Amateur astronomy today

LAG (Berto) Monard
Bronberg Observatory (2001-2010)
Kleinkaroo Observatory (2011-)

Overview

- Introduction:
  - state of the art of amateur instrumentation
  - early global surveys and their offerings
  - opportunities for amateurs
  - today's surveys and their impact
- What's left for amateurs
- Examples of observing projects

Introduction

The good times of amateur astronomy in the digital age:

- started shortly before the turn of the century
- affordable goto telescopes and CCD cameras
- internet access to results of the early surveys
- full autonomy in observing

Instrumentation 2011

- Meade RCX400 telescopes 30 and 35 cm f/8
- CCD cameras SBIG ST8-XME
- Filterwheel (BVRI&clear)
- Mostly used in binned mode (seeing)
- Image size: 21 x 14 arcmin
- Pier-wedge mounted, polar aligned

Early Astronomical Surveys

- Lots of time and effort to observe and compile
- Limited reach in magnitudes and sky coverage
- Specific wavelength ranges
- Specific aims

- Durchmusterung plates, Tycho, 2Mass (all sky), POSS, ROSAT, GALEX...

Products from those surveys

- DSS (Digitized Sky Survey): a STScI initiated compilation/digitization of POSS and UK Schmidt Telescope plates: a source for plotting star regions and reference templates for galaxies: great help to start with SN searching

- Catalogues : Rosat, Edinburgh-Cape Survey: great info for exploring and monitoring eventual eruptions of suspected CV s, catalogues for astrometric or photometric reference

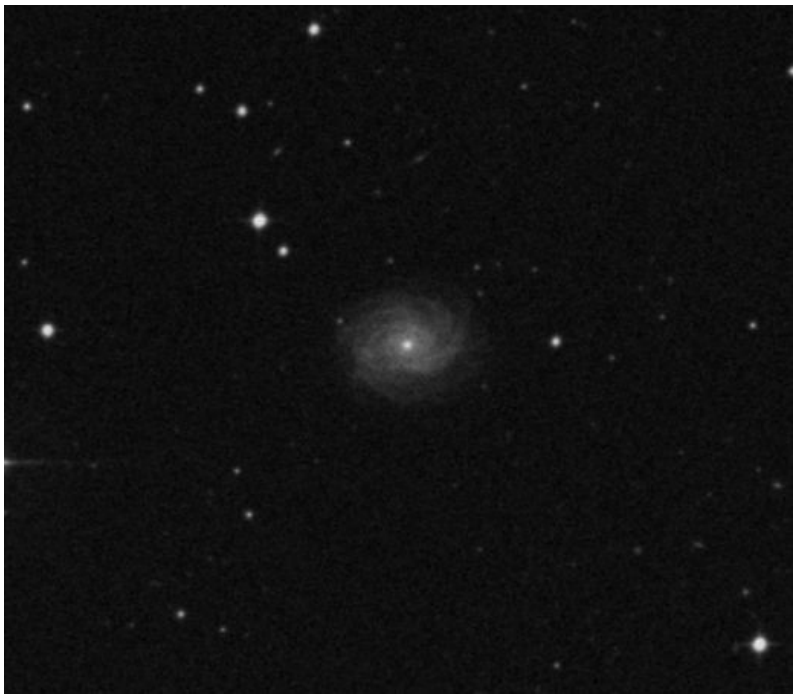
Some useful URLs/websites

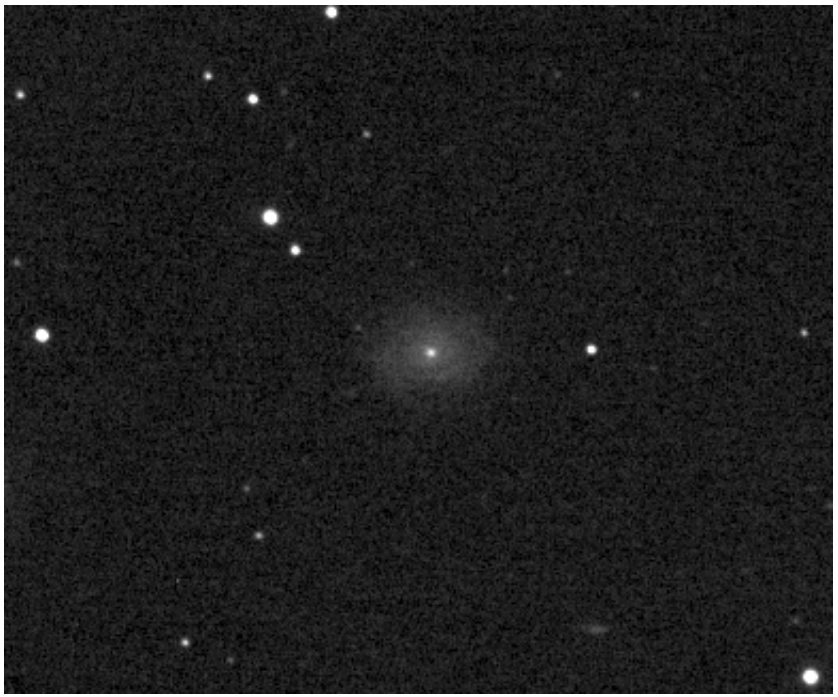
- http://vizier.u-strasbg.fr/viz-bin/VizieR-2
- https://archive.stsci.edu/cgi-bin/dss_form
- http://simbad.u-strasbg.fr/simbad/
- https://arxiv.org/archive/astro-ph

Supernova Searching Project

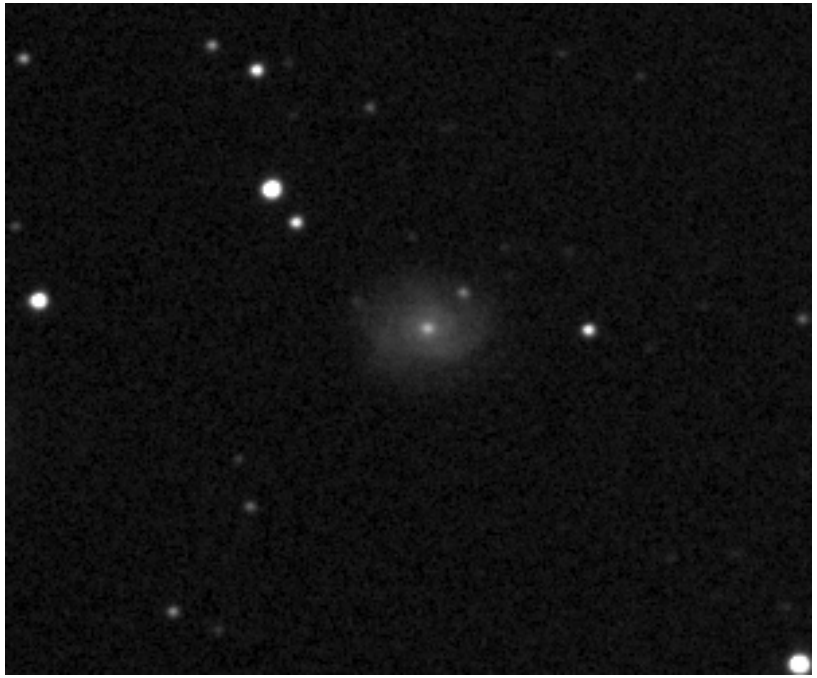
- SN search programmes could now be based on information from on-line catalogues of nearby galaxies: sizes, coordinates etc.
- The VizieR catalogue service from CDA (Centre of astron. Data) de Strasbourg provided an effective means to access those catalogues
- Third Reference Catalogue of Bright Galaxies RC3 (de Vaucouleurs)

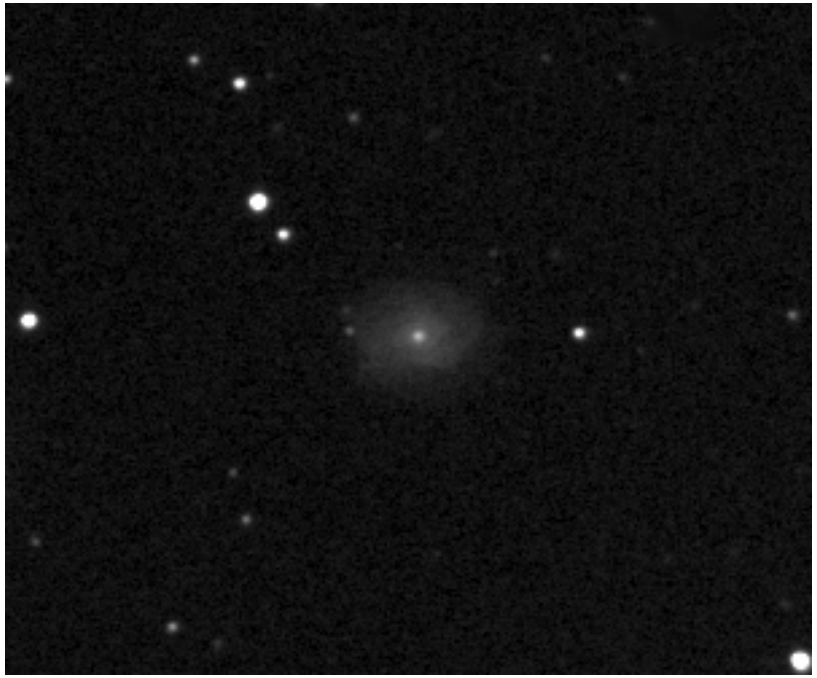
Galaxy ESO 244-31 (80 Mpc / 250 Mly)
DSS image □□ RCX400/ST8 image



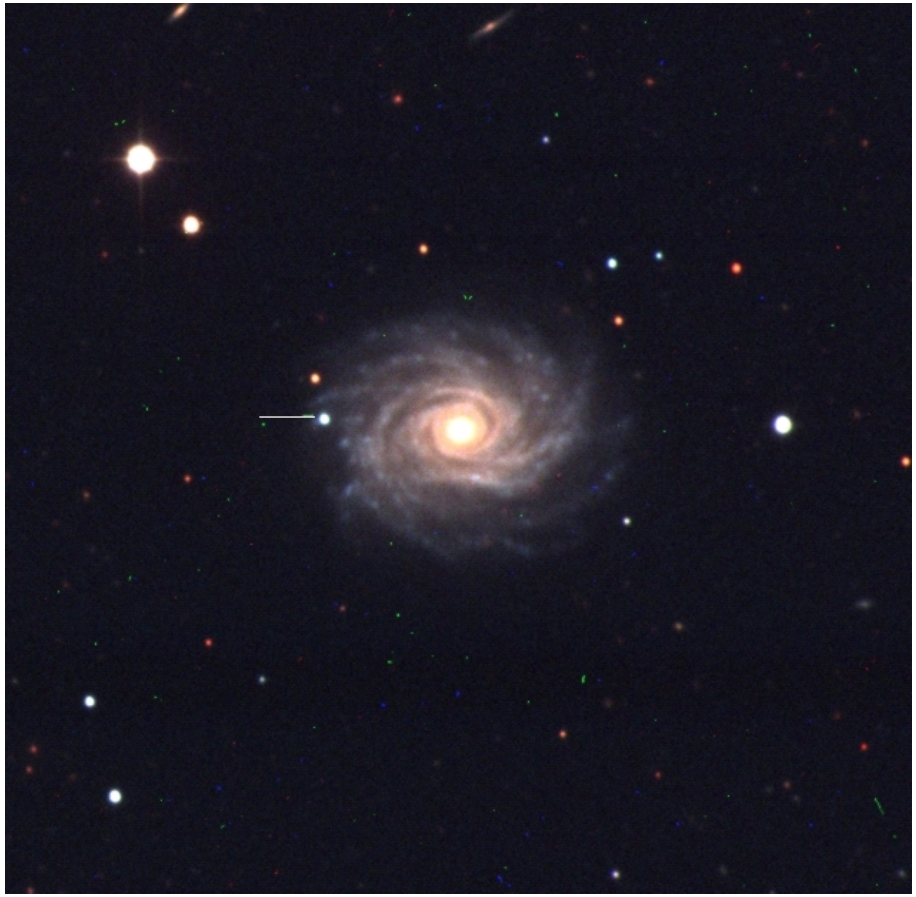


SN 2005Q and SN 2005me in ESO 244-31

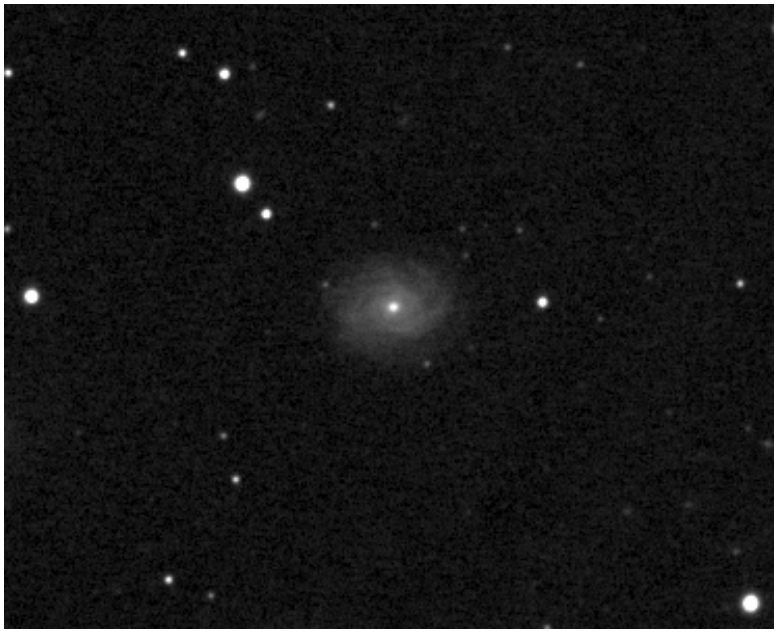




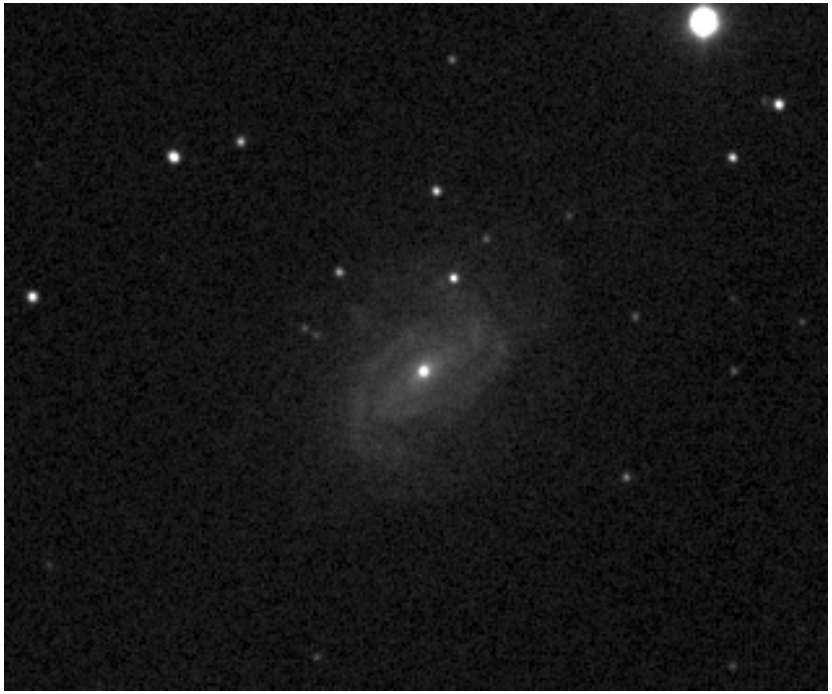
SN 2005Q and SN 2005me in ESO 244-31 / CSP

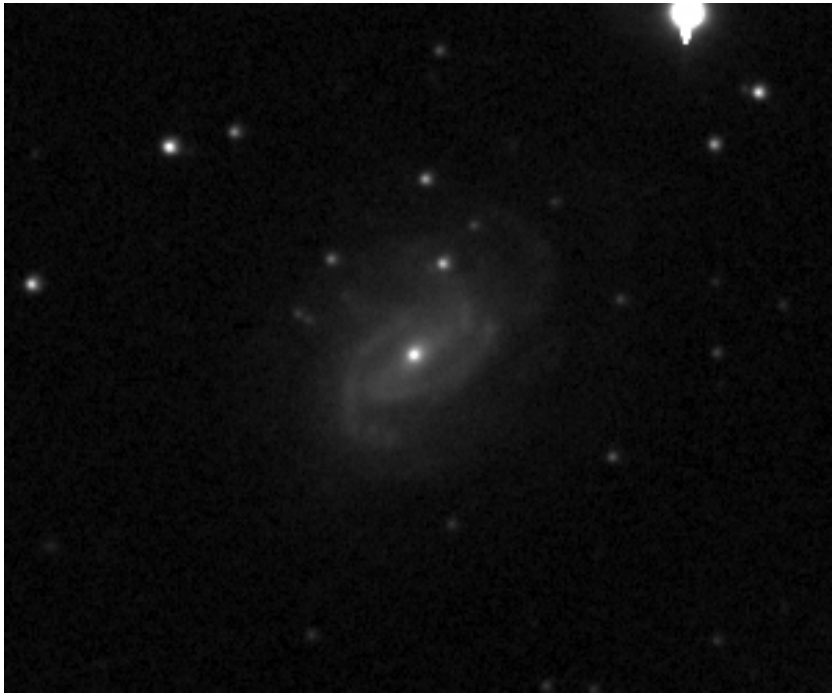


SN 2014di and SN 2010cm, two more SNe in ESO 244-31



SN 2007Y in NGC 1187 (20 Mpc)






Supernova SN2007Y

Today’s surveys

- Fully automated indiscriminative brute force continuous surveys with instantaneous data processing and prompt alerting

- OGLE (Gravitational lensing, MW, MCs)
- ASASSN (Supernovae): uses 5” telescopes
- Sloan DSS:
- ATLAS (nearby asteroids)
- GAIA (ESA, astrometry, space telescope)
- DLT40 (<40 Mpc supernovae, nightly)

- http://sci.esa.int/gaia/

- Astrometry
- Photometry

- Detect changes in
  - Position
  - brightness

http://www.astronomy.ohio-state.edu/~assassin/transients.html

Leftovers for amateurs / opportunities

A reality check:

- Compete in finding SNe:
  - go where nobody else is going
  - Do like DLT40 and hope they have bad weather

- Join:
  - Confirmation of ASASSN SN detections

- Follow up on alerted OTs (Optical Transients):
  - erupting CVs of different kinds, active galaxy cores, XR sources, gravitational lenses,

Follow up observations on OTs

- Timeseries photometry on bright OTs: observe continuously over a full night and derive a photometric LC, repeat many nights..

