Time-Domain Quasar Selection

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Transients Classification (optical surveys!):

Variable Stars, Collaborations w/ Stats People

Quasars, color-independent BAO Targeting
(Butler & Bloom 2010; arXiv:1008.3143)

Collaborators:

UCB Josh Bloom, Dan Starr, Dovi Poznanski (Astronomy),
John Rice, Joey Richards (Stats)

LBNL Nic Ross, Peter Nugent, David Schlegel

Center for Time-Domain Informatics
(UC Berkeley; http://cftd.info)

Josh Bloom (PI), cross-campus collaboration w/ Stats, Astronomy, Comp. Sci, etc.

Transients Classification Project (TCP)
(Bloom et al. 2008, Starr et al. 2008)

Time Series Features:

Simple: mean, variance, skewness, kurtosis, rise-time, etc.

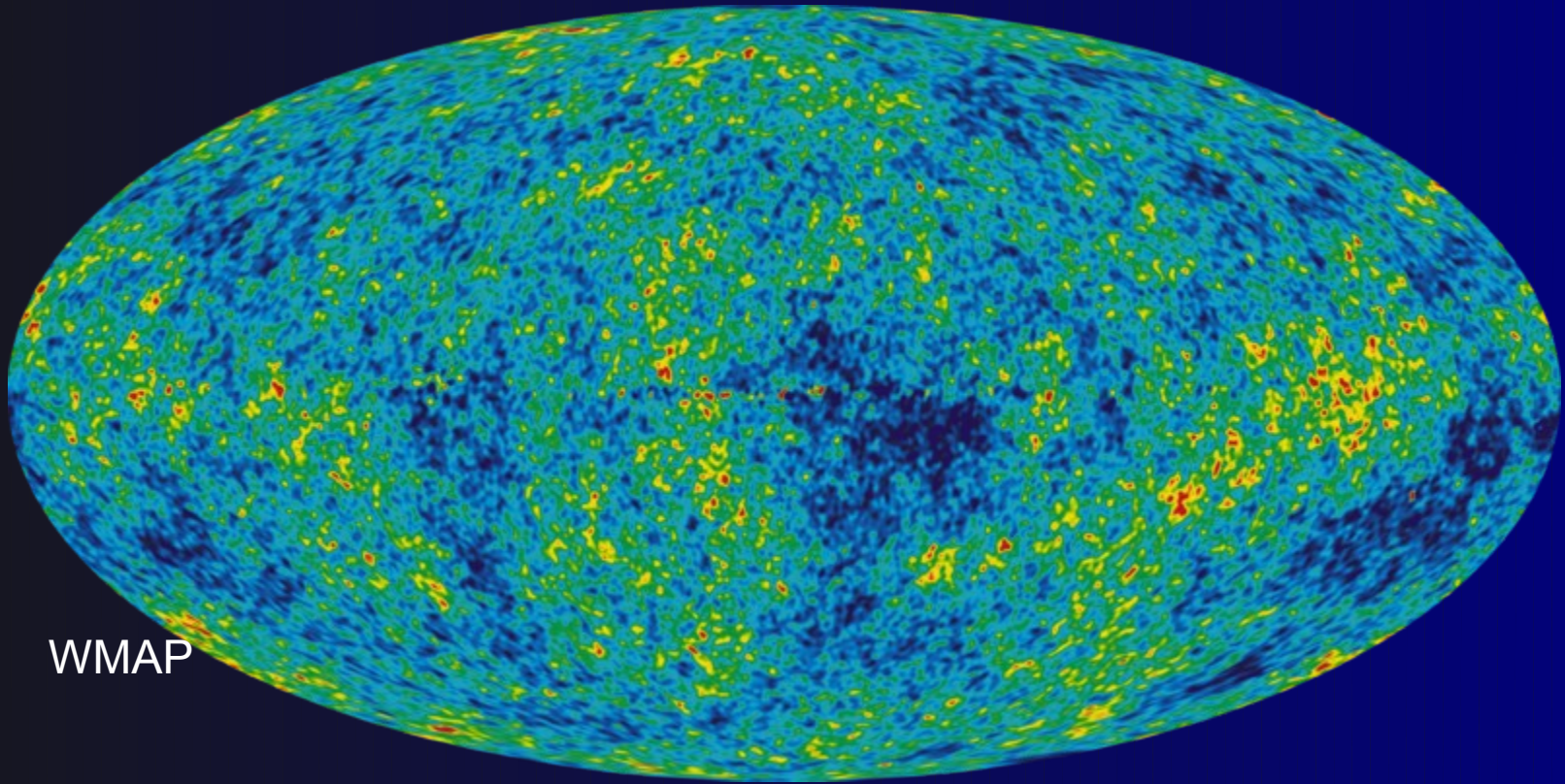Complex:
Fourier decomposition
Model fitting

