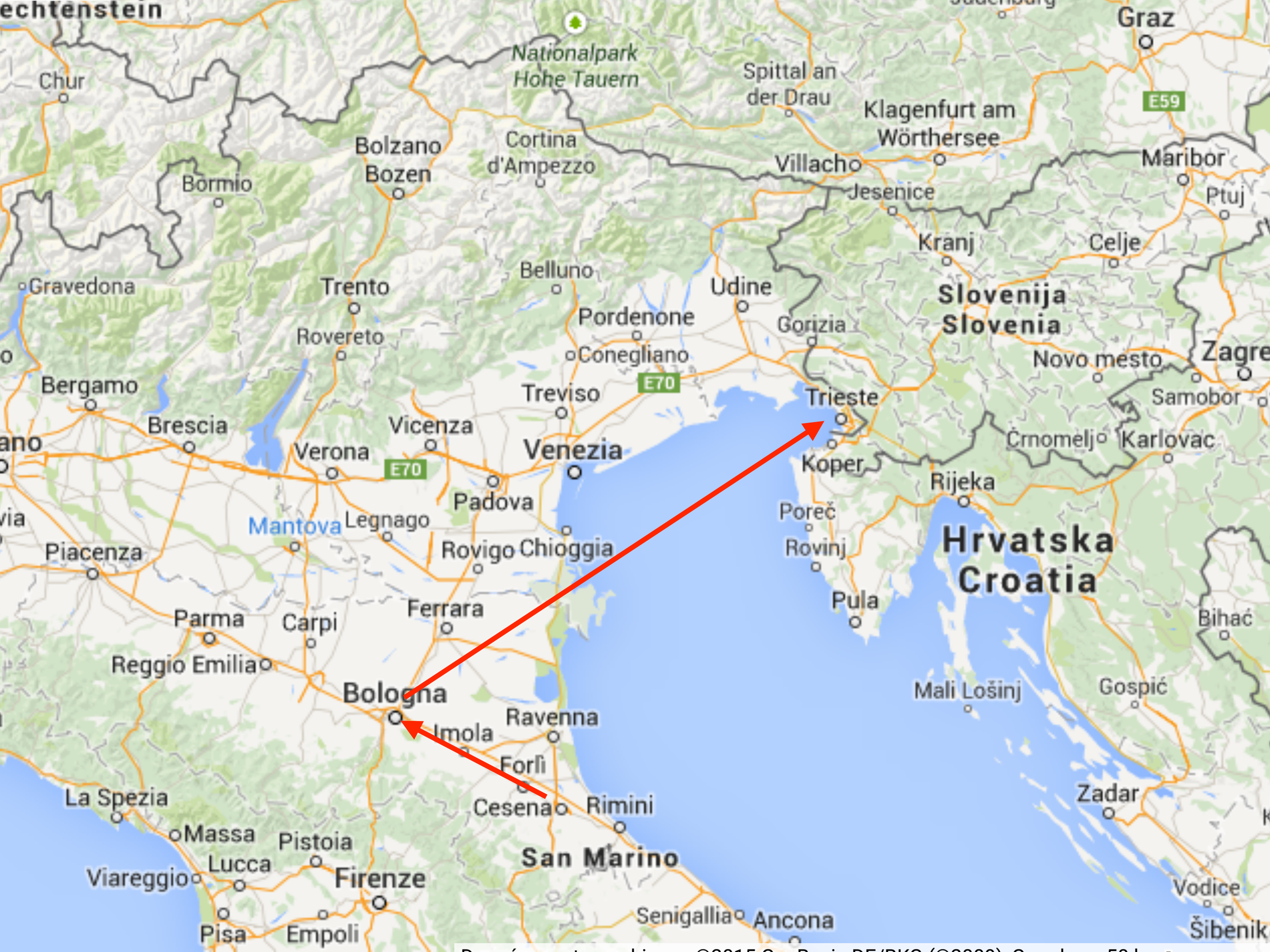
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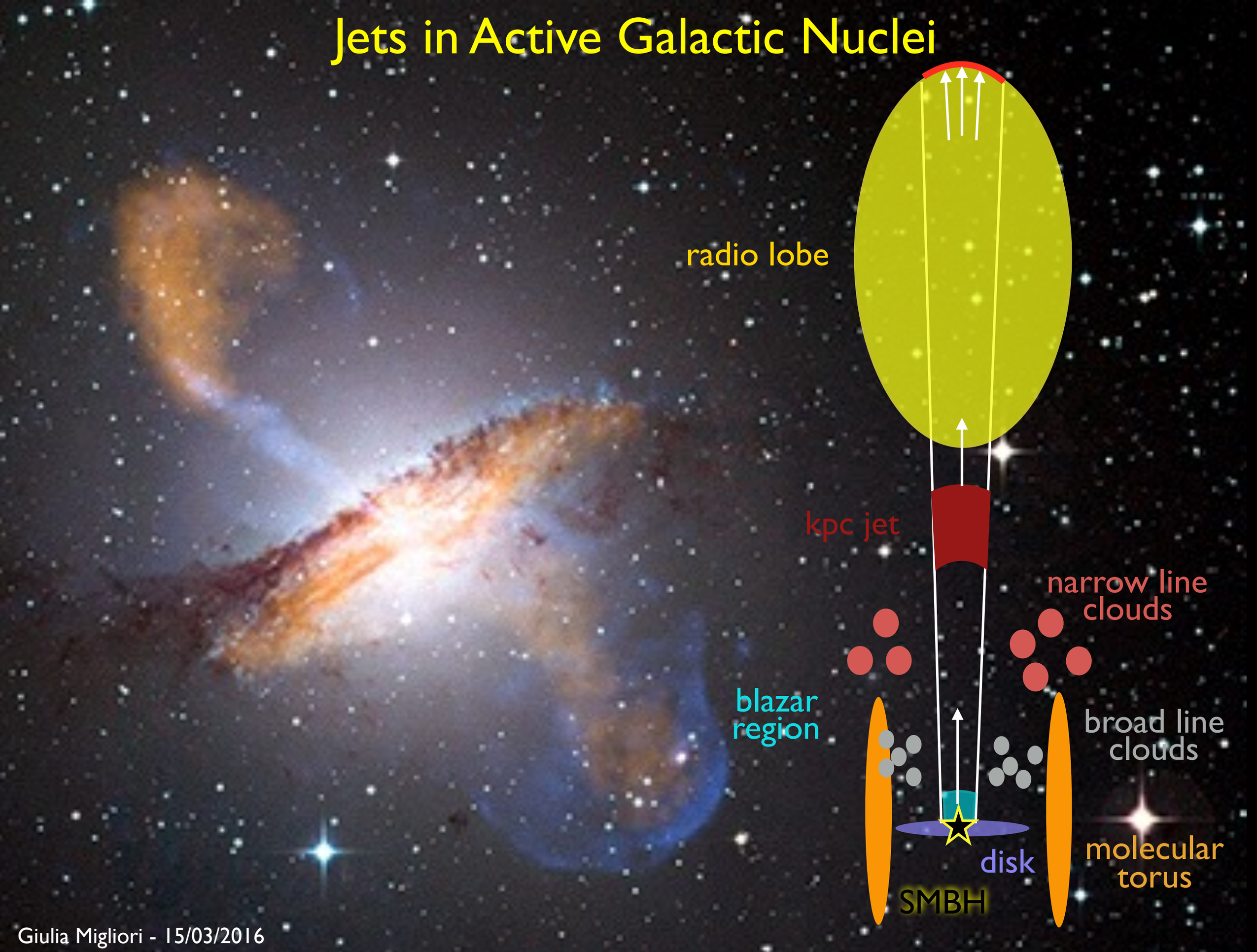
..and now: Relativistic Jets

4C29.30 z=0.064
(Siemiginowska+12)

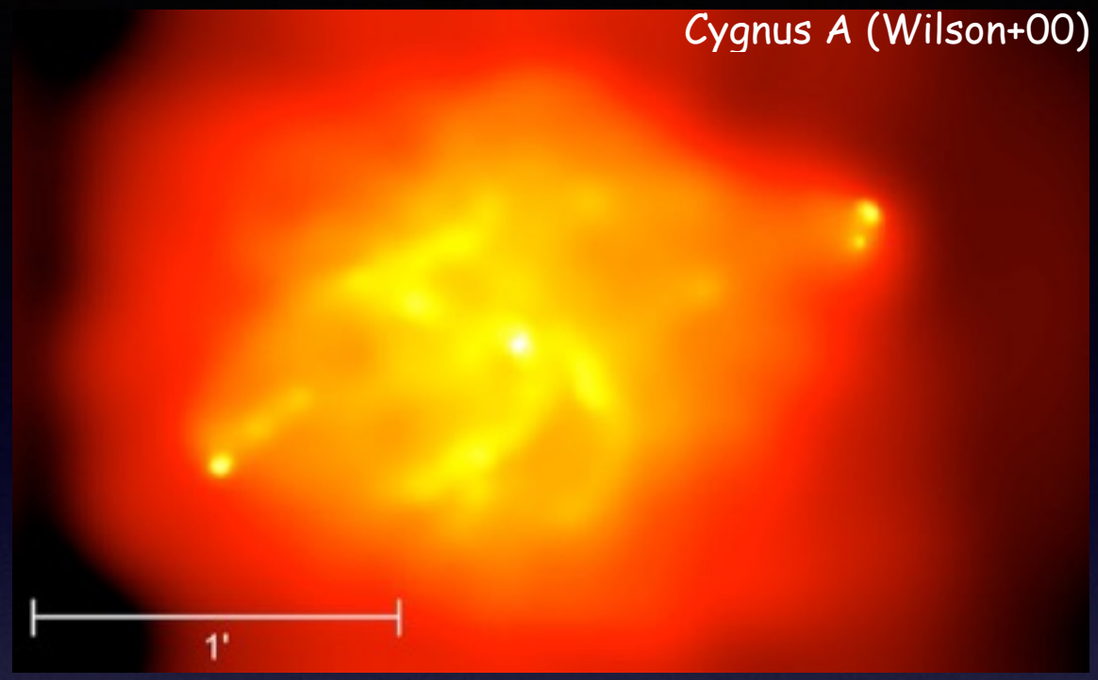
Jets in Active Galactic Nuclei



Jets in Active Galactic Nuclei: motivational slide

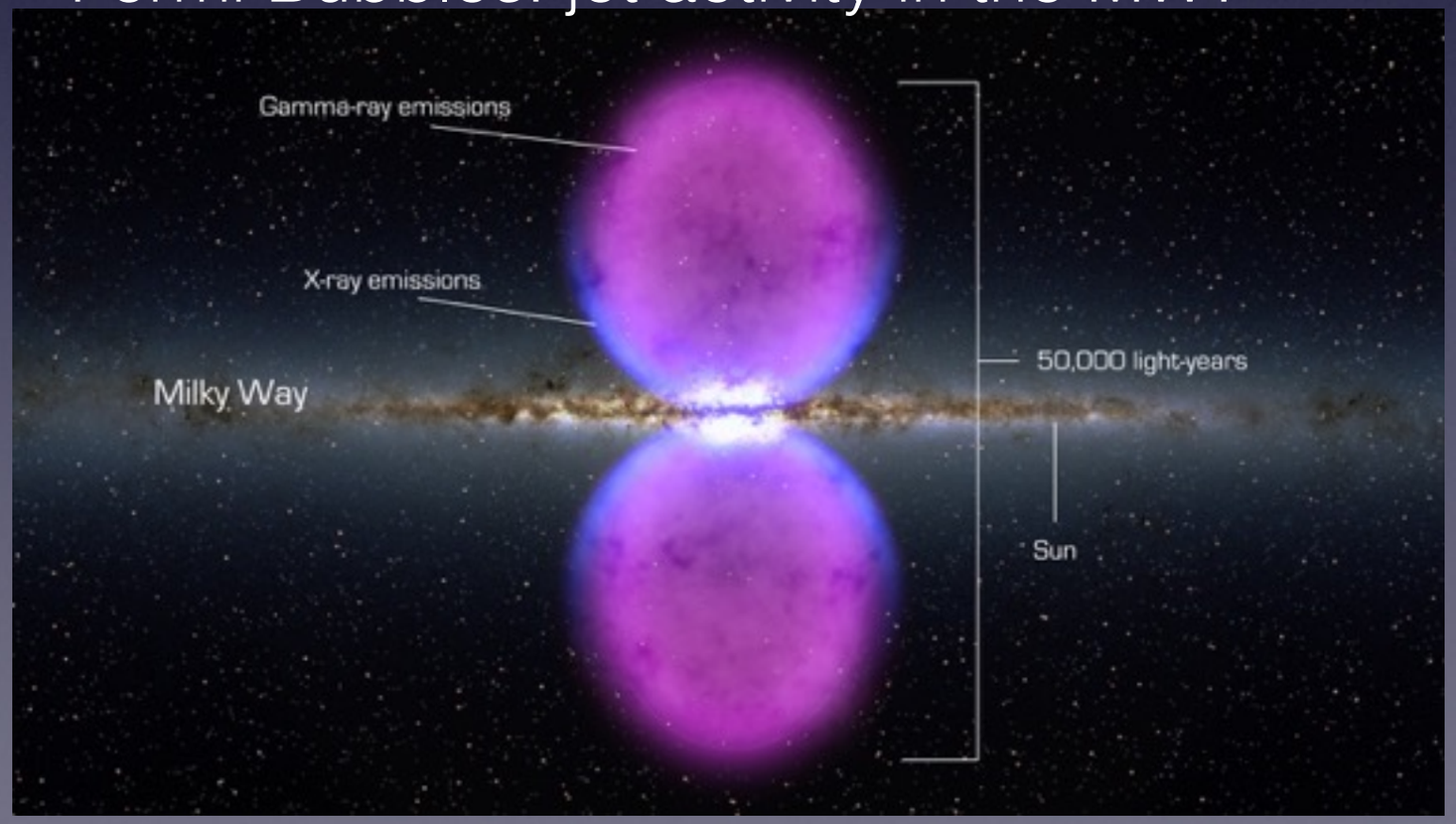
impact on the host galaxy/cluster:

Cen A jet (0.8-3 keV) Worrall+08



Candidate sources of UHECRs:

Fermi Bubbles: jet activity in the MW?



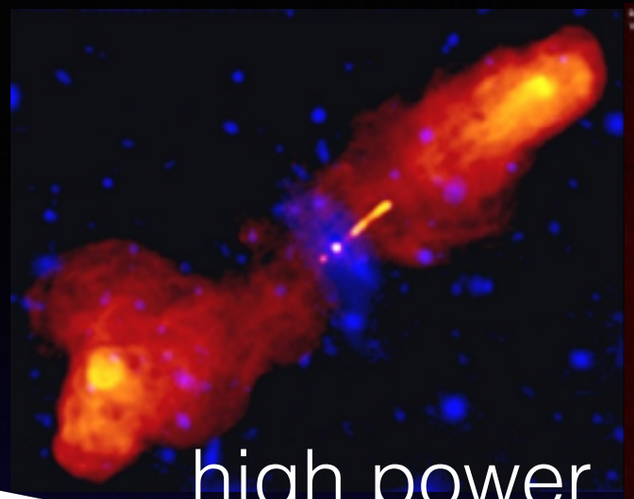
Jets in Active Galactic Nuclei: some questions

How do they form?

