

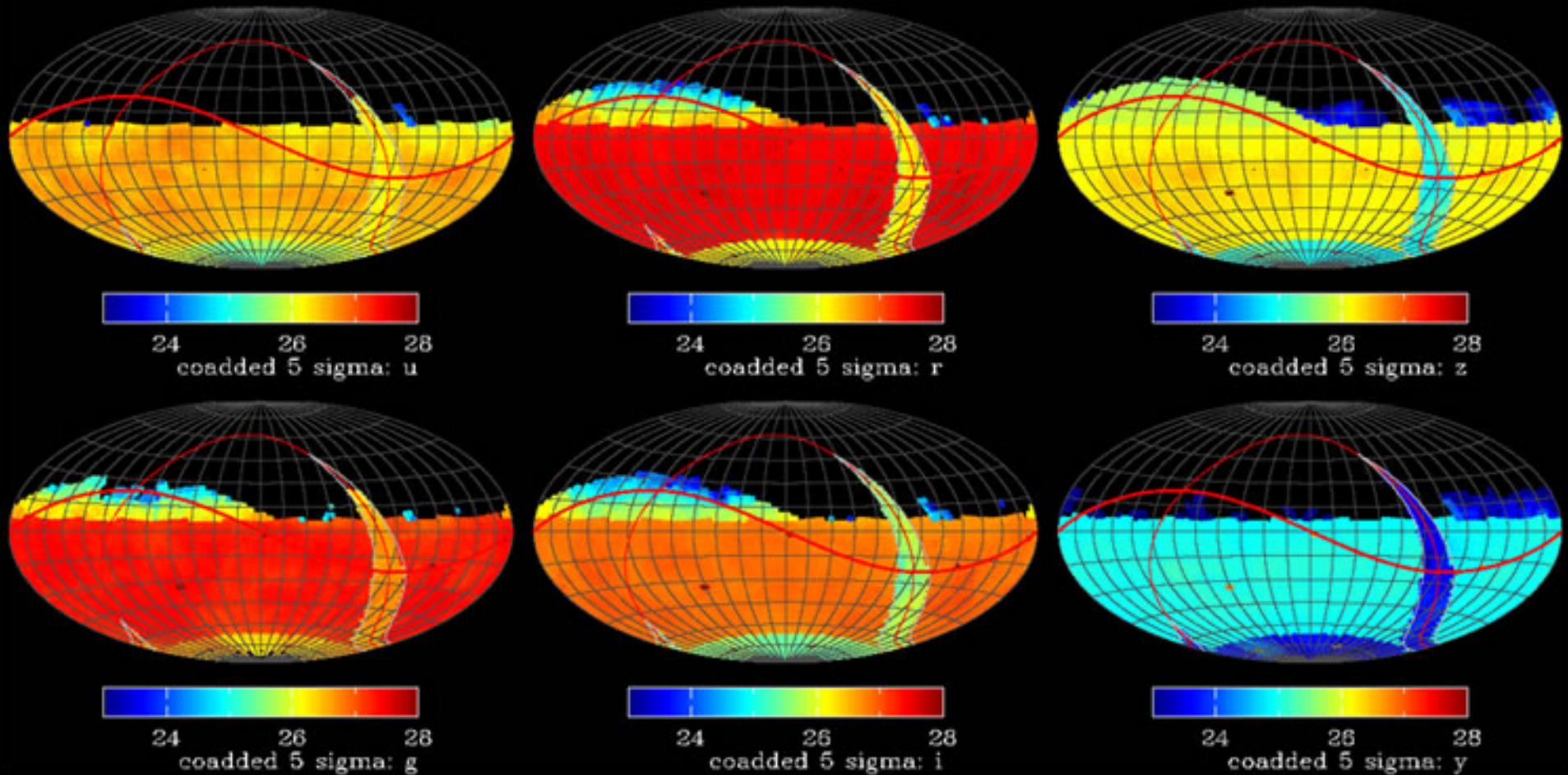
The LSST Contribution to a Temporal, Multi-Wavelength View of the Sky

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A Uniform Sky Survey

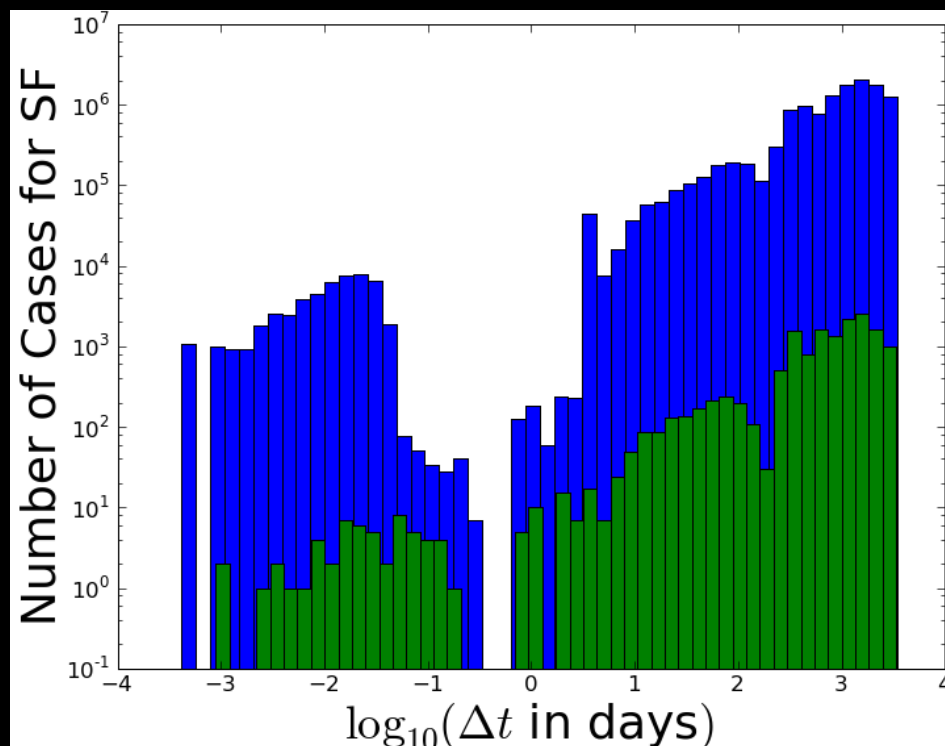
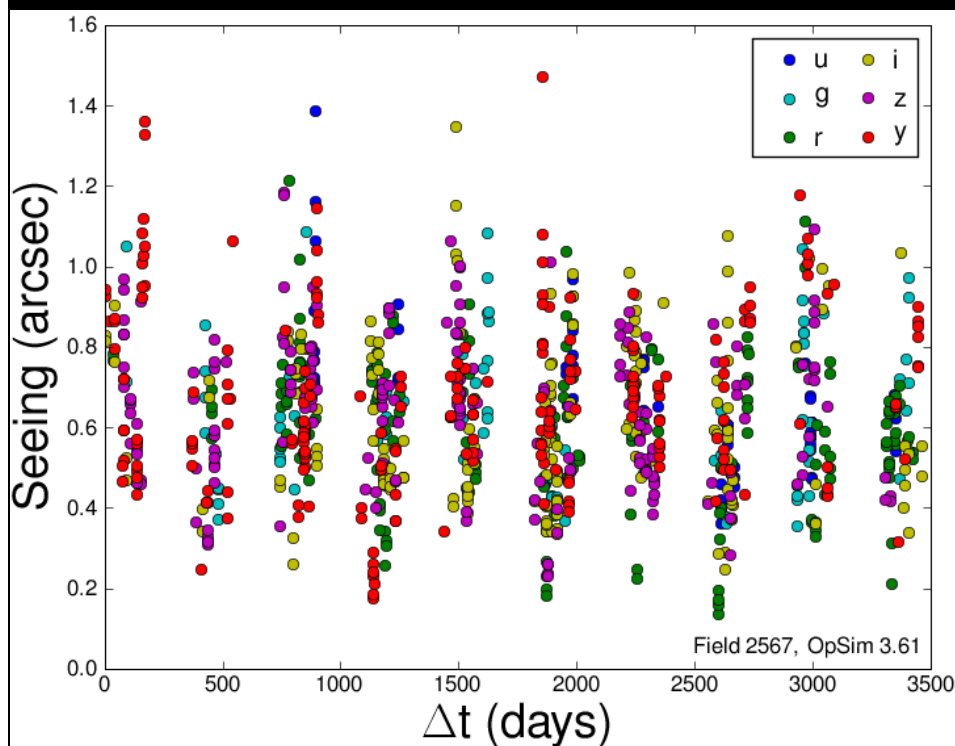
- 90% of time for a uniform survey: every 3-4 nights, the whole observable sky will be scanned
- Over 10 years, half of the sky will be imaged about 1000 times (ugrizy)
- About 100 PB of data, including a billion 16 Mpix images
- Optical catalogs
- Find optical counterparts, morphology, neighbors
- Rapidly alert on transients
- Ten-year histories
- Deep drilling fields