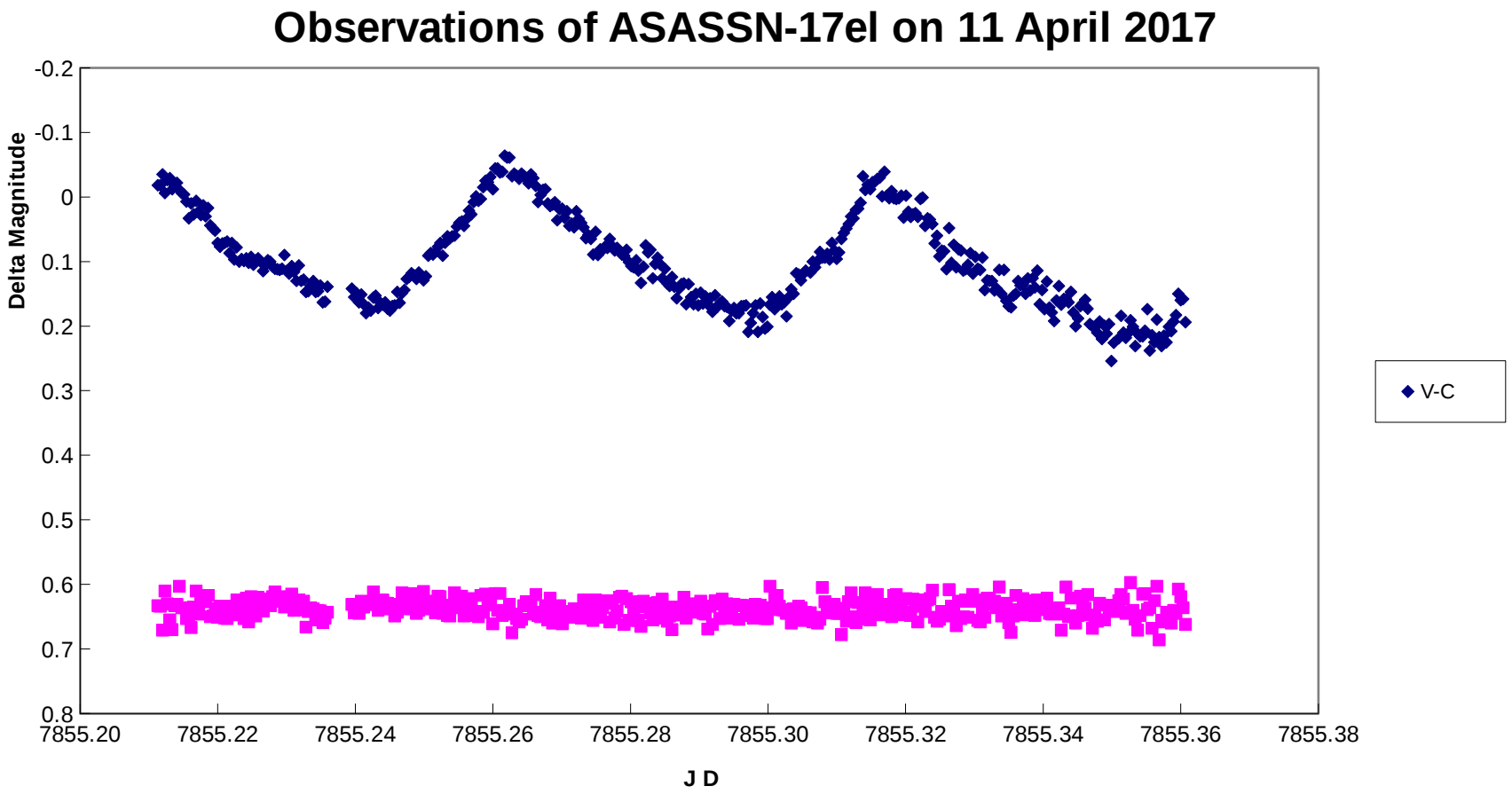
- Snapshot observations:
  - (B-)V-R-I observations of bright OTs (novae..)
  - Monitoring transients over time until they get too faint (nightly, weekly)

Note: professional astronomers are not always in a position to follow up promptly or do so intensively over long periods

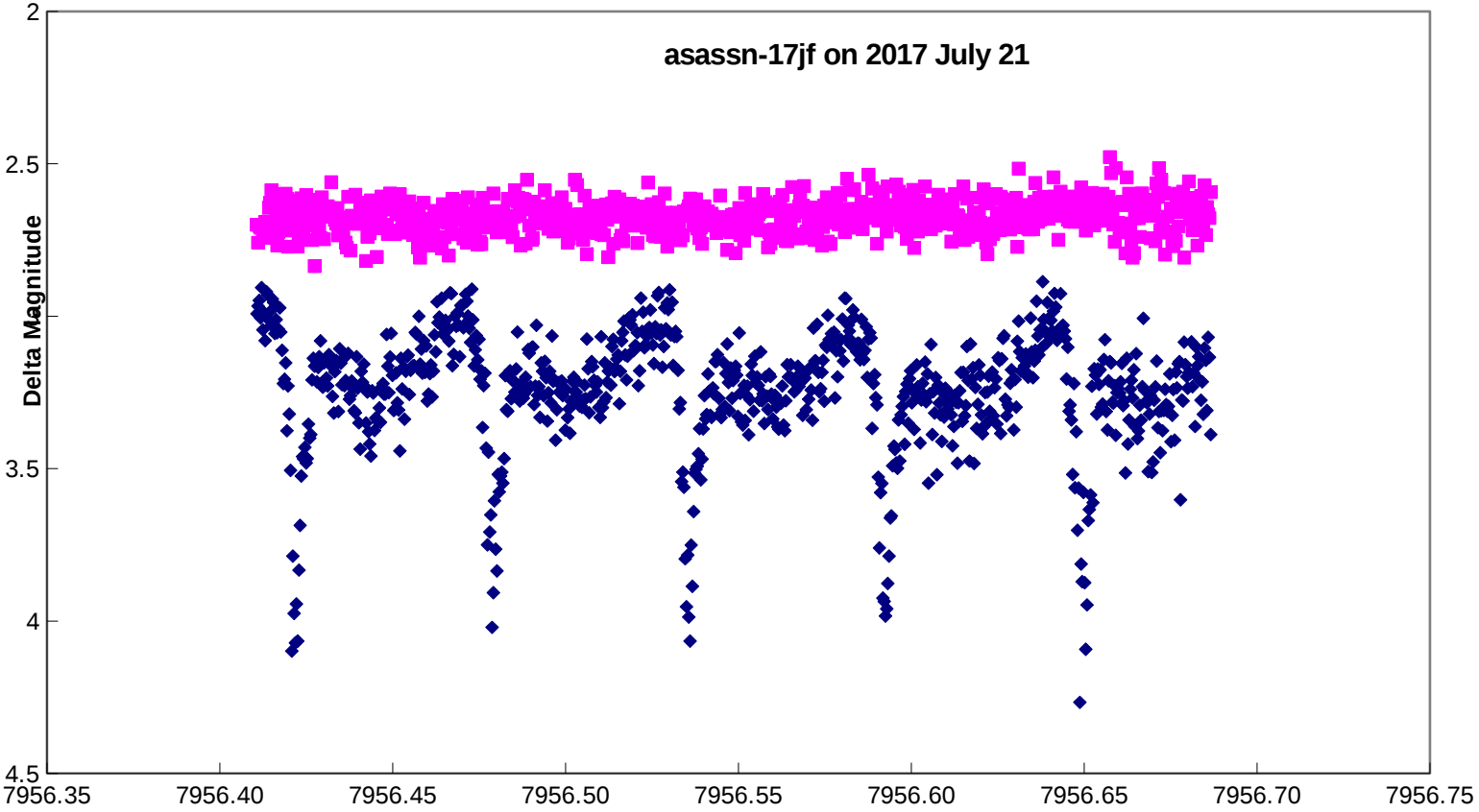
Some considerations re today's surveys

- Arm chair astronomers can do a lot of datamining from the findings of the surveys (which are found at the different websites).
- Despite all advances in automatic data processing and prompt alerting, many 'obvious' facts and associations are often overlooked,
- discretion is not part of computers yet. An experienced and knowlegeable individual can still find a lot more there.
- https://anu.prezly.com/anu-invites-everyone-to-join-the-search-for-exploding-stars

4 hours timeseries photometry

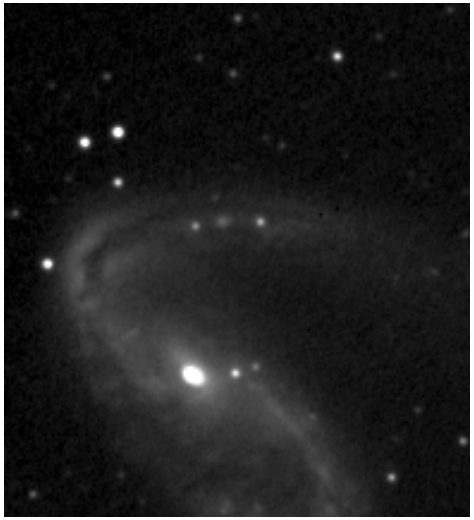
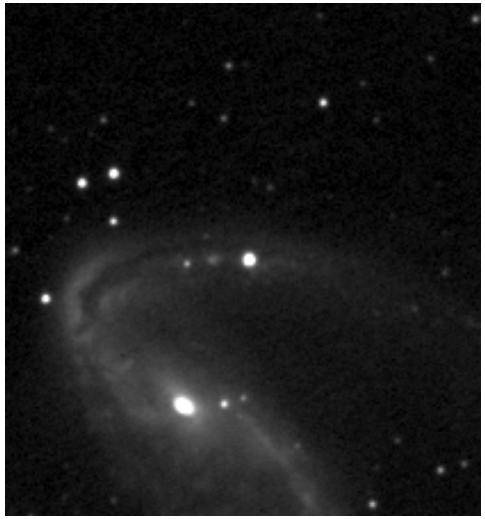
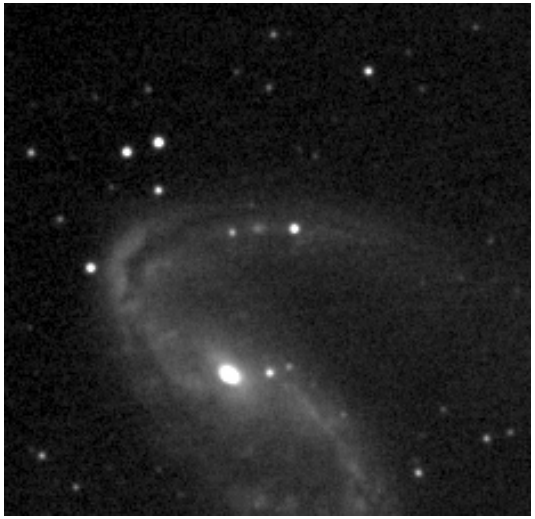


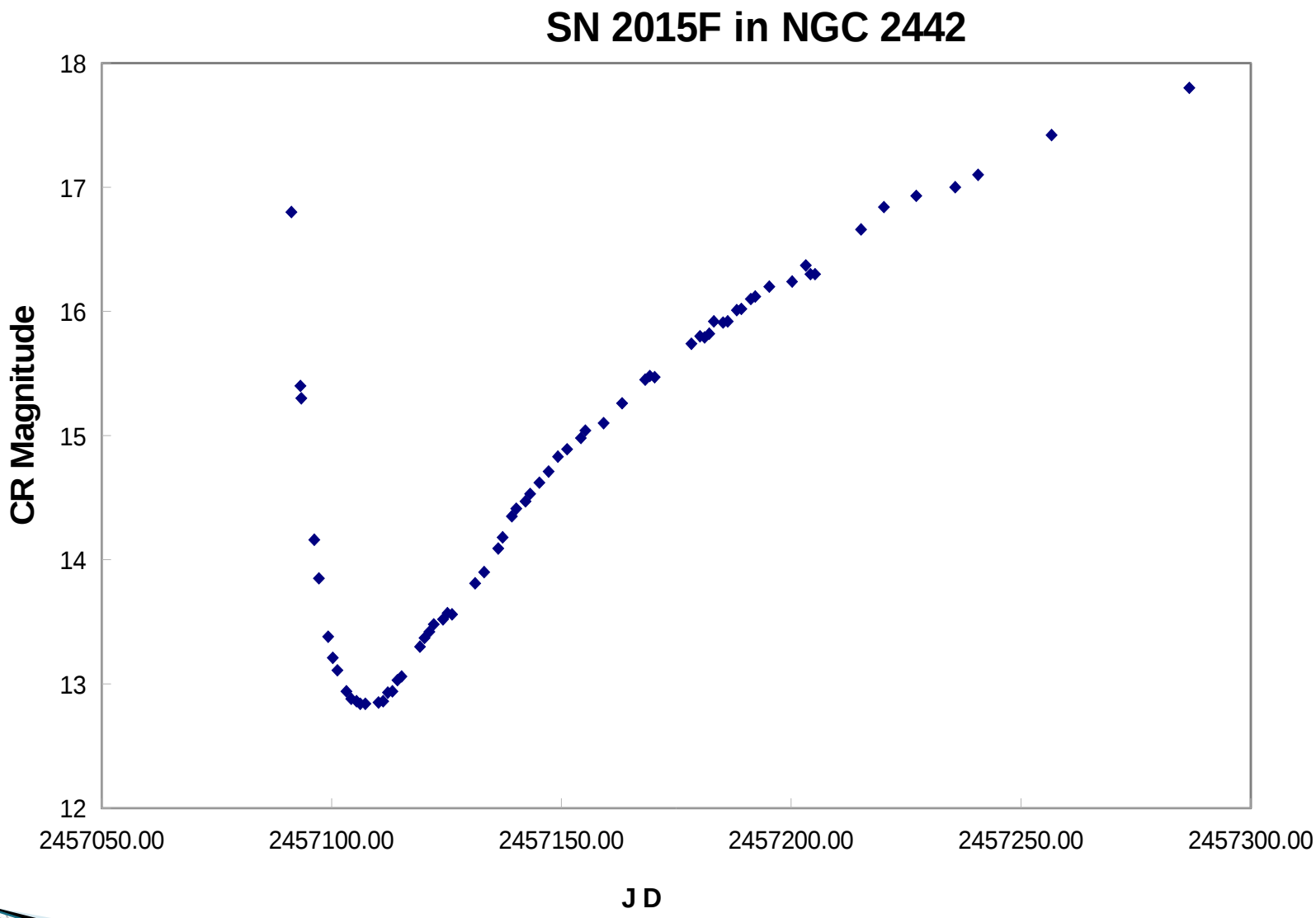
6 hours timeseries of ASASSN-17jf



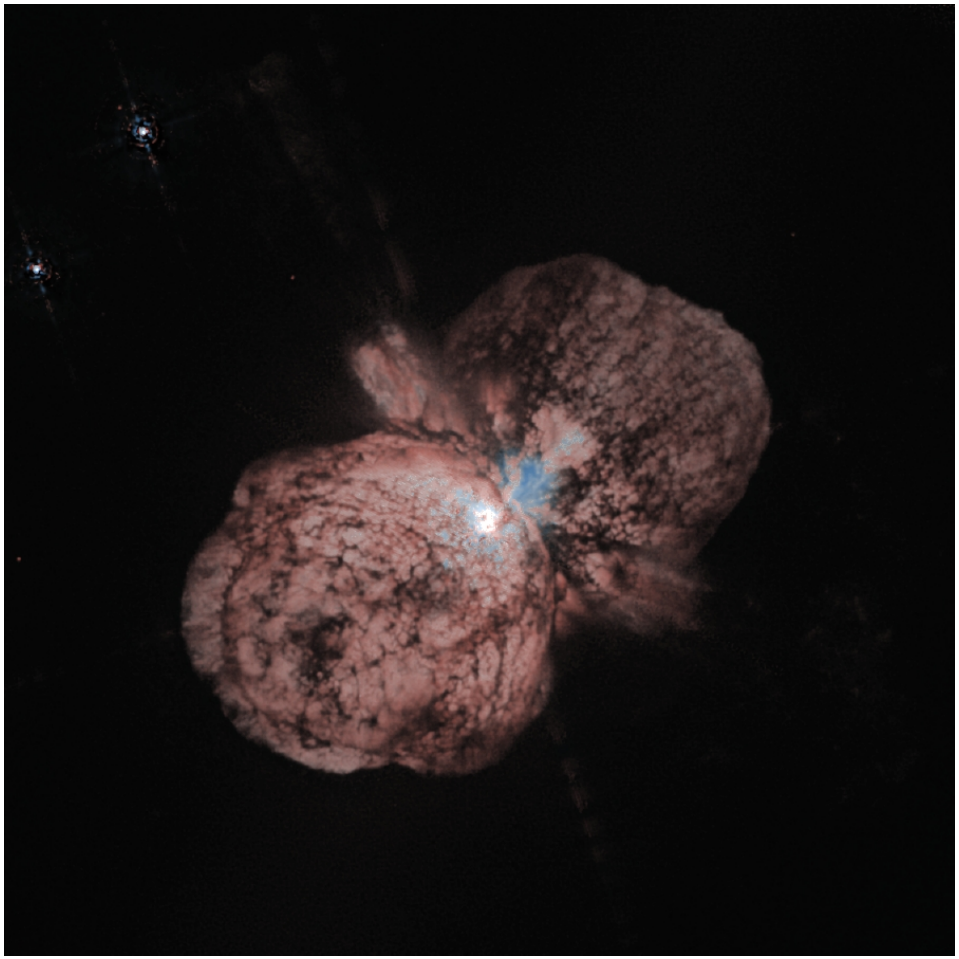
The Rise and Fall of Supernova 2015F

apod.nasa.gov/apod/ap160209.html

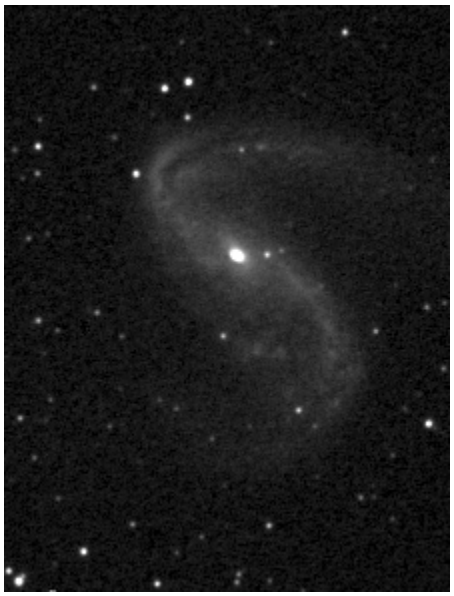
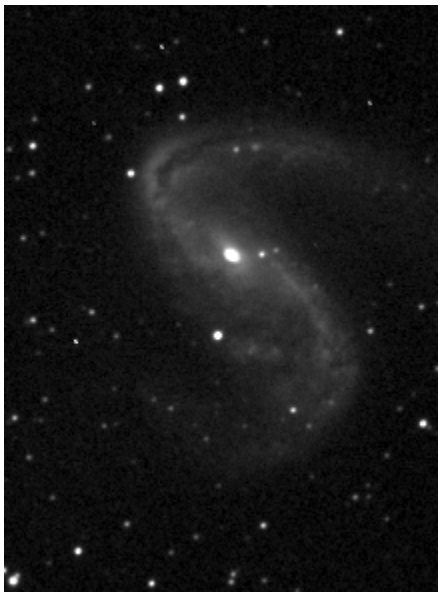
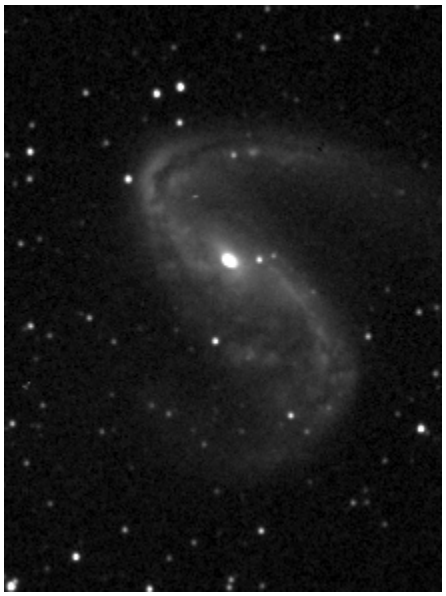





SN 2015F in NGC 2442
CR Magnitude
18
17
16
15
14
13
12
2457050.00
2457100.00
2457150.00
2457200.00
2457250.00
2457300.00
J D

