Young radio sources:

Truthful or liar objects?

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Young radio sources:

Truthful or liar objects?

(aka the Good, the Bad and the Ugly)

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Background (Paradigm) from Monica

Continuity HFP/GPS/CSS/FR - * sources

Most objects are at high z, a few nearby youngsters in local LLAGNs)

No (low) polarization (ambient medium) (e.g. Cotton+, 2003)

Lobe (jet) dominated emission (what are lobes and jets is very small/young objects if compared to CSS/GPS; imply a high core dominance?)

Still building up their luminosity (e.g. Snellen +, 2000) ⇨ Relativistic plasma being accumulated into lobes, injection more efficient than losses (radiative/expansion)

Do we expect some variability (discontinuous/irregular relativistic plasma production) ?

More similar to a derivative rather than to an integral of activity

Mostly based on

Orienti, Dallacasa & Stanghellini (2010), Orienti & Dallacasa (2012), (2008), Dallacasa & Orienti (2016)

The Good news, *i.e. principles*

- (Easy !) Selection on spectral shape,

Peaks at several GHz highest ν_P, the youngest the object

- Small ⇔ young ..... as small (young) as possible

- Smoking gun of the mechanism turning on the radio emission

Expectations:

ΔLS/LS larger than in GPS and CSS objects, (relatively fast) "evolution"foreseen

The Bad news...

i.e. Is nature against principles ?

- A small fraction of r-s population
  (10^3 yr old, ~10^{-4} of 10^7 yrs old objects)

- Selection of truly young objects may be inefficient
  Possible contamination form other populations
- Is the evolutionary paradigm HFP – GPS – CSS – MPS – FR I-II correct?
  (FR-non 0 are a small fraction.....)
- Luminosity can help (mess?), however this is only part of the story

How to study them?

- Small, i.e. Small number of resolution elements across the source, i.e.
- Difficult comparison with larger sources (can self-similarity be applied on pc scale?).

Statistical studies of very young radio sources via samples:

Bright HFP sample (we heard something from Monica)

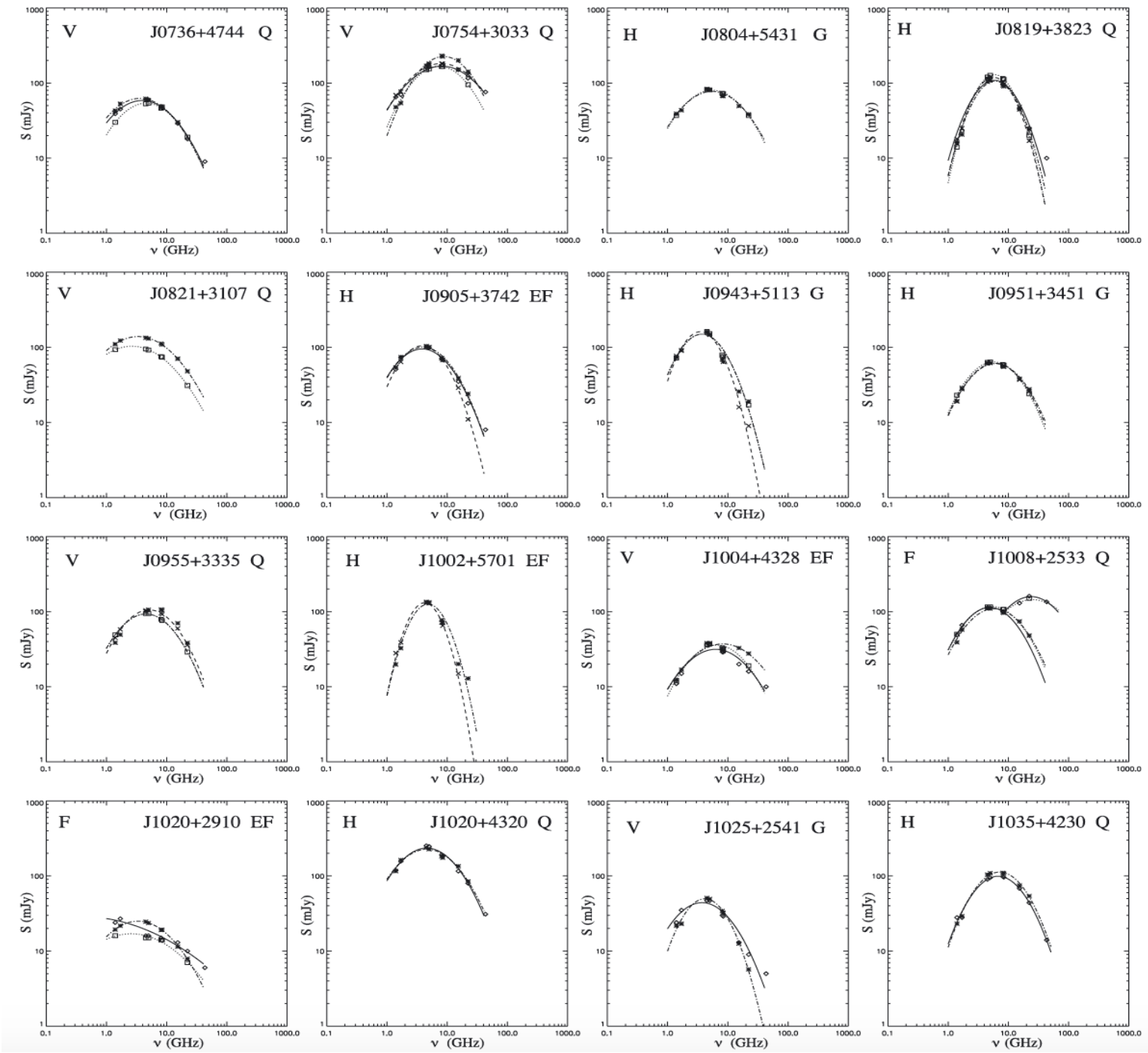
Faint HFP sample .... about 60 objects (~50 + ~10)

