The Variability Monitoring of HBC722

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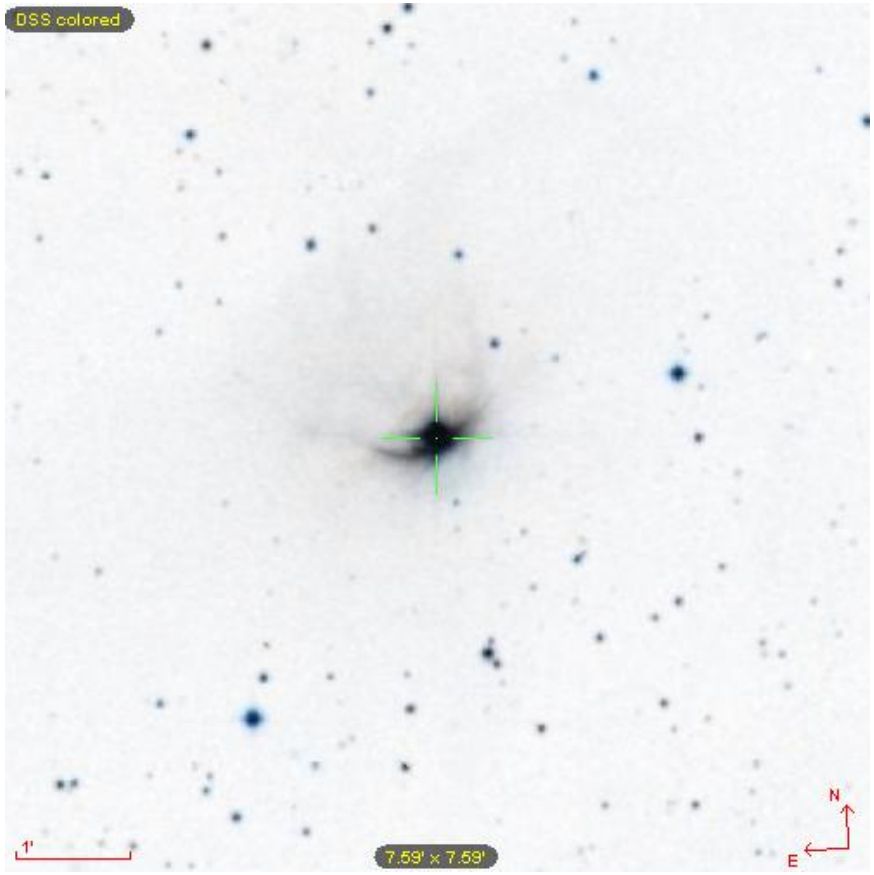
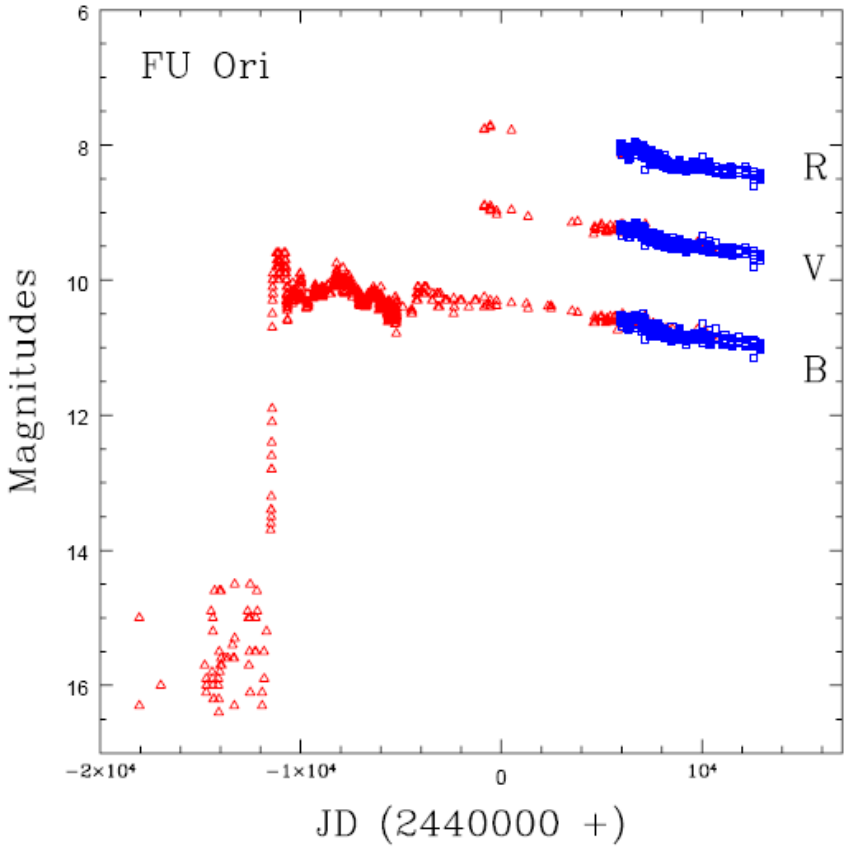
1. Introduction

