

Reverberation Mapping Campaign: Bok Photometry

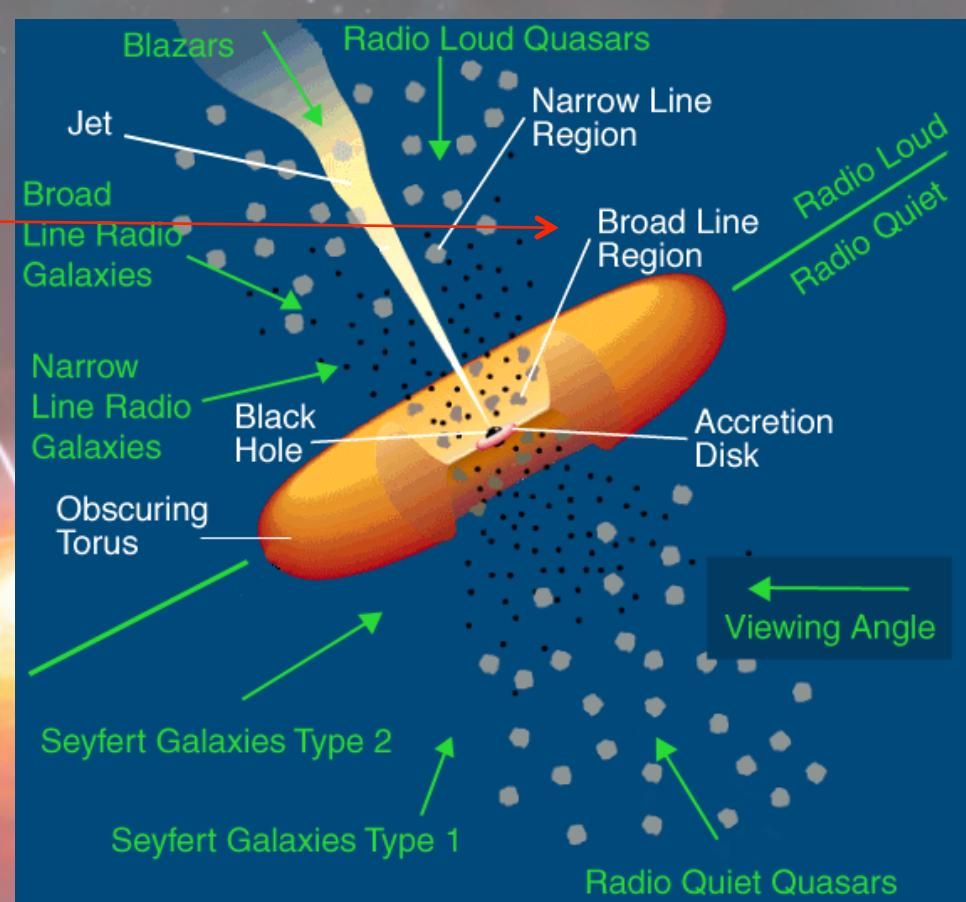
Yuguang Chen

Supervisor: Prof. Xiaohui Fan

Dr. Ian McGreer

Background Background

- The most recognized paradigm of AGN
 - Broad Line Region (BLR)