More data -->

Context Features:

Position in Galaxy

Catalog Queries:
Nearby SDSS objects
and their properties
Nearby ROSAT objects
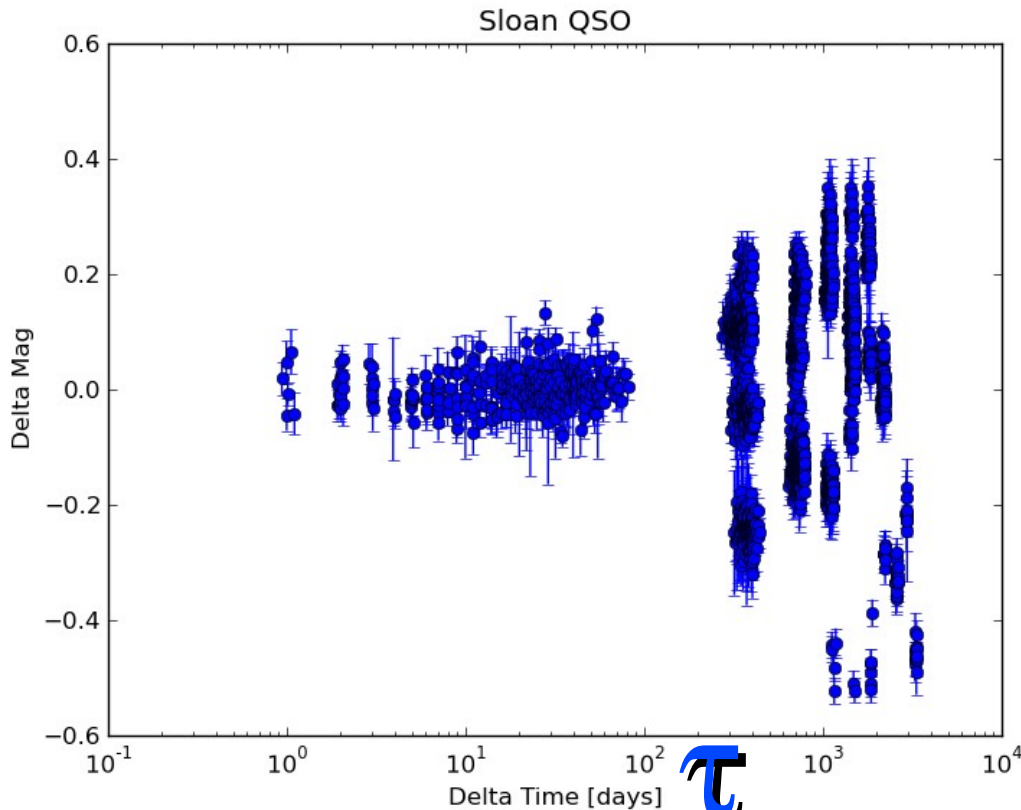
SDSS

Endgame: BAO Targets

WMAP

QSO Clustering measurements require targets at a variety of redshifts!
(e.g., Schlegel et al 2009)