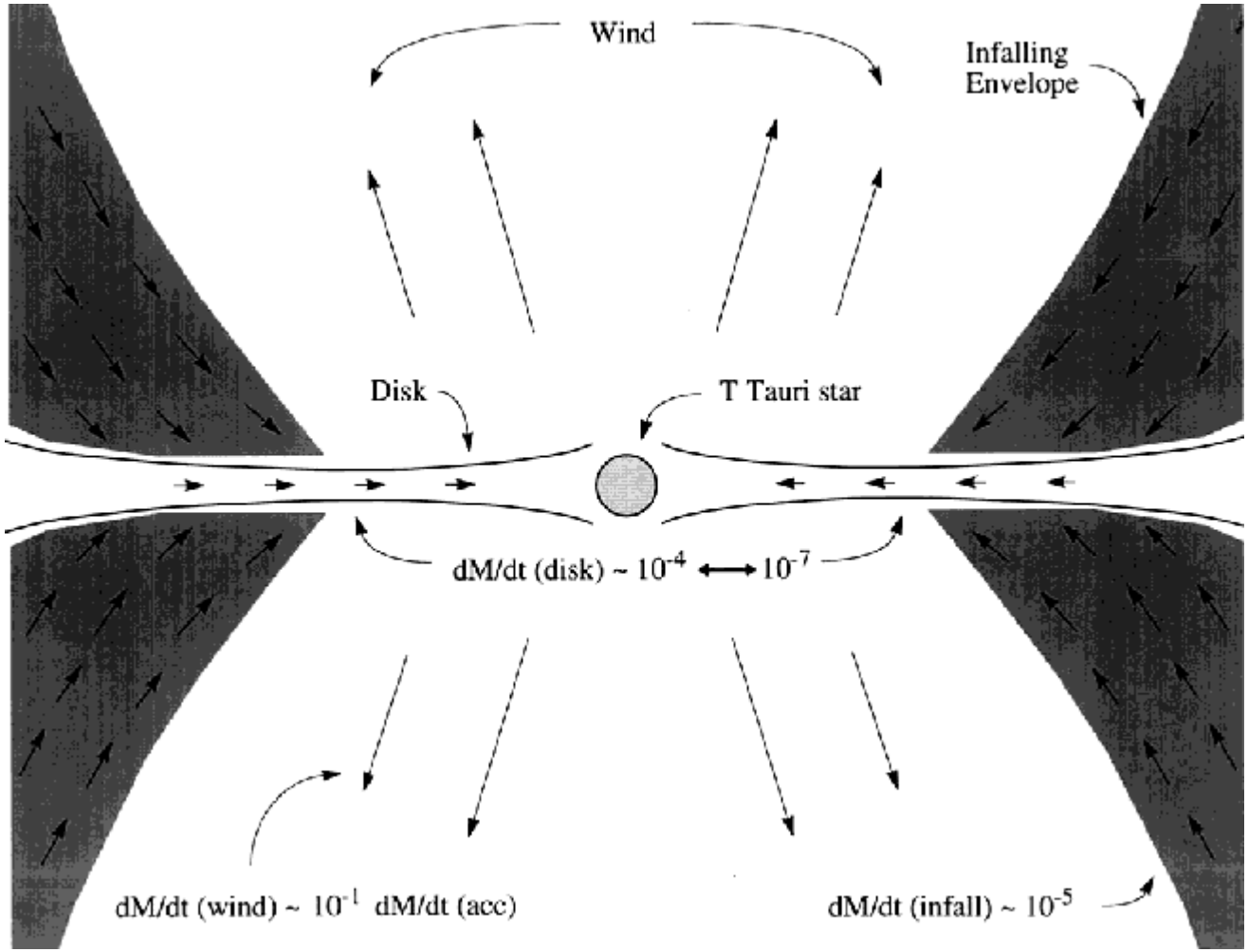
FU Orionis Type Object





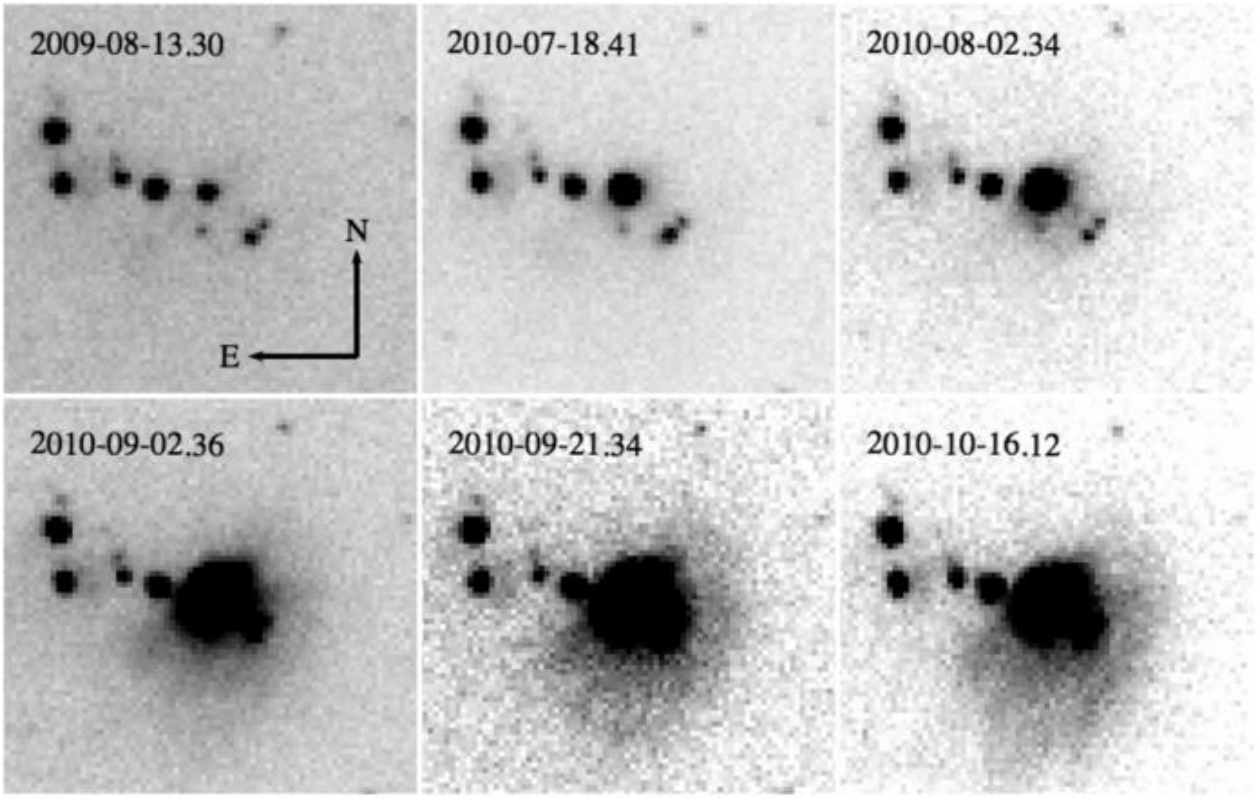
(Clarke et al 2008)

Accretion process and outburst



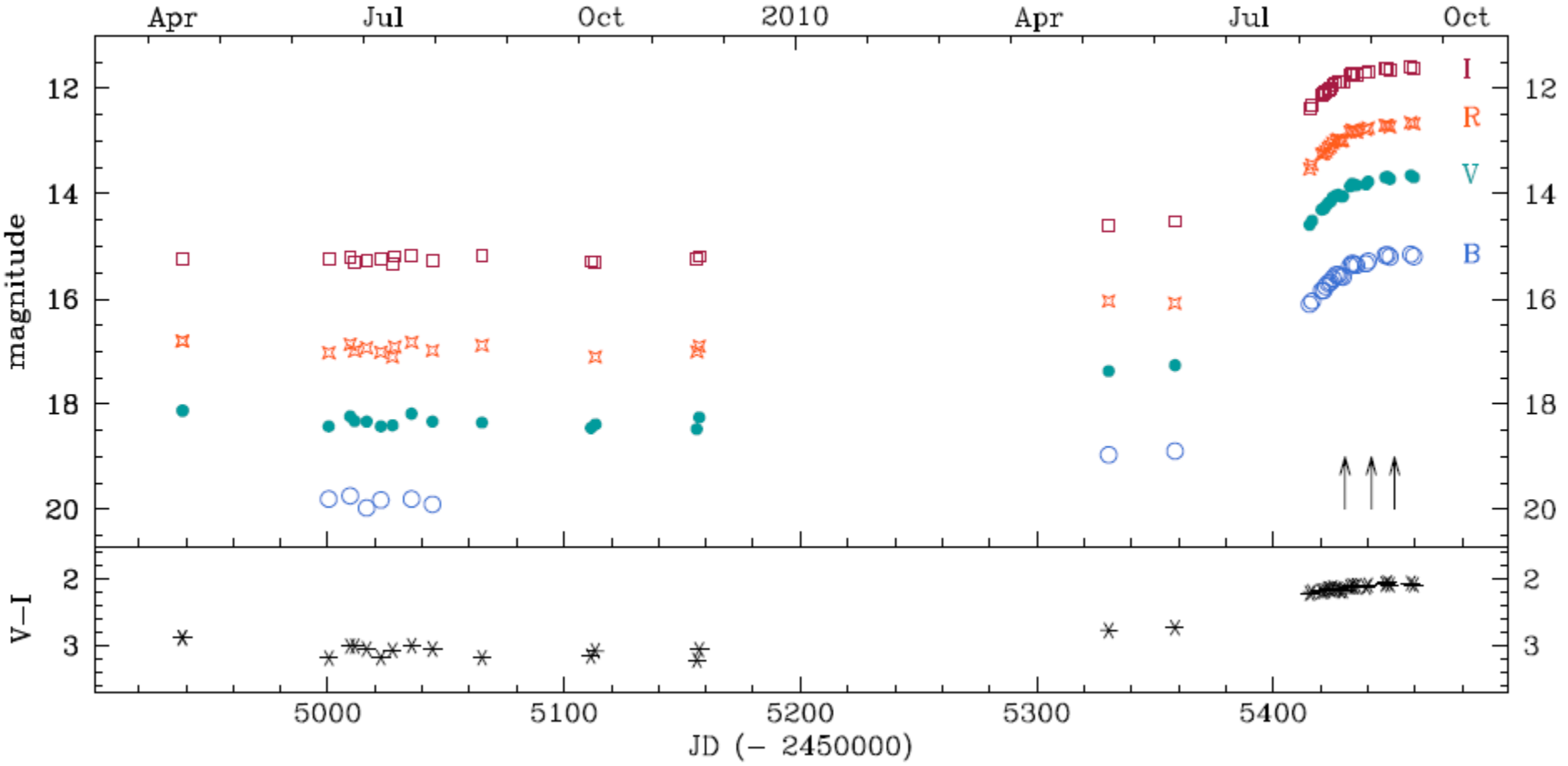
(Hartmann & Kenyon 1996)

