QUASARS as tracers of cosmic flows

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PLAN OF PRESENTATION

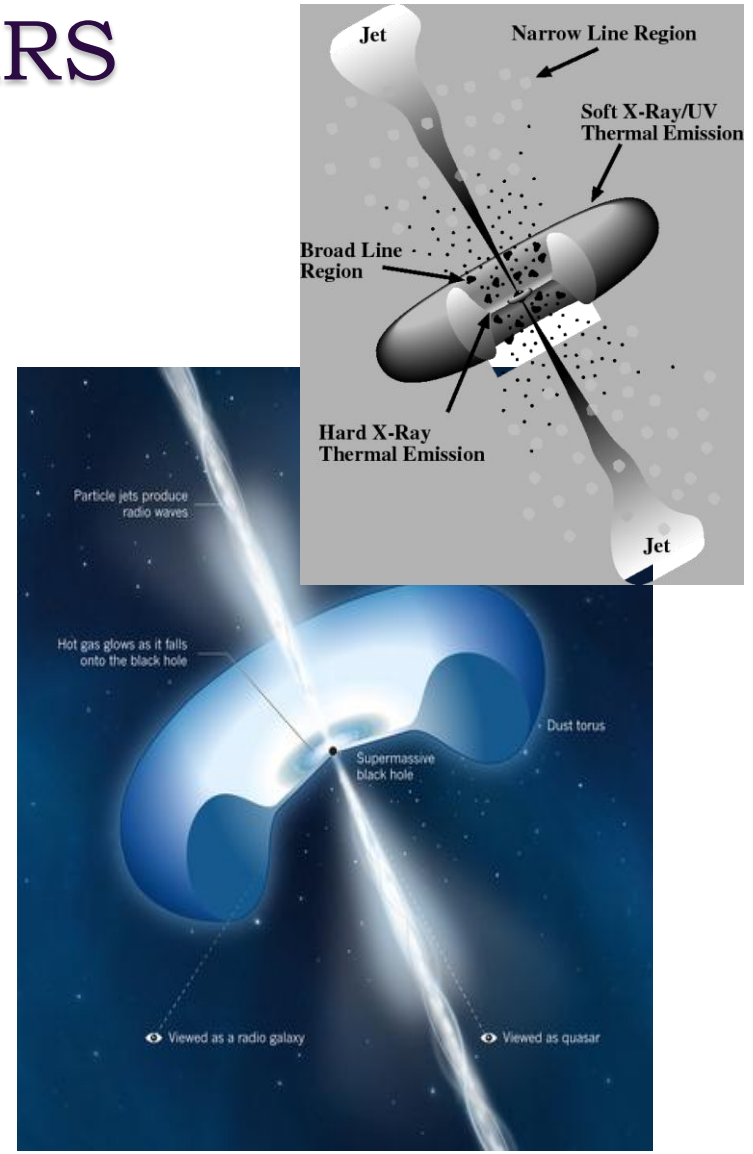
- Basic information about quasars
- SALT data/collaboration
- Object CTS C30.10
- What we do
- Project plans/discussion

BASIC INFORMATION ABOUT QUASARS

- Quasars are the most luminous, persistent sources in the Universe:

  (even $L \sim 10^{48}$ erg s^{-1})

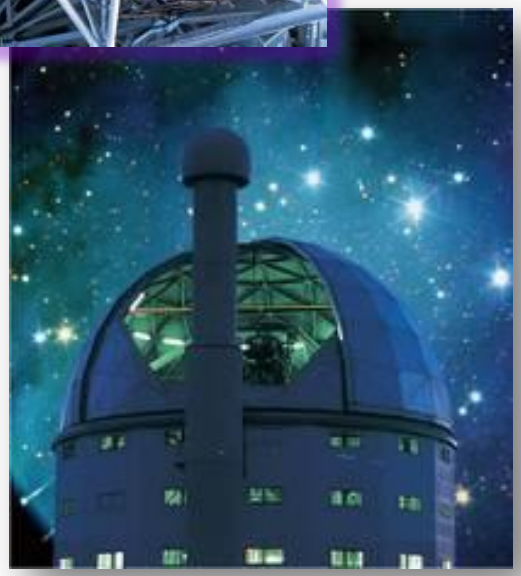
- Quasars are numerous: SDSS found more than 120,000 quasars.
- Quasars are currently observed over a wide redshift range ($0 \leq z \leq 7$).
- Quasars are evolving and most of them are at redshift $z \sim 2$.



- Figure 1: Structure of quasar.