Background Background

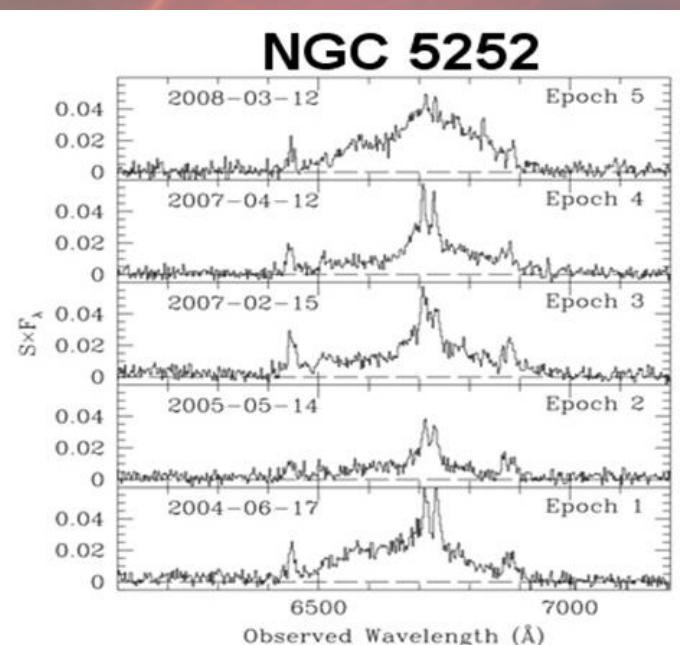
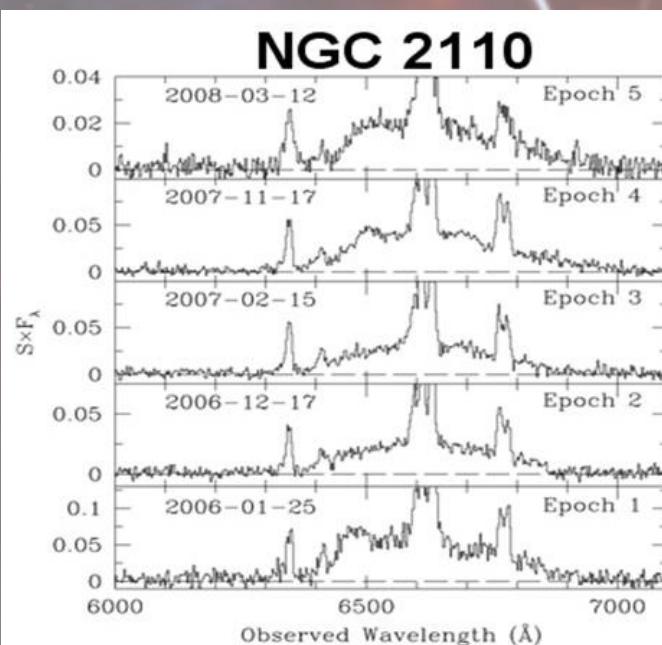
- **Broad Line Region**

- Powered by central emission
- Micro-arcsecond scale, spatially unresolved
- Disk-like structure

Physical structure & black hole mass?