LSST Deep-Wide Survey



- Main survey: about 20,000 deg² to depth u: 26.5 g: 27.4 r: 27.5 i: 26.9 z: 26.1 y: 24.9

LSST Cadence

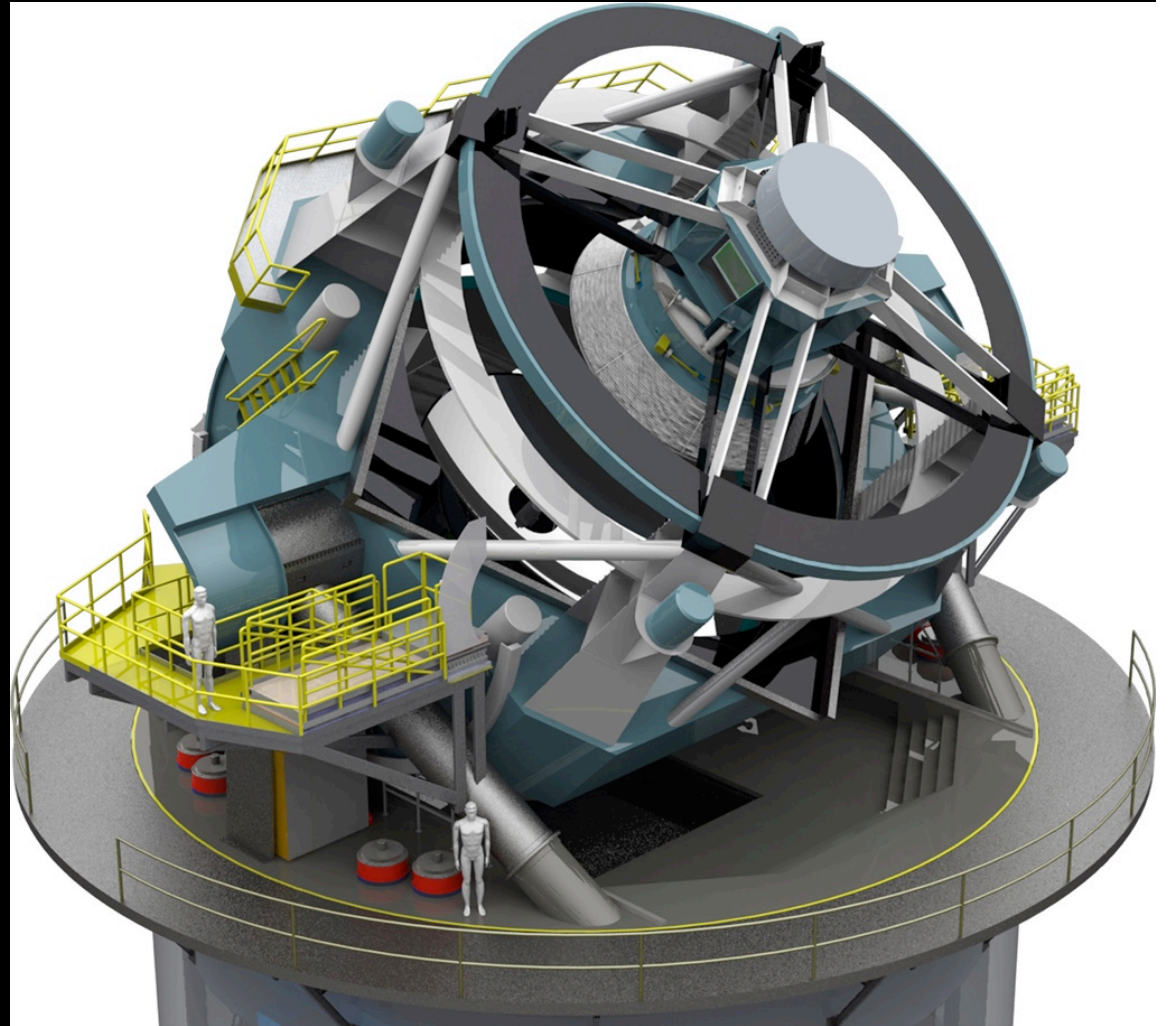


- Sample LSST schedule for entire 10-year survey, about 1000 visits per field

- Normal fields sampled over hours, days, years
- Deep-drill sampling on minutes to hours as well; feedback needed on cadence?

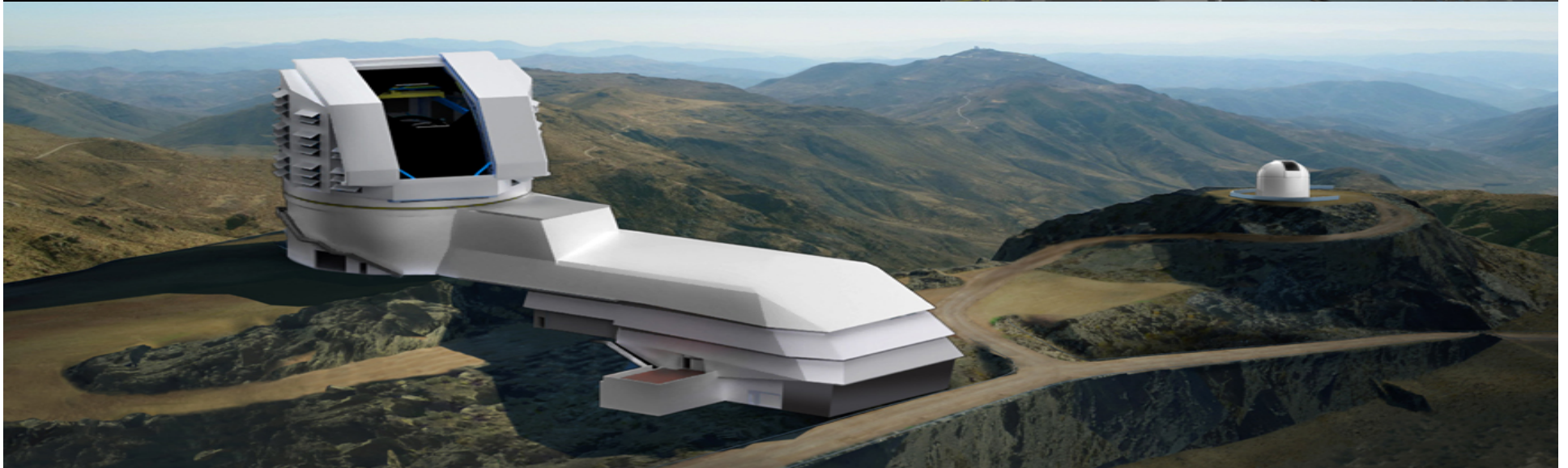
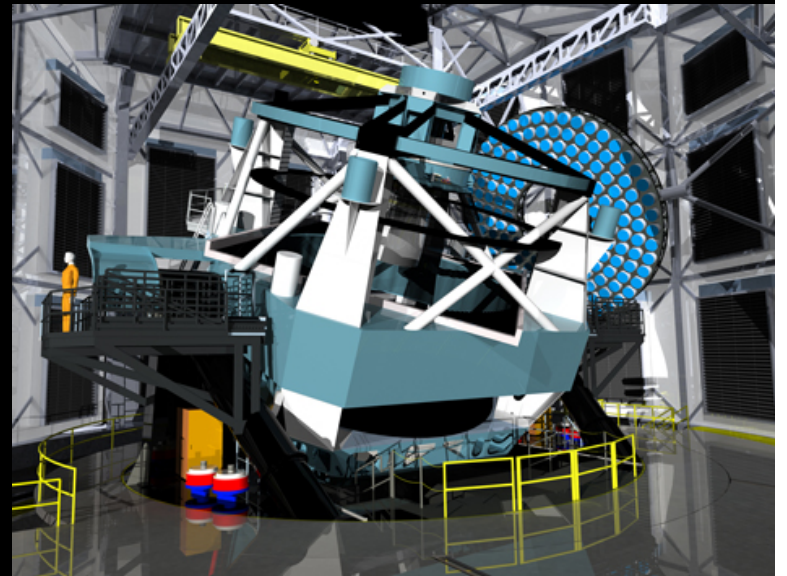
System Characteristics

- Large primary mirror to go faint and enable short exposures (30s)
- Agile telescope (5 sec for slew and settle)
- Large field of view to enable fast surveying
- Excellent image quality
- Camera with 3200 Mpix
- Sophisticated software (20 TB/night, 20 billion objects, 20 trillion measurements)



Calibration

- Dome projector
- Auxiliary telescope for atmospheric effects
- Self-cal solver tying together stars across the sky



Already Making an Impact...