Quasar Classification

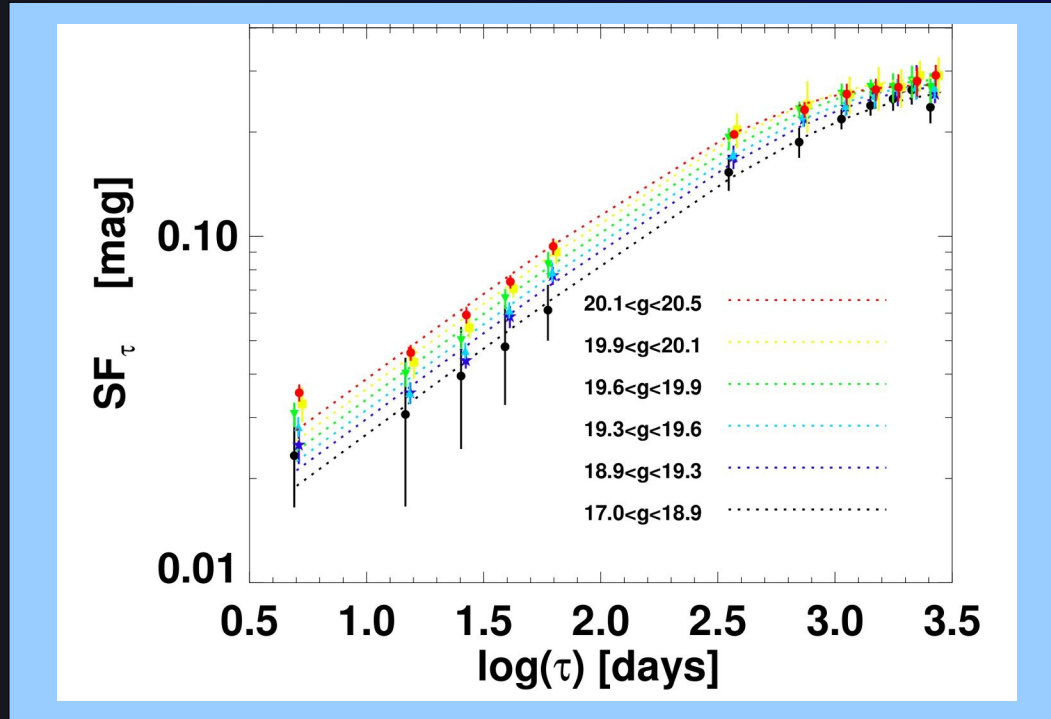*(Butler & Bloom 2010; arXiv:1008.3143; "Optimal Time-Series Selection of Quasars")*

Model the Lightcurves.

Evaluate Likelihood $P(\Delta m | \tau)$.

Classify based on few epochs.