Reverberation Mapping

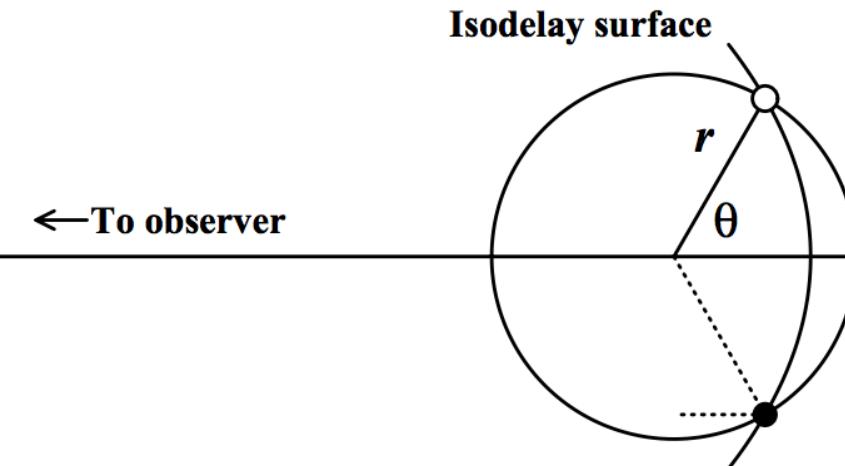


Background

Background

- **Reverberation Mapping**

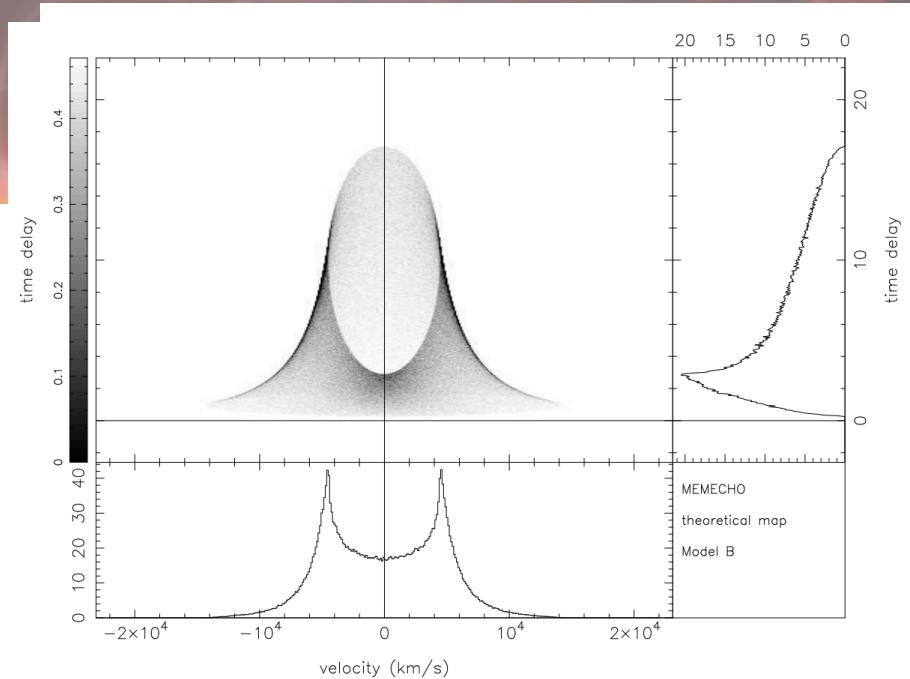
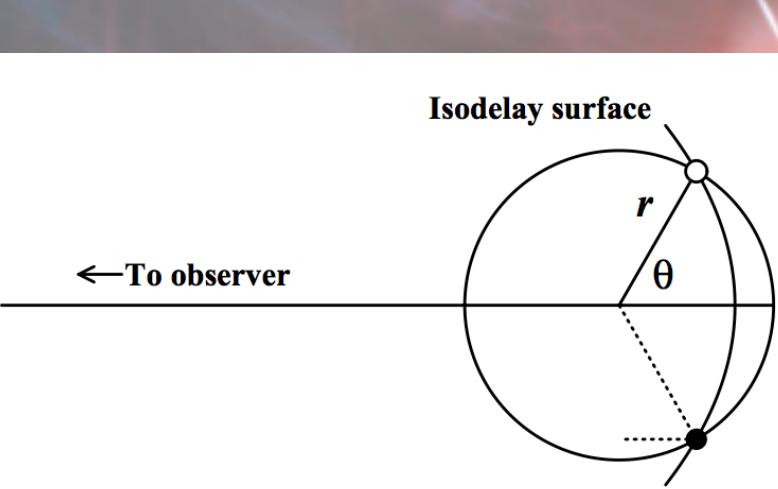
- Continuum originates from single central source
- Light travel time is most important