[Sample(s) of objects sharing the spectral shape at least once in their life]

Here a summary of

- spectral shape & variability,
- pc-scale properties
- .... and a prototypical case

Spectral shape, width & variability



Shape:

Generally convex

Variable…

…width among objects

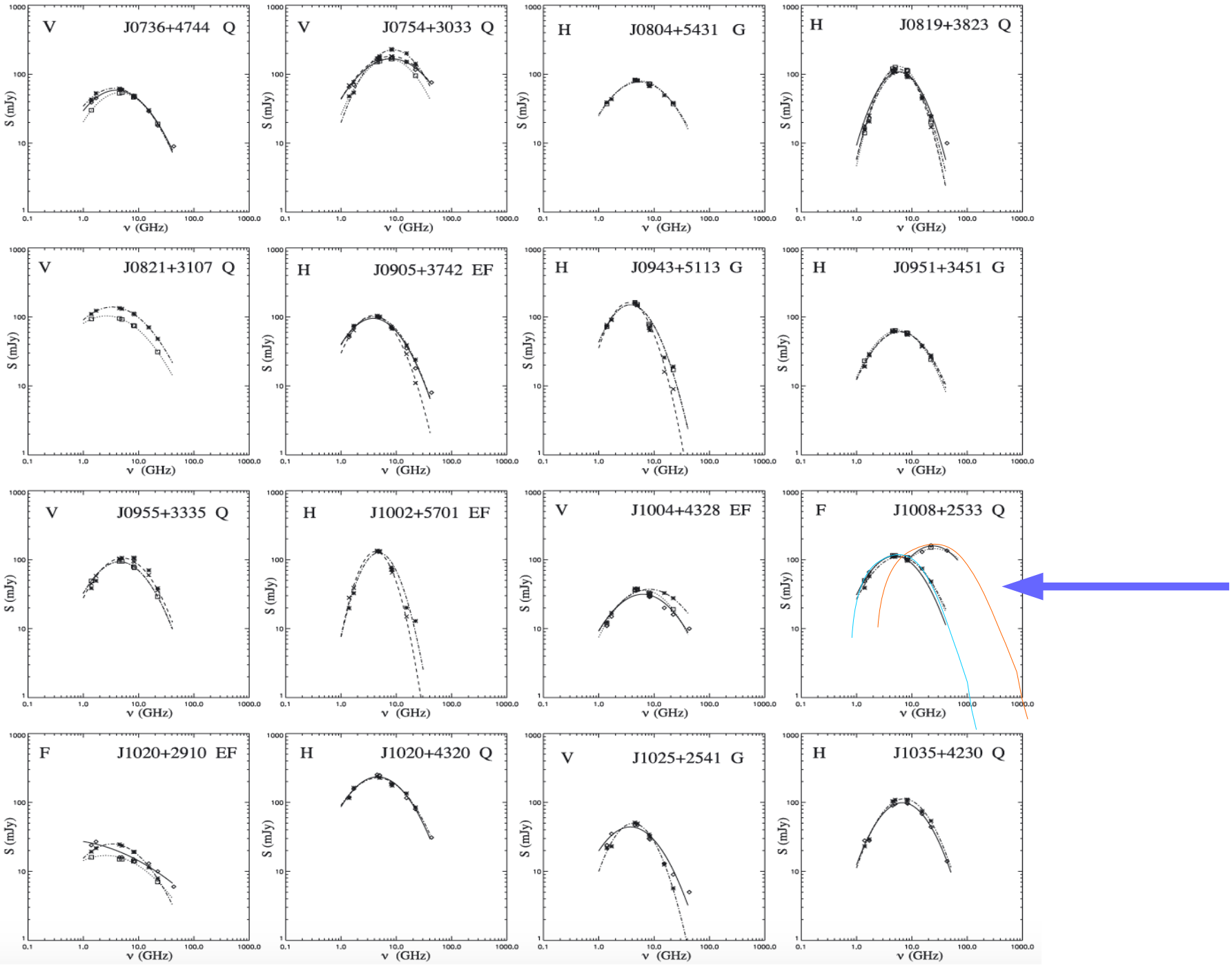
…peak parameters

Selection must

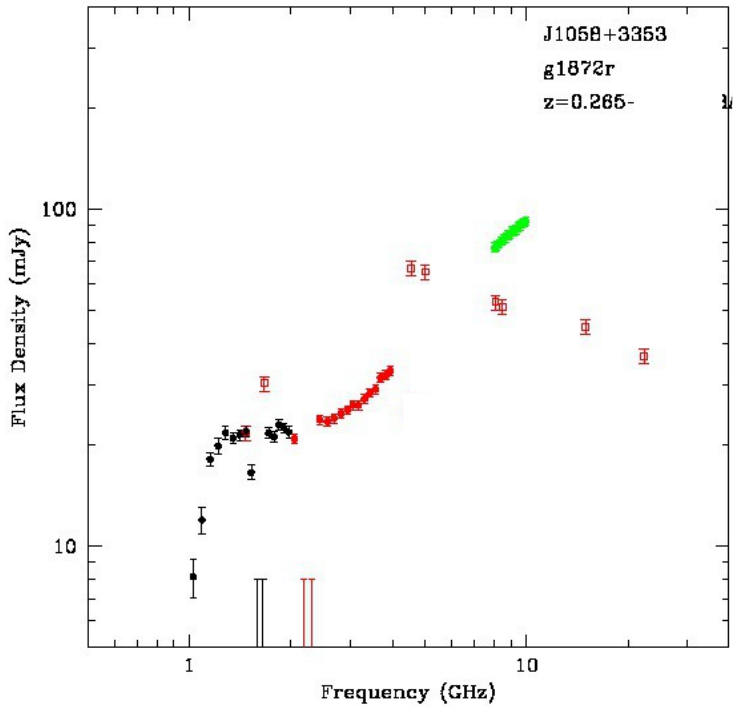
Remove FSO

$$V = \frac{1}{m}\Sigma_{i=1}^{m}\frac{(S_i - \bar{S}_i)^2}{\sigma_i^2}$$

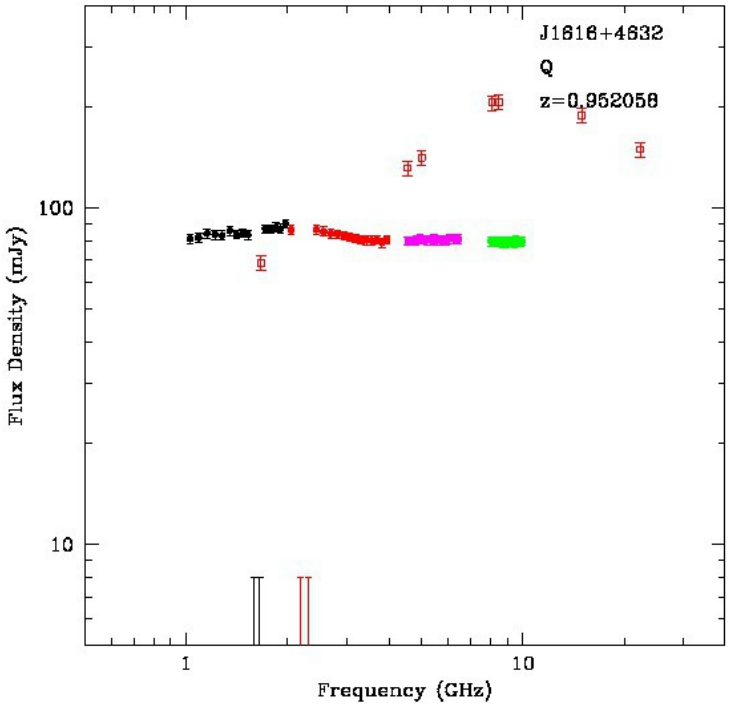
Spectral shape, width & variability



