Dark energy tests with quasar monitoring

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in collaboration with

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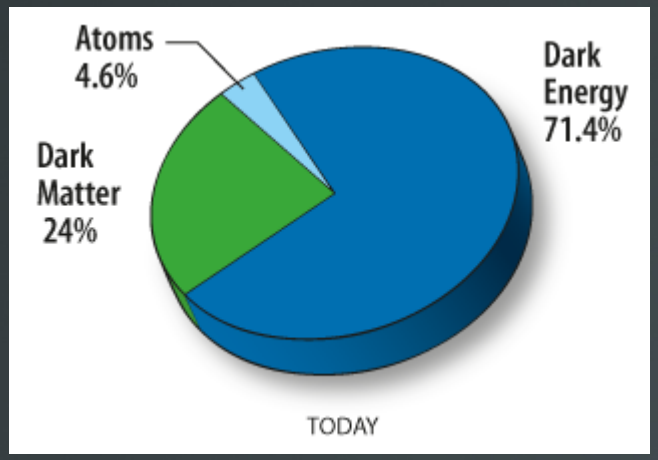
The content of the Universe



http://map.gsfc.nasa.gov/universe/uni_matter.html

METHODS of Dark Energy determination:

- Large Scale Structure (including BAO)
- Cosmic Microwave Background
- Supernovae Ia

- Weak gravitational lensing
- Galaxy clusters (S-Z + X-ray)
- Gamma-ray bursts
- Standard sirens in GW
- .....

We propose to use quasars as probes of the high redshift Universe.

The method

Belongs to the standard candle class, as SN Ia. Based on the theory of formation of the Broad Line Region. Steps:

Monitoring of continuum and of the Mg II line 2800 A for a quasar

Determination of the time delay of the line with respect to the continuum

Determination of the absolute quasar luminosity from the time delay

Constraining cosmology using the luminosity-distance relation

The advantages of using quasars:

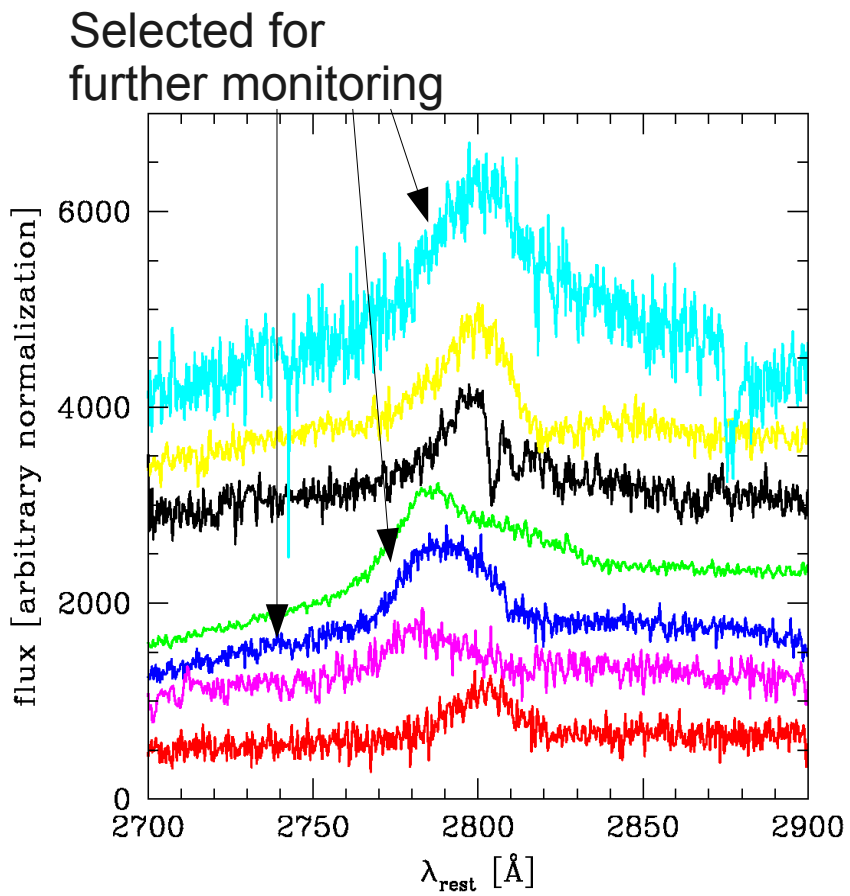
- Broad coverage of redshifts (0.5 to 1.4 for Mg II, higher redshifts for CIV and Ly alpha
- Weak dependence of the quasar metallicity on redshift

