Uraian Singkat
Teleskop dan Program Pengamatan
Observatorium Bosscha

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Observatorium Bosscha

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Instrumen

- Teleskop GAO–ITB RTS

Teleskop	: Celestron C11
Diameter	: 279.4 mm
Panjang fokus	: 2800 mm
Obstruksi	: 34 % diameter

- Spektrograf NEO R1000

Lebar slit	: 7.4 mm ($= 10''$)
Kolimator dan kamera	: sistem cermin dan lensa
Kolimator	: $f = 150$ mm
Kamera	: $f = 50$ mm
Grating	: 300 baris/mm
Resolusi teoritis	: $R = 500$
Lampu pembanding	: LED: Ne, HCT: FeNeAr (rusak)

- Spektrograf LHIRES III

Tabel: Performa berdasar simulasi untuk 8" f/10, slit 30 μm, KAF0400 kamera, exp=1^{h}, S/N = 100

Grating	baris/mm	2400	1200	600	300	150
Dispersi (H_α)	Å/pix	0.1	0.3	0.7	1.5	3.0
	km/s	5	17	35	75	150
R		17000	6000	2700	1300	600
Rentang spektrum	Å	85	250	550	1100	2300
m_{lim}		5	6	7	8	9

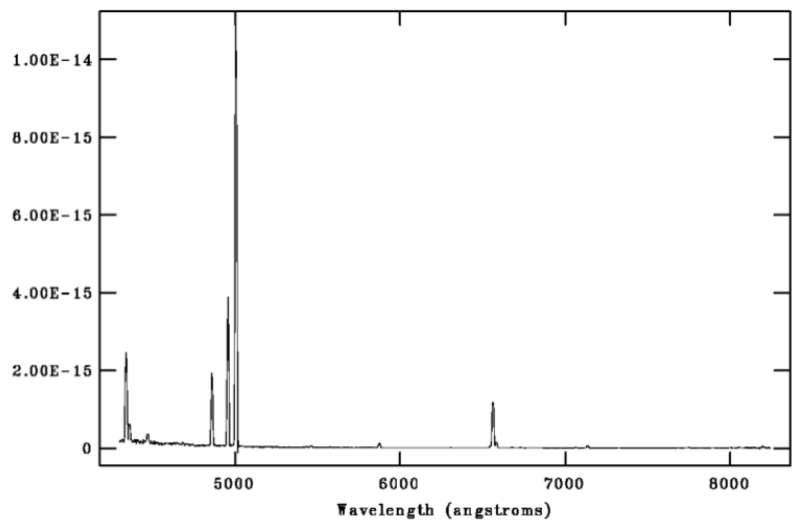
- Kamera CCD

Kamera	: CCD ST–8XMI
Jumlah pixel	: 1530 $\times$ 1020 pixel
Ukuran pixel	: 9 $\times$ 9 μm
Full well capacity	: 100000 e–
Dark current	: 1 e–/pixel pada 0° C
Rentang λ efektif	: 360 nm – 800 nm
FoV	: $16.9' \times 11.27'$
Resolusi	: $0.8''/\mathrm{pixel} \times 0.5''/\mathrm{pixel}$

Spektroskopi

Pengamatan Planetary Nebulae (PNe)

