Calcium Infrared Triplet Emission In Quasar by Subaru/FOCAS Spectroscopy

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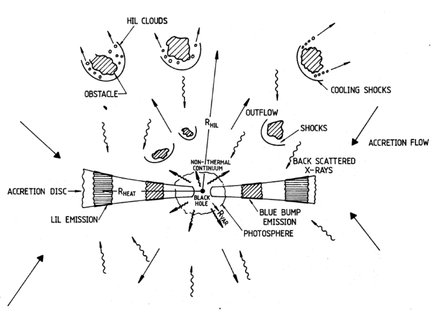
I. Introduction

Broad-Line Region (BLR) of Seyfert Nuclei

The BLRs of Seyfert 1 galaxies are thought to consist of a large number of high-density clouds.

- non-radiatively heated materials
- the high ionized lines (HIL) excitation lines (ex. C IV, N V) come from cooling gas behind shocks in hypersonic infalling materials
- the low ionized lines (LIL) emission lines (ex. Fe II, Ca II) might originate in the atmosphere of the accretion disk

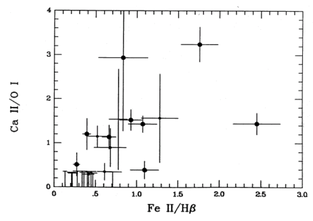
It is possible to probe such weakly ionized material with Calcium Infrared Triplet.

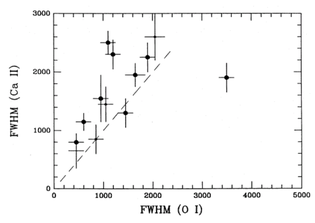


Calcium Infrared Triplet : λ 8498, 8542, 8662 Å

Persson 1988 (ApJ **330**:751-765) detected the Ca II infrared triplet emission lines in at least nine, and probably **14**, active galactic nuclei, out of a total of **40** surveyed.

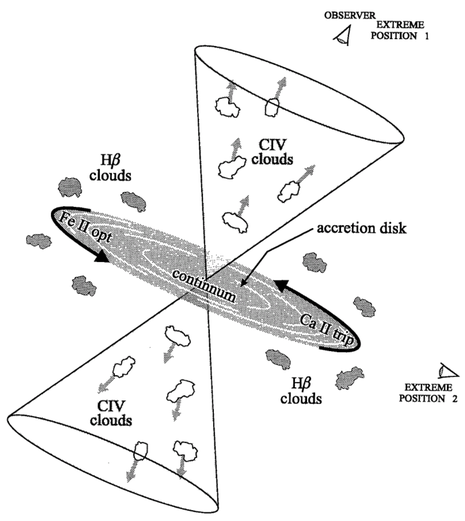
They confirmed that Ca II emission could be characteristic, at some level, of many AGN with Fe II emission. And the Ca II linewidths are significantly narrower than that of the OI line; a kinematically distinct region perhaps in the form of a disk.





They suggested that nonradiative heat source is dissipation in an accretion disk, and deduce that the BLR lies in close proximity to it, by virtue of the kinematic similarities demonstrated in above figure(right).

Recently, Dultzin-Hacyan et al. 1999 (ASPC **175**:303) showed more detailed picture of the BLR (see right picture). They concluded Ca II triplet and Fe II_{opt} lines must form in the same region -- this region is the accretion disk.



Observing the Ca II Triplet emission ⟶ a strong constraint on the geometry of BLR

II. Observation

Observation

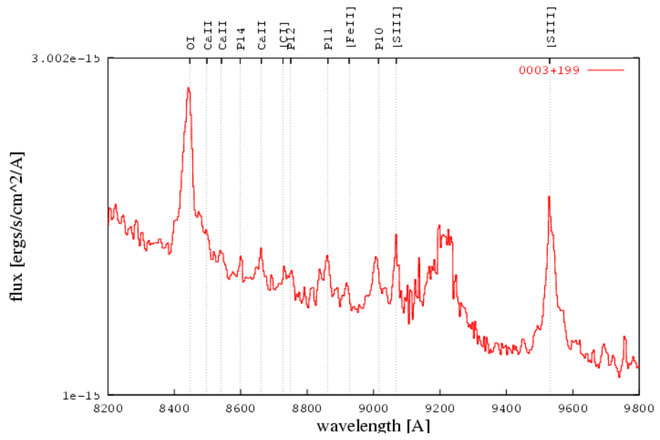
Observation	**Subaru Telescope & FOCAS (Open-Use I.D. S05A-047)**
Date	7th July, 2005 (UTC)
Weather	Clear
Observing Mode	
CCD	3 x 1 on-chip binning
grism	High Echelle grism
dispersion	0.98 Å / pix @ 9300 Å
filter	SDSS-z'
wavelength coverage	8300 Å – 10000 Å
slit	0.8 arcsec slit
Data Reduction	standard manners with using IRAF

