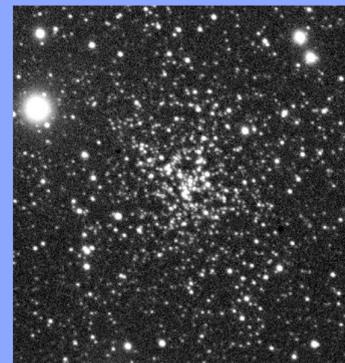


DASCH: Digital Access to a Sky Century@Harvard

Long-term Variables in the Kepler Field Scans

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Open cluster NGC 6819 in the Kepler Field (Plate MC 36426, taken in 1949)



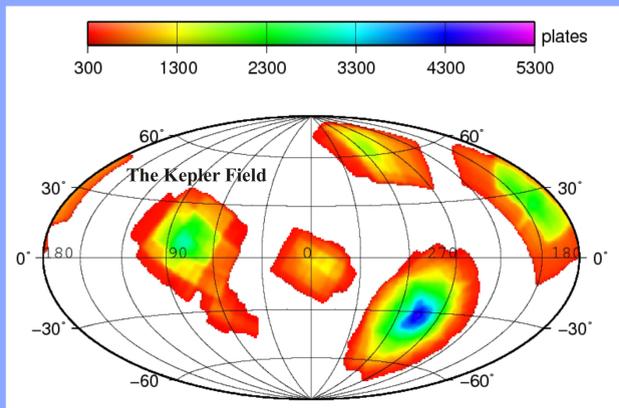
DASCH scanner
Simcoe et al. 2006

Abstract: DASCH is a project to digitize and analyze the scientific data contained in the ~550,000 Harvard College Observatory (HCO) plates taken between the 1880s and 1990s, which is a unique resource for studying temporal variations in the universe on ~10-100 yr timescales. Here we present a few most interesting long-term variables we found in or near the Kepler Field, including a group of Be variables showing ~1 mag variations over years, a group of K giants showing 10-100 yr slow variations, and two other examples.

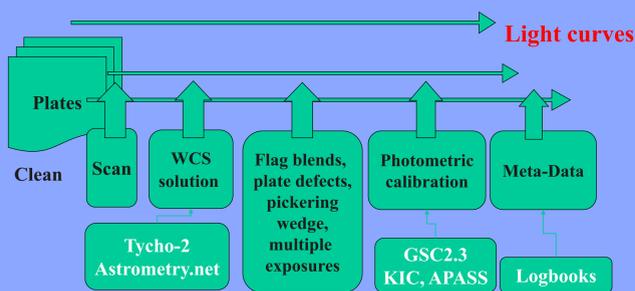
I. Introduction to DASCH:

- The Harvard College Observatory (HCO) maintains a collection of ~550,000 photographic plates between 1880s-1980s covering the whole sky (Grindlay et al. 2009).
- ~500-1500 measurements for each object with B<14-15 (up to 19 mag in some regions)
- Astrometry: 0.8-3"; Photometry: 0.1-0.15 mag (Laycock et al. 2010; Tang et al. in prep.).
- ~18,300 plates scanned so far, in several different fields, including the open cluster M44, Baade's Window near the Galactic center, 3C 273, the Kepler field, and partial coverage of the LMC (in progress).
- Full production estimated to start in a few months from now with 200-400 plates per day

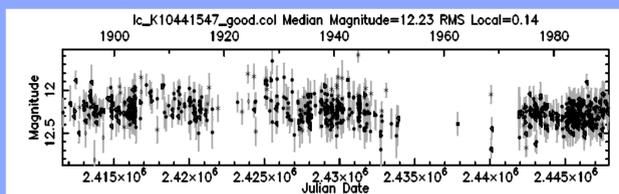
Exposure map of ~18,300 scanned plates With >300 plates



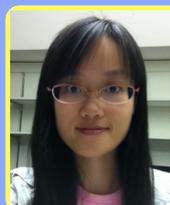
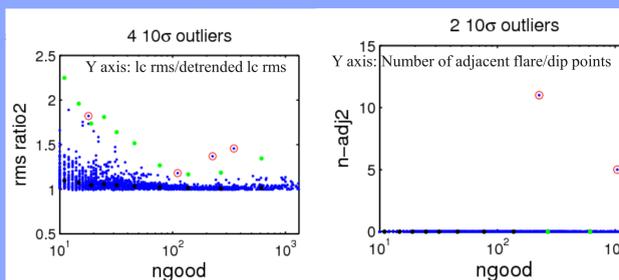
DASCH Pipeline



Example light curve of a constant star:



Variable Search: pick up outliers via different statistics



For more details see DASCH website:
<http://hea-www.harvard.edu/DASCH>

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II. Be variables with ~1 mag variations over years

Similar light curve to Be X-ray Binaries (BeXRBs)
Be stars with neutron star companions Tang et al., in prep.