Monitoring requirements:

- 5 spectroscopic observations per year
- 18 photometric observations per year
- 5 year observational campaign

For more details, see Czerny et al. 2012, arXiv:1212.0472

Selection of quasars



Criteria:

- EW should be large
- FWHM should not be small
- Redshift rather larger than 1.0
- Convenient monitoring by OGLE

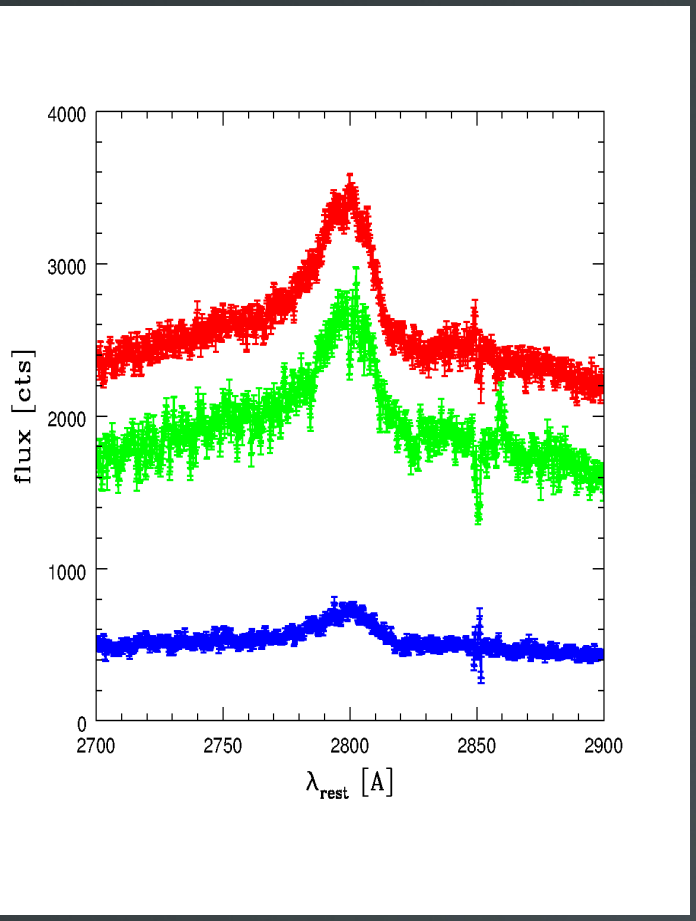
Quasars observed in semester II

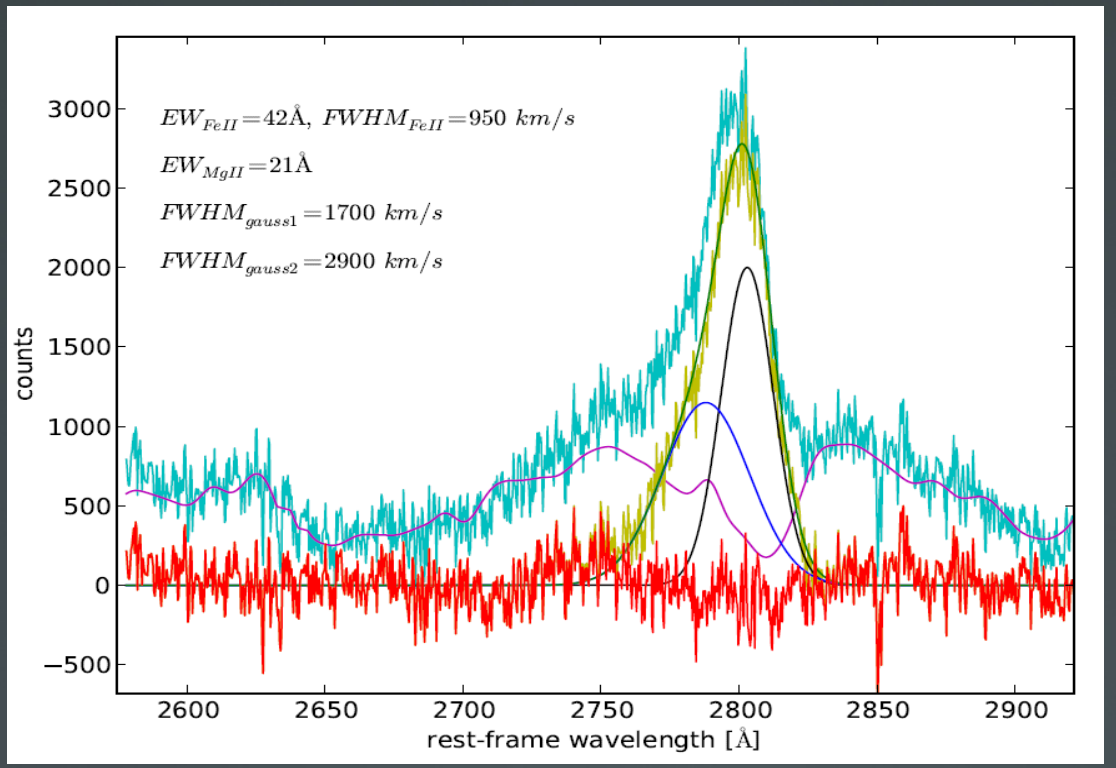
Spectra arbitrarily shifted for illustration