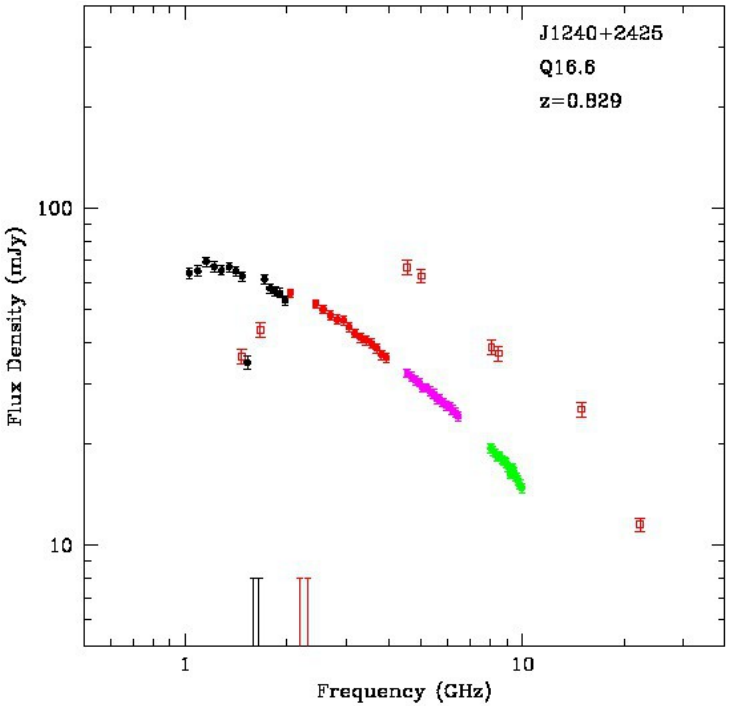
Spectral shape, width & variability



Shrunk

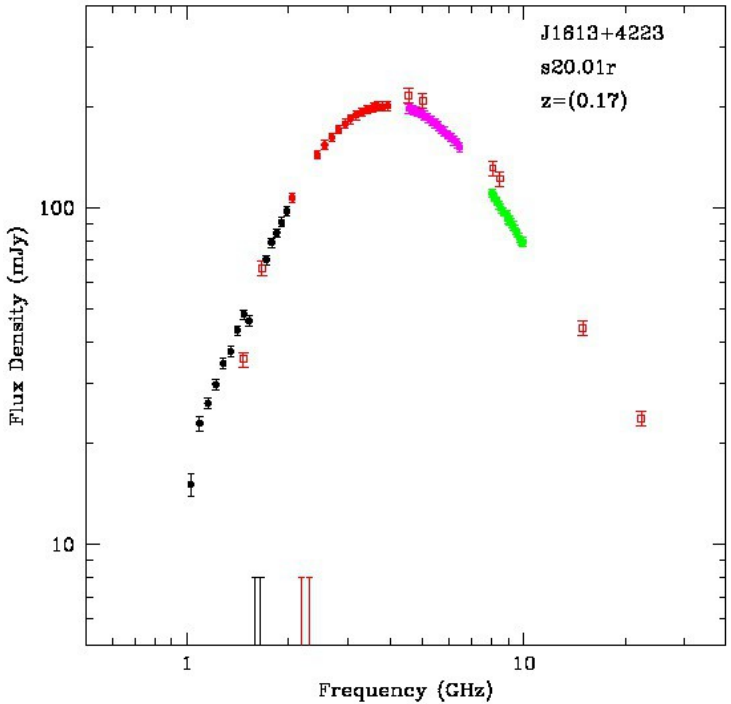


Flat spectrum



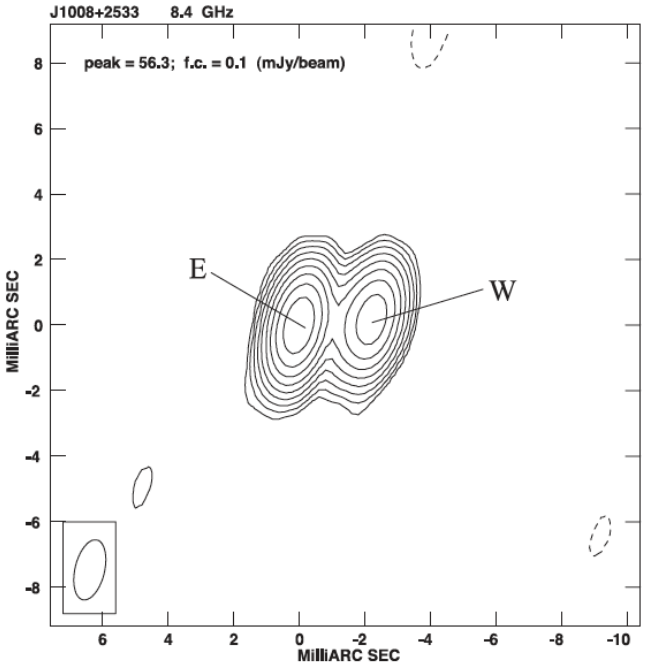
Expanded

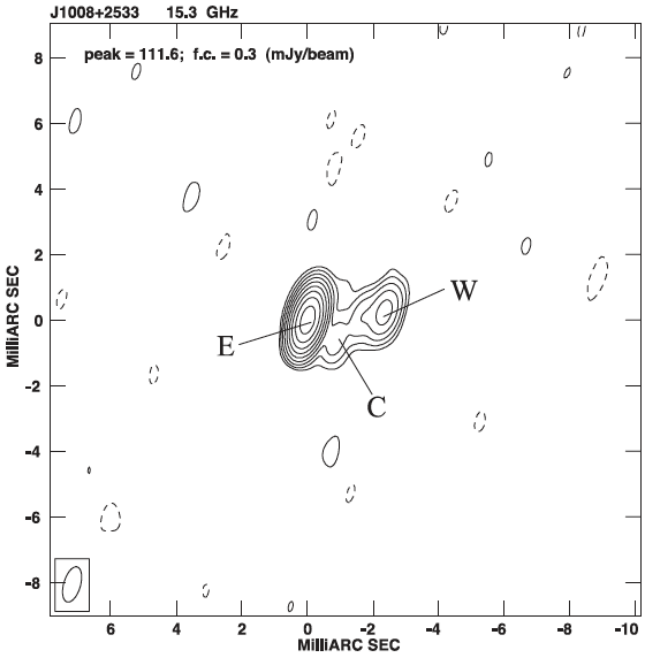
Interesting.....