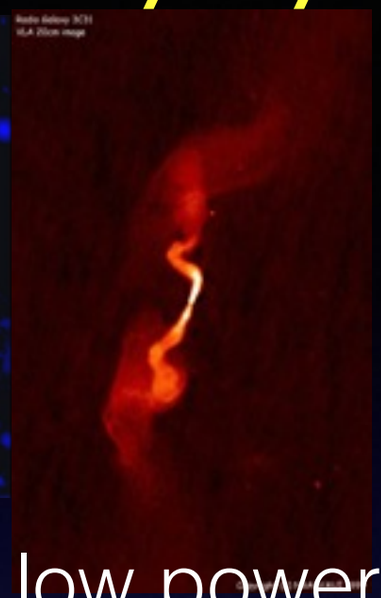
What is their structure
& composition?

How do they interact with
their environment?

Radio Duty Cycle

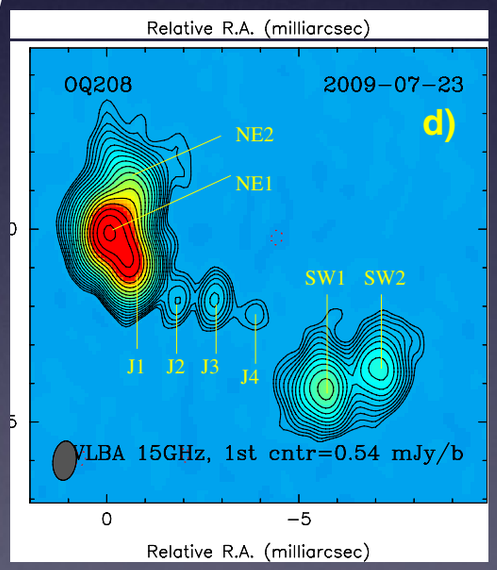


high power

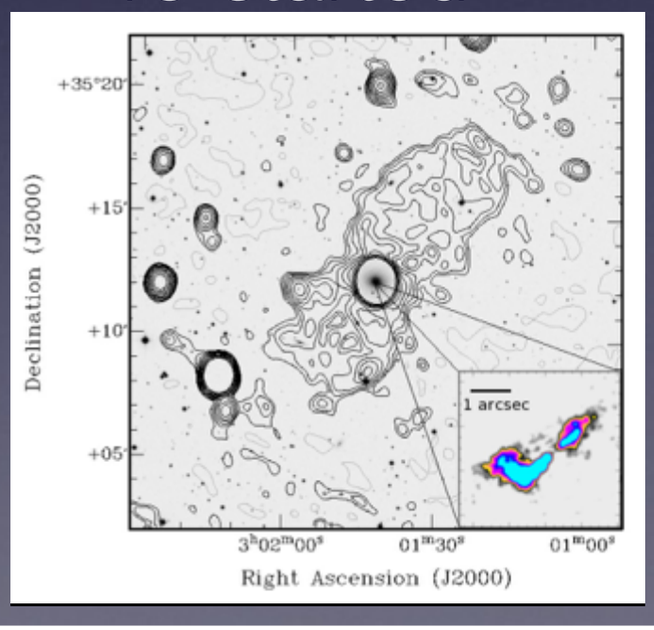


low power

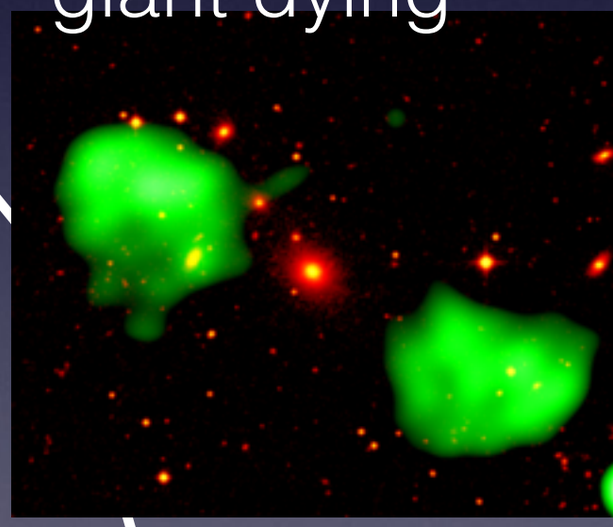
radio galaxy radio luminosity



re-started

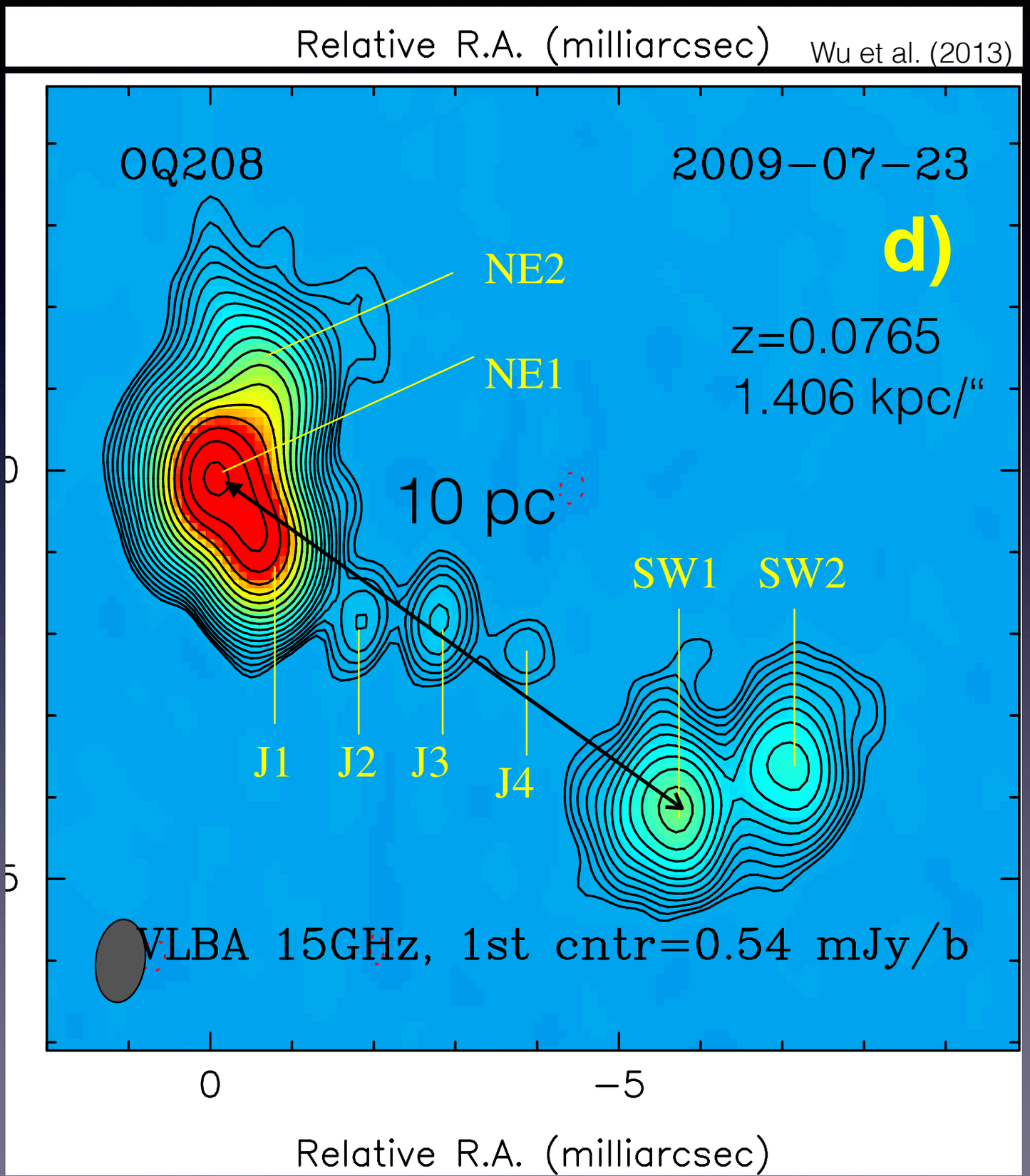


giant dying



radio galaxy size/age

Young Radio Sources



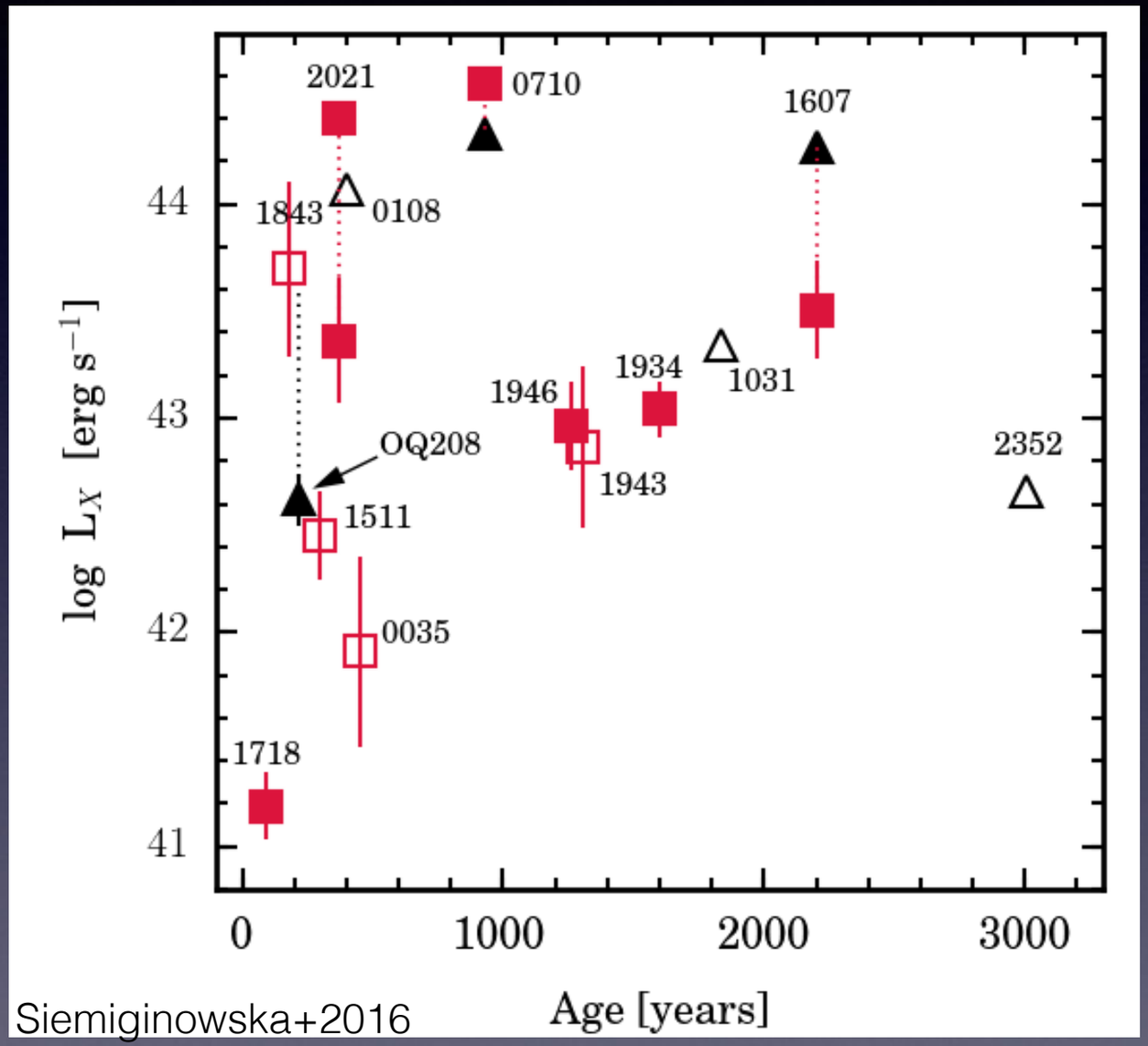
- linear size <1kpc;
- symmetric, two-sided radio morphology, dominated by mini-lobes/hotspots;
- estimated ages from the hot spots advance velocities: $<10^3$ yrs

Excess of young sources in catalogs of radio sources:

- intermittent radio activity?
- dense medium preventing the expansion of the radio source?

Young Radio Sources in X-rays

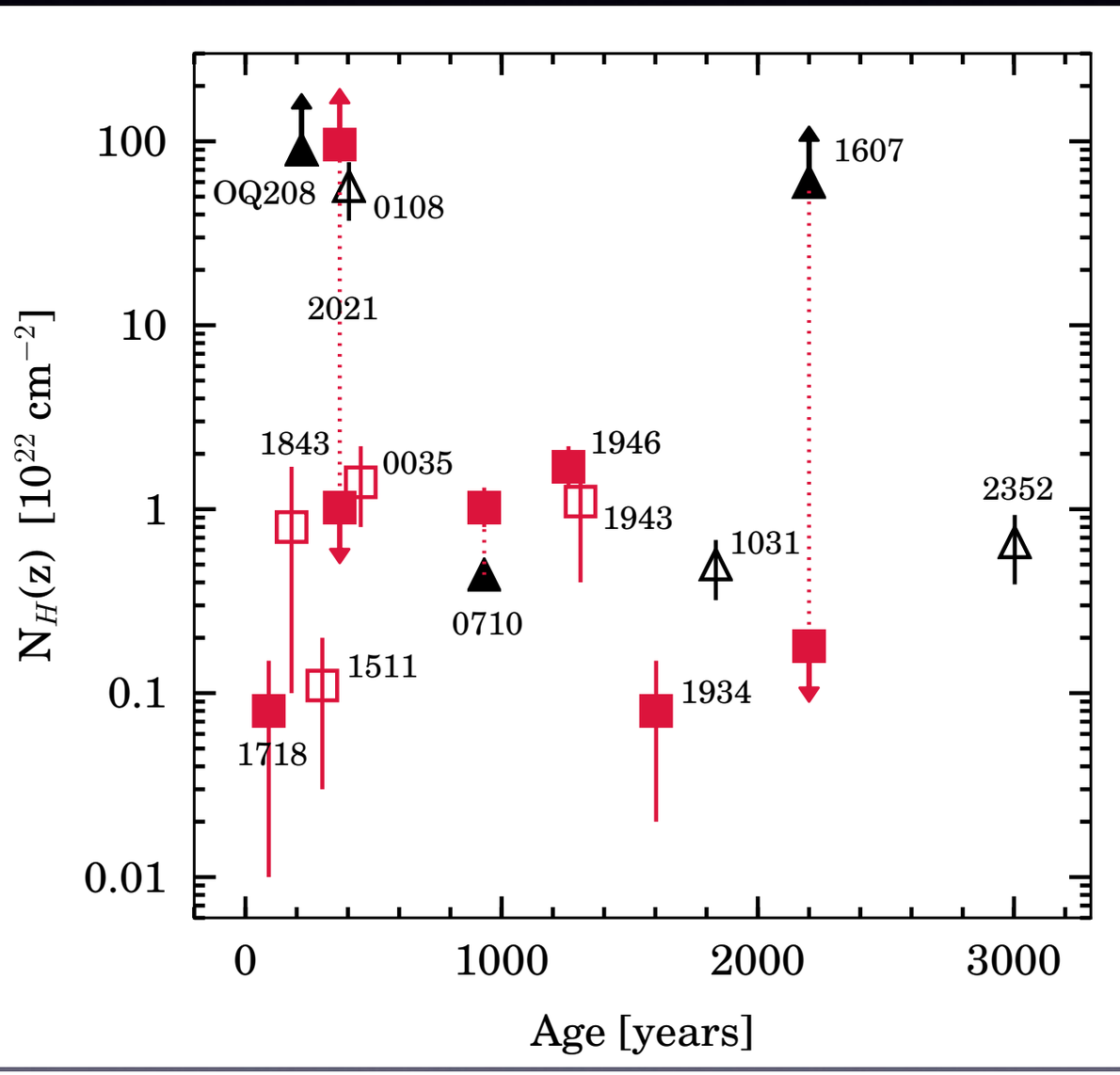
X-ray sample (16 sources, z<1.0):