Table 1: Objects selected for further monitoring.

Source	RA	Dec	V	z	EW(MgII) [Å] obs.frame	FWHW [km/s]
HE 0413-4031	4 15 14.496	-40 23 40.92	16.5	1.389	25.0	3900
CTS C30.10	4 47 19.896	-45 37 36.84	16.9	0.910	16.6	4400
HE 0435-4312	4 37 11.808	-43 06 2.88	17.2	1.232	16.2	3500

Decomposition of the quasar spectrum



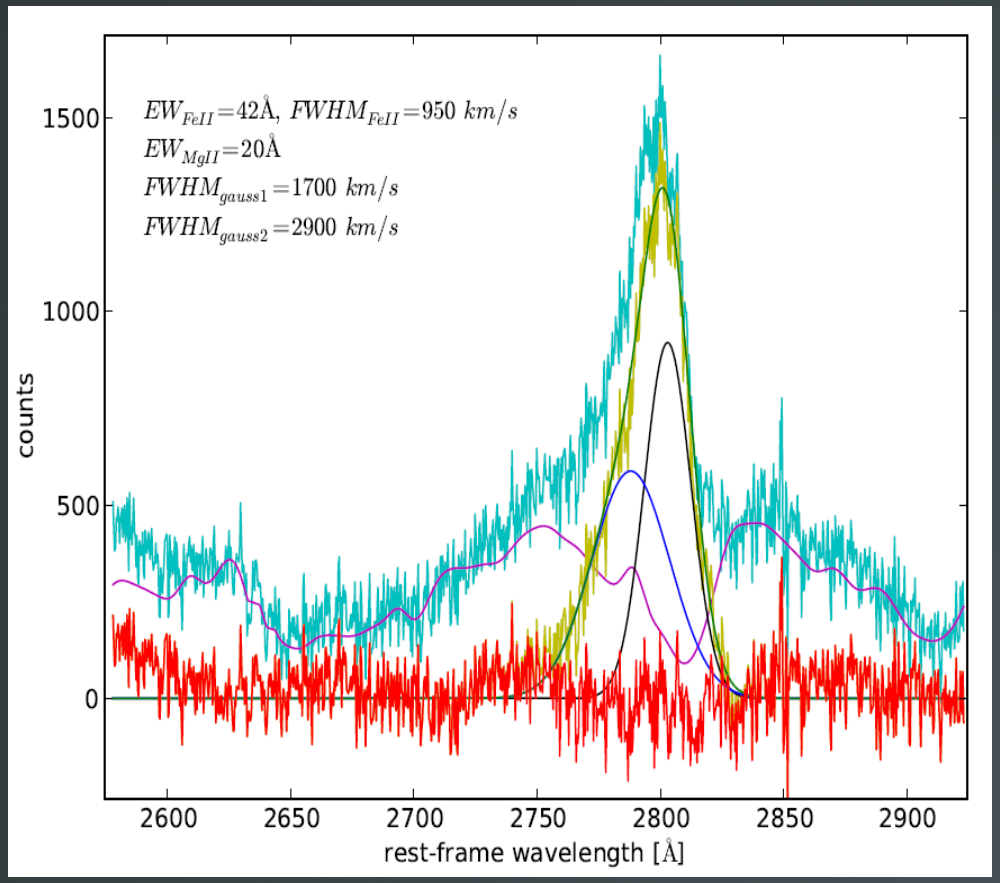


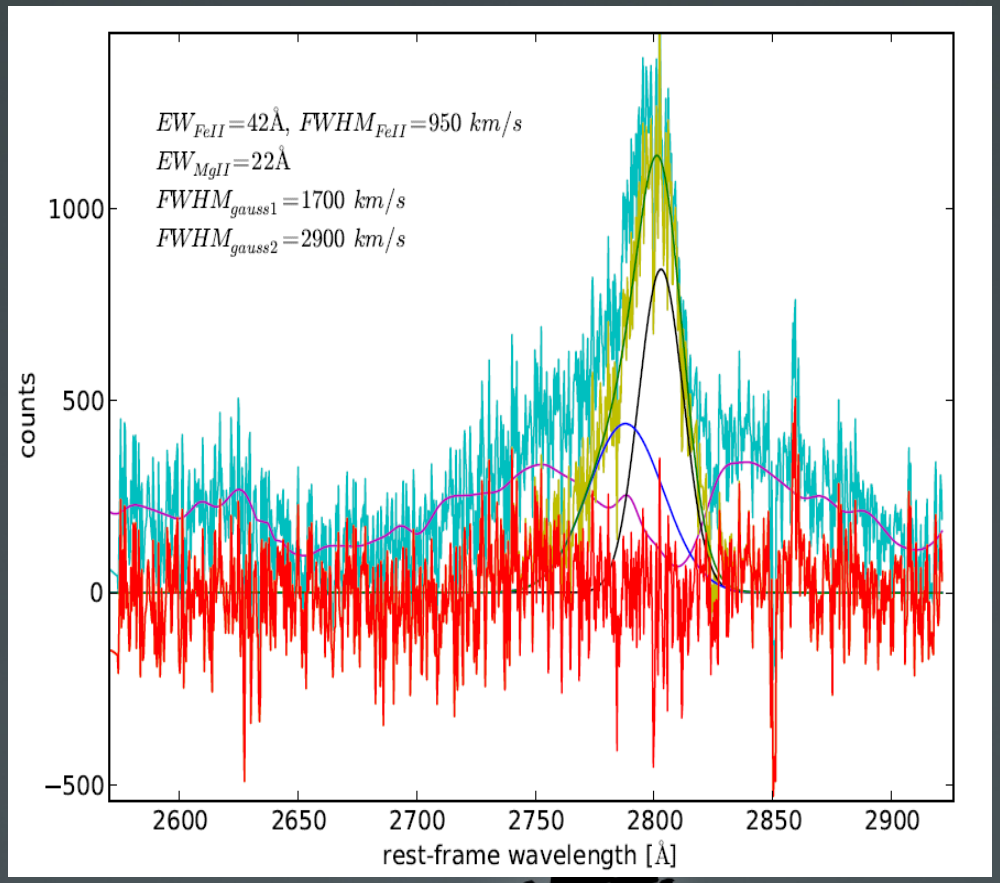
Decomposition of the mean spectrum

LBQS 2113-4538: semester I

Observation date	*EW (Mg II)*
May 15, 2012	11.29 +/- 0.03 A
July 30, 2012	12.38 +/- 0.05 A
Nov 19, 2012	12.78 +/- 0.11 A

