

Tenth International Fermi Symposium

9th-15th October 2022



Studying multiwavelength properties of γ -ray flaring blazars at redshift > 3

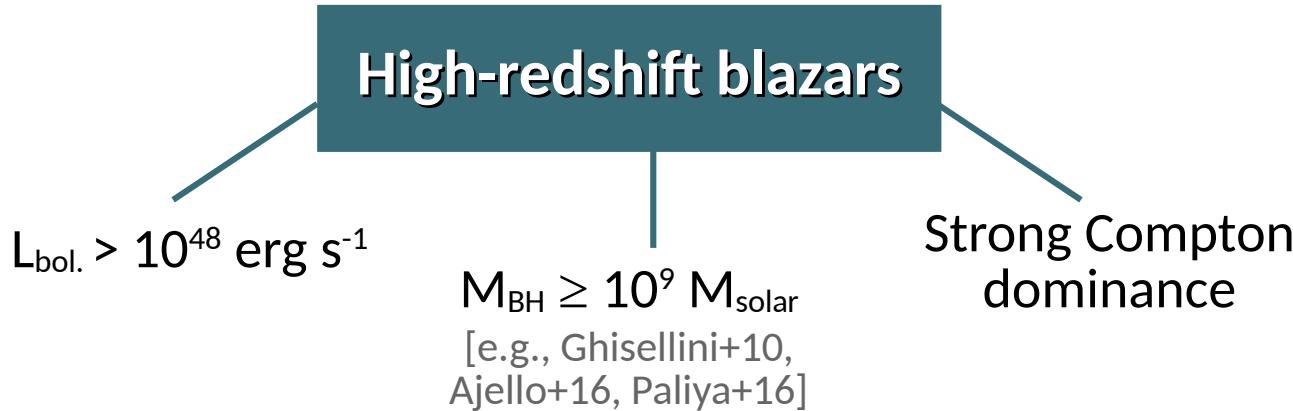
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Postdoctoral research associate at WashU in St. Louis

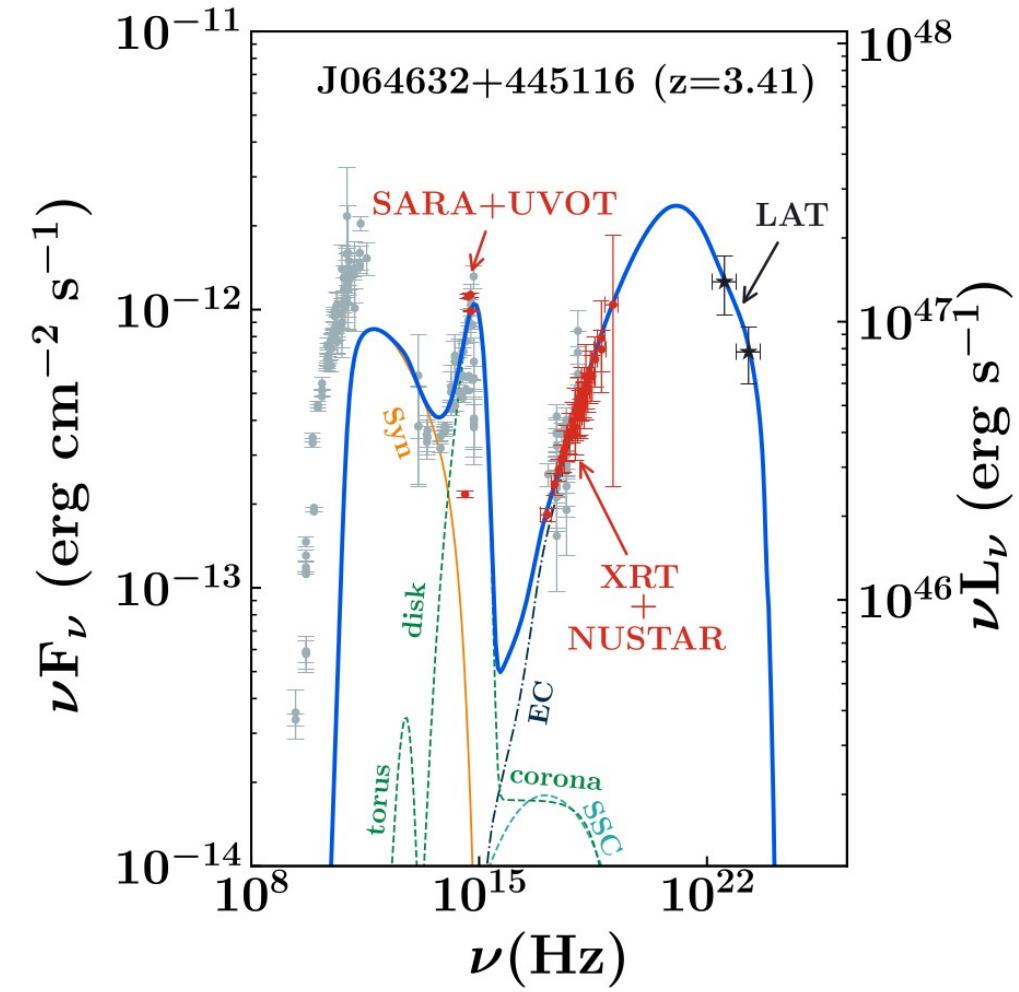
Collaborators: S. Buson, M. Kadler, F. McBride, R. Ojha, and D. J. Thompson on behalf of the *Fermi*-LAT collaboration; P. Benke, F. Eppel, L. Gurvits, J. Heßdörfer, J. Hodgson, A. Kraus, Y. Y. Kovalev, M. Lisakov, E. Ros, F. Rösch, J. Sinapius (radio team); J. Wilms (X-ray); M. Böttcher, M. Errando, M. Kreter, N. Zywicka (modelling); D. Reinhart, R. Steineke, B. Horst, J. Seufert, K. Rosenlehner, N. Bader, M. Feige, C. Lorey (optical; high school team)

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Why interesting?