Siemiginowska+2016

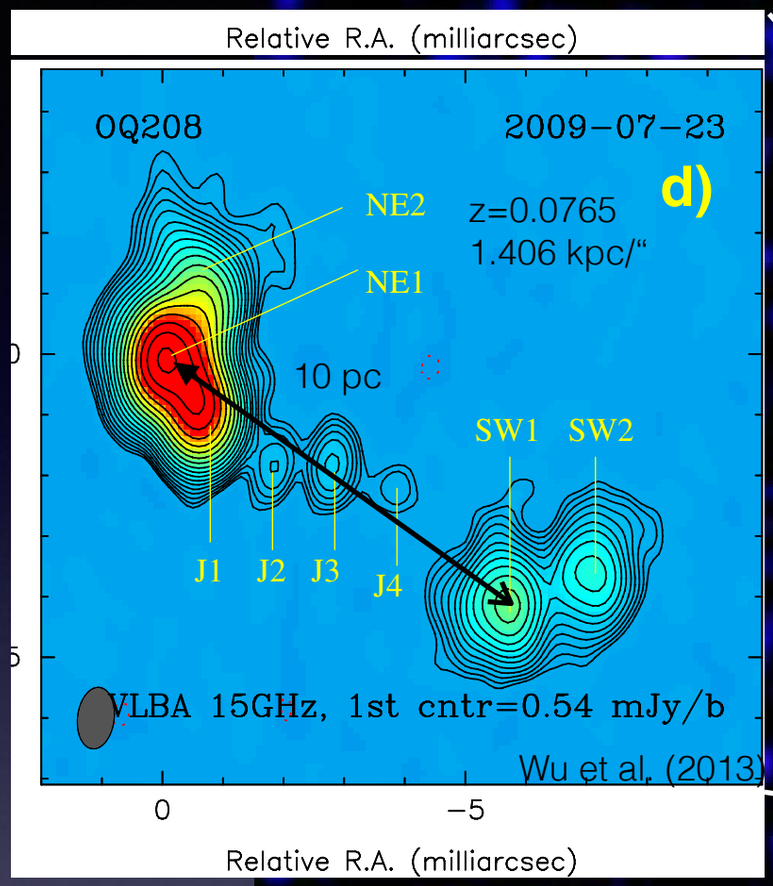
all detected with snapshot observations

Probing the environment:



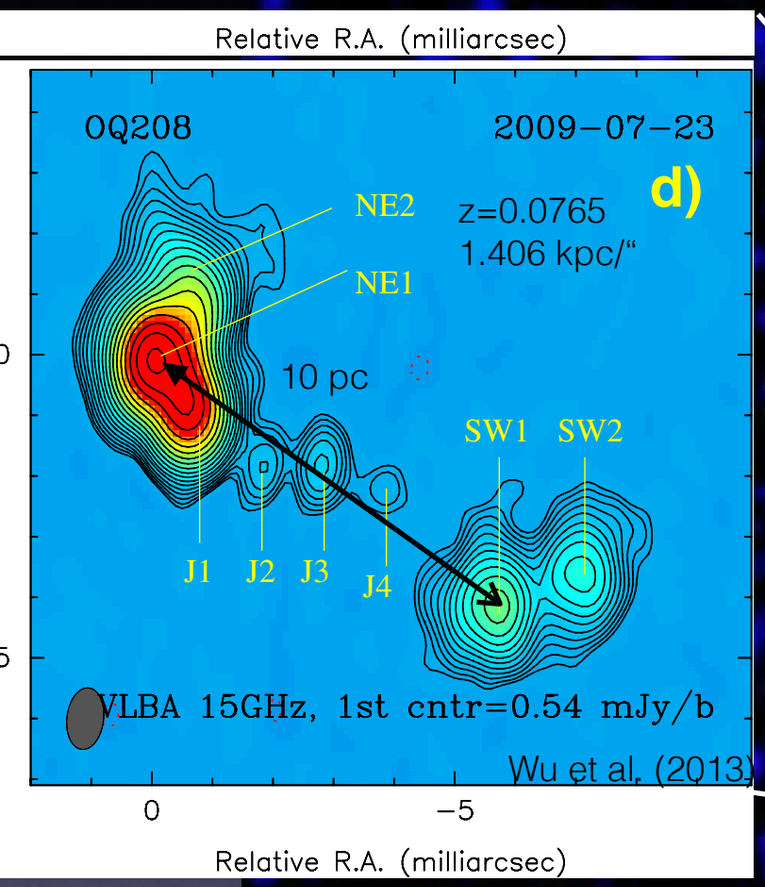
moderate column densities in the majority of the sources: no dense environment

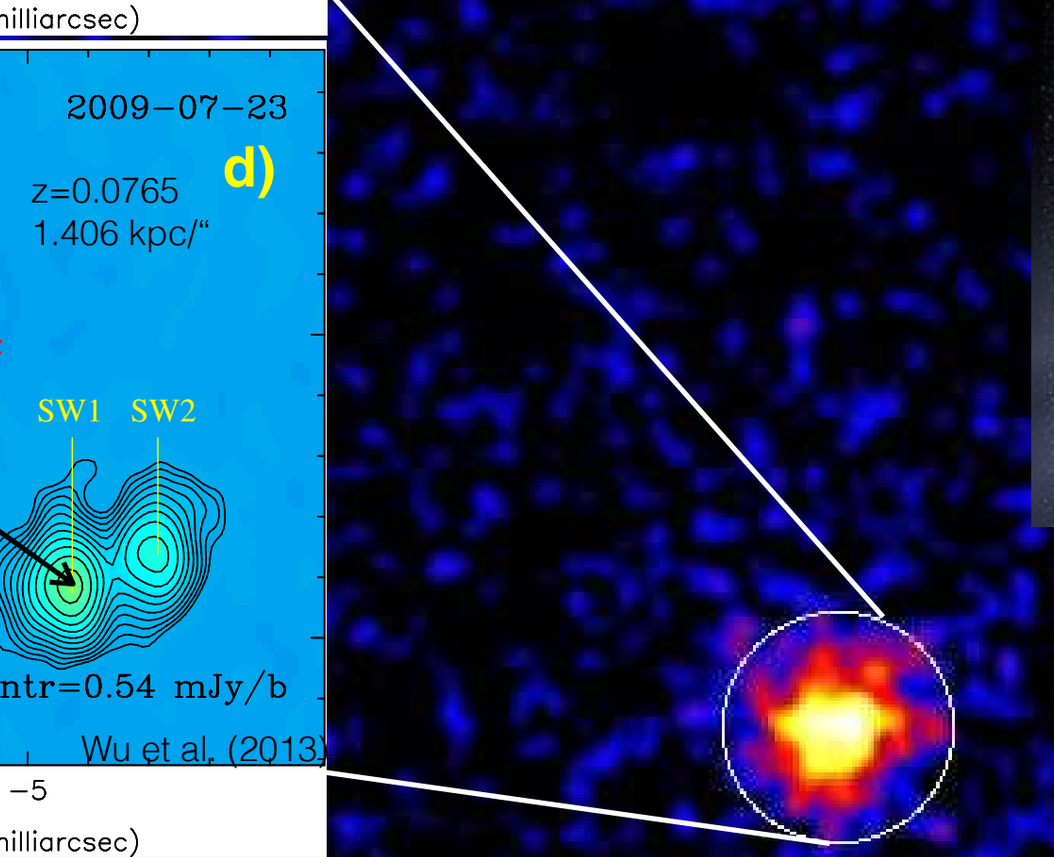
Young Radio Sources in X-rays

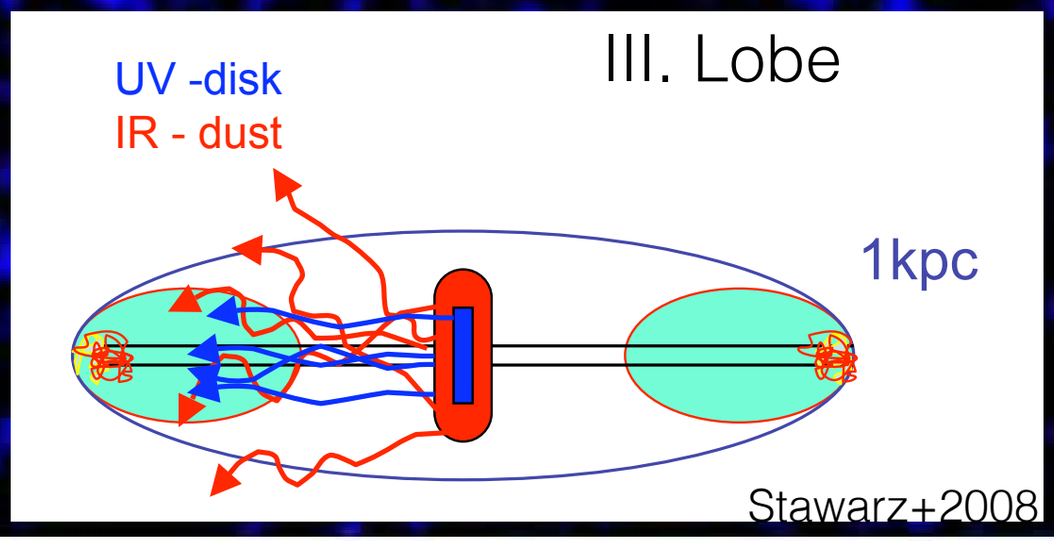


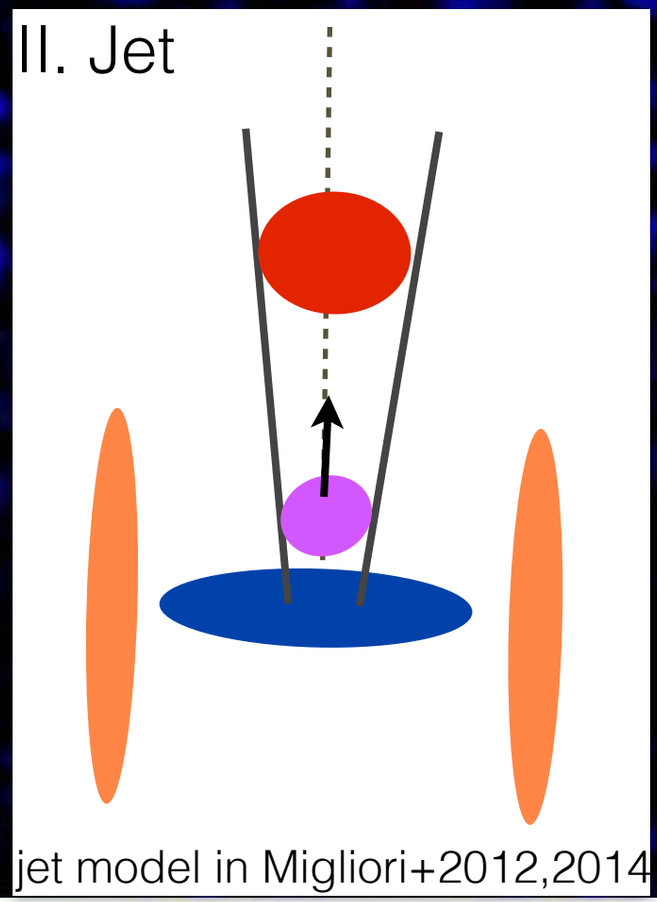
Young Radio Sources in X-rays

Origin of the emission?