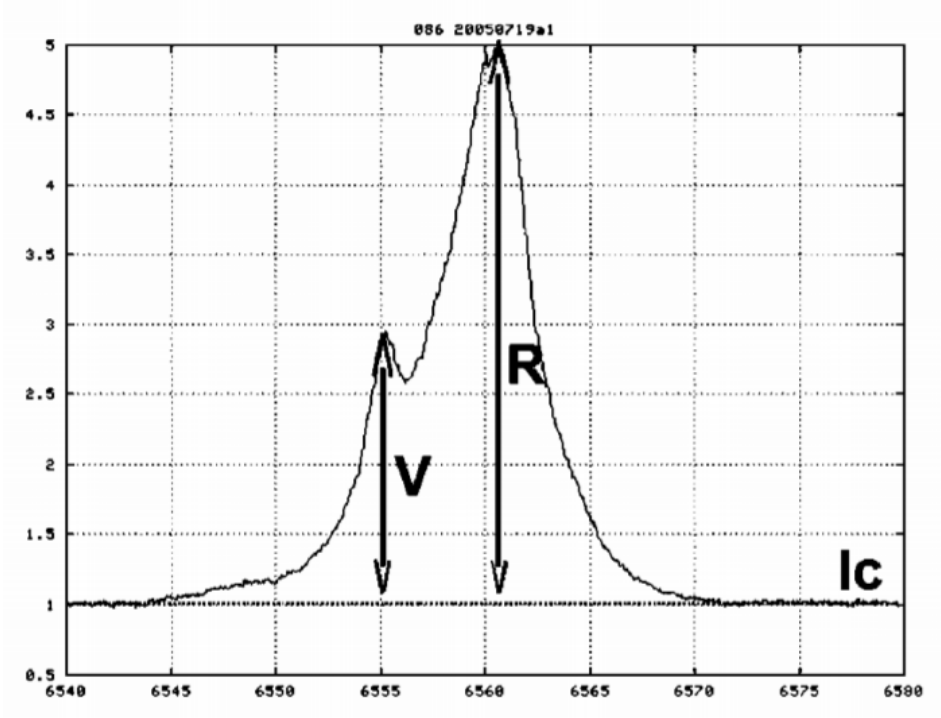
1. $\varnothing$ kecil + low–res $\rightarrow$ lebih banyak obyek yang bisa diamati
2. Rencana program:
   - Kecepatan ekspansi selubung
   - Perhitungan jarak (dikombinasikan dengan pengamatan fotometri) (Frew et al, 2016)



Gambar: Spektrum PN C6 (Puspitaningrum et al, 2014)

Spektroskopi Bintang B-emisi (Be)

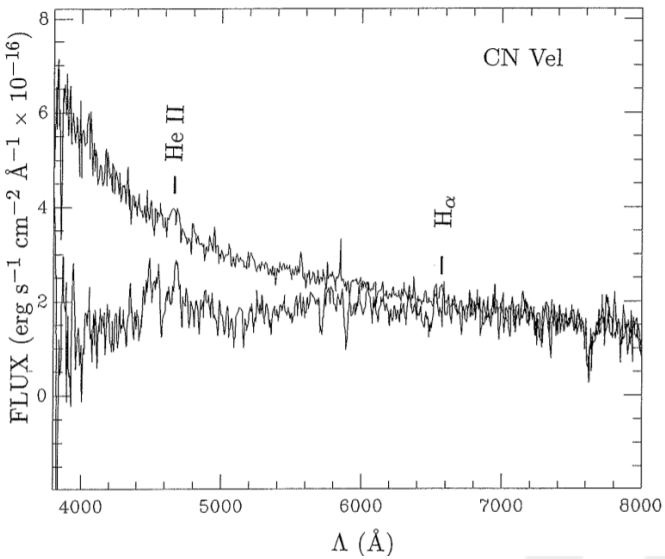
1. Rencana program:
   - Variasi V/R, eq. width
   - Kombinasikan dengan fotometri $\rightarrow$ korelasi perubahan mag dengan variasi V/R (?)



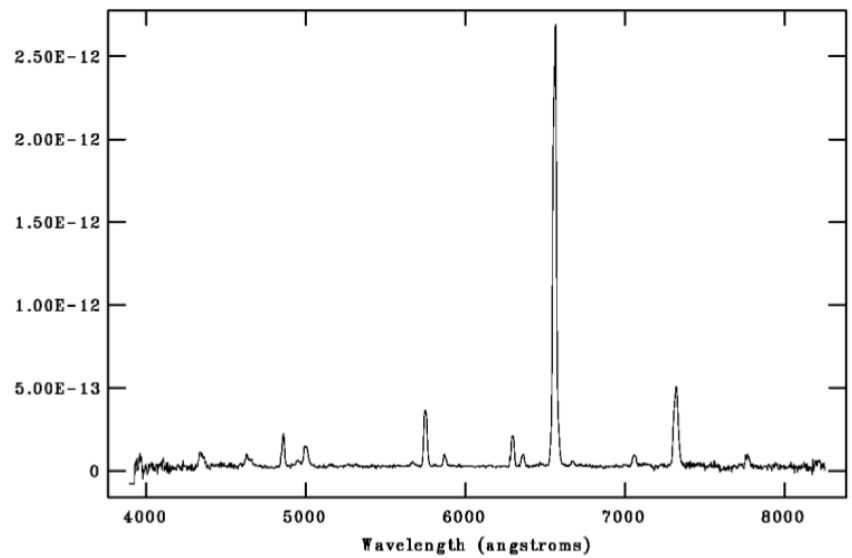
Gambar: Pengukuran variasi V/R pada spektrum puncak ganda (Thizy 2008)

