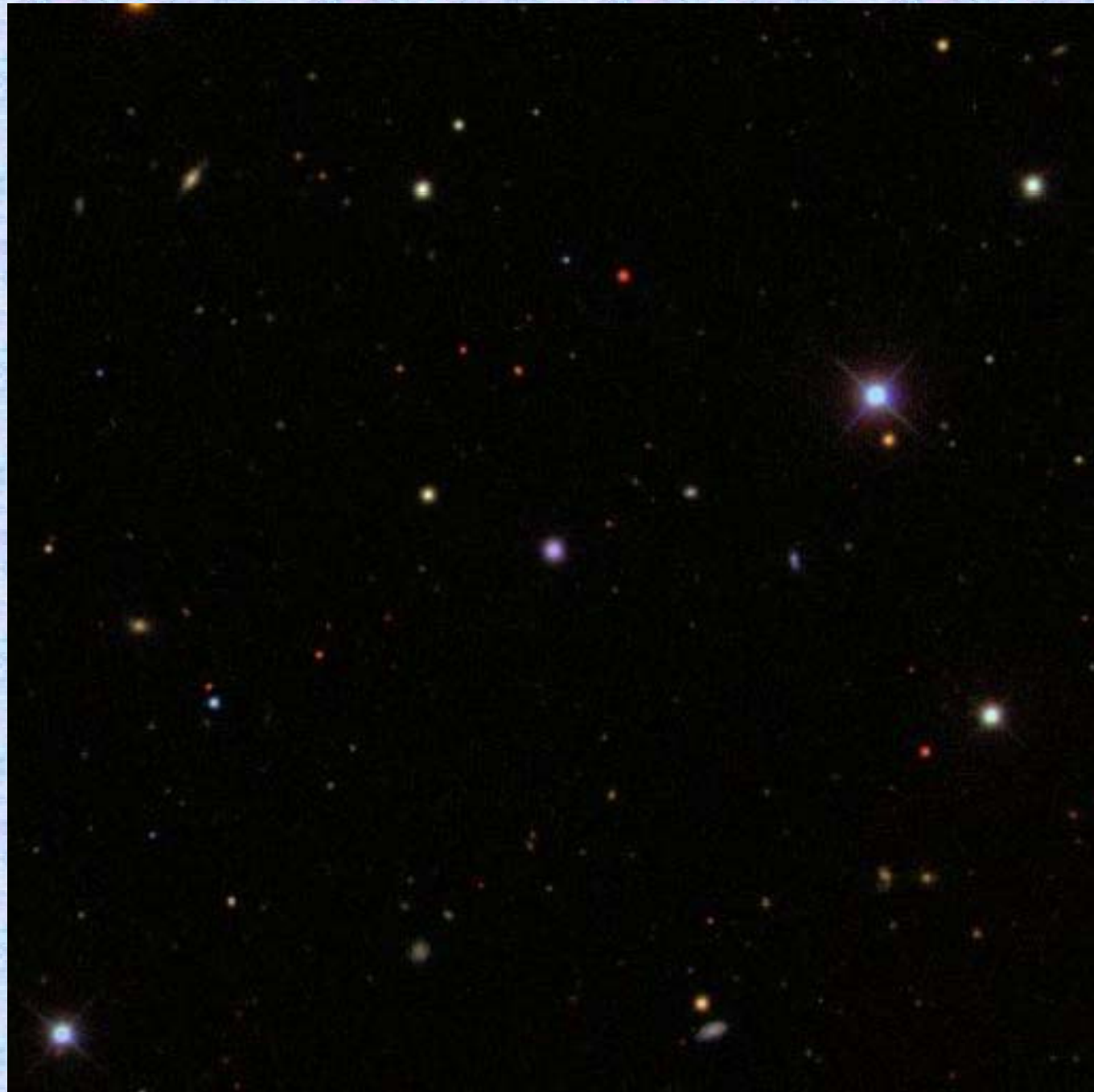


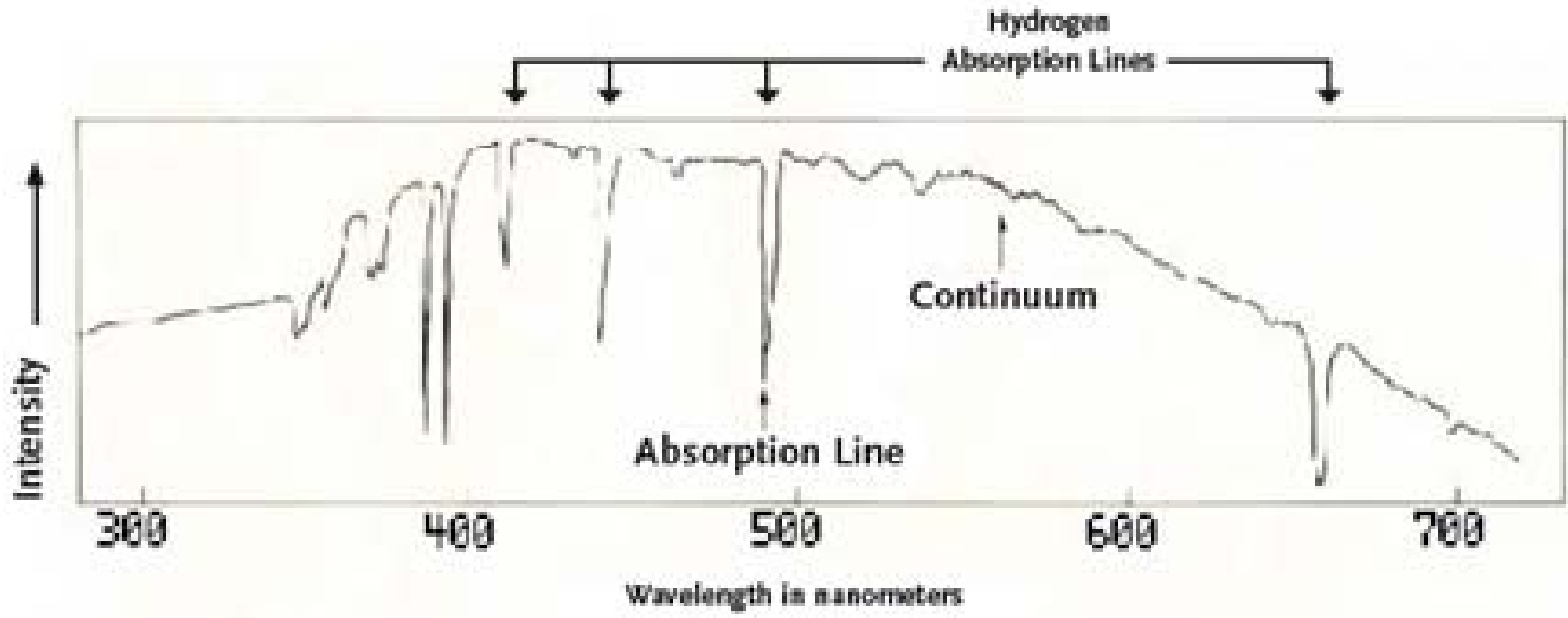
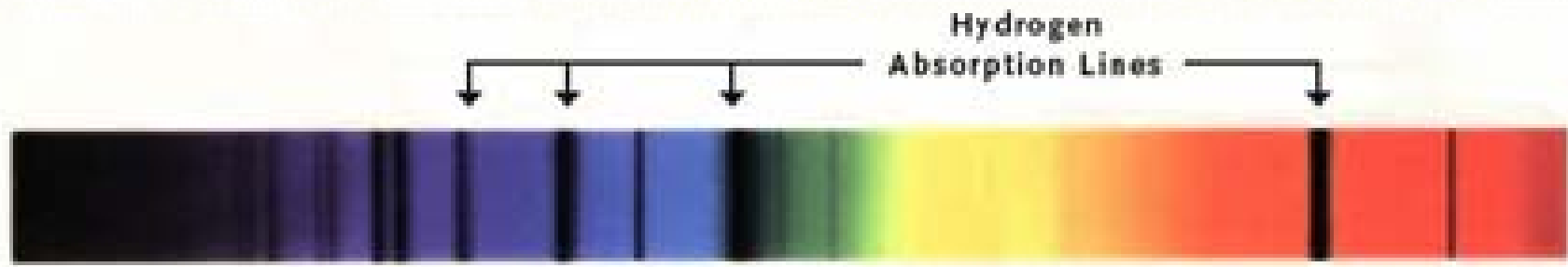
The Case for Two Quasar Populations

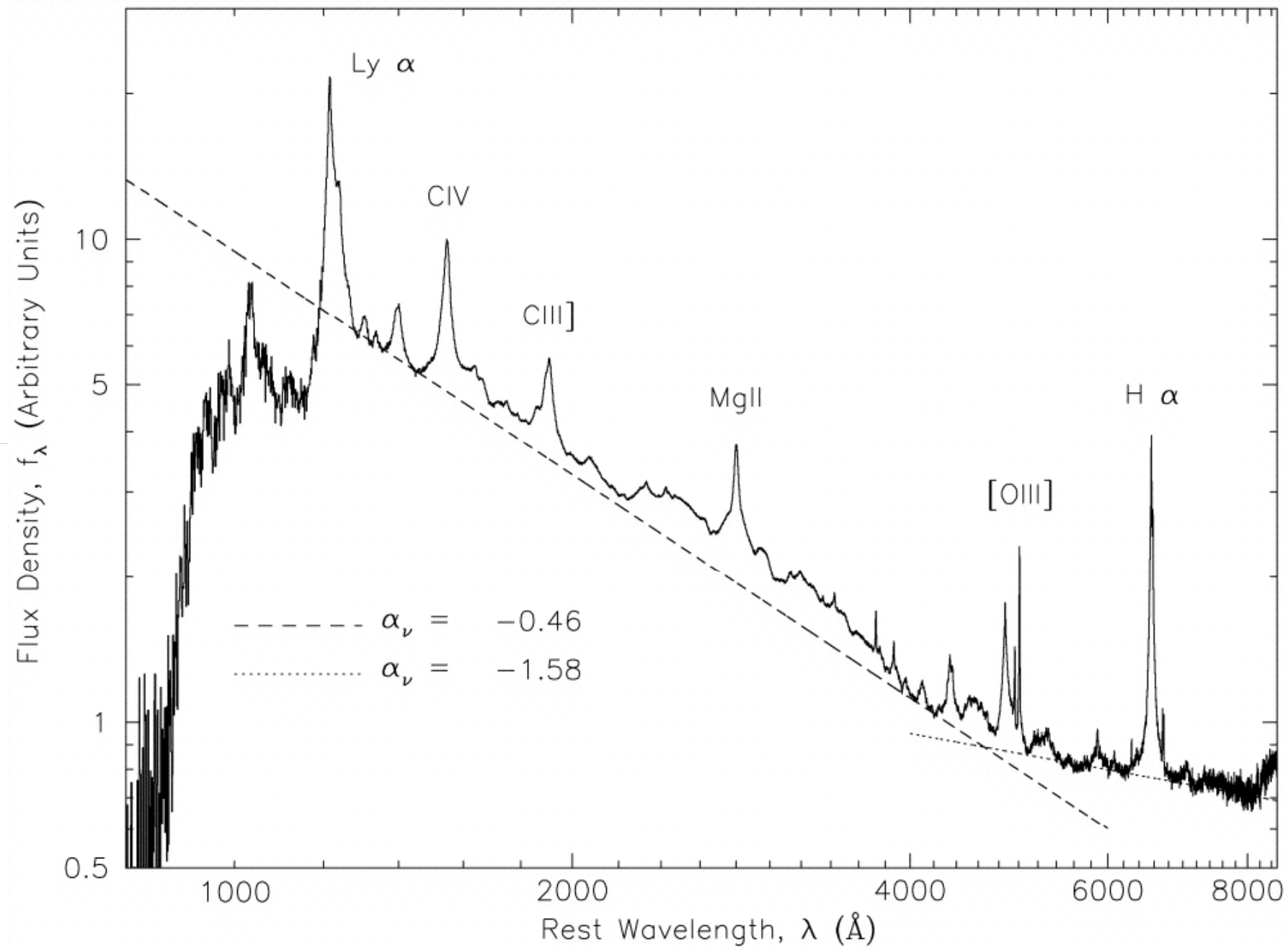
J. Sulentic – Instituto de Astrofísica de Andalucía

