

Gamma-ray and optical polarimetric monitoring of GeV bright blazars

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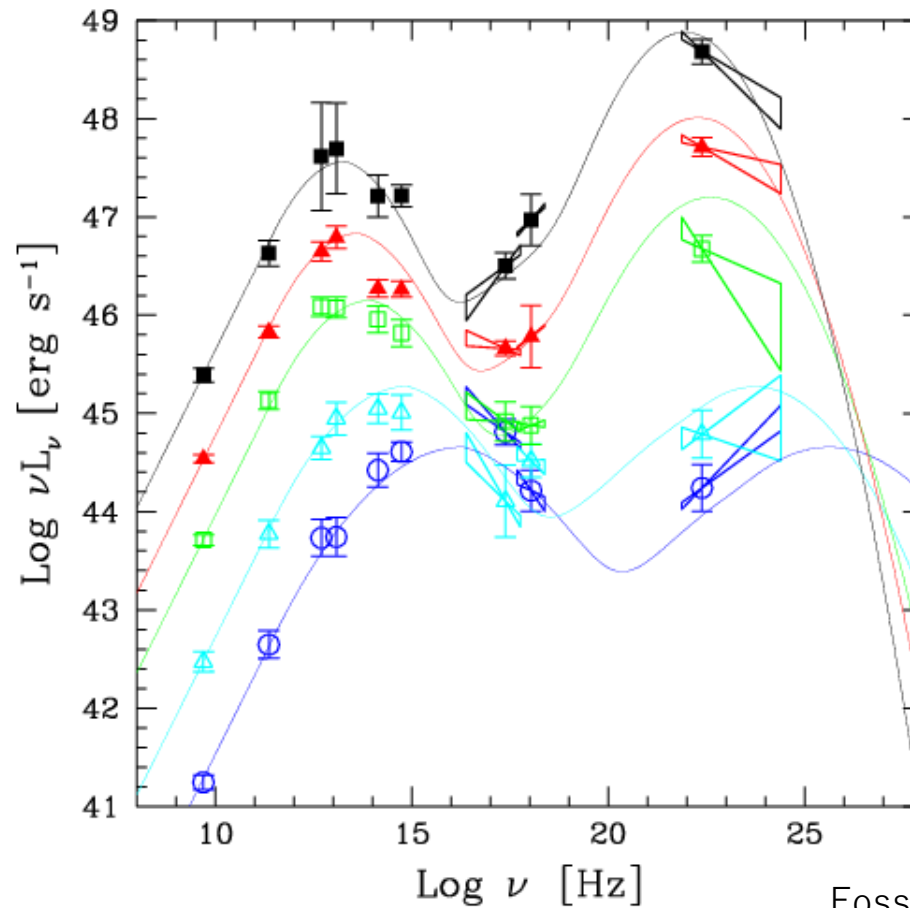




Motivation



What is the **major** parameter for blazars ?