Pc-scale (thin) emission

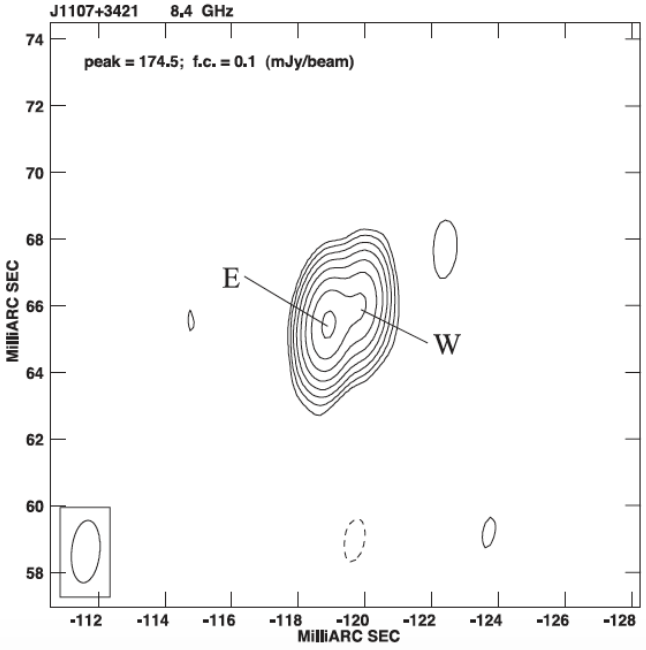
Orienti & Dallacasa (2012)