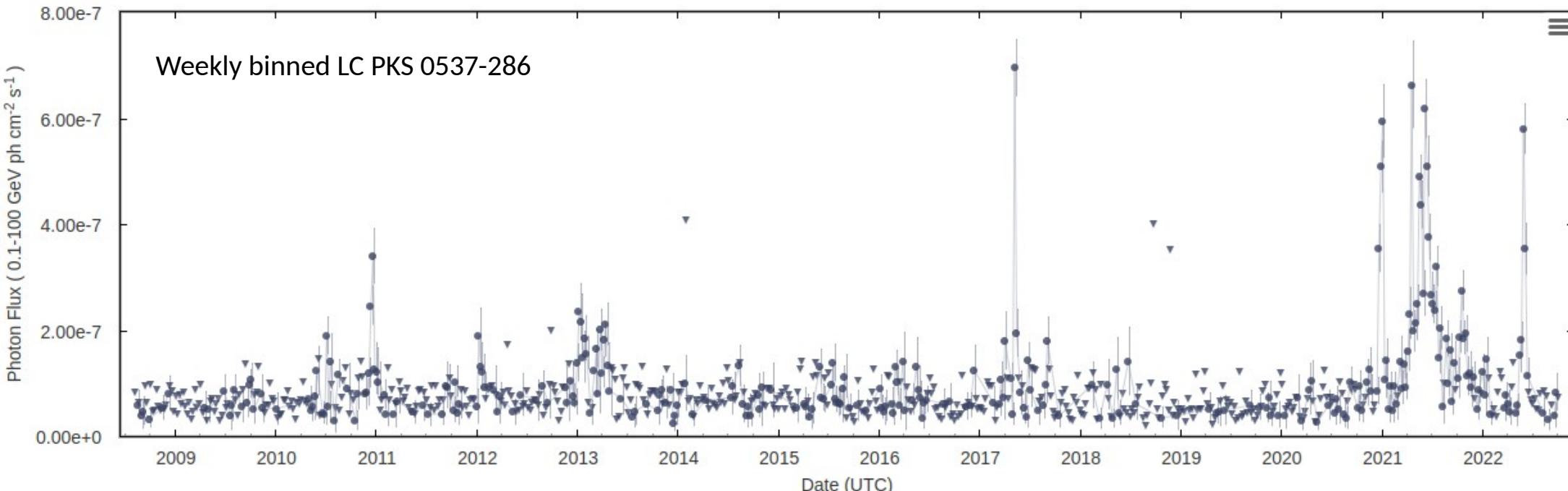
- High-energy hump peaks in MeV band
→ (simultaneous) X-ray and γ -ray data necessary
- Accretion disk emission redshifted to optical/UV range
- One detection implies existence of several hundred similar, misaligned sources [e.g., Sbarato+14]
- High redshift enables radio observations of regions closer to SMBH



Credit: Marcotulli+20

Search for γ -rays from high-z sources

- Accumulating *Fermi*-LAT data & report in catalogs
- Monitoring of daily sky (LAT Flare Advocates) → PKS 0537-286 ($z = 3.1$)
- Search for signal on monthly time scales: Kreter+20
 - Using approach to gather simultaneous MWL data set with pipeline
 - Monitoring 80 sources reported in BZCAT with $z > 3$ & daily check

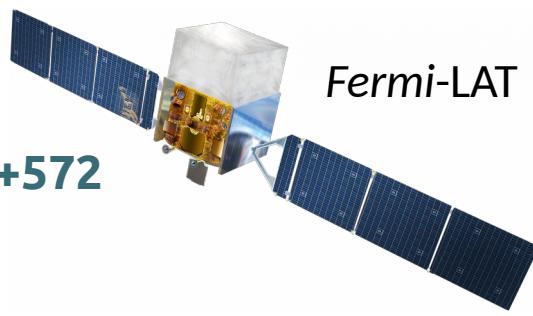


Credit: Kocevski+21, Fermi-LAT light curve repository

GB 1508+5714

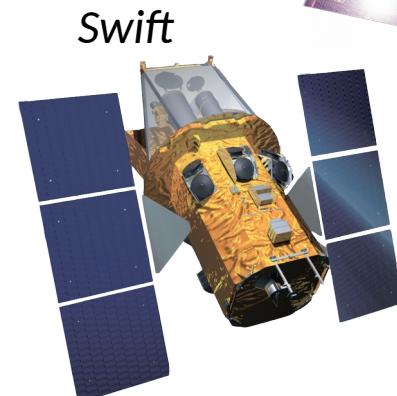
a.k.a. 4FGL J1510.1+5702, TXS 1508+572

- Redshift $z = 4.3$ [Hook+95]
- Flare detected on Feb 4 this year → 25 x 4FGL flux in 5-day interval [Atel #15202, Gokus+22]
- γ -ray luminosity: $(3.5 +/- 1.4) \times 10^{49}$ erg/s
- Observational multi-wavelength campaign

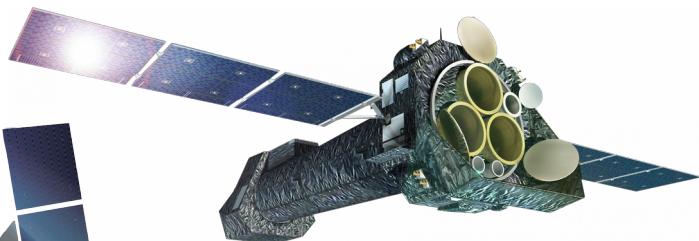


Fermi-LAT

Credit: NASA Spacecraft Icons



Swift



XMM-Newton



Hans-Haffner Observatory,
University of Würzburg

Credit: Naturwissenschaftl. Labor für
Schüler am FKG e.V.