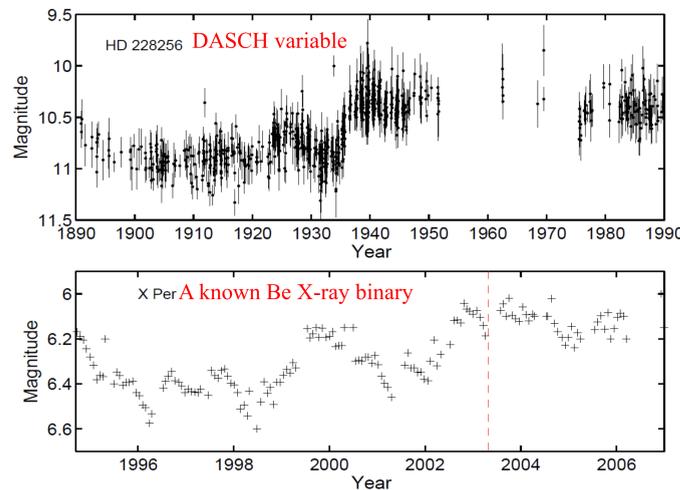
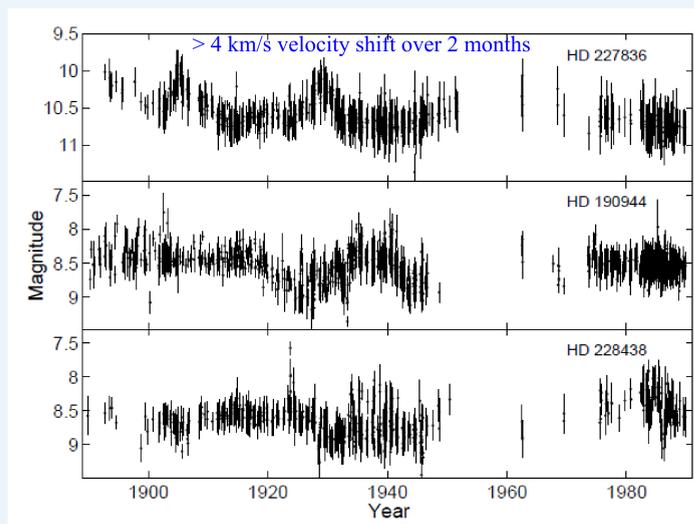
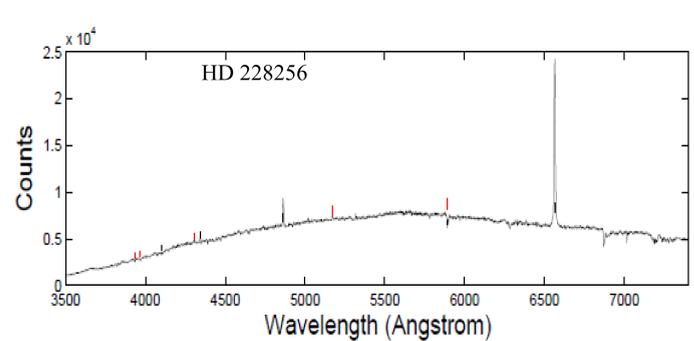
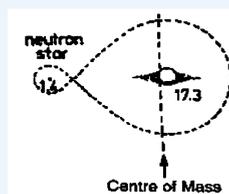


Figure 1: Upper panel: DASCH light curve of Be star HD 228256. Lower panel: AAVSO V band light curve of Be X-ray binary X Per binned in 25 day increments, with time of its X-ray burst in 2003 marked by red dashed line (Grundstrom et al. 2007).



Further observation needed:
X-ray (SWIFT); binary orbit (TRES).