HBC722 Outburst in 2010



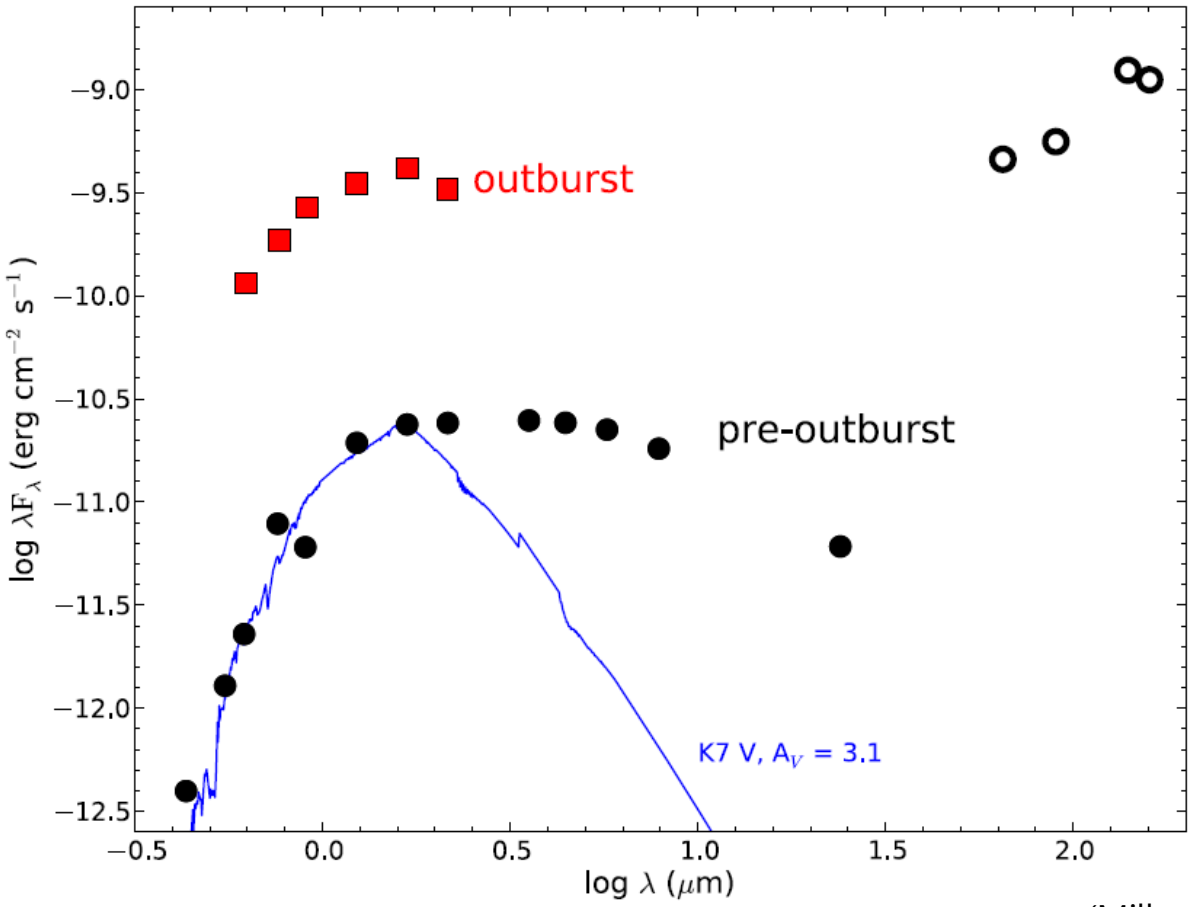
(Miller et al 2011)

HBC722 Outburst in 2010



(Semkov et al 2010)

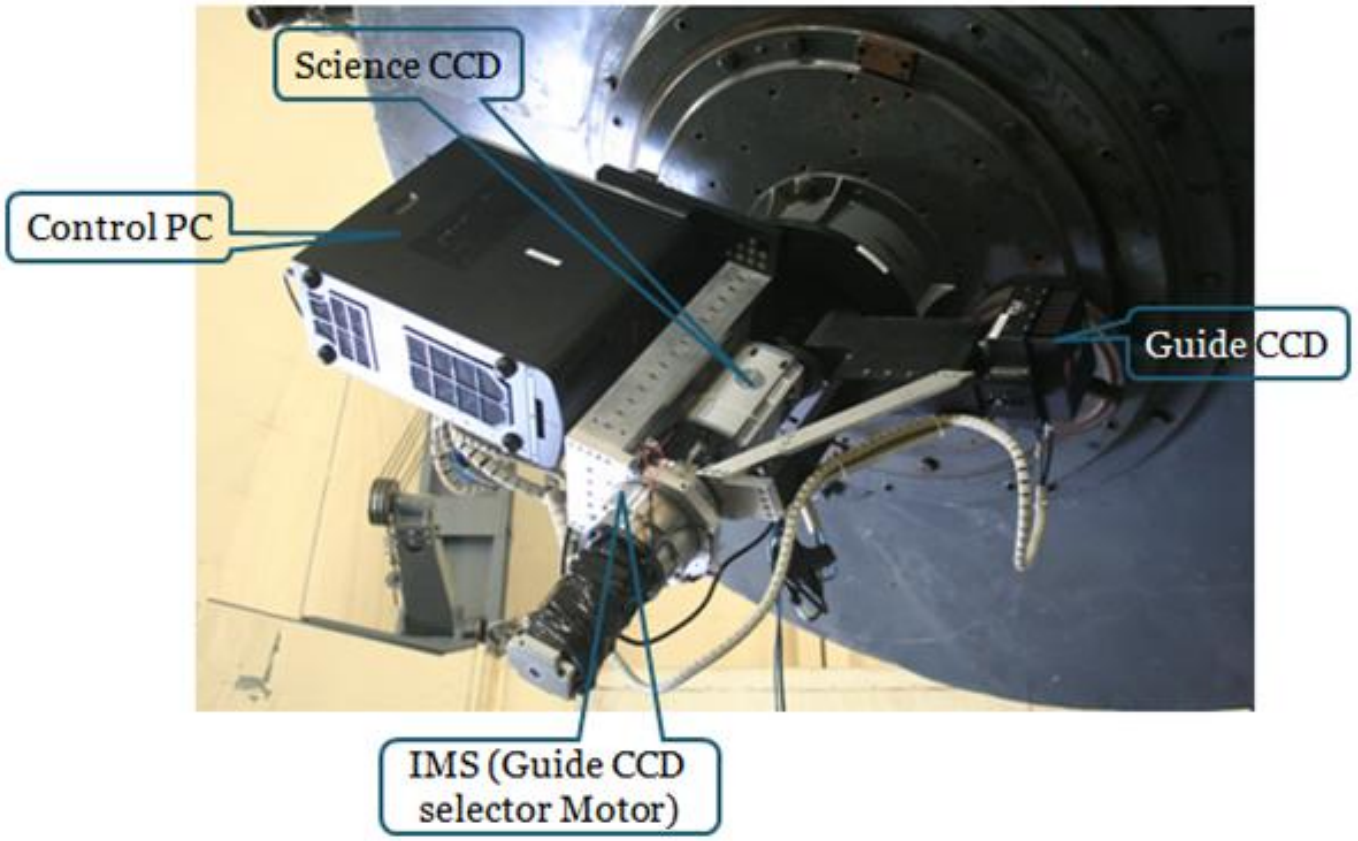
HBC722 Outburst in 2010



(Miller et al 2011)