100-m Effelsberg
radio telescope

Credit: Florian Eppel



Hobby
Eberly
telescope

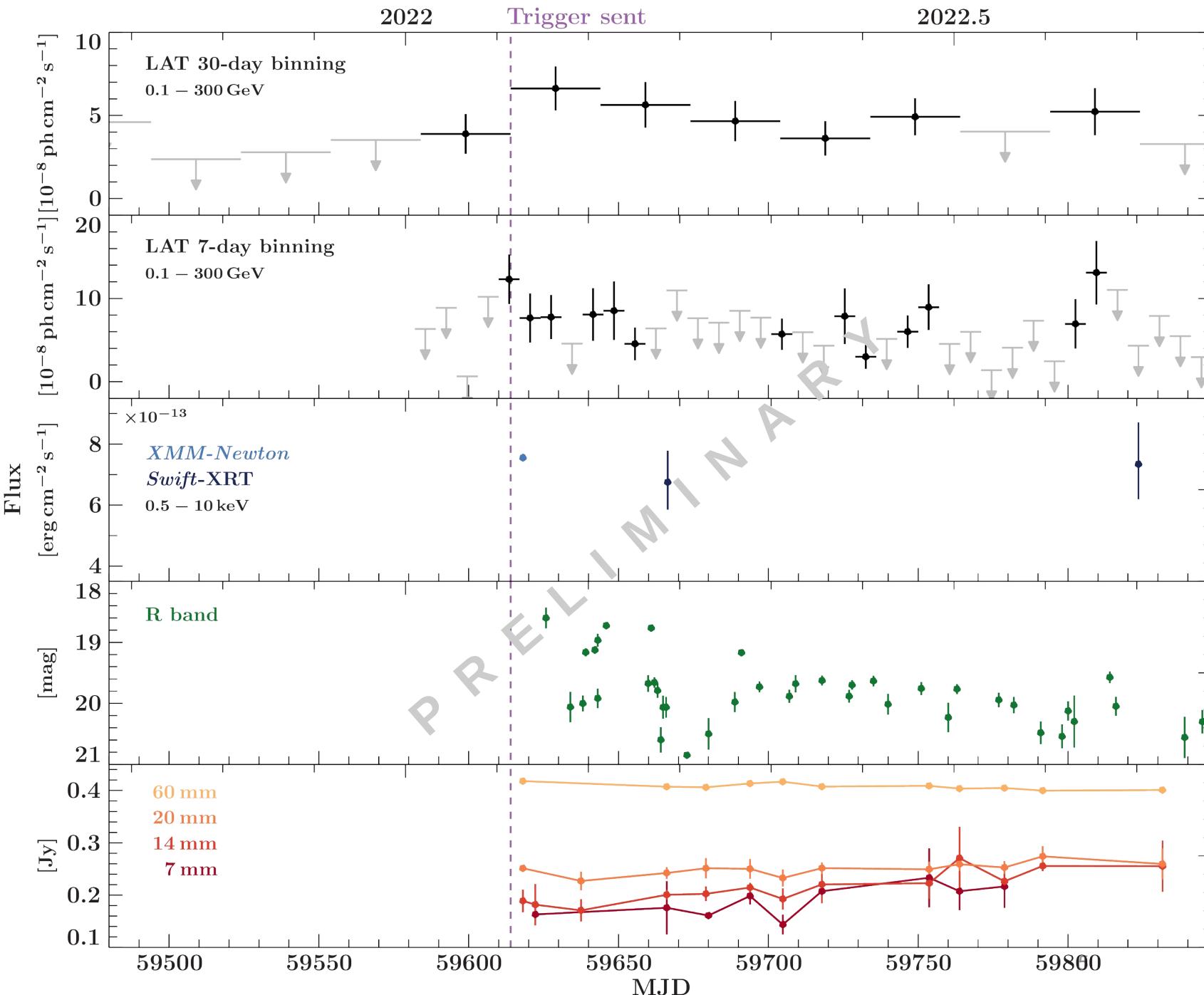


VLBA

Credit: NRAO

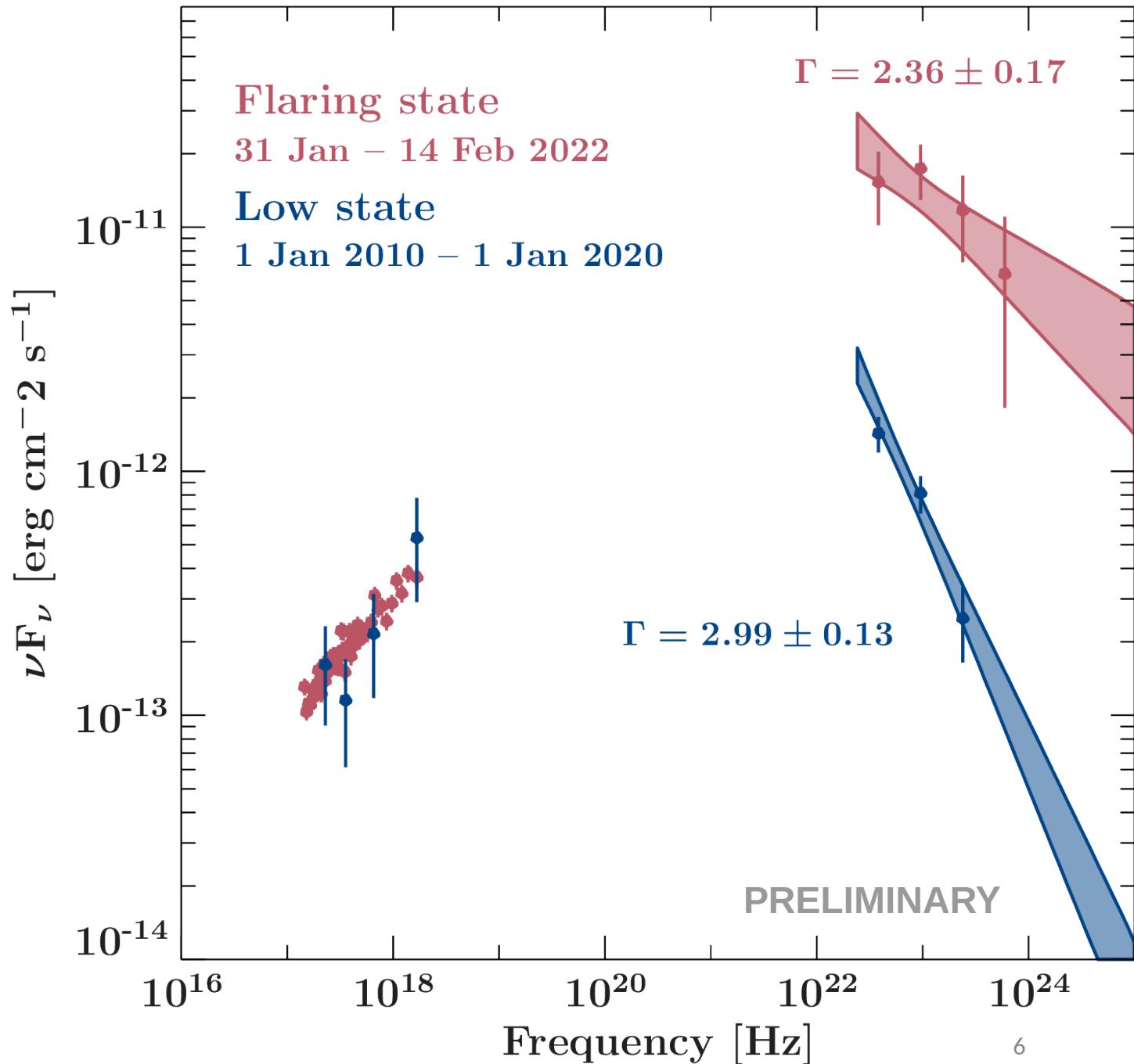
GB 1508+5714

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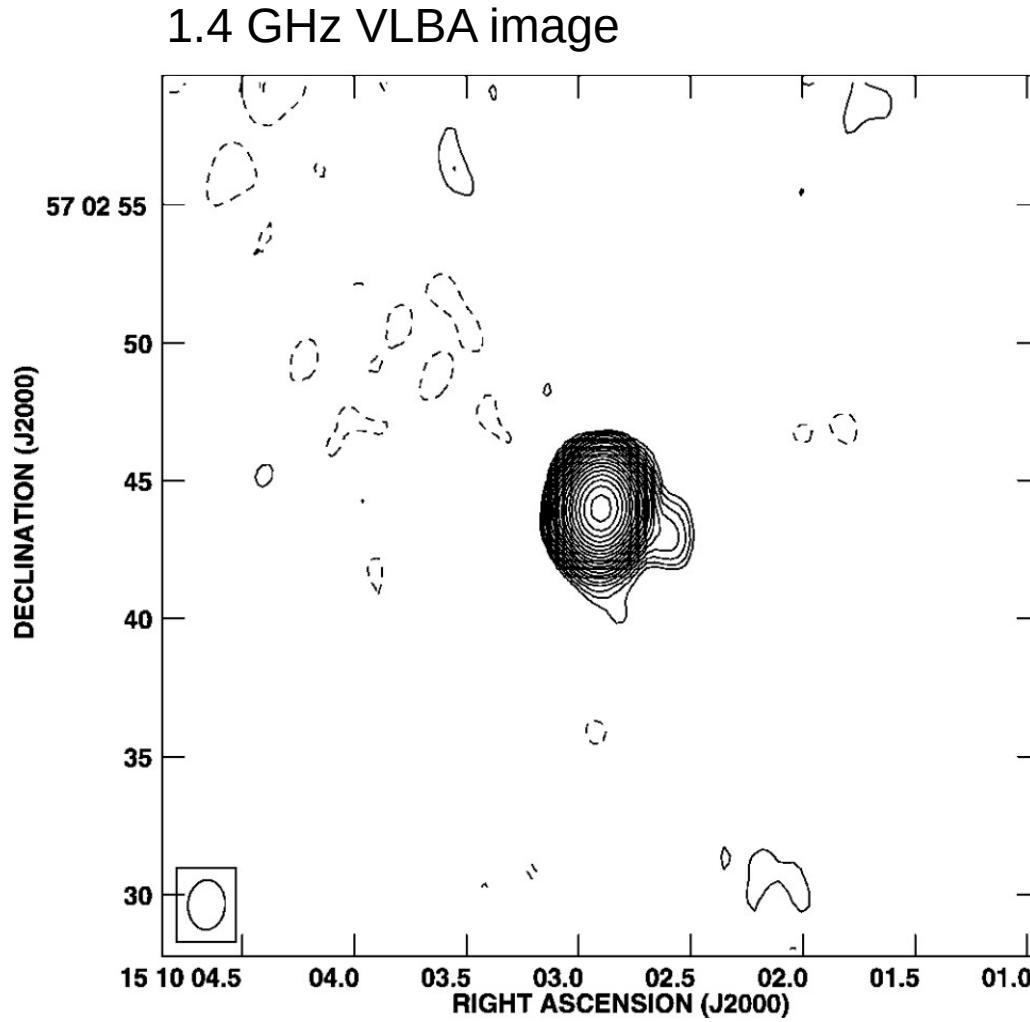