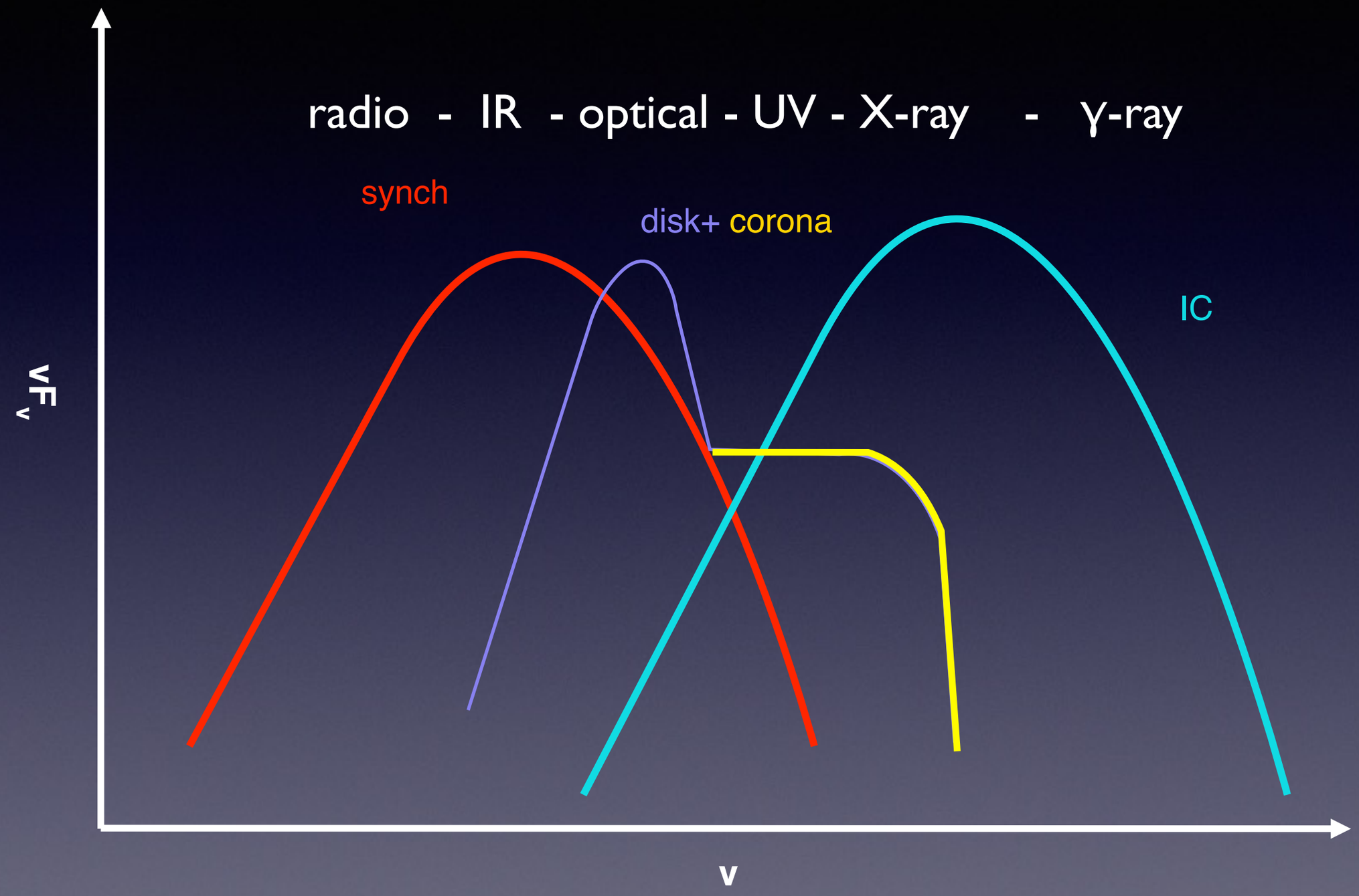






Young Radio Sources in gamma-rays

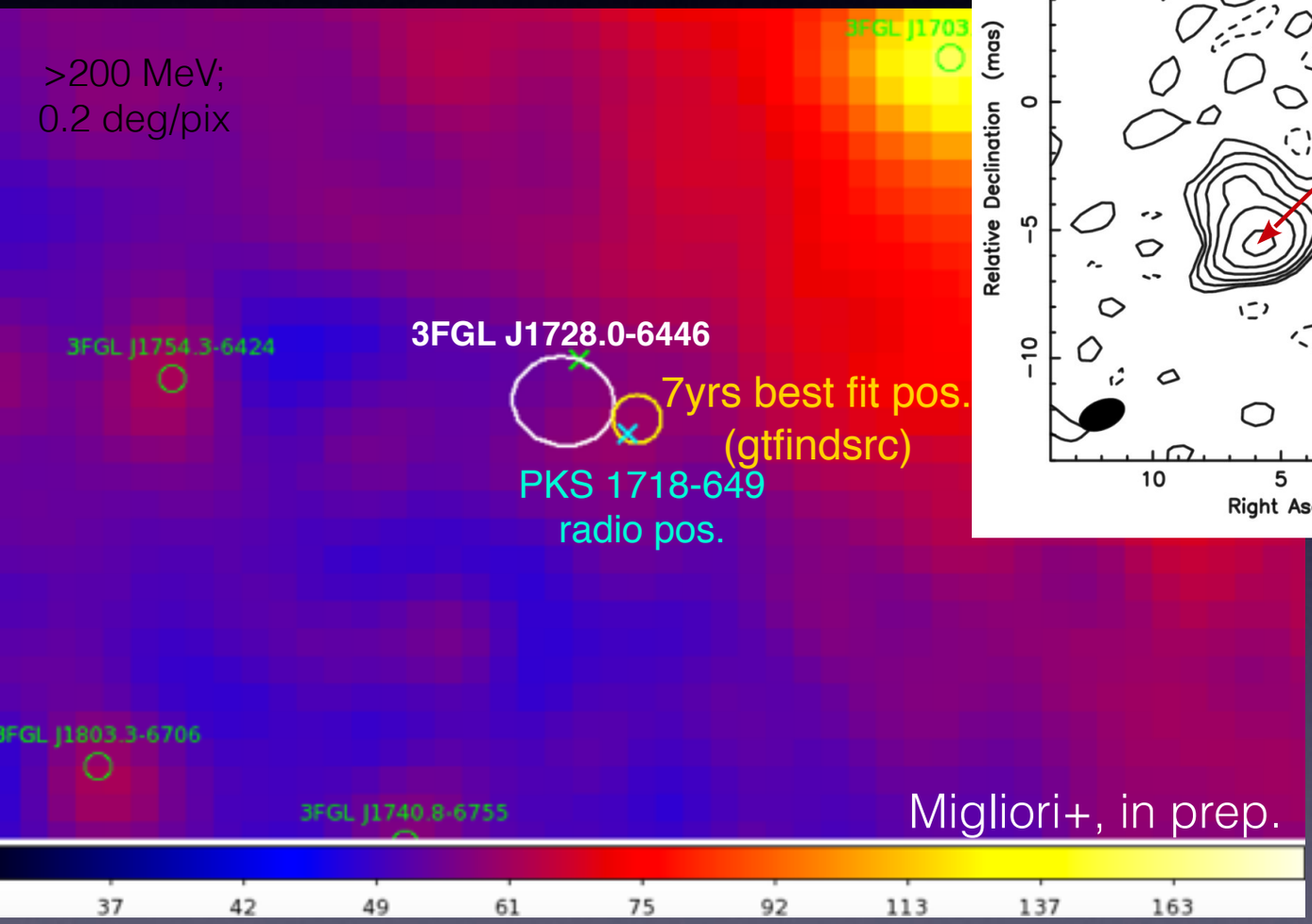
The answer is in the gamma-rays:



The jets/lobes can produce non-thermal gamma-ray emission detectable with Fermi-LAT

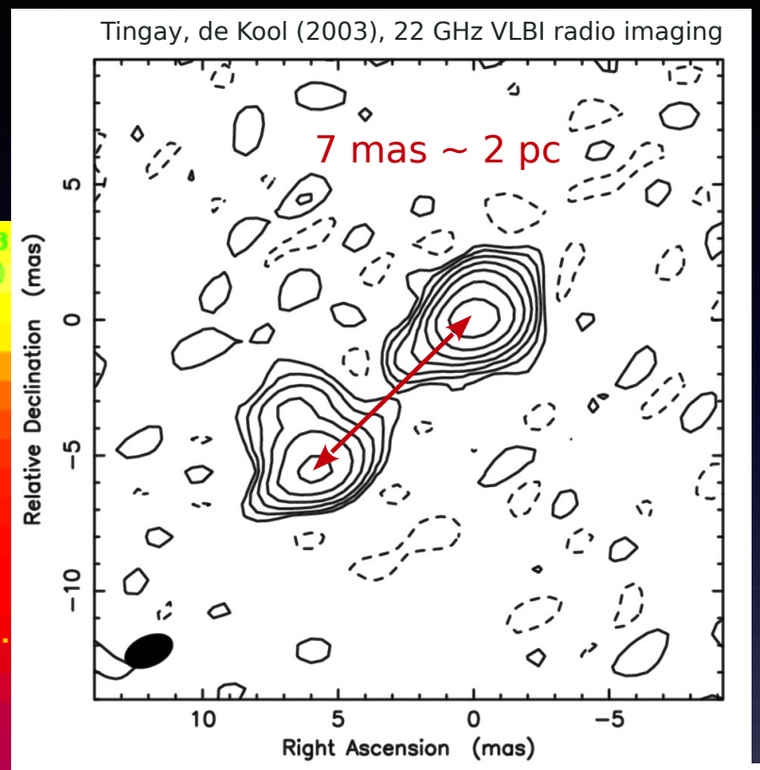
Young Radio Sources in gamma-rays

PKS 1718-649 (z=0.014, ~100yrs): detection in gamma-rays with 7yrs Fermi-LAT observations



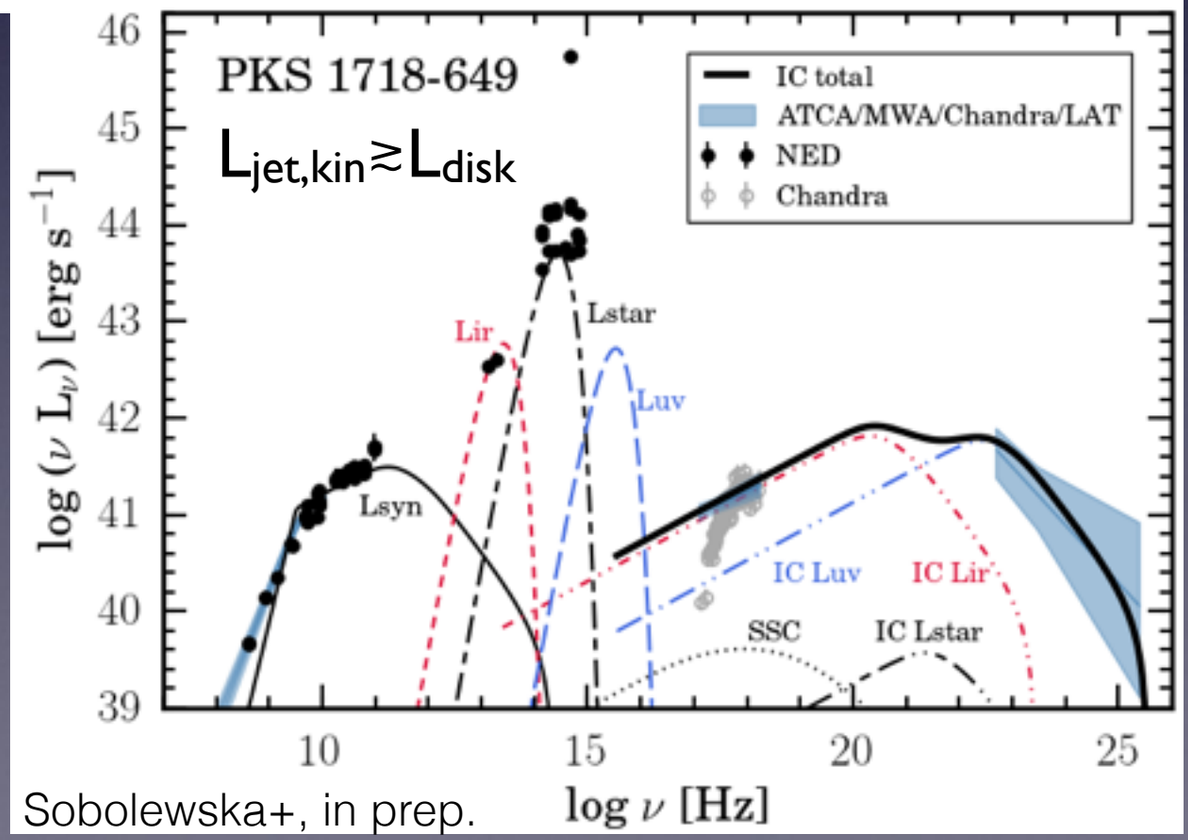
Migliori+, in prep.

Faint, non variable gamma-ray emission



High-energy emission from the compact radio lobes?

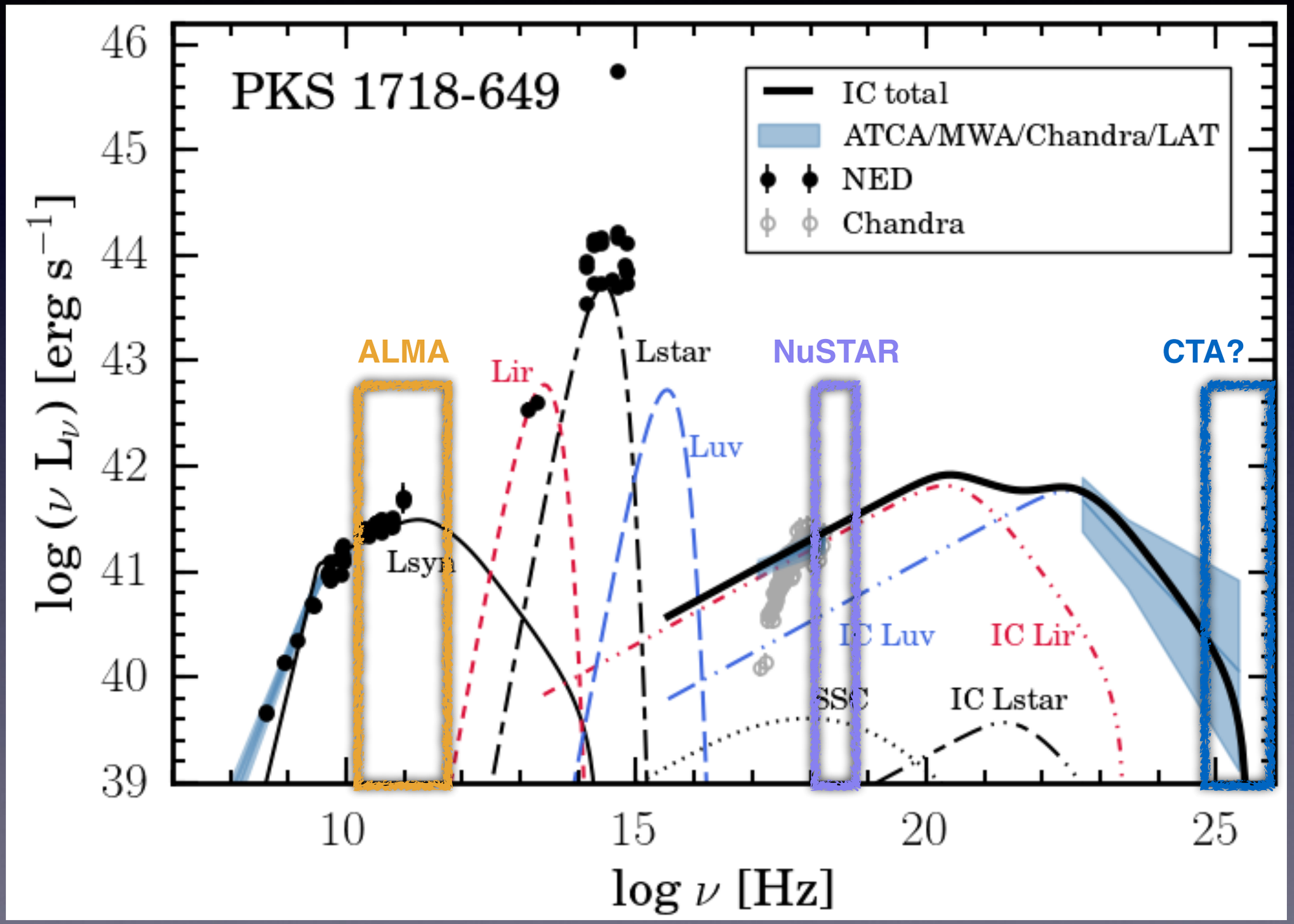
preliminary:



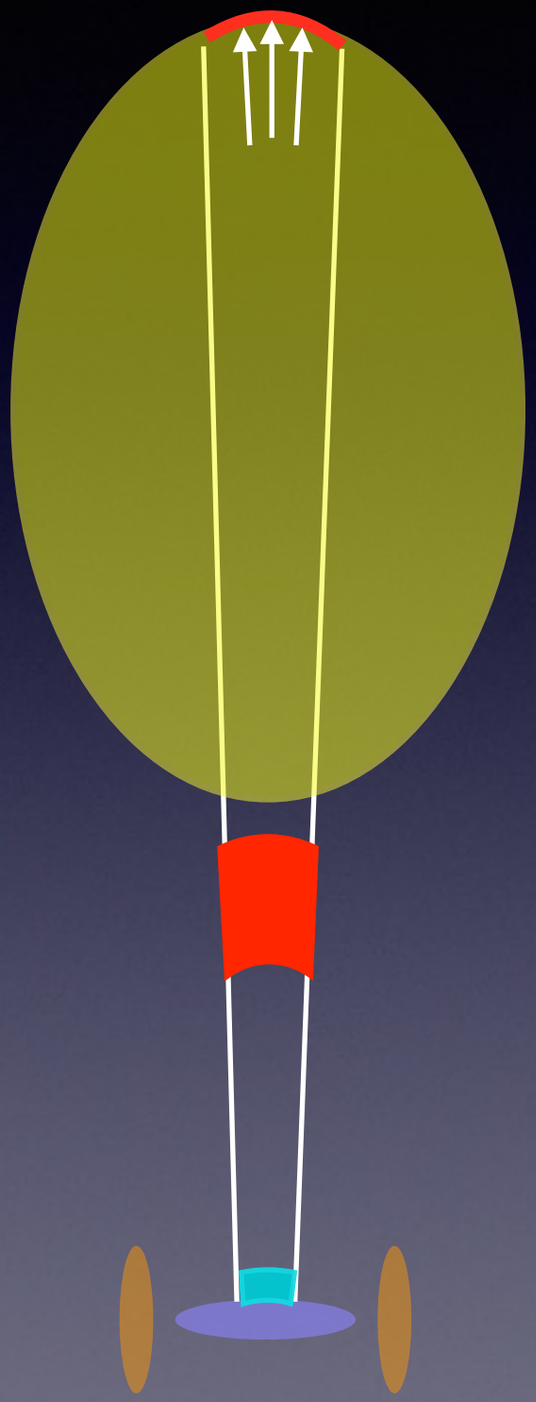
Sobolewska+, in prep.