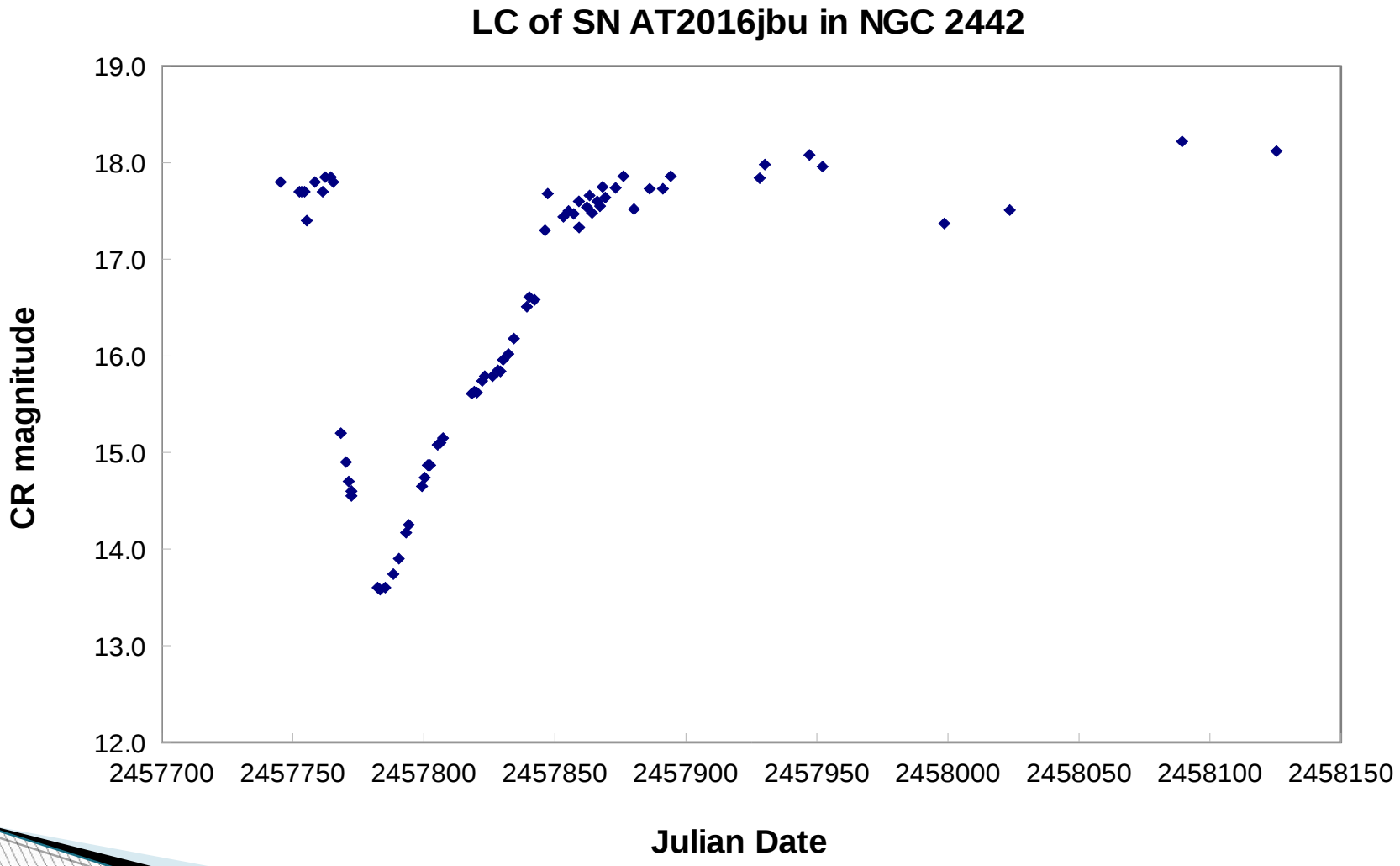
Eta Carinae



AT 2016jbu in NGC 2442

SN with precursor outburst

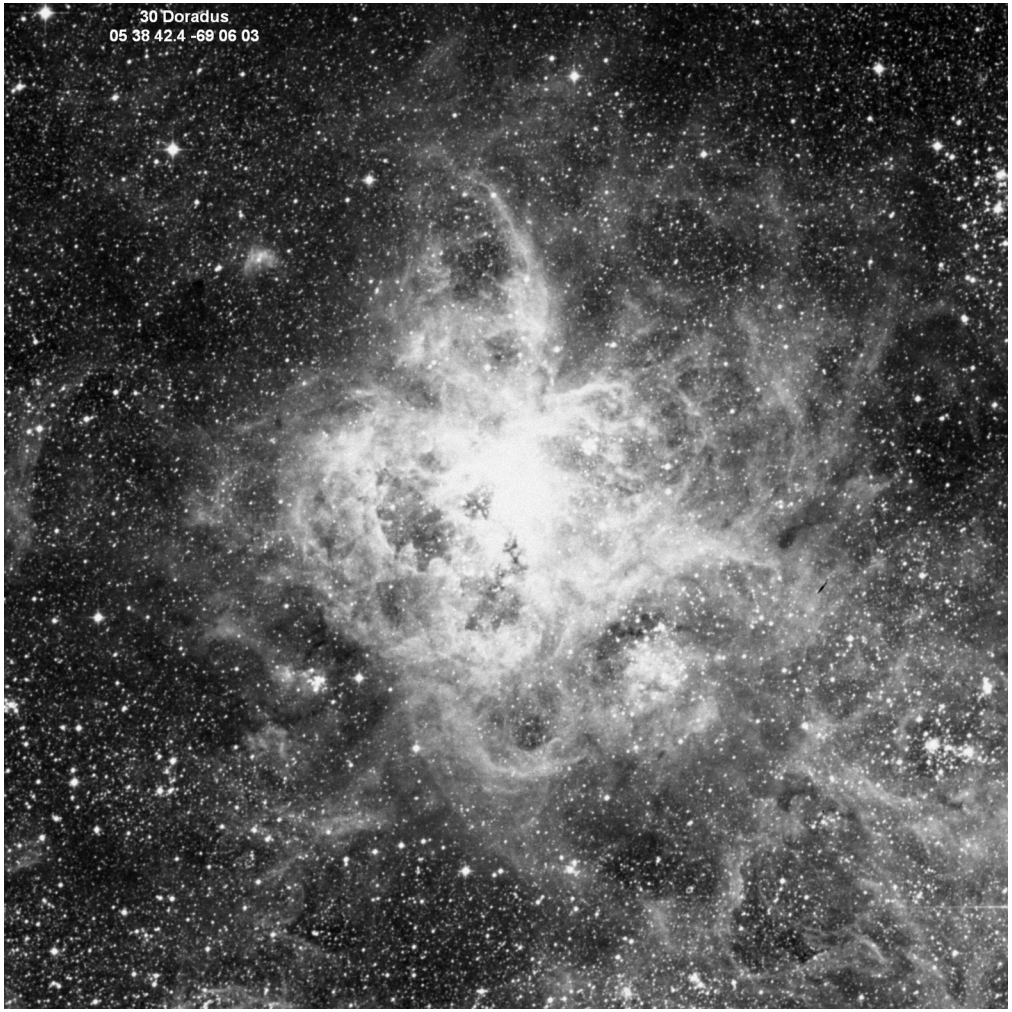


More observing projects at KKO

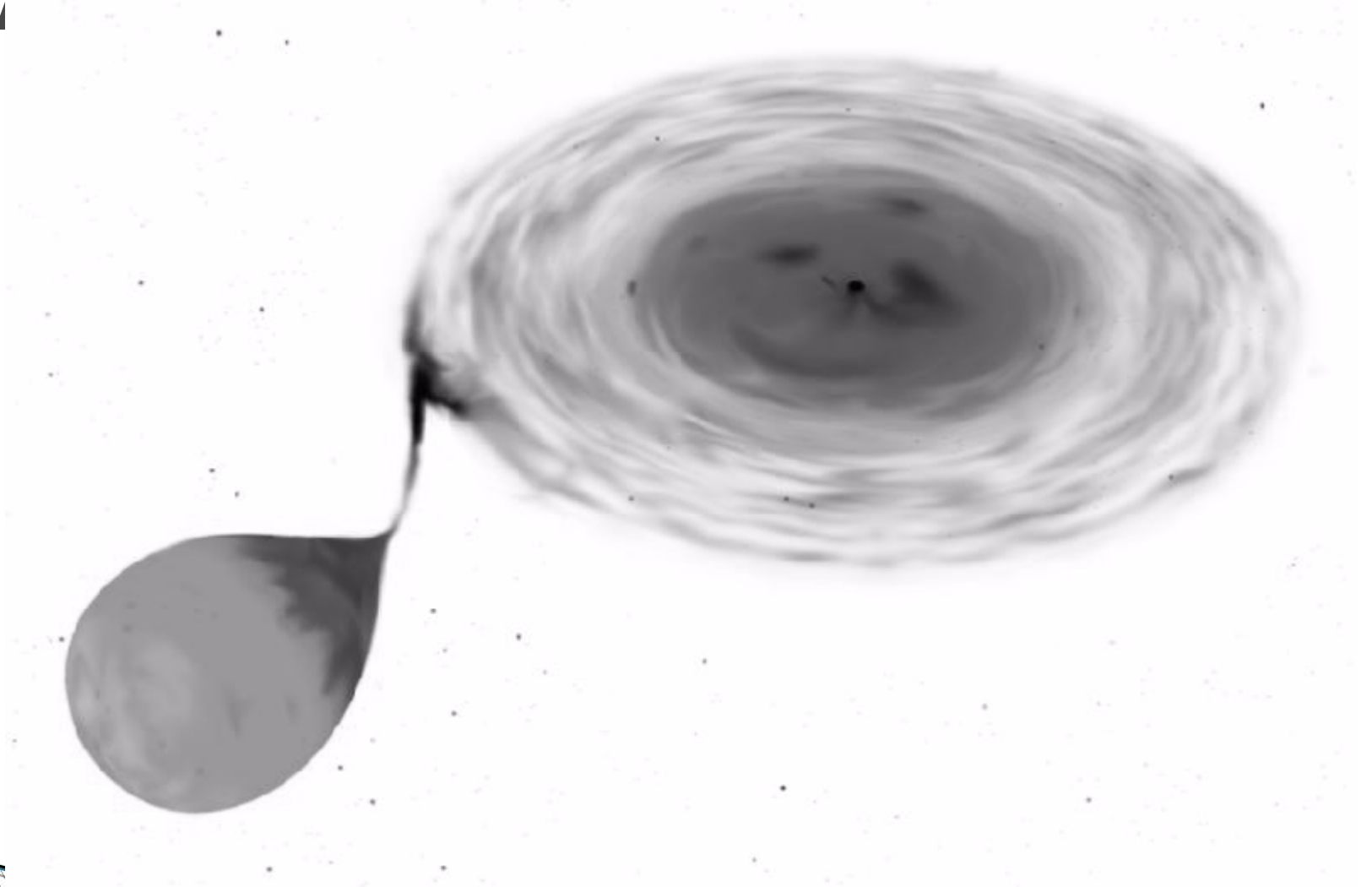
- Long term monitoring of:
  - Faint CVs (cataclysmic Variables): since 2001
  - Symbiotic stars in V, Ic: since 2004
  - (Old) novae in V, R, Ic and unfiltered timeseries of brighter specimen
  - Monthly observations of clusters

- Timeseries photometry of known and newly discovered CVs:
  - CBA network participation: https://cbastro.org/

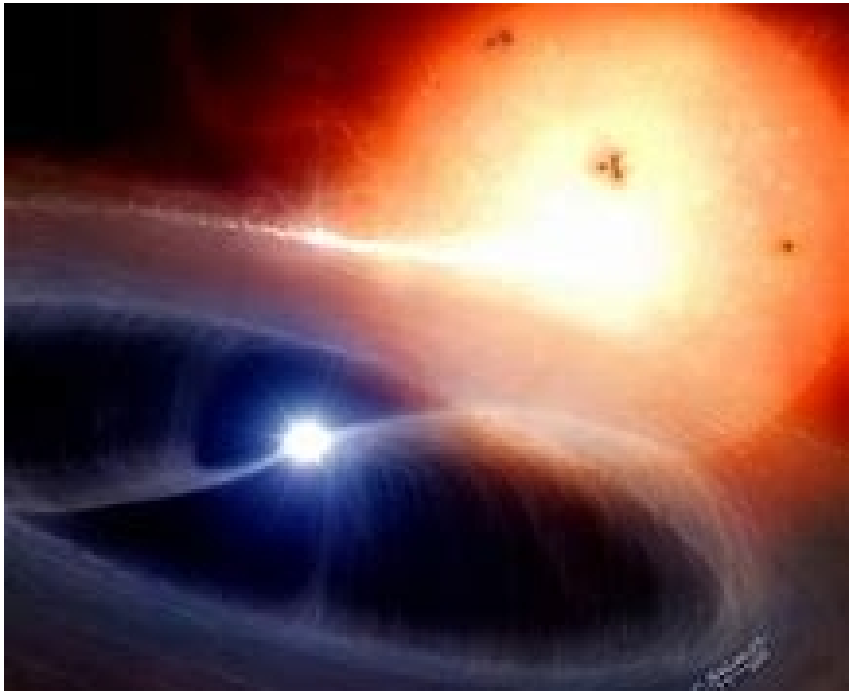
30 Doradus (LMC) / Tarantula Nebula



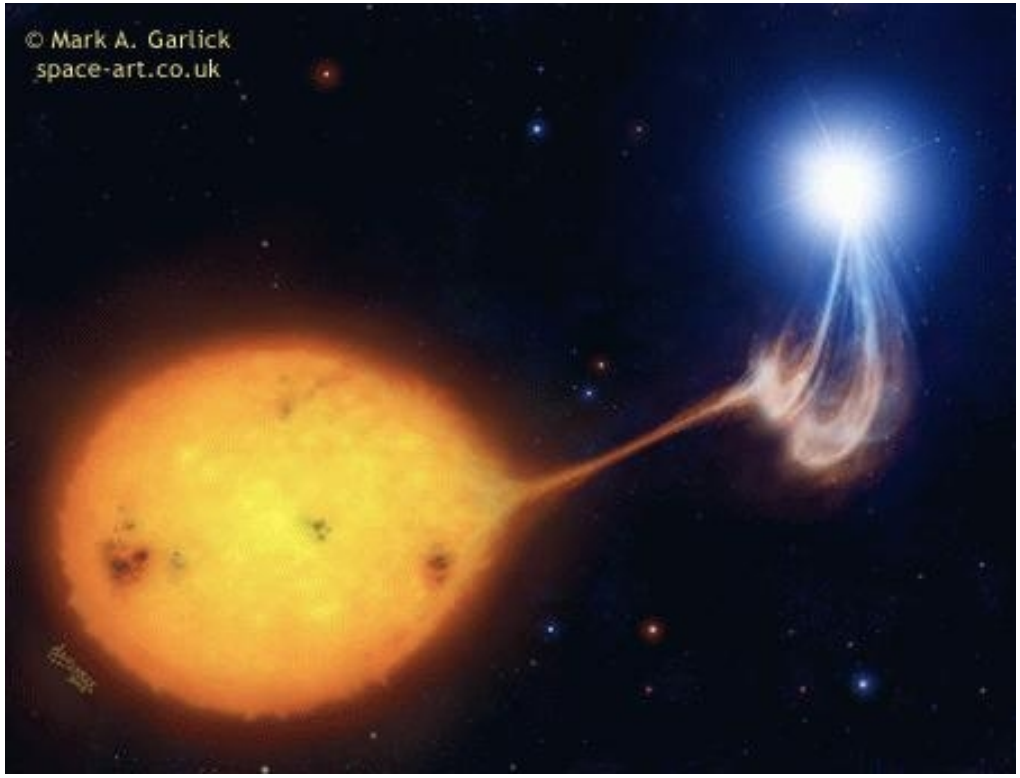
Non- magnetic cataclysmic variables



Schematic of an intermediate polar (dq her)



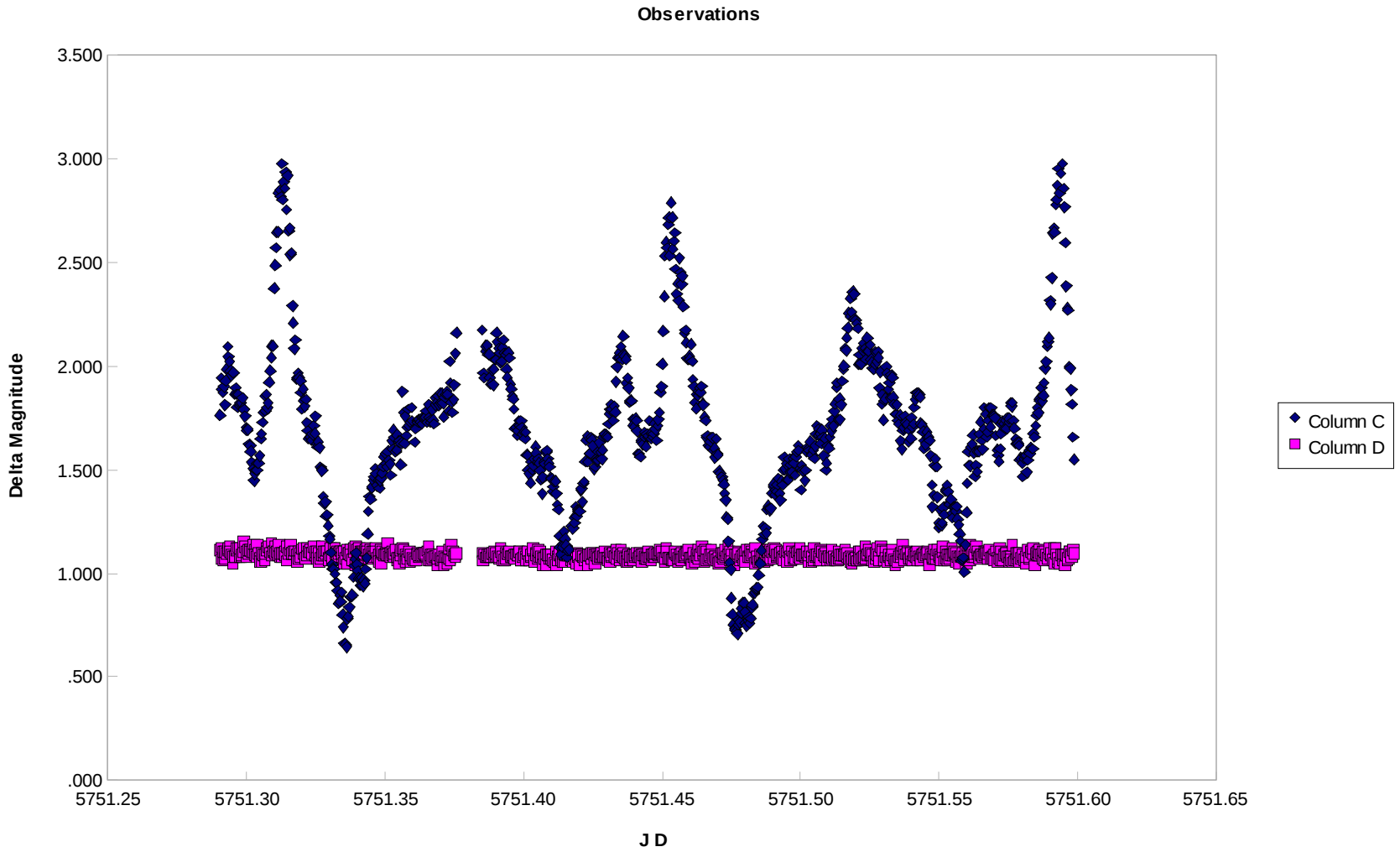
Schematic of a polar (am her)



Observations of Cataclysmic Variables

- Timeseries photometry (mostly unfiltered):
  - Tracking the star until it goes down in the West
  - Observe continuously: pe 30sec exposure, 3 sec download, 30sec exp etc.. Until dawn or the setting of the object on the W horizon: 400-1000 images per night.
  - Apply photometric reduction software. Get the LC.
  - Stack a set of good images. Deep image for the night
  - Repeat on the next night.
  - Collaborate with similarly minded observers from other time zones.

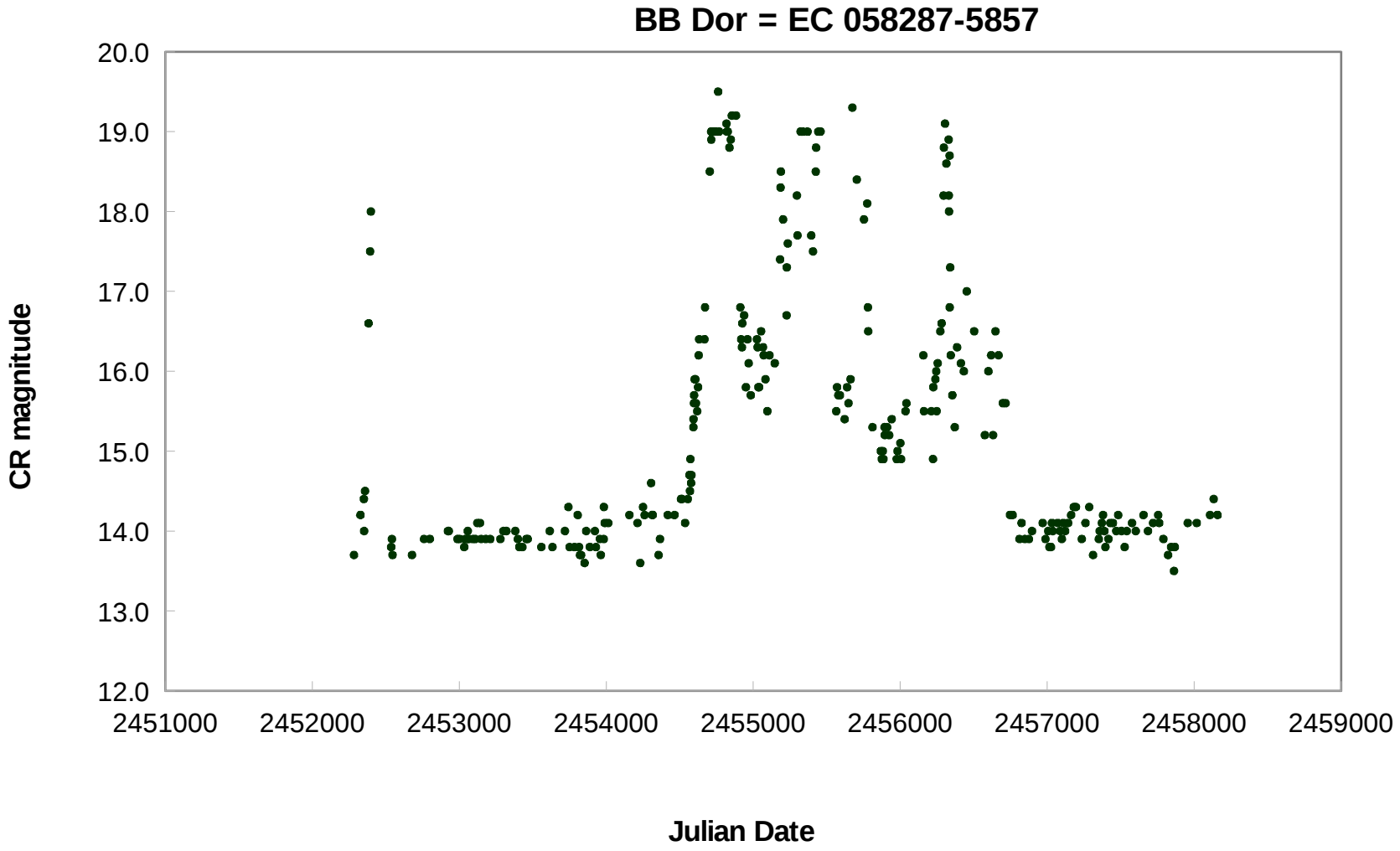
8h of polar V1432 Aql on 8 July 2011



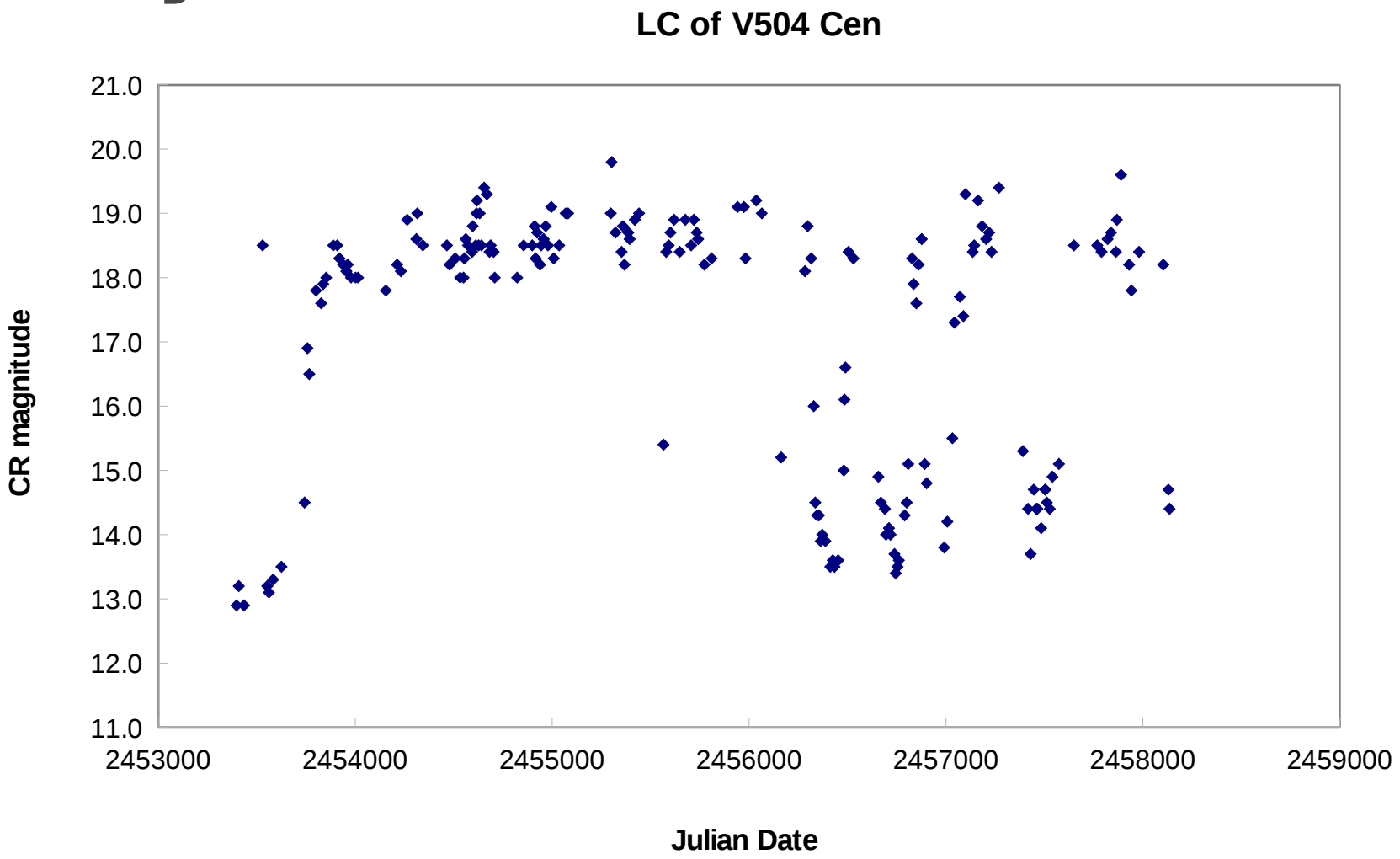
Observations of Cataclysmic Variables

- Snapshot observations every week/month
  - Snapshots are resulting images from stacks of sequential images taken at one time: stack of 3-10 images to get a deep image.
  - Depending on the purpose or the merit of the observed object, snapshots are done at shorter or longer intervals.
  - Bright CVs and young novae would benefit from observations through filters (B-V-R-I).

