Undergraduate Astronomy Research/Education at the University of Saskatchewan

Daryl Janzen

“I’m an Astronomer. I study the reason for the seasons and for lunar phases”

– No one

Motivation

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- Incidentally AI-proof pedagogy

The Course

- First-year stars class for STEM majors
- ~120 students
- 12-week course, 4 hours/week lecture/tutorial
- Replaced weekly lab/problem assignment structure with weekly practical assignments and drop-in help desk in computer lab (open 9 hours/week)
- Three research projects: double stars, clusters, and periodic variables
- Students chose 2 of 3 ‘publications’ for their research

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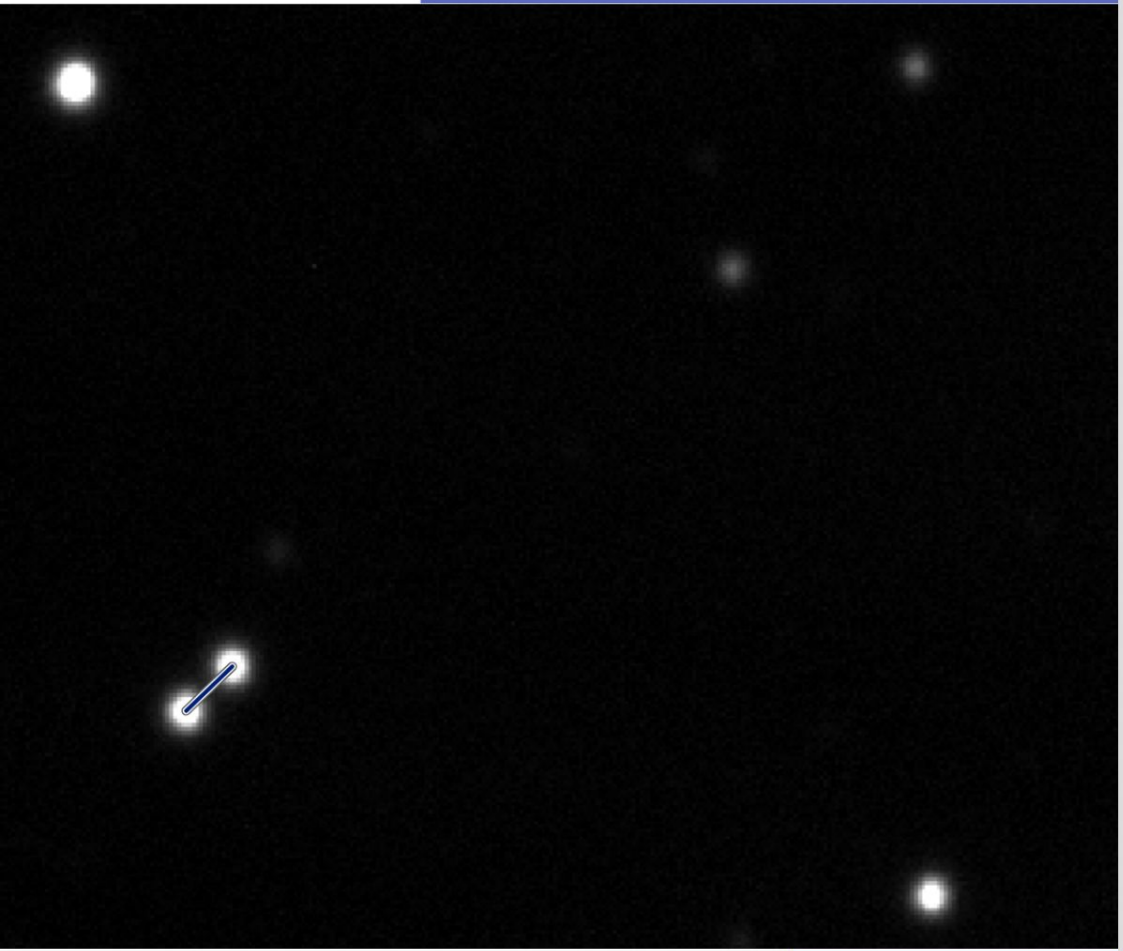

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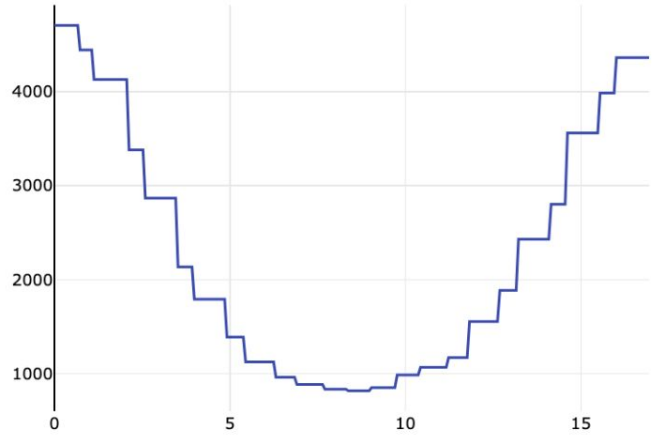