Spektroskopi Nova

1. Rencana program:
   - Mempelajari distribusi energi kontinum Nova pada berbagai fase (misal Bianchini et al, 1991)
   - Kecepatan ekspansi



(a)

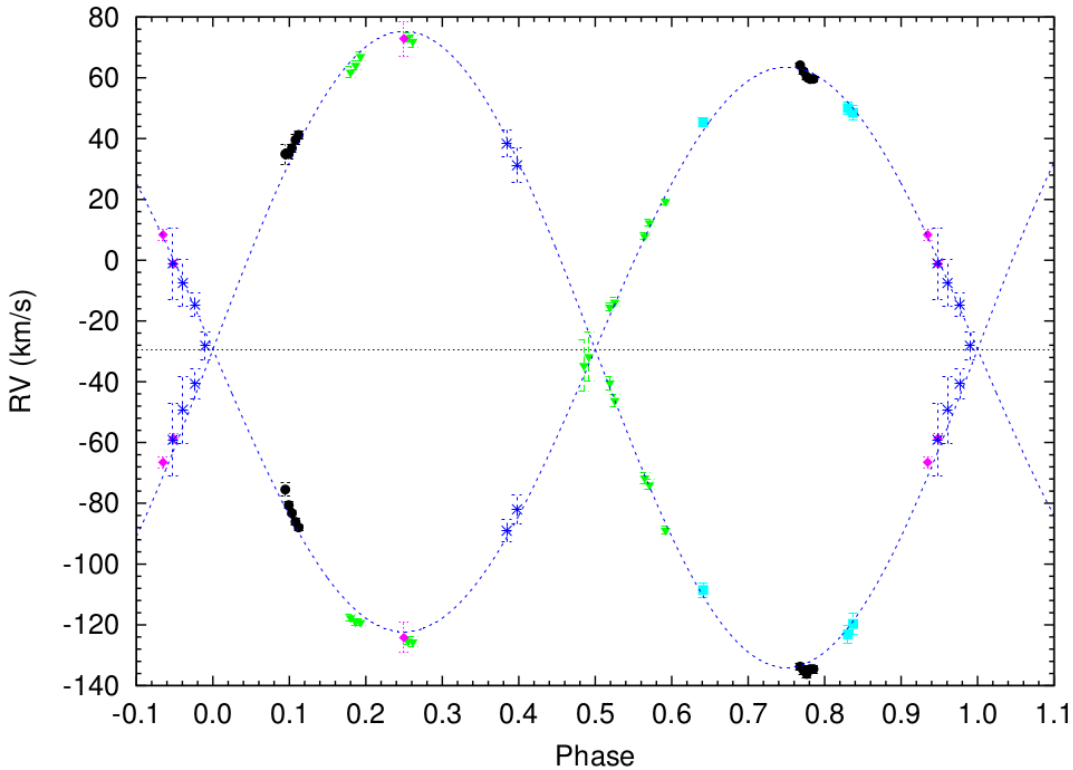


(b)

Gambar: (a) Perbandingan spektrum resolusi rendah Nova CN Vel saat flare dan quiescence (Bianchini et al, 1991); (b) Spektrum Nova Cyg 2014 (Puspitaningrum et al, 2014)

Spektroskopi Bintang Variabel

1. Memberikan *constraint* rasio massa, q
2. Kurva kecepatan radial, Kelimpahan kimia
3. bersinergi dengan pengamatan fotometri bintang ganda $\rightarrow$ parameter absolut

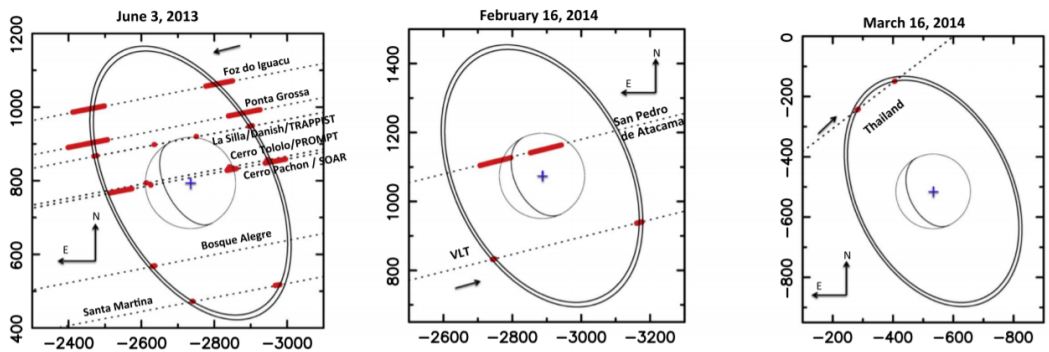


Gambar: Kurva kecepatan radial CD Tau (Jatmiko 2009)