16 years of BB Dor photometry



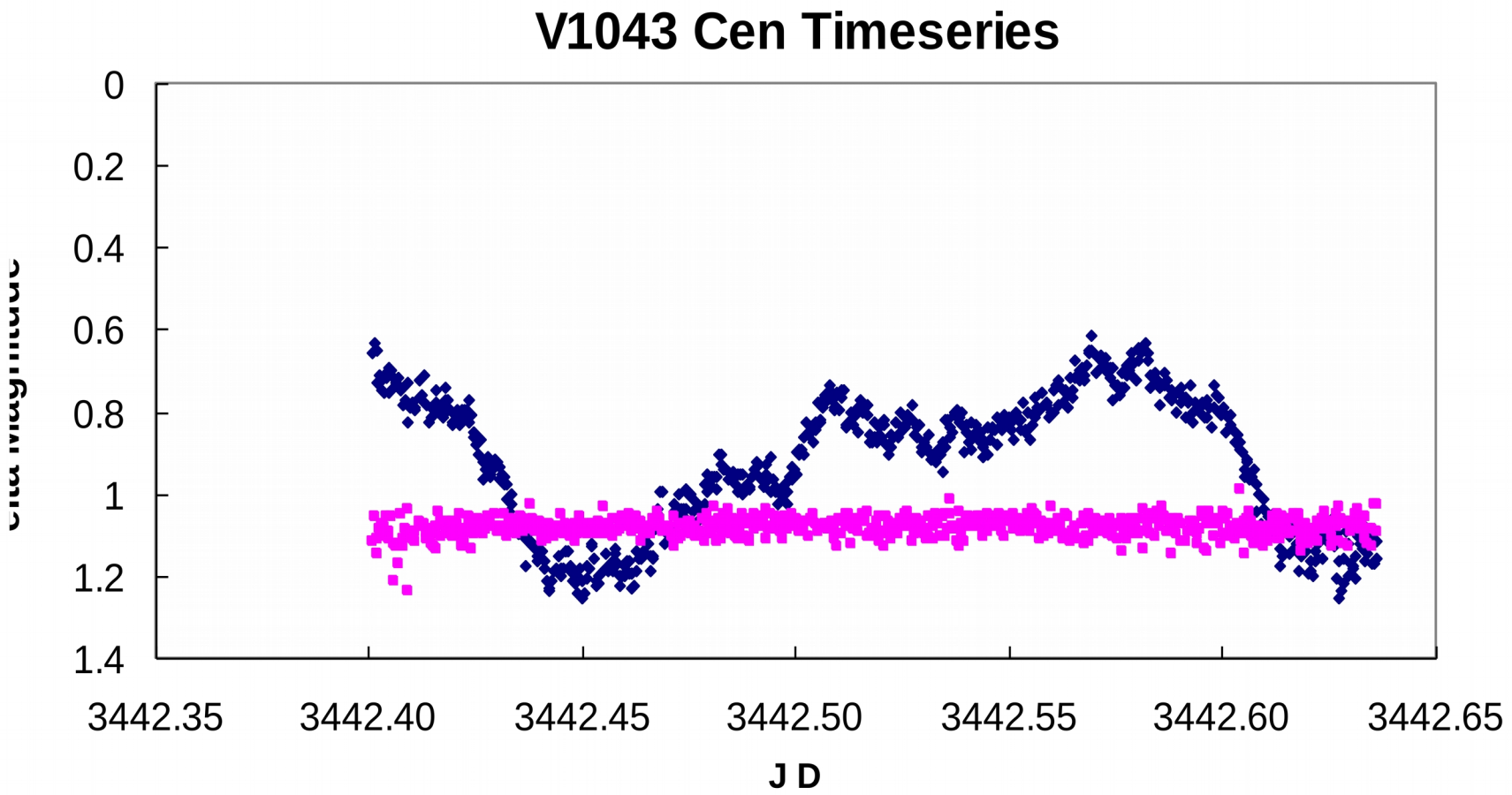
14 years of V504 Cen



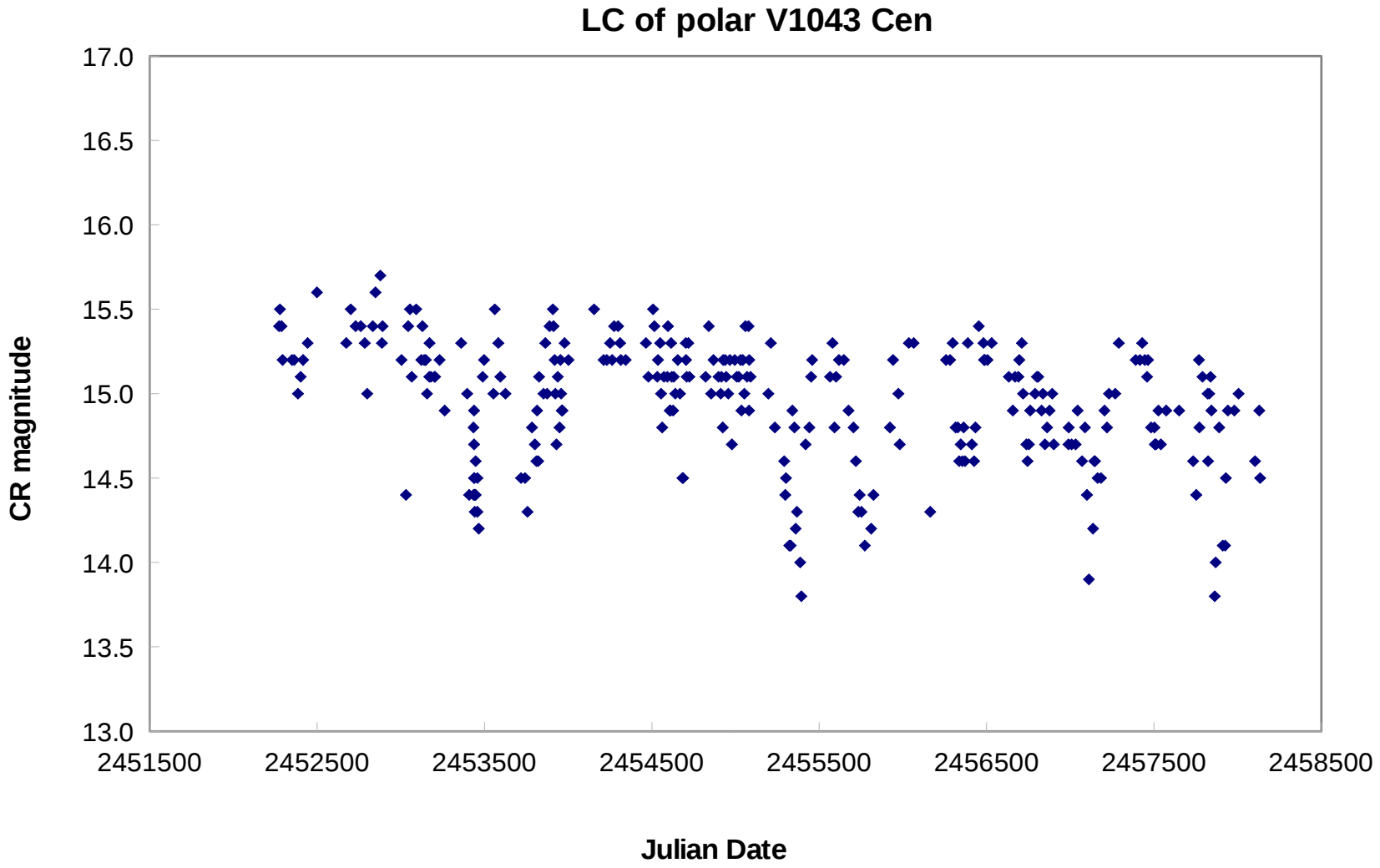
V1043 Centauri

- **GCVS Name:** V1043 Cen
- **Other Name:** RX J1313.2-3259
- **RA:** 13:13:17.14
- **DEC:** -32:59:12.2
- **Object Type:** am
- **Magnitude Range:** 16 V -
- **Period:** 0.174592d

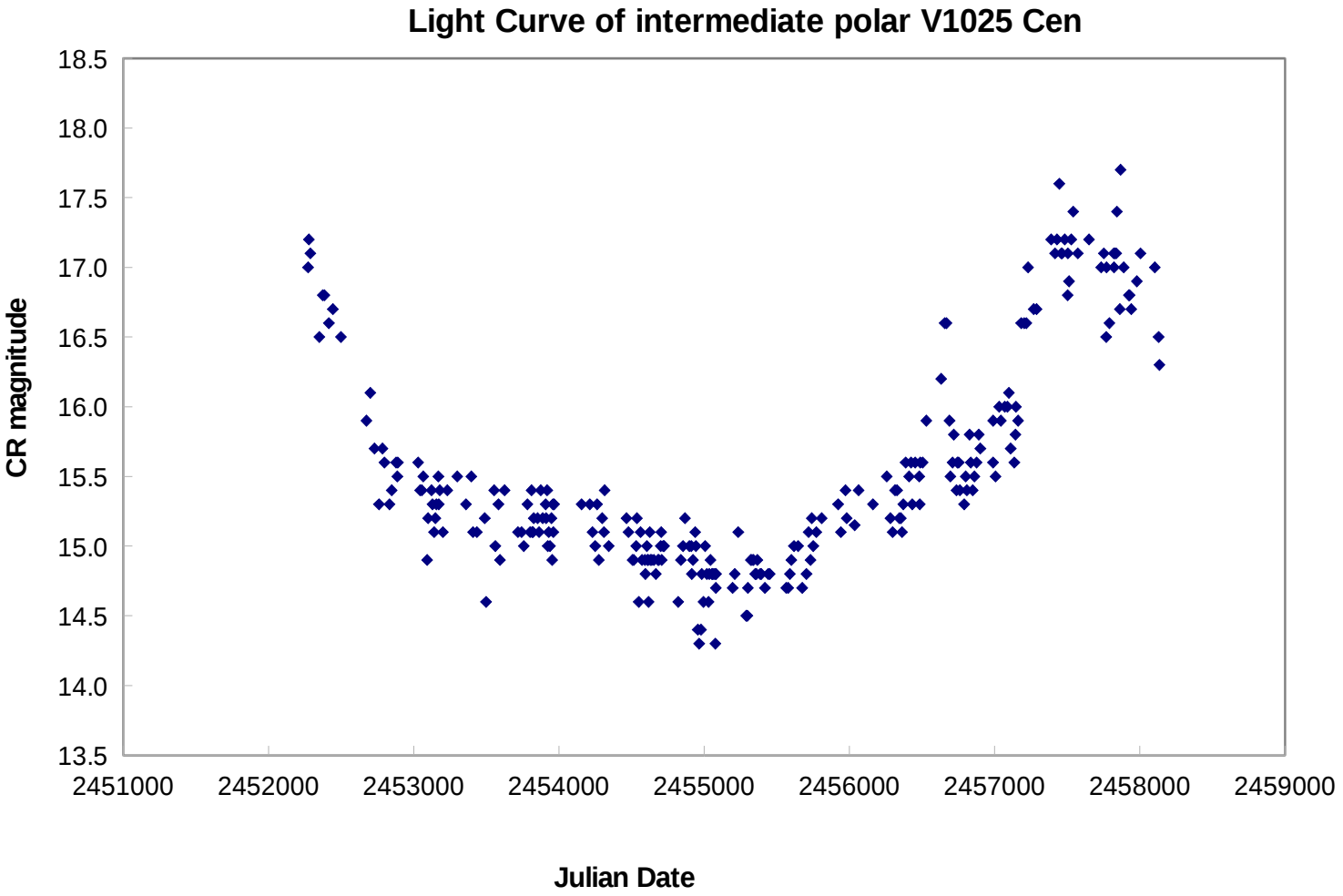
6 hours timesries of V1043 Cen



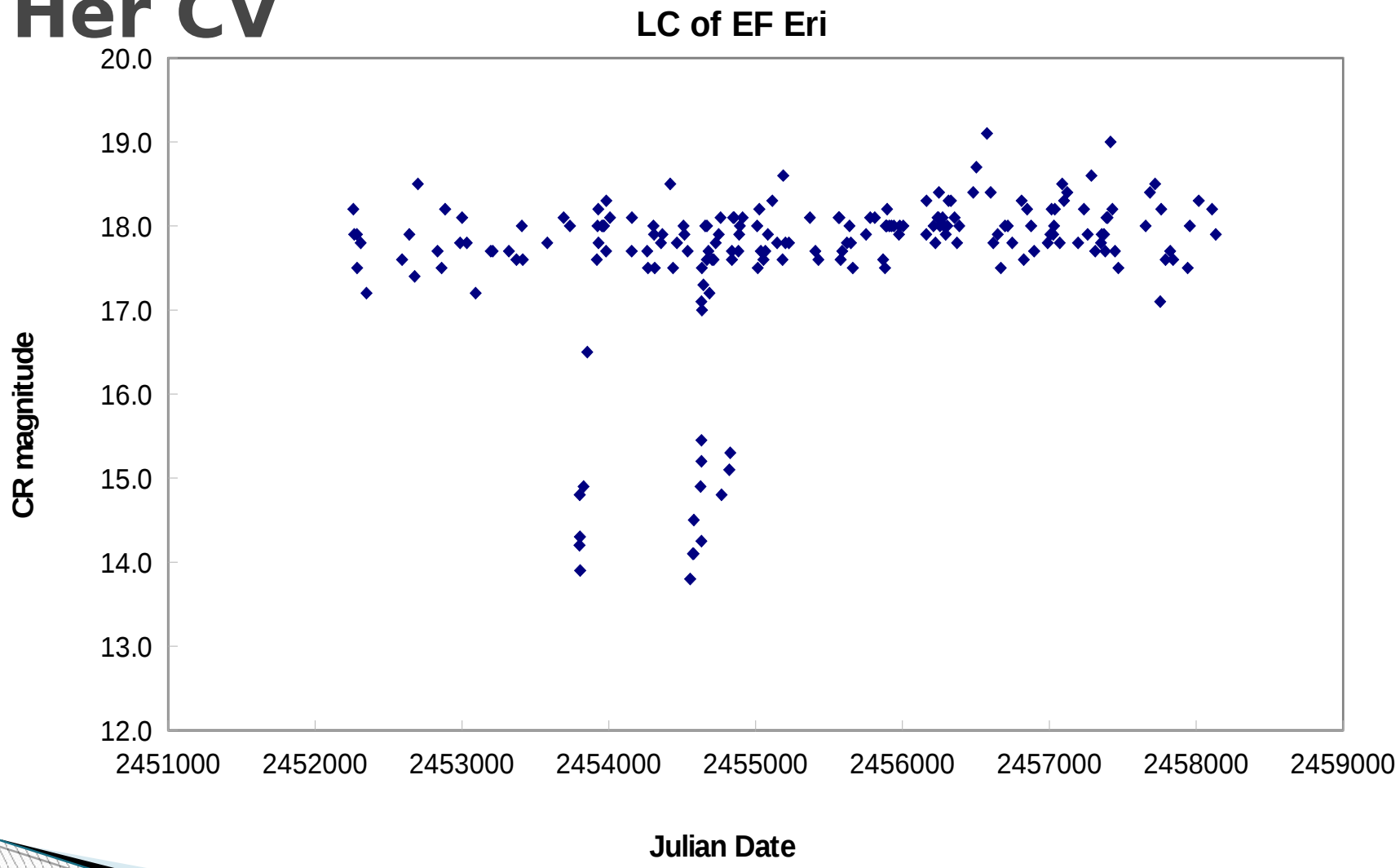
16 years of V1043 Cen (am her)



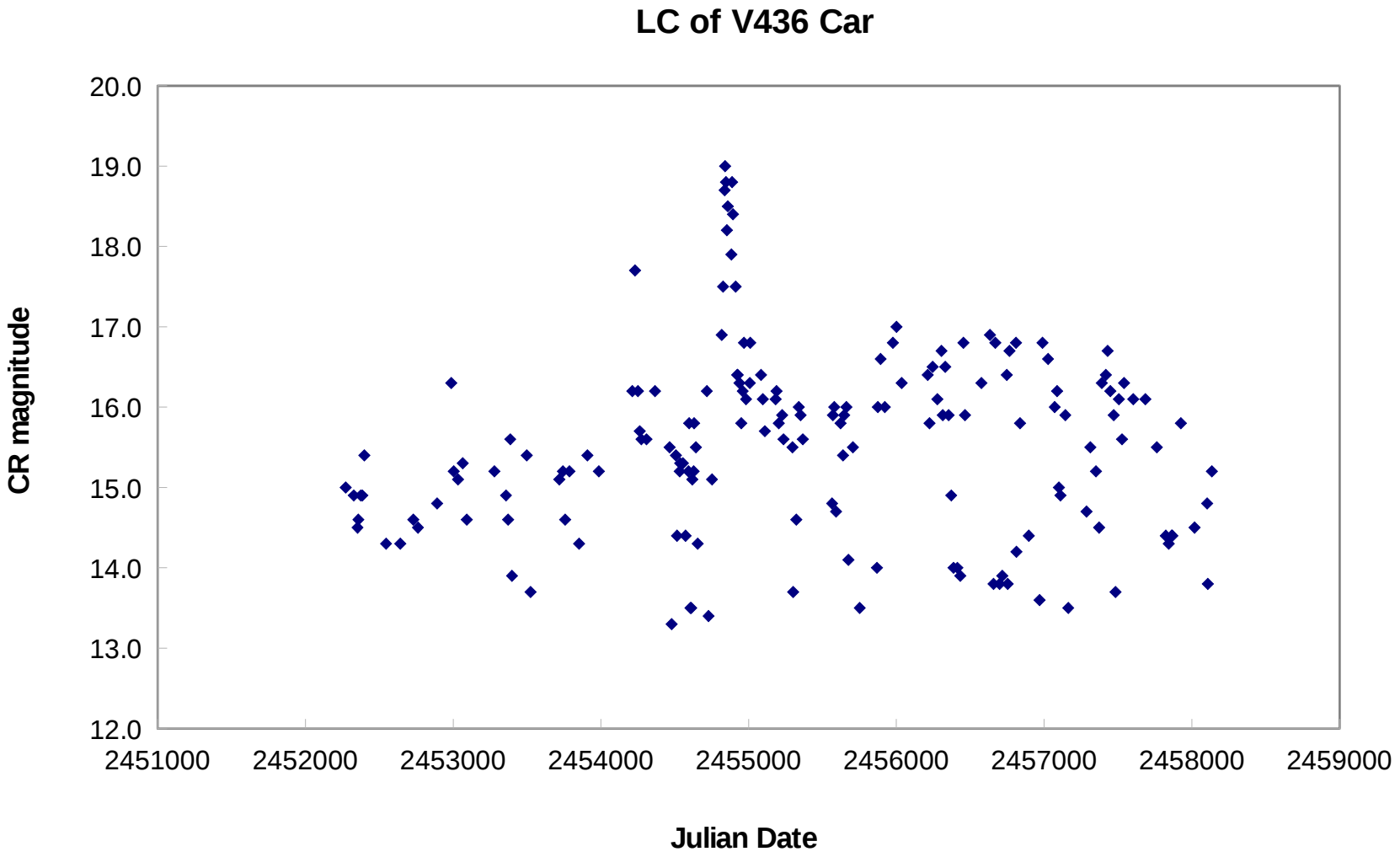
16 years of V1025 Cen (dq her)



