The relationship between variable and polarized optical spectral components of luminous type 1 non-blazar quasars

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Kokubo 2016, PASJ, 68, 52

arXiv: 1604.04626

East-Asia AGN Workshop 2016, SNU, Sep. 21-23, 2016

NASA/CXC/M.Weiss

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    for 4 quasars which were spectropolarimetrically observed by Kishimoto, Antonucci, et al. (2004)
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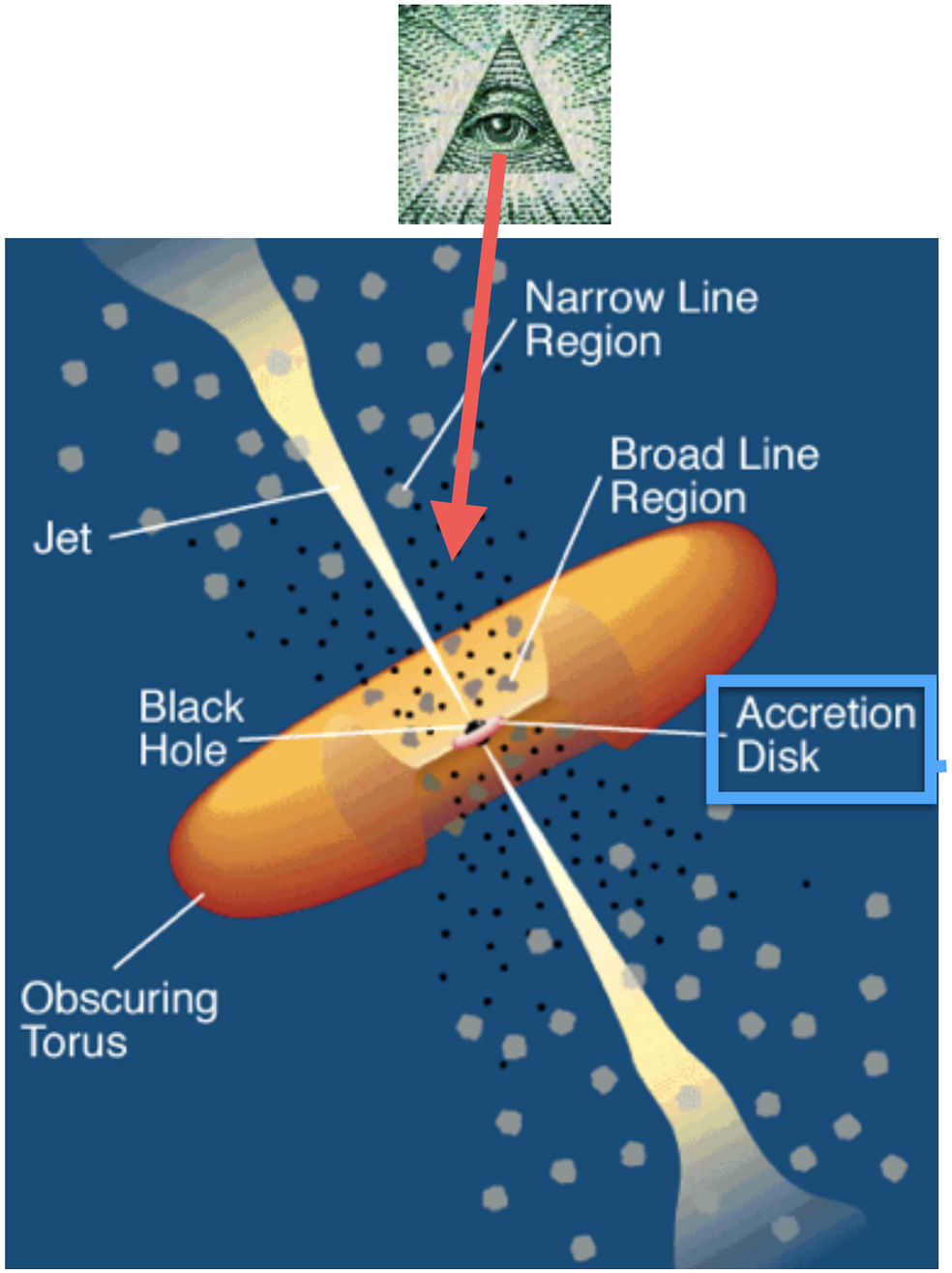
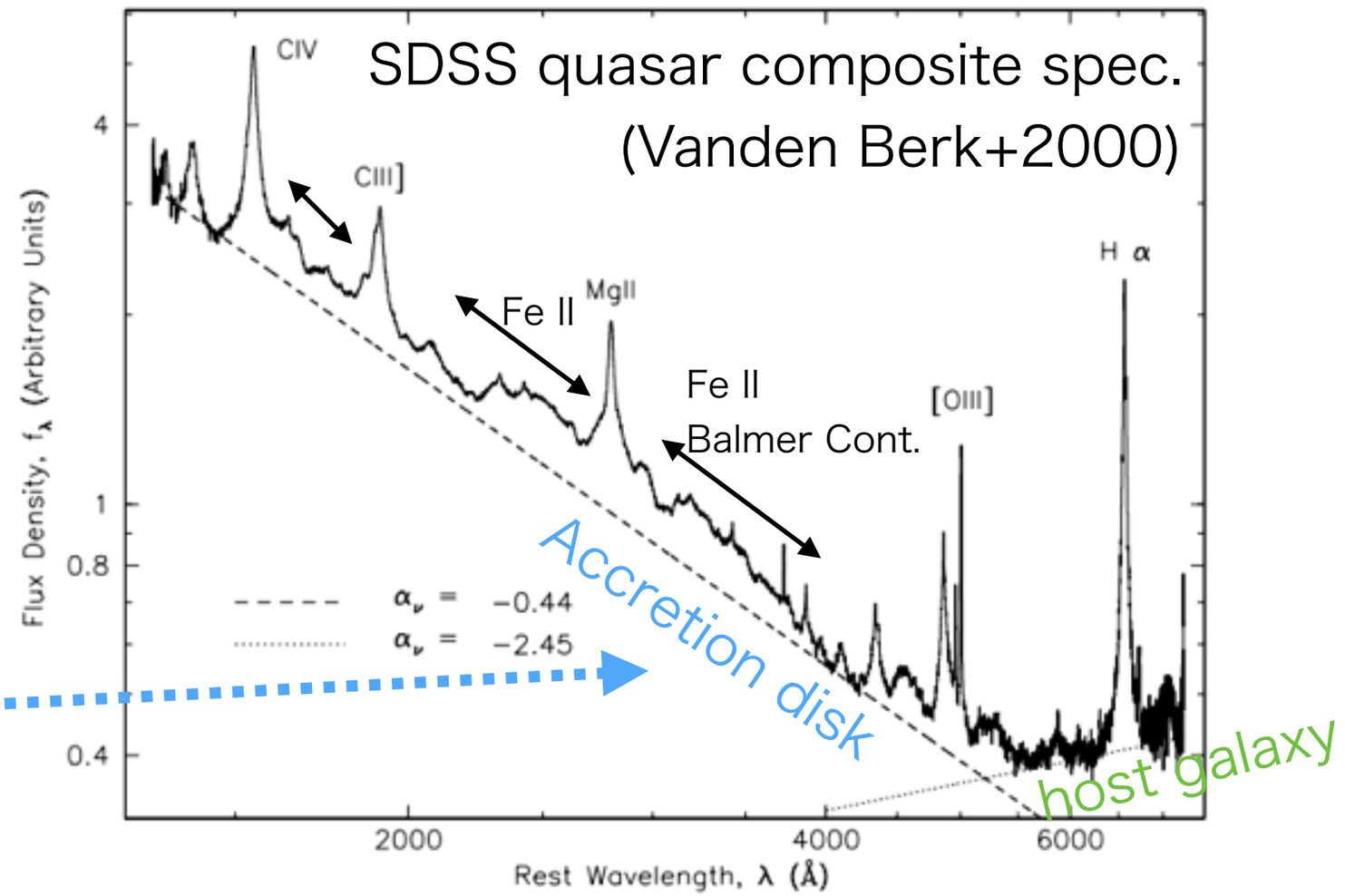
Quasar UV-optical emission