Decomposition of the quasar spectrum



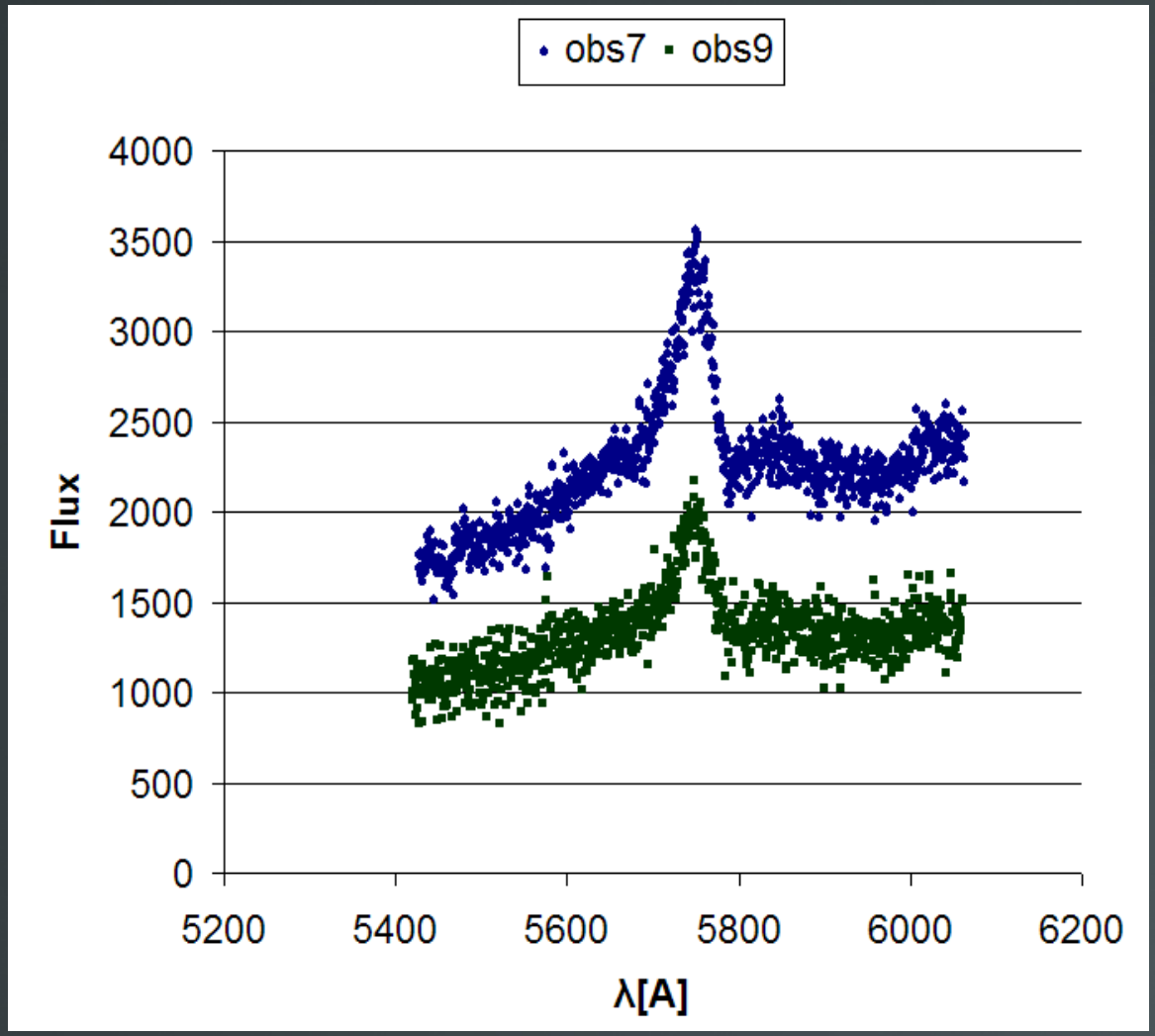


May 15, 2012

July 30, 2012

LBQS 2113-4538

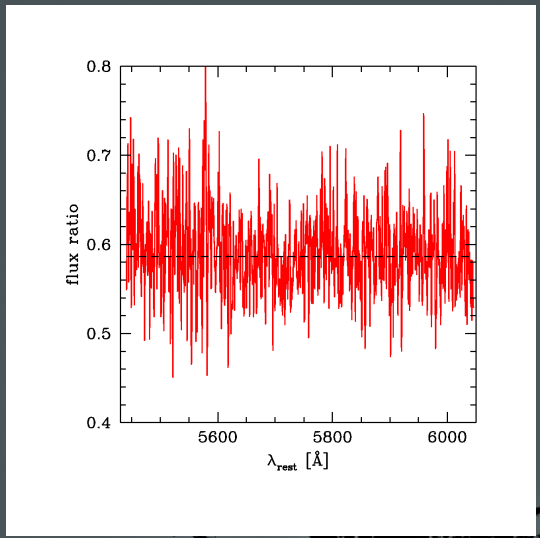
Observation accuracy



OBJECT: HE 0439-5254

Dates: 2013-01-23
2013-01-26

Flux ratio: 0.586
X^2/dof = 1.70 (dof = 1200)



Expected results

- Decomposition of high quality quasar spectra, comparison with available observational and theoretical shapes of the Fe II pseudo-continuum
- Relative variability of Fe II pseudo-continuum and Mg II
- Comparison of the Mg II line after decomposition with theoretical models of the Broad Emission Line Region
- Time delays of the line and continuum for three quasars in 5 years, and thus cosmological constraints