2. Observation

•Telescope -- 2.1m Otto Struve telescope at McDonald Observatory, USA



*** Instrument -- CQUEAN(Camera for QUasars in EArly uNiverse)**

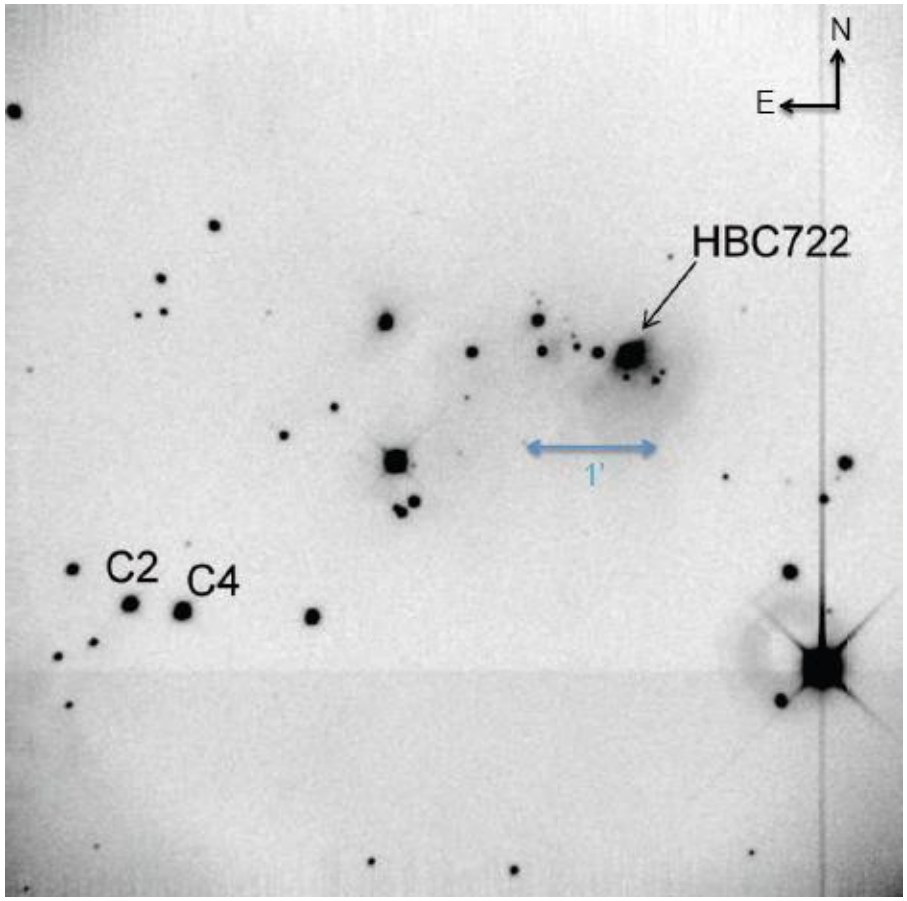
: Optimized at 0.7 – 1.1㎛ wavelength region

: 4.7′ X 4.7′ Field of view

*** Object -- HBC722 (LkHα 188 G4)**

*** Filter -- SDSS r, i and z band**

3. Data Reduction



r-band image of HBC 722 and surroundings (2011 Aug. 18). (Green et al 2012)

1. Pre-processing with IRAF
   Bias subtraction , Flat Field Correction

2. Photometry with Source Extractor

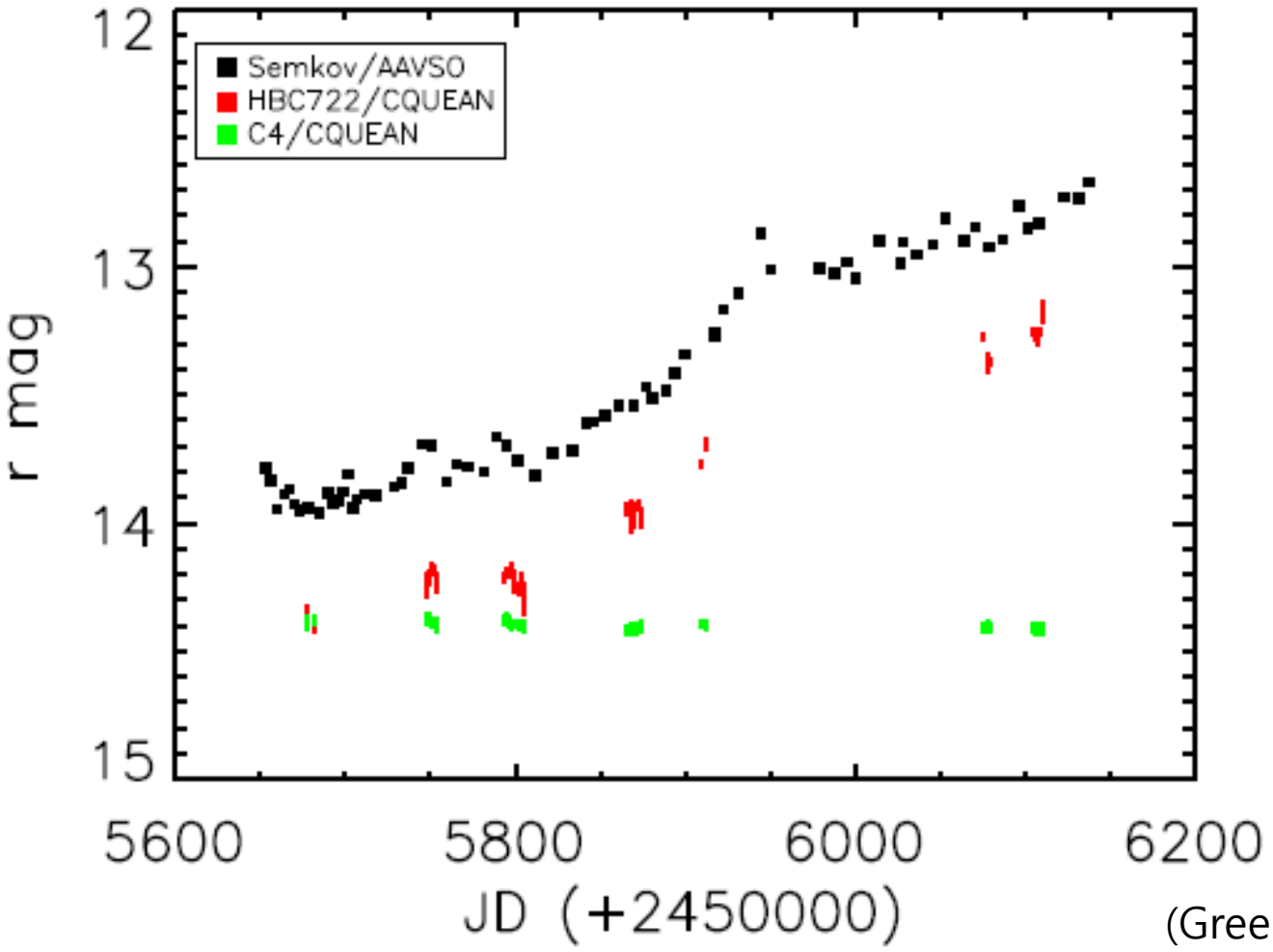
   * Aperture Differential Photometry
   - set by the FWHM of each night
   - Comparison star selected in the same field labeled as C2 and C4