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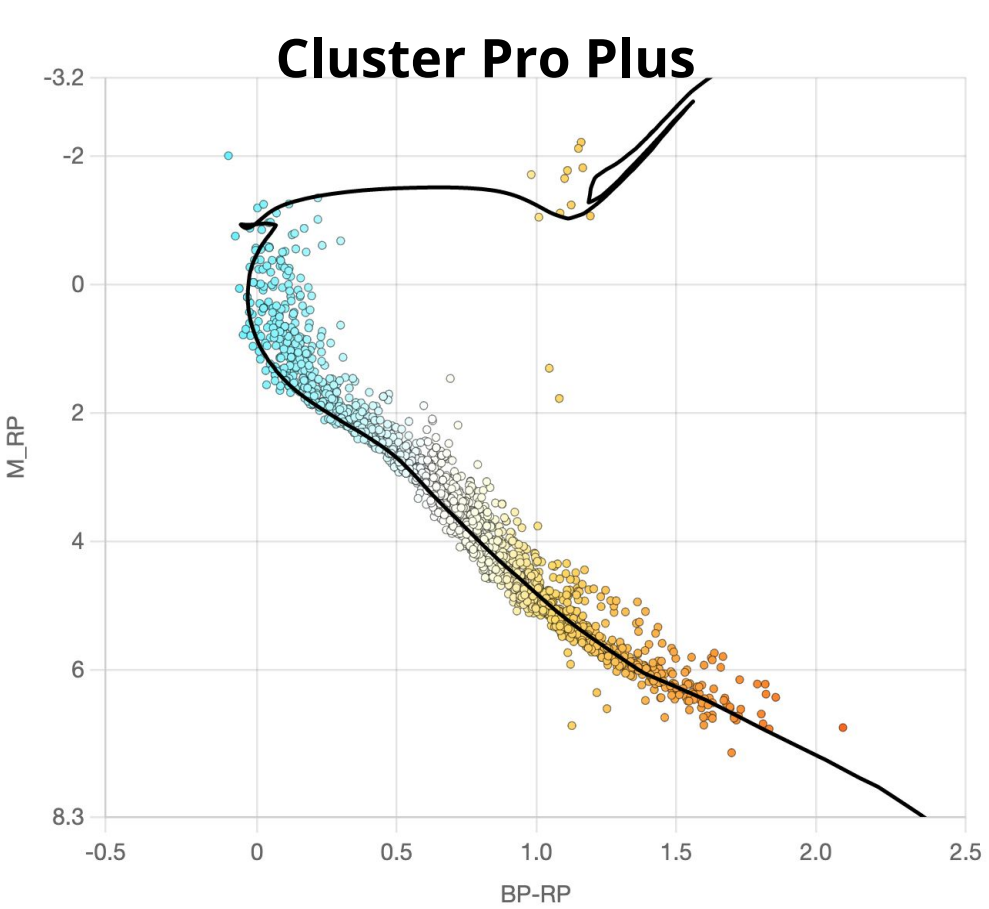
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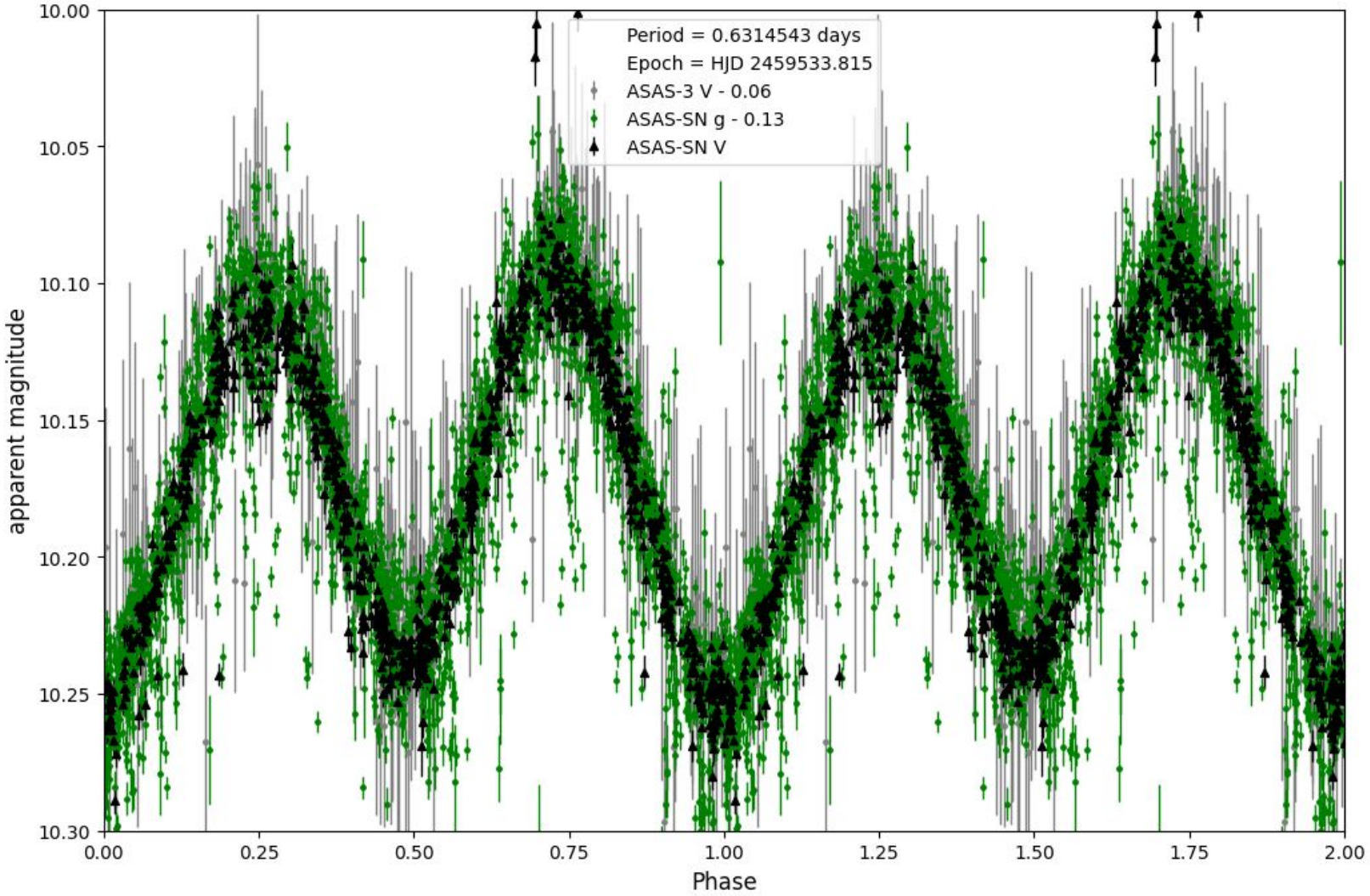
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Journal of Double Star Observations