Fotometri

Okultasi

1. Resolusi tinggi dengan *modest instruments* $\rightarrow$ orde mili-detikbusur
2. Pengamatan relatif 'mudah' dilakukan: teknik, kondisi langit
3. Keberhasilan pengamatan di masa lalu dengan kondisi terbatas
4. Mudah diduplikasi oleh astronom amatir maupun profesional: membangun jejaring
5. Bisa dilakukan dengan teleskop berbagai ukuran: tidak *obsolete*
   - $\varnothing < 1$ m $\rightarrow$ studi kegandaan, satelit/cincin asteroid
   - $\varnothing > 1$ m $\rightarrow$ diameter sudut, deteksi *circumstellar shell*
6. Jumlah praktisi sedikit untuk kawasan Asia Tenggara



Gambar: Rekonstruksi geometri okultasi Chariklo (Bérard et al, 2017)

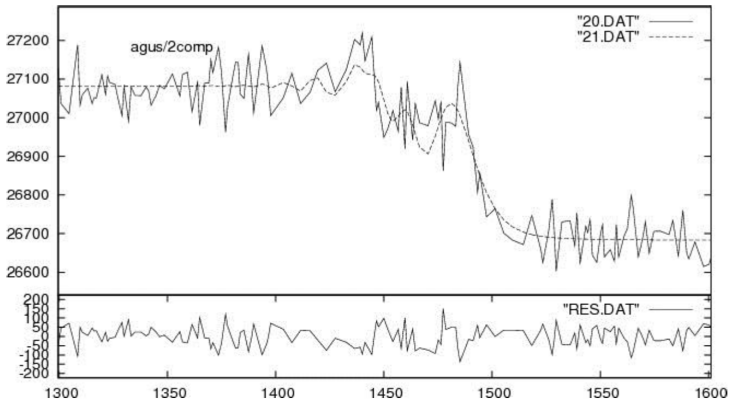


Figure 4. Fit by a 2-source model.

(a)

	Slope	PA(true)	CA(true)
Solution 1:	-3.9	61.1	-35.9
Solution 2:	-67.9	-2.9	-99.9

(event slower than predicted: - 4.5%)
R: 1.7911 +/- 0.0362 - Mag: 0.6328 +/- 0.0220
Sep = 11.50 +/- 0.27 (mas) - SNR : 7.29
VLIN= 0.48427 +/-0.00335 (m/ms)
tot F0= 398.99 (counts)
BKG0= 26682.63 (counts)

(b)