P. Marziani – INAF, Osservatorio Astronomico di Padova

S. Zamfir – U. Wisconsin Stevens Point





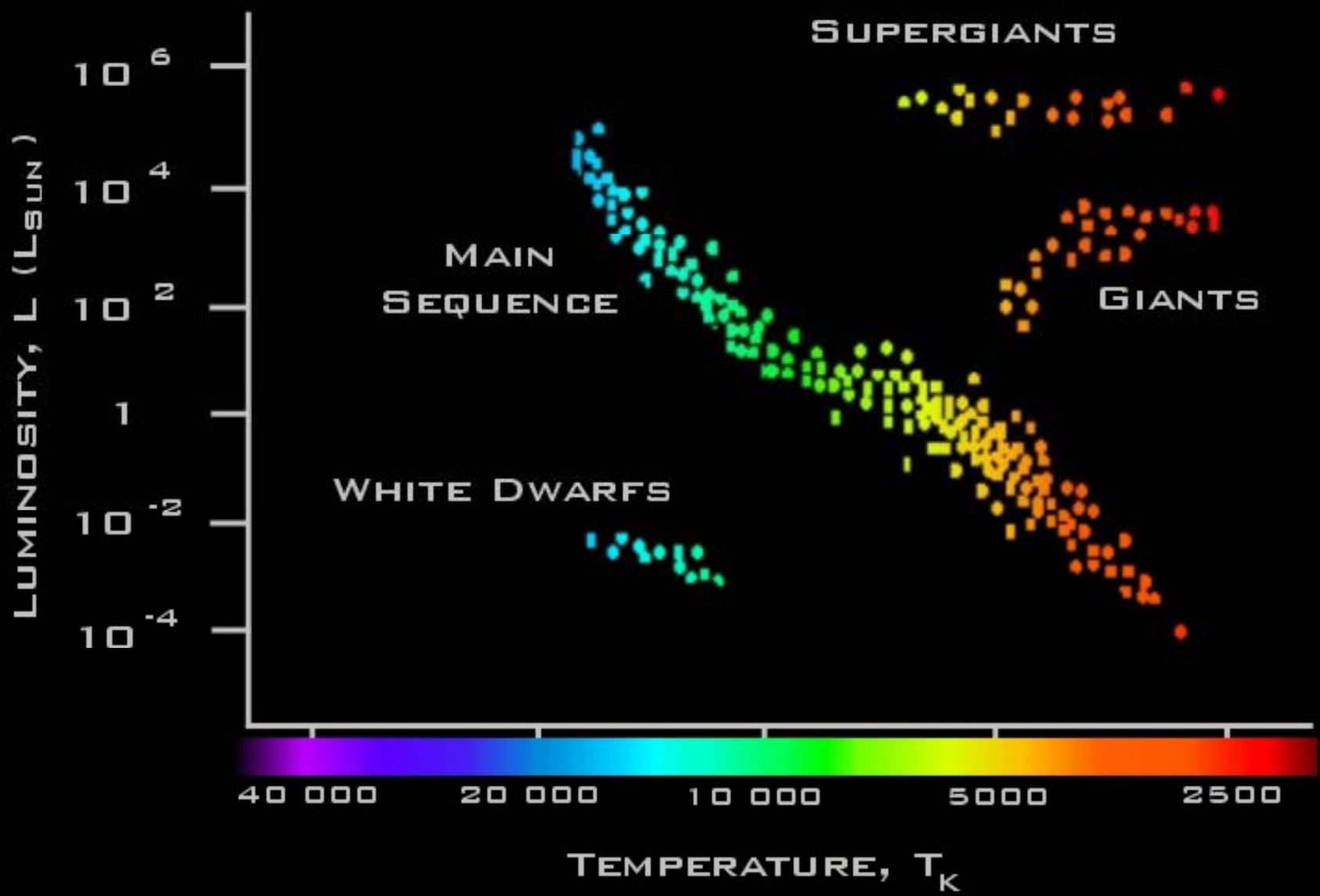


median

Vanden Berk, D. E. et al. - 2001, AJ, 122, 549

A SURROGATE H-R DIAGRAM FOR QUASARS

- **A CONTEXT THAT UNIFIES
SPECTROSCOPIC DIVERSITY**
- **MULTI-WAVELENGTH**
- **MULTI-DIMENSIONAL**
- **TO REMOVE DEGENERACY
BETWEEN PHYSICS AND
ORIENTATION**



4D EIGENVECTOR 1 PARAMETER SPACE

FWHM H_{β}

velocity dispersion of LIL

EW (Fell Optical) / EW (Broad H_{β}) (R_{Fell})

ratio of LIL with opposite density dependences

Soft X-ray Photon Index (Γ_{soft})