SDSS Stripe 82 "Structure Func."
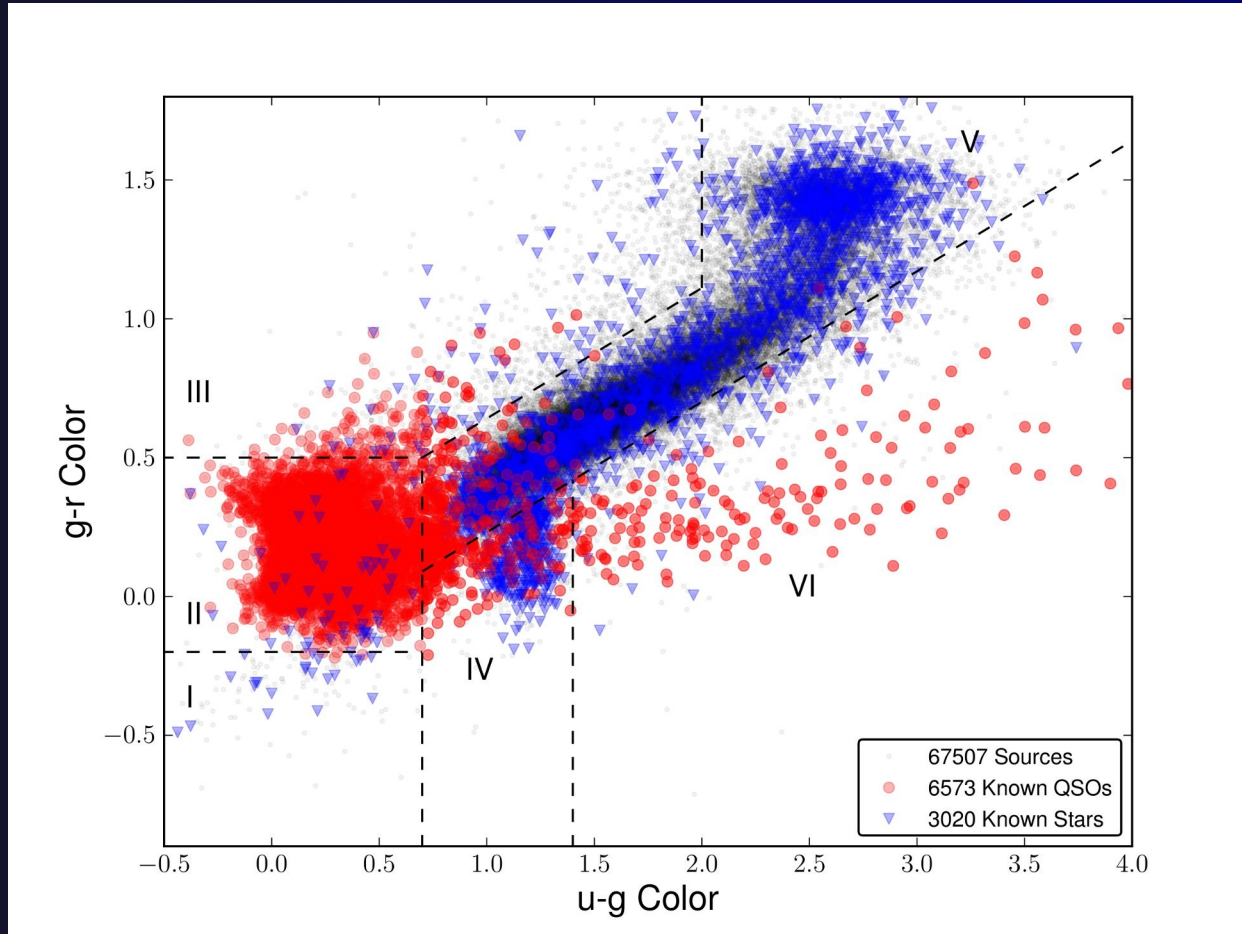
(Butler & Bloom 2010)

Exploit QSO "structure"

Model as damped random walk to get $P(\Delta m | \tau)$.