LSST-webcam 2 2011-03-08 12:56:02



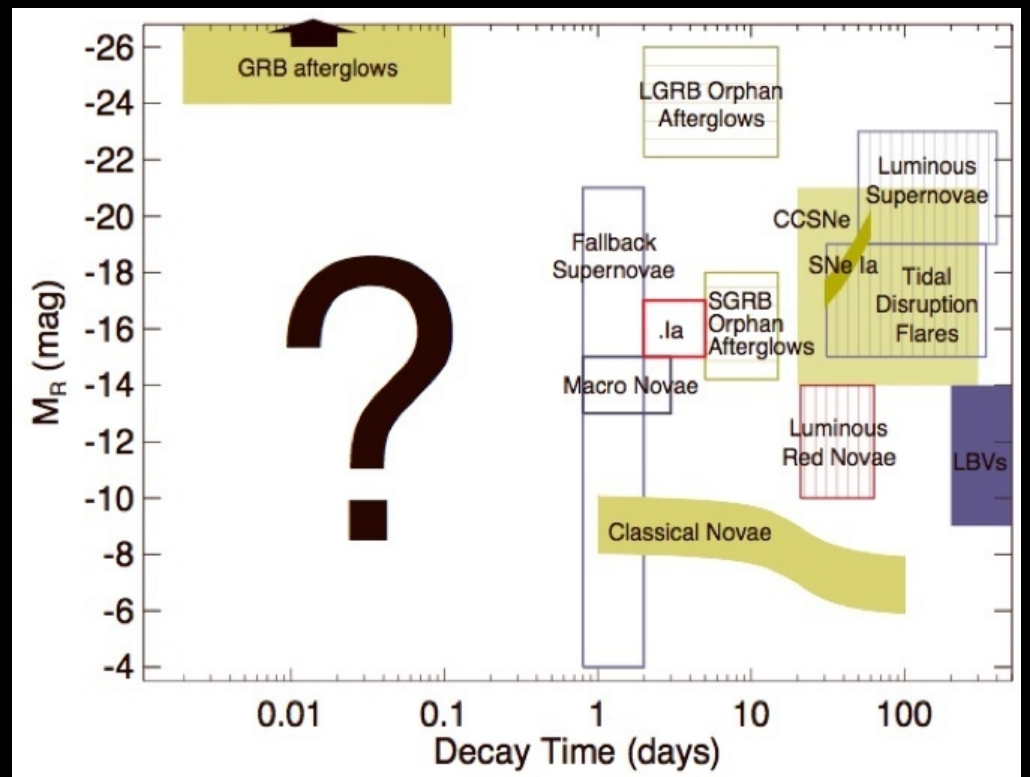
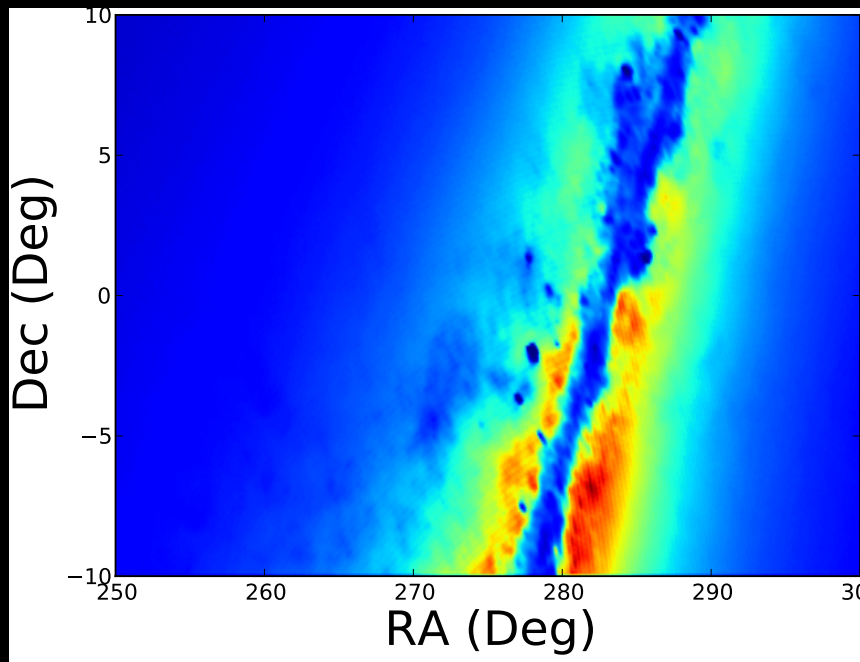
El Penon: Mar 8, 2011

At 8:56:00 the first blast was detonated on the El Penon summit in preparation for the LSST...