Background

L -- Broad line light curve
C -- Continuum light curve
 Φ -- Velocity-delay map

$$\Delta L(V, t) = \int \Phi(V, \tau) \Delta C(t - \tau) d\tau$$

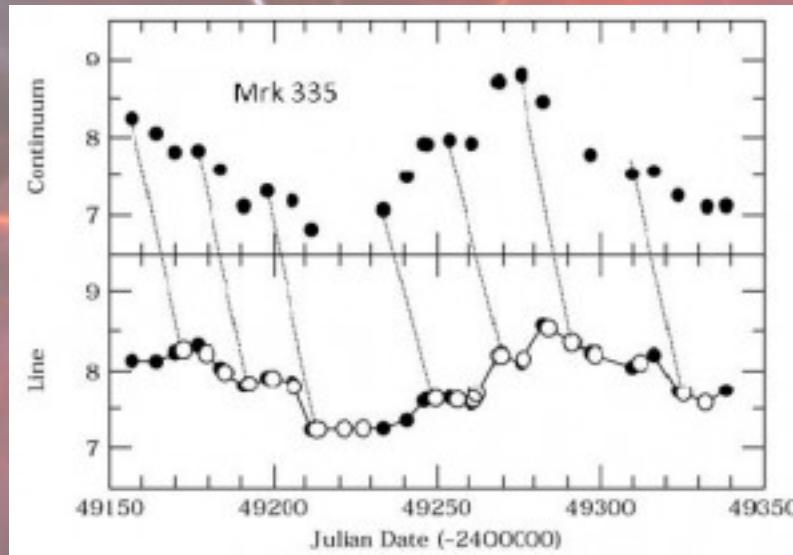


Background

Background

- Black Hole Mass

$$M_{BH} = \frac{fr\Delta V^2}{G} \approx \frac{fc\tau\Delta V^2}{G}$$



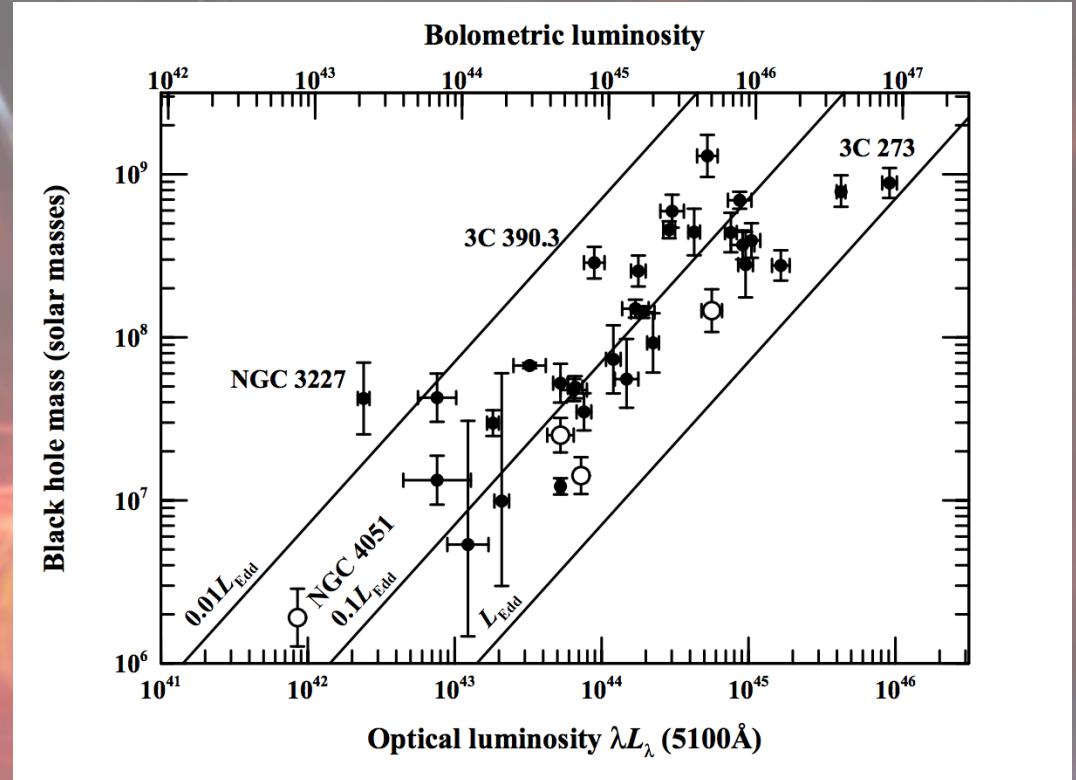
Background

- Single-Epoch Method (SE)