$$SF_\tau \propto \hat{\sigma} \tau_\circ^{1/2} [1 - \exp\left(-\tau_{ij}/\tau_\circ)\right)]^{1/2}$$
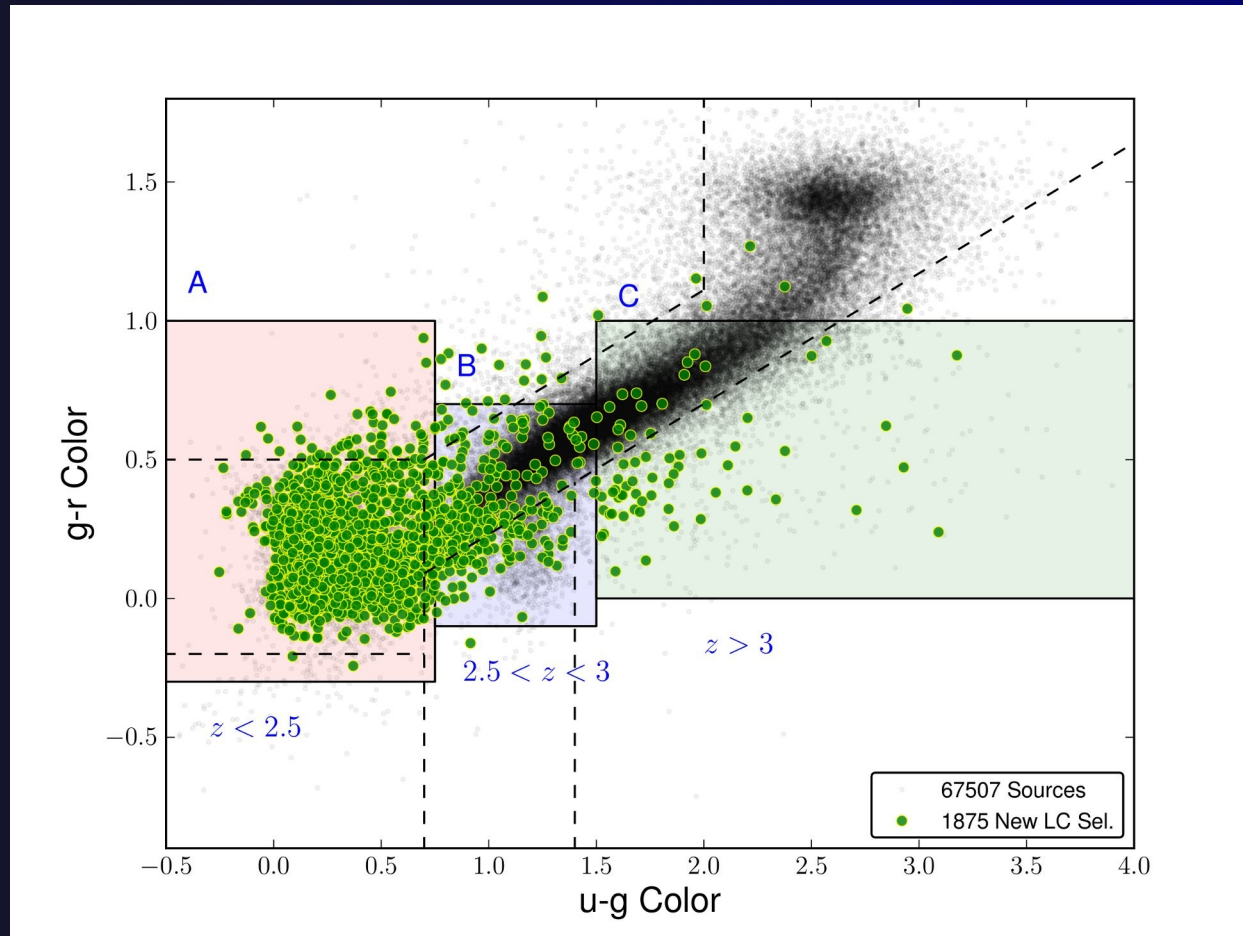