Urry & Padovani 1995

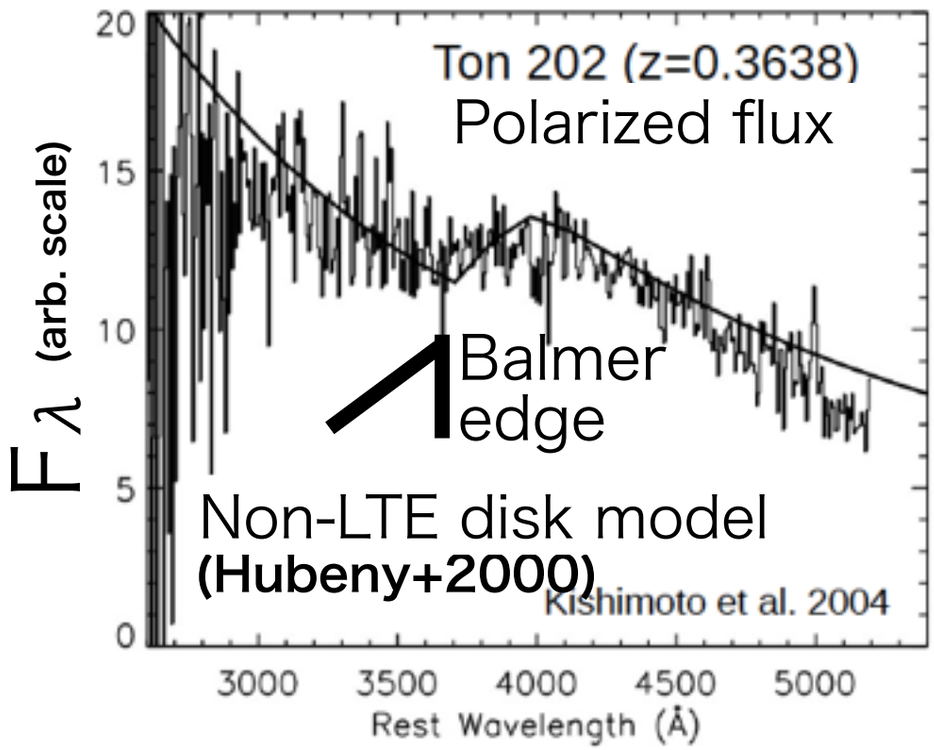


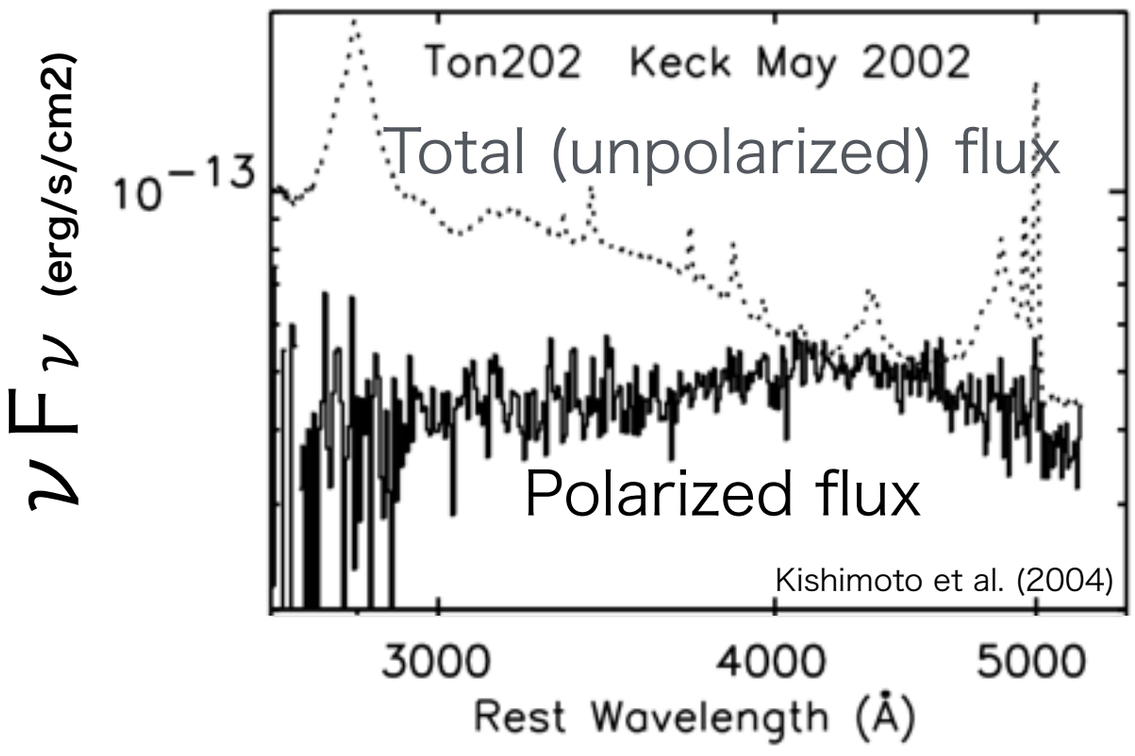
Disk thermal emission is buried under
BLR emission + Host galaxy light
—> preventing us from direct comparison between the observed spectrum with disk models.

