# Nature of quasars without emission lines in SDSS and 2dF surveys

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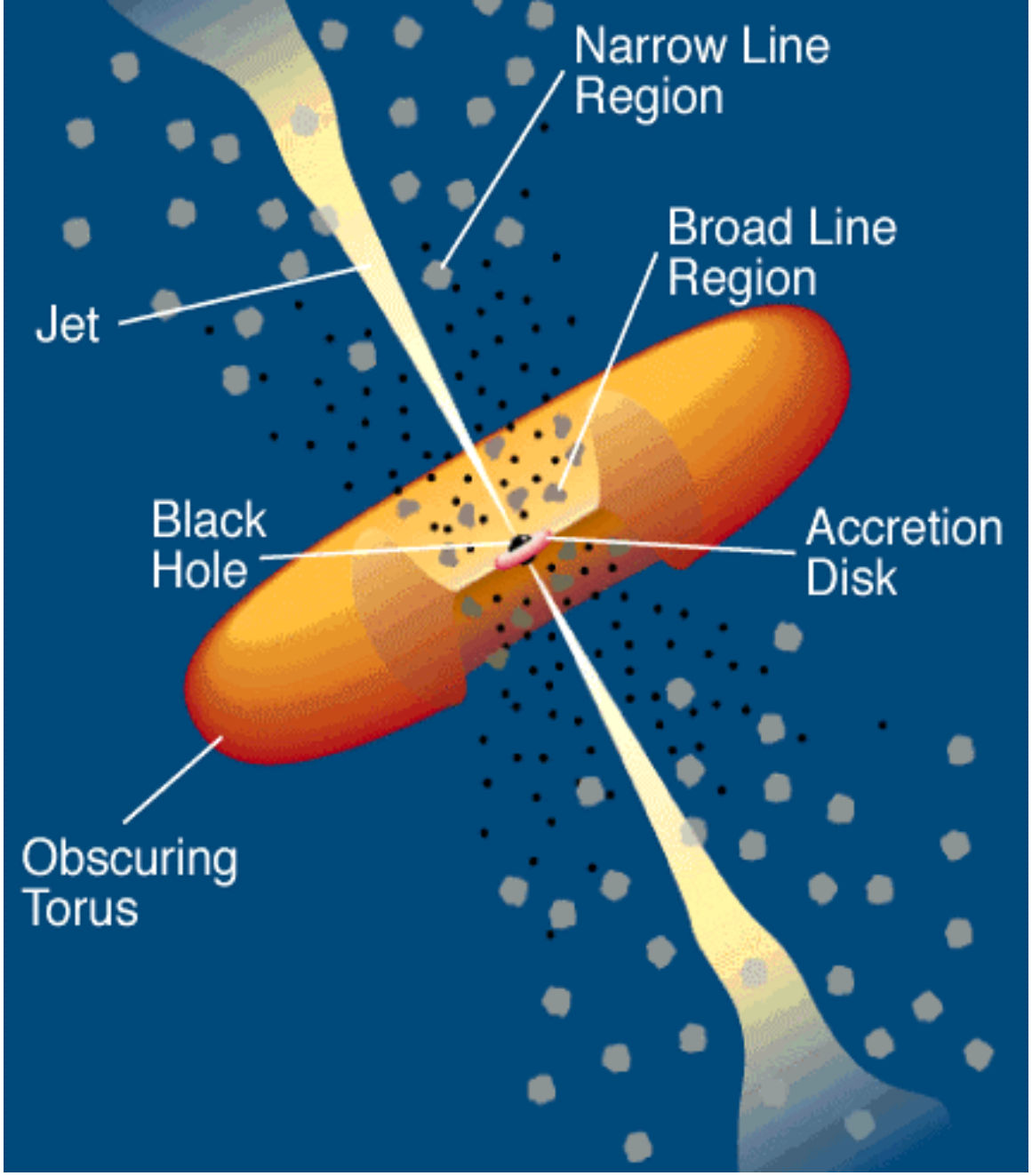
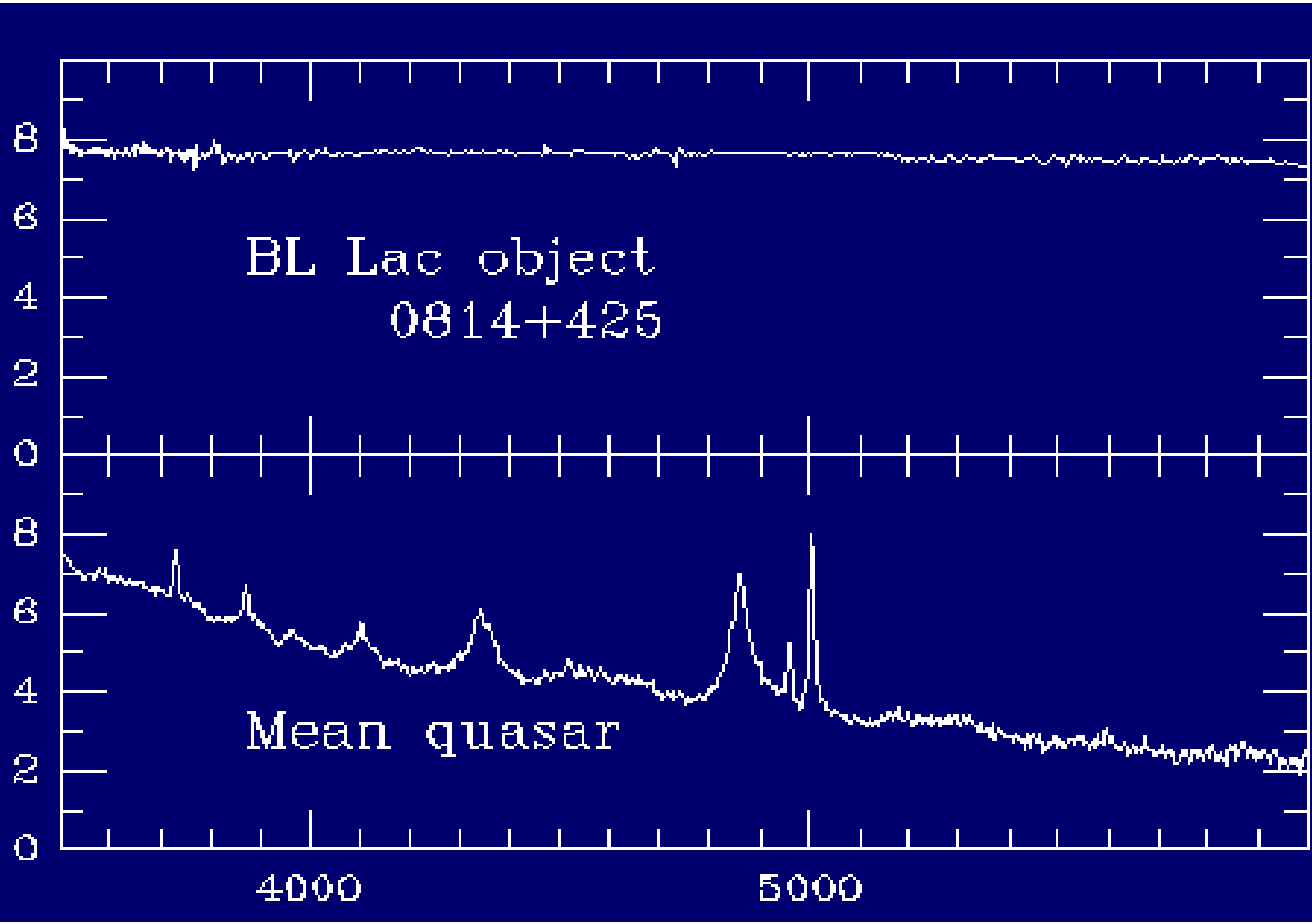
# Quasars