   * Uncertainties : RMS mag estimated from two comparisons

3. Flux Calibration

4. Result & Discussion

4.1 r-band : R & r band lightcurves in 2011-2012



(Green et al 2012)

4.1 r-band : Period Analysis

- Generalized Lomb-Scargle periodogram

: Frequency analysis for unequally spaced data

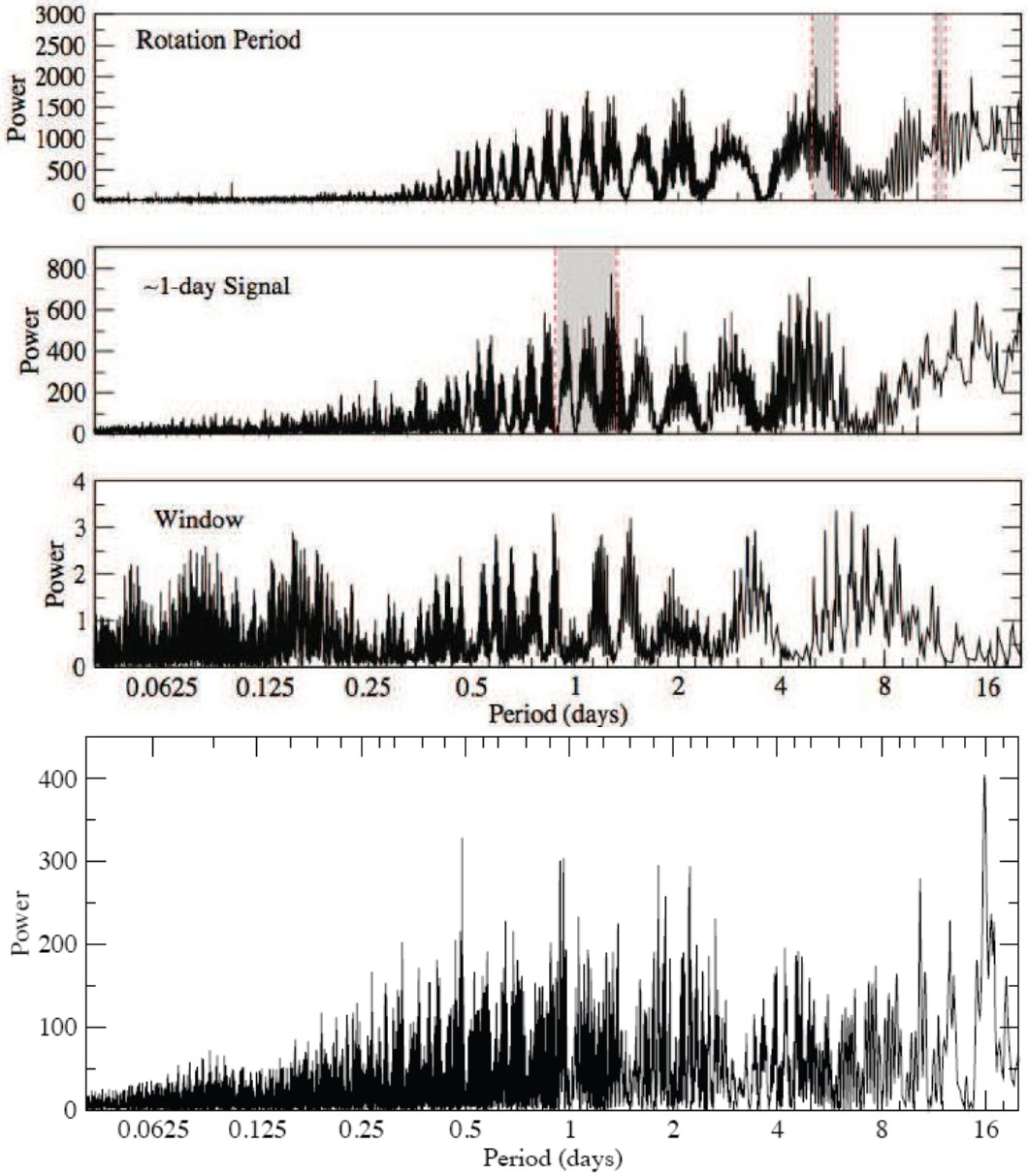
: Fitting data to full sine wave by least square fitting

$$y(t) = a\cos\omega t + b\sin\omega t + c$$

: Including an offset (floating mean)

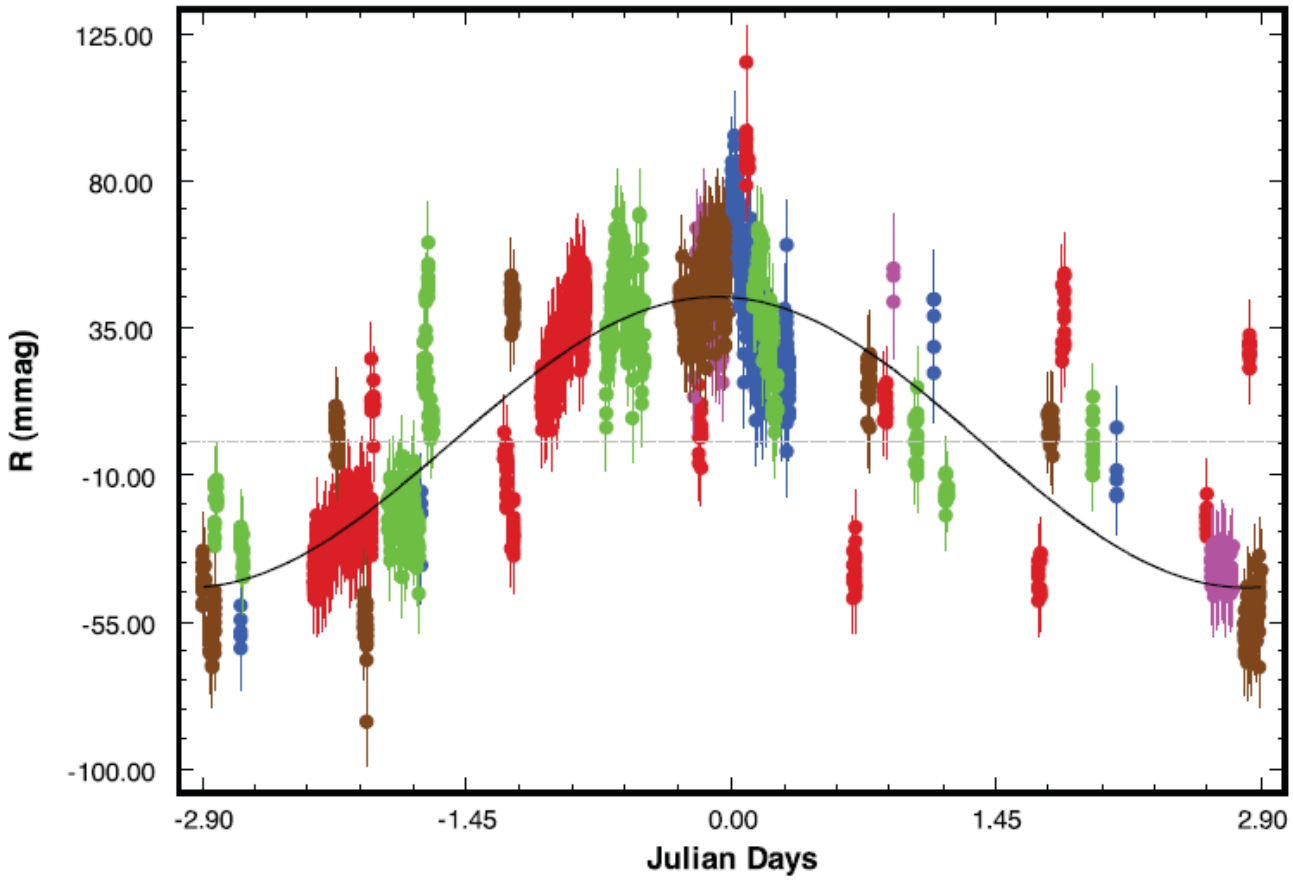
and weights (measurement error)