Gambar: δ Sco ($V \sim 2.32$): 20cm f/10 SCT + ST–8 XME

Lunar Occultation Observation of μ Sgr: a Progress Report

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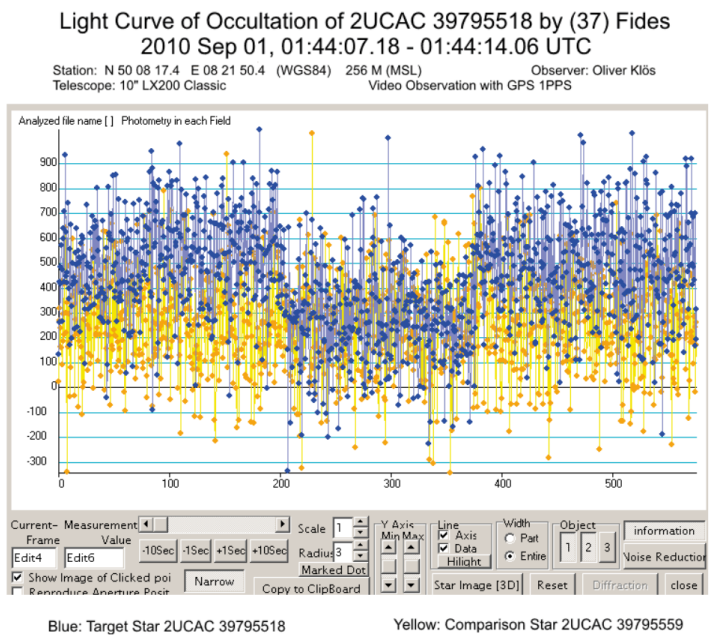
Abstract. Lunar Occultation (LO) is an event where limb of the Moon passing over a particular heavenly bodies such as stars, asteroids, or planets. In other words, during the event, stars, asteroids and planets are occulted by the Moon. When occulted objects contact the lunar limb, there will be a diffraction fringe(s) which can be measured photometrically, until the signal vanishes into noise. This event will give us a valuable information about binarities (of stars) and/or angular diameters estimation (of stars, planets, asteroids) in milliarcsecond resolution, by fitting with theoretical LO pattern. CCDs are common for LO observation because of its fast read out, and recently are developed for sub–meter class telescope. In this paper, our LO observation attempt of μ Sgr and its progress report are presented. The observation was conducted on July 30th, 2012 at Bosscha Observatory, Indonesia, using 45cm f/12 GOTO telescope combined with ST–9 XE CCD camera and Bessel B filter. We used drift–scan method to obtain light curve of the star as it was disappearing behind Moon's dark limb. Our goal is to detect binarity (or multiplicity) of this particular object.

Gambar: μ Sgr ($V \sim 3.88$): 45cm f/12 GOTO + ST–9 XE

Rencana program:

1. Pengamatan rutin LO dengan mode video (digital) maupun *drift scan*
   - studi kegandaan, asteroid
   - olah data (*fitting* kurva cahaya)
2. Melanjutkan kembali pengembangan *code* untuk *fitting* kurva cahaya; Bayesian inference w/ python $\rightarrow$ butuh bantuan intensif!
3. *Code* akuisisi untuk CCD non–SBIG
4. Memikirkan pengembangan perangkat keras untuk *time stamping* video digital: beli? buat sendiri? kamera khusus ber-GPS?



Gambar: Kurva cahaya okultasi 2UCAC 39795518 oleh asteroid (37) Fides. Alat yang digunakan adalah video camera dengan teleskop 10". (Klös, 2011)

Variable stars katalog ASAS

1. EB dengan $\delta < +28^{\circ}$: cocok untuk Indonesia
2. Banyak bintang–bintang (terutama di belahan langit Selatan) yang belum jelas parameter astrofisisnya
3. Salah satu obyek ujicoba yang baik untuk sistem teleskop baru, misal teleskop robotik

Light Curve Analysis of Eclipsing Binary System ASAS 172533–1221.4

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Abstract. Using the data taken from our 0.36 m f/7.2 robotic telescope, we performed a very first light curve (LC) analysis of eclipsing binary ASAS 172533–1221.4, one of target stars which is part of program stars in our variable star survey project. The LC of this star was constructed by using LEMON, a semi–automatic photometric pipeline written in Python. We refined a Time of Minima (ToM, T_0) and variability period of this system, P and updated its ephemerides as $HJD(min\ I) = 2457200.255578 + 0.678861 * \phi$. The LC modeling of the system was conducted with the PHOEBE (PHysics Of Eclipsing BinariEs) software [4] built on top of the widely used WD program [9]. The assorted LC solution parameters are shown as follows: mass ratio $q = 0.811 \pm 0.009$, inclination $i = 70.62 \pm 0.01°$, Temperature of primary and secondary component $T_1 = 5559.23 \pm 83.51\ K$ and $T_2 = 3871.64 \pm 43.66\ K$, respectively, and modified Kopal potentials which are a function of primary's and secondary's radii $\Omega_1 = 3.436 \pm 0.018$ and $\Omega_2 = \Omega_{cr} = 2.980$, respectively. It is concluded that ASAS 1725533–1221.4 is found to be near–contact system with almost similar size between primary and secondary components, with its secondary component is already filling its Roche lobe.

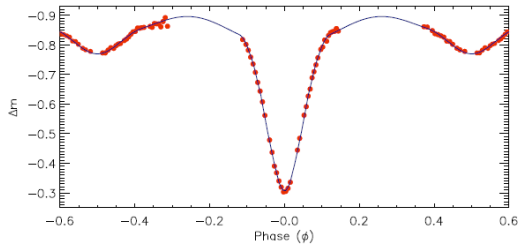


Figure 1. The theoretical LC compared to observation data for ASAS 172533–1221.4. The dots are the observed data points, and the thick line is best fits of a LC model to data points.