Sample

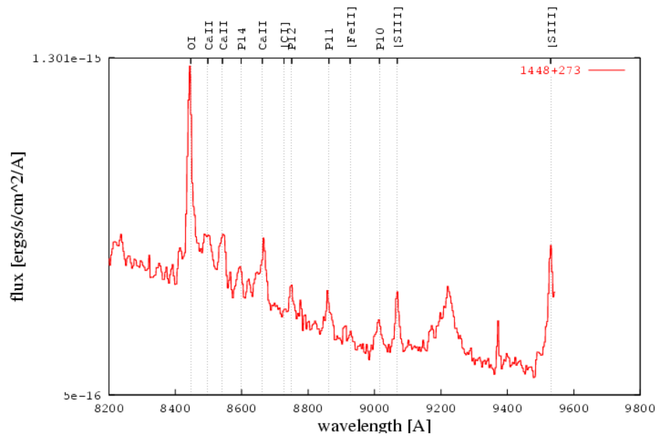
PG QSO	Other Name	*z*	Exp. (sec)
0003+199	Mk 335	0.025	1800
1448+273	-	0.065	1200
1534+580	MK 290	0.030	1800
2209+184	-	0.070	1200
2214+139	MK 304	0.065	1800
2304+042	PB 5250	0.042	2700

III. Results and Discussion

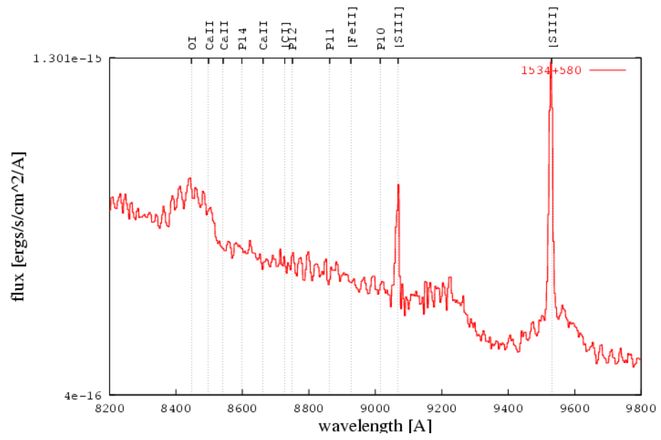
0003+199



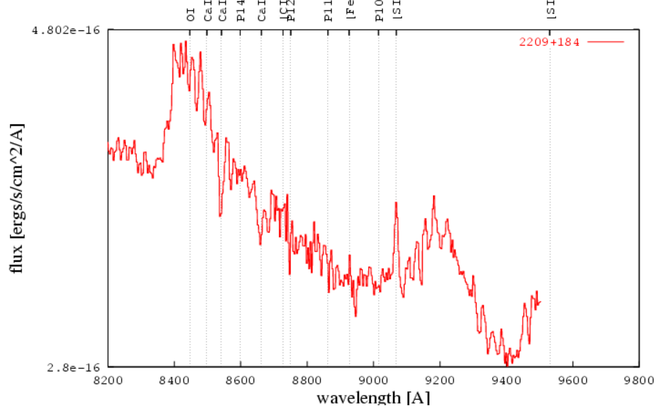
1448+273



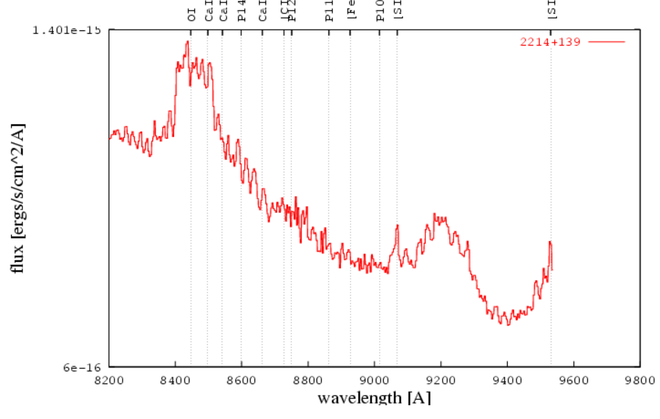
1534+580



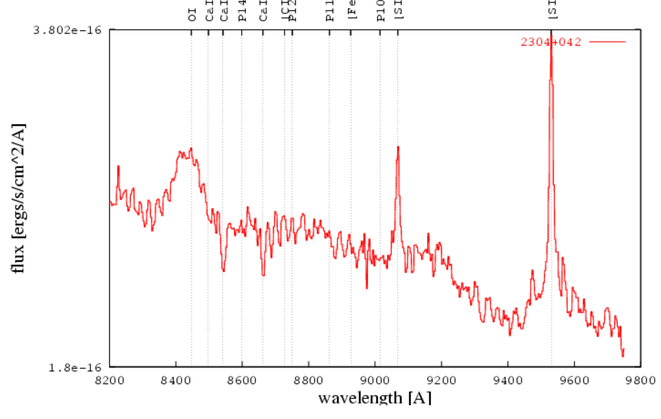
2209+184



2214+139



2304+042



- We detected the calcium infrared triplet emission in 0003+199 and 1448+273 (maybe with Paschen series contamination).
- Ca II emission detectability is 2/6 in our samples. This result is comparable with Persson 1988 (ApJ **330**:751-765), 9-14 / 40.
- We can see the calcium absorption lines in 2209+184 and 2304+042.
- 1534+480, 2209+184, 2214+139 and 2304+042 have very broad components.
- λ 9100-9300 Å feature is a blend of a number of lines of low ionization species (Mg II, O I, He I, Ne I, and Fe II) plus the Paschen 9 line of H I.

Paschen (Å)		Ca II (Å)
17	8467	
16	8502	8498
15	8545	8542
14	8598	
13	8665	8662
12	8750	