High-energy SED

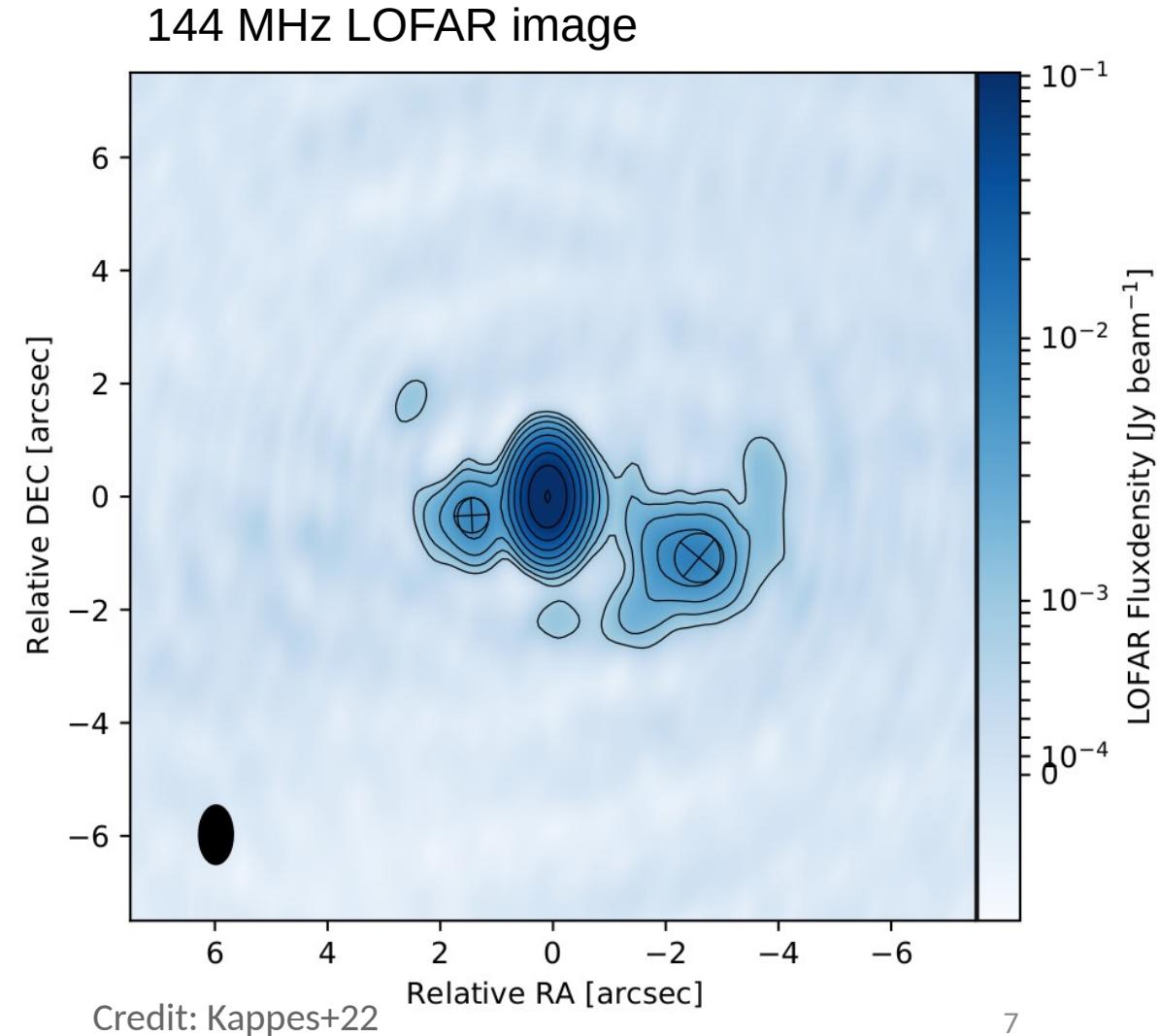
- During flare:
 - Flux change only visible in γ -rays
 - γ -ray spectrum significantly harder
- Quiet state: NuSTAR observation available → Γ consistent with flaring state
- Broadband SED modelling → determine CD & dominant processes