thermal emission signature

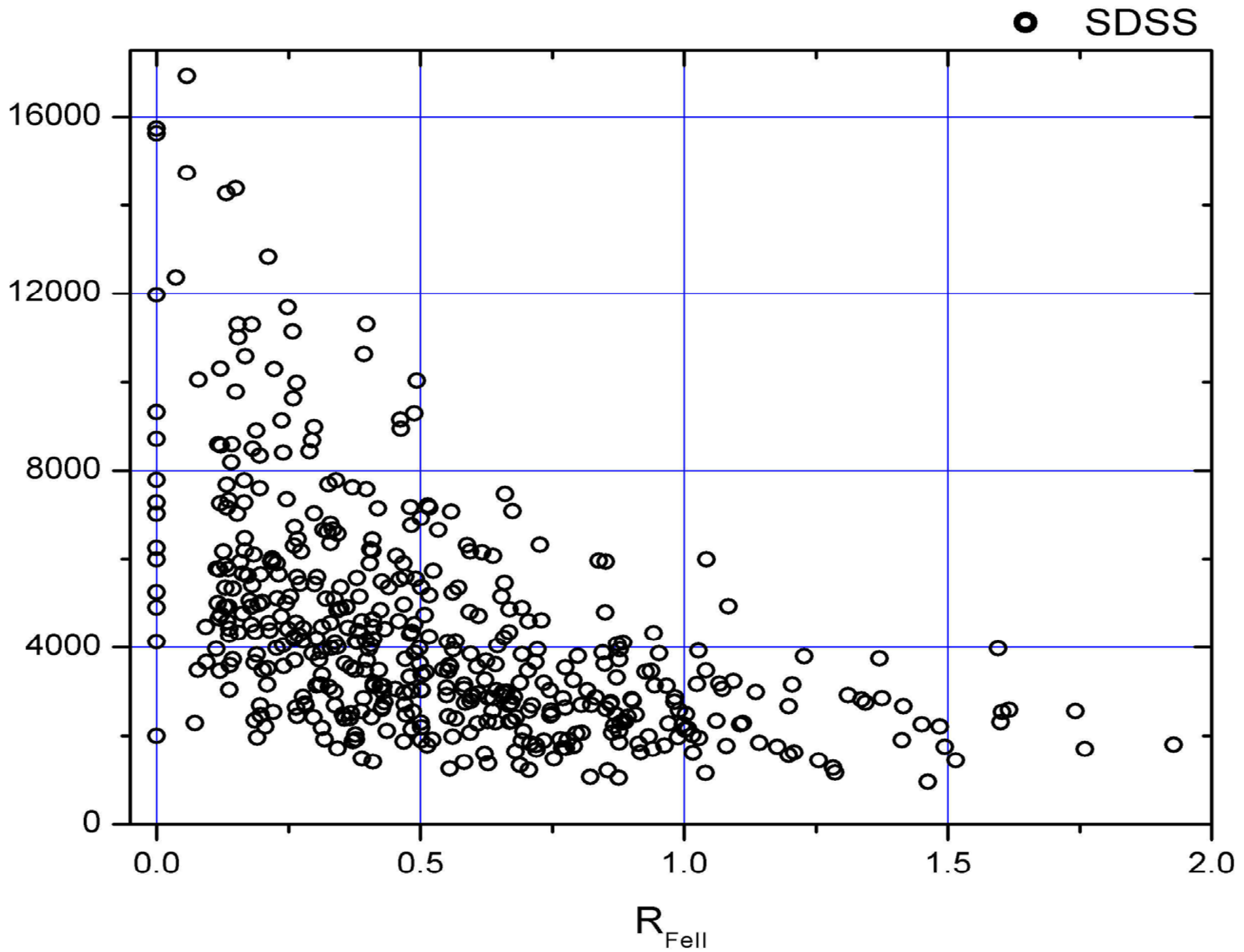
CIV $\lambda 1549$ Broad Line Shift

systematic motions of HIL

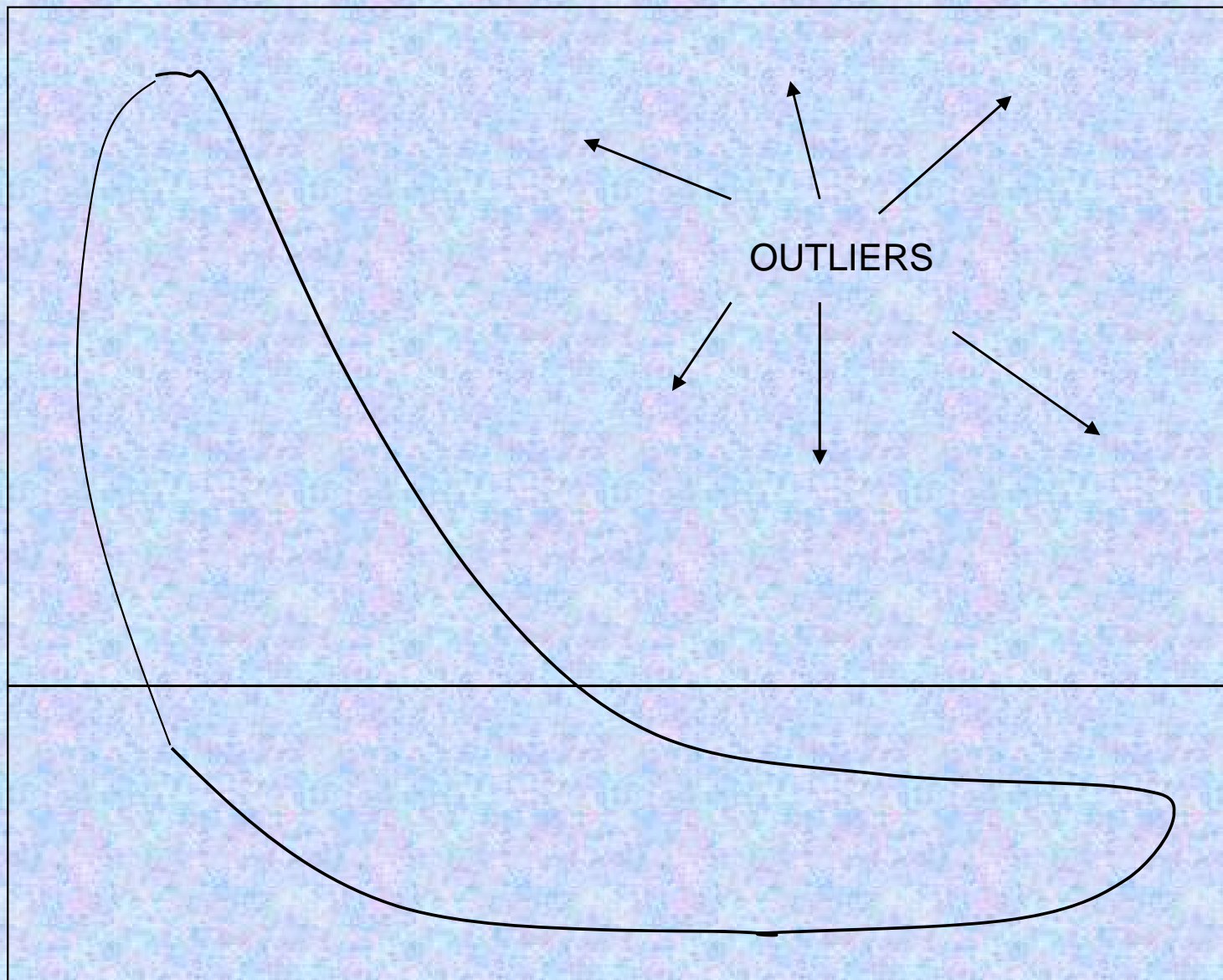
Precursors:

Boroson & Green (1992); Boller et al. (1996);

Marziani et al. (1996); Wang et al. (1996); Laor et al. (1997)



FWHM H β



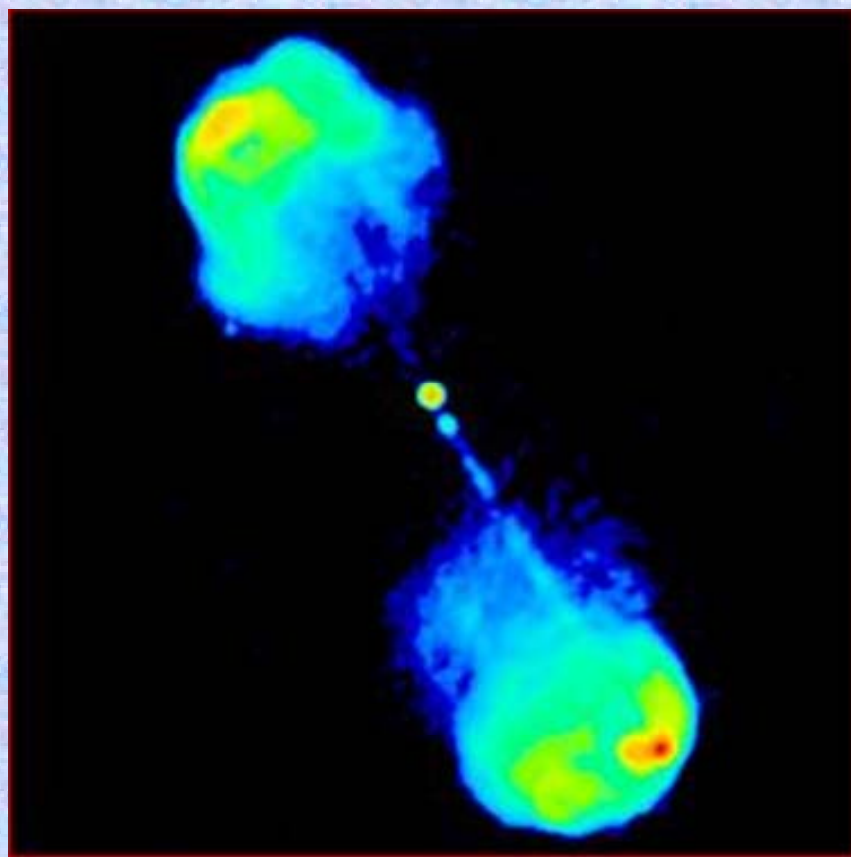
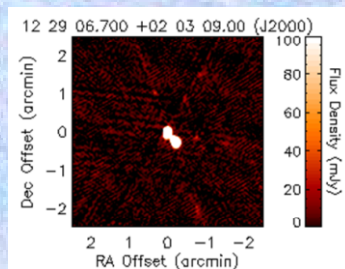
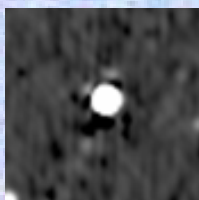
OUTLIERS

R_{Fell}

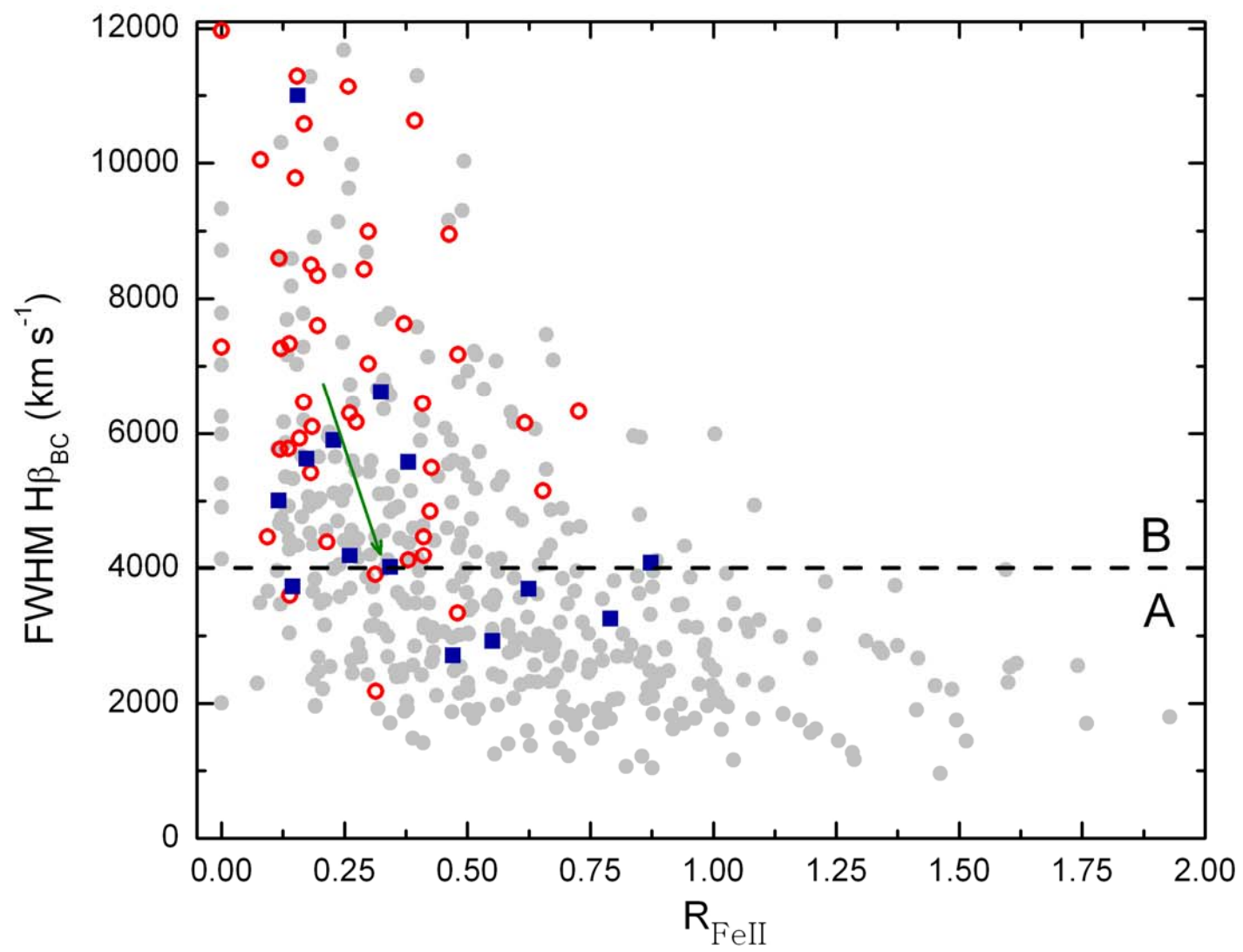
RL --RQ DICHOTOMY?