- < 50 AGNs, $z < 0.3$



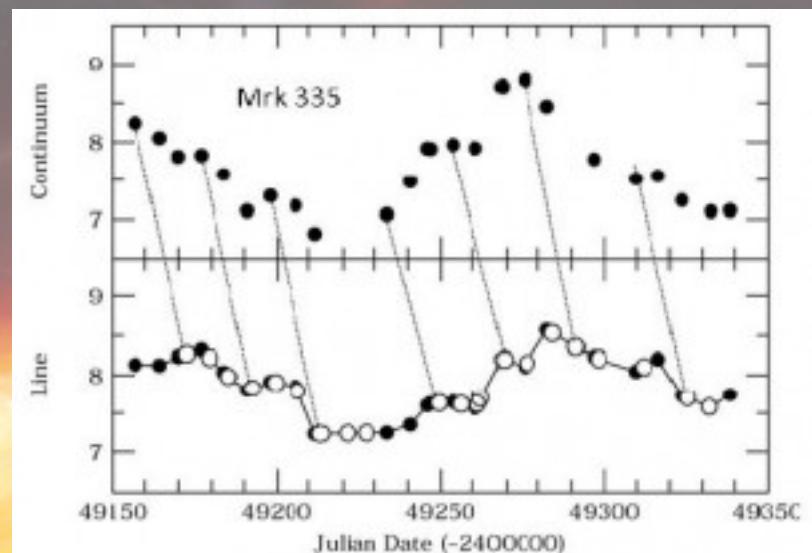
- ~ 850 AGNs, $0 < z < 5$
- No pre-selection
- 1st systematic study on Mg II at $z > 0.9$ (also significant for C IV)



Background

• Usage of Photometry

- Critical component of RM
- Precise continuum flux
- Increase spectrophotometric accuracy
- Provide more data points



Observation

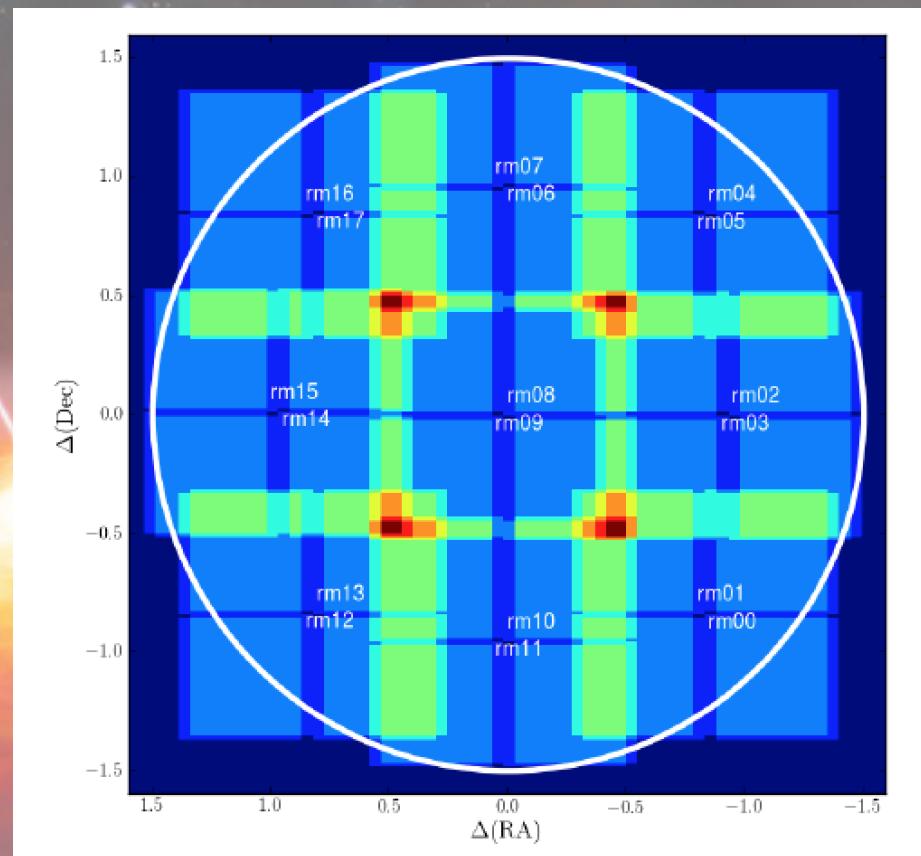
OBSERVATION

- Telescope: Bok – 2.3m
- Instrument: 90Prime
 - Totally ~75 nights from Dec 2014 to July 2014
 - Personally observed ~25 nights (PI for 5 nights)