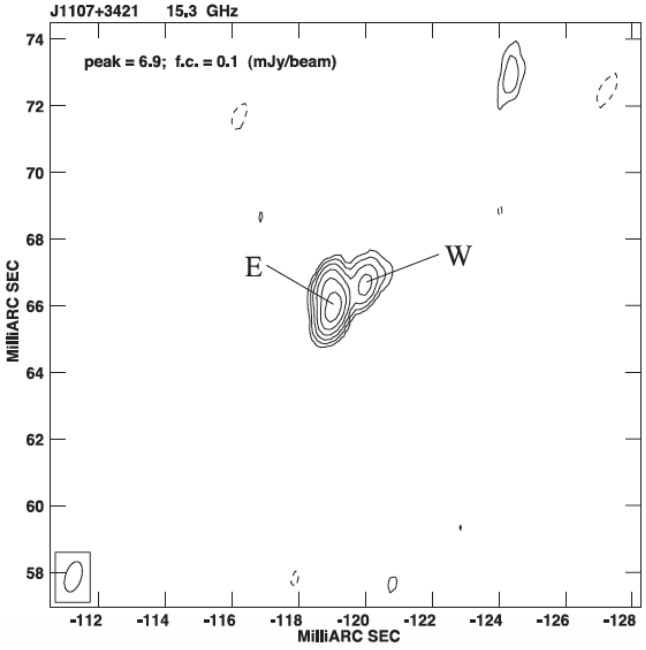




3.5 cm

2 cm





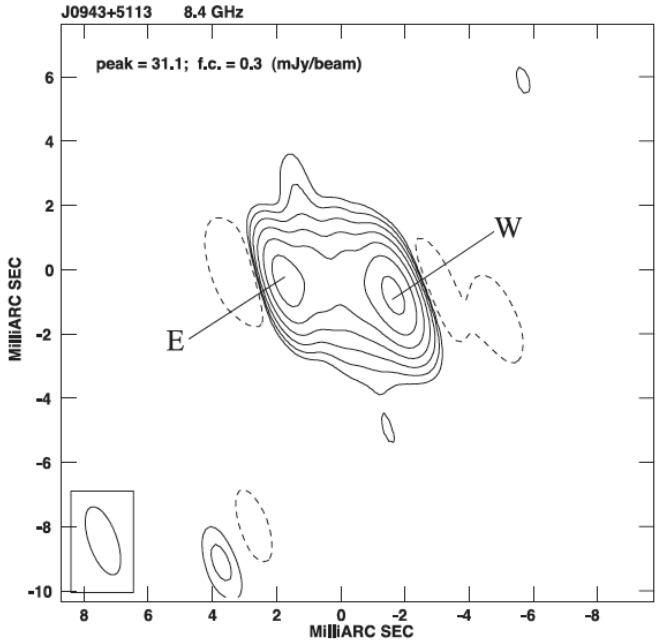
Pc-scale (thin) emission

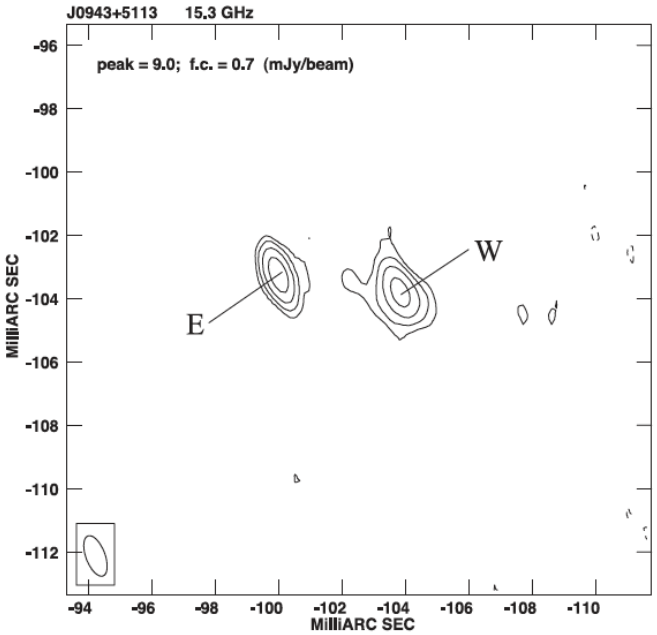
Unresolved (6)
Marginally Resolved (5)
Resolved (6)

Need a few years to