Blazar variability

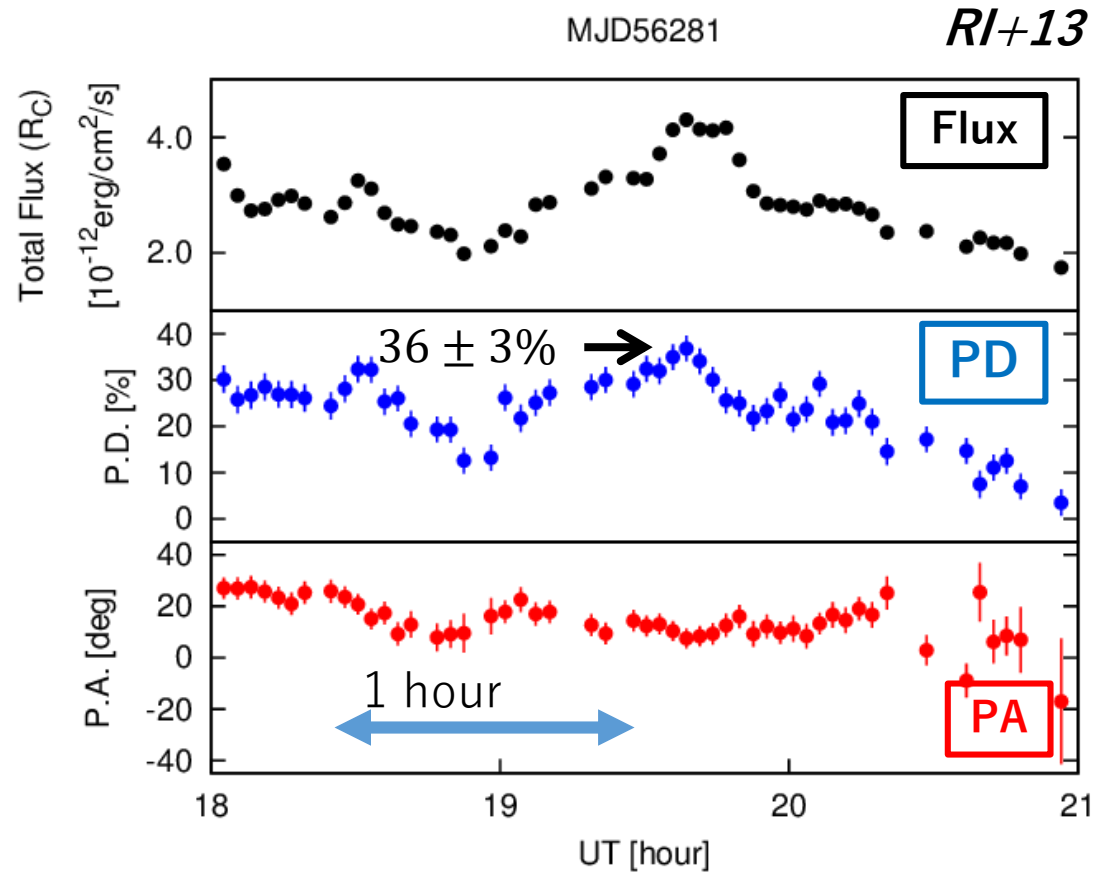


e.g., PMN J0948+0022 flare in 2012

Well correlated total flux
& P.D. with constant P.A.
is explained by

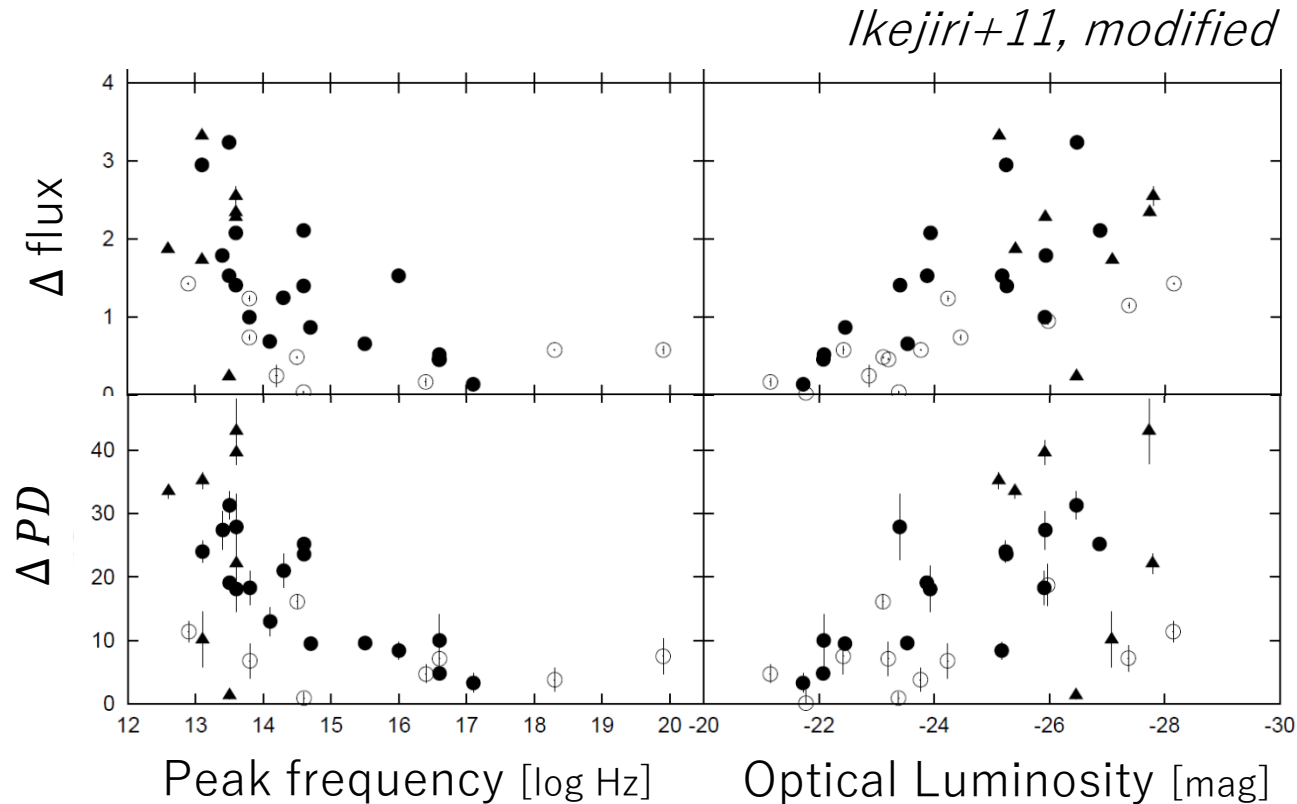
**simple one-zone
'shock-in-jet' model**