Quasar optical polarization (p ~ 1%)

- Spectropolarimetric survey for 14 type 1 quasars carried out by Kishimoto, Antonucci et al. (2004)
  —> In 5 of 14 quasars, polarization is confined only to the continua (BLR emission is unpolarized)

- Interpretation: polarized flux spectra of these quasars are the Thomson-scattered disk continua
  i.e., the spectral shape of the polarized flux directly reflects the spectral shape of the intrinsic disk emission spectrum (e.g., Smith+2005).





Broad MgII and Balmer emission lines do not appear in the polarized flux spectrum.

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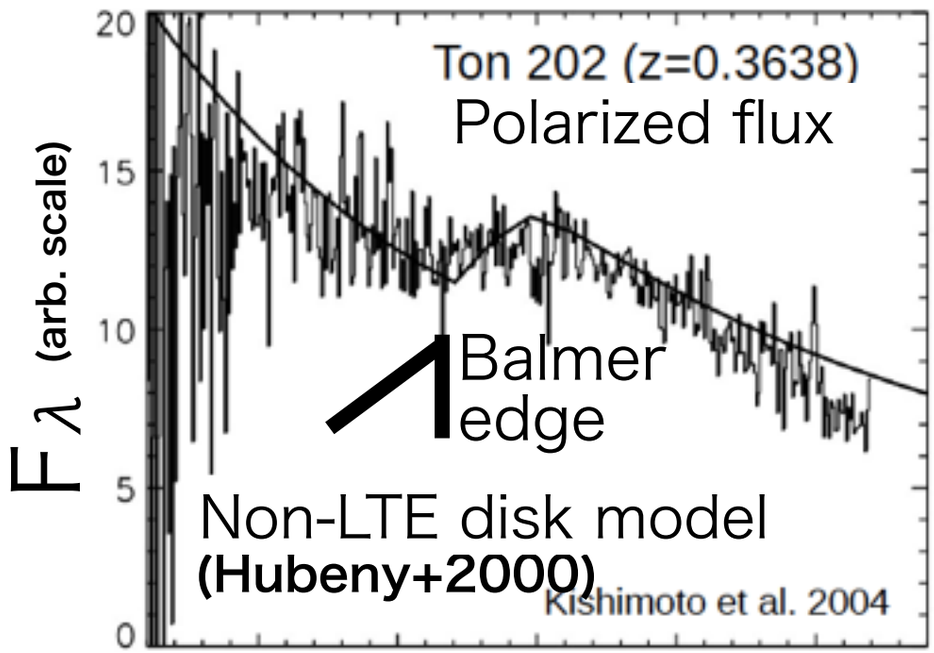
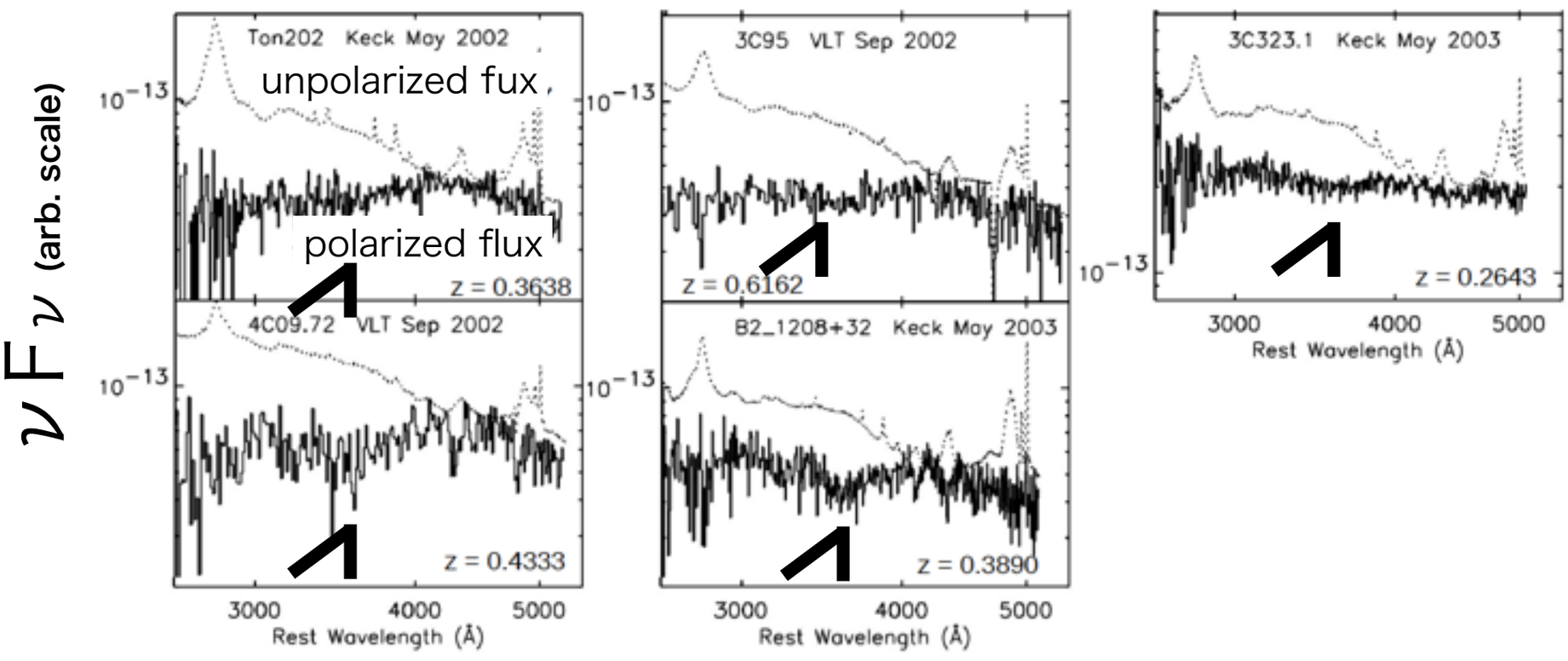
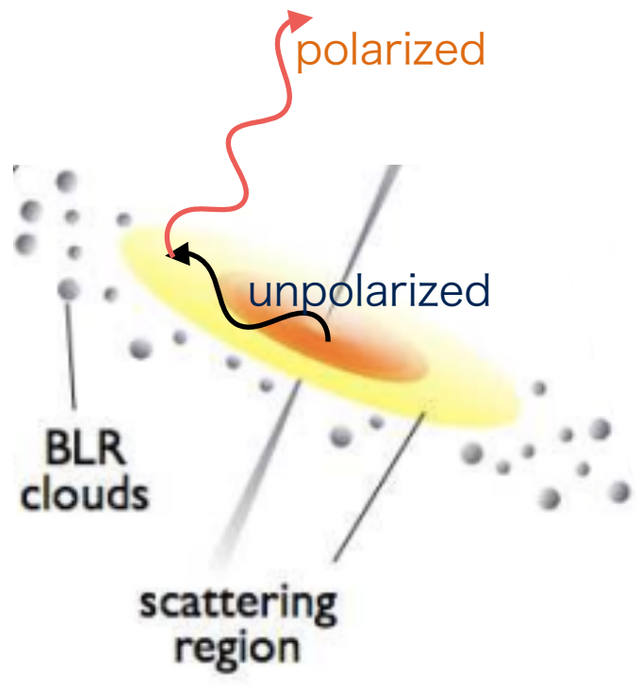