(Kelley at et al. 2009, Koslowski & Kochanek 2010) [Rybicki & Press 1994]
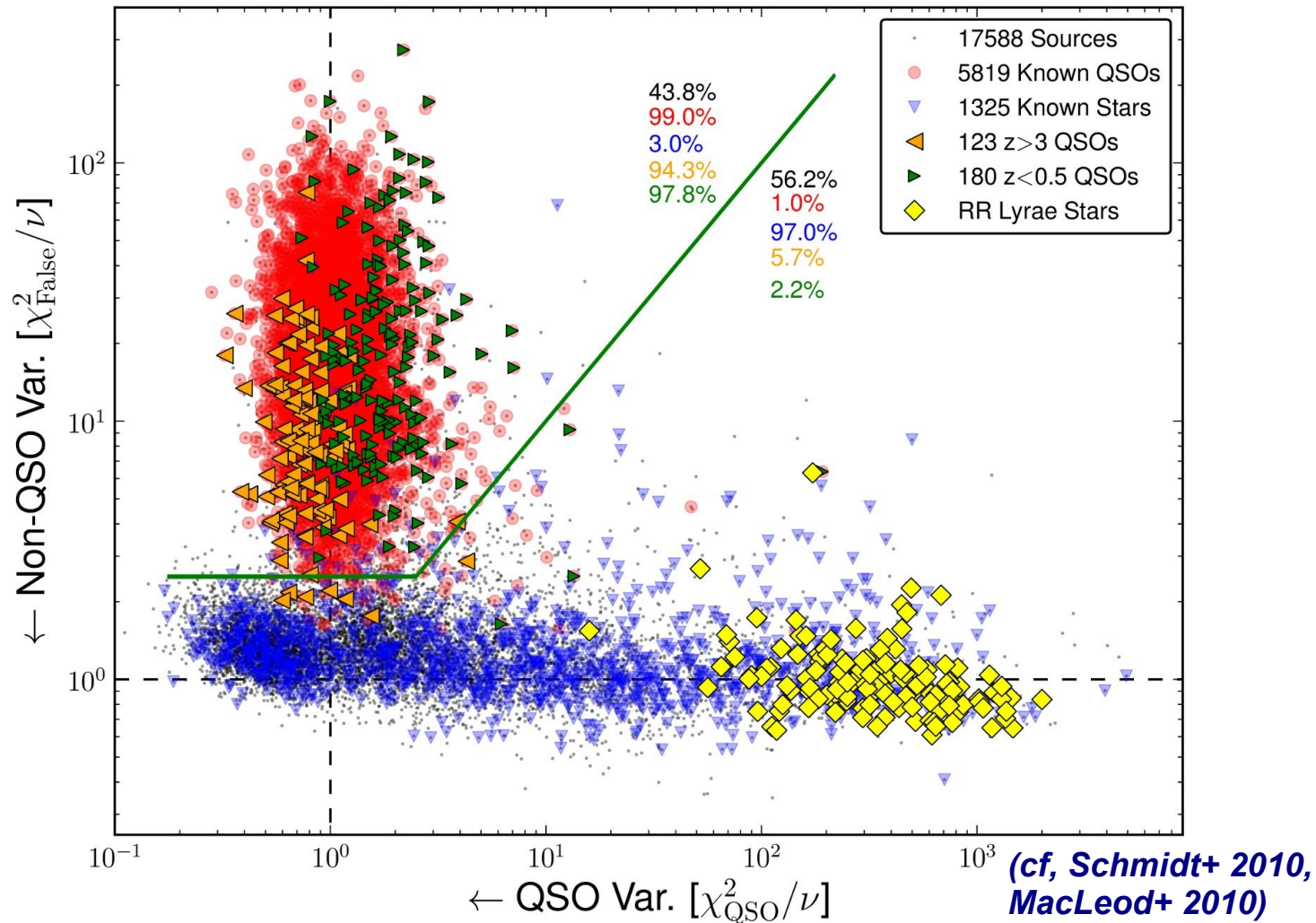
QSO/Variable Star Selection (color)