one-zone models
also produce
correlated synchrotron
+ gamma-ray variability
(e.g., Mastichiadis & Kirk 1997)





Systematic study for blazars



Variability of flux, color and polarization

Correlation between optical flux, polarization and gamma-ray flux

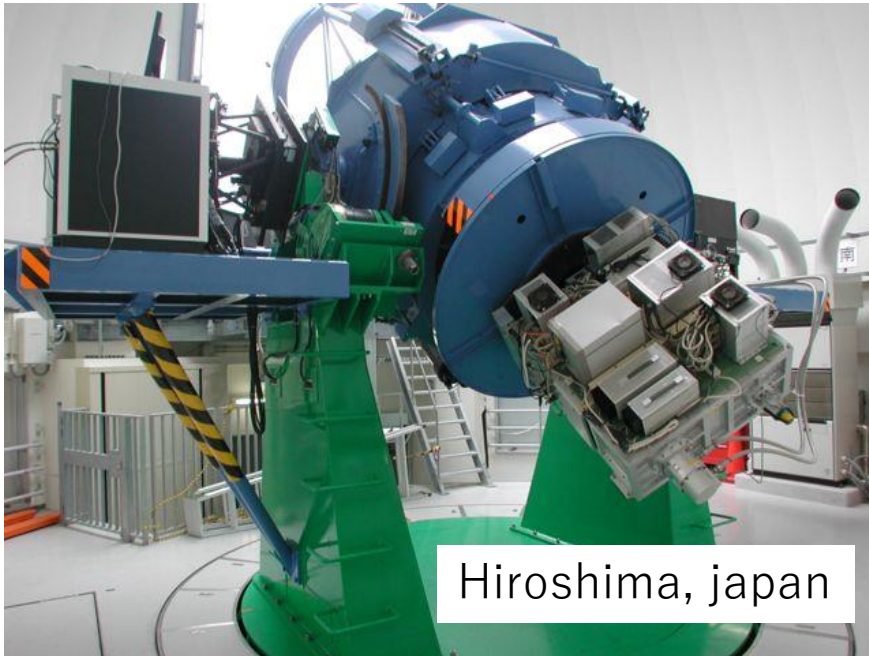
Varies by sources (or flares)



Observations



Kanata 1.5m telescope



Hiroshima, japan

Simultaneous Optical/NIR band obs.
Imaging polarimetry

- Since Fermi launched (2008-), we performed
- Daily polarimetric monitor of ~40 AGNs
 - Follow-up observation of GeV flare targets