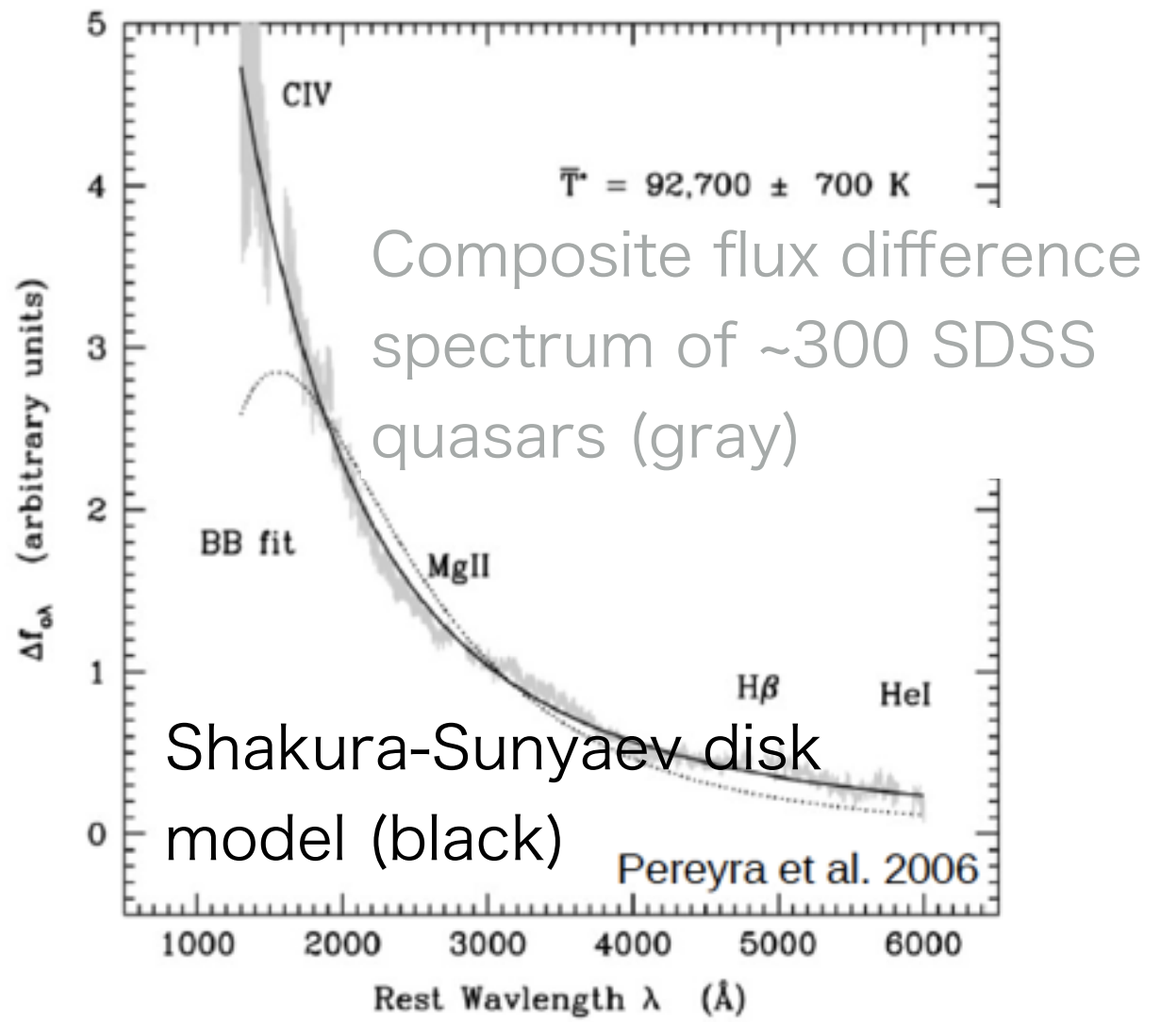


Quasar optical variability

- Quasar UV-optical continuum emission shows flux variability

- The emission from broad line region also varies, but with smaller amplitude compared with the continua (< 30%) (Wilhite et al. 2004)

—> Spectral shape of the variable component is though to reflect the spectral shape of the intrinsic disk continuum (e.g., Pereyra+2006, Schmidt+2012, Kokubo+2014).



Motivation of this work

- According to the current understanding、both of the polarized and variable component spectra reflect the spectral shape of the intrinsic accretion disk emission.

  This implies that the spectral shape of the polarized and variable component **in each quasar** must be the same
  <— yet to be observationally confirmed

- In this work, we derive the variable component spectra of 4 quasars spectropolarimetrically observed by Kishimoto et al. (2004), and then examine the consistency of spectral shape between the variable and the polarized component spectra