Radio VLBI observations - Archival



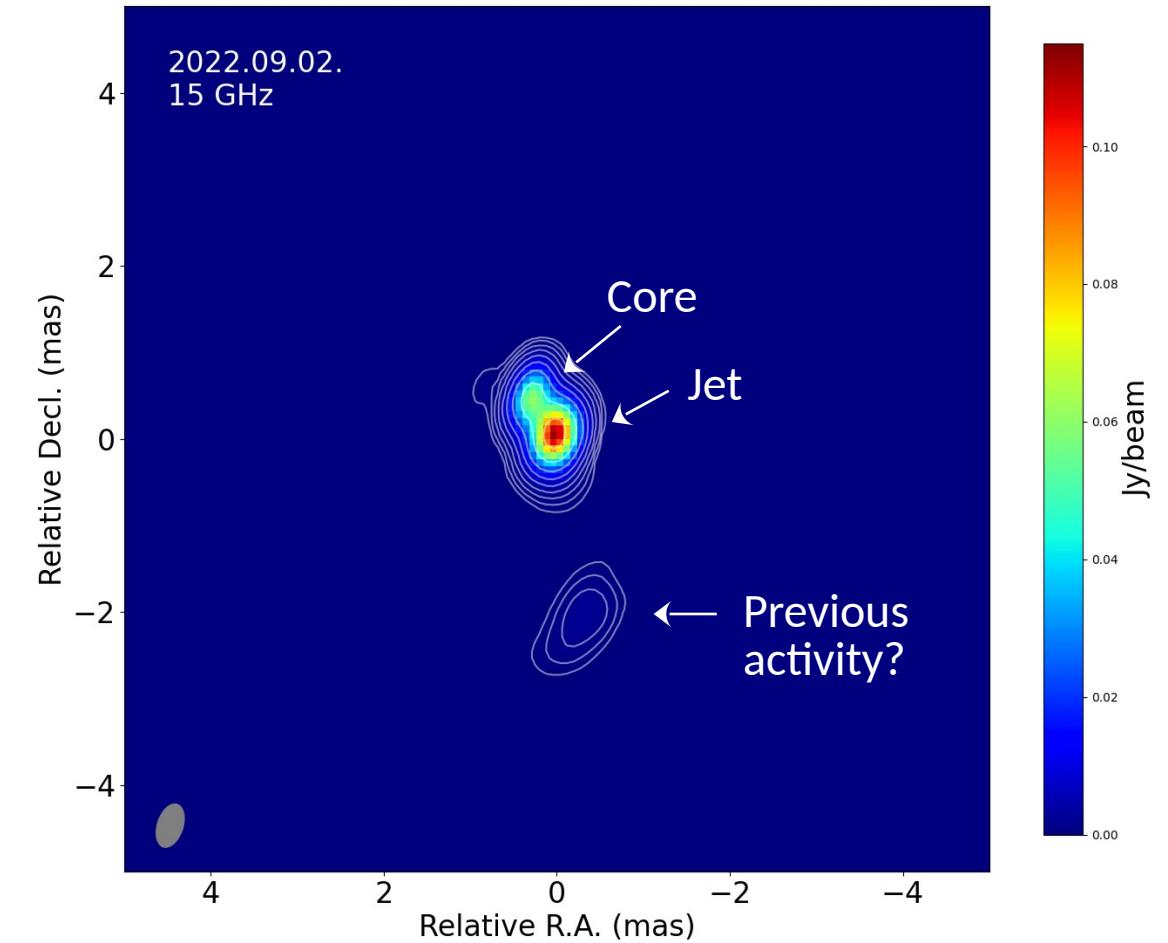
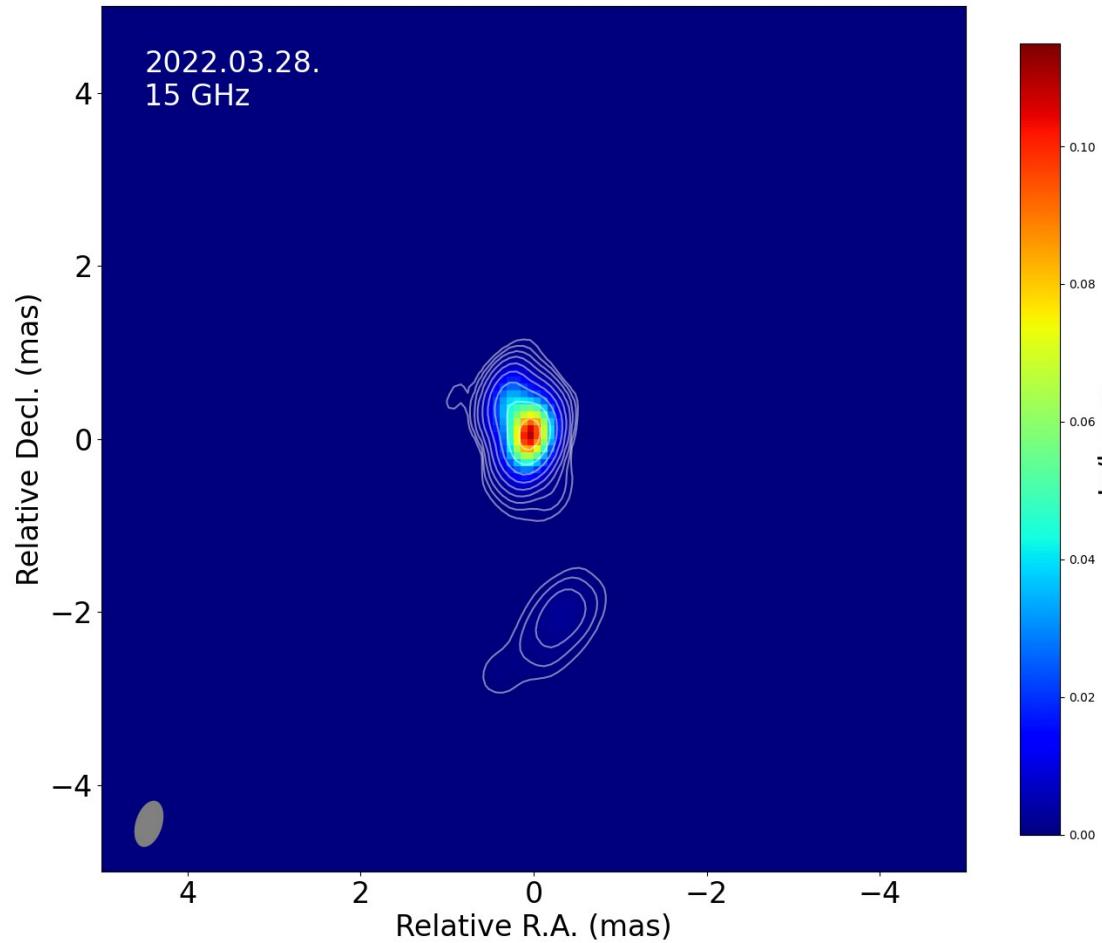
Credit: Cheung 04