Observation

- 7 square degree field
- i and g band imaging
- S/N \sim 15 at i=22



Data Reduction

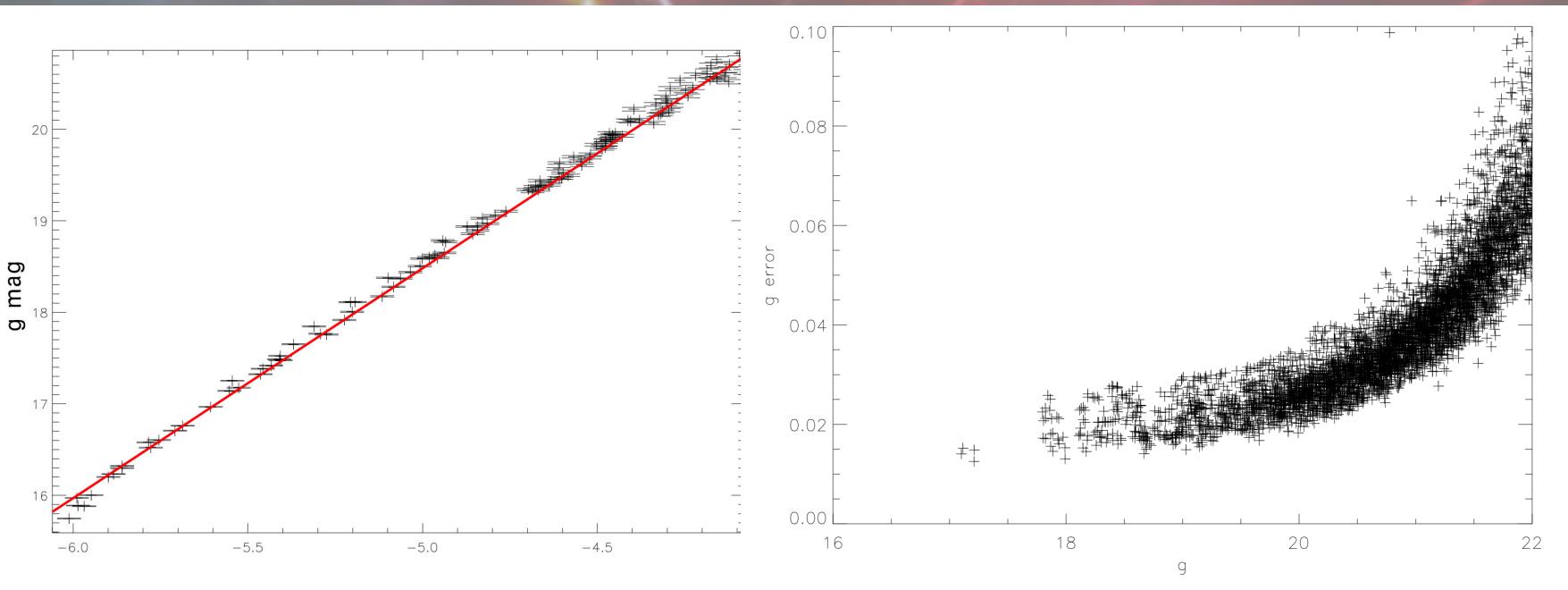
• Modification of Pipeline

Year modified	2009	2014
by	Linhu Jiang	Yuguang Chen
Astrometry RMS	~0.25''	~0.15''
Utilities	Bias, dome flats, mask, sky background, fringing, astrometry, psf photometry	+ super flat, aperture photometry , zero point, seeing
External callings	SExtractor, SCAMP	Only SExtractor
Database for calibration	SDSS	UCAC4, SDSS
Speed	Fast at image processing, slow at astrometry (SCAMP)	Slow at image processing (super flat), fast at astrometry
Collimation tolerance	Infinite	Set to 500 pixels to accelerate