15 years of EF Eri, a starving AM Her CV



15 years of a magnetic CV (dq her)

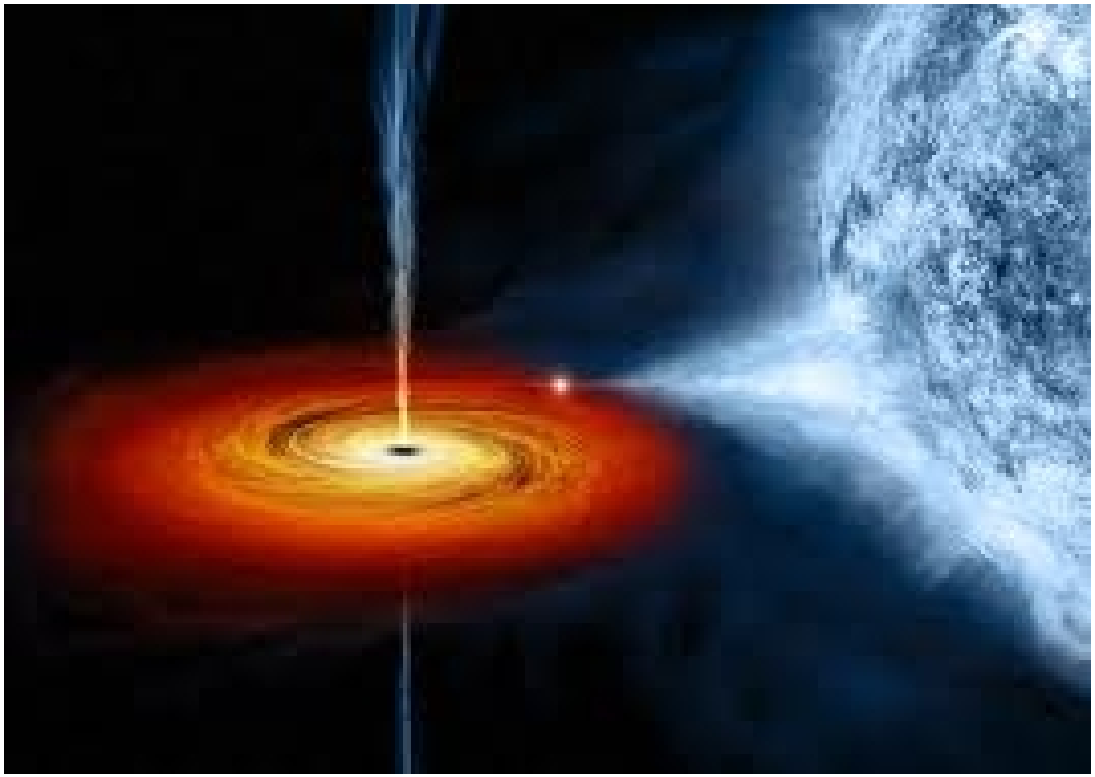


Symbiotic stars

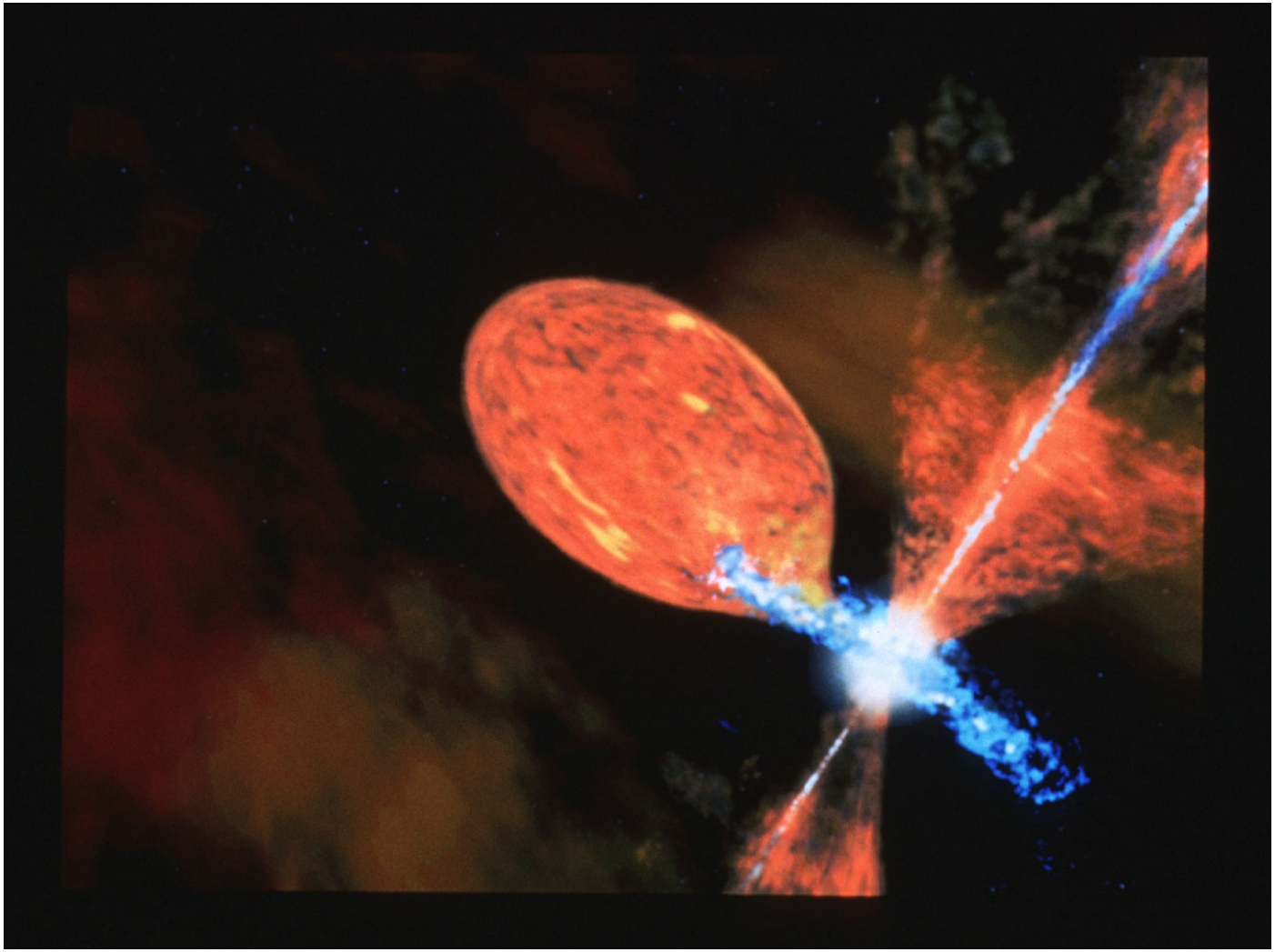
Periodic monitoring of known and suspected Z And stars (+ some other unknown types)

- 200+ targets since end 2004
- Observed weekly, monthly
- Observed in V band and Ic band (2012-)
- Early results include corrections of wrong IDs, eclipsing systems not known to be and improved ephemerides.
- Symbiotic nova V618 Sgr (2017)

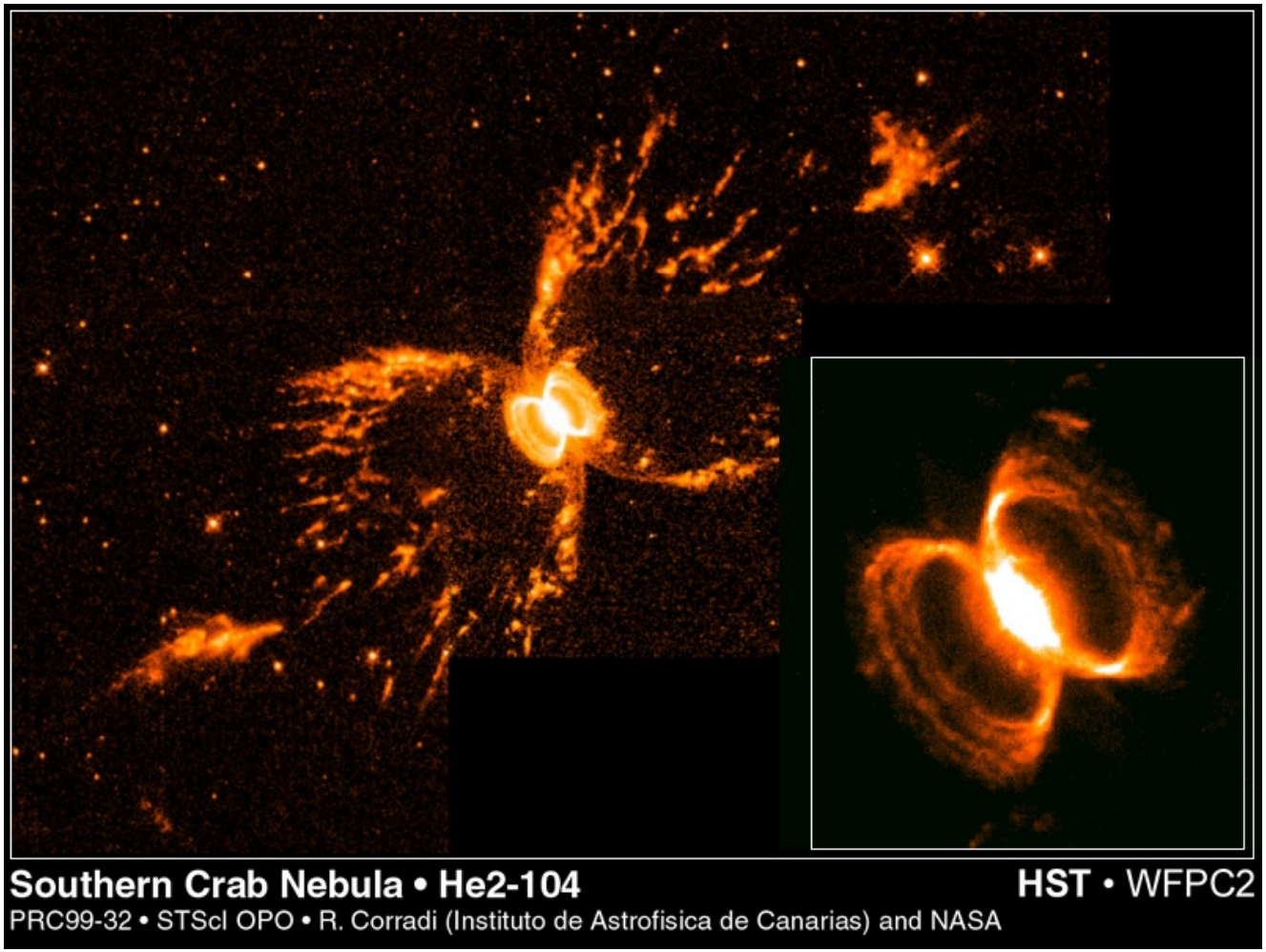
Schematic of a symbiotic star



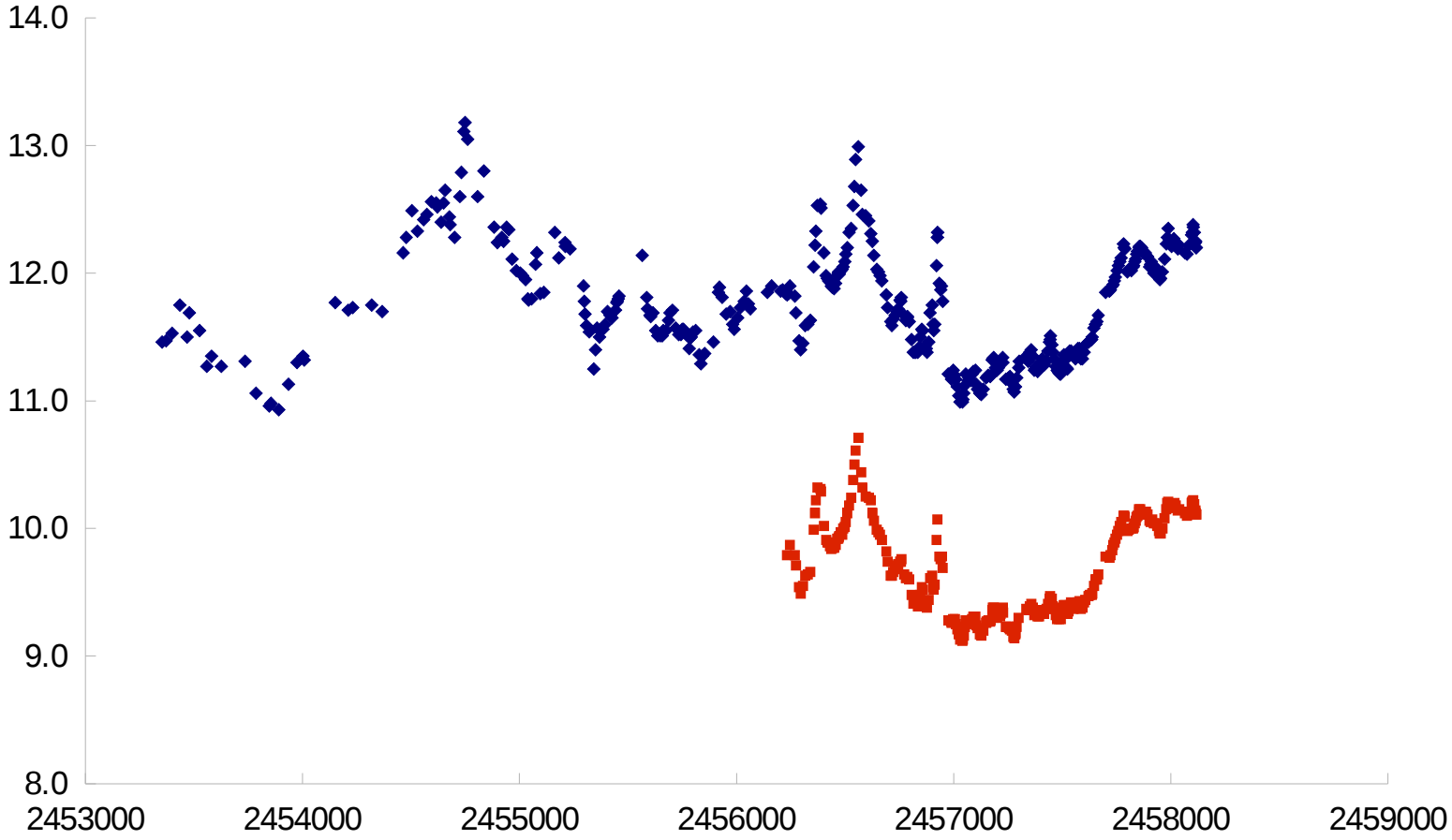
Symbiotic star R Aquarii



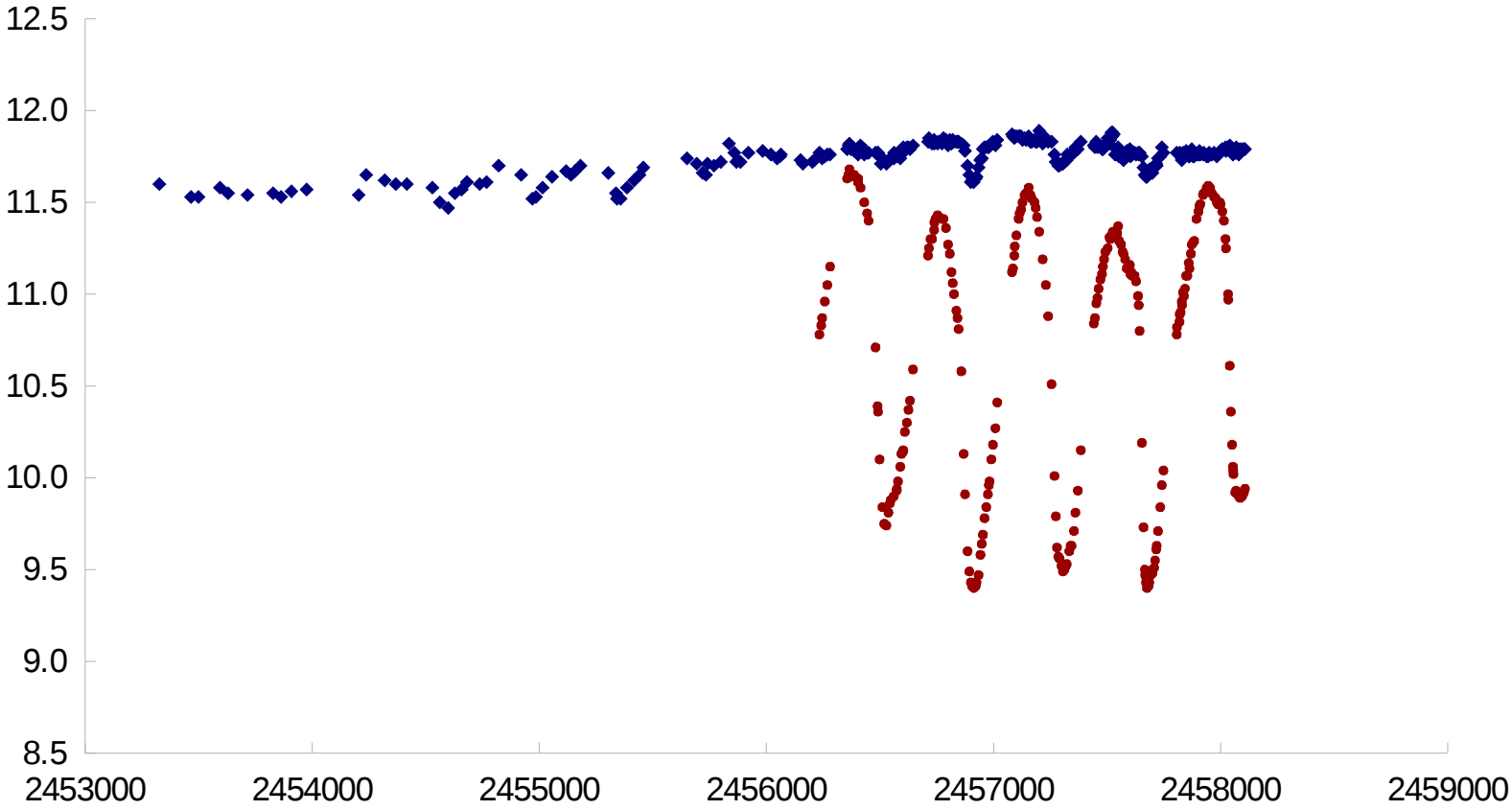
Symbiotic star Hen 2-104 / V852 Cen



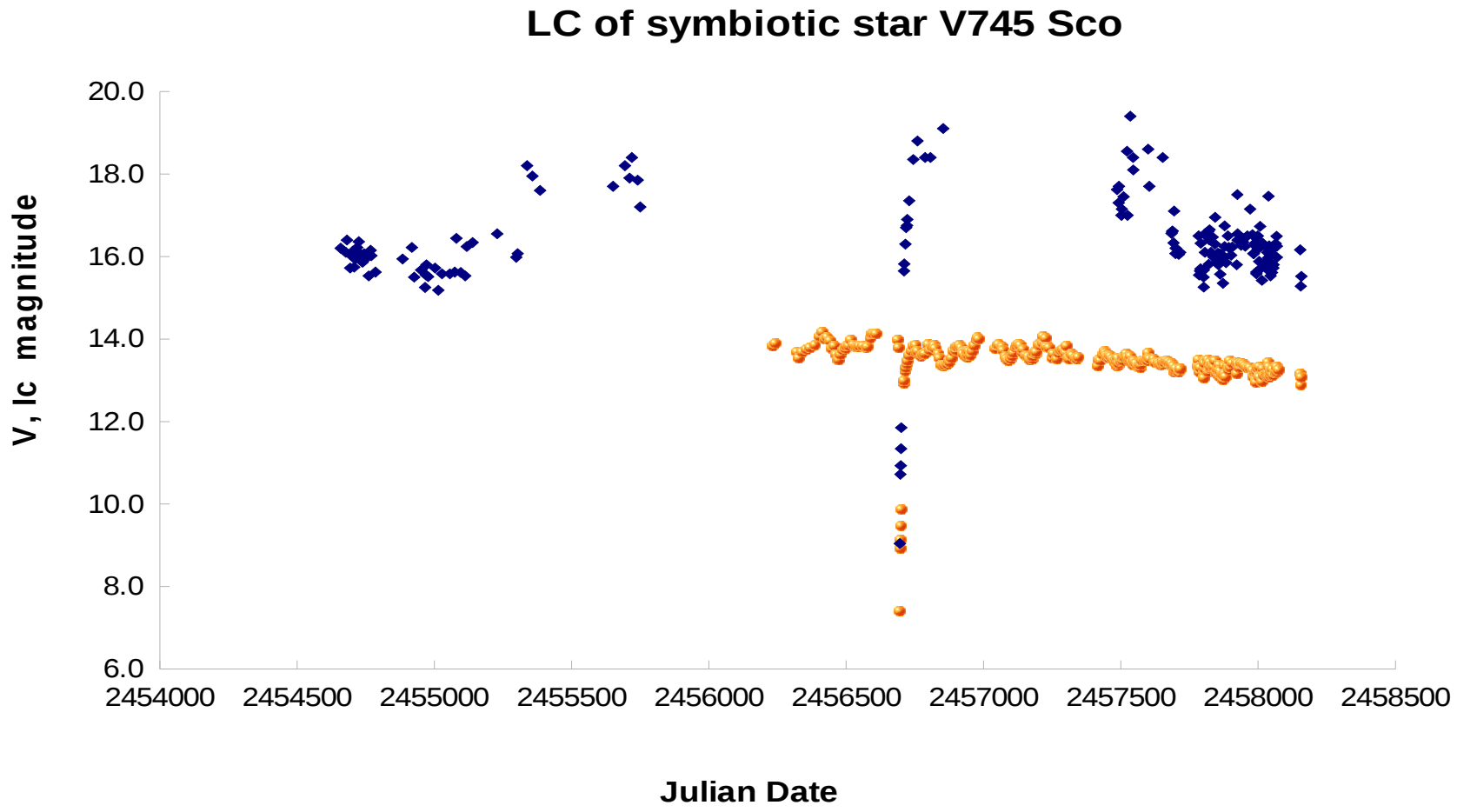
14 years of V417 Centauri: V, Ic mags vs JD