SALT DATA/COLABORATION

- The Southern African Large Telescope (SALT) is the largest single optical telescope in the southern hemisphere and among the largest in the world. It has a hexagonal primary mirror array 11 meters across, comprising 91 individual 1.2m hexagonal mirrors. Although very similar to the Hobby-Eberly Telescope (HET) in Texas, SALT has a redesigned optical system resulting in a larger field of view and effective collecting area.
- SALT can detect the light from faint or distant objects in the Universe

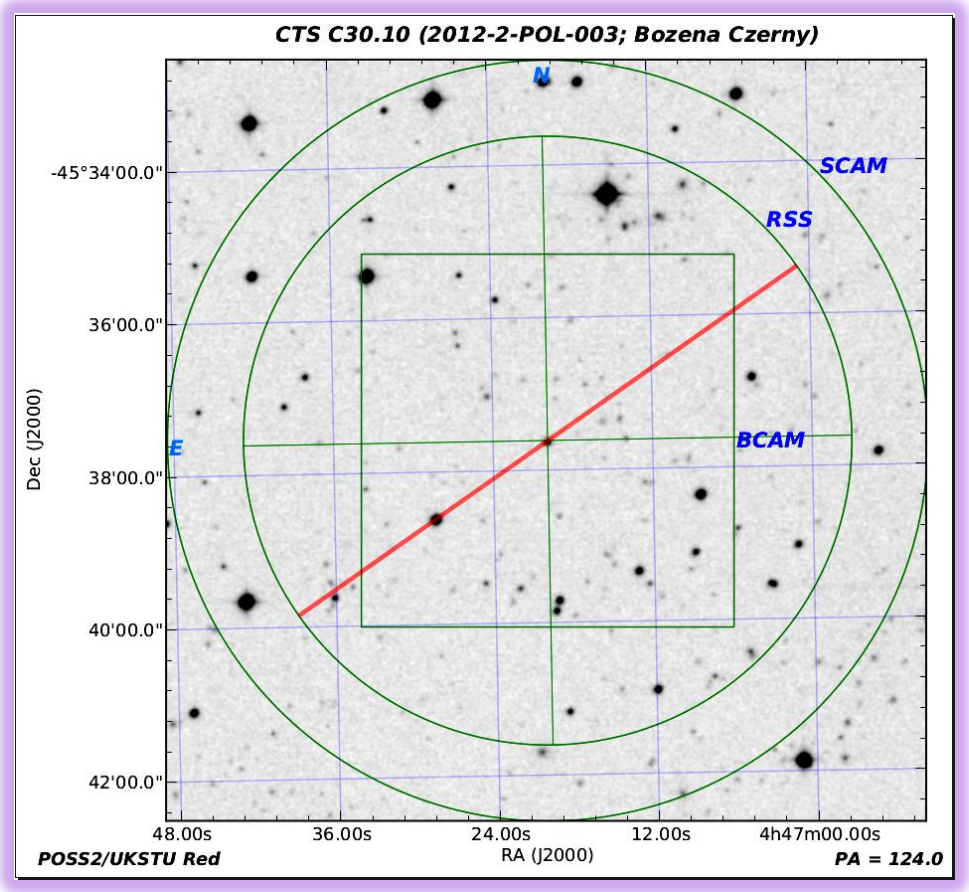


- Figure 2. SALT

OBJECT CTS C30.10

EquJ2000.0		Object	Velocity	Redshift	Mag.
RA	DEC	Type	Km/s	z	V
04h47m19.9s	-45d37m38s	QSO	>30000	0.910000	16.9

- Table 1. Information about quasar CTS C30.10 from NED.



- We have five observations between 06.12.2012 – 05.03.2014

- Figure 4. Sky–map of area where is quasar CTS C30.10.