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Journal of Double Star Observations

Volume 19 Number 2 - (Download entire issue)

Inside this issue:

Speckle Analysis and Lucky Imaging of Close Double Stars with a 1.2 m Cassegrain Telescope in 2022
Rainer Anton and Johannes M. Ohlert

Automated Speckle Interferometry of Known Binaries
Nick Hardy, Leon Bewersdorff, David Rowe, Russell Genet, Rick Wasson, James Armstrong, Scott Dixon, Mark Harris,

aavso.org/vsx/

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	Lecture	Assignment
Week 1	Definitions, Celestial Sphere, Science	Intro to Skynet
Week 2	Scientific Revolution and Newtonian gravity	Intro to Afterglow
Week 3	Telescopes, seeing, parallax, light/blackobdy	**Double star selection/observation**
Week 4	Stellar spectra, T, L, m/M, E(B-V), R, M	**Double star analysis**
Week 5	Atoms/spectra, measurements, HRD, M-L	Skynet parallax lab
Week 6	The Sun: p-p, solar model, neutrinos	**Cluster selection/obs**, MIDTERM
Week 7	Nebulae and star formation, protostar evol	**Double star paper**
Week 8	Main Seq., Giant branch, HB/AGB, [Fe/H], clusters	**Cluster analysis**
Week 9	Pulsators, Binaries, low mass death	Skynet RRL/Cepheid/SN Ia lab
Week 10	Core collapse SN, types, SN Ia, neutron/pulsars	**Periodic variables analysis**
Week 11	Magnetars, XRB, Black holes, GRB, etc	Skynet MW rotation (pulsars next year?)
Week 12	Cosmology crash course	**Research Publications (choose 2/3)**

Research Products

JDSO papers (13 papers/72 students)

Cluster blogs (70 individual blog posts)

VSX revisions (~40 revisions submitted)