- Quasars come under two broad classes (radio-loud and radio-quiet)
- About 85% of quasars are radio-quiet
- Spectral energy distribution is the same (radio and hard X-ray)
- Flat Spectrum Quasars
- Steep Spectrum Quasars
- BL Lac objects

Qu


Narrow Line
Region
Broad Line
Region
Jet
Black
Hole
Accretion
Disk
Obscuring
Torus


BL Lac object
0814+425
Mean quasar
8
6
4
2
0
8
6
4
2
0
4000
5000

# BL Lac objects and radio quiet quasars

- Radio loud
- X-ray loud
- Featureless optical spectrum
- High polarization
- Intra-night optical variability (large amplitude and large duty cycle

- Radio quiet
- X-ray weak
- Optical spectrum has features
- Low polarization
- Intra-night optical variability (small amplitude and low duty cycle)

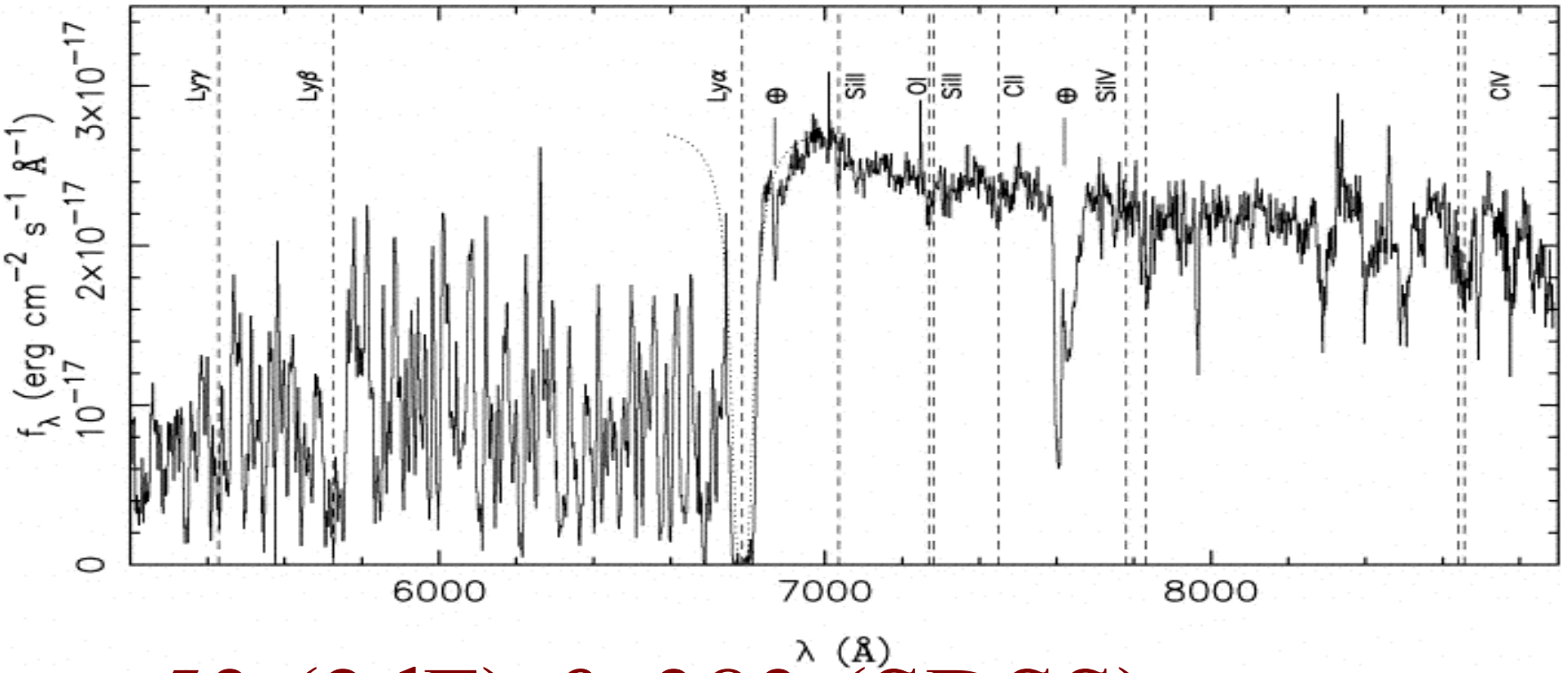
# ecuiiar sources in SDSS and 2dF surveys

- Featureless spectrum (similar to classical BL Lacs)
- Radio-quiet
- X-ray quiet
- Optically un-polarized

# SDSS J153259.96-003944.1

First reported by Fan et al. 1999; z = 4.52

< 60 micro-Jy (1.4 Ghz); < 4% optical polarization; weak detection by Chandra




53 (2dF) & 383 (SDSS)

# Possible explanations

- Are they Radio-quiet BL Lacs ?
- Are they radio-quiet quasars undergoing micro-lensing ?
- Are they radio-quiet quasars without a Broad Line Region