(e.g., Sesar et al. 2007)

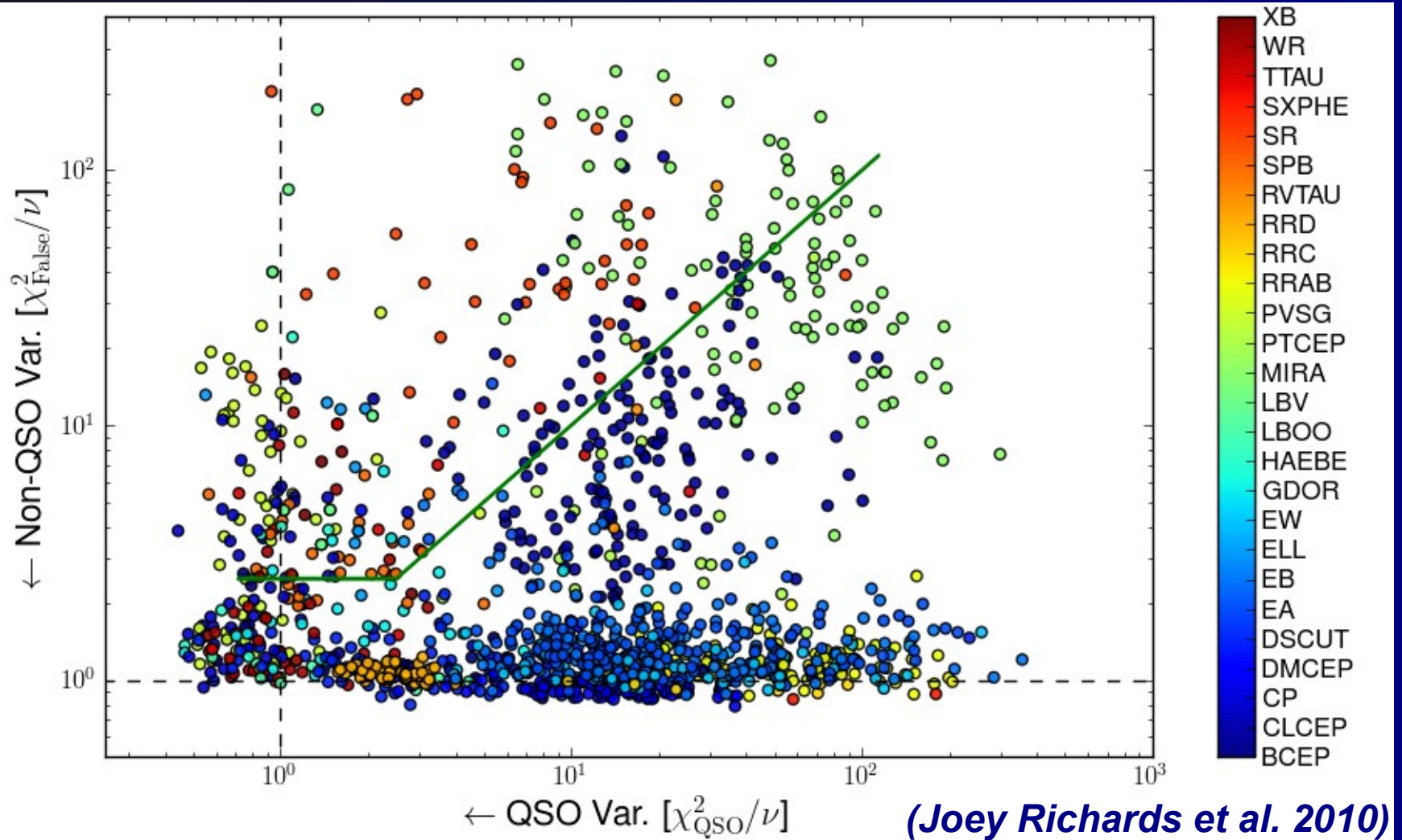# Time Selection in Color-Color Space

QSO/Variable Star Selection (time)
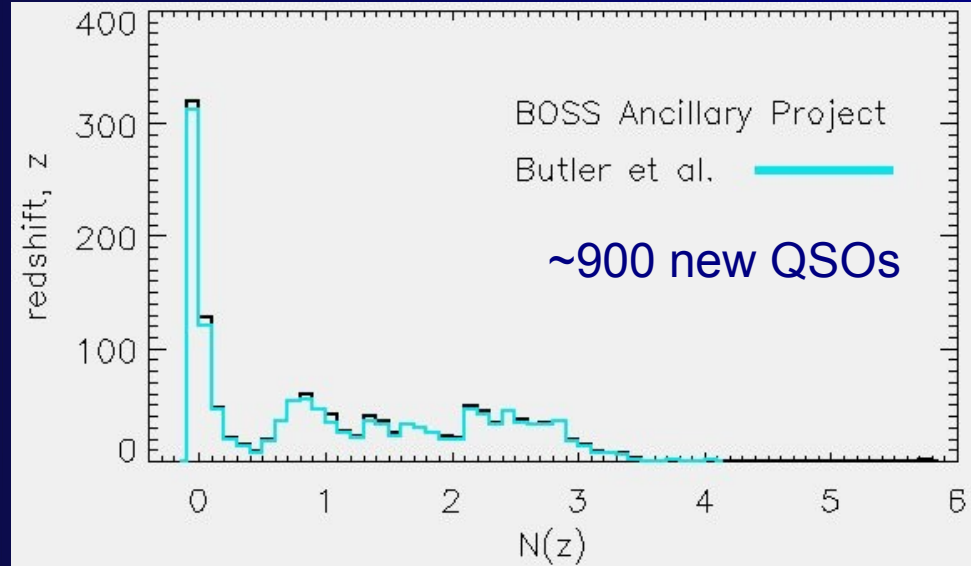
QSO Interlopers

(Joey Richards et al. 2010)

Next Steps

QSO Selection:
  Accepted SDSS3/BOSS Proposal (1500 candidates, observing now)
  Few data limit (PTF -> BAO)

Variable Star Classification:
  apply classifier other surveys

BOSS Ancillary Project
Butler et al.

~900 new QSOs

(credit: Nic Ross)

  * Preparedness for LSST/DES/WFIRST era...
          Fast and efficient (scalable algorithms)
          Cloud implementations
          Domain knowledge → real tools