Fermi/LAT



http://space.skyrocket.de/img_sat/glast_1.jpg

100 MeV – 300 GeV
All sky survey
Pass 8 6.5 years data



Target List



Red; GeV bright source

FSRQ	LSP	ISP	HSP	RL-NLSy1
3C 454.3 (498)	BL Lac (539)	S5 0716+714 (628)	Mrk 501 (244)	1H 0323+342
3C 273 (332)	OJ 287 (413)	3C 66A (487)	PG 1553+113 (225)	PMN J0948+0022
3C 279 (177)	AO 0235+164 (93)	1ES 1959+650 (202)	PKS 2155-304 (161)	
PKS 1749+096 (163)	OJ 49 (70)	S2 0109+22 (102)	Mrk 421 (74)	
3C 371 (124)	S4 0954+658 (5)	PKS 0048-097 (63)	ON 325 (56)	
RX J1542.8+612 (113)	1ES 1218+304 (3)	ON 231 (48)	1ES 0806+524 (54)	
PKS 1510-089 (110)		OQ 530 (19)	H 1722+119 (66)	
Mis V1436 (106)			PKS 0422+004 (42)	
CTA 102 (92)			1ES 2344+514 (33)	
PKS 1502+106 (76)			1ES 0647+250 (24)	
QSO 0454-234 (28)			1ES 0323+022 (21)	
S5 1803+784 (35)				
PKS 0754+100 (28)				
PKS 0215+015 (5)				
GB6 J1239+0443 (5)				