LSST CCD, No Background



Stars

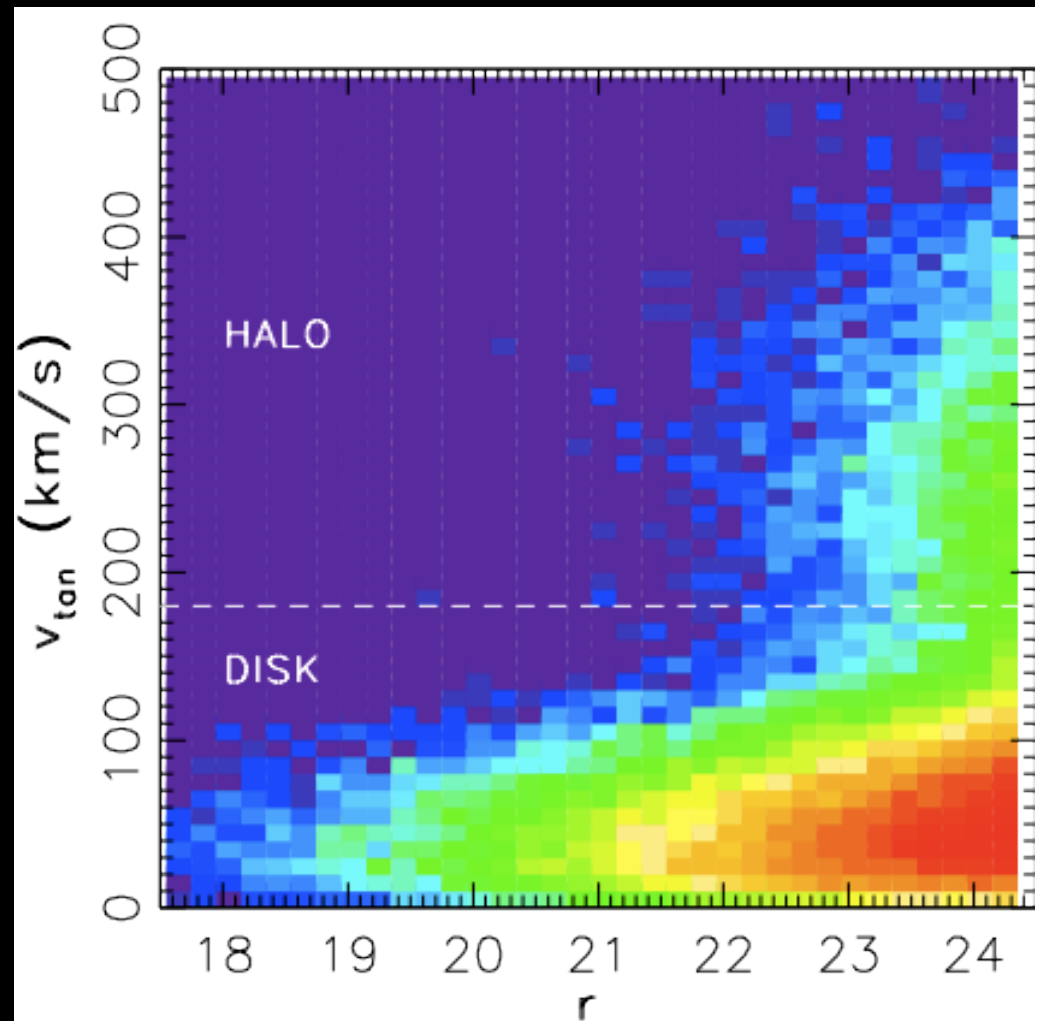


- LSST can “see” 10 times as far as SDSS over 2x the area

- 10 billion stars, with time-domain information

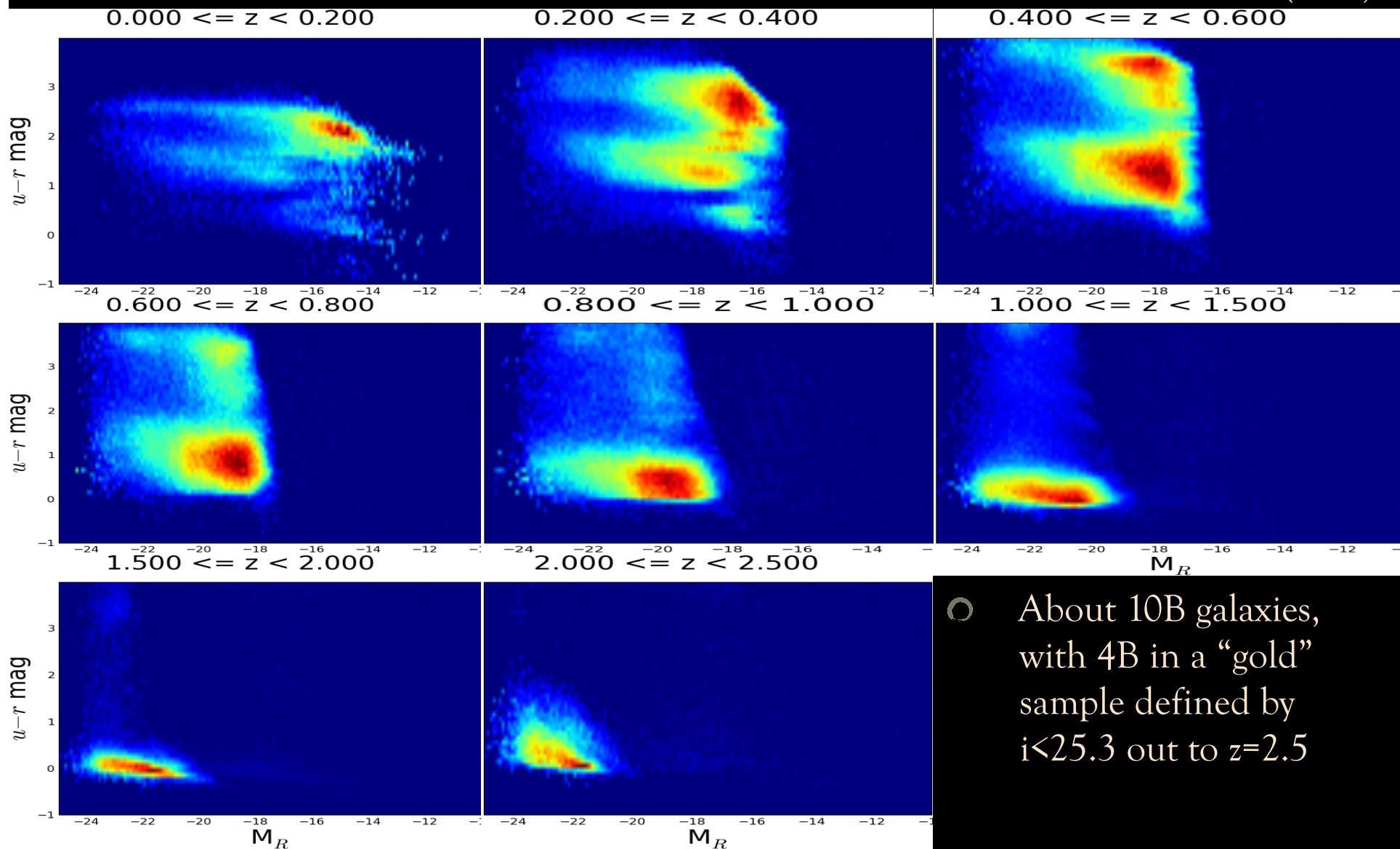
“Dwarfs” and RR Ly

- About 400,000 halo WDs, 10M total
- 200,000 L-dwarfs and 2400 T-dwarfs with 5σ proper motion and parallax
- RR Ly out to 400 kpc, or 4 times the current distance limit



Galaxies

Derived from
De Lucia et al. (2006)



○ About 10B galaxies,
with 4B in a “gold”
sample defined by
 $i < 25.3$ out to $z = 2.5$

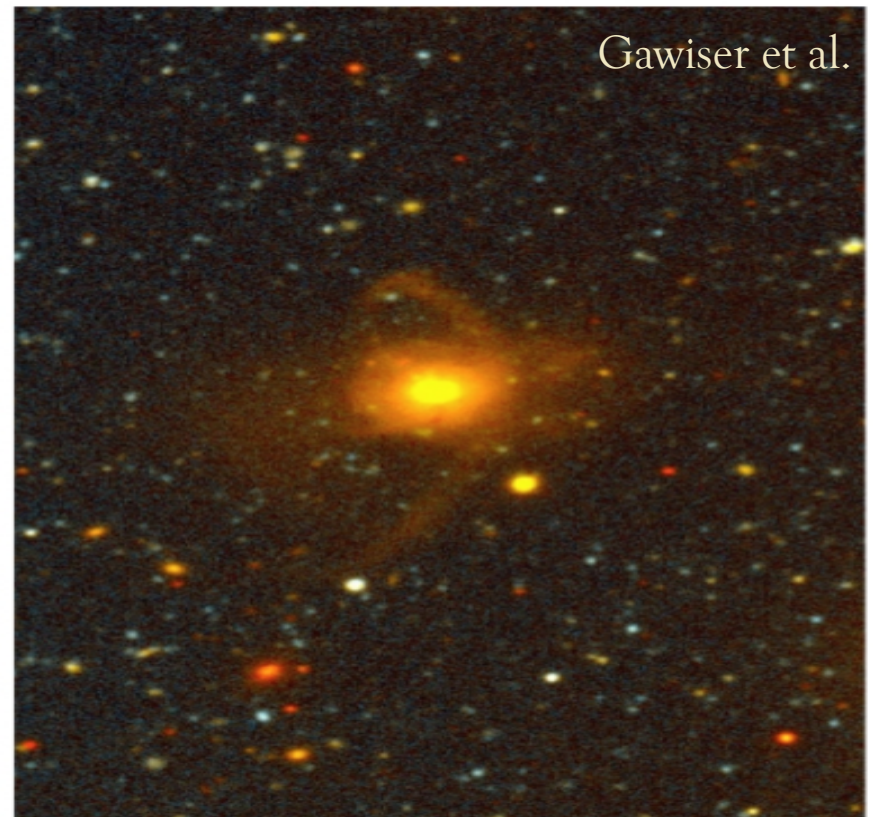
Galaxy Morphology

- Example: SDSS vs. MUSYC UVR images of $z=0.1$ galaxy revealing recent interaction

