Automatic Reduction & Photometry Pipeline

The *quick* software suite

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Problems

- IRAF:
  - Old and not user friendly
  - Difficult to automate
  - Difficult to run on large amounts of data

But

  - Industry standard
  - Very powerful
  - Can do everything

Aim

- Automated reduction and analysis pipeline
  - As little human input as possible
  - Extremely robust
  - Very little user interaction required

Options

- Start from scratch
  - Create a new way to do photometry (!)
- Program *within* IRAF
  - Learn IRAF programming language
- Write a script from outside IRAF that calls to it (and others) when needed

Details

- Bash script – should work on any Linux distro
  - Tested on Fedora and Ubuntu
- Requirements (all free)

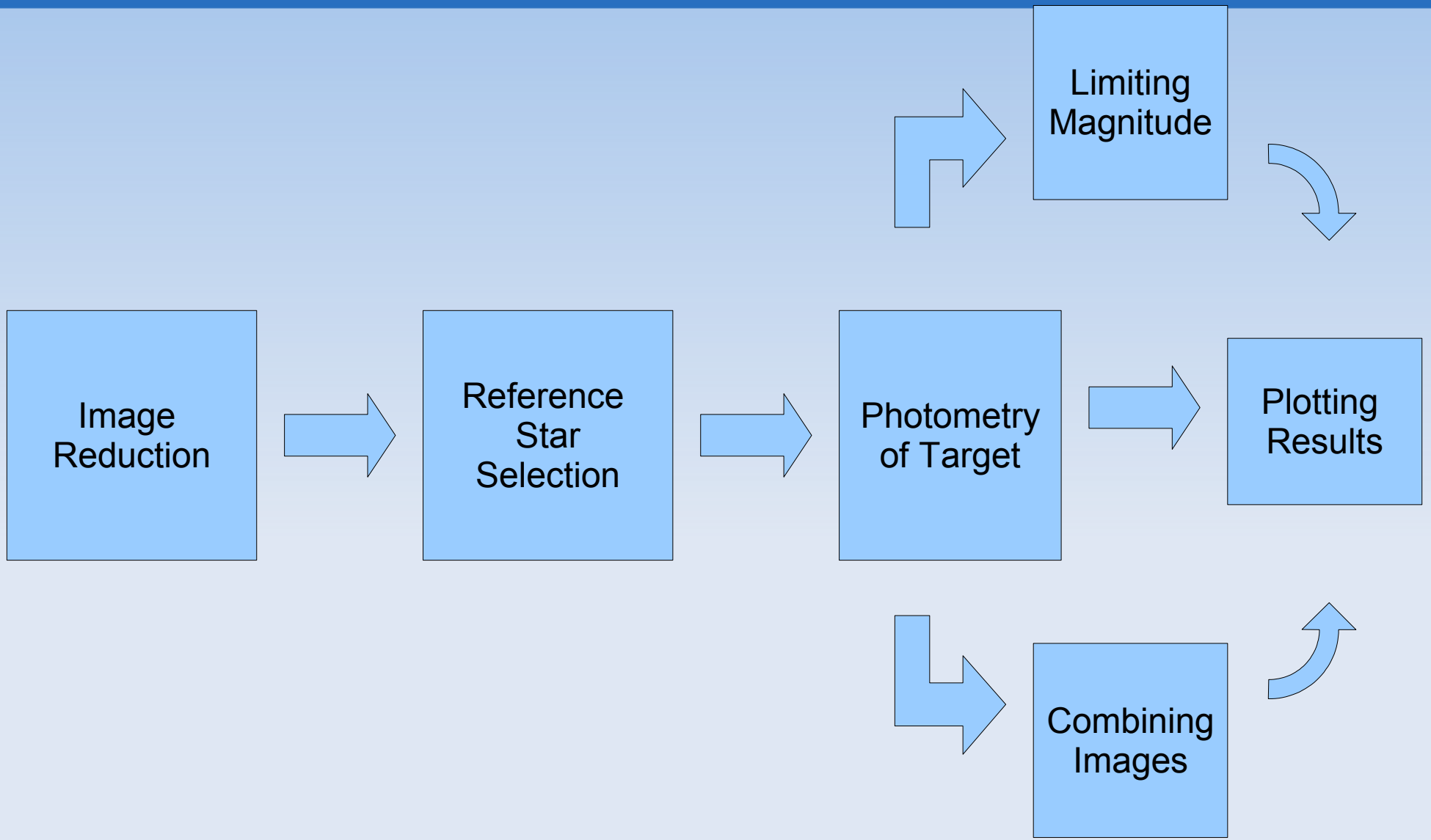
  Iraf

  Octave

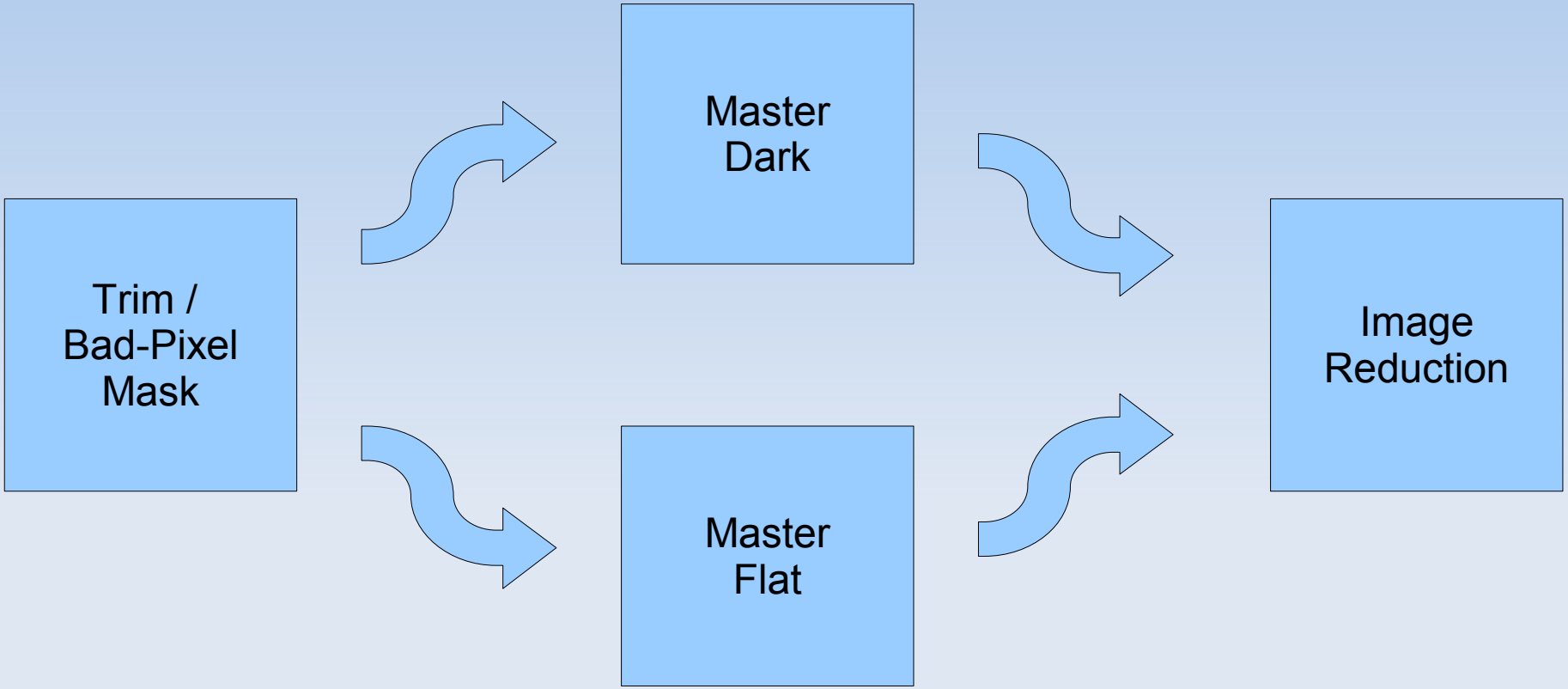
  Gnuplot

  Wcstools
- Modular code

Analysis Process



Reduction


Trim /
Bad-Pixel
Mask
Master
Dark
Master
Flat
Image
Reduction

Darks & Flats

- Darks
  - Remove spurious darks
    - Use *imstat* to get mean pixel value
    - If this is above some threshold x remove the image
  - Create master dark
    - Organise by exposure and use *darkcombine*
- Flats
  - Remove spurious flats
    - Use *imstat* to get mean pixel value
    - If this is below some threshold x remove the image
  - Create master flat
    - Organise by filter and use *flatcombine*