RL QUASARS OCCUPY A RESTRICTED
PARAMETER SPACE RELATIVE TO
THE RQ MAJORITY

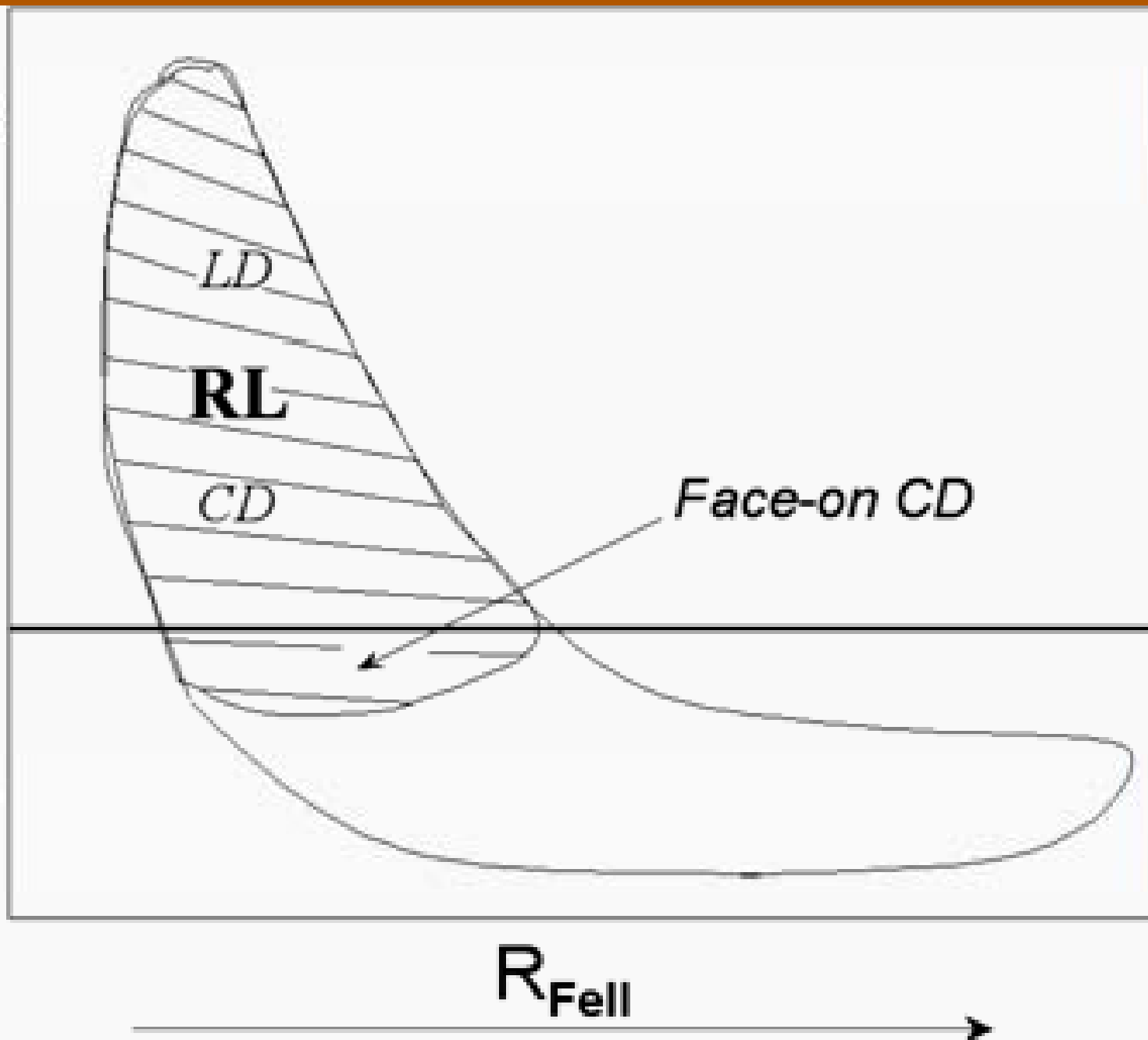
CORE AND LOBE DOMINATED RL's
ALSO SHOW PARAMETER SPACE
DIFFERENCES



Samples n1-parent and n2-test	Coordinates of quadrants FWHM H β (km s $^{-1}$) ; R_{FeII}	Probability of null hypothesis
392-non-RL and 85-RL	3875 ; 0.49	$P \sim 6.2 \times 10^{-8}$
46-RL FRII and 39-RL CD	6100 ; 0.18	$P \sim 9.8 \times 10^{-4}$



FWHM H β

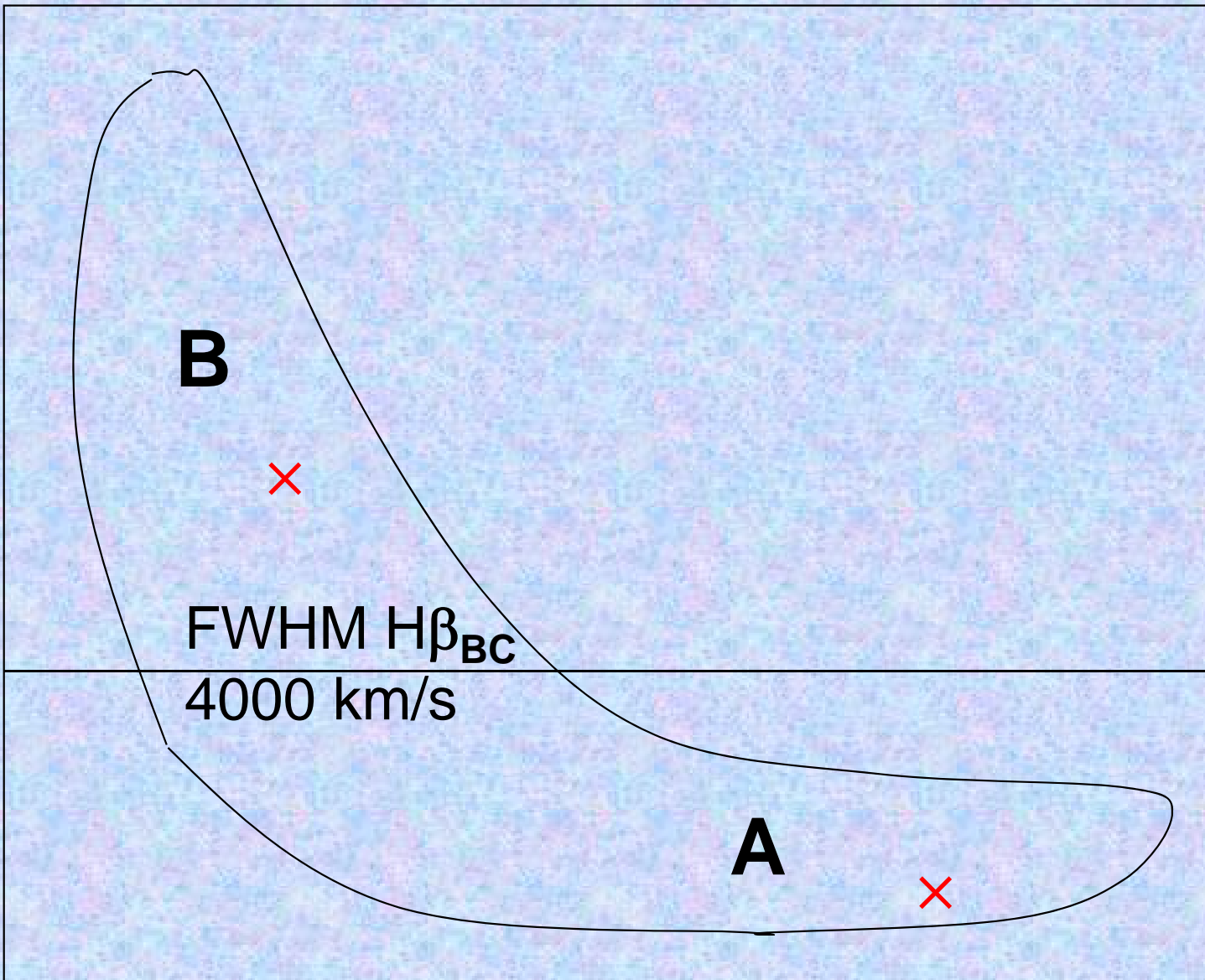


IS

FWHM HBETA = 4000 km/s

A MAGIC NUMBER?