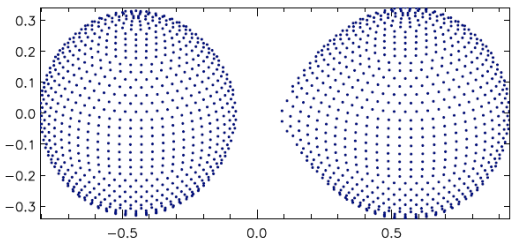


Figure 2. The geometric configurations of ASAS 172533–1221.4 at $\phi = 0.25$.

(a)

(b)

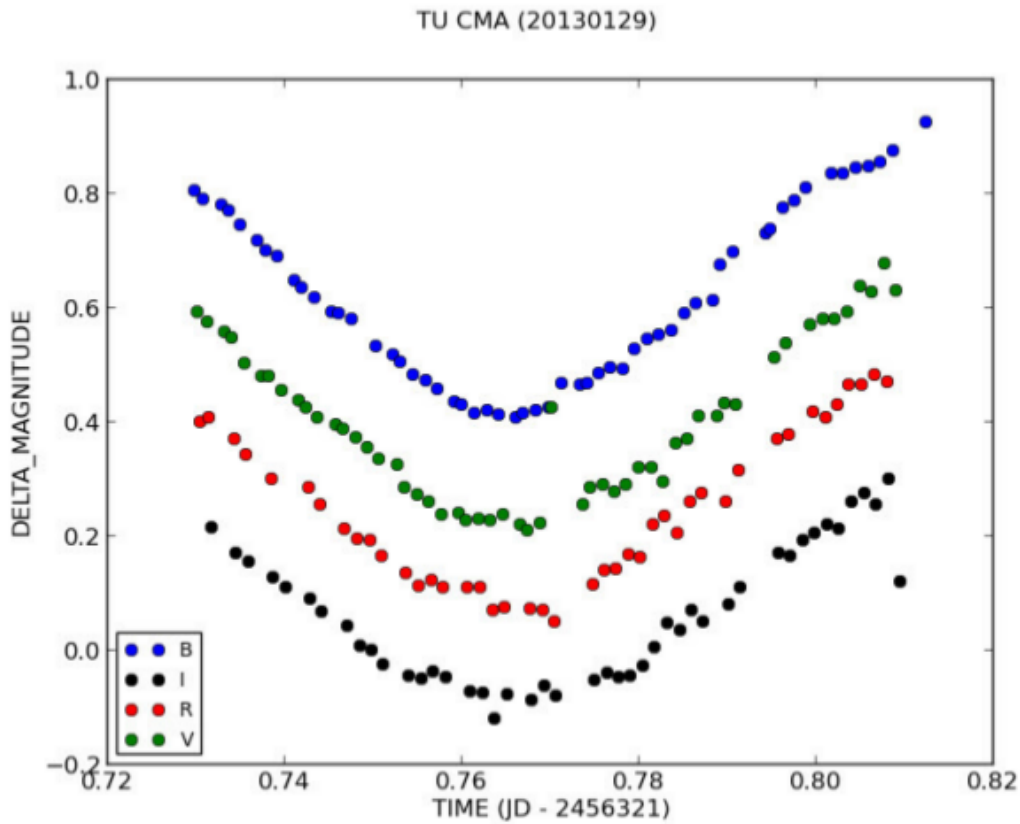
Gambar: ASAS 172533–1221.4

Rencana program:

1. Pengamatan fotometri beberapa obyek ASAS untuk mendapatkan kurva cahaya penuh ($P < 1$ hari (tipikal $\sim 6^{\mathrm{h}}$), $\Delta m \sim 0.3$, $V < 13$)
2. Penurunan parameter fisis obyek ASAS
3. Elaborasi dengan pengamatan spektroskopi untuk mendapatkan parameter absolut dari obyek

Pengukuran Time of Minima, ToM

1. GAO–ITB RTS pre–NEO R1000
2. Kolaborasi Observatorium Bosscha dan NARIT, Thailand → `Eclipsing Binary Minima (BIMA)` Project



Gambar: Kurva cahaya TU CMa pada filter BVRI (Haans et al, 2015)