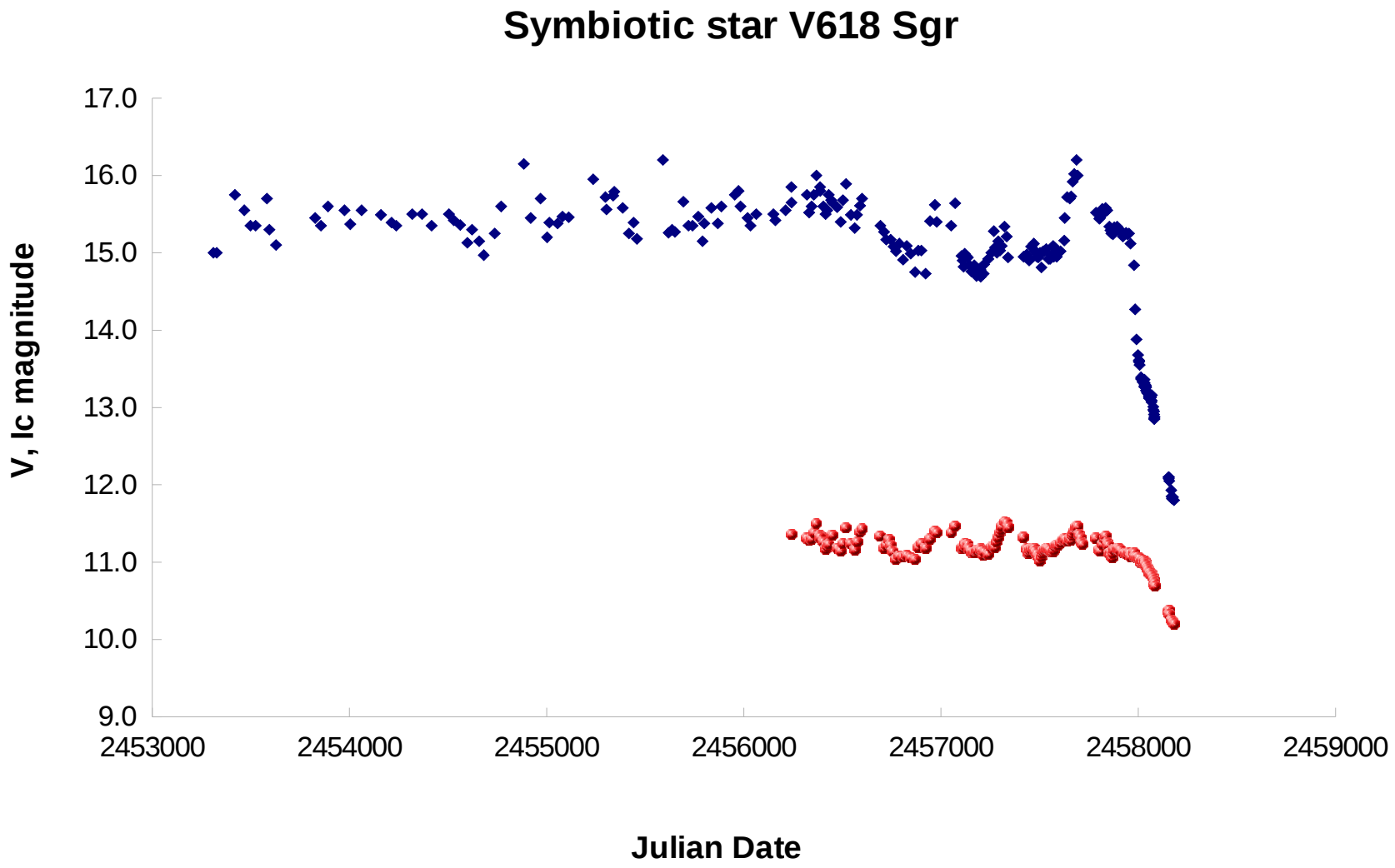
14 years of RR Telescopii: V, Ic mags vs JD

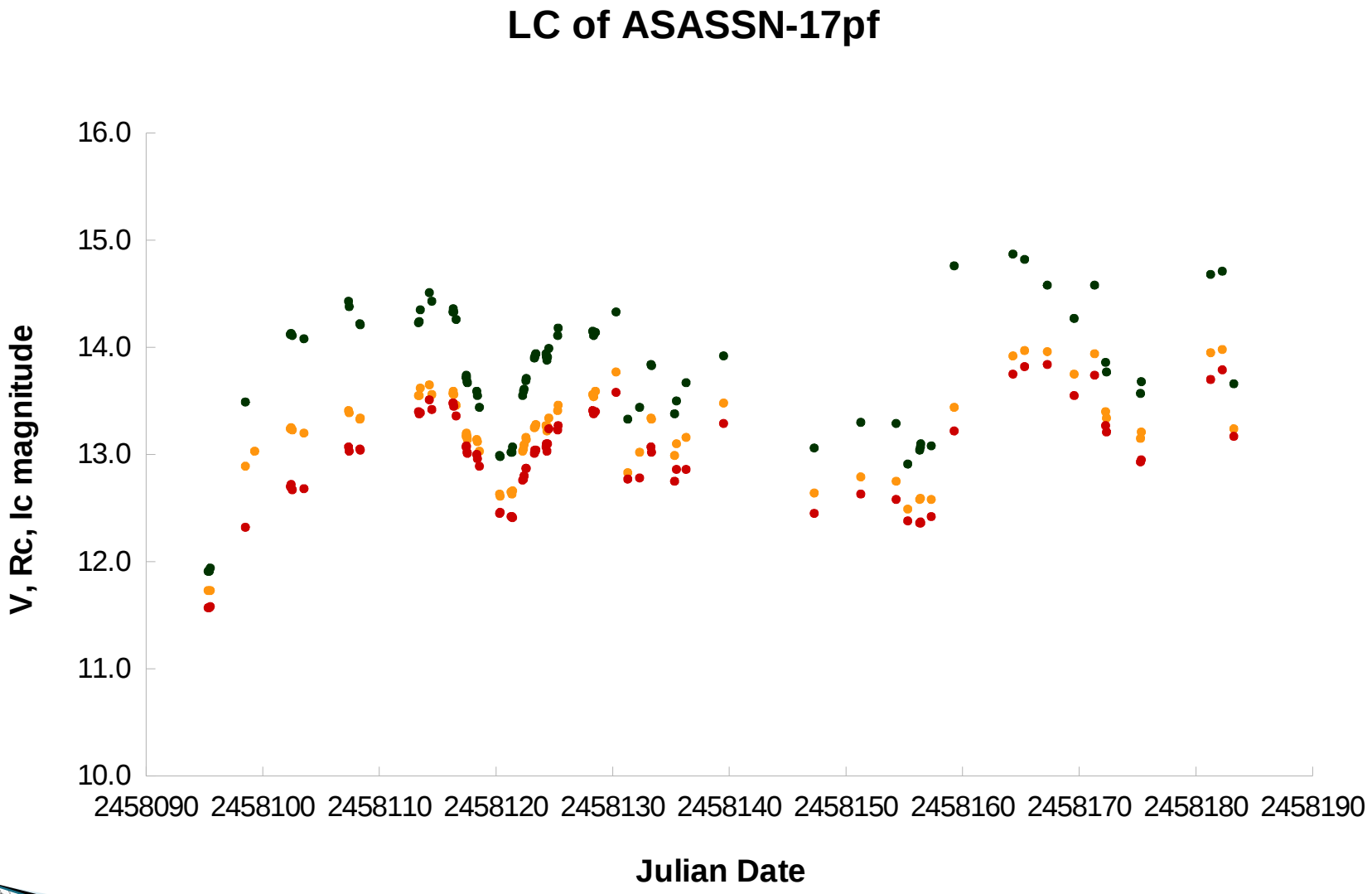


10 years of symbiotic star / recurrent nova V745 Scorpii



V618 Sgr, a symbiotic nova in 2017




LC of ASASSN-17pf
V, Rc, Ic magnitude
16.0
15.0
14.0
13.0
12.0
11.0
10.0
2458090
2458100
2458110
2458120
2458130
2458140
2458150
2458160
2458170
2458180
2458190
Julian Date

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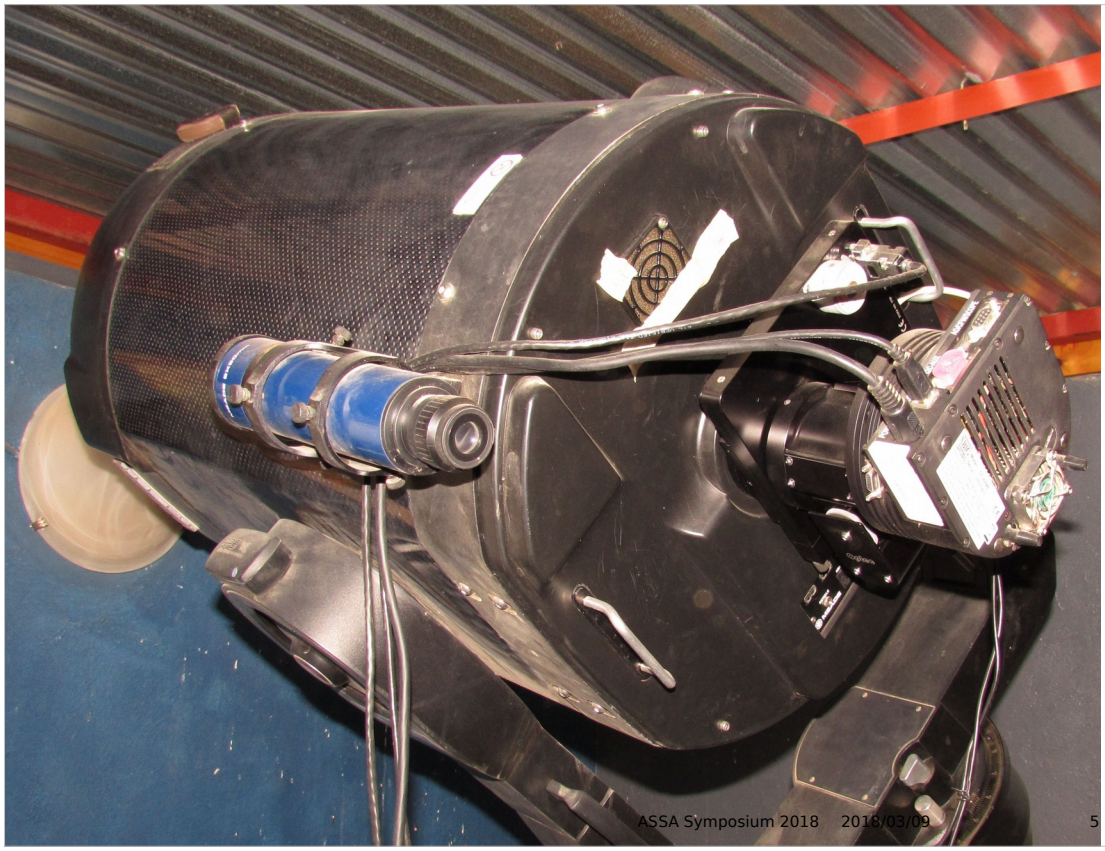

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- Catalogues : Rosat, Edinburgh-Cape Survey: great info for exploring and monitoring eventual eruptions of suspected CV s, catalogues for astrometric or photometric reference

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- http://simbad.u-strasbg.fr/simbad/
- https://arxiv.org/archive/astro-ph

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DSS image □□ RCX400/ST8 image

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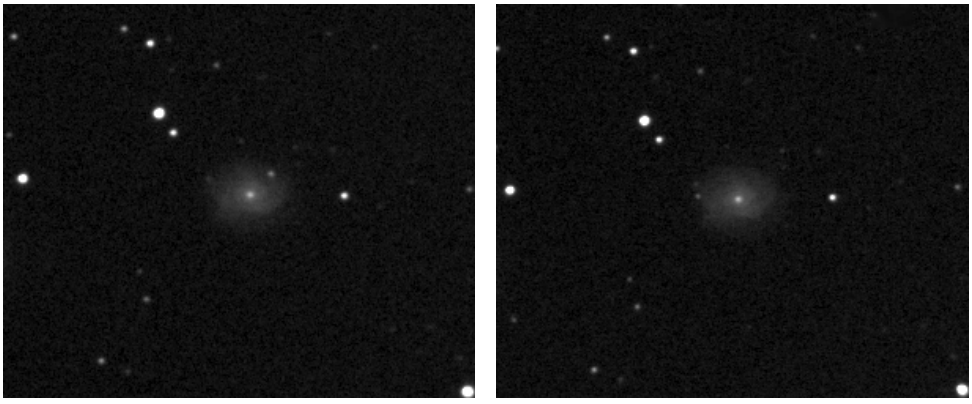

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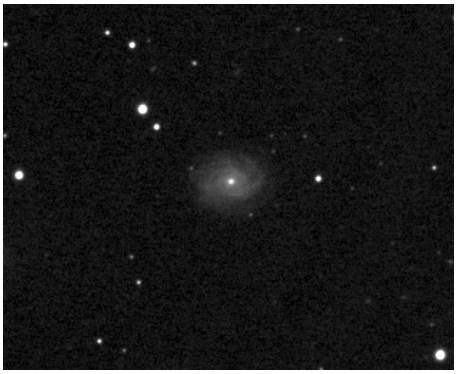
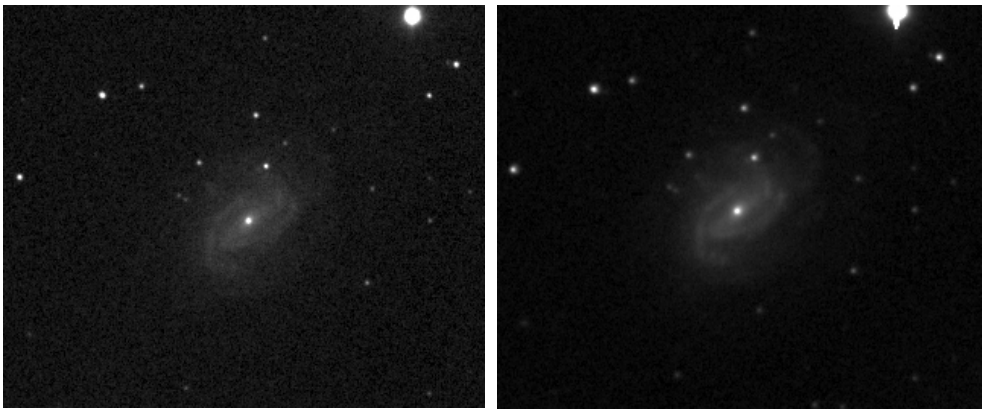
SN 2014di and SN 2010cm, two more SNe in ESO 244-31



SN 2007Y in NGC 1187 (20 Mpc)




Supernova SN2007Y

Today’s surveys

- Fully automated indiscriminative brute force continuous surveys with instantaneous data processing and prompt alerting

- OGLE (Gravitational lensing, MW, MCs)
- ASASSN (Supernovae): uses 5” telescopes
- Sloan DSS:
- ATLAS (nearby asteroids)
- GAIA (ESA, astrometry, space telescope)
- DLT40 (<40 Mpc supernovae, nightly)

- http://sci.esa.int/gaia/
- Astrometry
- Photometry
- Detect changes in
  - Position
  - brightness


ASAS SN
http://www.astronomy.ohio-state.edu/
~assassin/transients.html

Leftovers for amateurs / opportunities

A reality check:

- Compete in finding SNe:
  - go where nobody else is going
  - Do like DLT40 and hope they have bad weather
- Join:
  - Confirmation of ASASSN SN detections
- Follow up on alerted OTs (Optical Transients):
  - erupting CVs of different kinds, active galaxy cores, XR sources, gravitational lenses,

Follow up observations on OTs

- Timeseries photometry on bright OTs: observe continuously over a full night and derive a photometric LC, repeat many nights..

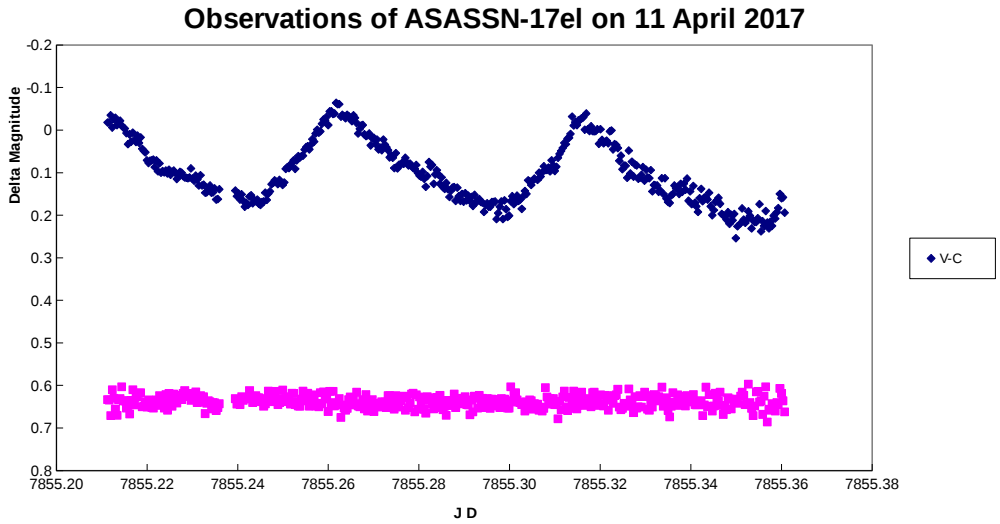
- Snapshot observations:
  - (B-)V-R-I observations of bright OTs (novae..)
  - Monitoring transients over time until they get too faint (nightly, weekly)

Note: professional astronomers are not always in a position to follow up promptly or do so intensively over long periods

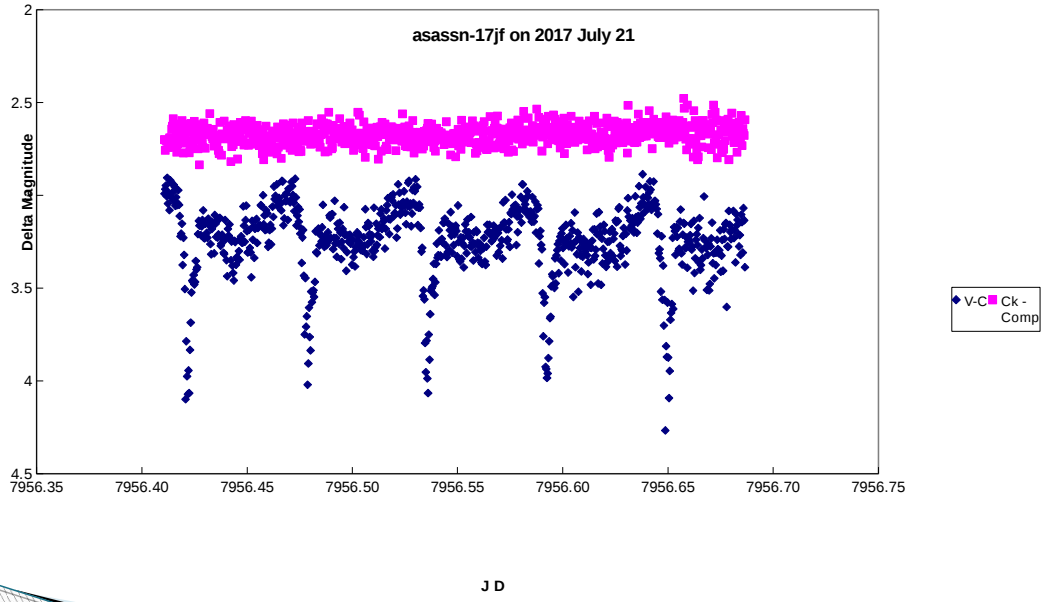
Some considerations re today's surveys

- Arm chair astronomers can do a lot of datamining from the findings of the surveys (which are found at the different websites).
- Despite all advances in automatic data processing and prompt alerting, many 'obvious' facts and associations are often overlooked,
- discretion is not part of computers yet. An experienced and knowlegeable individual can still find a lot more there.
- https://anu.prezly.com/anu-invites-everyone-to-join-the-search-for-exploding-stars