FWHM $H\beta$



B



FWHM $H\beta_{BC}$
4000 km/s

A

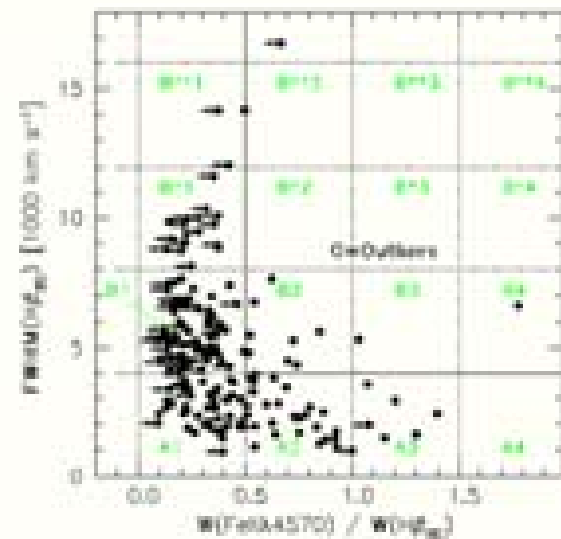


R_{Fell}

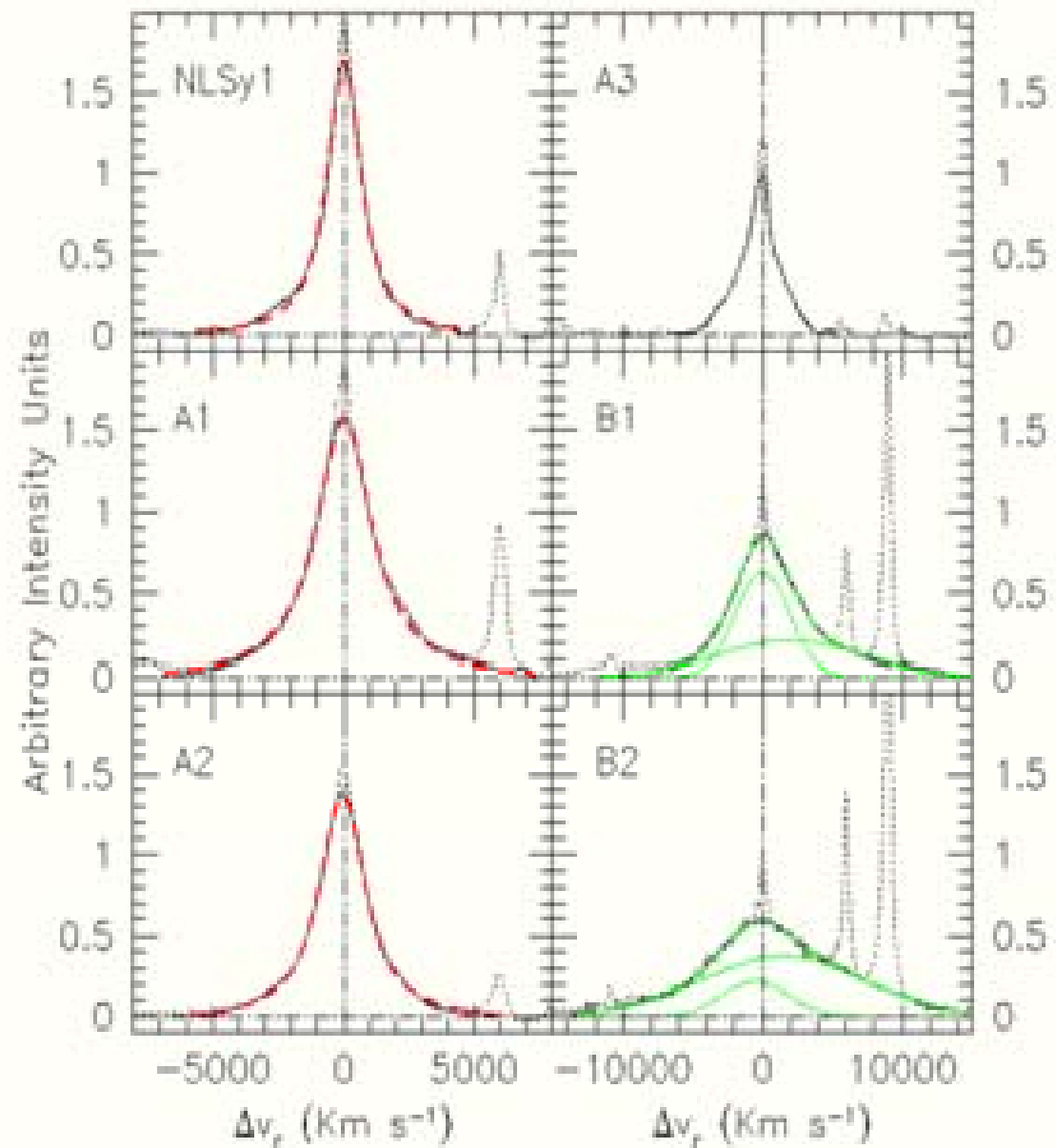


DICHOTOMY?

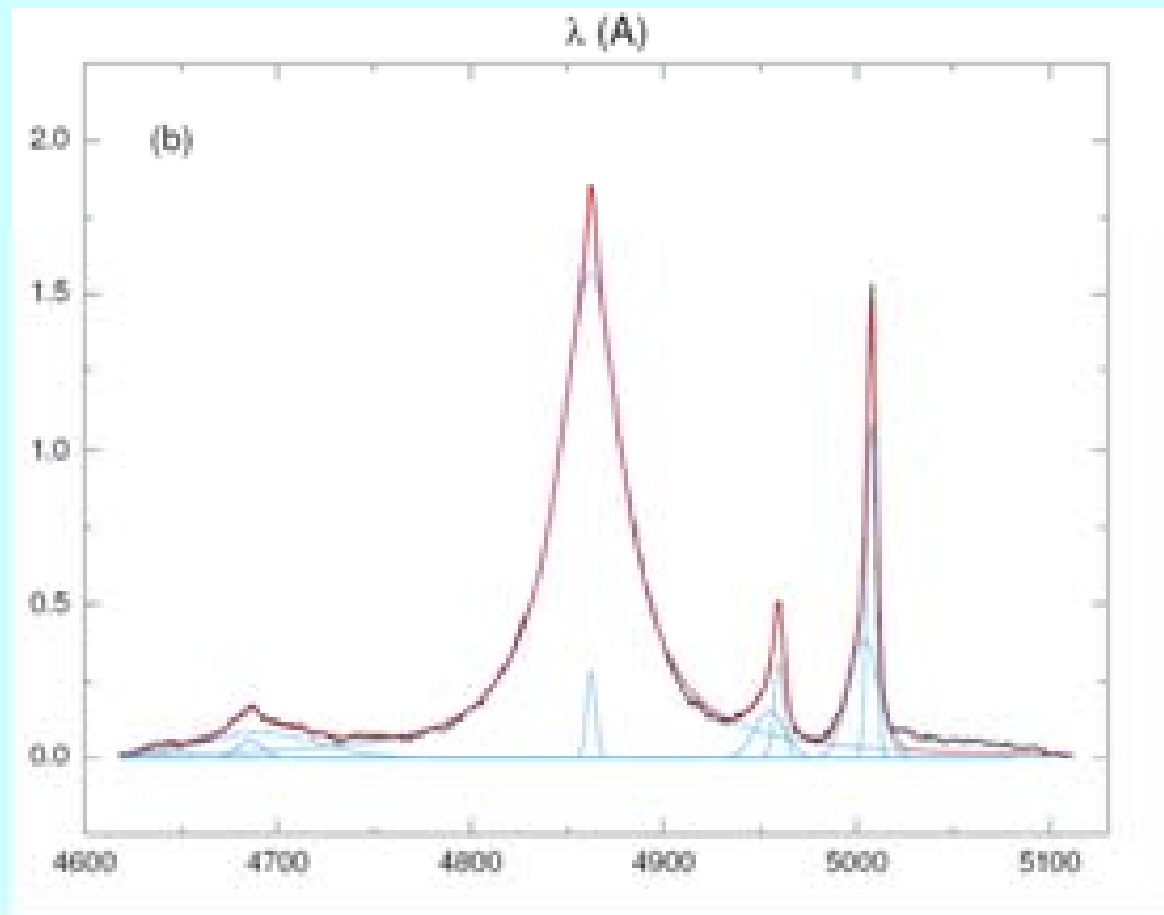
- Population A: FWHM HBETA < 4000 km/s, RFE > 0.5, HIL (e.g. CIV 1549) blueshift/asymmetry, soft X-ray excess, RQ
- Population B: FWHM HBETA > 4000 km/s, RFE < 0.5, no HIL blueshift or soft X-ray excess, mixed RL-RQ



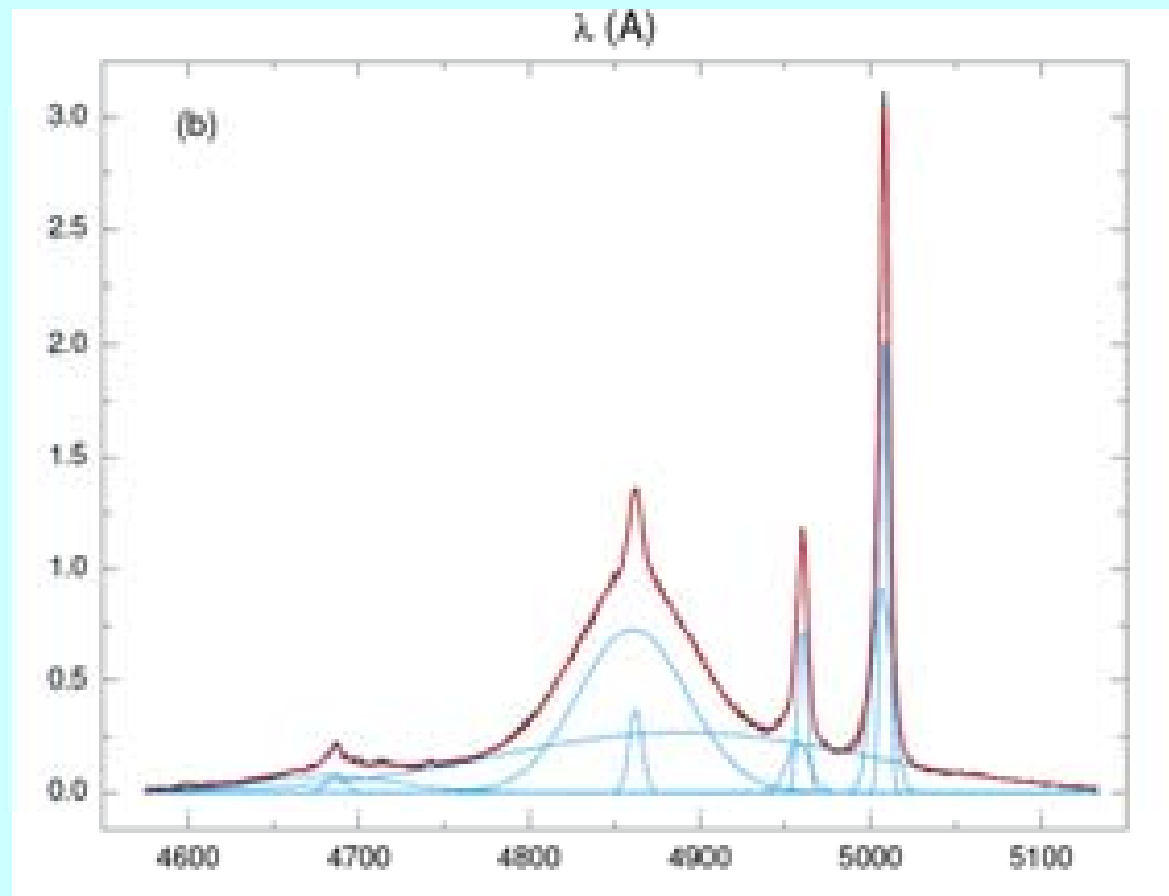
Sulentic et al. 2002:
**LIL/BLR Structural
 Difference between
 Population A and B**
 (Sample of about 200
 Seyfert 1 and
 low-redshift quasars
 High S/N and resolution
 4 Å FWHM)