**41 blazars, 6.5 year data
All photopolarimetric
data were public**



Vizier Kanata blazar



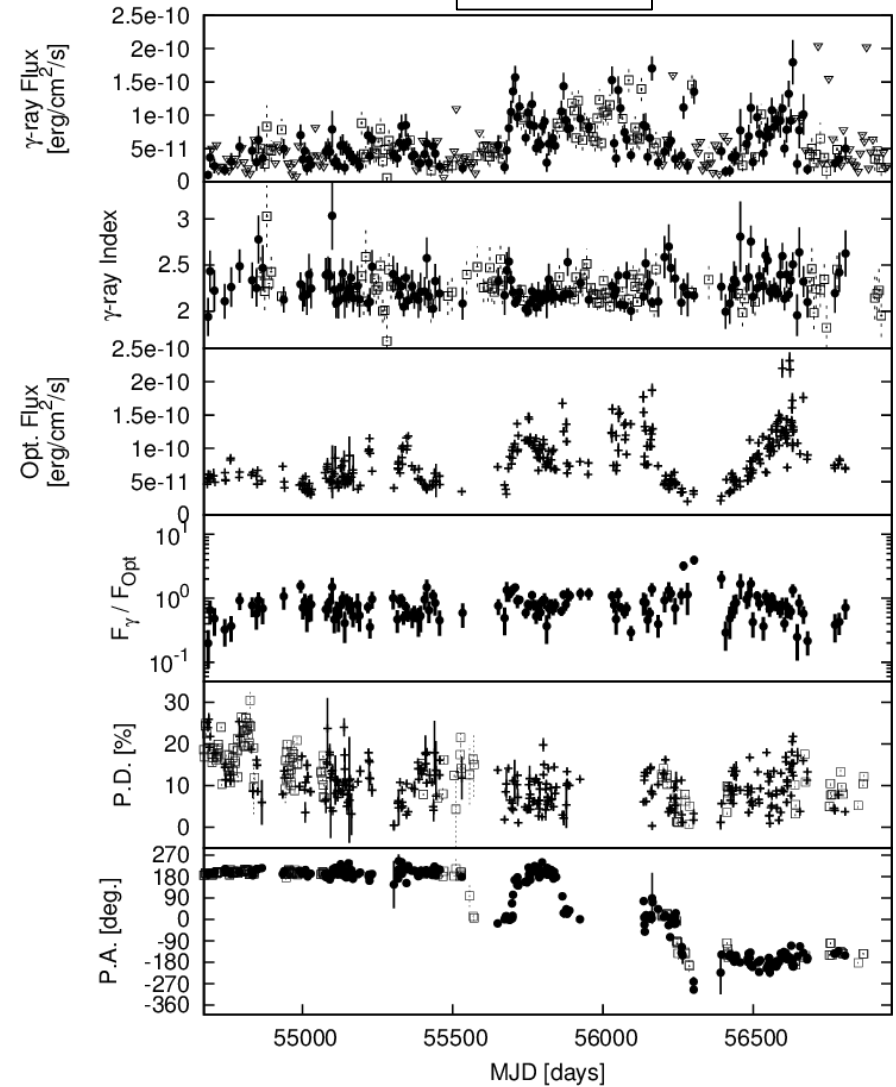
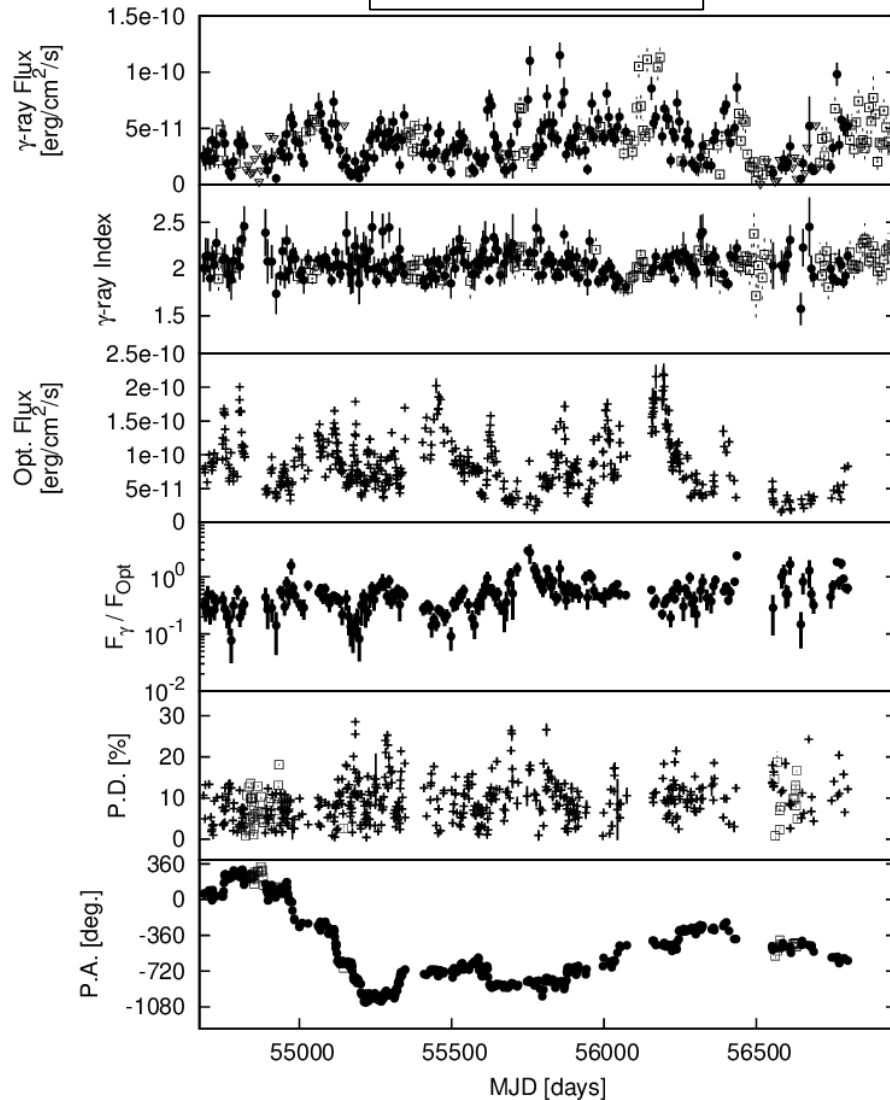
Light curves