Multi-band photometric monitoring observations with 1.05m Kiso Schmidt Telescope

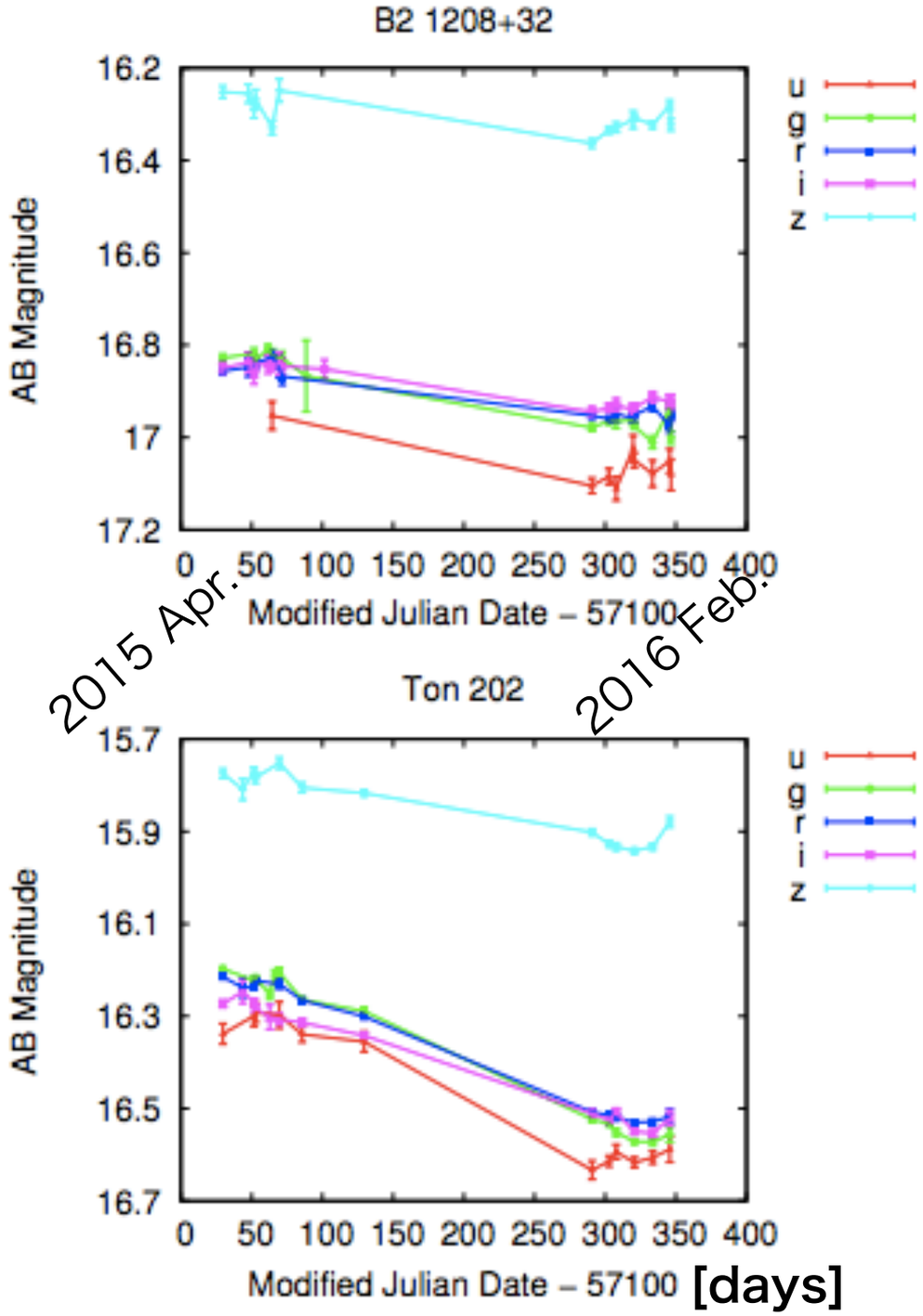
5 quasars with continuum-confined polarization (Kishimoto et al. 2004)
M_{BH}~10^9 M_{sun}, Eddington ratio ~ 0.1

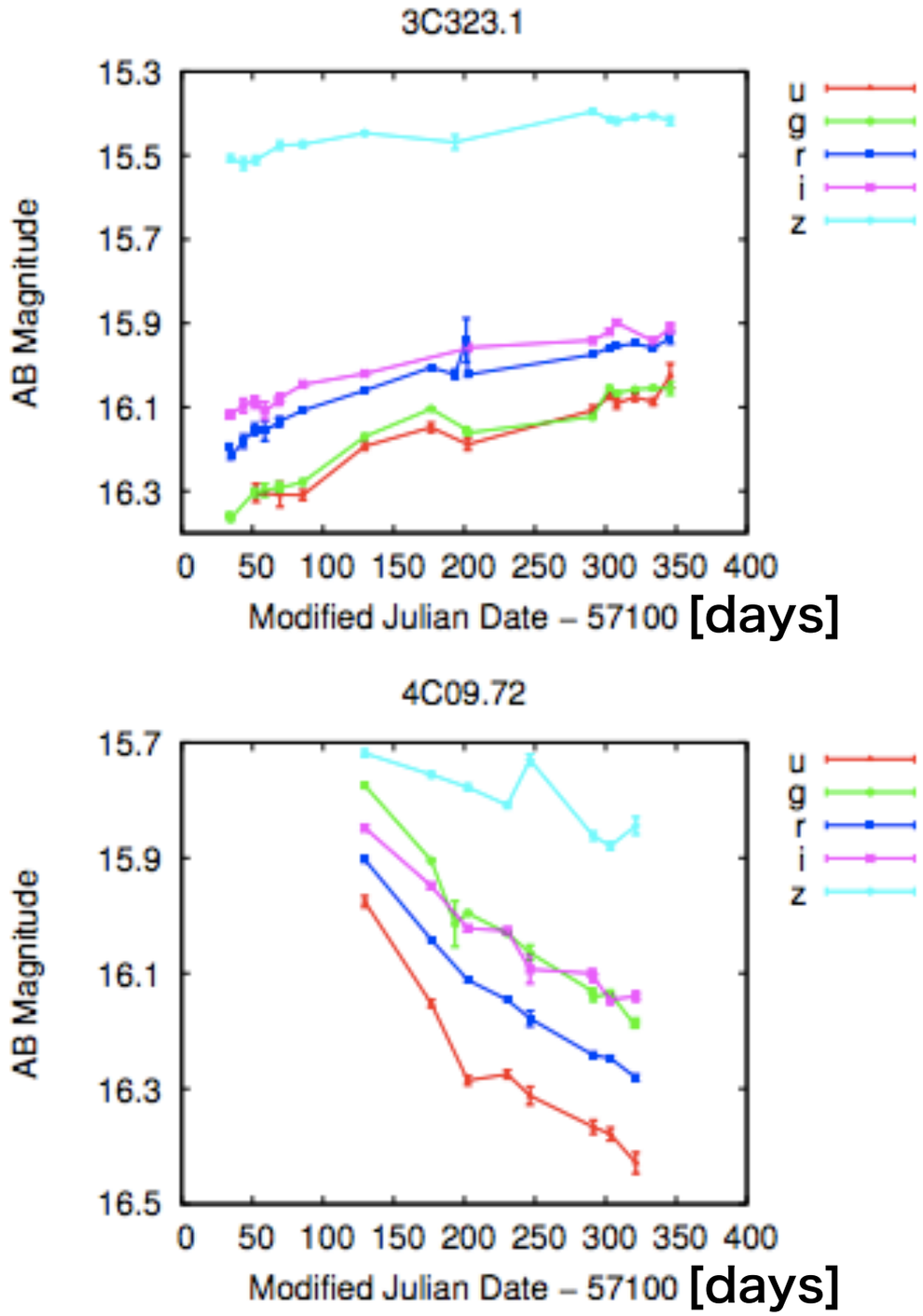
Name	R.A.	Decl.	Redshift	Ar [mag]	V-band [mag]	P [%] (4000Å)
3C95	03:51:28.5	+14:29:09	0.6162	0.18	~16.2	1.17±0.02
B2 1208+32	12:10:37.6	+31:57:06	0.3890	0.05	~16.7	1.41±0.01
Ton202	14:27:35.6	+26:32:15	0.3638	0.05	~16.0	2.11±0.01
3C323.1	15:47:43.5	+20:52:17	0.2643	0.12	~16.7	1.37±0.01
4C09.72	23:11:17.7	+10:08:15	0.4333	0.12	~16.0	1.33±0.01