SDSS

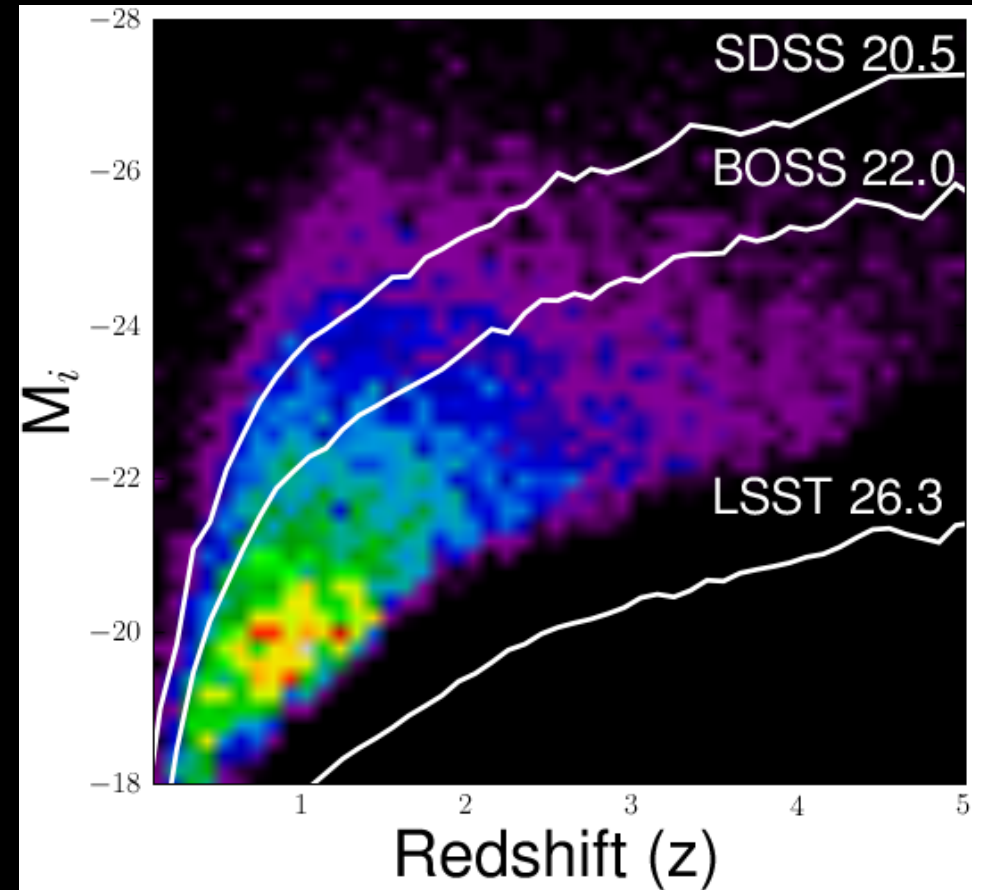


MUSYC

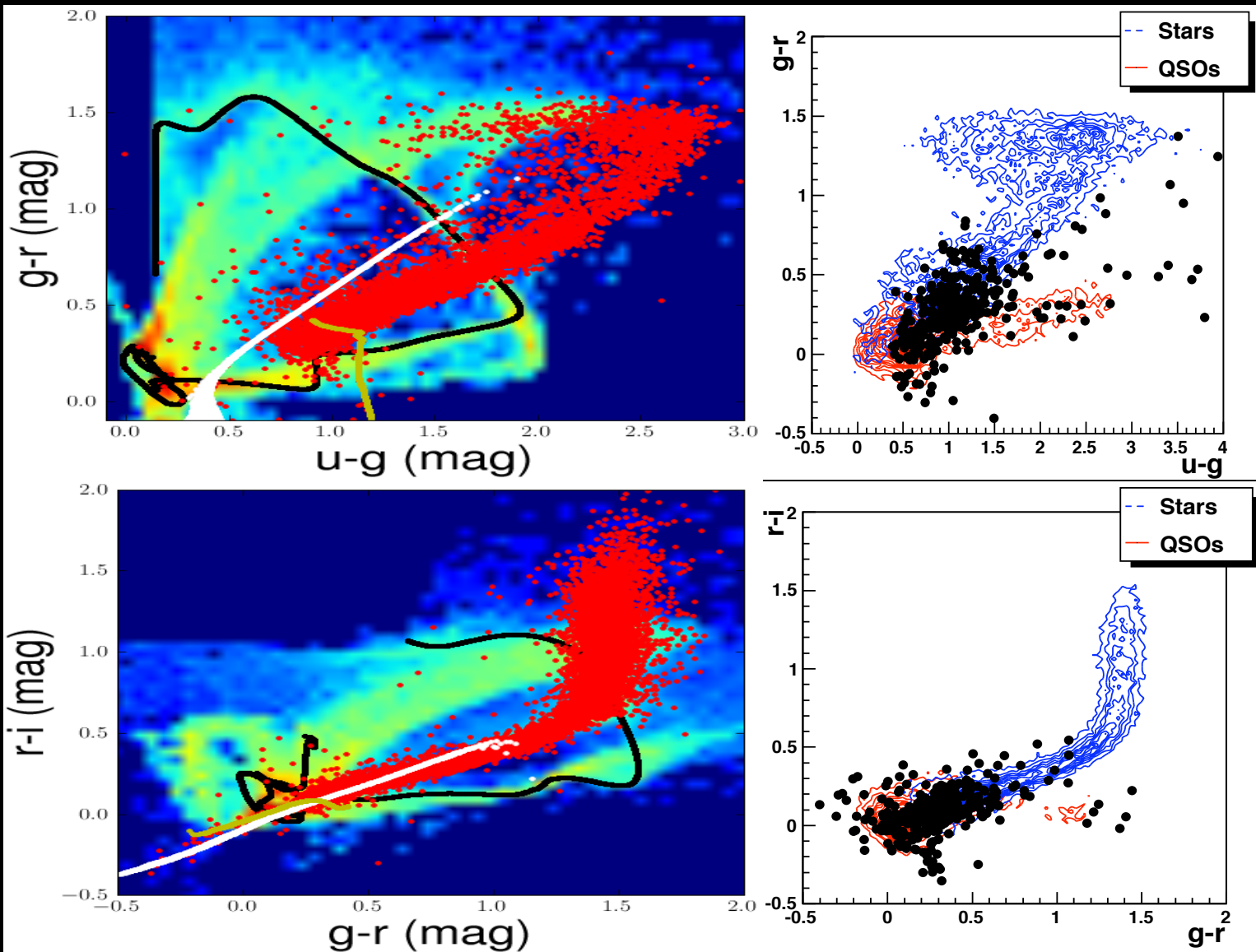


Quasars and AGN

- About 10 million *quasars* will be discovered using variability, colors, and the lack of proper motions
- The sample will include $M_i = -23$ objects even at redshifts beyond 3
- Variability studies will be based on millions of light curves with 1000 observations over 10 yrs



Var-Selection in Stellar Locus



Palanque-Deslaurier et al. (2011)