RI+16

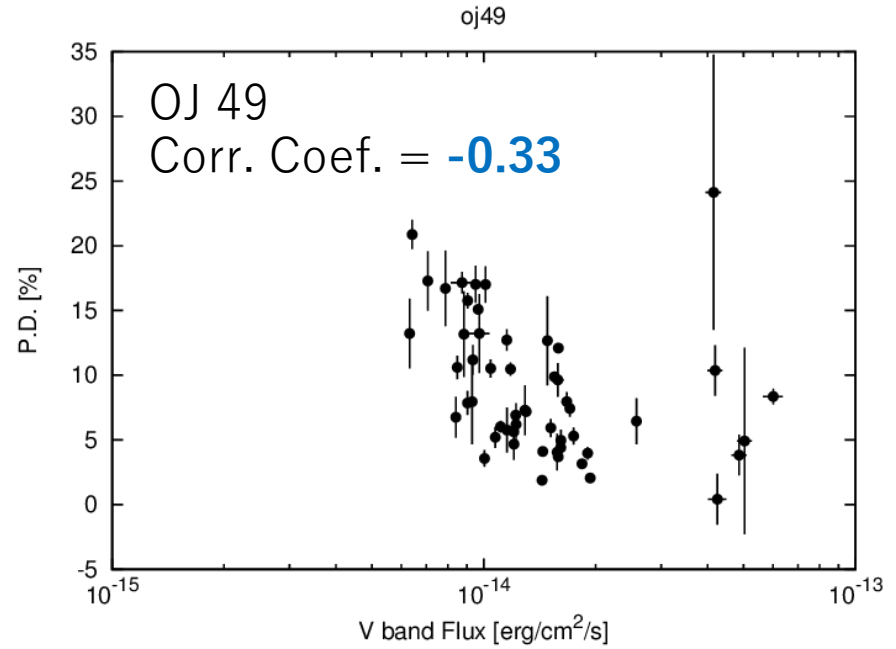
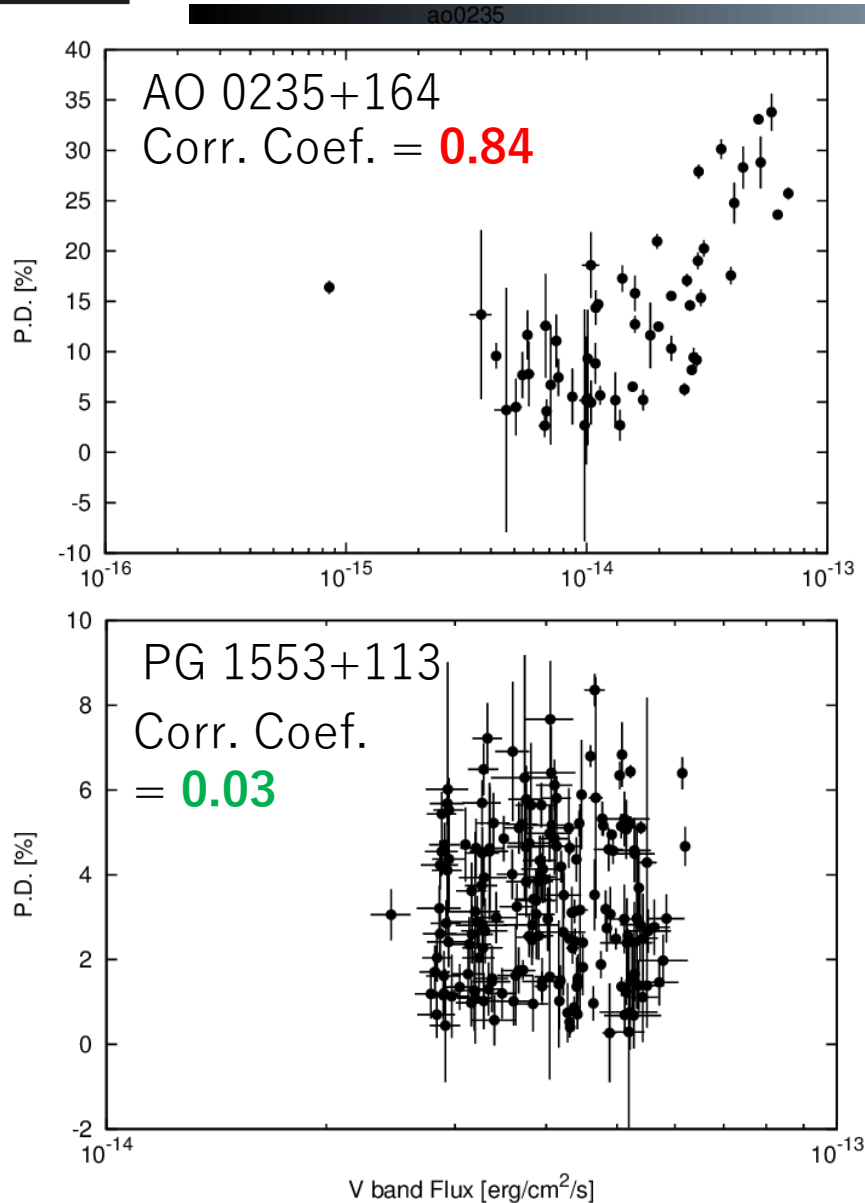
S5 0716+714

BL Lac





Correlation betw. flux and P.D.