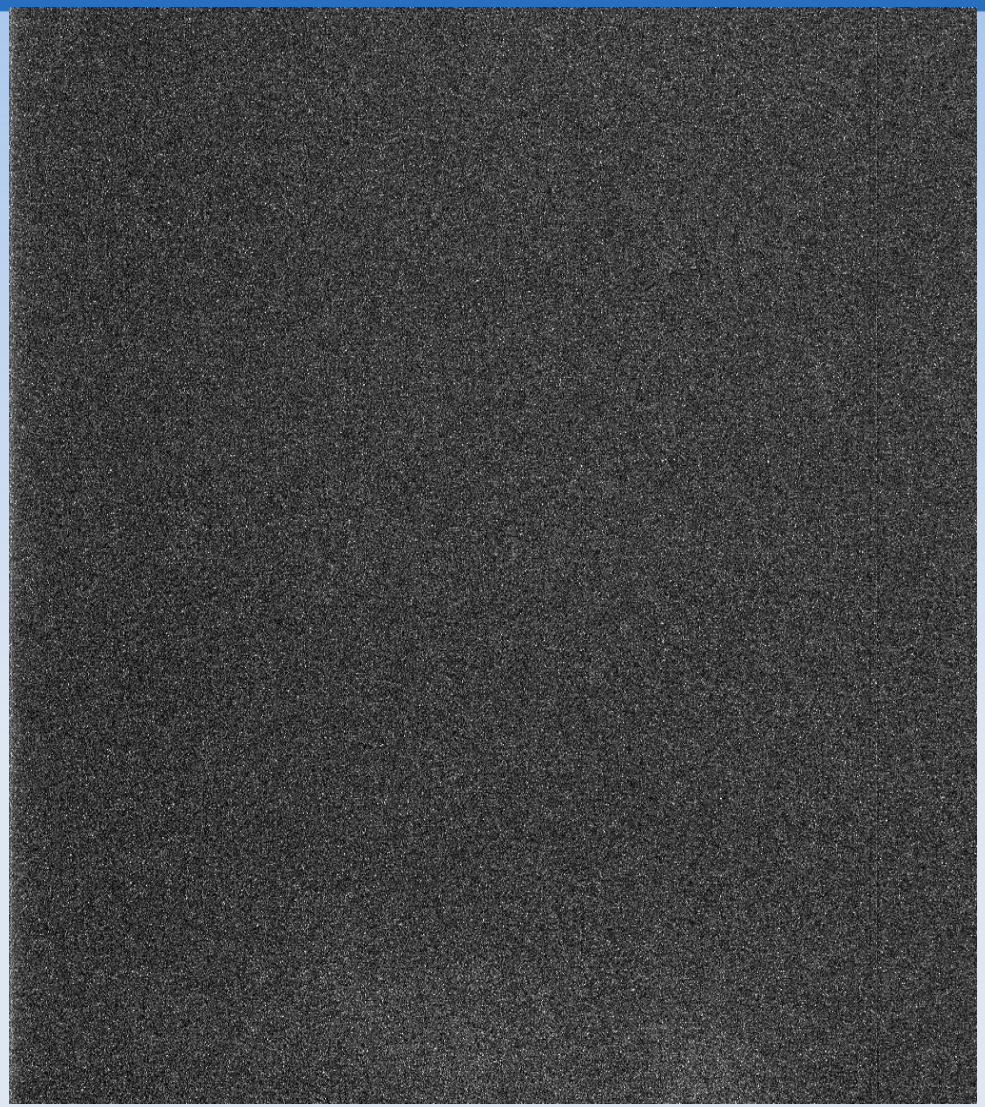
Image Reduction

Organise image frames by filter & exposure

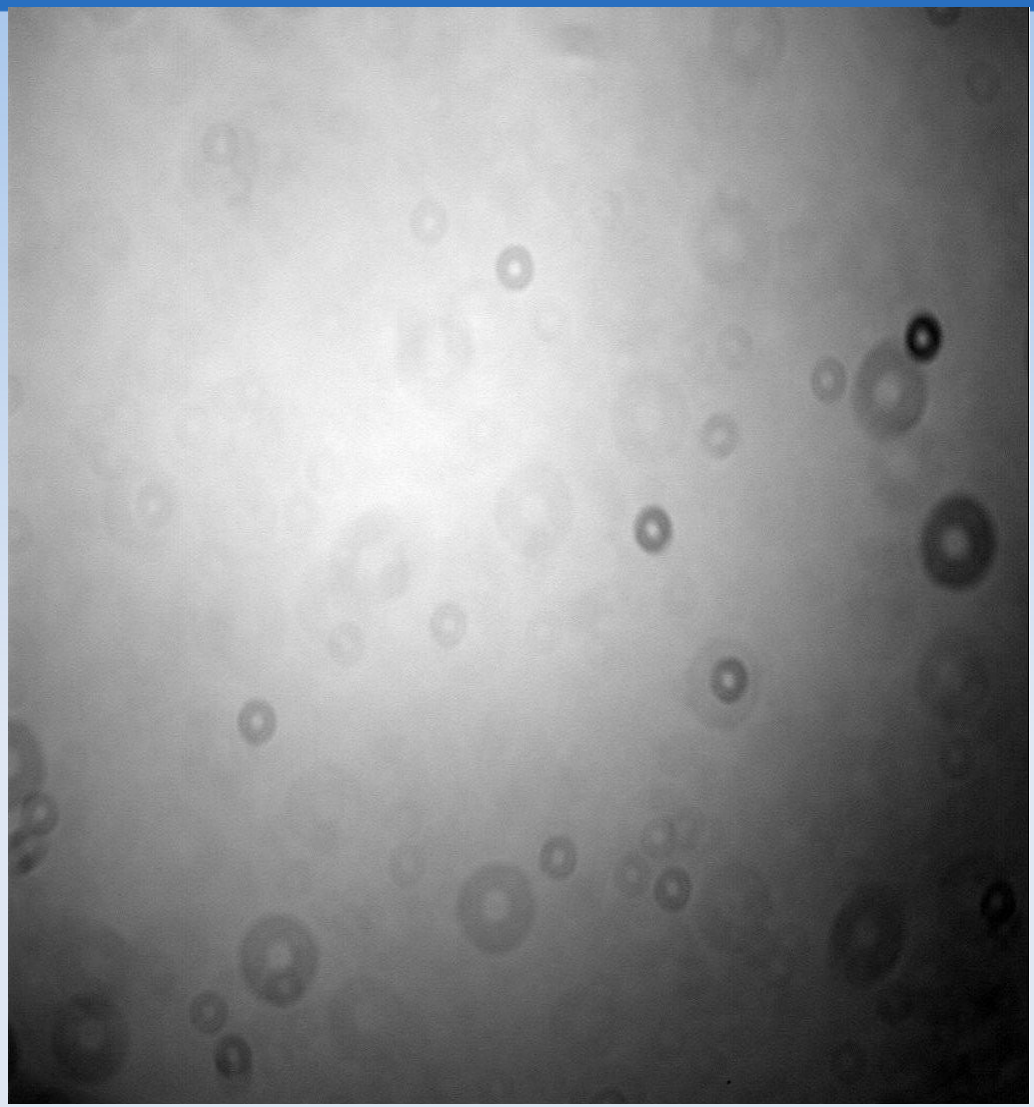
Use *ccdproc* to reduce images with appropriate master darks and flats