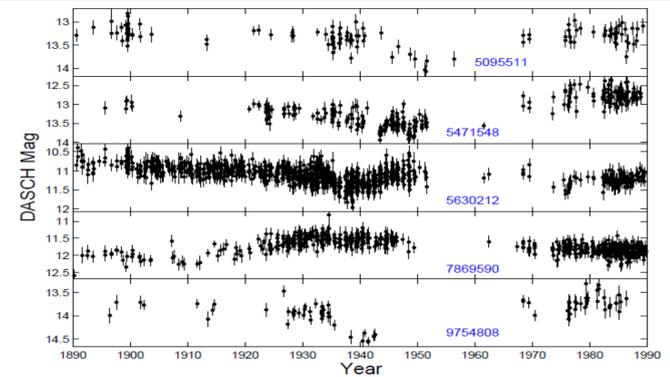
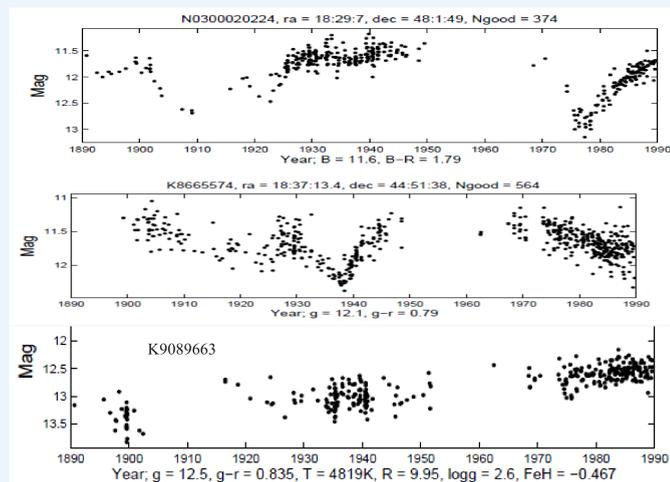
A promising new way of hunting for High Mass X-ray Binaries (HMXBs)

Most Be X-ray binaries were first discovered with X-ray telescopes, many during outbursts, increasing the susceptibility of the known sample to undetected selection effects. For example, only one controversial system, gamma Cas, has been identified as a possible Be+white dwarf system, despite predictions from population synthesis models that 70% of BeXRBs should harbor a white dwarf companion (Raguzova 2001).

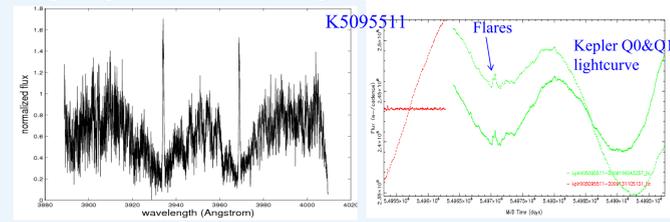
If confirmed, our sample would present the opportunity to uncover a previously undetected sub-population of quiescent BeXRBs, which would aid in the improved characterization of the entire galactic BeXRB population, and have the potential, in light of the dearth of Be+WD BeXRB systems.

III. K giants with >~10 yr variation

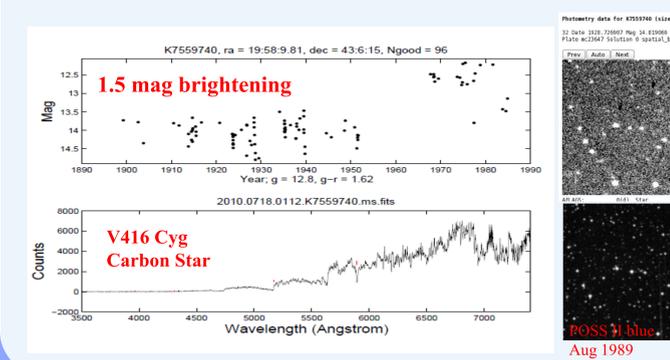
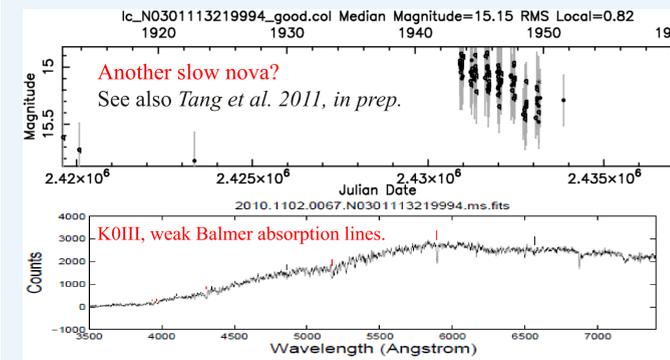
Similar to what we found in M44 scans (Tang et al. 2010)
An unknown phase of RGB/AGB evolution with dust production?
RS CVn systems (but still how to produce the long-term variations)?



Strong Ca K&H emission lines, star spot activity and flares in the Kepler light curve indicate strong magnetic activity: RS CVn binaries?



IV Two other variables



POSS 21 blue, Aug 1989