Data Reduction

- Photometric Calibration

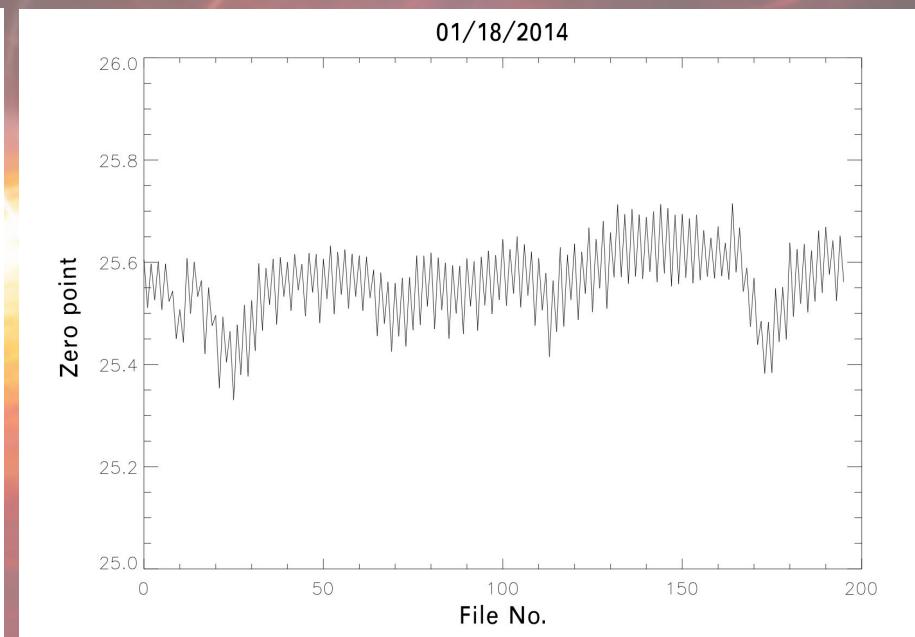
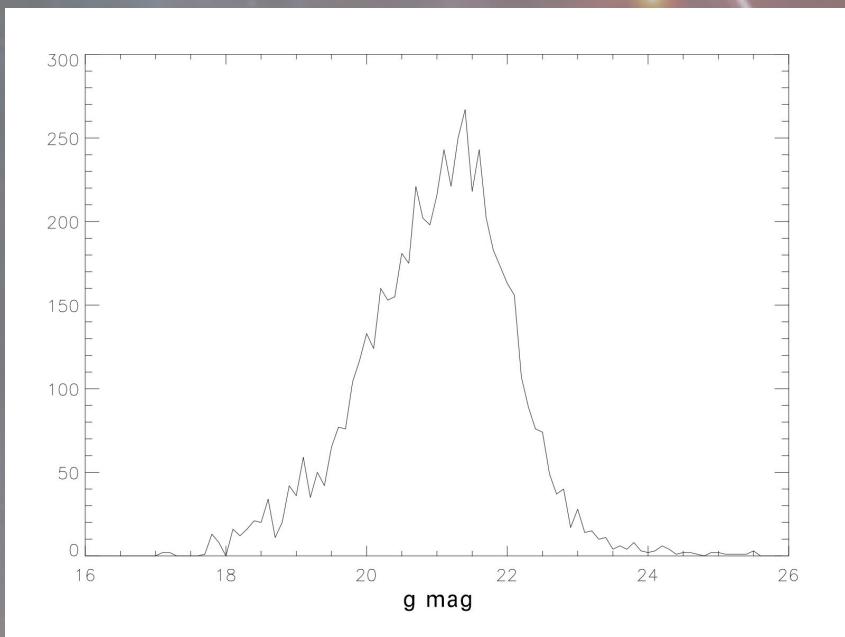
- RMS ~ 0.07



Data Reduction

• Photometric Calibration

- Most of the targets: $g \sim 21$
- Zero point at photometric nights: 25.6 (g), 25.1 (i)



Future Works

LARALE MOLK?

- Improve some details of the **pipeline**. (Current:
FITS header, aperture size)
- Get **all** observations reduced
- Get the **light curve**
- Find a good way to **merge** images of close
observations





Thanks!