4 hours timeseries photometry

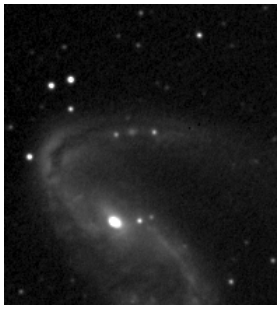
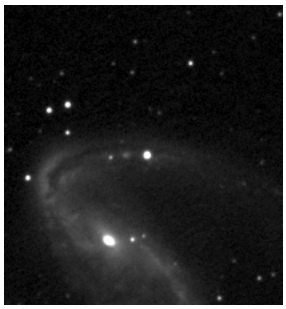
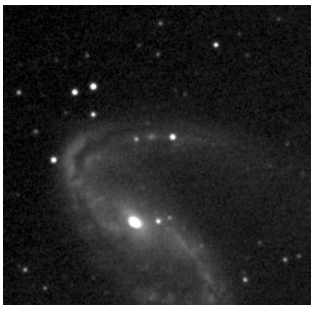


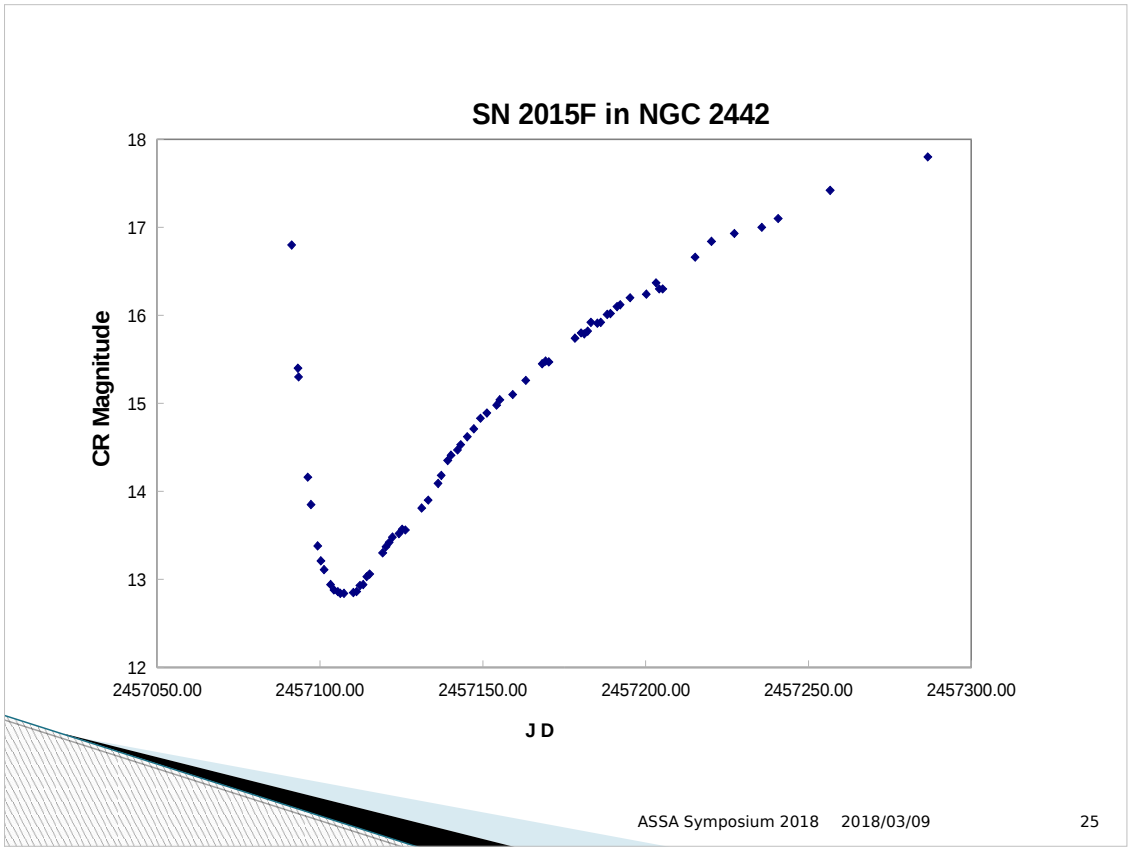
6 hours timeseries of ASASSN-17jf



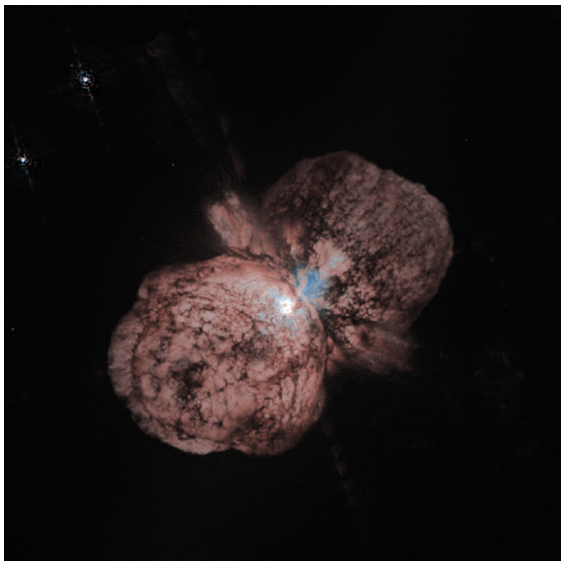
The Rise and Fall of Supernova 2015F

apod.nasa.gov/apod/ap160209.html

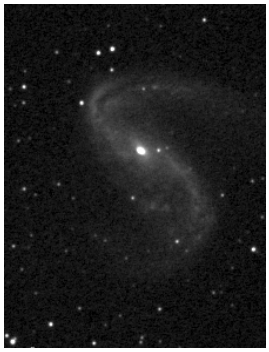
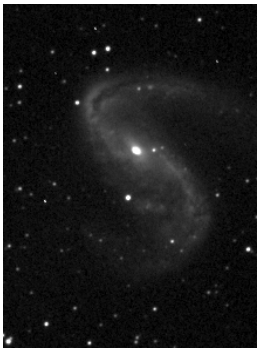
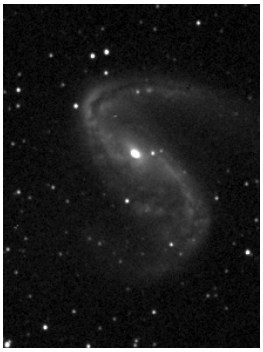





SN 2015F in NGC 2442
CR Magnitude
18
17
16
15
14
13
12
2457050.00
2457100.00
2457150.00
2457200.00
2457250.00
2457300.00
J D

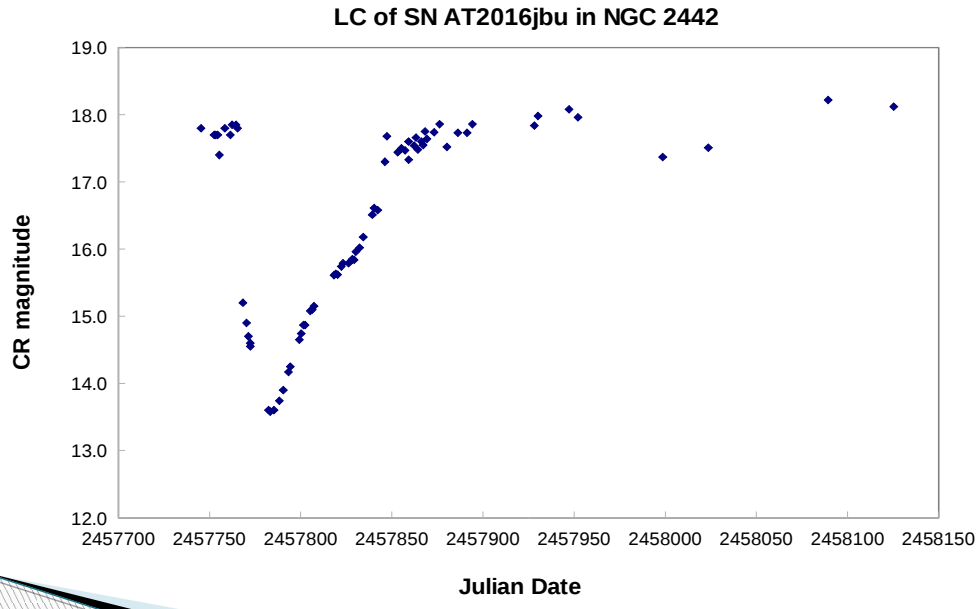
Eta Carinae



AT 2016jbu in NGC 2442

SN with precursor outburst

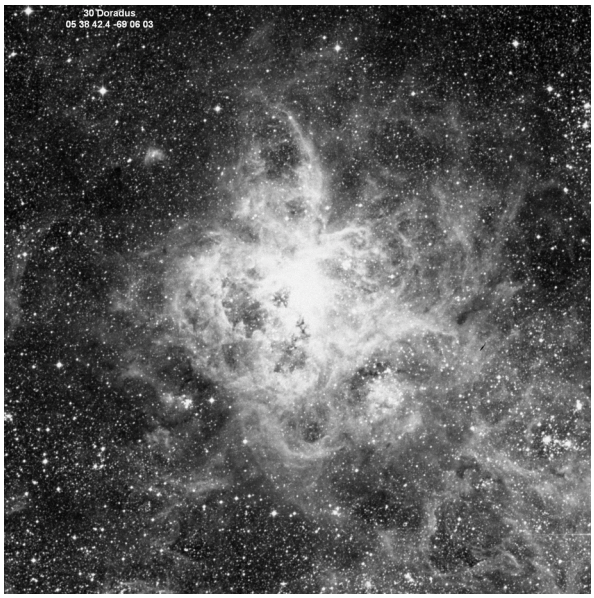


More observing projects at KKO

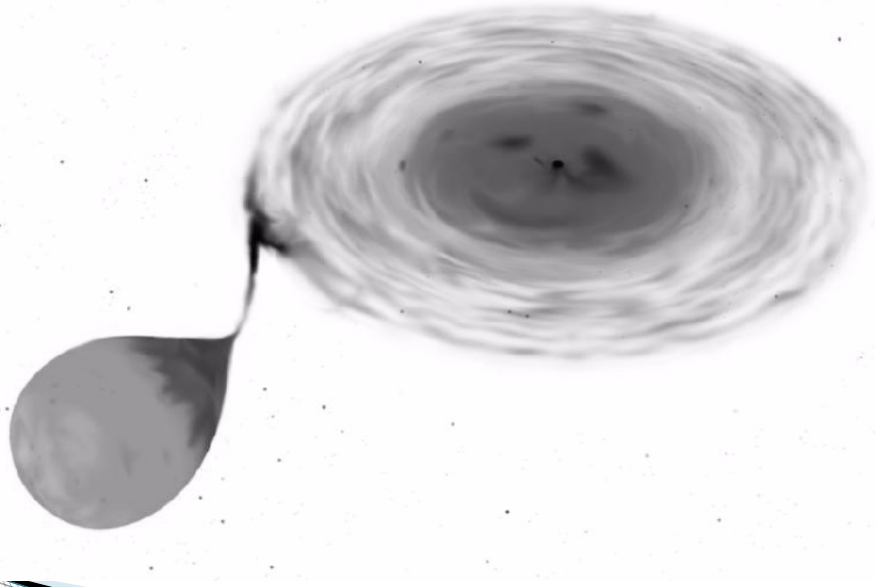
- Long term monitoring of:
  - Faint CVs (cataclysmic Variables): since 2001
  - Symbiotic stars in V, Ic: since 2004
  - (Old) novae in V, R, Ic and unfiltered timeseries of brighter specimen
  - Monthly observations of clusters

- Timeseries photometry of known and newly discovered CVs:
  - CBA network participation: https://cbastro.org/

30 Doradus (LMC) / Tarantula Nebula

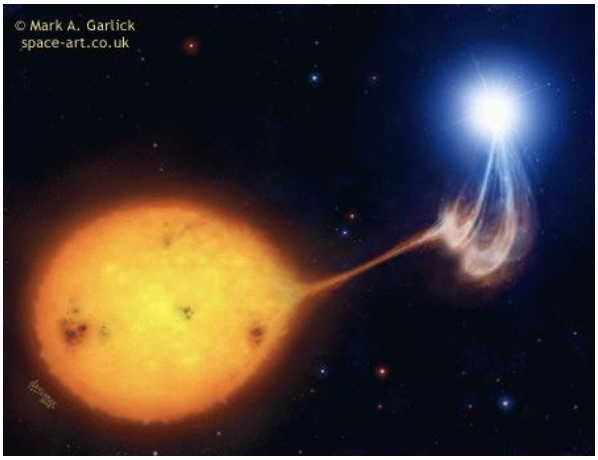


Non- magnetic cataclysmic variables



Schematic of an intermediate polar (dq her)

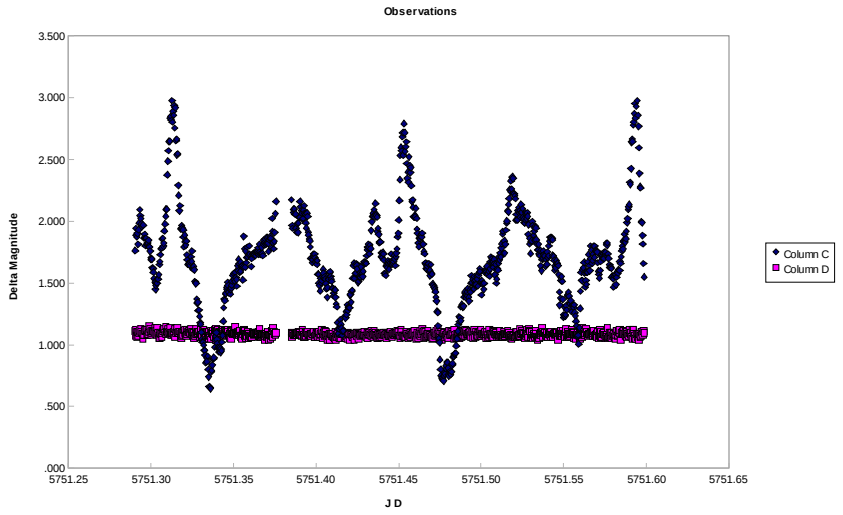
Schematic of a polar (am her)



Observations of Cataclysmic Variables

- Timeseries photometry (mostly unfiltered):
  - Tracking the star until it goes down in the West
  - Observe continuously: pe 30sec exposure, 3 sec download, 30sec exp etc.. Until dawn or the setting of the object on the W horizon: 400-1000 images per night.
  - Apply photometric reduction software. Get the LC.
  - Stack a set of good images. Deep image for the night
  - Repeat on the next night.
  - Collaborate with similarly minded observers from other time zones.

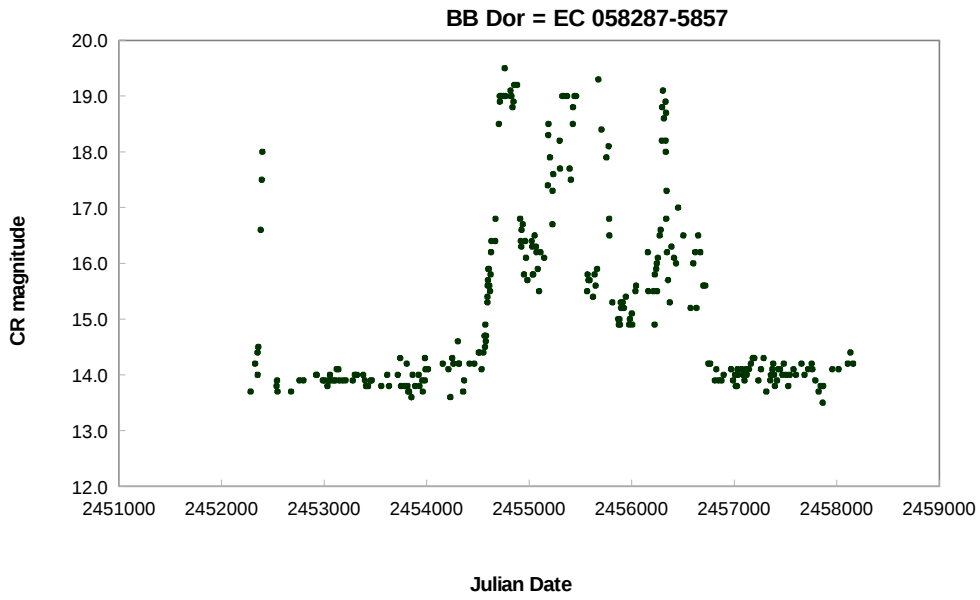
8h of polar V1432 Aql on 8 July 2011



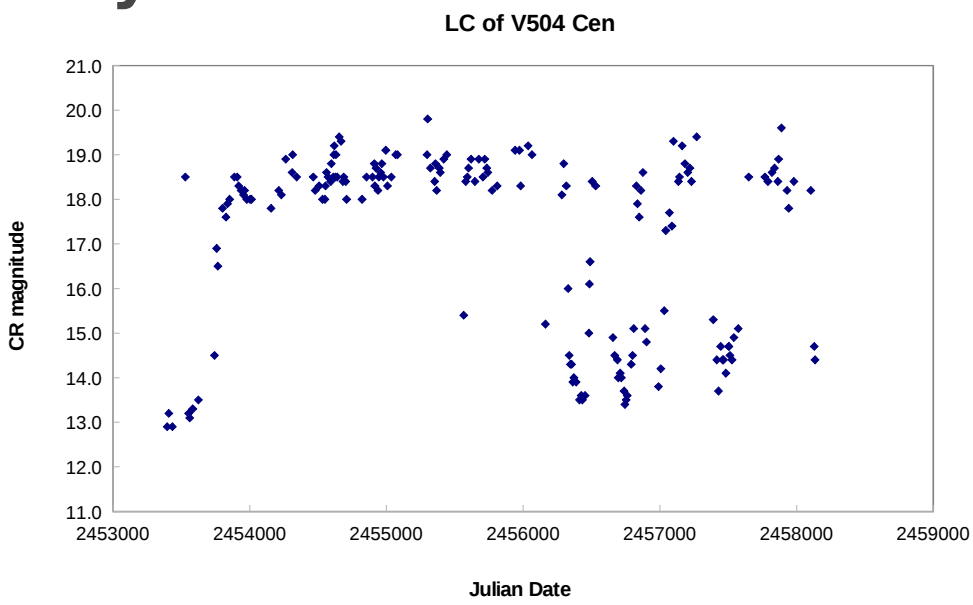
Observations of Cataclysmic Variables

- Snapshot observations every week/month
  - Snapshots are resulting images from stacks of sequential images taken at one time: stack of 3-10 images to get a deep image.
  - Depending on the purpose or the merit of the observed object, snapshots are done at shorter or longer intervals.
  - Bright CVs and young novae would benefit from observations through filters (B-V-R-I).