Organise reduced images into directories by filter

Examples

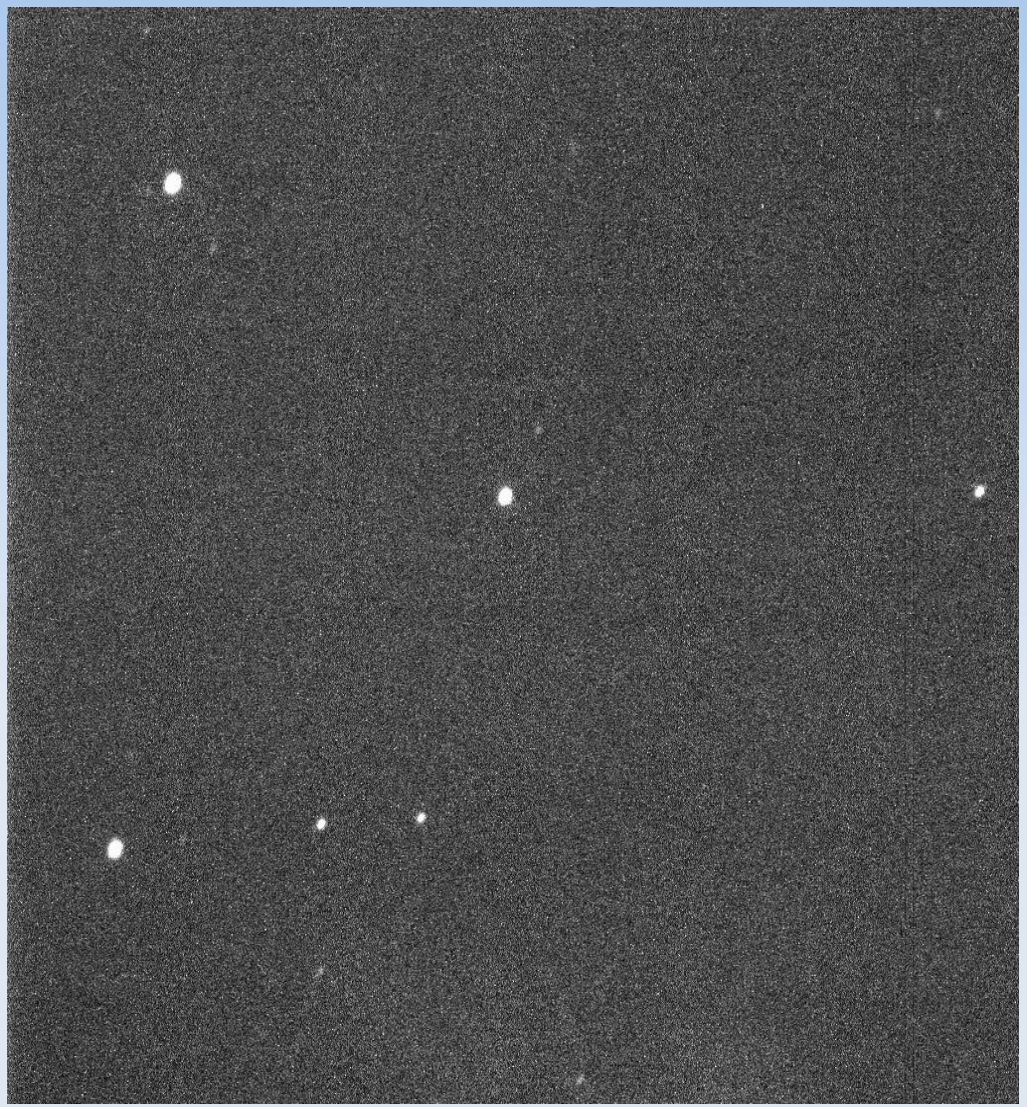


Master Dark

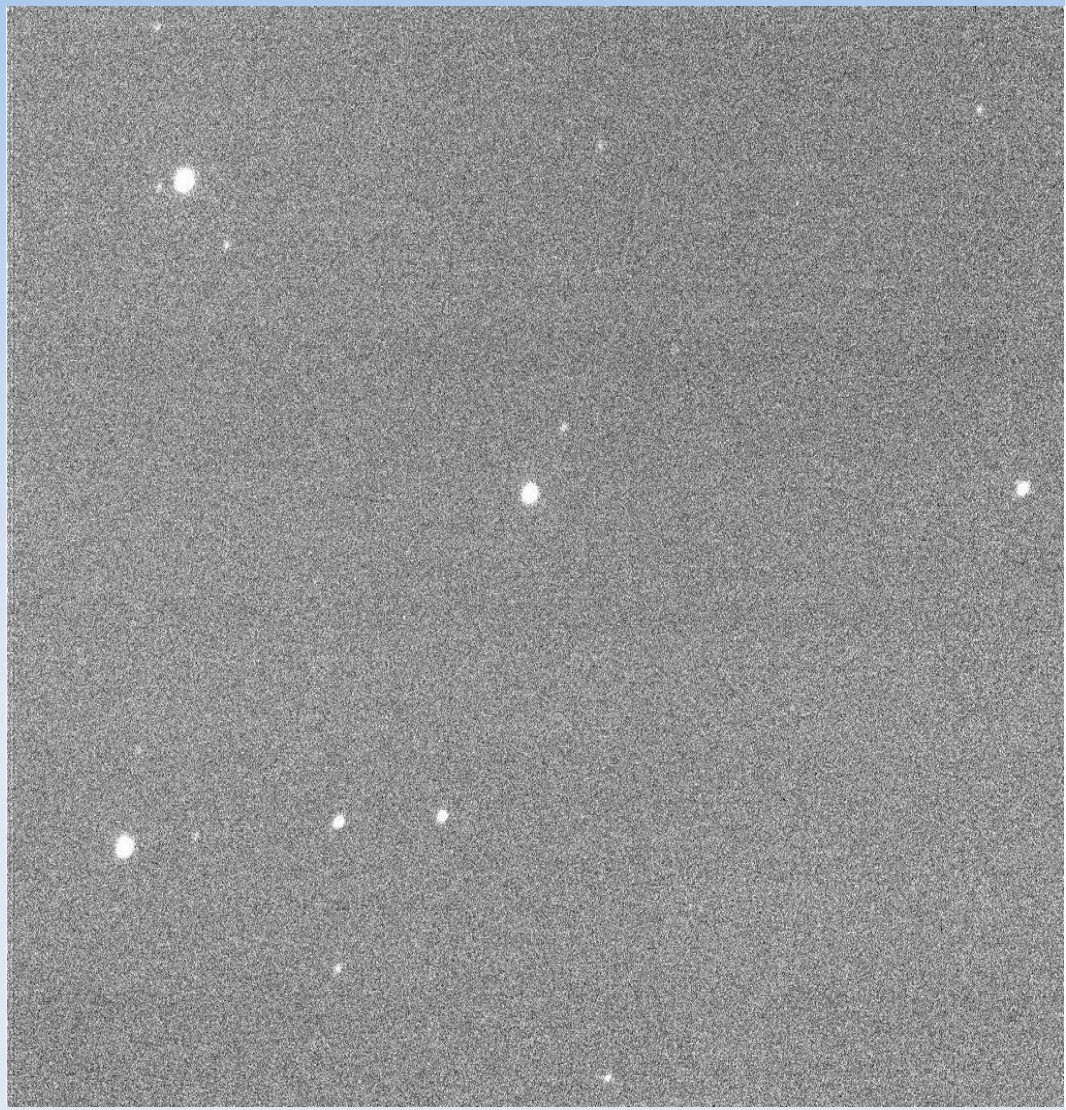


Master Flat

Results



Original



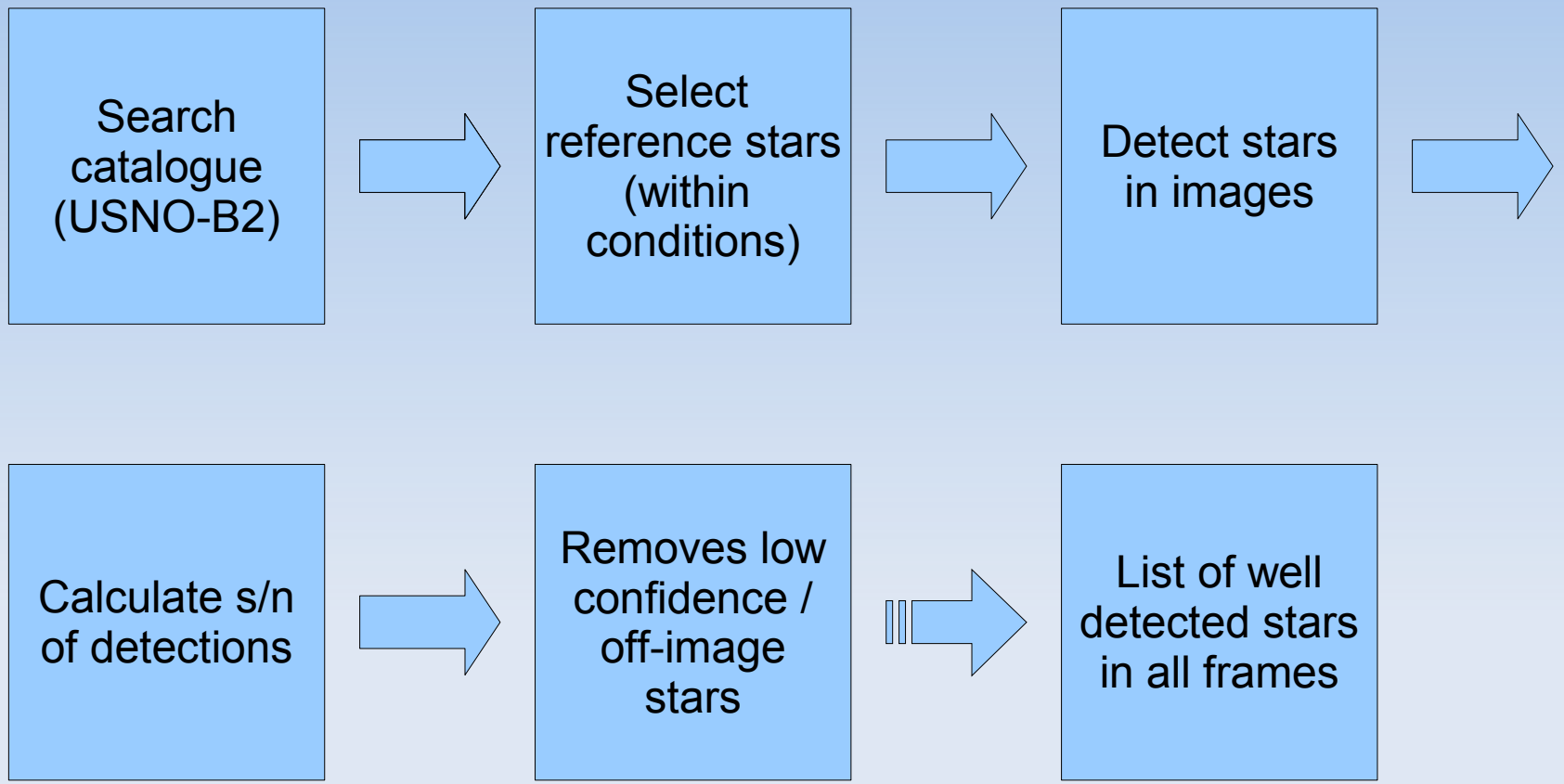
Reduced

Reference Stars

- Good reference stars:
  - In every frame
  - Well detected
  - Non variable

  If possible
  - Close to the target
  - Of a similar magnitude to the target

quick_reference_star



Photometry

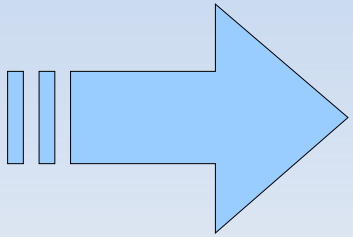
Inputs

Outputs

Coordinates of target & ref stars

FWHM, filter, exposure, etc.

Gain, readnoise, aperture, etc.