Credit: Kappes+22

Radio VLBI observations – Our campaign

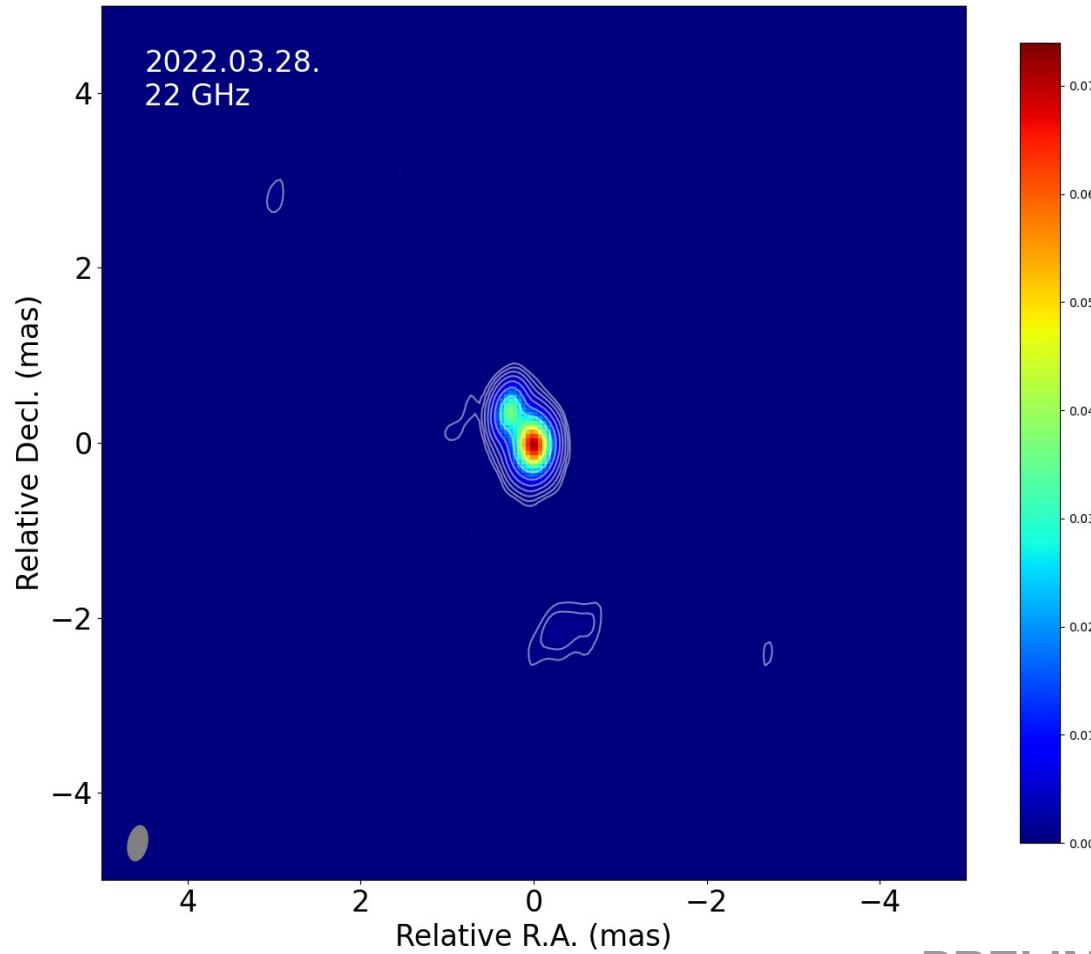
VLBA + Effelsberg - 15 GHz | 79 GHz



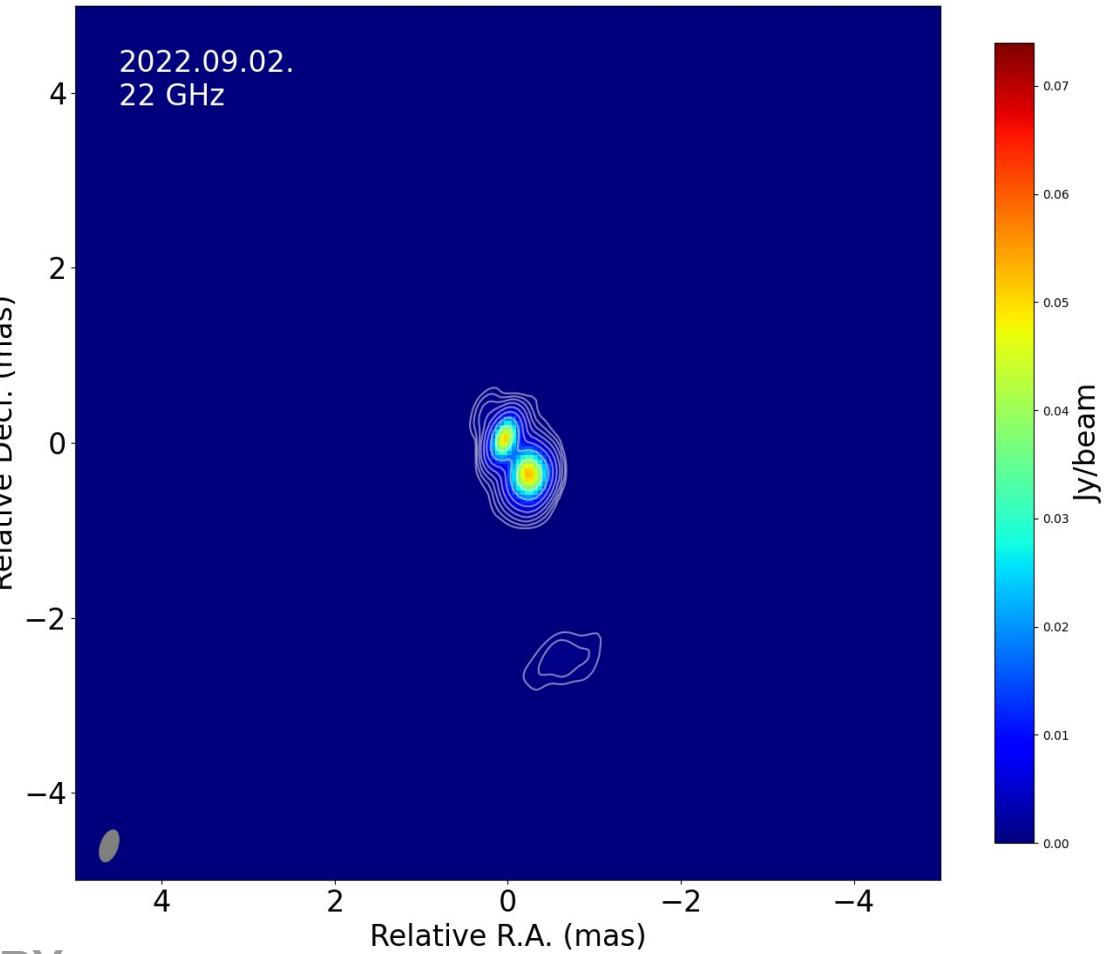
PRELIMINARY

Radio VLBI observations – Our campaign

VLBA + Effelsberg - 22 GHz | 117 GHz

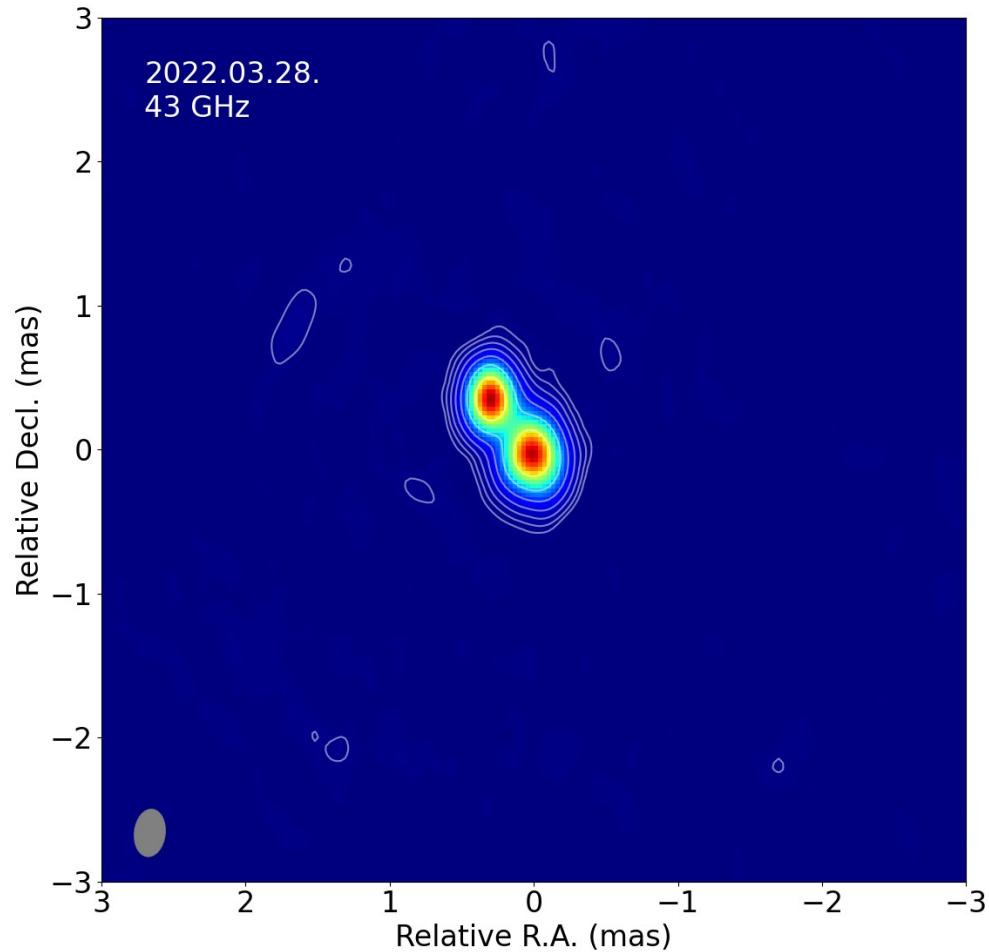


PRELIMINARY

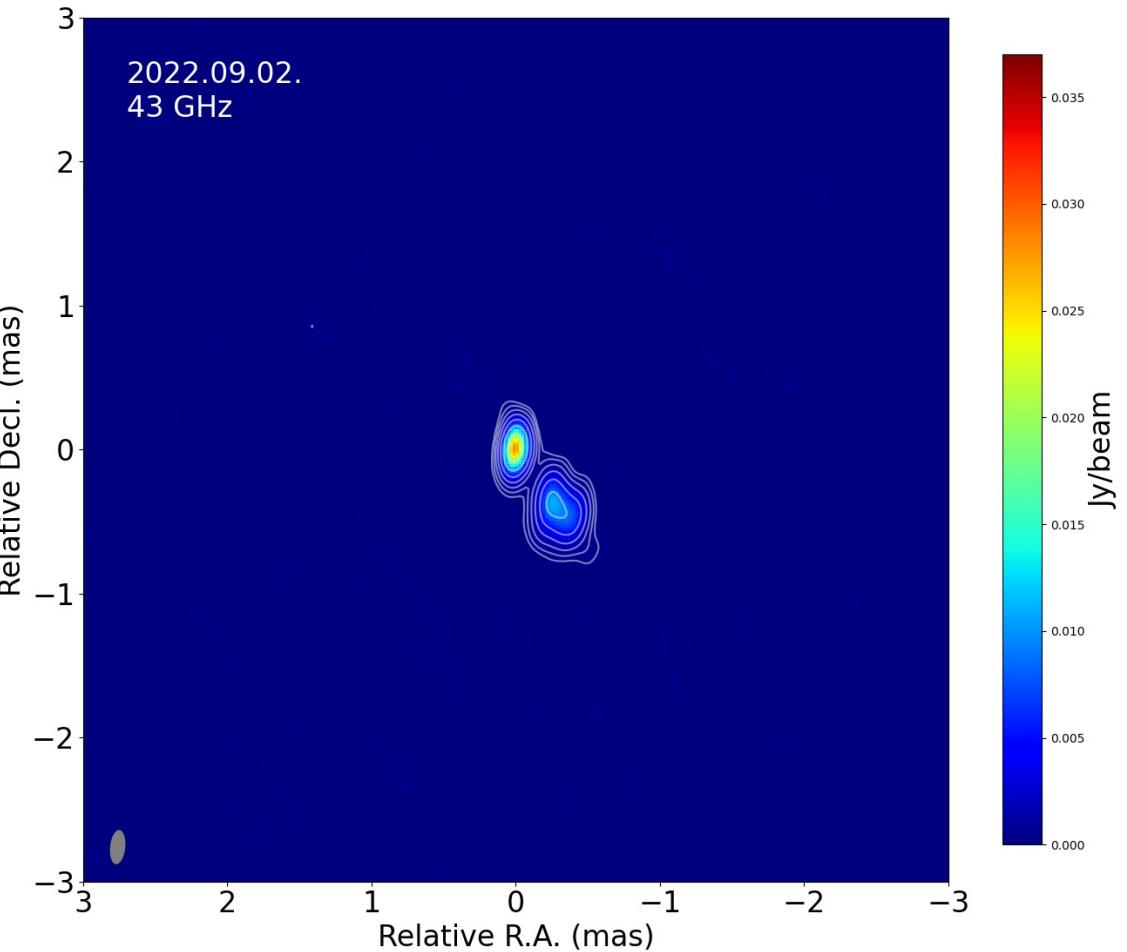


Radio VLBI observations – Our campaign