4.1 r-band : Period Analysis



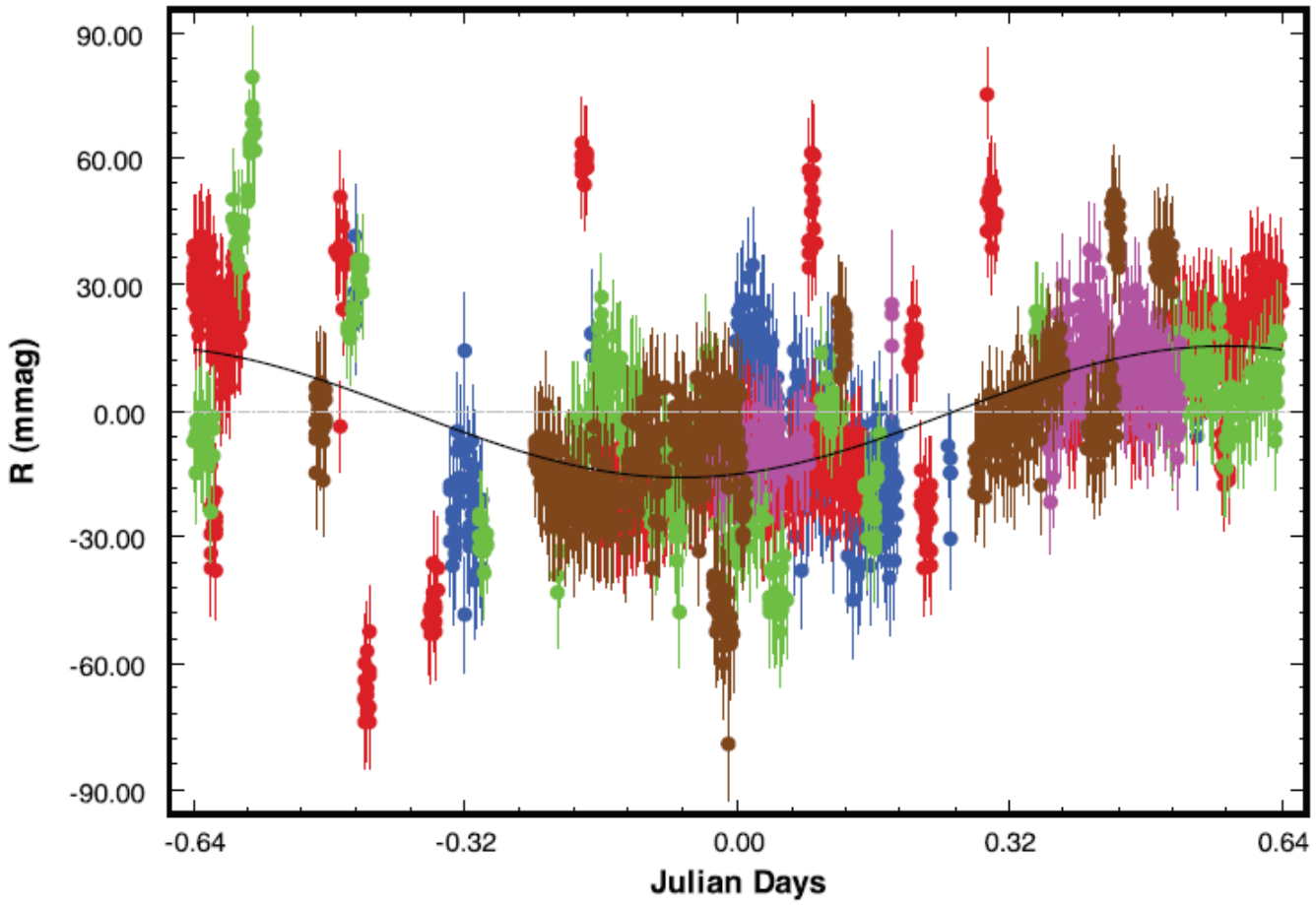
(Green et al 2012)

4.1 r-band : Phase diagram of 5.8day signal



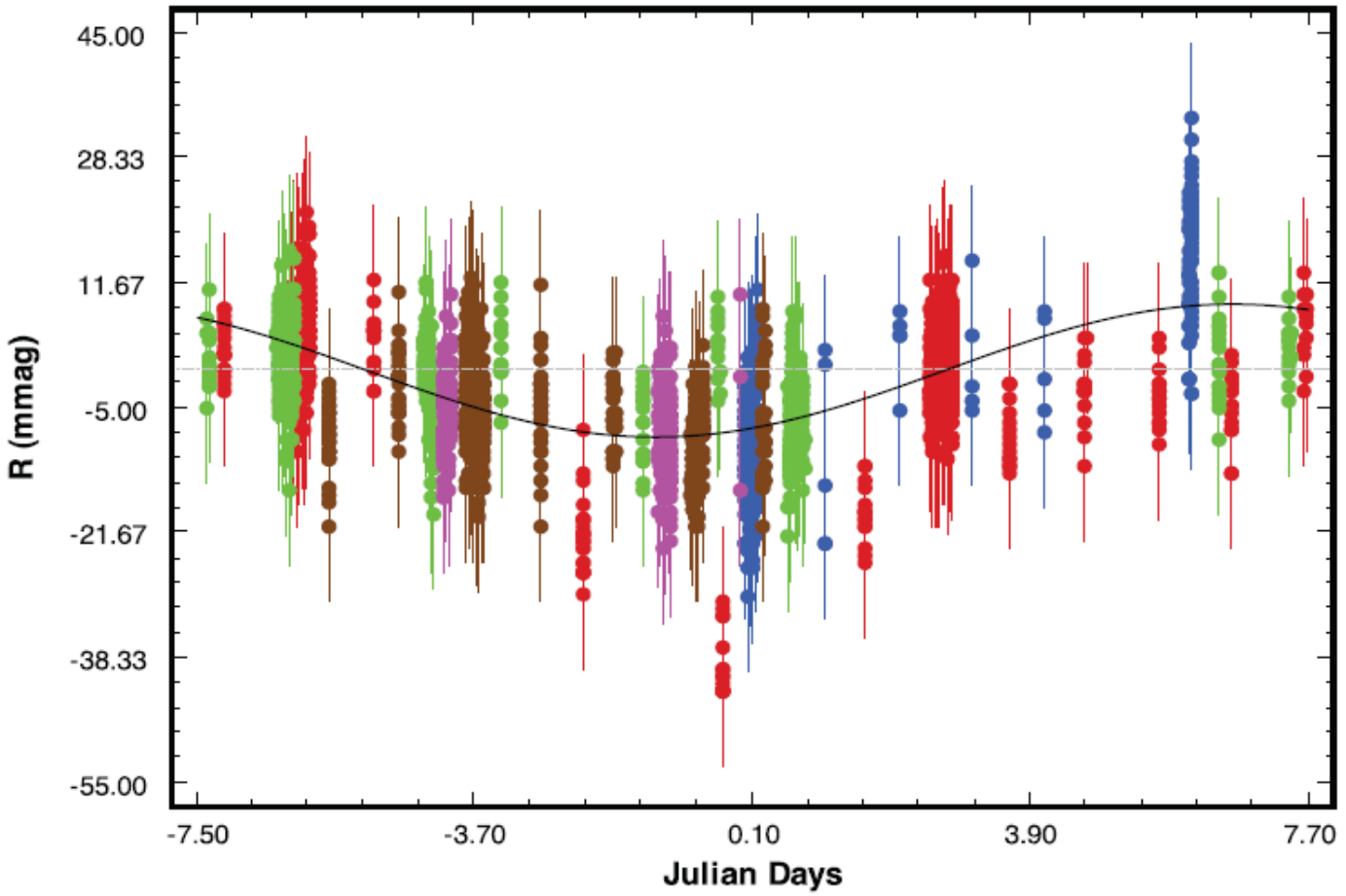
(Green et al 2012)