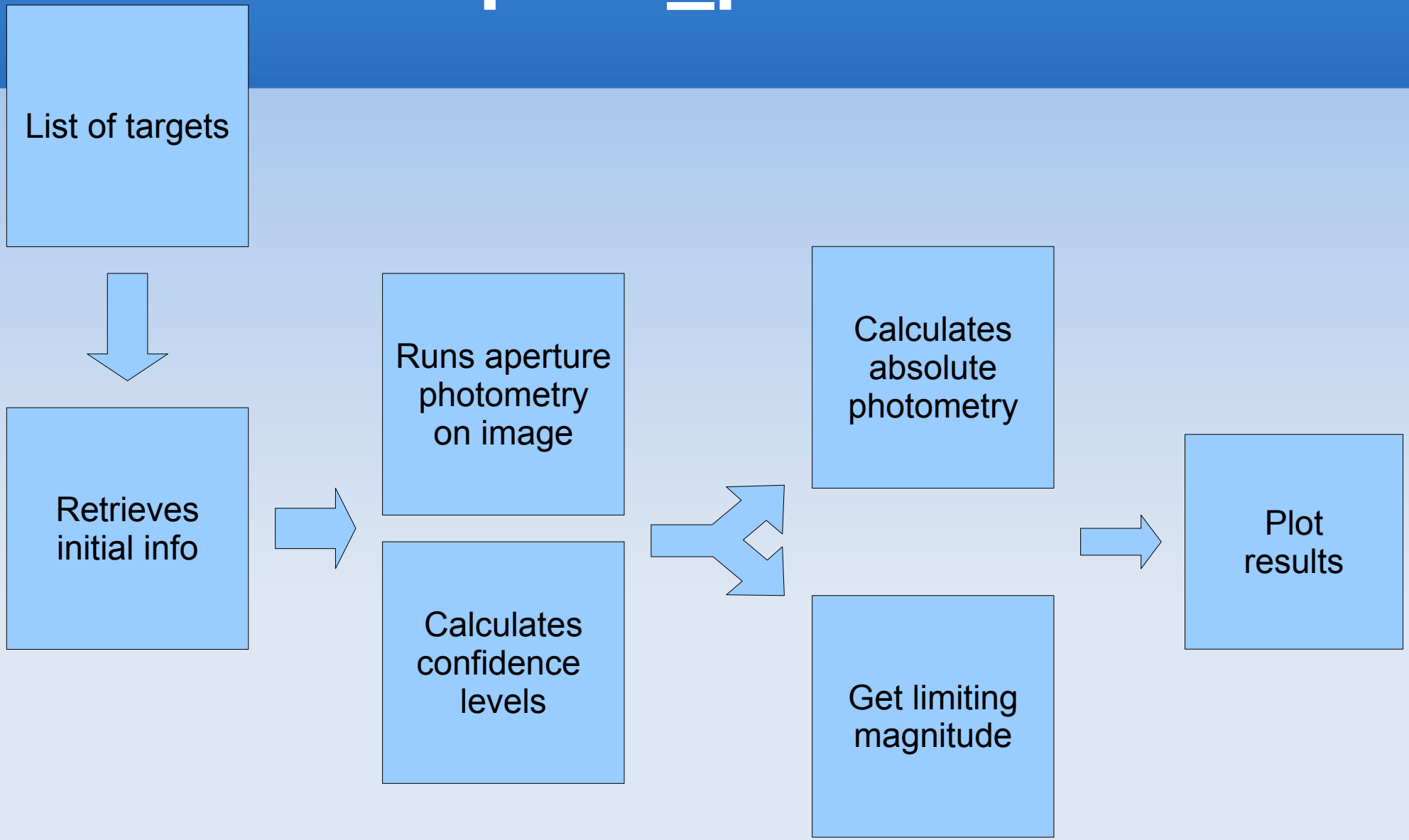
Easily readable results

Absolute magnitude

Confidence of detection

Nice plot

quick_phot


List of targets
Retrieves initial info
Runs aperture photometry on image
Calculates confidence levels
Calculates absolute photometry
Get limiting magnitude
Plot results

quick_phot

- Create a *region of interest* (roi) file

  Include initial time (JD), coordinates of target and ref stars, catalogue magnitudes of ref stars

  e.g.

  #description

  T0=x (in JD - get this from GCN or JD of first image)

#name	ra	dec	magnitude
object	hh:mm:ss	dd:mm:ss	(leave this blank)
ref1	hh:mm:ss	dd:mm:ss	catalogue mag1
ref2	hh:mm:ss	dd:mm:ss	catalogue mag2
ref3	hh:mm:ss	dd:mm:ss	catalogue mag3

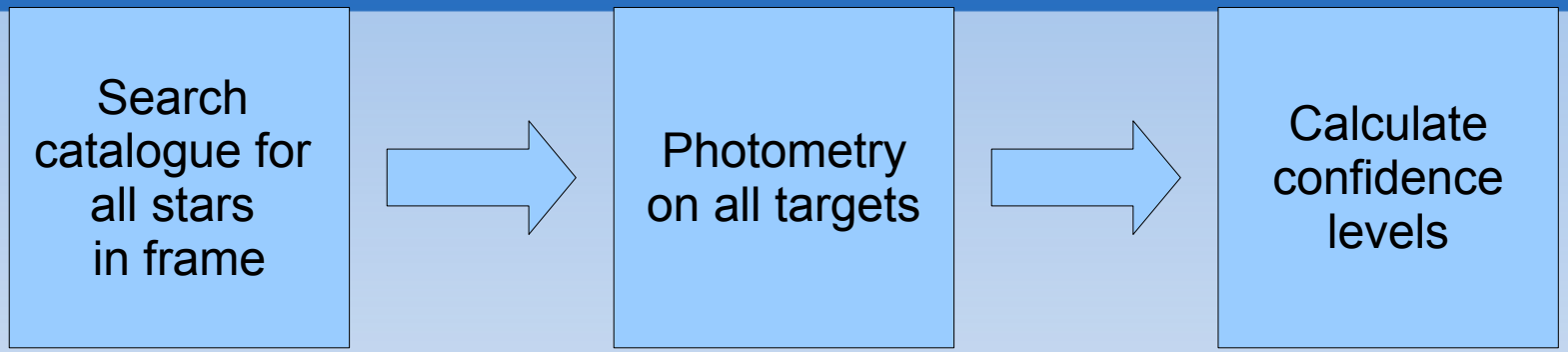
quick_phot

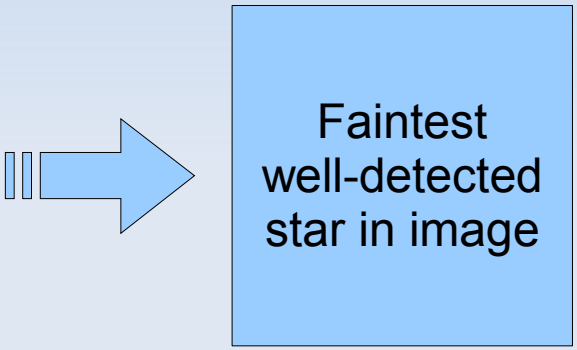
- Sample output

#OBJECT=xxx
#Filter=C

#JD	T-T0	EXP	MAG	MAG_ERR	S/N	SIGMA
2454266.60020833	91	10	16.4055	0.261	2.828	3.304
2454266.60069444	133	10	16.3835	0.261	2.909	3.382
2454266.60083333	145	10	16.024	0.176	4.247	5.425
2454266.6012963	185	10	15.5235	0.117	6.188	8.723
2454266.60193287	240	10	16.1405	0.214	3.615	4.386

Limiting Magnitude





Scripts

- quick_reduce
- quick_reference_star
- quick_phot
- quick_limiting_magnitude
- quick_combine
- quick_plot

- Core scripts
  - quick_phot_core
  - quick_cat_core
  - quick_time_core
  - quick_conf_core
  - quick_aphot_core