Difference Imaging

2385: 06/15/2001



4849: 09/22/2004



5781: 10/27/2005



6430: 10/03/2006



7188: 11/21/2007



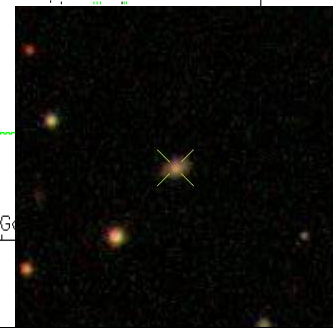
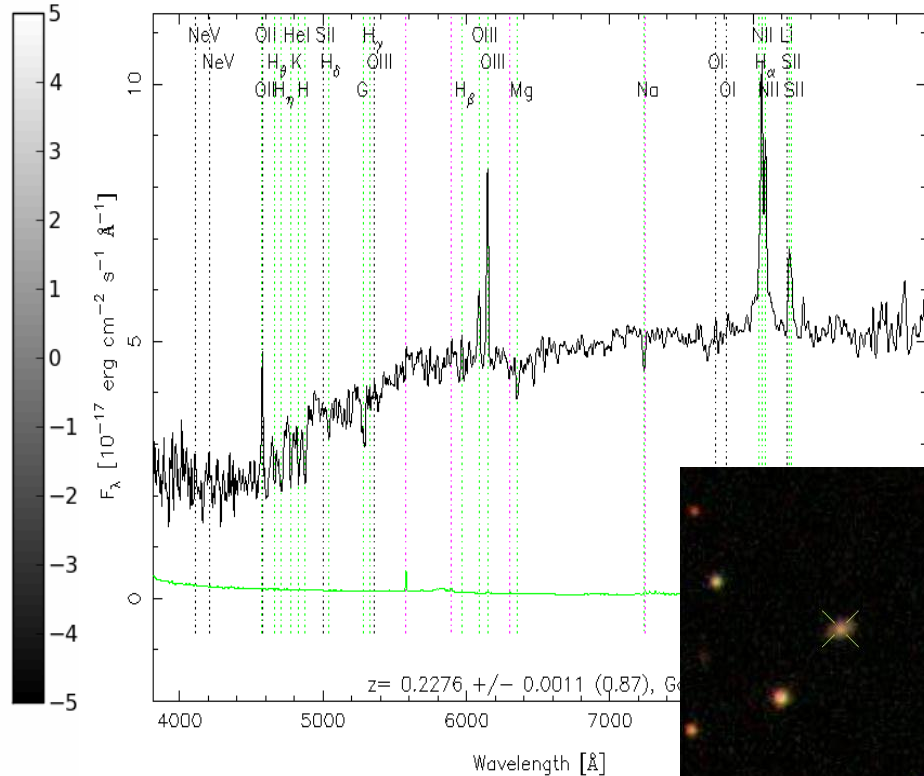
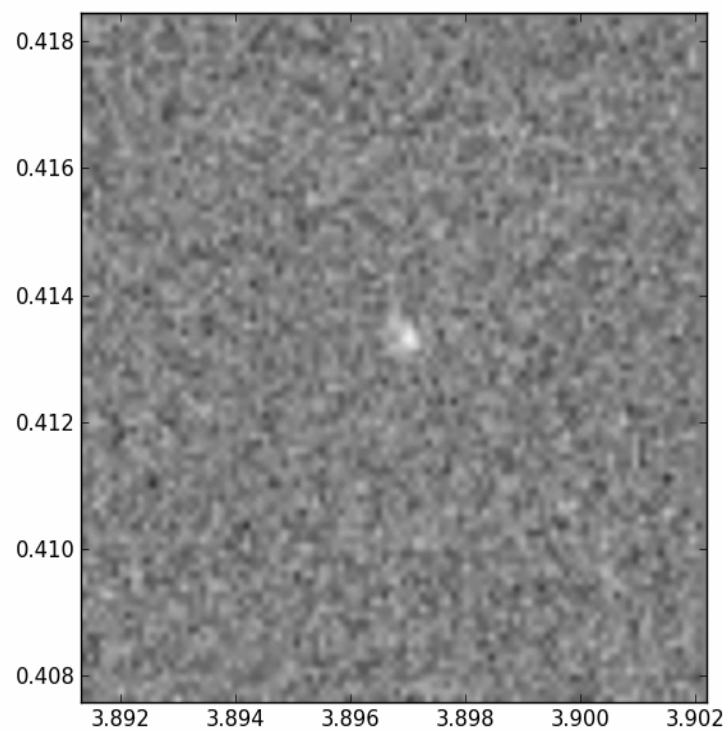
Coadded Template