4.1 r-band : Phase diagram of 1.28 day signal



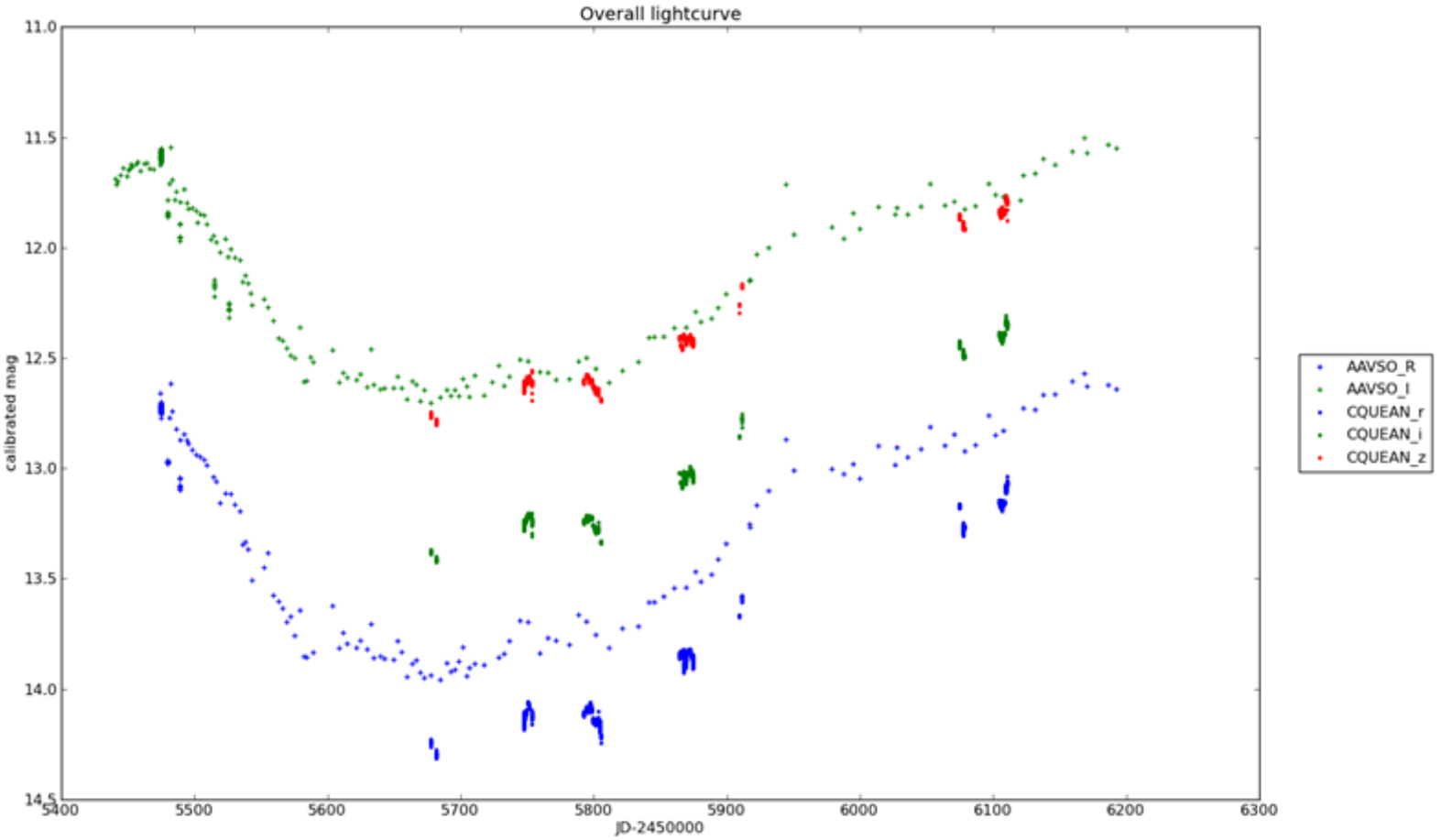
(Green et al 2012)