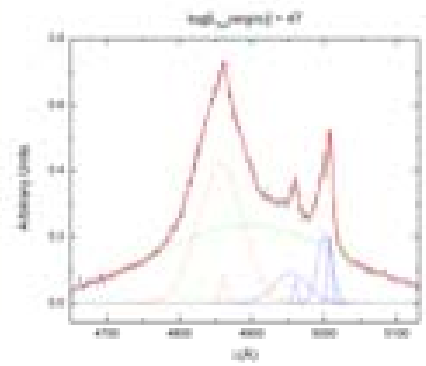
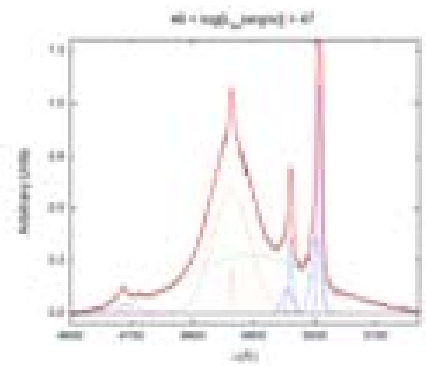
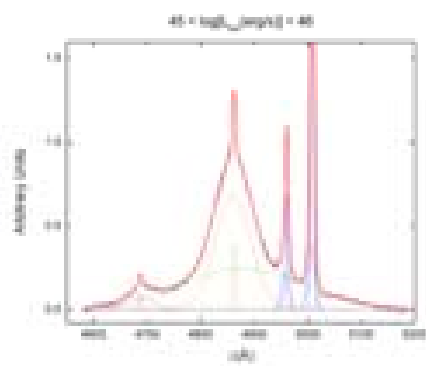
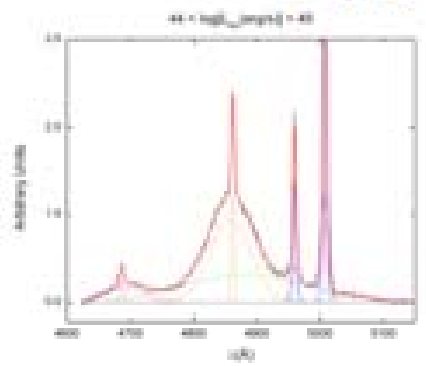
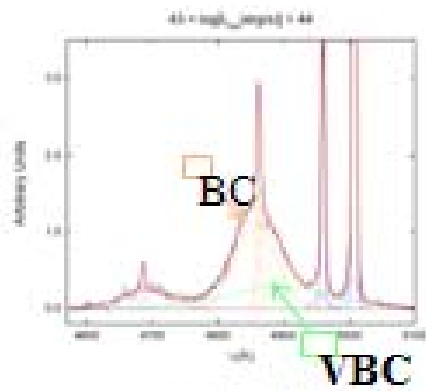


BIN A1 MEDIAN



BIN B1 MEDIAN





AN EXTRA LINE
COMPONENT IN POPULATION B
HBETA

VERY BROAD LINE COMPONENT

FWHM HBETA $\sim\sim 10000\text{km/s}$

REDSHIFT $\sim\sim 1-2000\text{km/s}$

PG 1416-129:

Inner H β

Very Broad

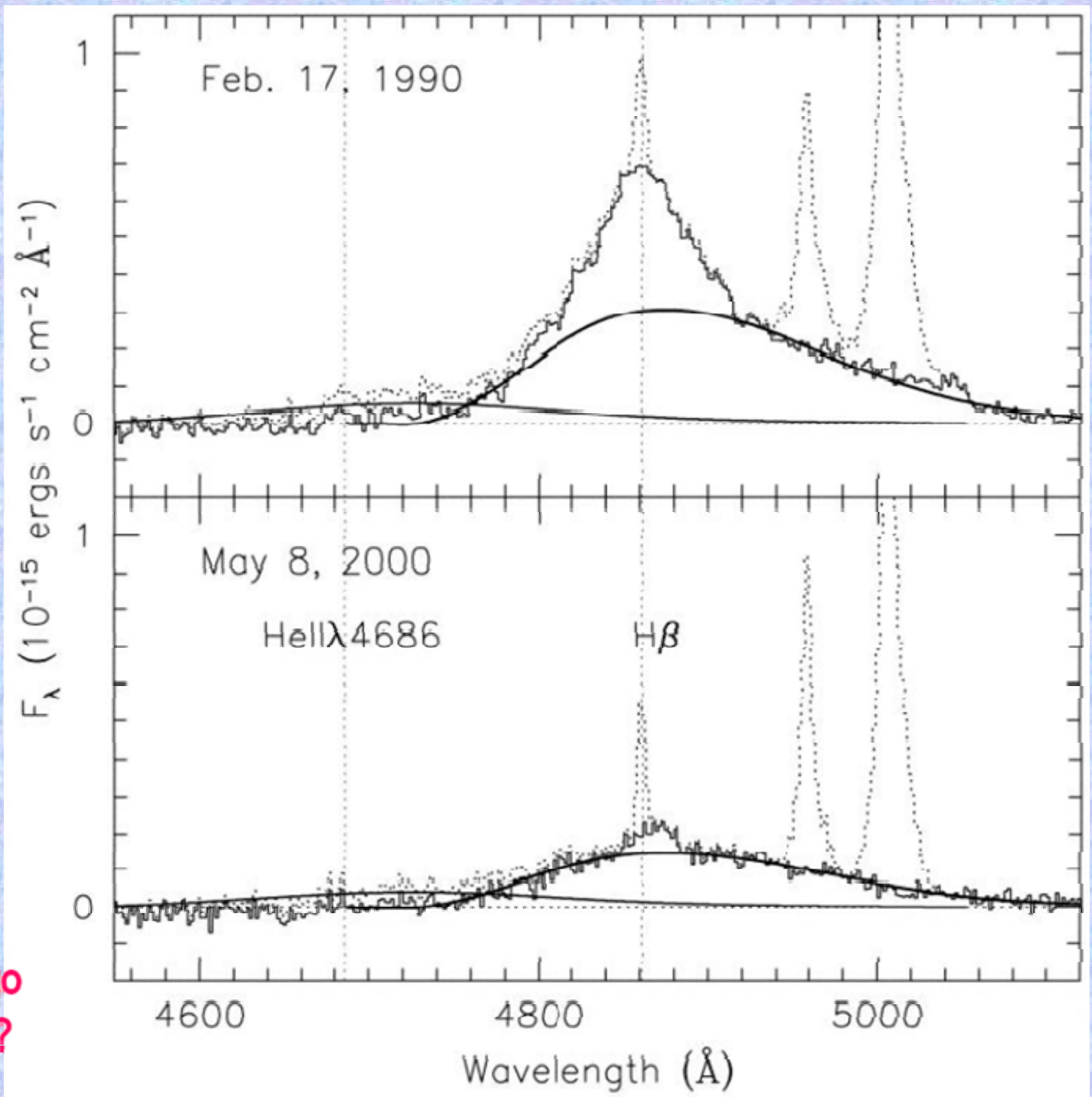
Component:

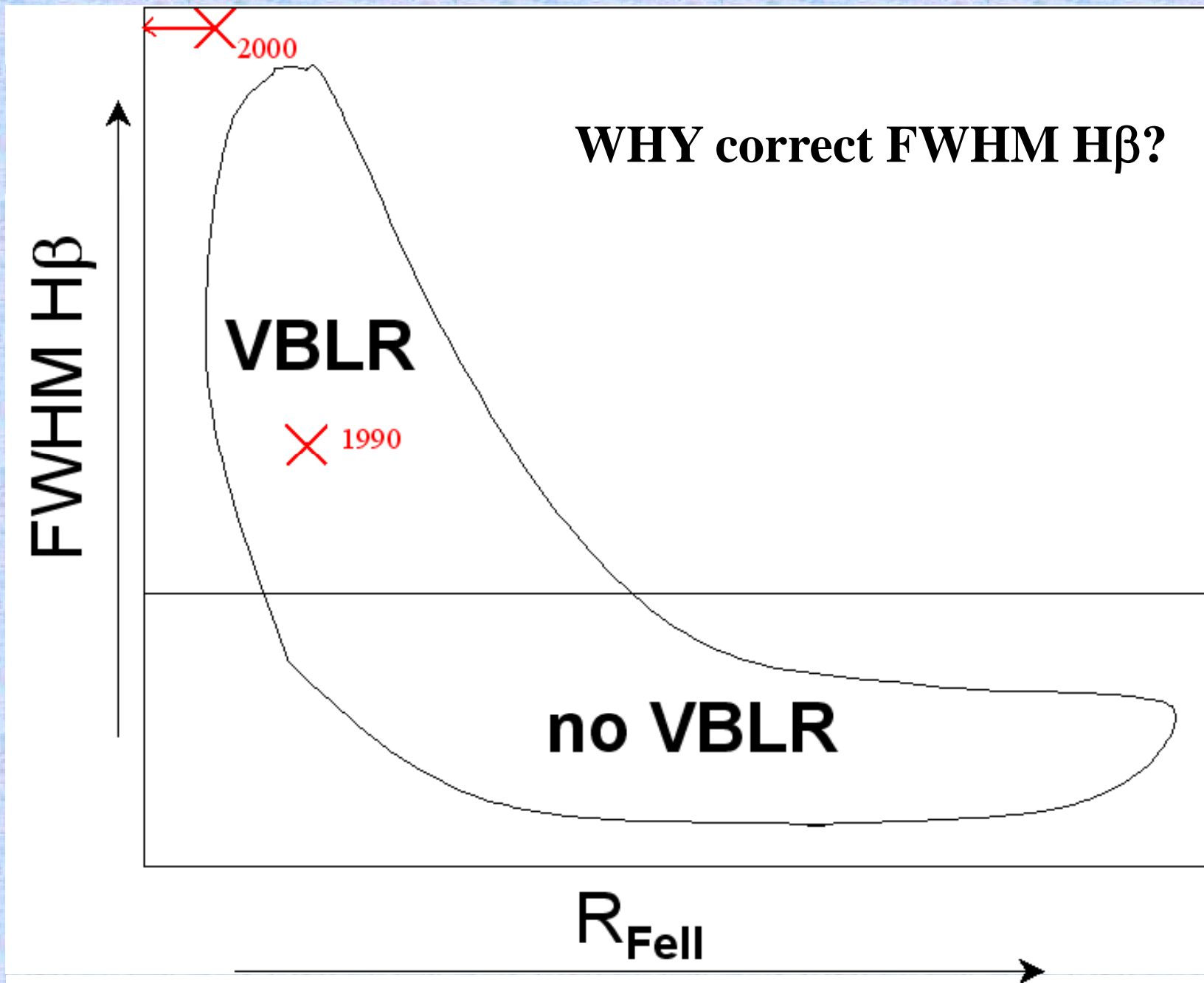
A large covering factor region (i.e., almost a thin shell) located closest to continuum source and marginally thick or optically thin to the HI ionizing continuum