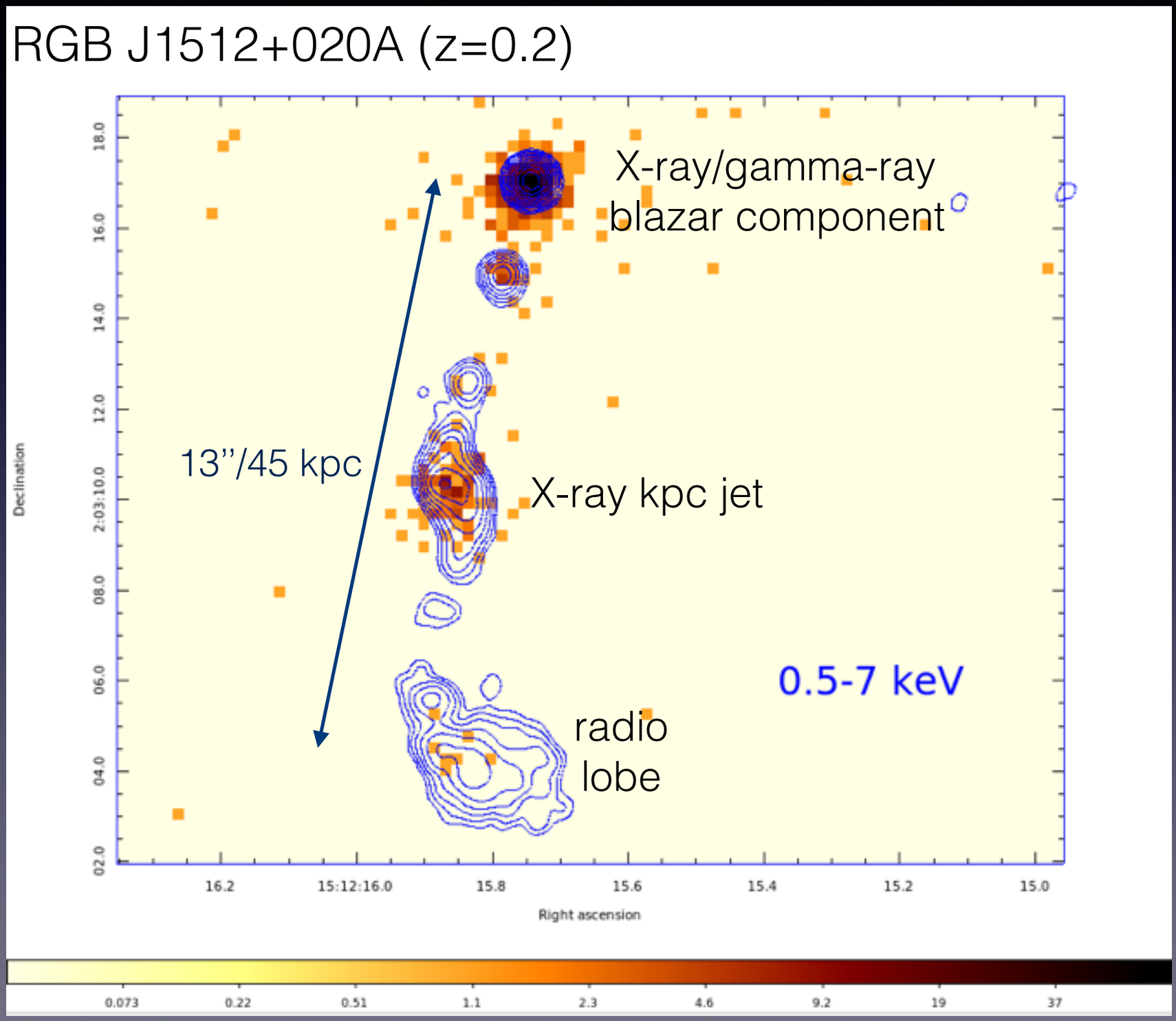
Young Radio Sources in gamma-rays

Testing the lobe scenario:

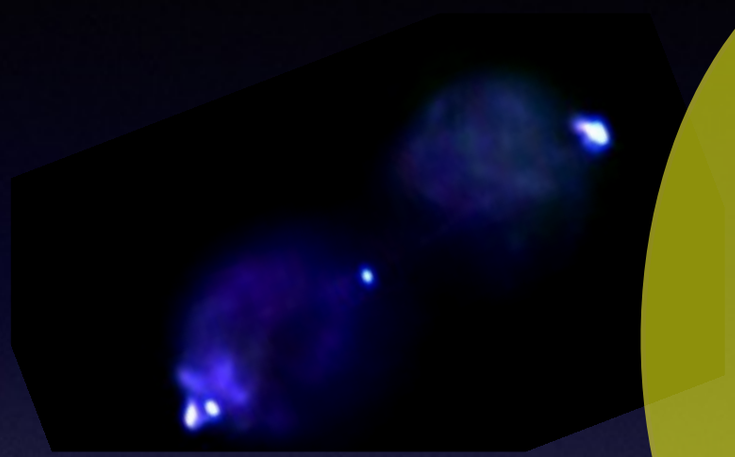


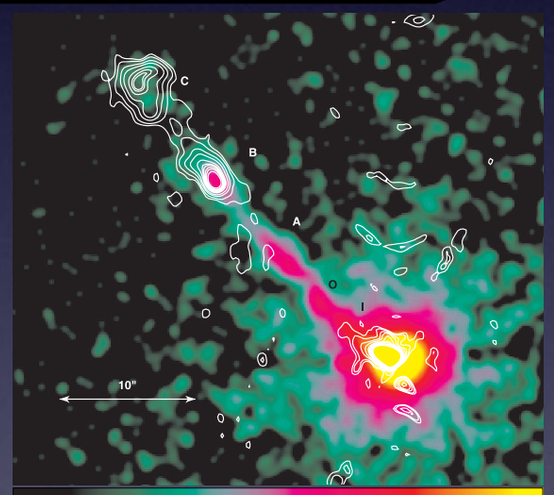
Jets in Active Galactic Nuclei: structure & energetics

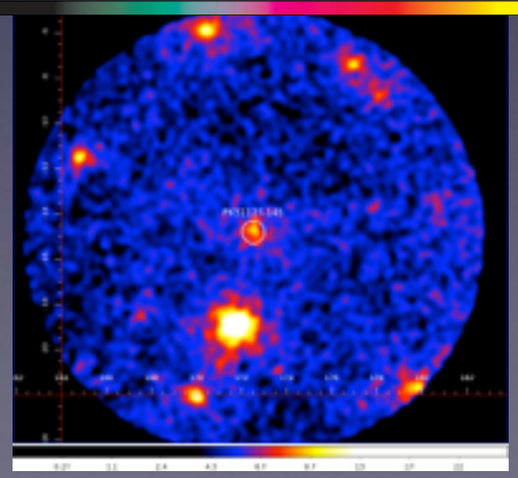


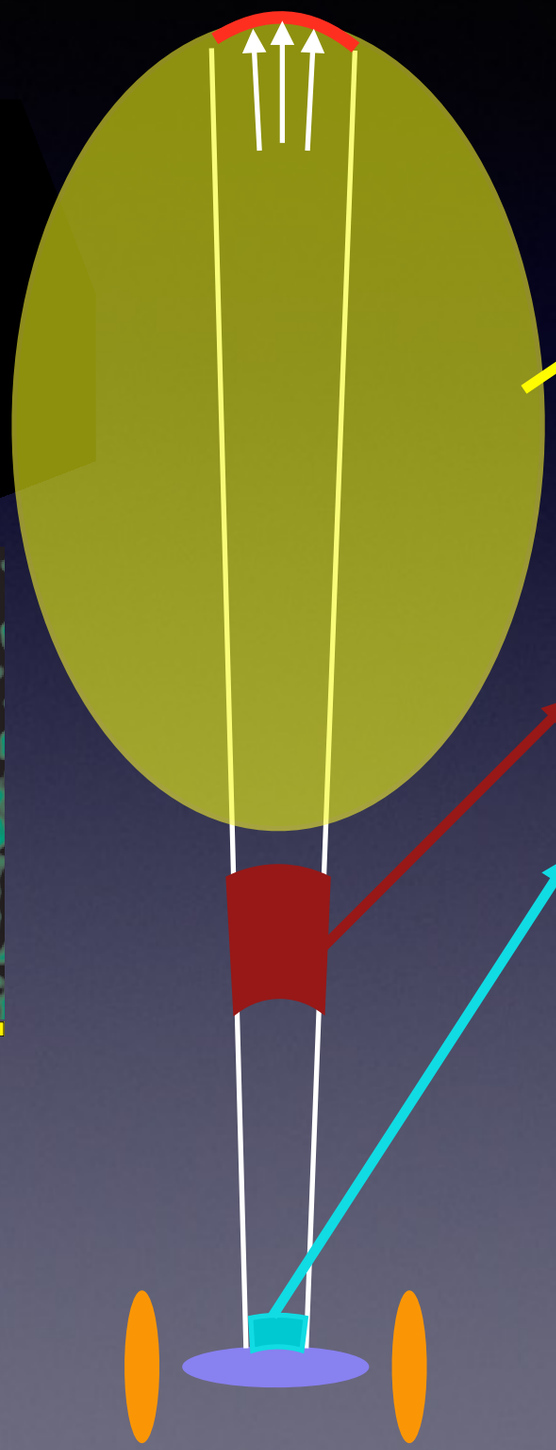


Jets in Active Galactic Nuclei: tracing the jet emission









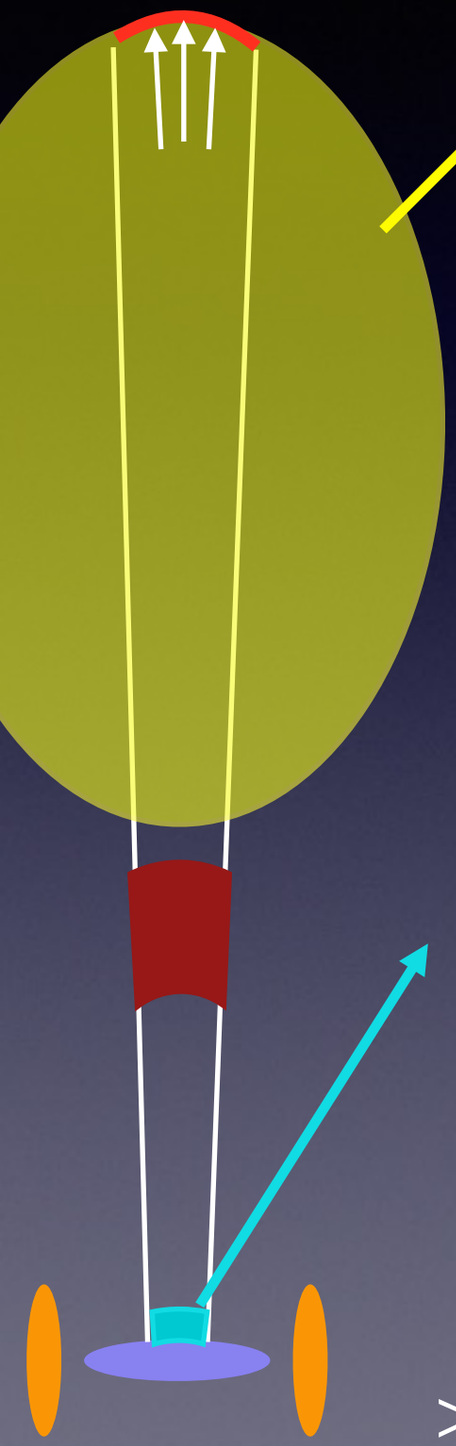
integrated jet power from the radio lobes