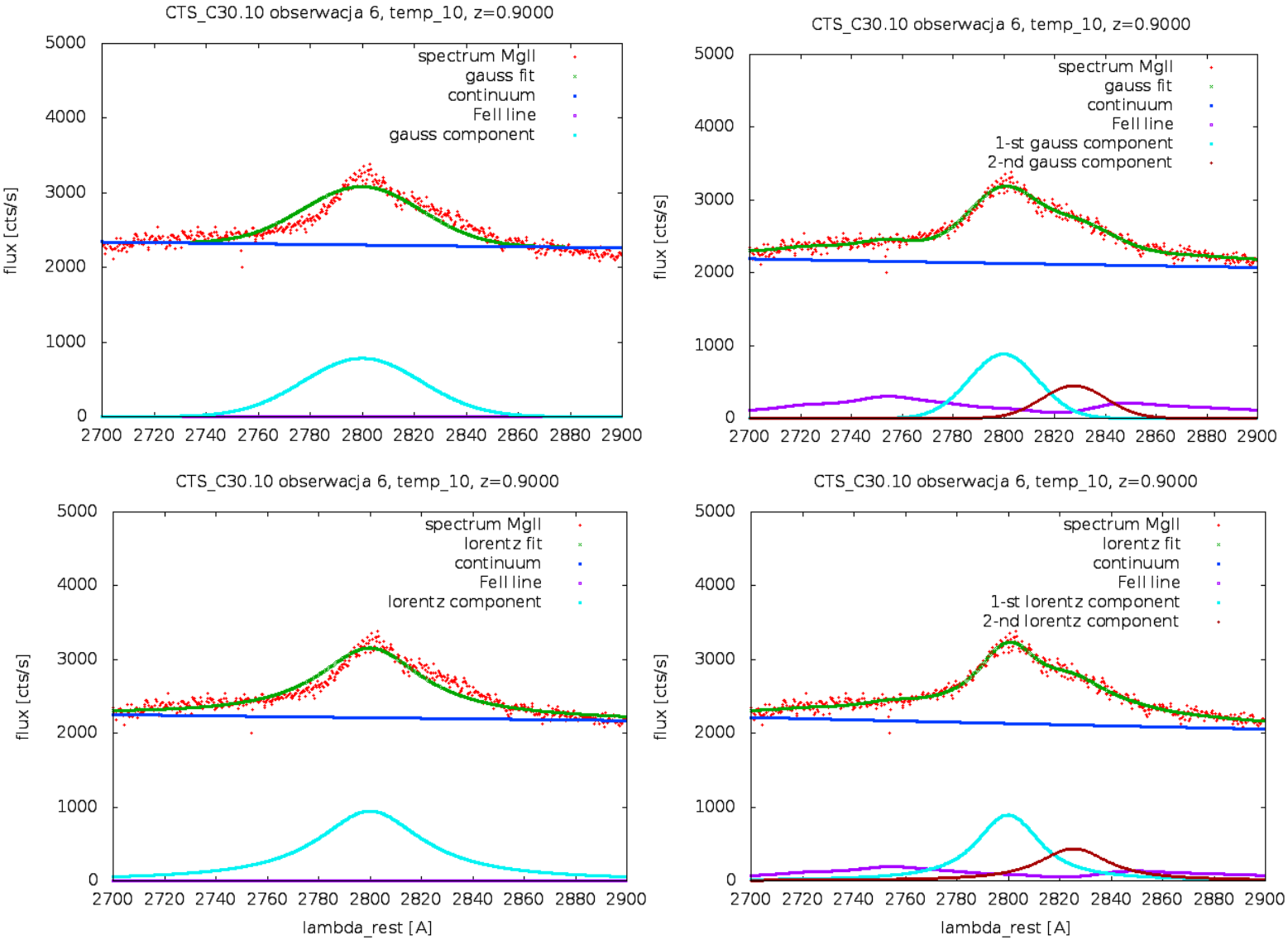
WHAT WE DO

- We obtain the spectrum in the observed frame (5040 – 5720A), rest frame (2650 – 3010A) containing strong MgII line .
- We get the spectrophotometric standard observed by SALT staff. We obtain the calibration curve by comparing it with calibrated ESO spectrum.
- We use fitting program to find the best fit to the quasar spectrum in 2700 – 2900 Angstroms rest frame assuming the components:

1. power – law continuum
2. FeII pseudo – continuum
3. MgII emission line

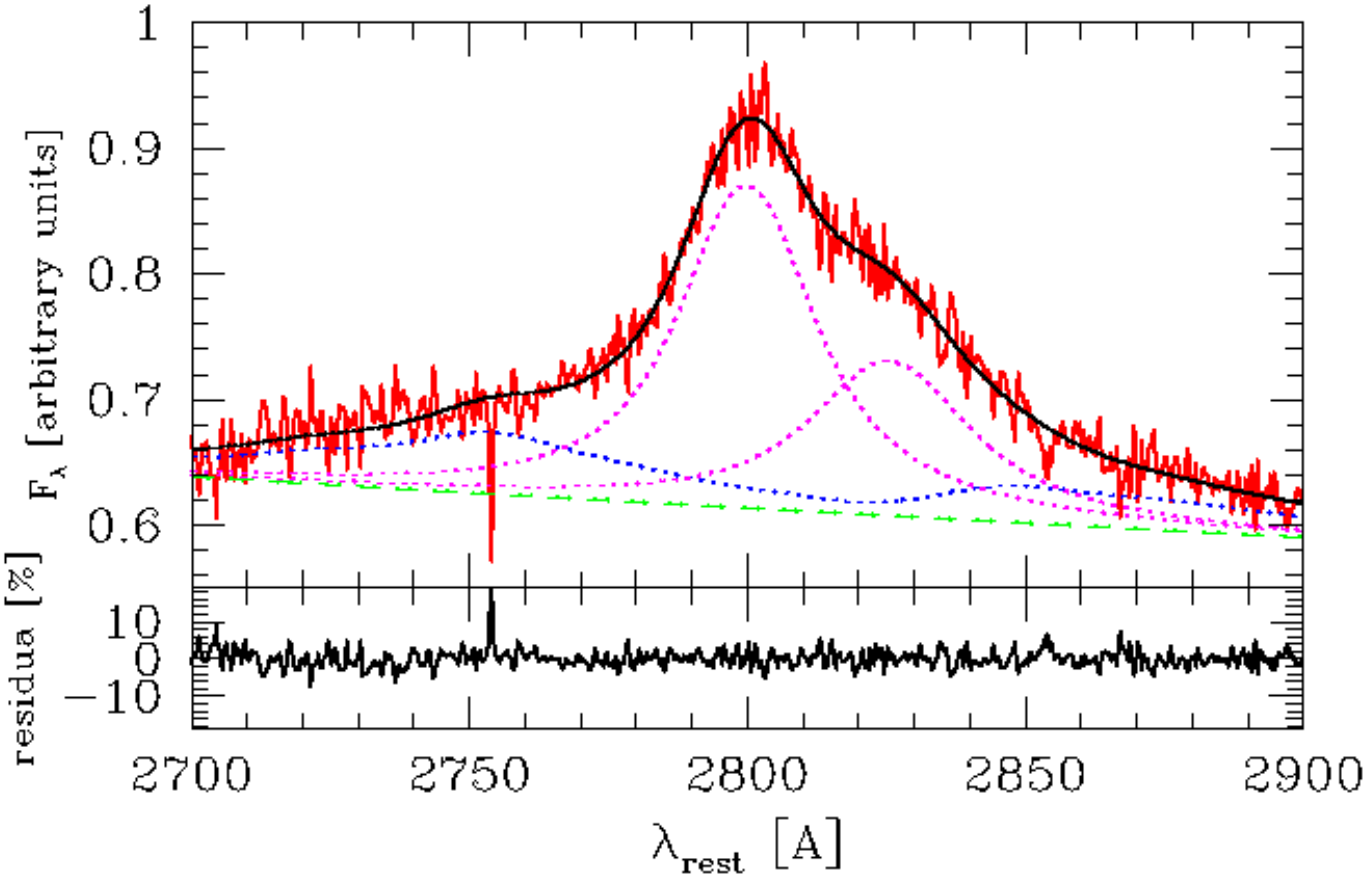
- We consider several templates of FeII to check which one is the best.

WHAT WE DO



- Figure 5. Fitting curves of MgII line: single gauss, double gauss, single lorentz and double lorentz, observation 2.

WHAT WE DO



- Figure 6. Double lorentz fit, observation 2, template 13.

WHAT WE DO

Fe II temp	Line shape	EW MgII [A]	EW FeII [A]	χ^2
observation 1				
13	DL	25.63	6.98	230.78
observation 2				
13	DL	26.51	8.38	422.49
observation 3				
13	DL	27.45	10.21	202.69
observation 4				
13	DL	29.47	11.30	604.04
observation 5				
13	DL	29.82	11.21	232.07

- Table 2. Comparison our fitting results for template 13 for five observations of quasar CTS C30.10.