Redward

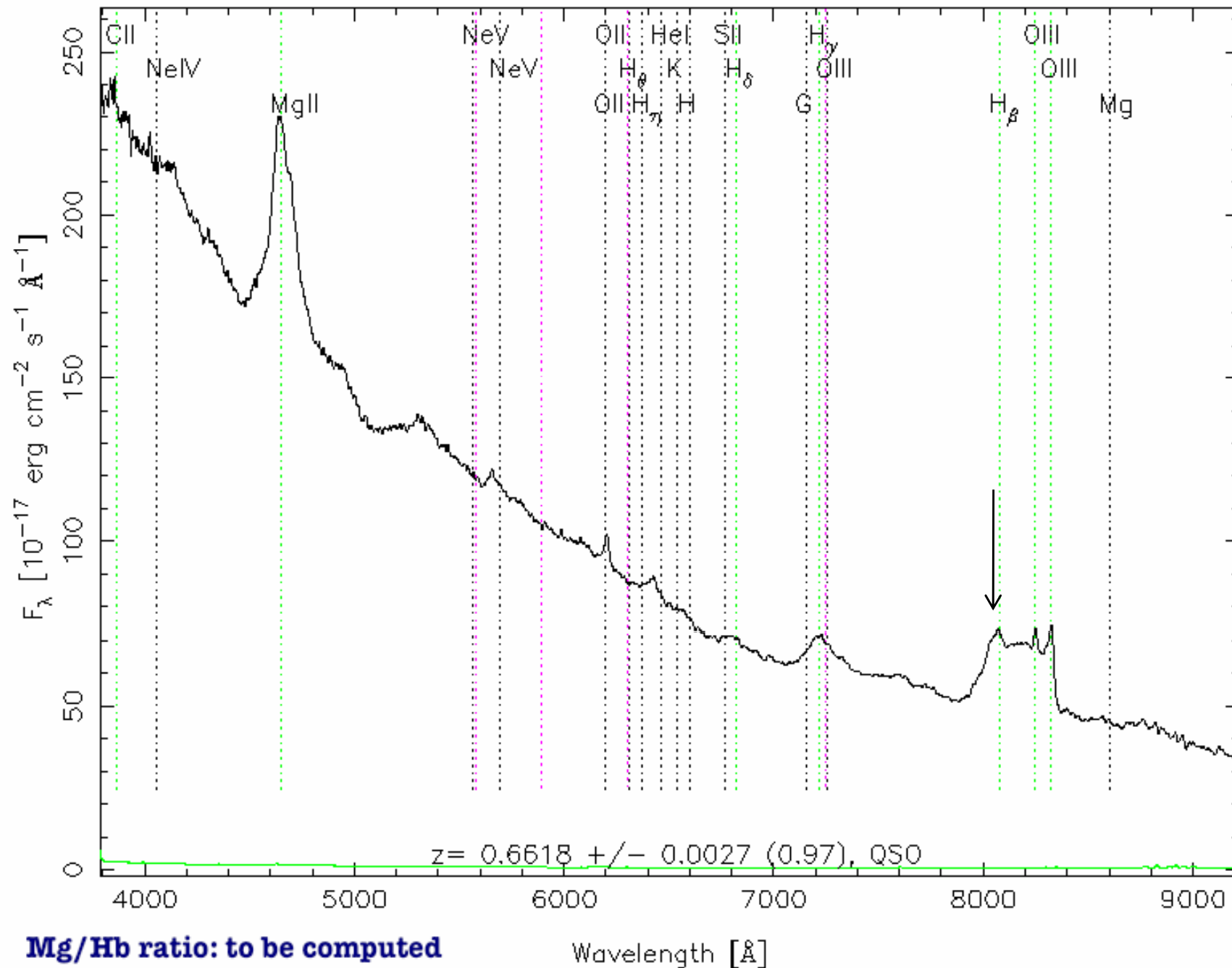
Asymmetry of

Population B sources due to optically thin infalling gas?





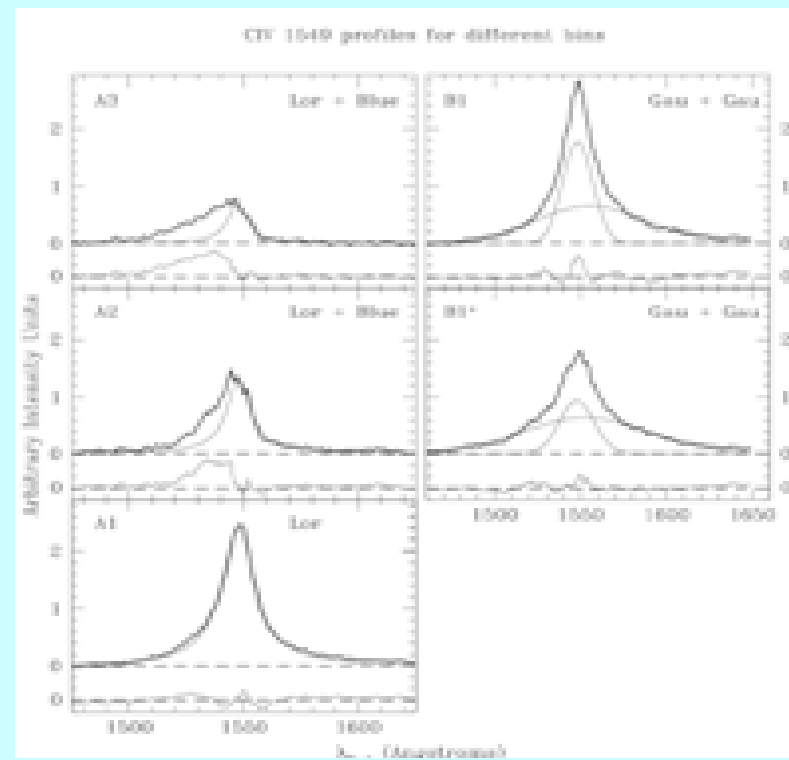
RA=181.10014, DEC=43.51582, MJD=53120, Plate=1448, Fiber=451