VLBA + Effelsberg - 43 GHz | 228 GHz

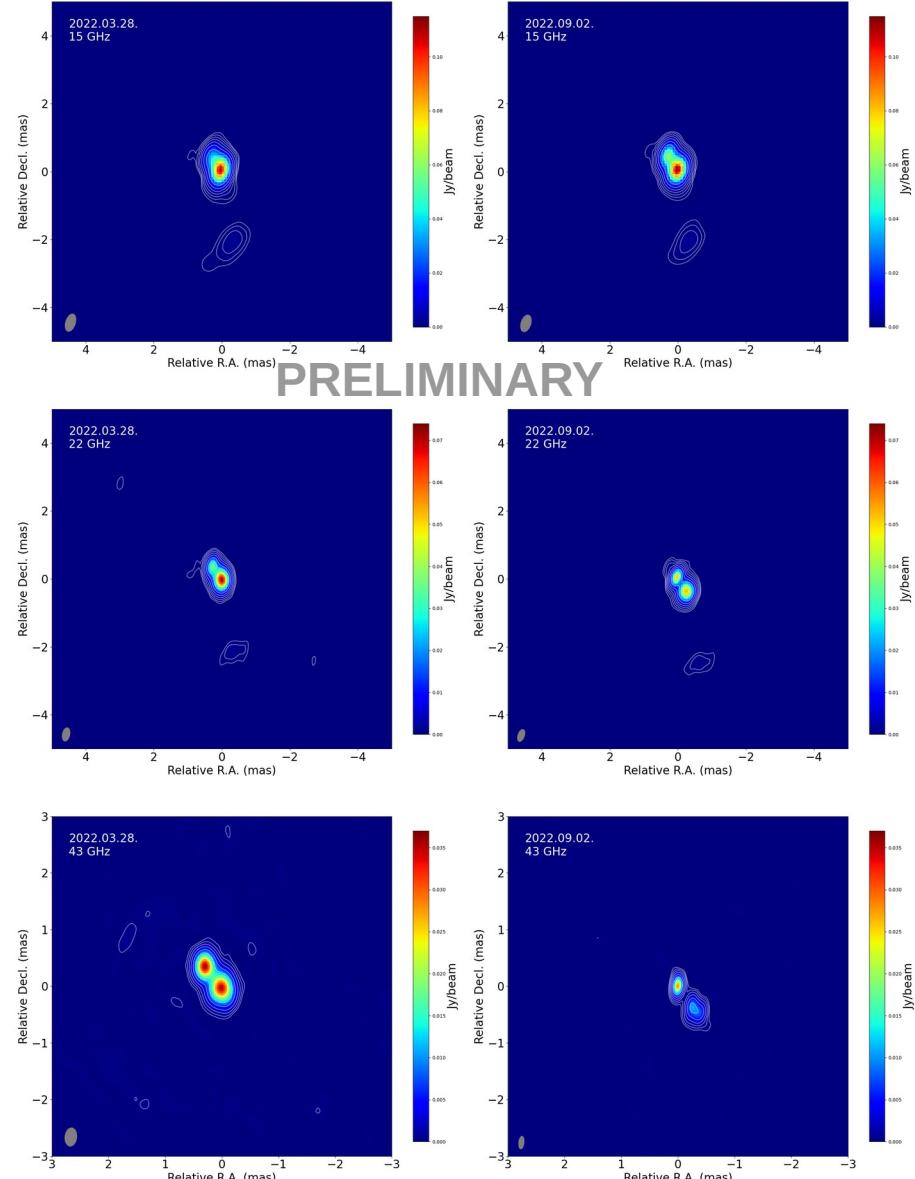


PRELIMINARY



Radio VLBI observations – Our campaign

- High brightness temperatures $> 10^{11}$ K in core at 15 & 22 GHz
- Third epoch planned for December → constraints on jet speed
- VLBI monitoring of jet component over several years: $v = 0.1$ mas/yr [Gurvits+23]



Conclusions

- Existing pipeline to search for high-redshift blazar flares
→ expect 2-3 events per year
- First quasi-simultaneous observations of flaring blazar at $z > 4$
- γ -ray luminosity $\sim 3 \times 10^{49}$ erg s⁻¹ → possibly 2nd most luminous blazar flare
- VLBI campaign on-going → probing frequencies up to ~ 230 GHz
- Multiwavelength analysis in progress
- Pathfinder project for future MeV missions