4.1 r-band : Phase diagram of comparison C4

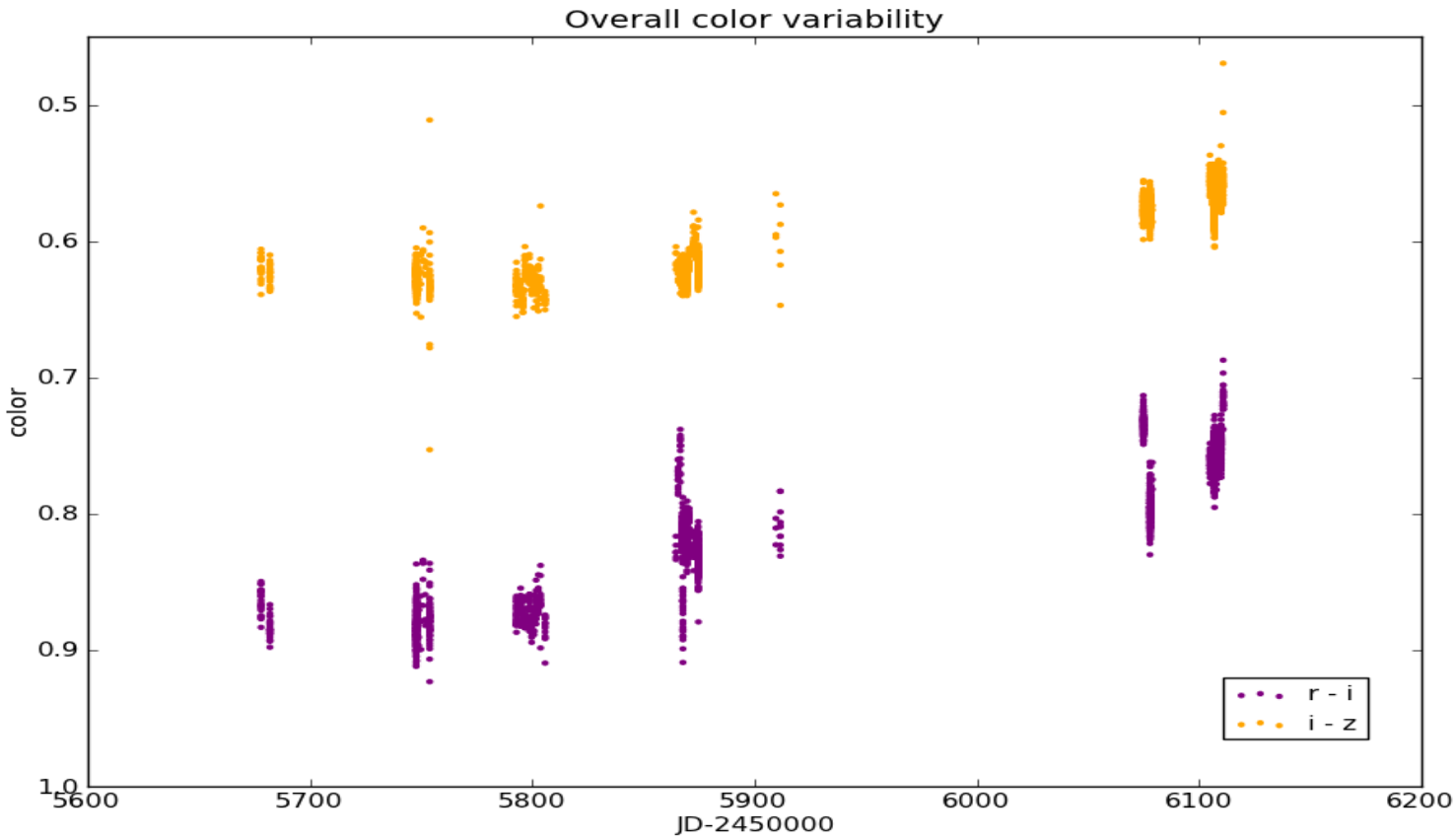


(Green et al 2012)

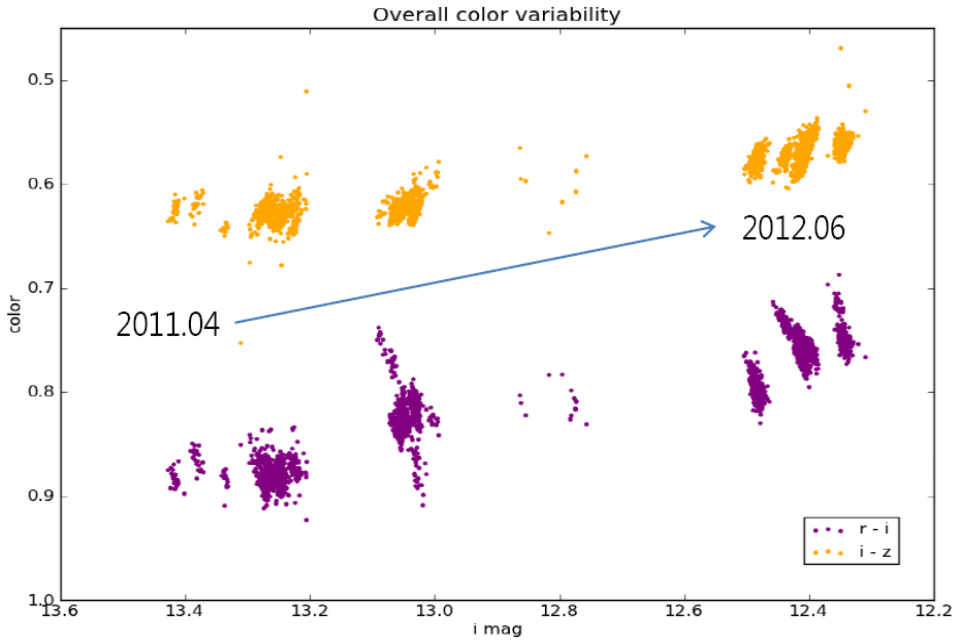
4.2 Multi-band : r, i and z band lightcurves in 2010-2012



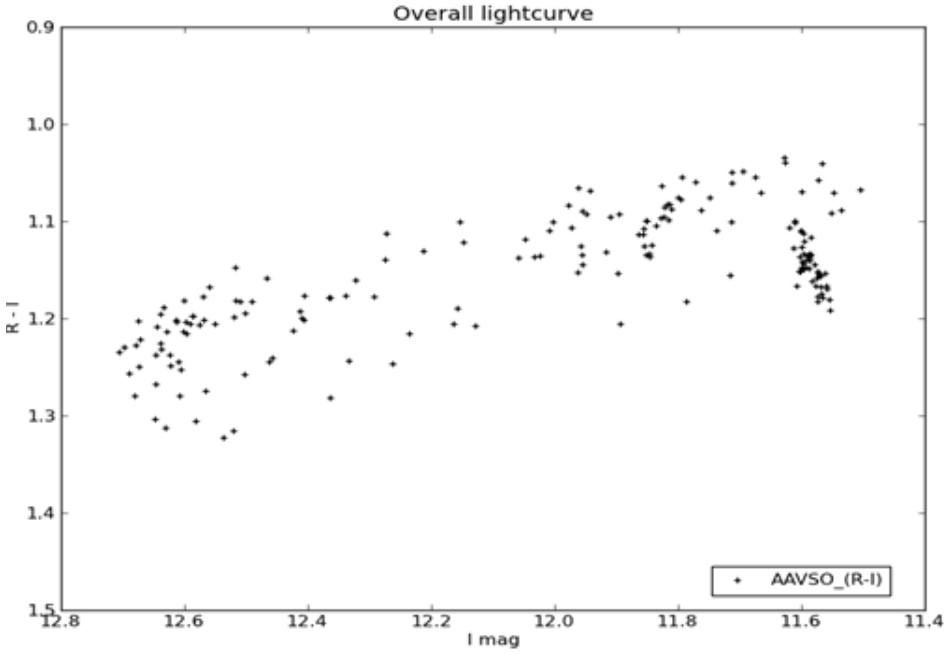
4.2 Multi-band : (r - i) and (i - z) lightcurves in 2011-2012



4.2 Multi-band : Color-Magnitude plot



(r - i) and (i - z) vs i mag



(Rc - Ic) vs Ic mag, AAVSO

5. Summary

Summary

- We have observed a FU Orionis type object, HBC722 from 2011 April to 2012 Nov with CQUEAN at McDonald Observatory.
- Rapid cadence monitoring in SDSS r, i and z band were conducted to chase short-term variability, might attribute to stellar rotation or Keplerian rotation at the instability region of inner accretion disk.
- In r band lightcurve analysis,families of periodicity at 5.8 day (0.044 mag amplitude) and 1.28 day (0.016 mag amplitude) were detected.
- We analyze the color variability during the observed period by assuming that different colors chase different instability regions of accretion disk.
- To separate individual periods in each band and color, period analysis with generalized Lomb-Scargle periodogram will be conducted.
- By comparing color in period, try to find the tendency along the wavelength, explore the structure at the stellar surface-inner disk.