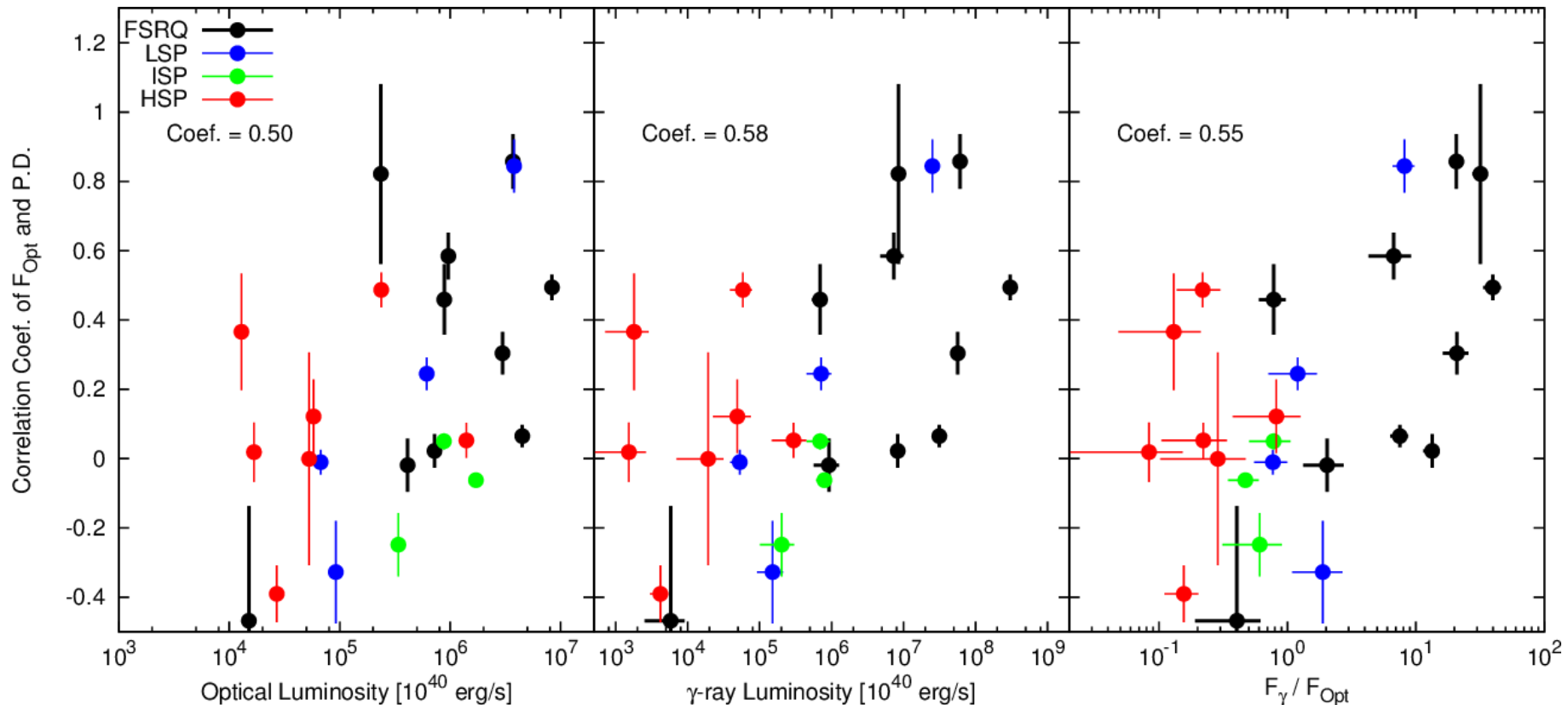
Even same type source does not shows same trends
Chaotic!!



Correlation between Lum. & Correlation coef.



RI+16



Gamma-ray luminous blazars tend to show correlation between optical flux and P.D.