X-ray kpc jet

γ-ray blazar component

jet power through the linear scale

Jets in Active Galactic Nuclei: tracing the jet power



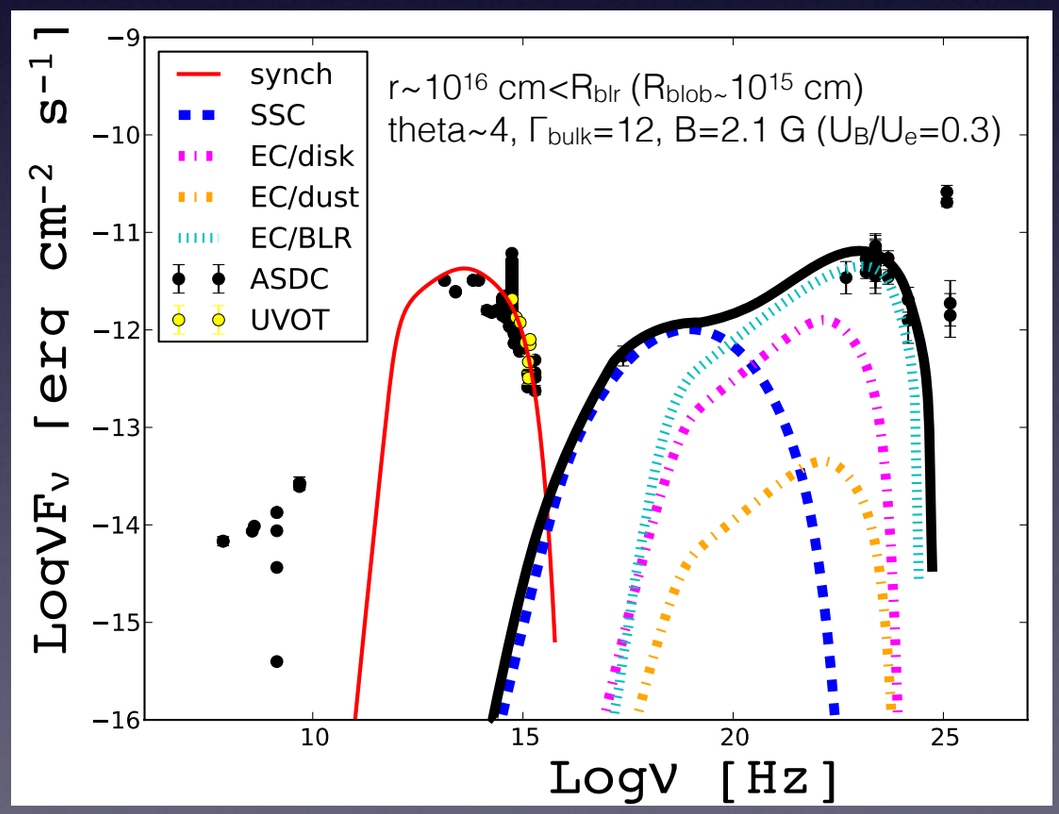
jet power from the radio luminosity @151MHz (Willott+99)

$L_{jet,kin}=3\times10^{21} \times f^{3/2} \times L_{151}^{6/7}$ erg s^{-1}

$L_{jet,kin}\sim10^{45}$ erg s^{-1}

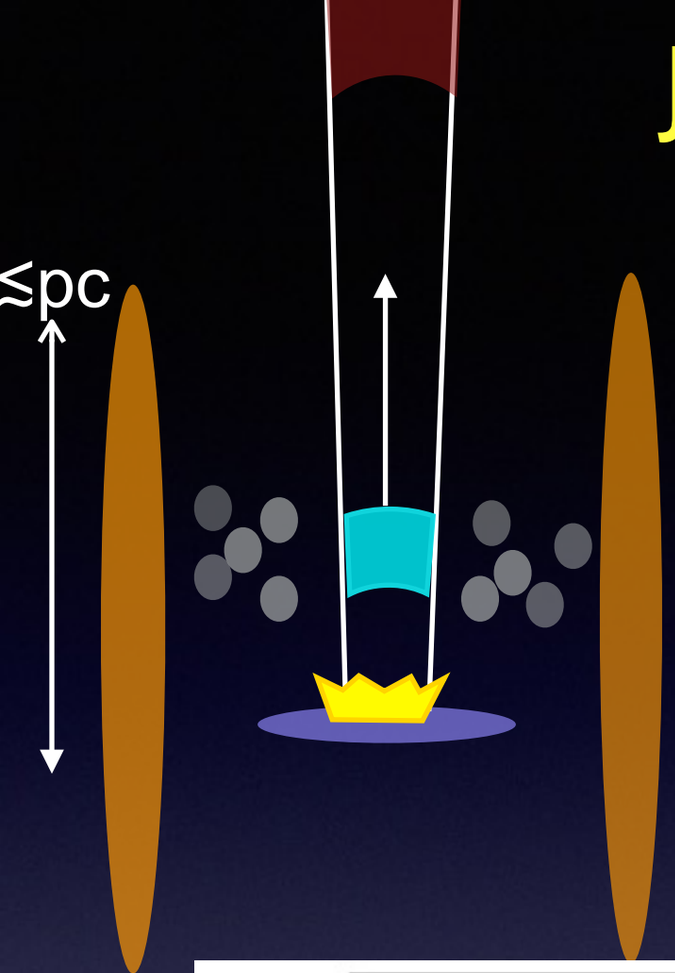
jet power from SED modeling of the γ-ray blazar component

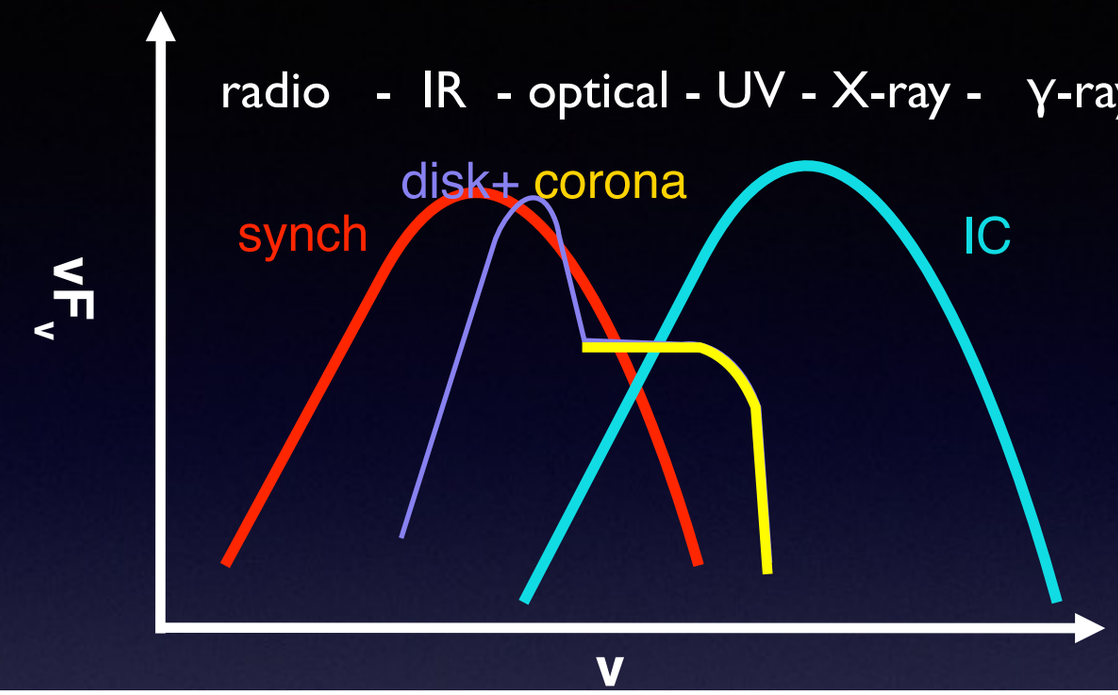
$L_{jet,kin}\sim10^{44\text{-}46}$ erg/s

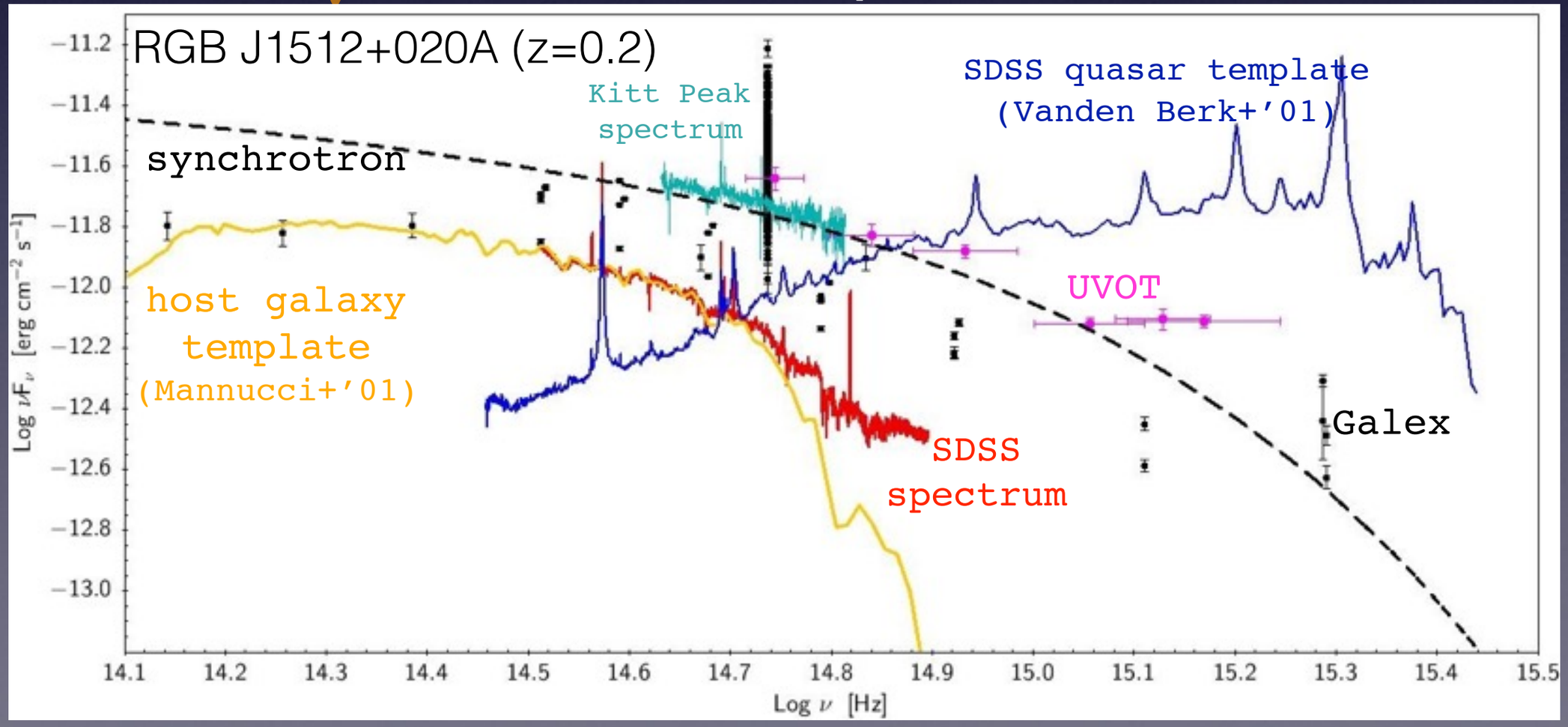


>10% of the initial jet power transported to kpc scales

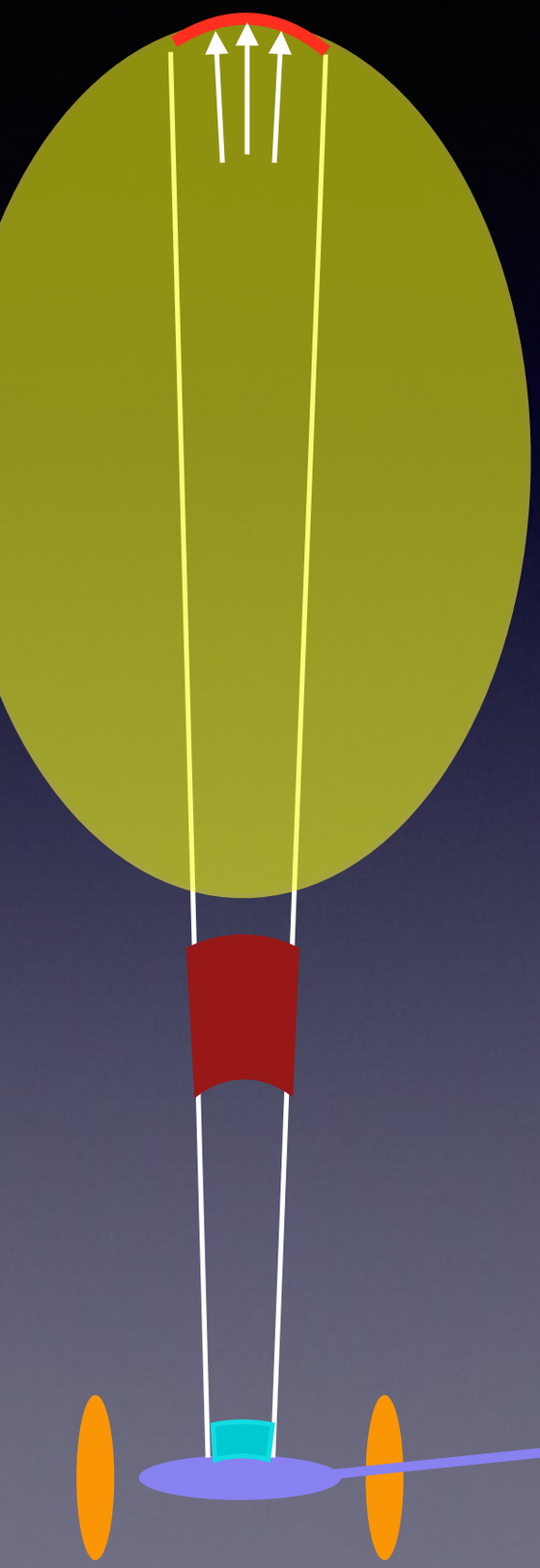
Jets in Active Galactic Nuclei: accretion & ejection