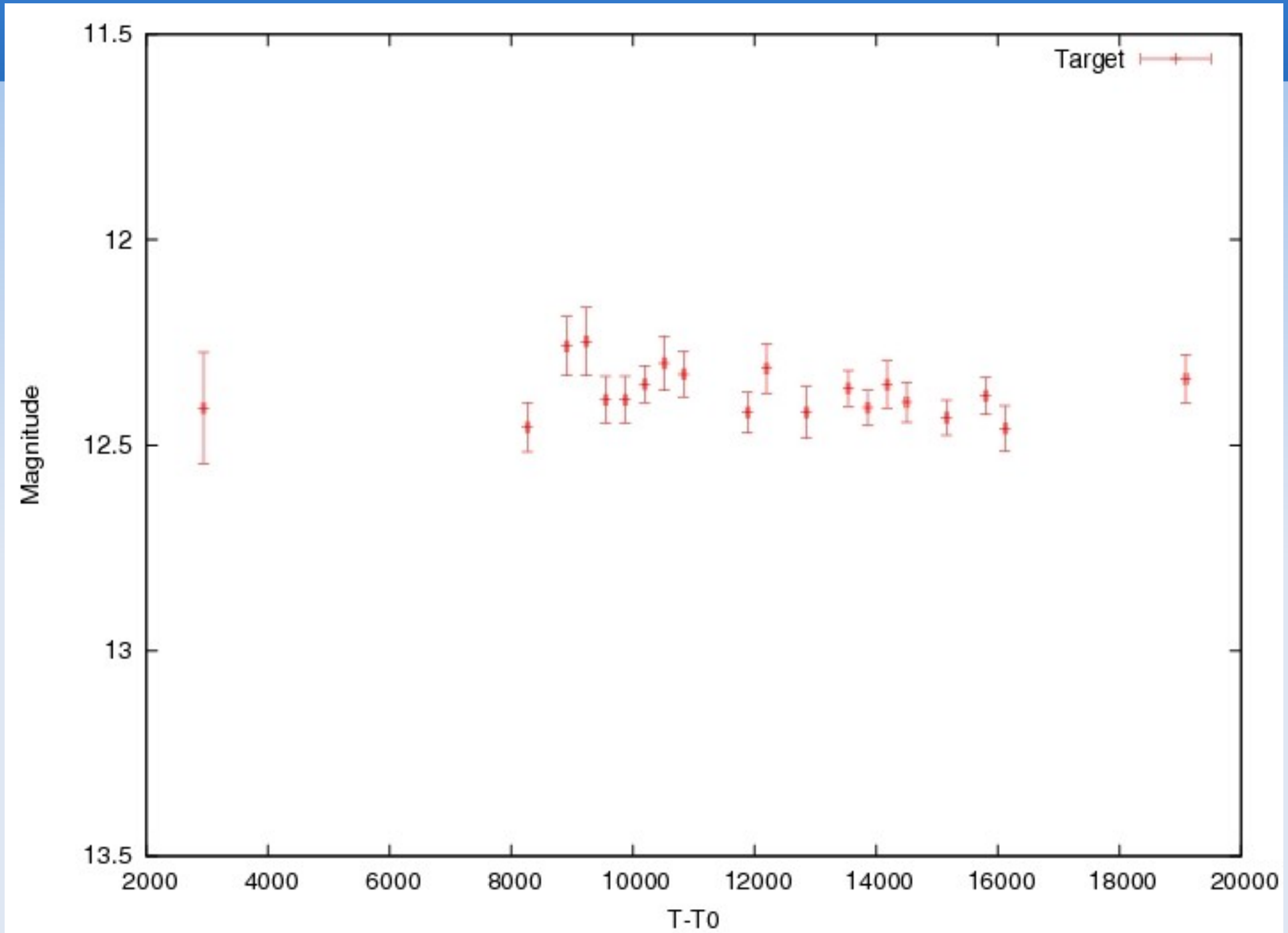
Supplementary scripts

- quick_name
  - Renames images based on header info
- quick_combine
  - Combines images in specified groups and writes new exposure to header
- quick_region
  - Creates ds9 region file from list of targets to easily see reference stars etc.
- quick_night
  - Organises data from many nights into separate directories

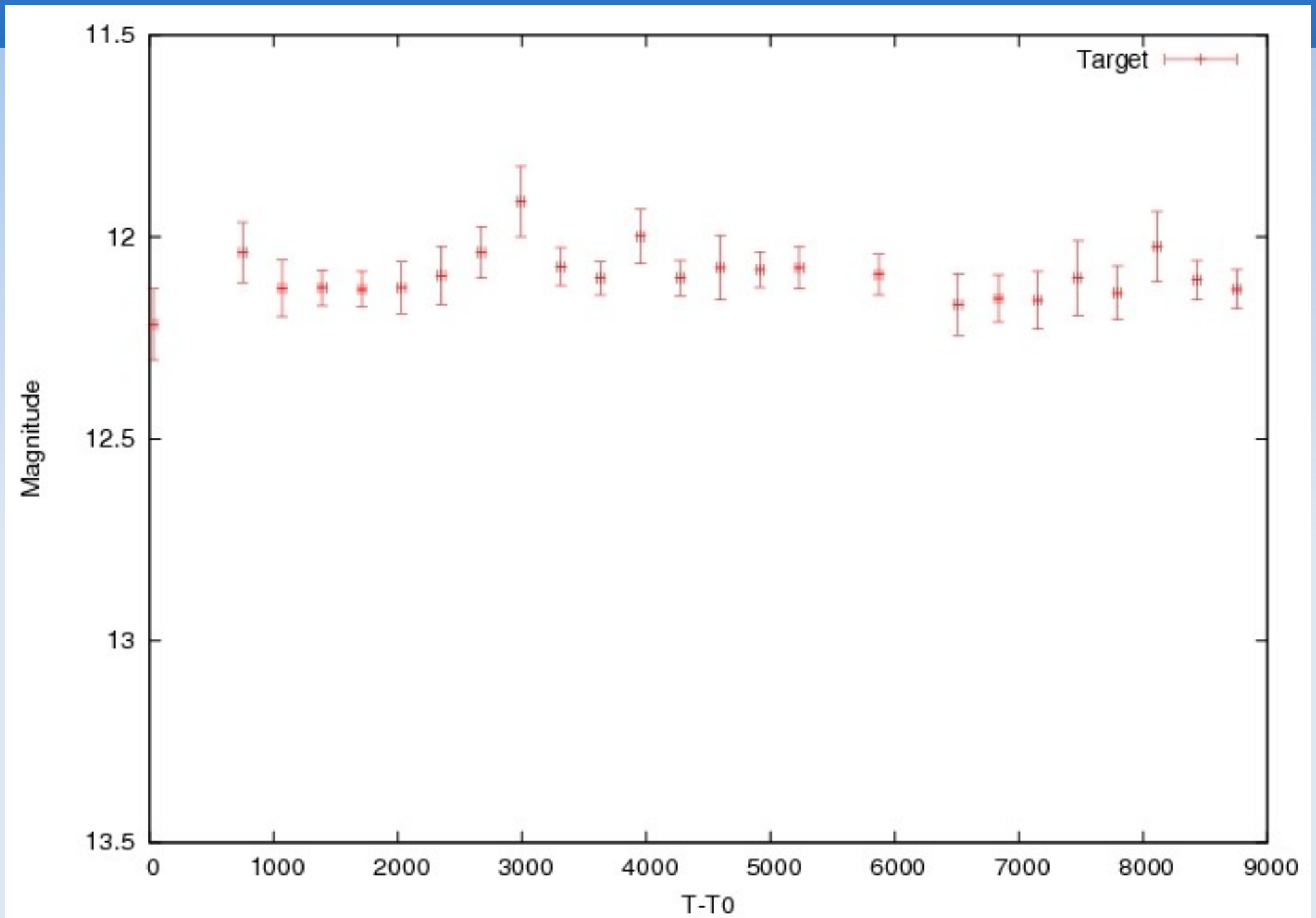
To Do

- Can only automatically get magnitudes for B, R and I bands (as given by USNO-B2)
  - Need to implement support for V band
- Set up an easy way to add support for data from different telescopes

