2018 Dec. 07.16098	<19.087	0.143	V	HBB	Details...

My last observation April 3, 2019 (<20.1 CV)



Martin Henze, past PI of the campaign

“I admire the skills and dedication of the amateur observers and citizen scientists with whom I have collaborated in my research projects over the last ten years. Many discoveries would not have been possible without the excellent work of these women and men. The interconnected, international amateur associations epitomise the spirit of scientific communities as mutually supportive networks full of respect and passion for knowledge. I believe that close collaborations between the professional and amateur communities will continue to grow in importance through the next age of large surveys, ensuring increasing discovery rates and detailed follow-up studies. I would like to encourage all interested amateur astronomers to participate in cutting-edge research to the best of their abilities.”

The new PI (since February 2019)

Dr Matt Darnley MPhys PhD MInstP FRAS FHEA

Reader in Time Domain Astrophysics

Undergraduate Programme Director

Astrophysics Research Institute

IC2, Liverpool Science Park, Liverpool, L3 5RF, UK

"Both Martin and I are extremely grateful for all your contributions over the past eruptions of 12a, from contributing eruption observations, quiescent monitoring, and even detections of new eruptions. We would both love to continue working with you all in the future."

Questions?

Arto Oksanen

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