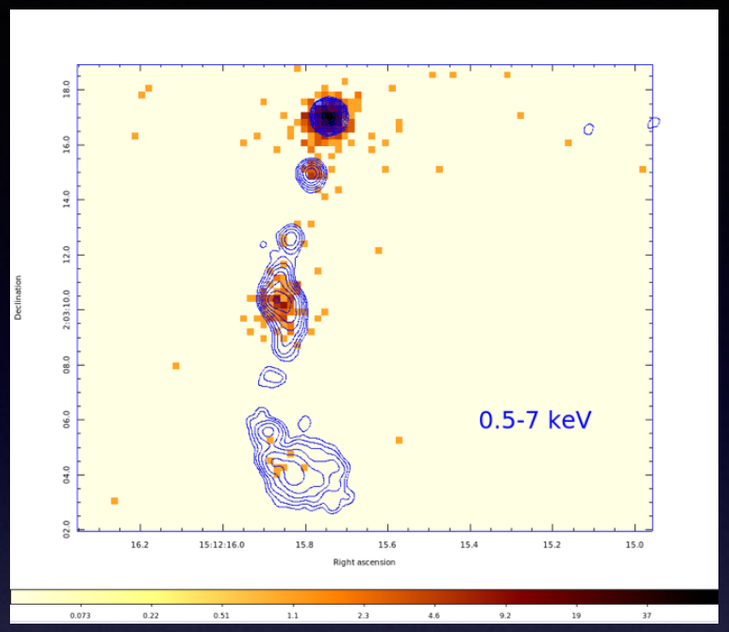






Jets in Active Galactic Nuclei: accretion & ejection



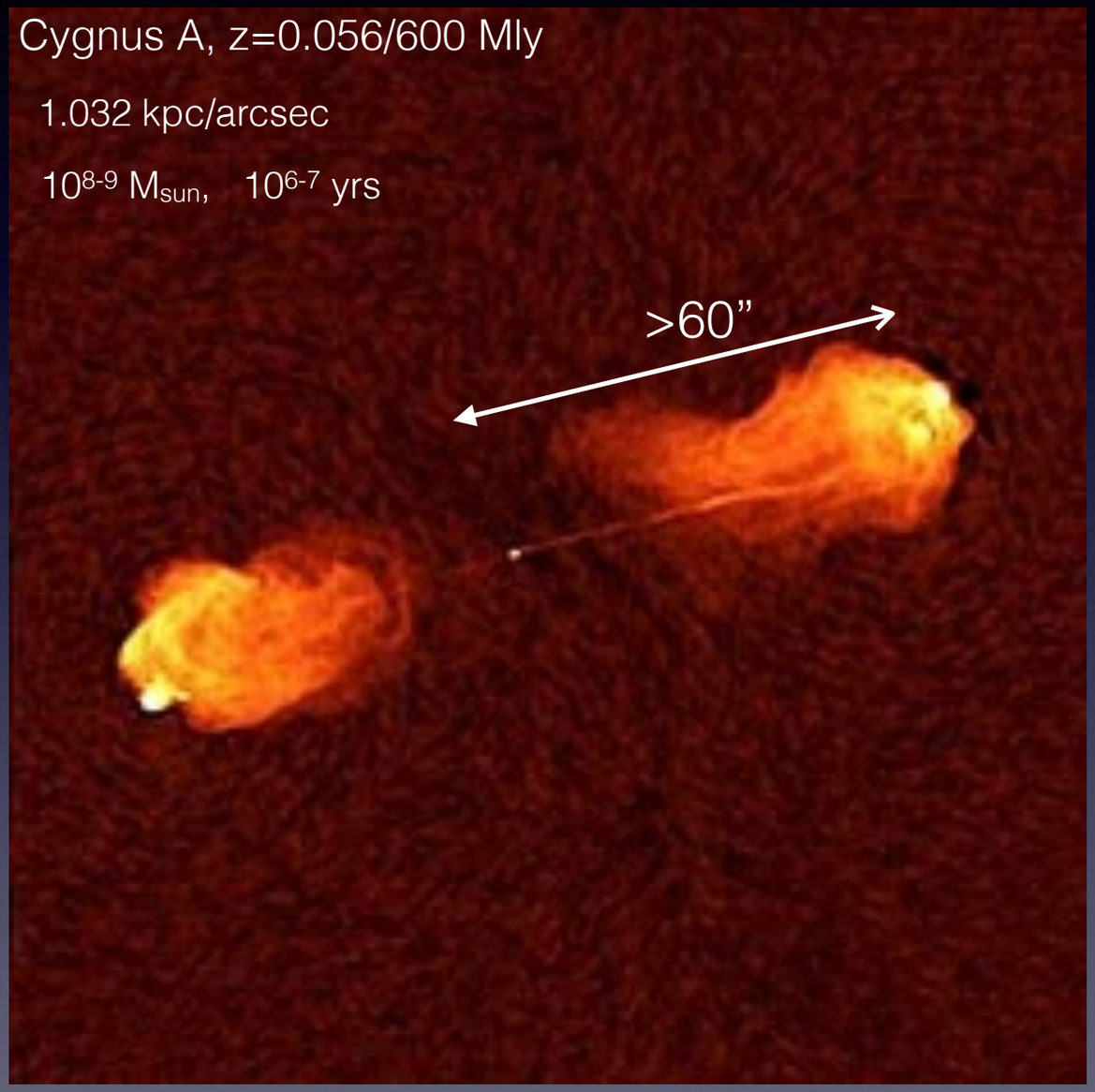


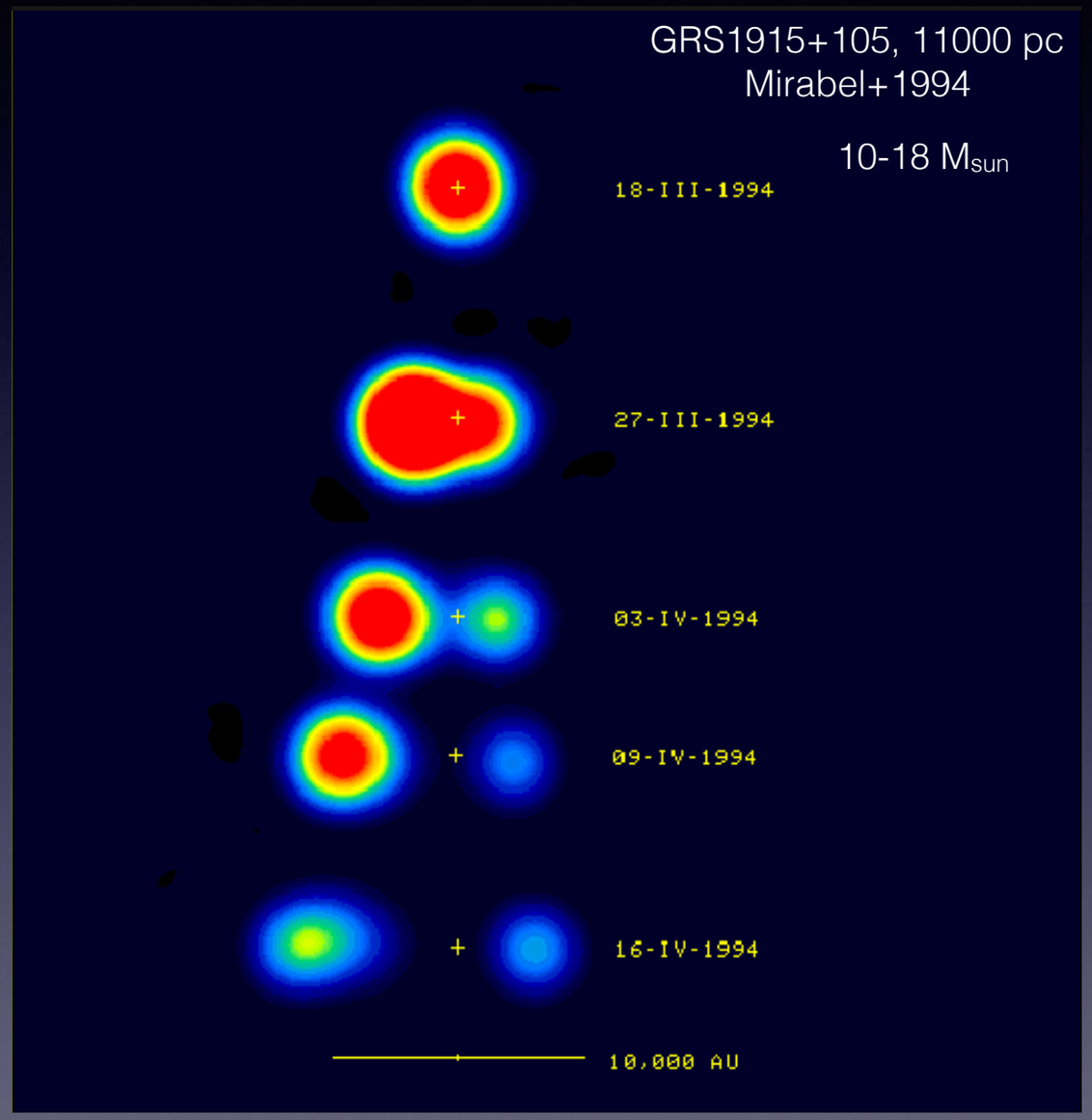
$L_{jet,kin} \gtrsim 10^{44}$ erg s^{-1}

disk luminosity:
$\lesssim 10^{44}$ erg s^{-1}

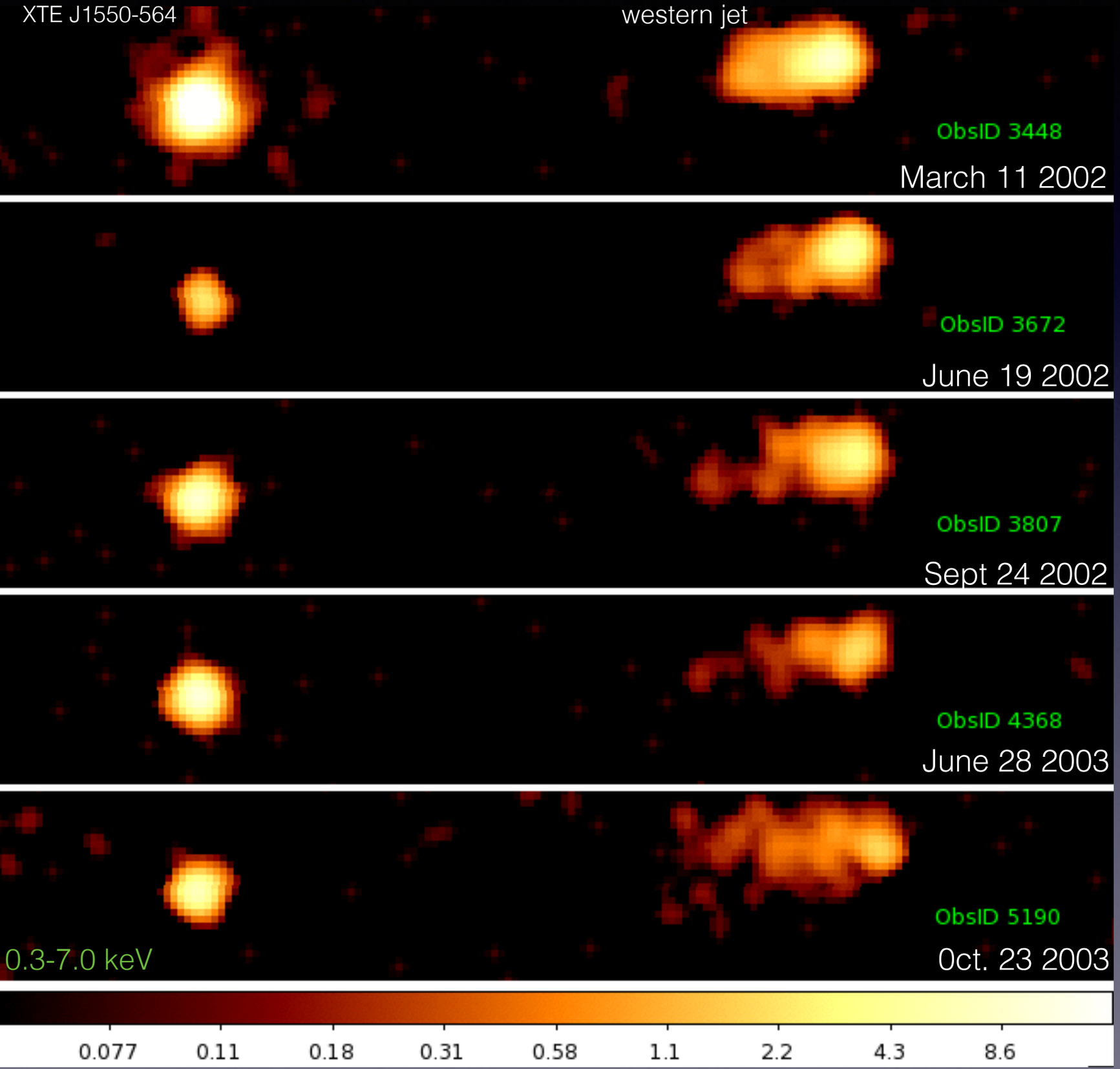
$L_{jet,kin} \gtrsim L_{disk}$:
the mechanism responsible for the jet formation is maximally efficient in extracting the BH rotational energy (see also Ghisellini+'11)

From Quasar to Microquasar:





Microquasar:
Time lapse of a jet-ISM interaction

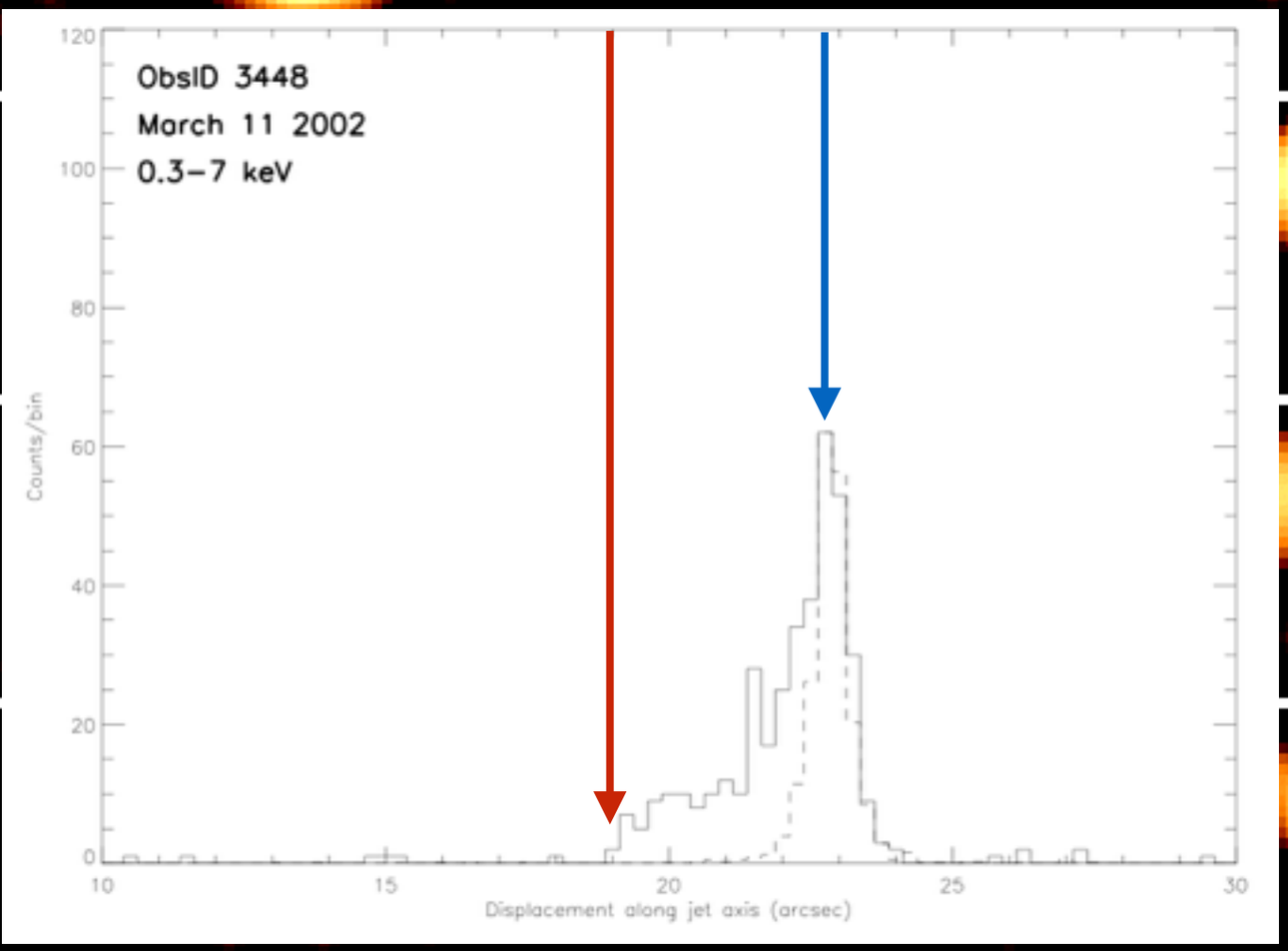


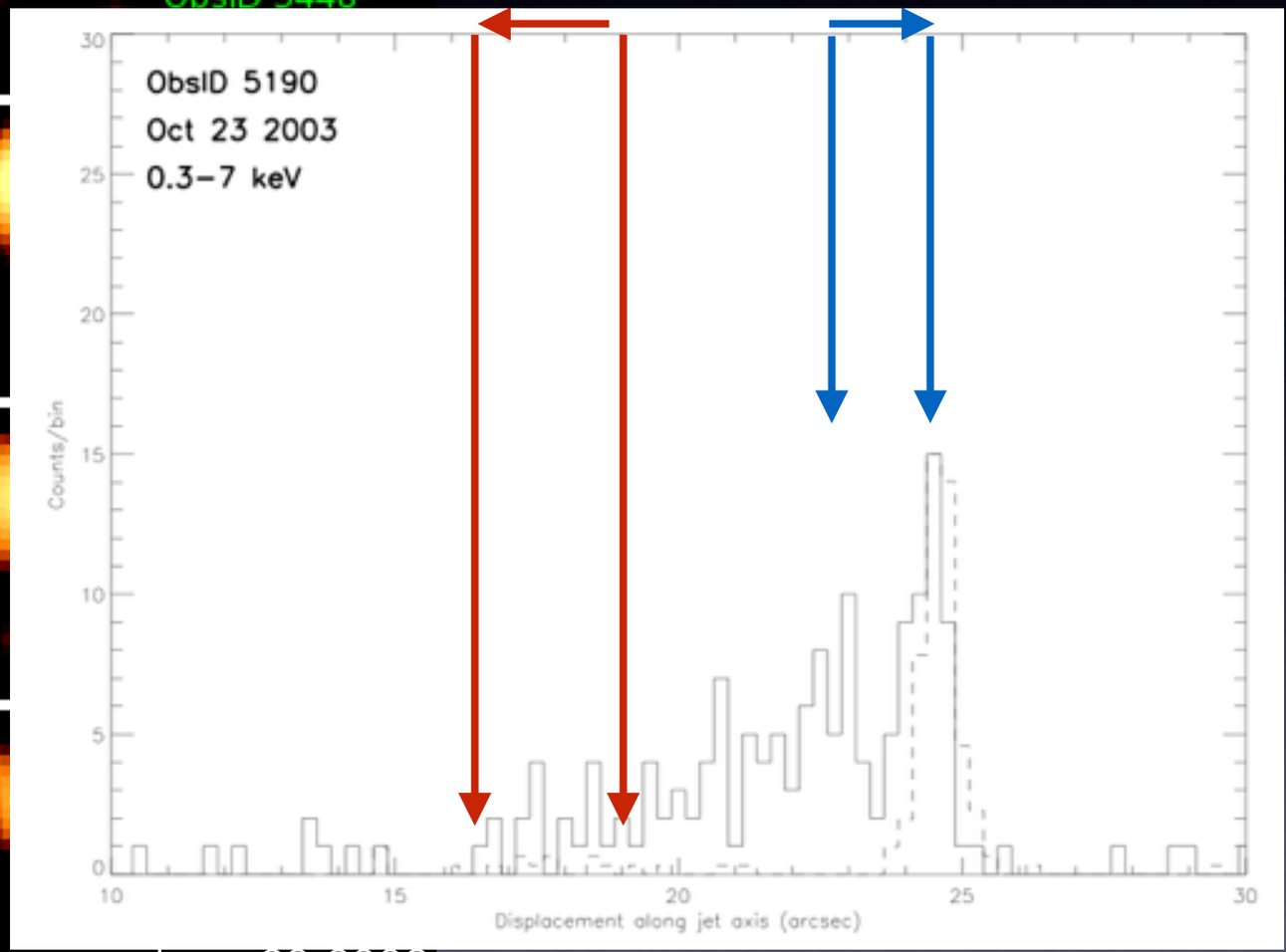
Migliori et al. in prep.

Microquasar:
Time lapse of a jet-ISM interaction

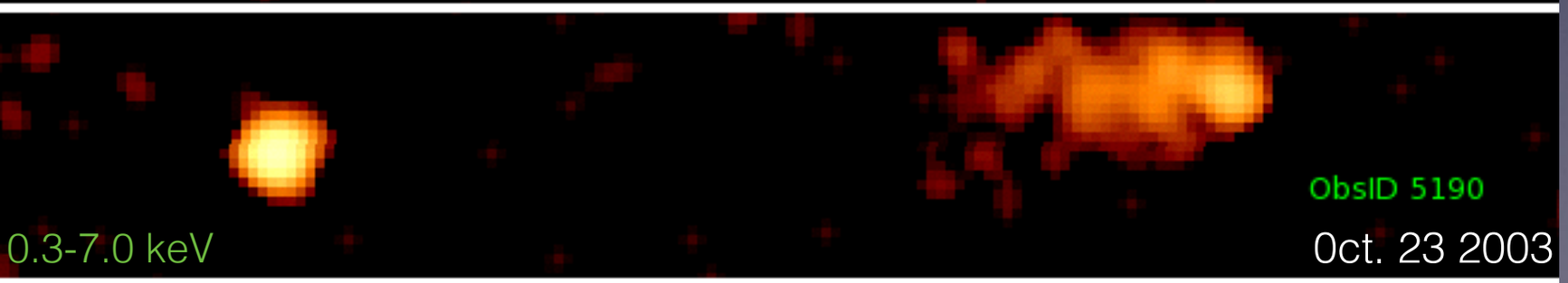
XTE J1550-564

western jet





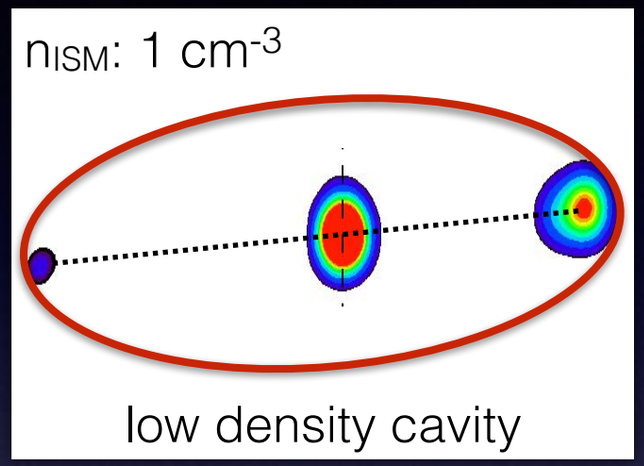
June 28 2003

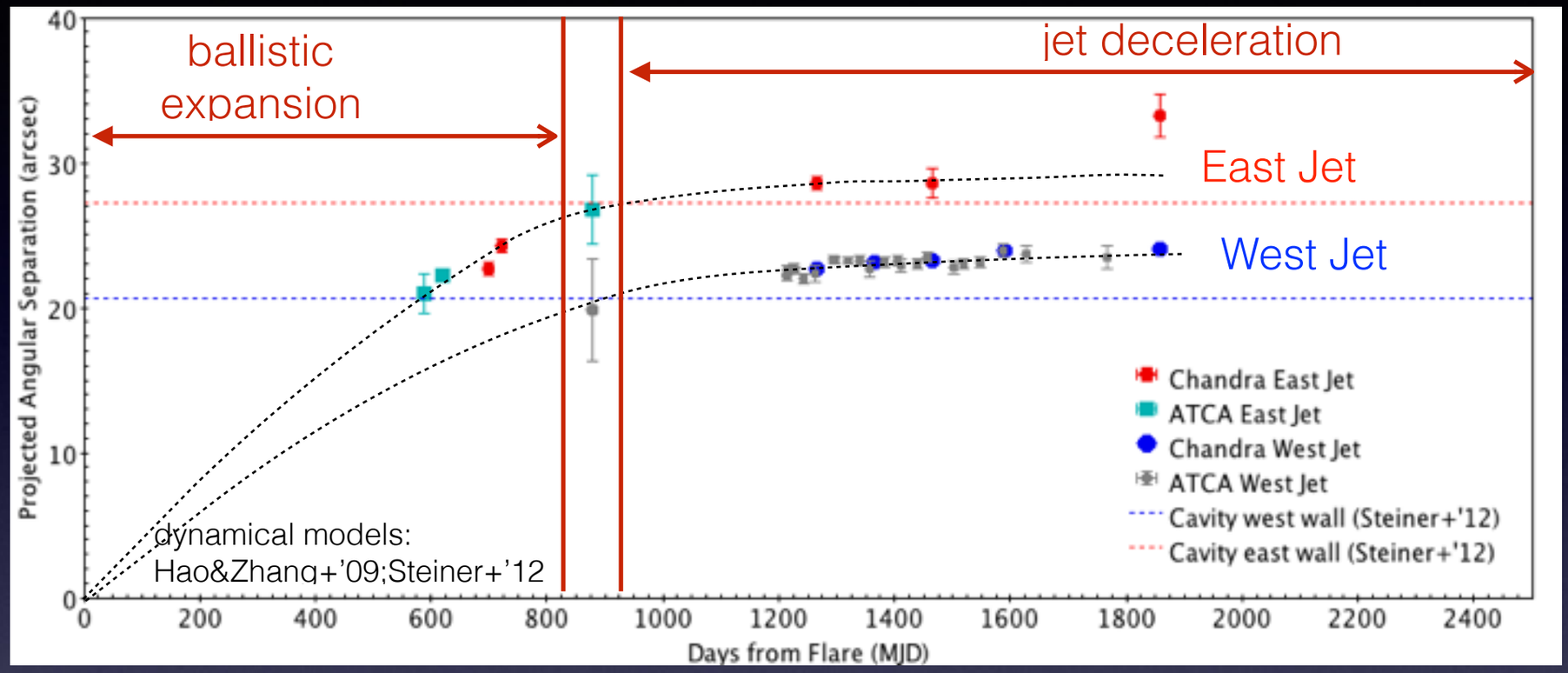


Migliori et al. in prep.

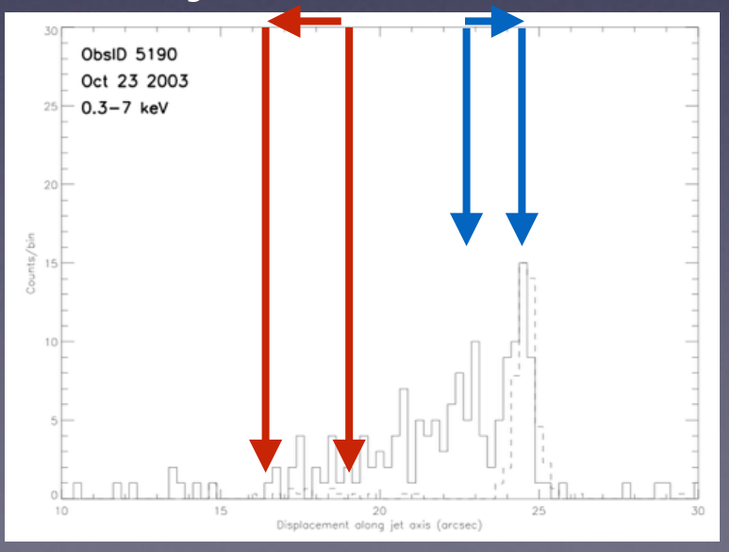
Microquasar:
Time lapse of a jet-ISM interaction

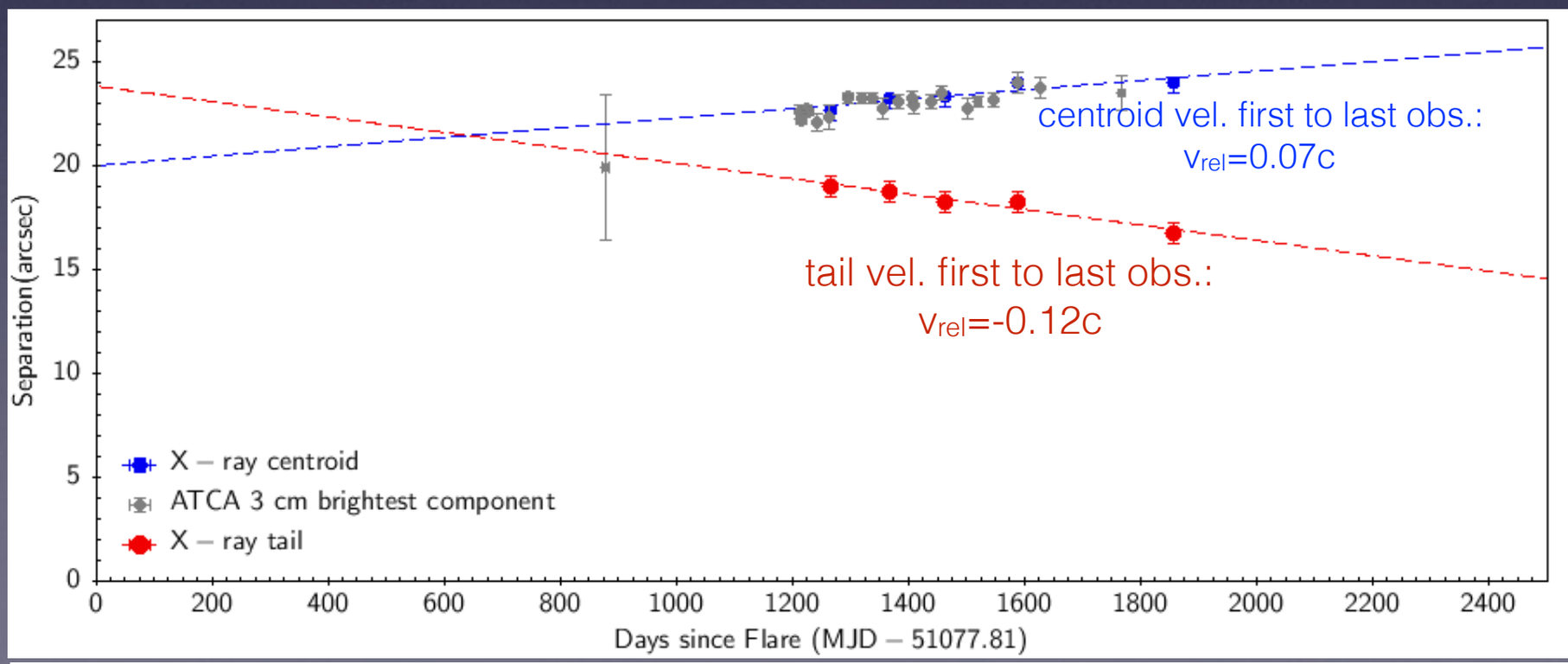
Jets' dynamics:





West Jet dynamics:





Future Perspectives

- Observations at low radio frequencies (LOFAR) will tell us more on the radio duty cycle;
- High sensitivity radio observations will look for radio jets in radio quiet sources;
- Multi-wavelength all-sky survey (LOFAR/SKA, LSST, EROSITA/SVOM, CTA) will monitor radio transients (blazars, microquasars, GRBs, SNs..);