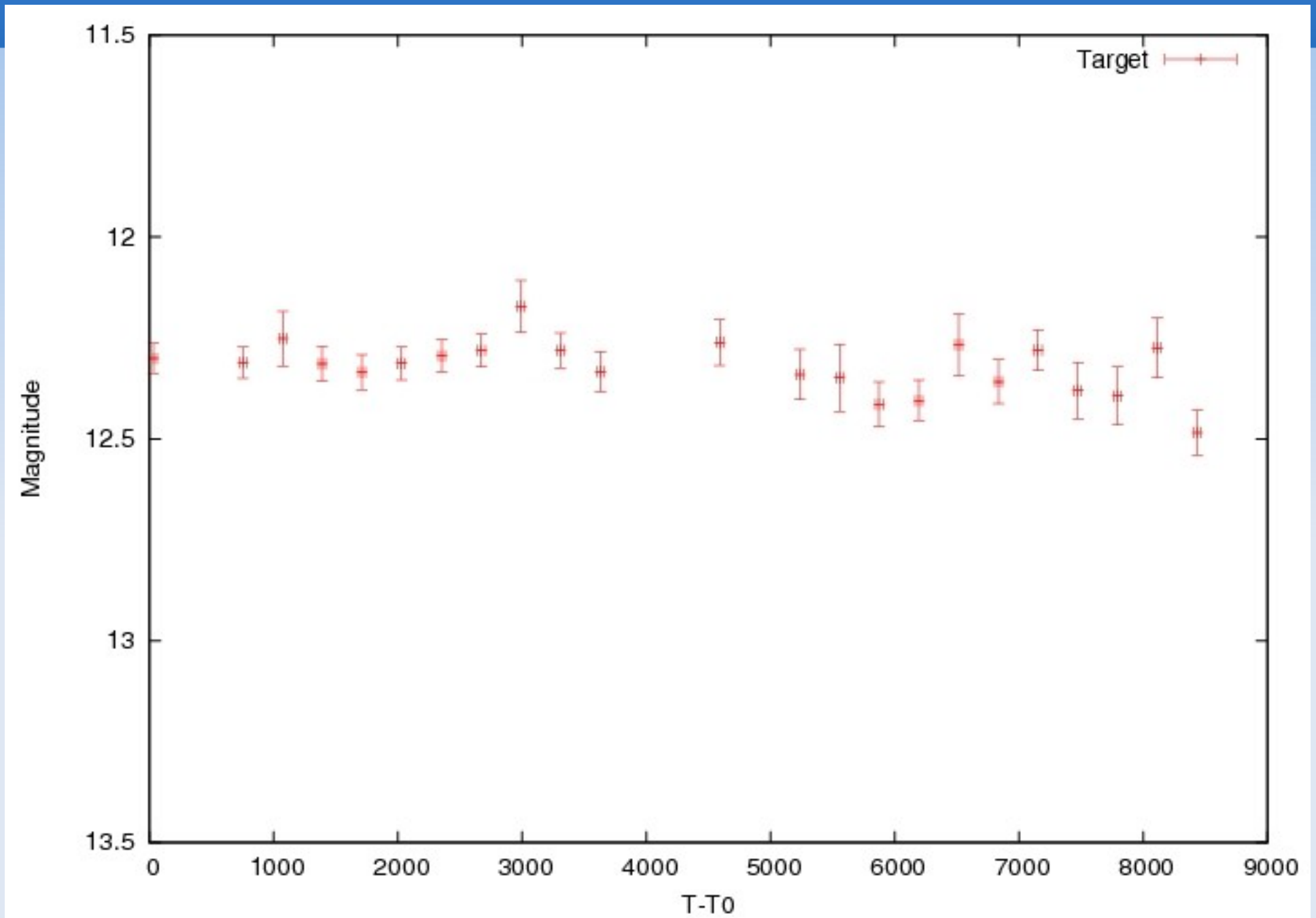
PKS 2155-304 23-24/07/06



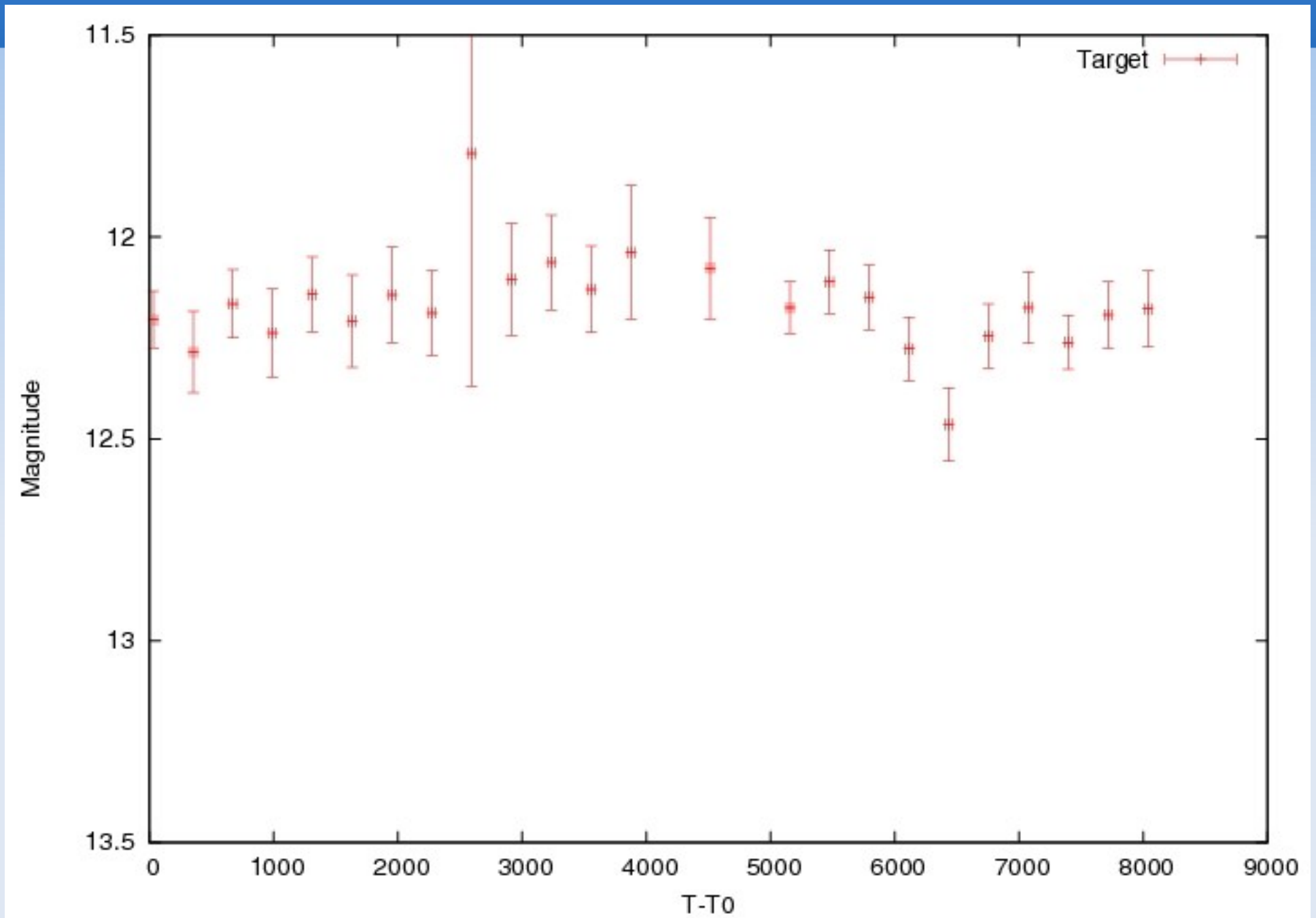
24 - 25


Target
Magnitude
T-T0
11.5
12
12.5
13
13.5
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