WHAT WE DO

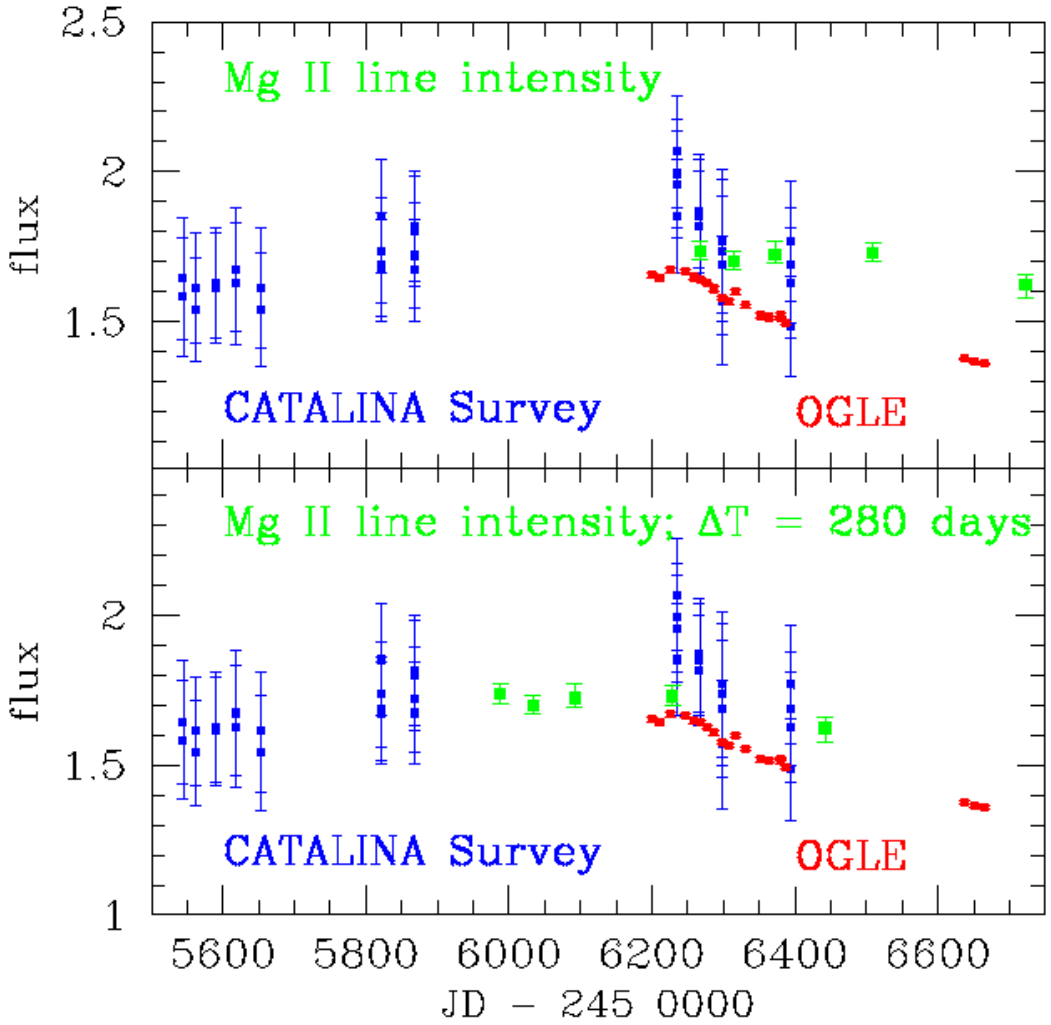


Figure 7. The time evolution of the V–band flux and the MgII line intensity measured (upper panel) and after a shift of 280 days corresponding to plausible time delay (lower panel).

PROJECT PLANS

- Studying spectrum of QSO in optical band, specially clearly visible MgII line we can get important information about this object. From the shape of the line we get:

1) The mass of the black hole at the center of QSO,
2) Geometric character of BLR.

- In our results about CTS C30.10 we see double nature of the MgII line, and we need to theoretically explain the existence of these two components. Maybe answer is in nature of BLR.
- Most difficult and long – term part of this project is to use quasars as cosmological probes. We will base on the theory of the formation BLR in active galaxies (Czerny & Hryniewicz, 2011) .
- Understanding quasar structure allows us :

1) To measure the quasar distance AND the redshift INDEPENDENTLY,
2) To determine the expansion rate of the Universe.
3) To measure the dark energy,

DISCUSSION

- How quasars can be used to determine the expansion rate of the Universe:
- We need to measure for each quasar :

1) The redshift,
2) The observed brightness,
3) The time delay between the line and continuum. This delay allows to calculate the absolute luminosity of a quasar.

- The method is essentially equivalent to the use of the SN Ia but It's important to have several independent tracers as each of them specific. It's hard to estimate systematic error.
- Having information like this, we have independent measurement of the distance (comparison of the absolute luminosity to observed brightness) and the expansion of the Universe (redshift) between the time send light through the QSO and the present.

THANK YOU FOR YOUR ATTENTION

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