16 years of BB Dor photometry



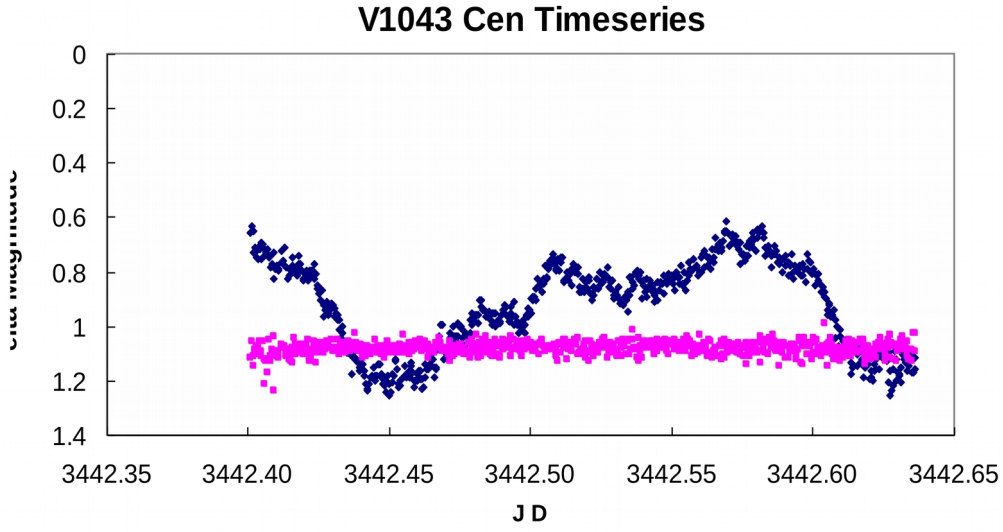
14 years of V504 Cen



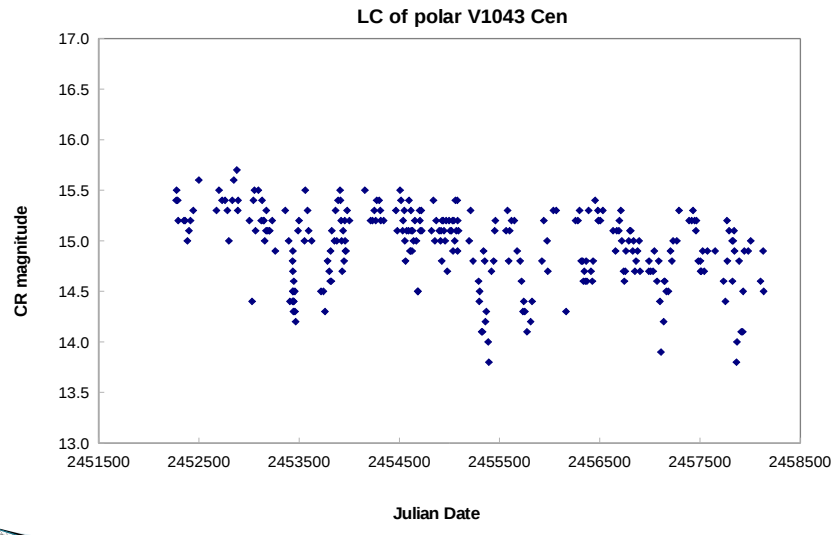
V1043 Centauri

- **GCVS Name:** V1043 Cen
- **Other Name:** RX J1313.2-3259
- **RA:** 13:13:17.14
- **DEC:** -32:59:12.2
- **Object Type:** am
- **Magnitude Range:** 16 V -
- **Period:** 0.174592d

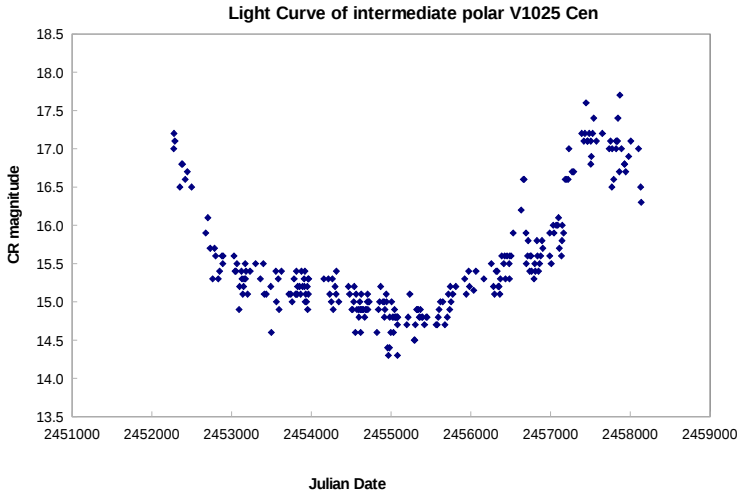
6 hours timesries of V1043 Cen



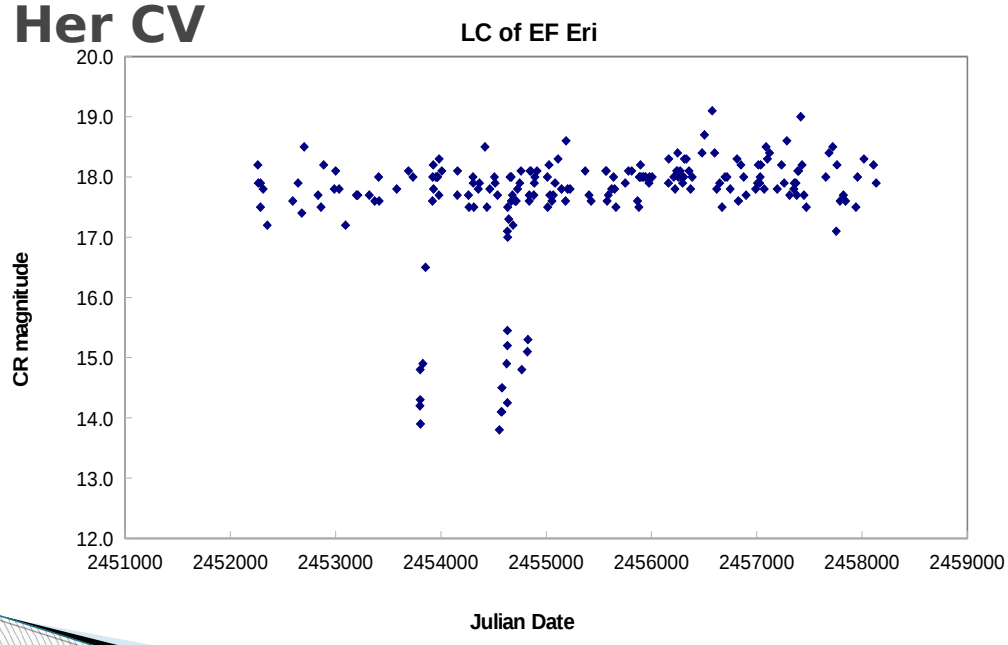
16 years of V1043 Cen (am her)



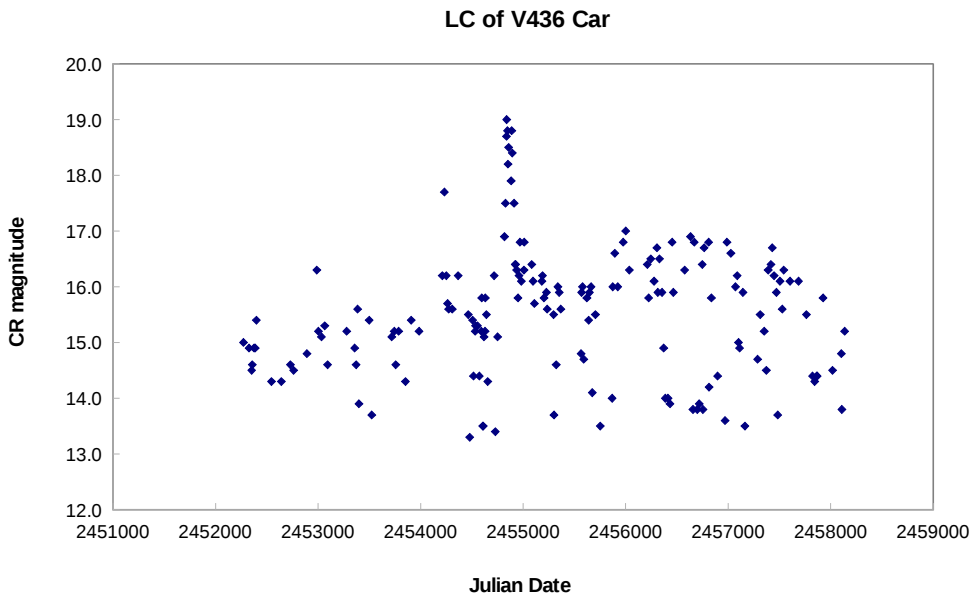
16 years of V1025 Cen (dq her)



15 years of EF Eri, a starving AM Her CV



15 years of a magnetic CV (dq her)

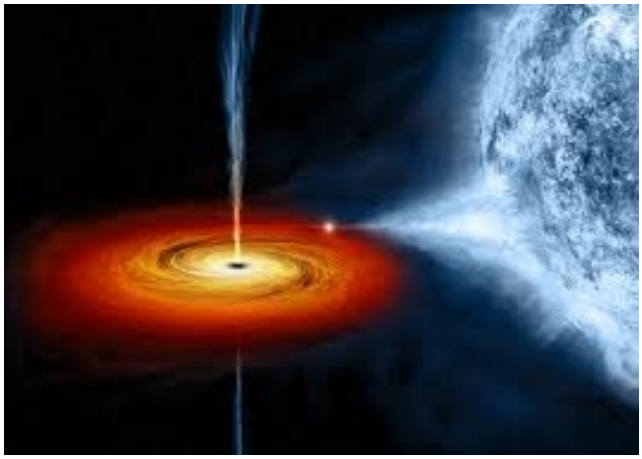


Symbiotic stars

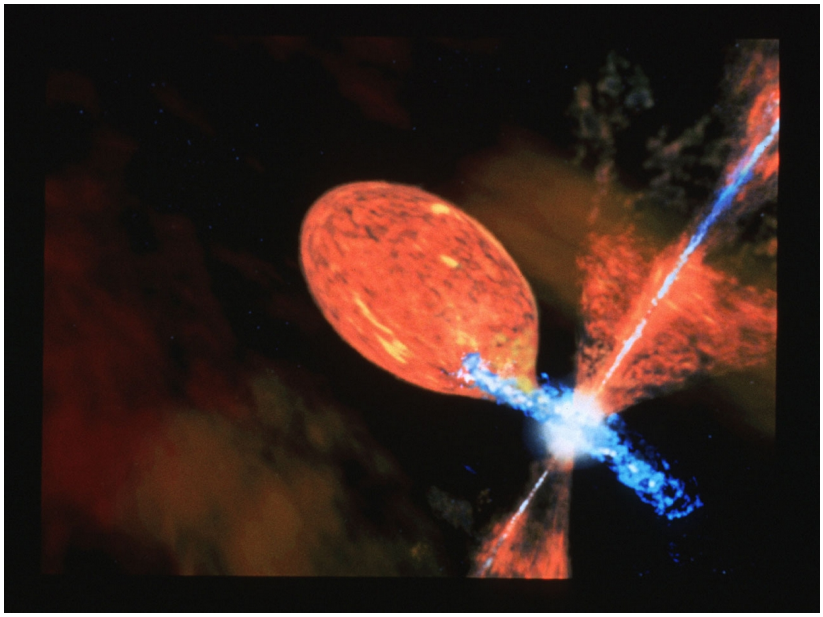
Periodic monitoring of known and suspected Z And stars (+ some other unknown types)

- 200+ targets since end 2004
- Observed weekly, monthly
- Observed in V band and Ic band (2012-)
- Early results include corrections of wrong IDs, eclipsing systems not known to be and improved ephemerides.
- Symbiotic nova V618 Sgr (2017)

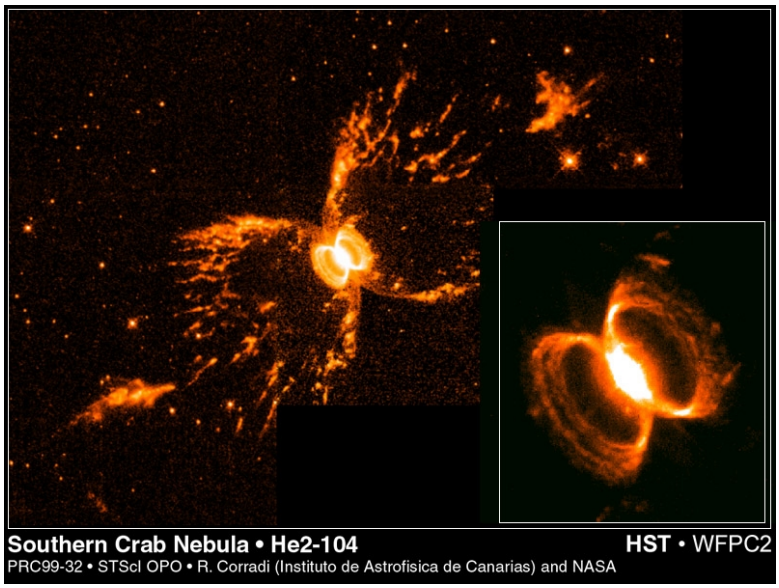
Schematic of a symbiotic star



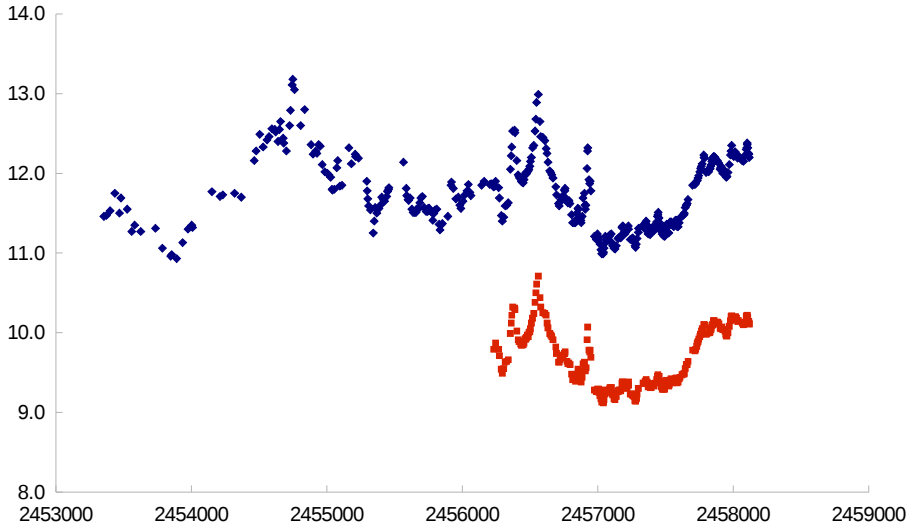
Symbiotic star R Aquarii



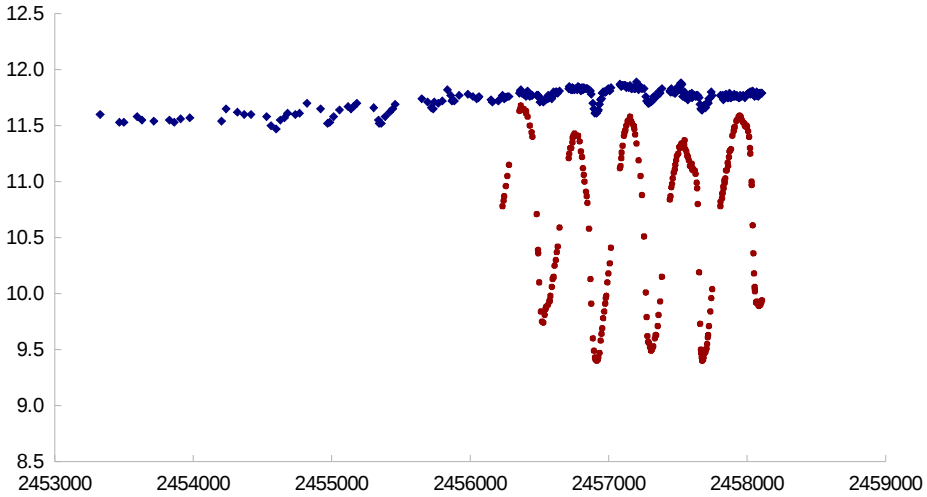
Symbiotic star Hen 2-104 / V852 Cen



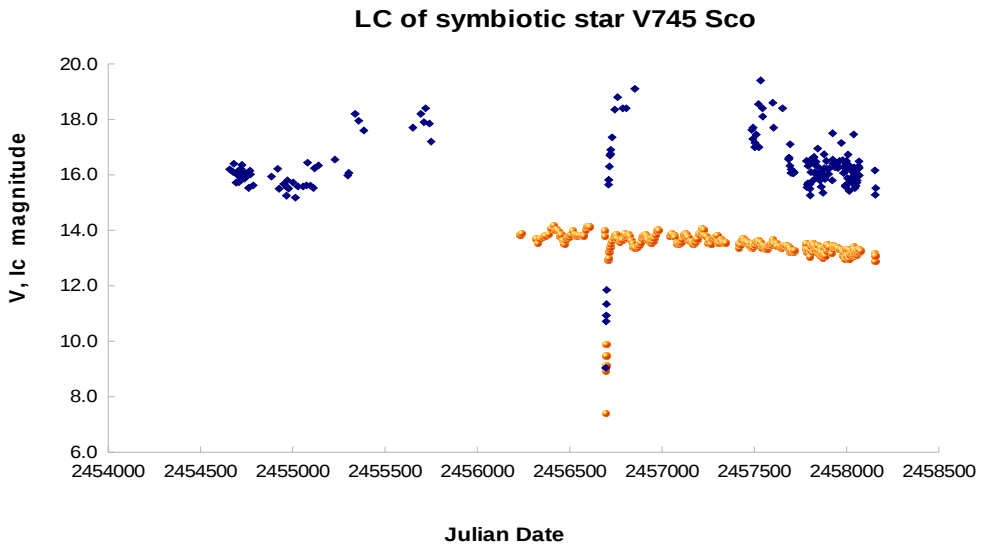
14 years of V417 Centauri: V, Ic mags vs JD



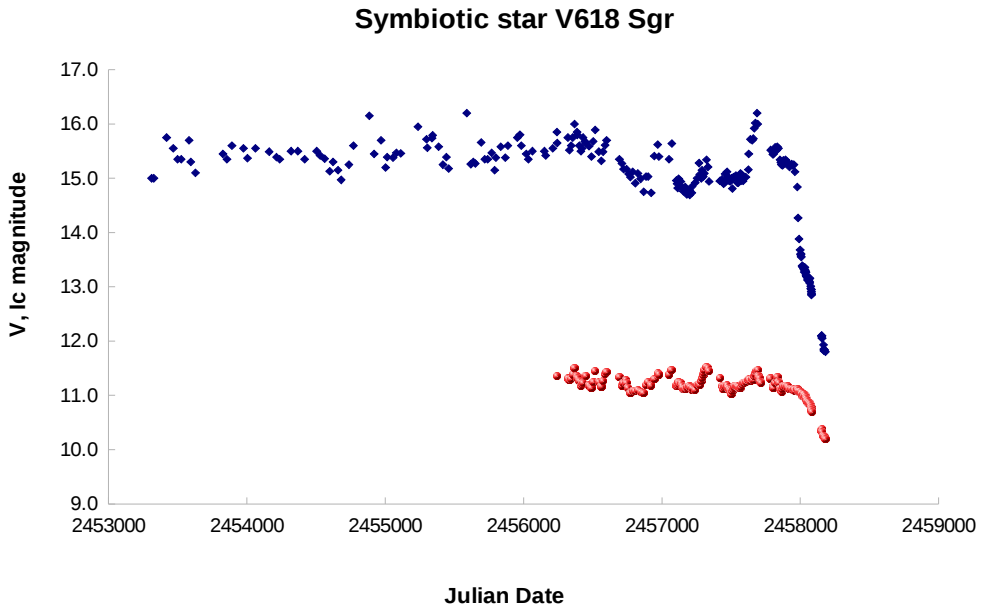
14 years of RR Telescopii: V, Ic mags vs JD

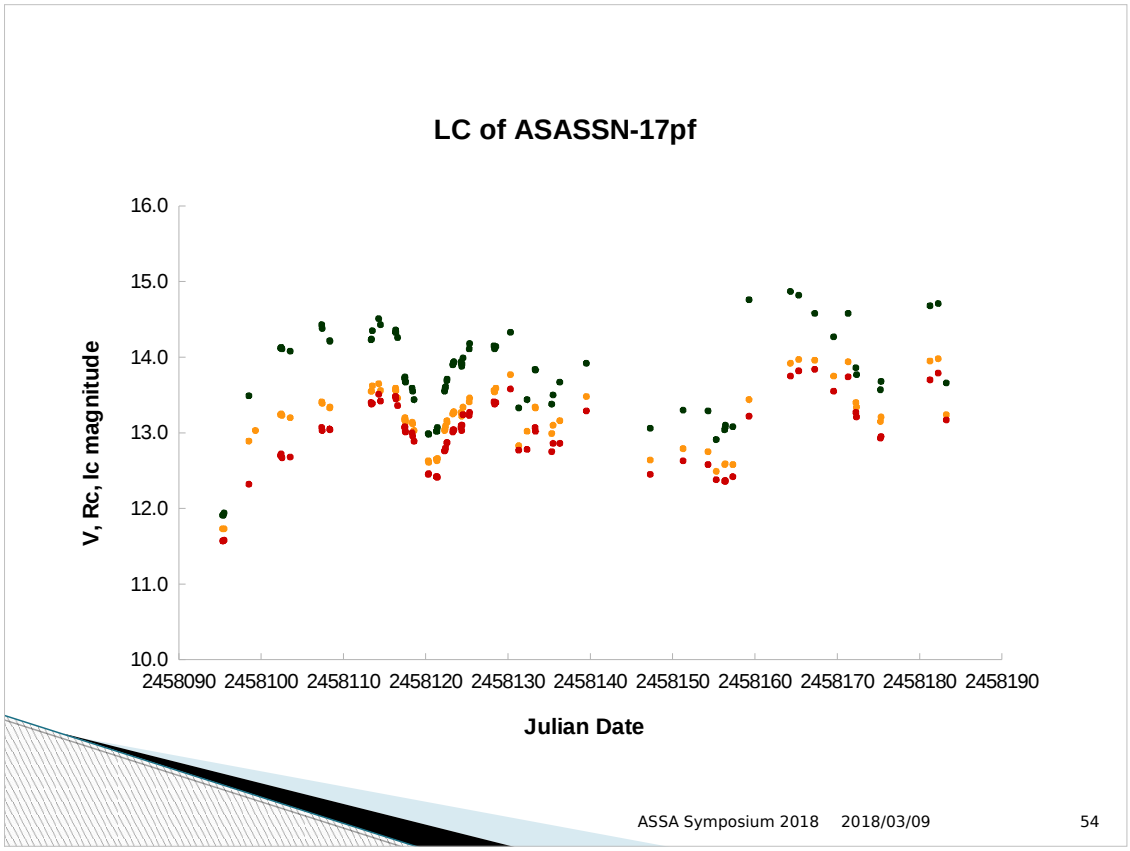


10 years of symbiotic star / recurrent nova V745 Scorpii



V618 Sgr, a symbiotic nova in 2017




LC of ASASSN-17pf
16.0
15.0
14.0
13.0
12.0
11.0
10.0
V, Rc, Ic magnitude
2458090 2458100 2458110 2458120 2458130 2458140 2458150 2458160 2458170 2458180 2458190
Julian Date