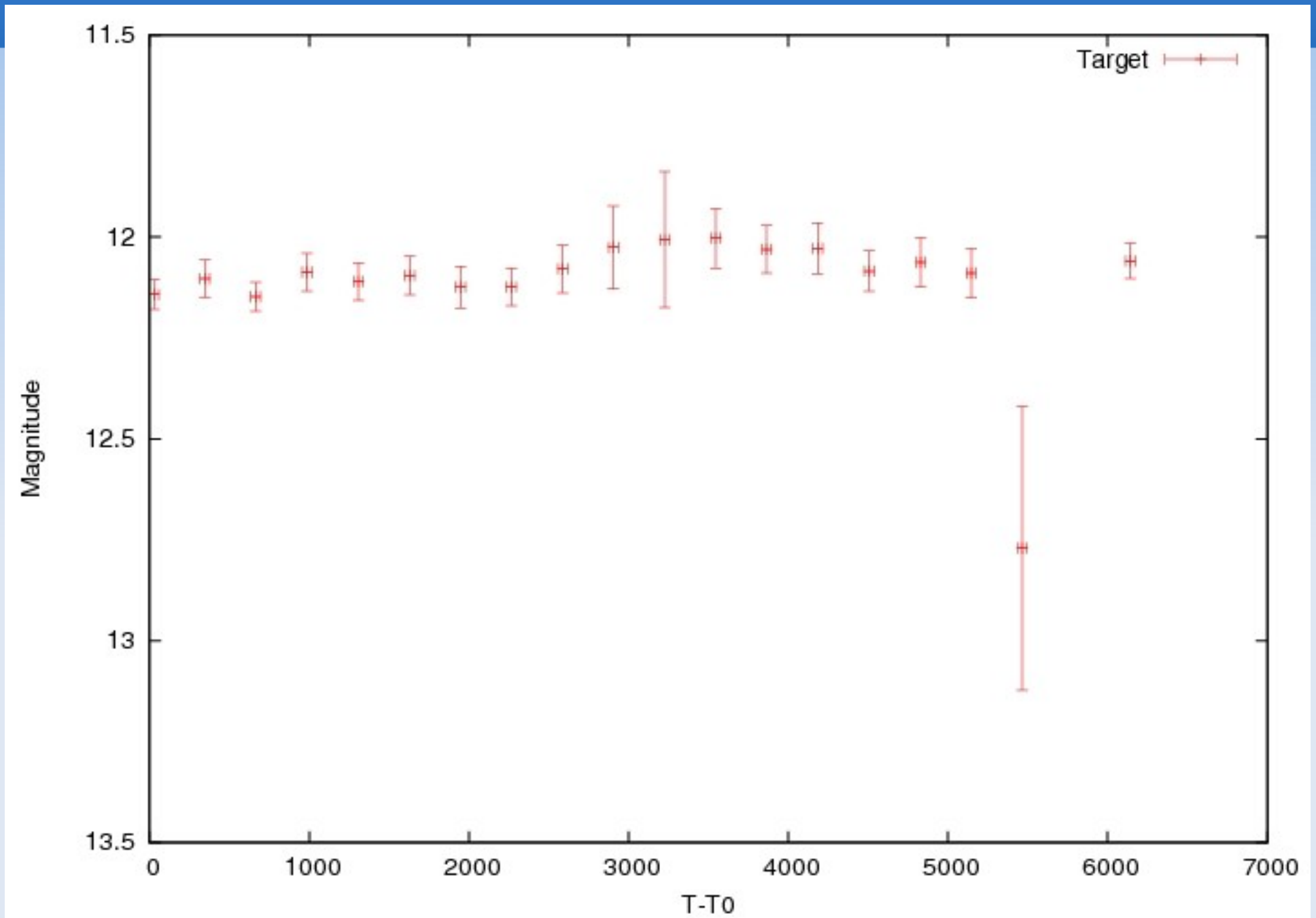
25 - 26


Target
Magnitude
T-T0
11.5
12
12.5
13
13.5
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

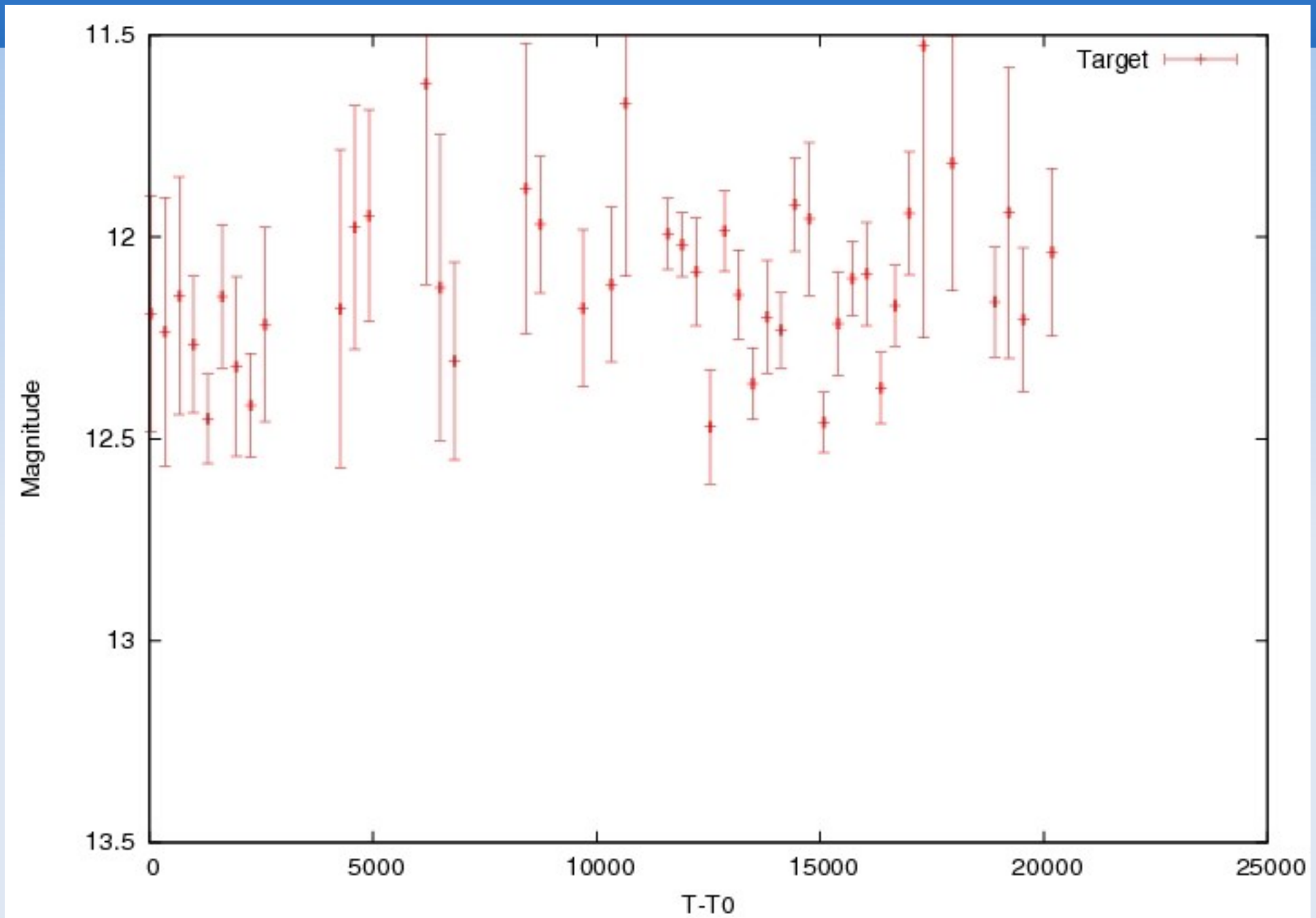
26 - 27


Target
Magnitude
11.5
12
12.5
13
13.5
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
T-T0

30 - 31


Target
Magnitude
T-T0
11.5
12
12.5
13
13.5
0
1000
2000
3000
4000
5000
6000
7000

31 - 01


Target
Magnitude
T-T0
11.5
12
12.5
13
13.5
0
5000
10000
15000
20000
25000