Remarks: Double Stars Project

- Excellent intro to practical aspects of observing: celestial sphere, seeing/resolution, dynamic range in digital imaging, modelling trends, statistical measurement and uncertainty
- Great intro to spreadsheets
- May update/simplify some of the analysis
- Need better emphasis on the fact that most physical doubles aren’t binaries
- Should draw connection to clusters and evaporation/Galaxy evolution
- Should have students recap/reflect on practical learning gains

Remarks: Clusters Project

- Tool goes beyond ‘cartoon’ version of cluster evolution common in textbooks:
  - Field stars and proper motion/distance
  - Unresolved binaries and the main sequence
  - Blue stragglers and various stages of giant evolution
  - Emphasises HR Diagram as quantitative graph of colour and magnitude, aspects that are qualitatively apparent in tri-colour images
  - Visually represent the effects of reddening

ISM-Reddened NGC 3293

De-Reddened NGC 3293

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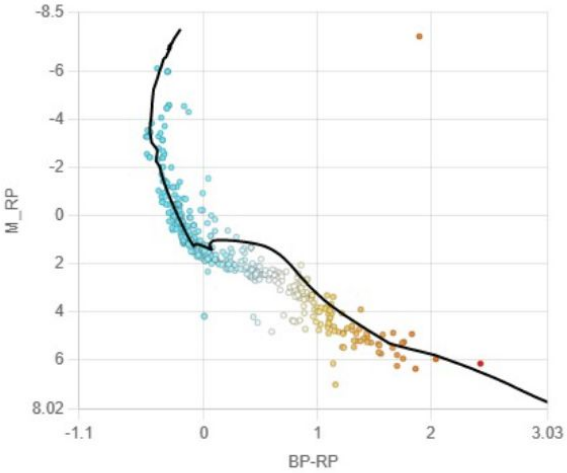
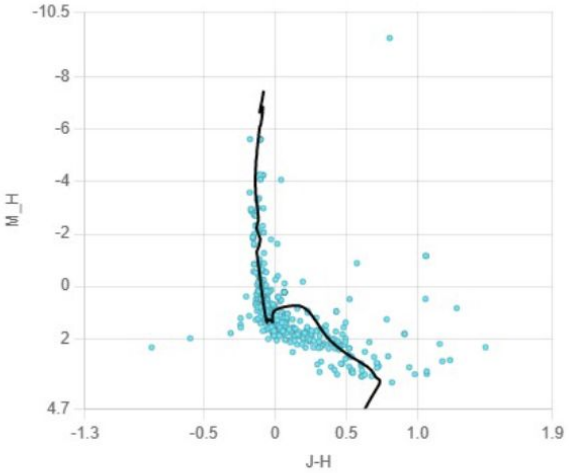
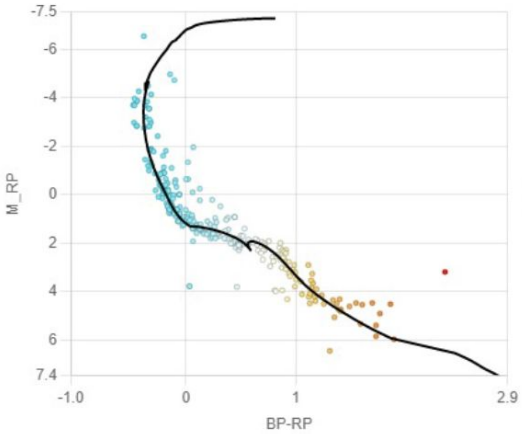
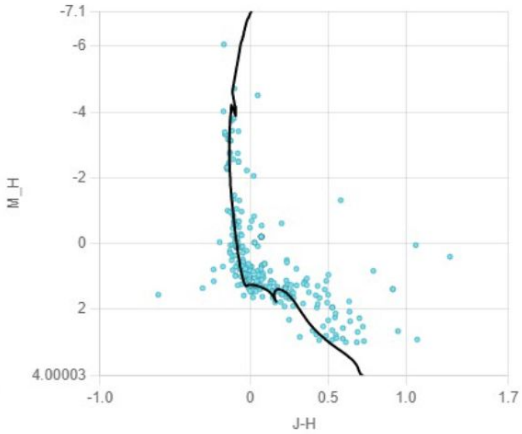
  - The importance of age AND metallicity, and curve-fitting
- Comparison with published results





Milky Way Star Clusters Catalogue





My Photometry Plotted Values

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  - Visually represent the effects of reddening
  - The importance of age AND metallicity, and curve-fitting
- Comparison with published results
- Currently lacking catalogue that students can contribute to, so run with informal blog

Remarks: Variable Stars Project

- Great project for learning about all the messiness of variable star classification
- Contribution to AAVSO VSX
- Scalability of VSX is an issue, not easy to actually revise