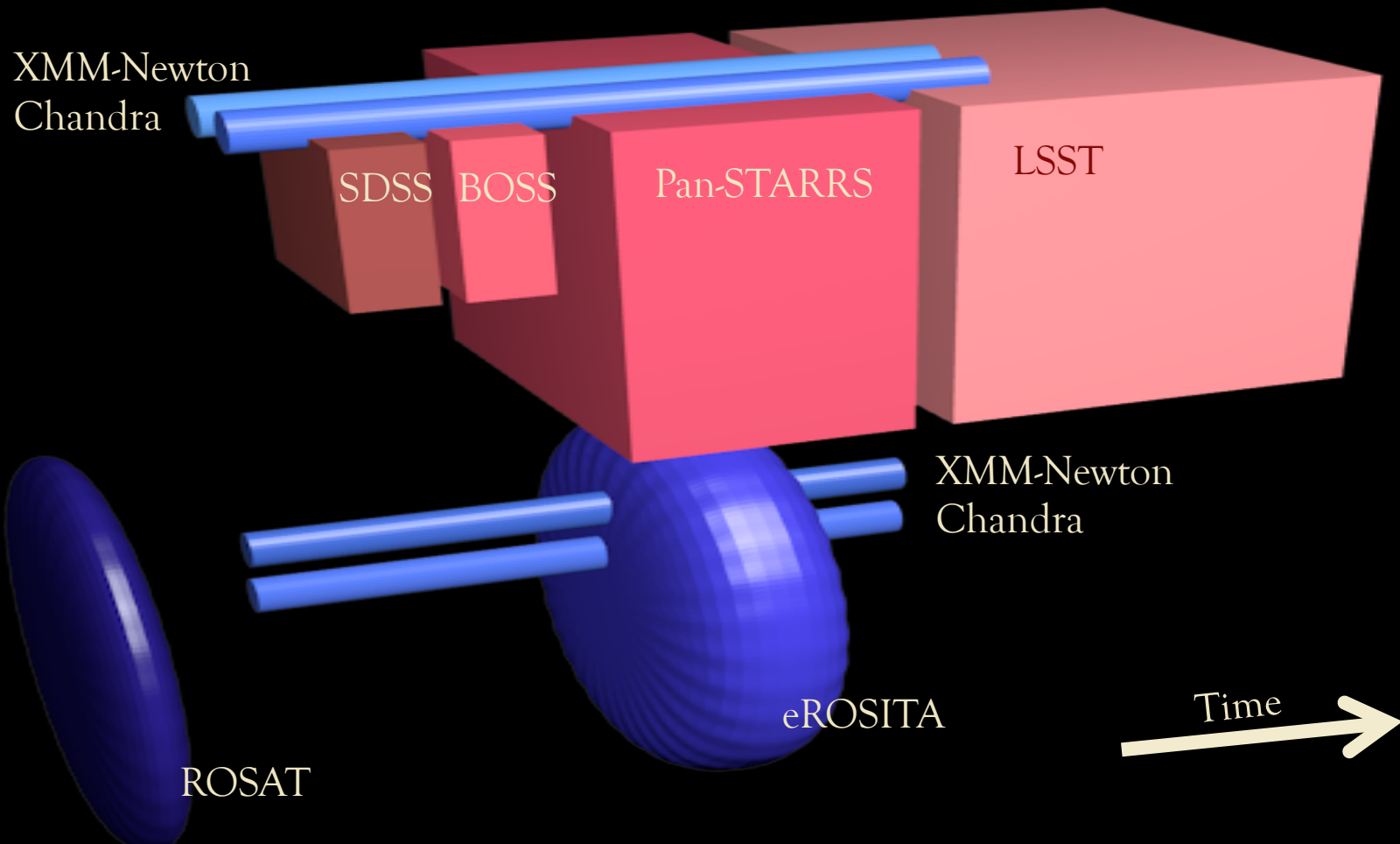
AGN in Host Galaxies

004128 0149 g 4, pow: 1.00, sm

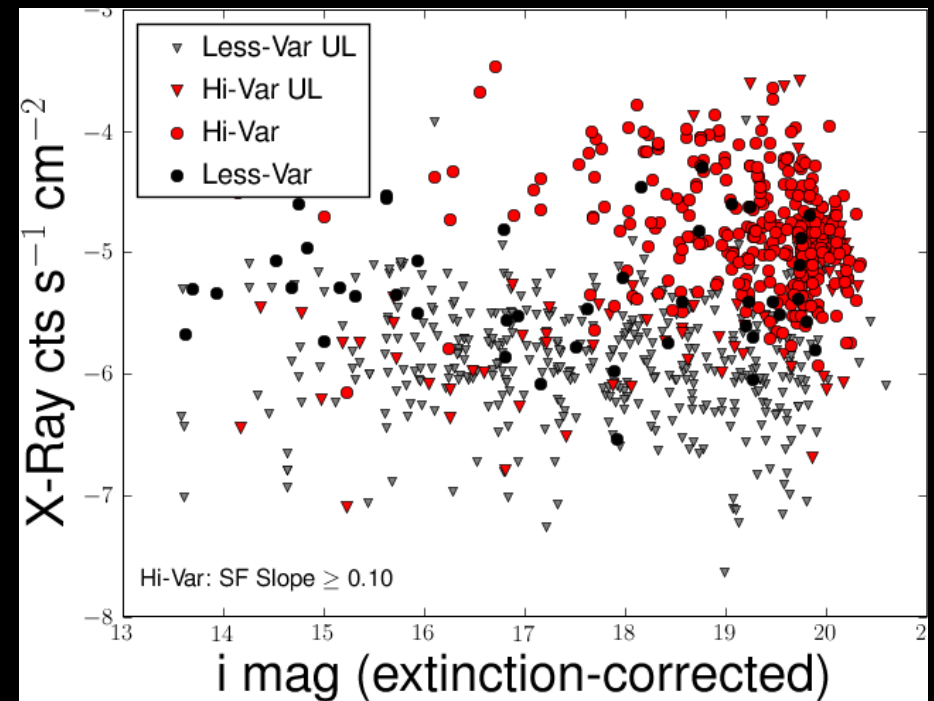
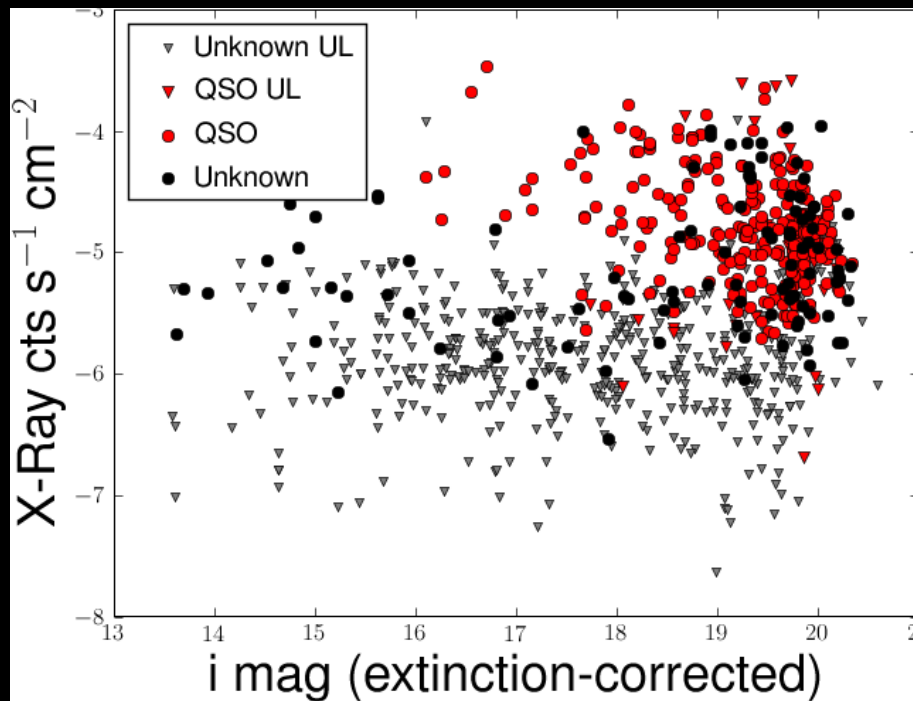
RA= 3.89698, DEC= 0.41318, MJD=51795, Plate= 389, Fiber=482



An Era of Surveys



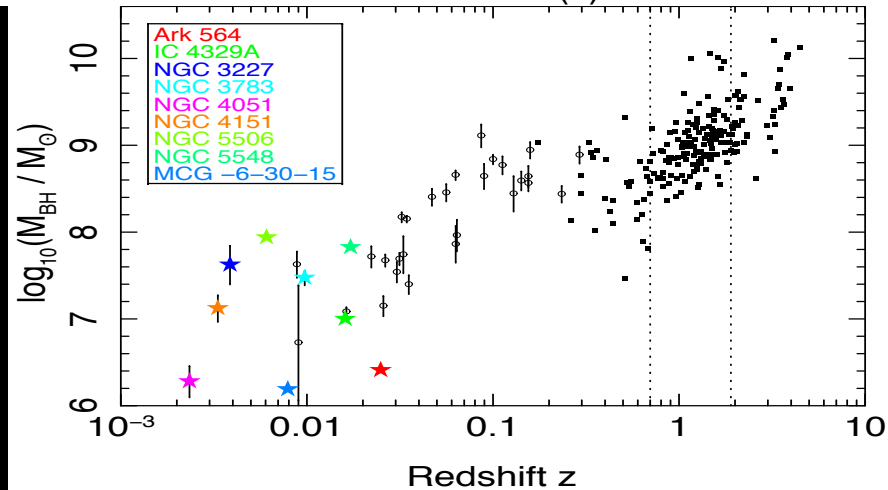
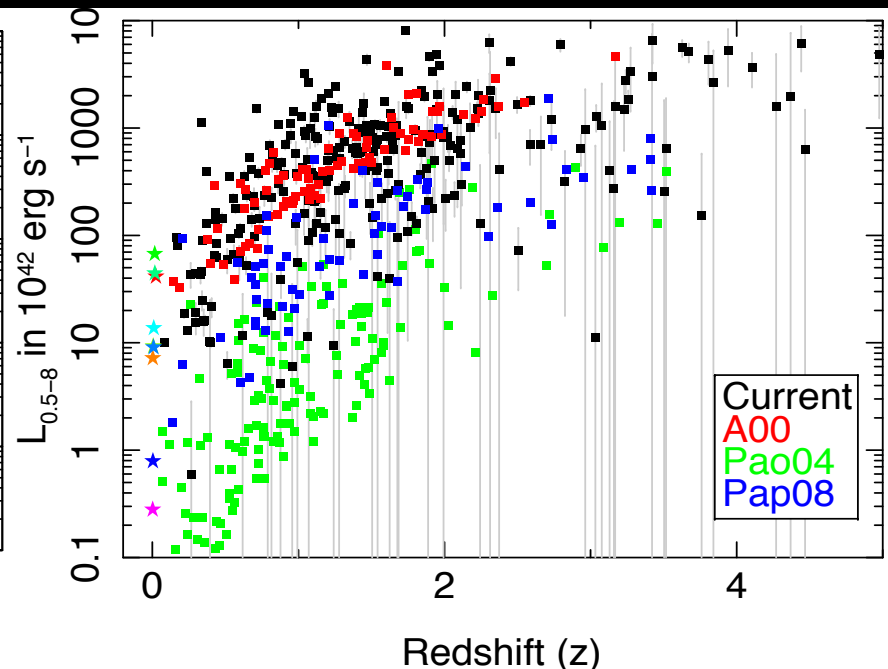
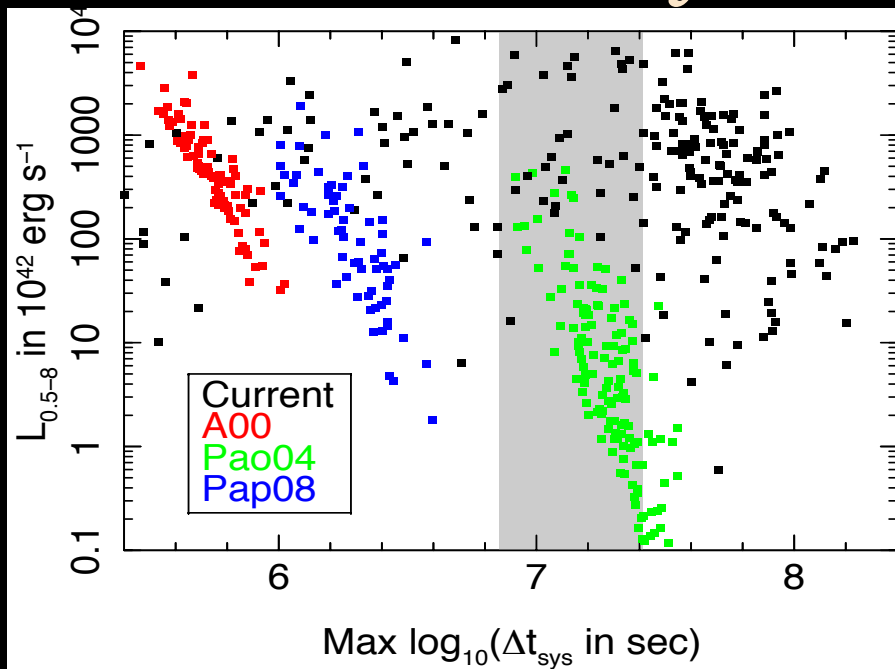
X-Rays Complement Optical Var



Y. Choi et al. in prep.

- Known spectroscopic DR7 quasars in red; X-ray detections in black
- Structure function slope ≥ 0.1 in red; smaller slopes in black