*3C95 has not yet been analyzed

- Filters : u, g, r, i, z (calibrated by SDSS field stars)
- Cadence : Once per three weeks, 5-band simultaneous
- Period : April 2015 — February 2016

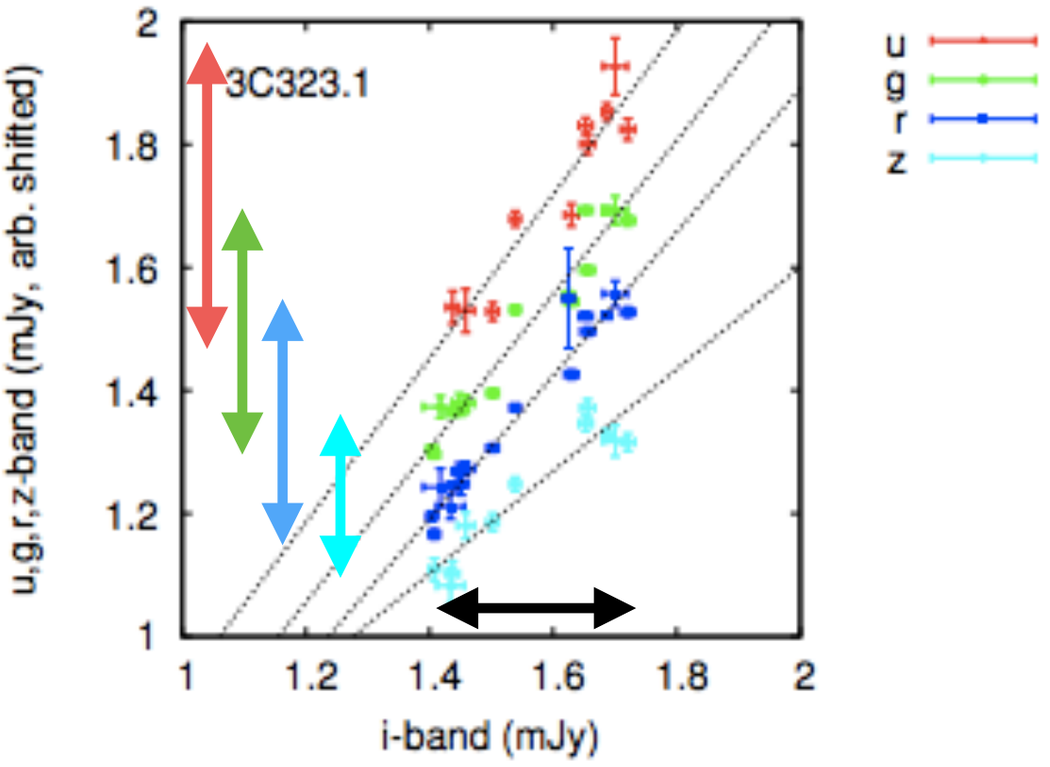
Result: multi-band light curves

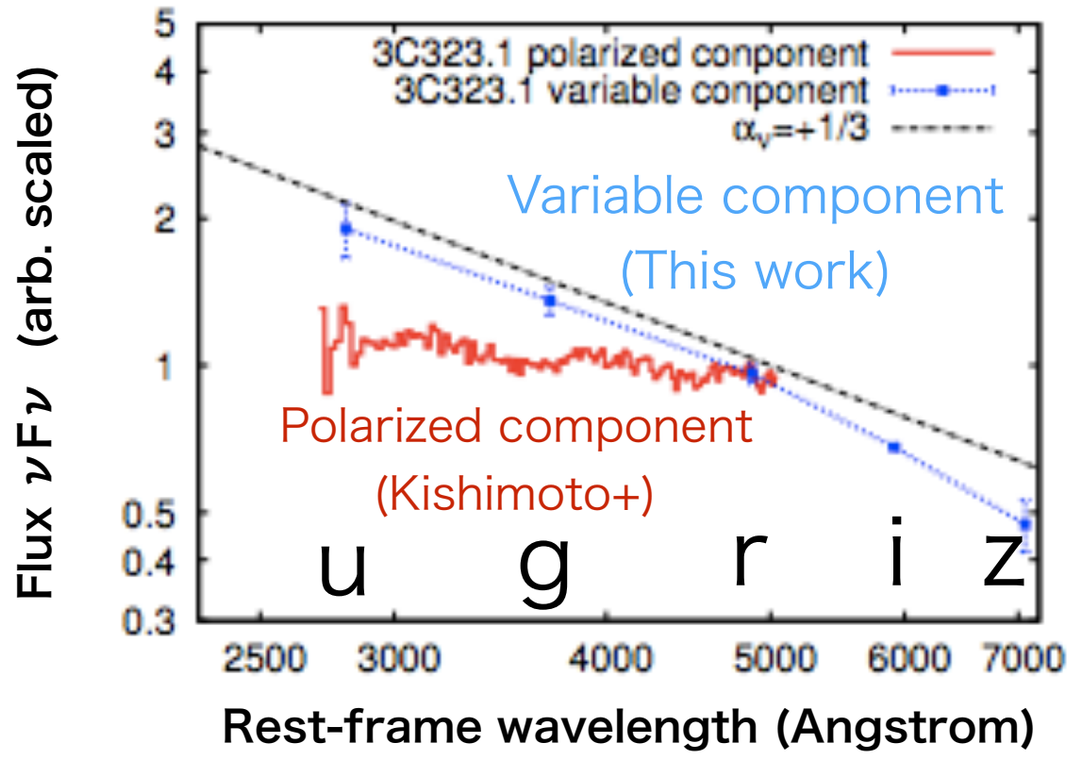




> 0.1 mag variability has been detected in all quasars

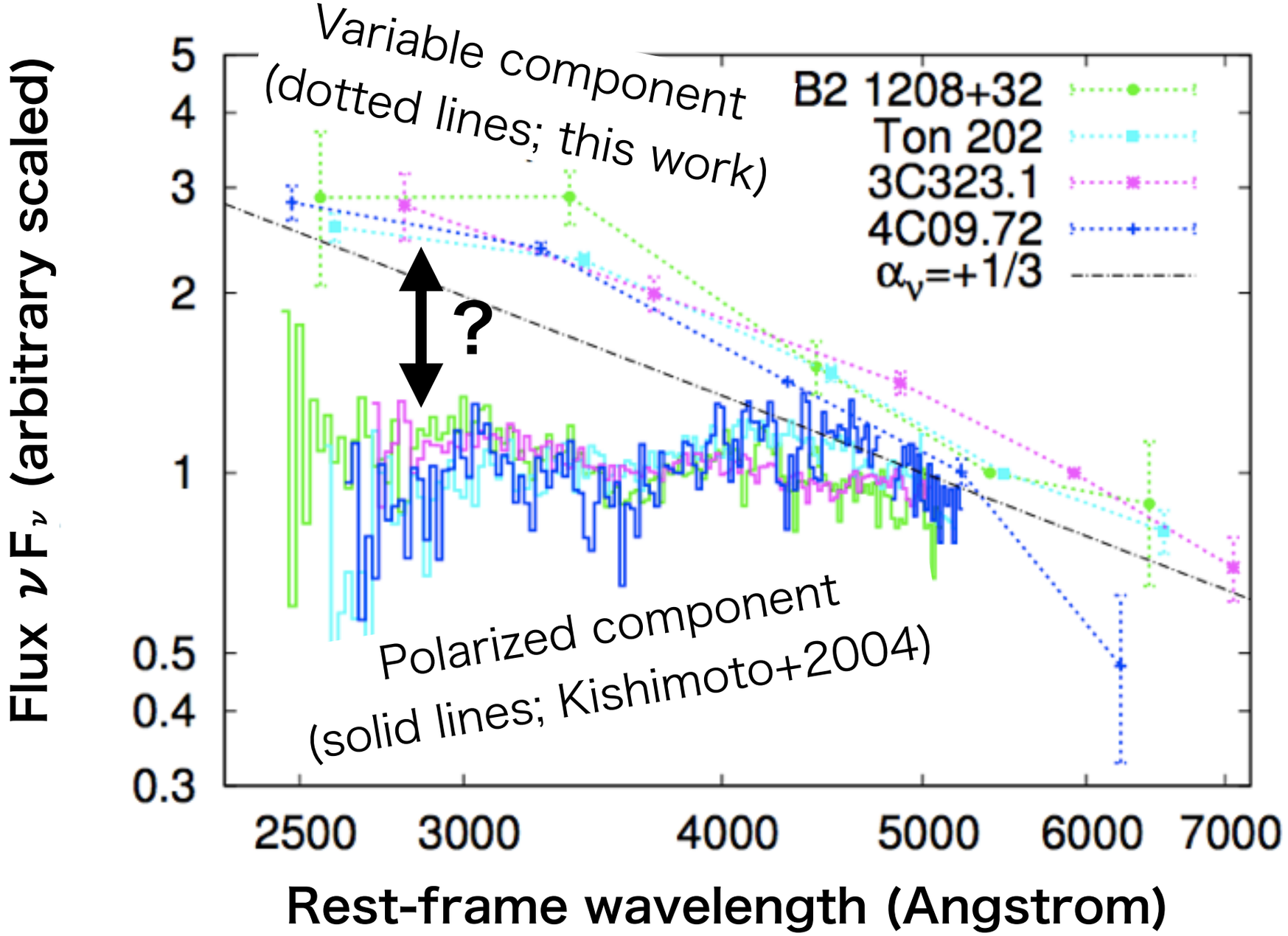
Deriving the spectral shape of the variable component





- The flux ratios of the variability amplitudes = the color of the variable component spectrum
- (Left panel: the variability amplitudes of u, g, r, and z-band, relative to i-band)
  —> 5-band ”relative” spectrum of the variable component; right panel)

Result: the spectral shape of the variable and polarized flux component



Contrary to expectation, we confirm that the two spectral components of these quasars have totally different spectral shapes