# Observational Tests

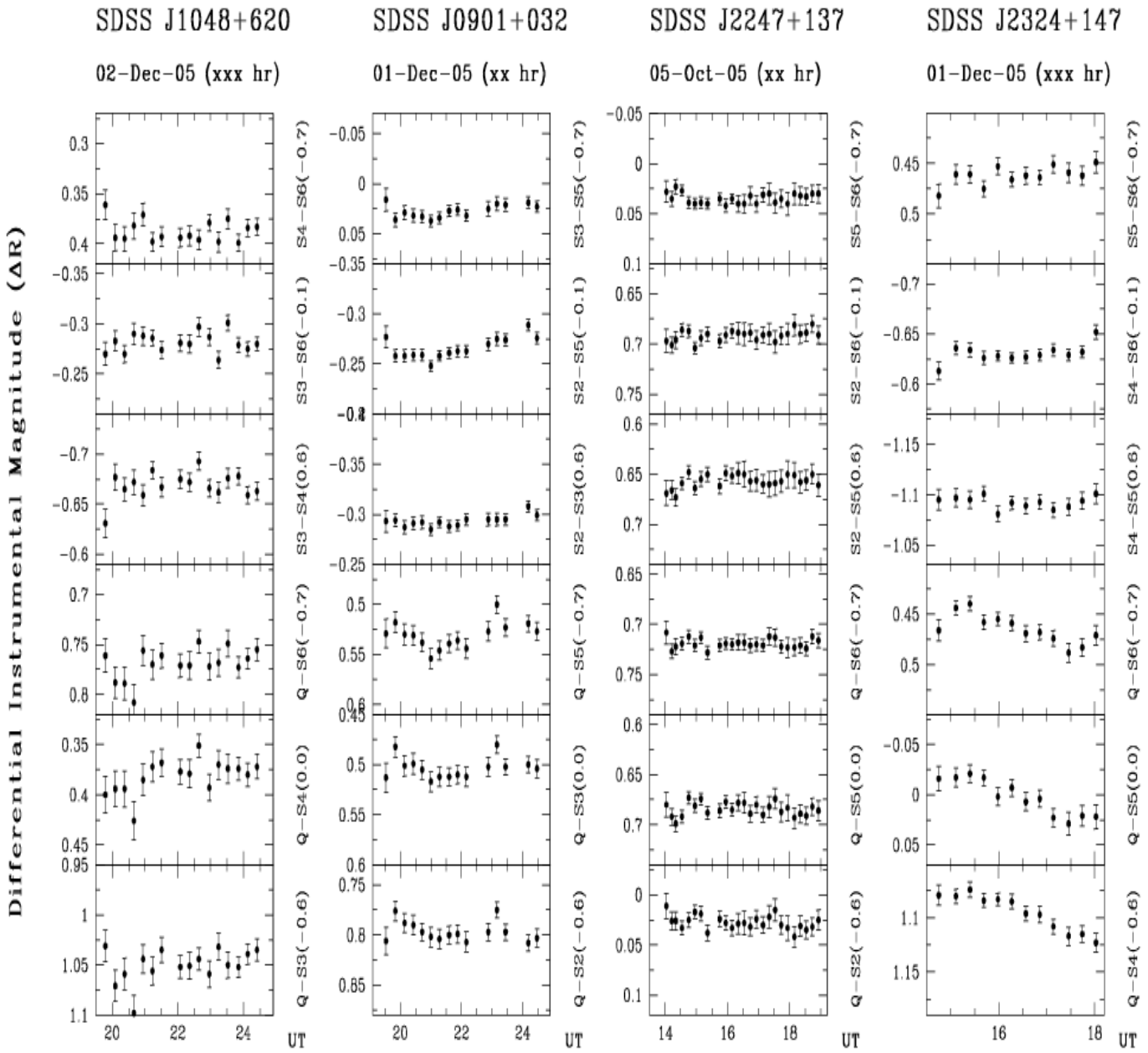
- Intra-night optical variability observations
- Optical polarization
- Deep radio observations
- Deep X-ray observations

# Observations

- Intra-night optical variability (Telescopes: 2m HCT and 1.2m OHP)
- 12 objects monitored in R-band on a total of 23 nights (13 nights on HCT & 10 nights on OHP)
- Polarization observations (Telescope: ESO 3.6m)
- 19 objects observed for Polarization

# Results

- Low levels of variability (similar to radio-quiet quasars) seen in two objects
- All 19 objects have < 2% optical polarization (similar to radio-quiet quasars)


SDSS J1048+620
02-Dec-05 (xxx hr)
SDSS J0901+032
01-Dec-05 (xx hr)
SDSS J2247+137
05-Oct-05 (xx hr)
SDSS J2324+147
01-Dec-05 (xxx hr)
Differential Instrumental Magnitude (ΔR)
S4−S6(−0.7)
S3−S6(−0.1)
S3−S4(0.6)
Q−S6(−0.7)
Q−S4(0.0)
Q−S3(−0.6)
S3−S5(−0.7)
S2−S5(−0.1)
S2−S3(0.6)
Q−S5(−0.7)
Q−S3(0.0)
Q−S2(−0.6)
S5−S6(−0.7)
S2−S6(−0.1)
S2−S5(0.6)
Q−S6(−0.7)
Q−S5(0.0)
Q−S2(−0.6)
S5−S6(−0.7)
S4−S6(−0.1)
S4−S5(0.6)
Q−S6(−0.7)
Q−S5(0.0)
Q−S4(−0.6)
UT
UT
UT
UT

April 12-

# Conclusions

- This optical sample is not the yet unrecognized radio-quiet BL Lac population
- Could belong to a new population of radio-quiet quasars without a Broad Line Region ??
- Could some be BL Lac objects at $z > 1$ (but with properties different from their low redshift counterparts) ???