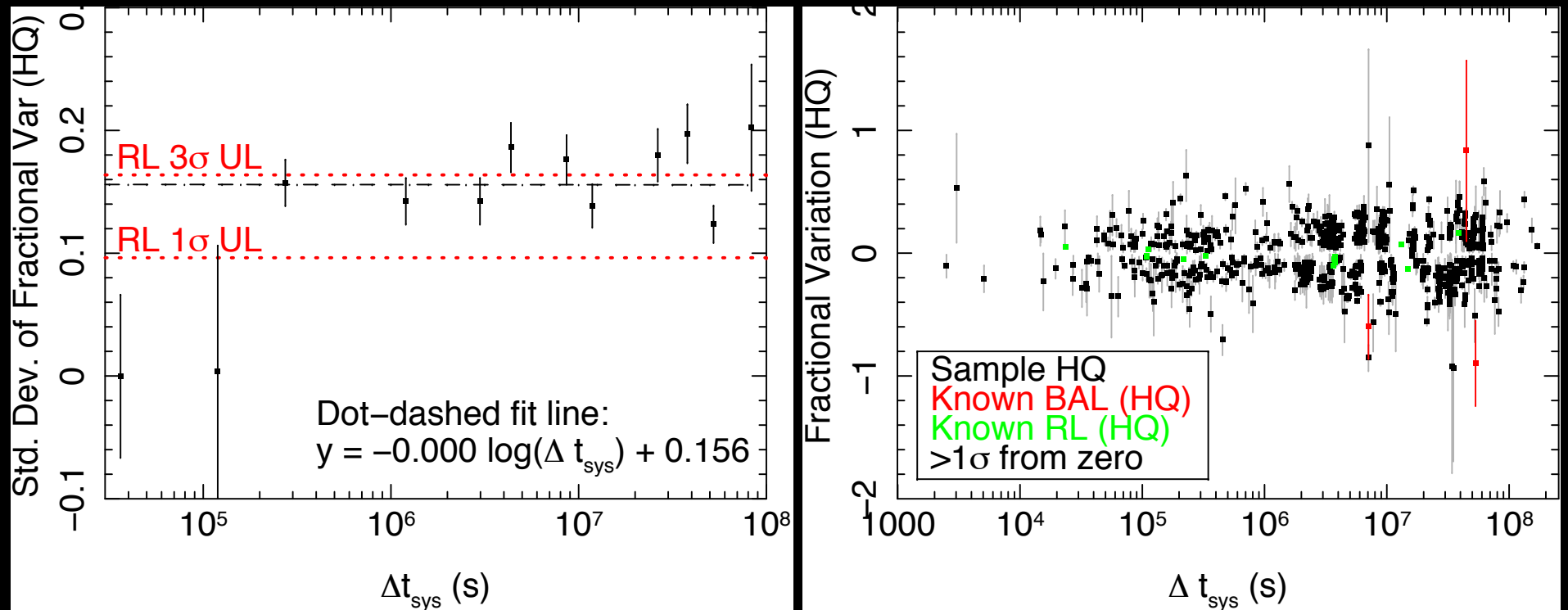
Growing Reach of Archives in *X-Ray Time-Domain*



- *Chandra* archives explore Δt , luminosity, redshift, M_{BH} space for serendipitous sources

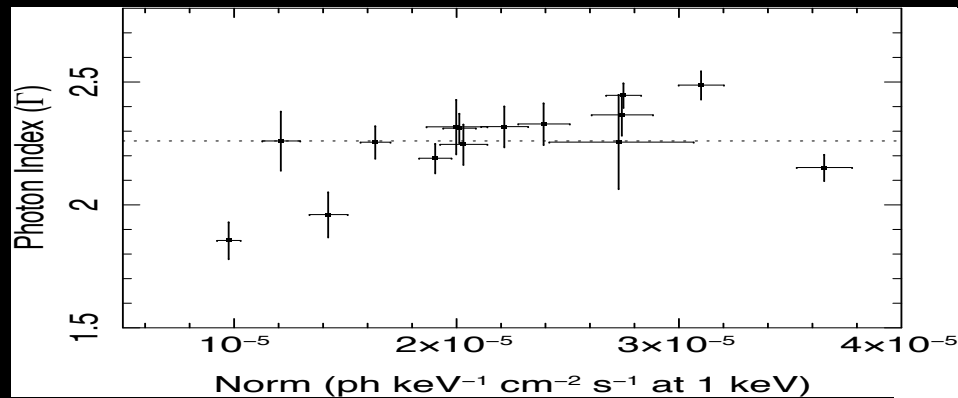
Gibson & Brandt (2011)

X-Ray Variation of Quasars



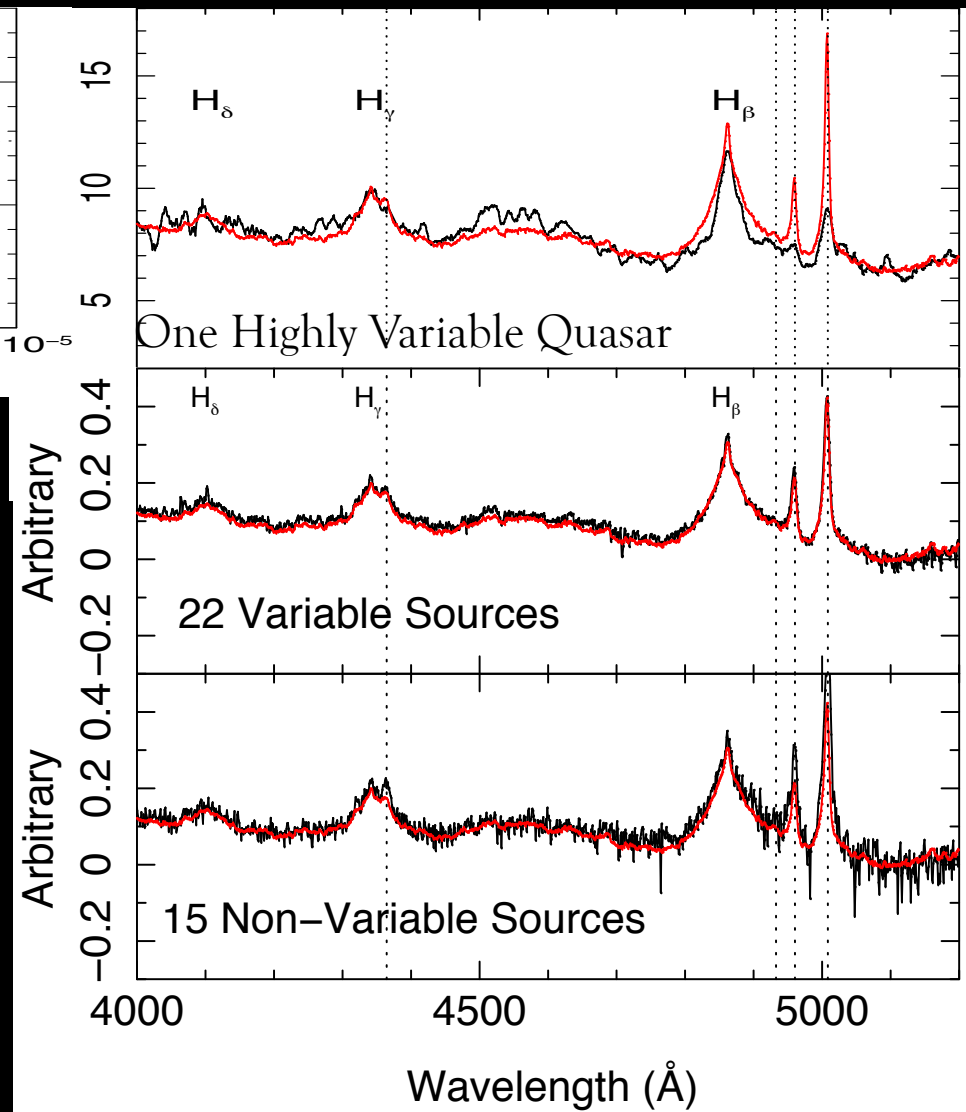
Gibson & Brandt (2011)

X-Ray and BLR/NLR Connections?



Gibson & Brandt (2011)

- X-ray variation may be related to Eigenvector 1 and/or optical emission properties



Time-Domain, Multiwavelength

- There is a coming era of “survey convergence” that will map out the time domain in the optical and X-rays
- Where will we obtain the software expertise, network bandwidth, and processing resources to analyze large, multi-dimensional data sets?
- What physics underlies the X-ray (corona?) variation?
- How are X-ray emission and the NLR/BLR related?
- Do temporal properties evolve with redshift, host, or environment?
- How is optical emission related to M_{BH} , accretion rate, and other physics?
- Do luminous quasars and local Seyfert AGN vary similarly?
- Will new types of AGN be revealed by temporal selection and/or classification?