Discussion and Conclusions

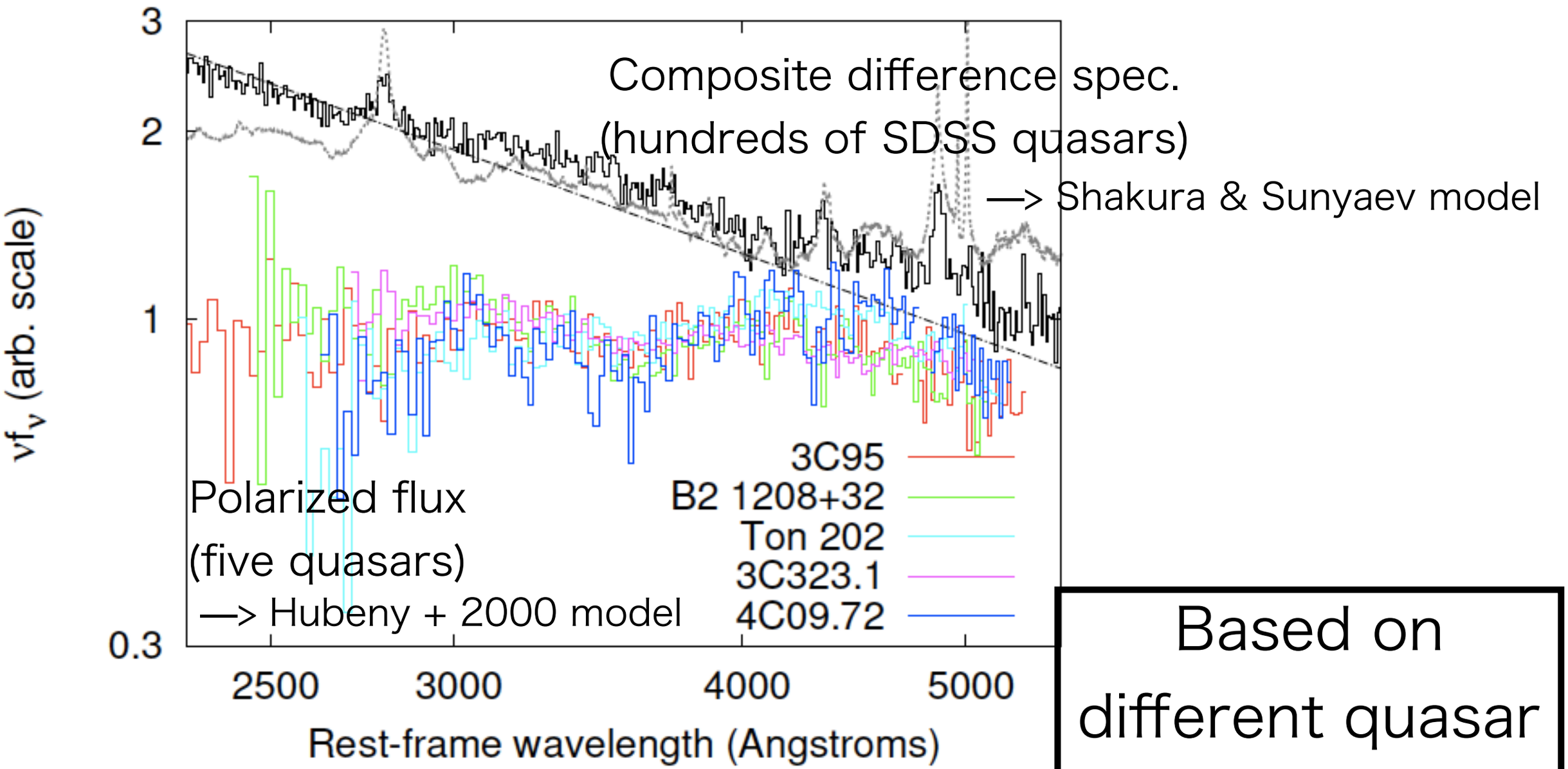
- Contrary to expectation, we confirm that the variable and polarized spectral components of these 4 quasars have totally different spectral shapes
  —> there is fundamental problems in our current understanding of the quasar UV-optical variability and/or polarization

Two possibilities :
(1): the polarization source is not the electron(Thomson) scattering of the disk emission
(2): the variable component spectra do not reflect the whole accretion disk emission (the variability is caused by local instability ? —> Z.-Y Cai's talk)

(Spectro)polarimetric monitoring observations are needed to conclusively decide either the polarized component or variable component spectrum well represents the intrinsic accretion disk spectrum (or both of the interpretations are invalid).

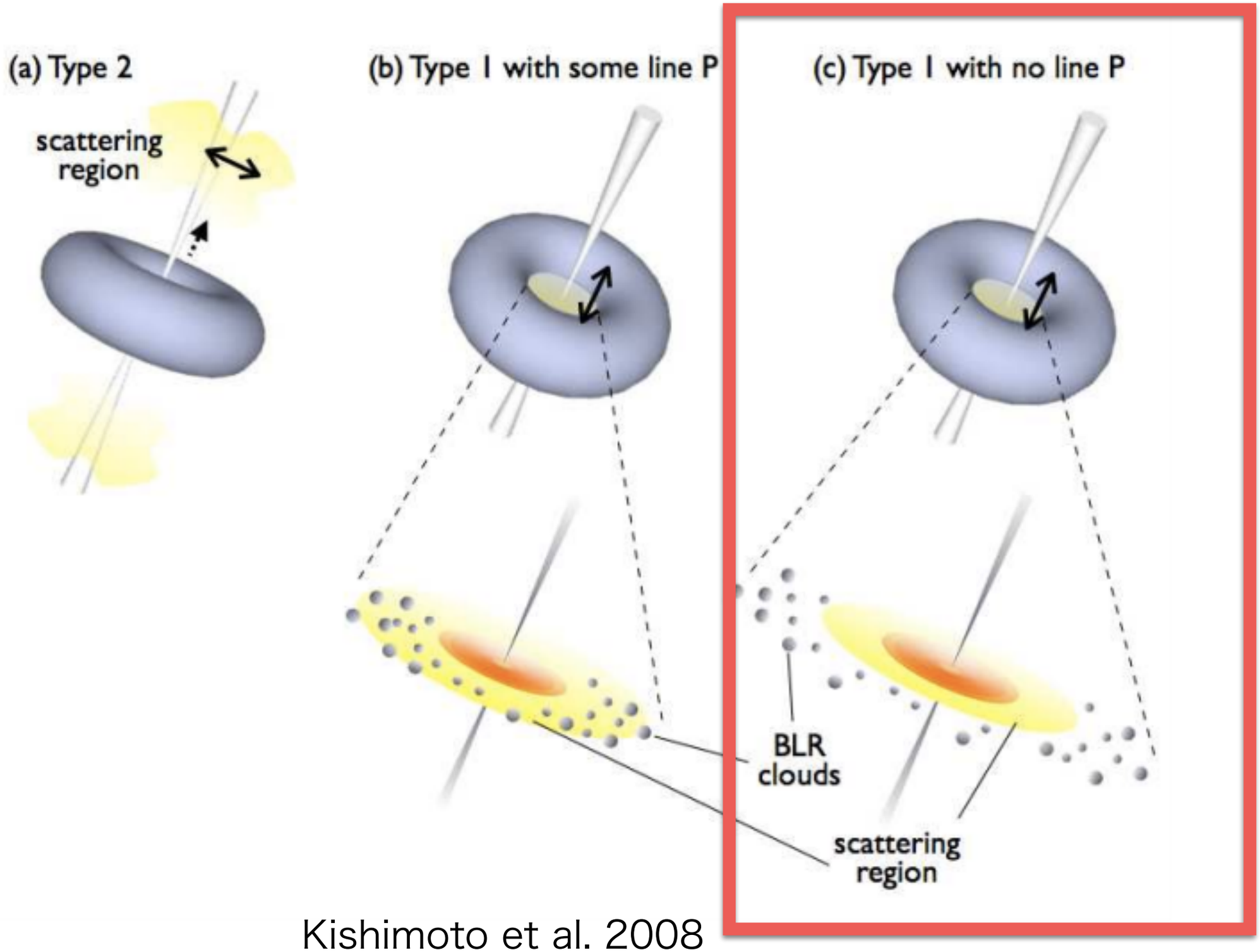
Thank you for listening !

The relationship between the variable and polarized component ?



Based on different quasar sample

Geometry of the putative electron scattering region



Kishimoto et al. 2008