AN EXTRA LINE
COMPONENT IN POPULATION A
CIV

BLUE ASYMMETRIC COMPONENT

AVG. CIV PROFILES



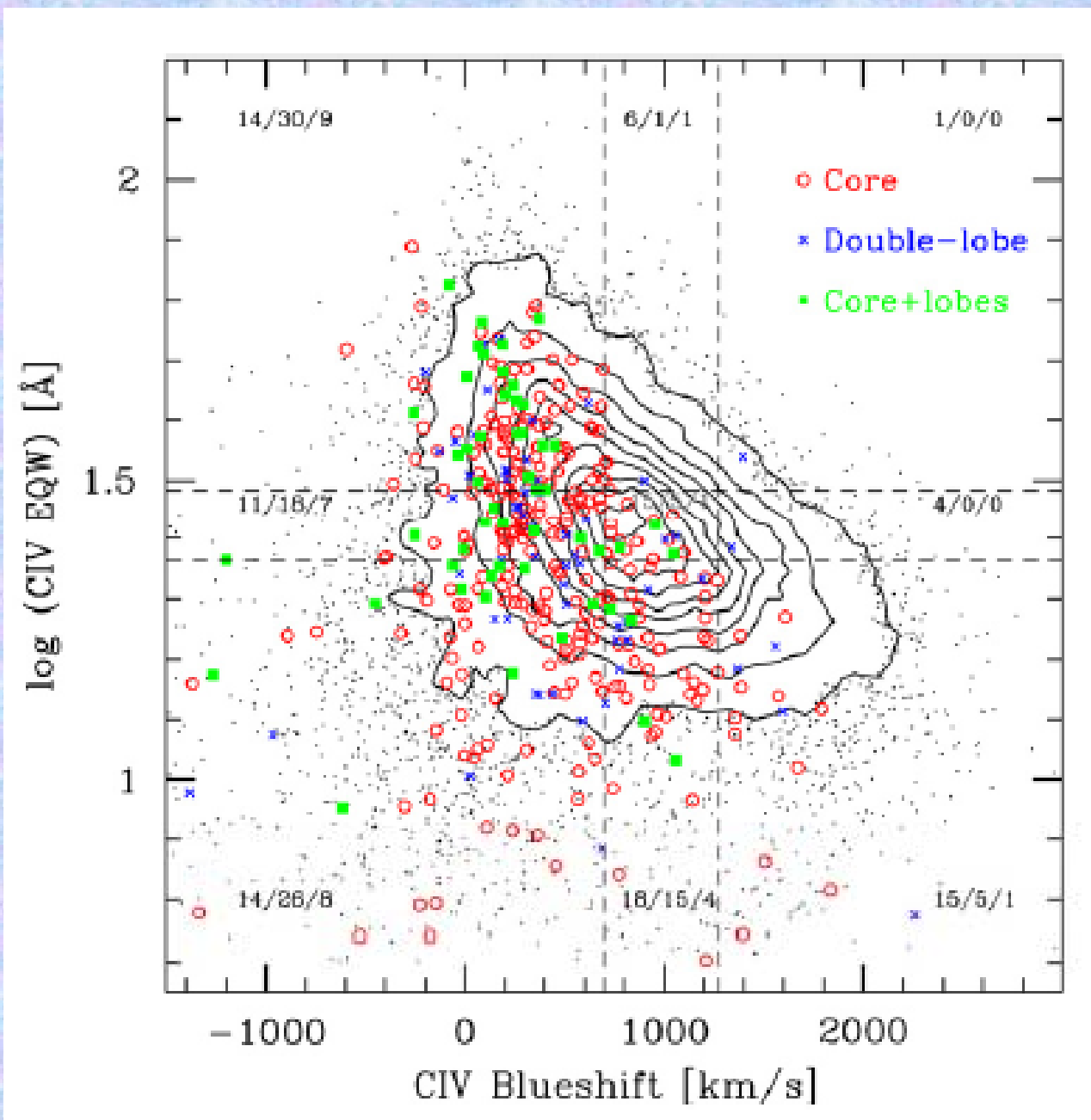
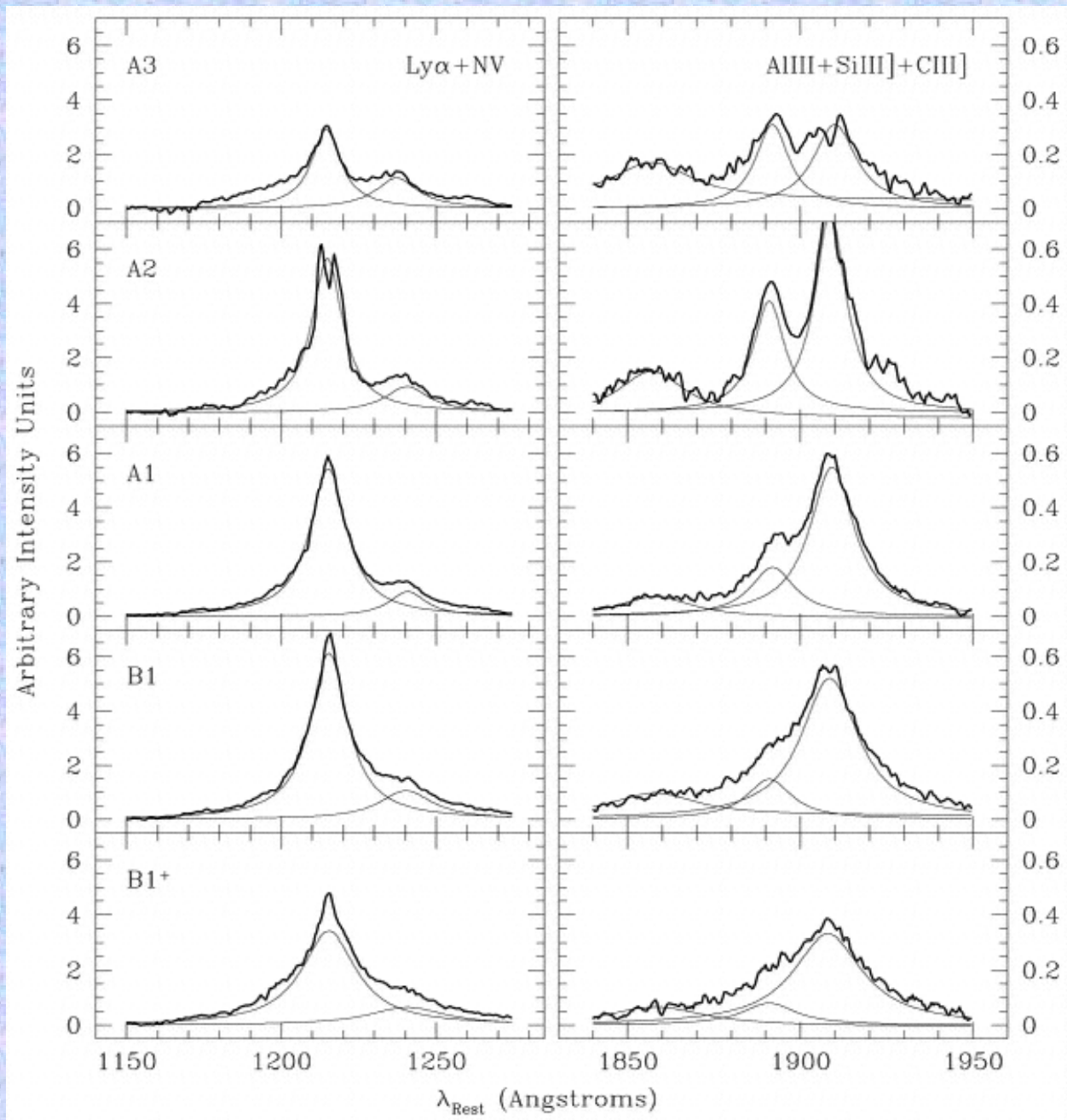
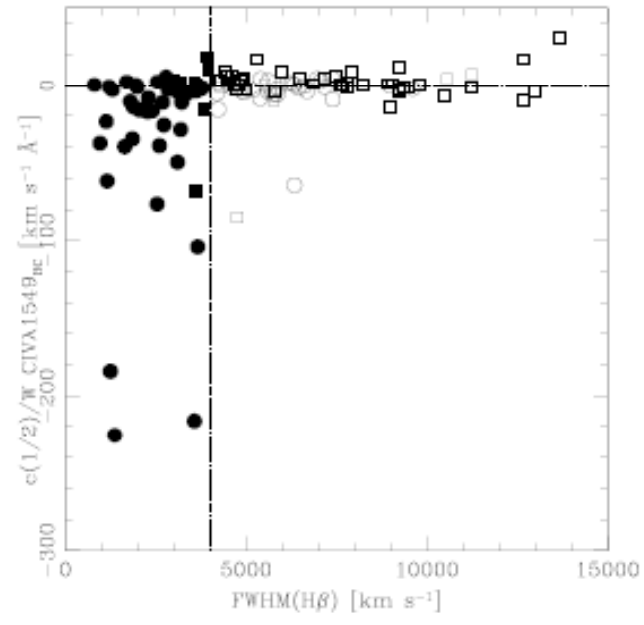
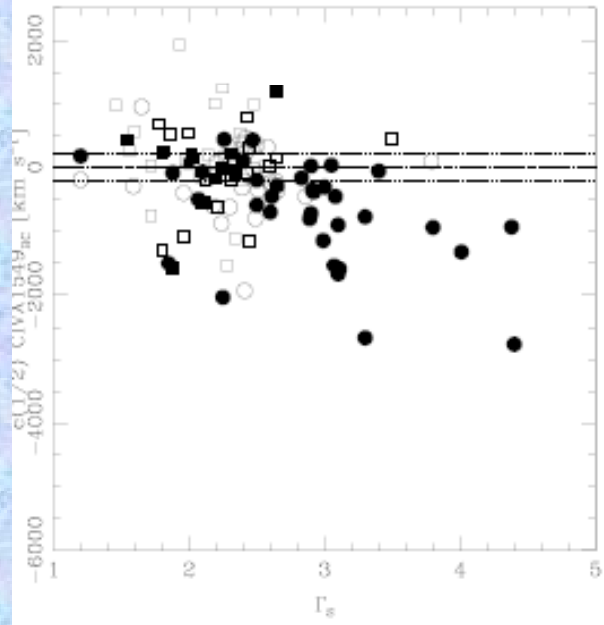
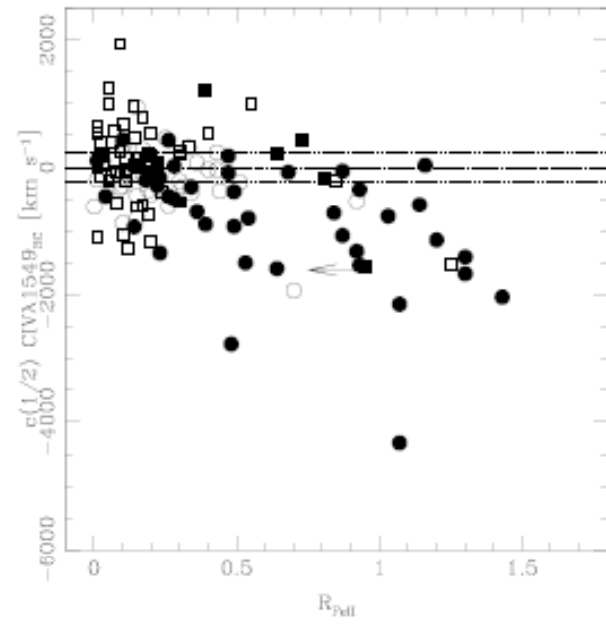
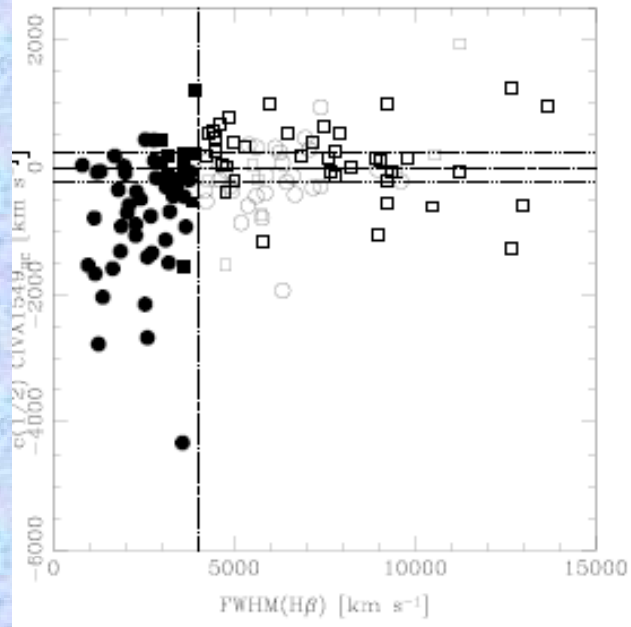


Table 1. MAIN TRENDS ALONG THE 4DE1 SEQUENCE

Parameter	Population A	Population B	References
FWHM($H\beta_{BC}$)	800 – 4000 km s ⁻¹	4000 – 10000 km s ⁻¹	1,2
R_{Fe}	0.7	0.3	1
$c(\frac{1}{2})_{CIV\lambda 1549_{BC}}$	-800 km s ⁻¹	zero	3,10
Γ_S	often large	rarely large	1,11
$W(H\beta_{BC})$	~ 80 Å	~ 100 Å	1
$H\beta_{BC}$ profile shape	Lorentzian	double Gaussian	4,7
$c(\frac{1}{2})_{H\beta_{BC}}$	~ zero	+500 km s ⁻¹	5
SiIII / CIII]	0.4	0.2	8,9
FWHMCIV $\lambda 1549_{BC}$	(2–6) · 10 ³ km s ⁻¹	(2–10) · 10 ³ km s ⁻¹	0
$W(CIV\lambda 1549_{BC})$	58 Å	105 Å	0
AI(CIV $\lambda 1549_{BC}$)	-0.1	0.05	0
X-ray variability	extreme/rapid common	less common	12,13
optical variability	possible	more frequent/higher amplitude	14
probability radio loud	≈ 3–4%	≈ 0.25 %	15
BALs	extreme BALs	less extreme BALs	16,17
log density ¹	>11	9.5 – 10	8
log U ¹	-2.0/-1.5	-1.0/-0.5	8
log M_{BH}	6.5 – 8.5	8.0 – 10.0	5,6
L/L_{Edd}	0.1 – 1.0	0.01 – 0.5	5,6

1: Sulentic et al. 2000a; 2: Collin et al. 2006; 3: Sulentic et al. 2007; 4: Veron-Cetty et al. 2001; 5: Marziani et al. 2003b; 6: Peterson et al. 2004; 7: Sulentic et al. 2002; 8: Marziani et al. 2001; 9: Wills et al. 1999; 10: Baskin & Laor 2005; 11: Wang et al. 1996 12: Turner et al. 1999 13: Grupe et al. 2001; 14: Giveon et al. 1999; 15: Zamfir et al.





PHYSICAL DRIVERS FOR QUASARS?

- Orientation
- Black Hole Mass
- Eddington Ratio
- BH Spin?
- Host Galaxy Morphology?