Discussion; Multi emission region



Compton Dominance (for external Compton)

$$\frac{L_{\text{EC}}}{L_{\text{sync}}} \sim \Gamma^2 \frac{u_{\text{ext}}}{u_B} \quad \text{Sikora+08}$$

	High PD	Low PD
Bulk Lorentz factor	High	Low
Number of emission region	Few	Many
Compton dominance	High	Low

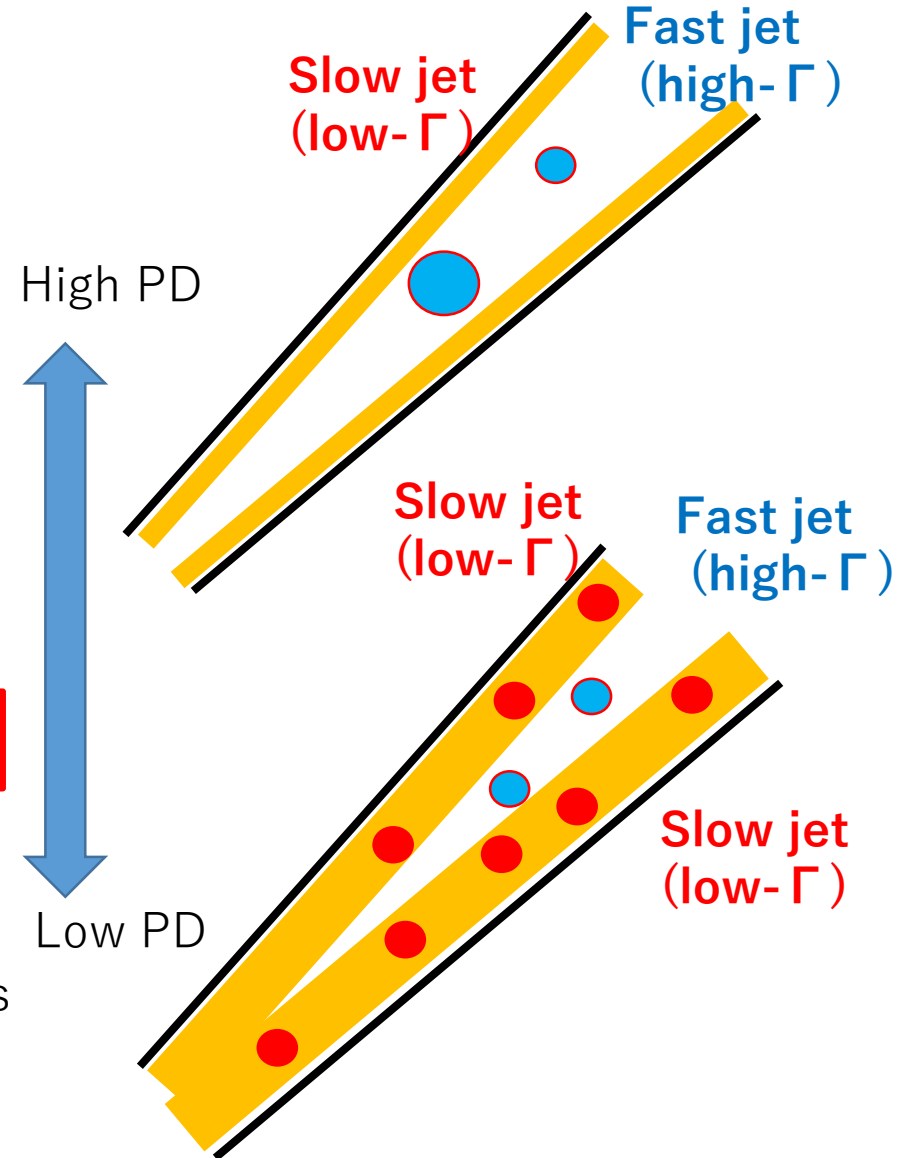
Spine-sheath model

+

Multi-Emission region model

Spine: aligned magnetic field
sheath: chaotic magnetic field

Superposition of several emission regions with various magnetic field directions will result in low degree of total polarization.





Summary for systematic study of blazar



- We performed long-term optical polarimetric observation of ~ 40 blazars with Kanata and *Fermi/LAT*.
- we found **Compton dominance might be good indicator** of polarization properties
- It imply a systematic difference in the intrinsic alignment of magnetic fields in pc-scale relativistic jets between different types blazars
- A measurement of “Flare cadence” will be helpful to test the assumption of “multi-emission region” model.