Measure kinematic age.

Radiative age unlikely to
be measured.

Helpful in finding
truly young sources
(morphology)





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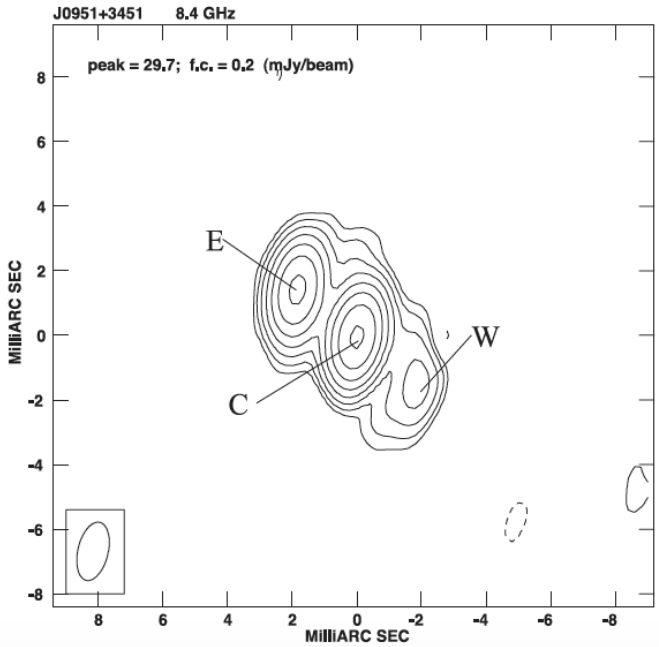
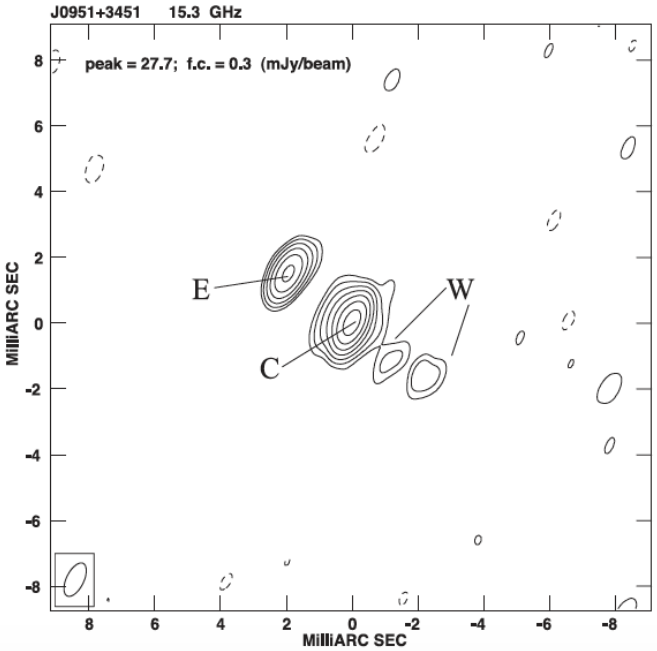
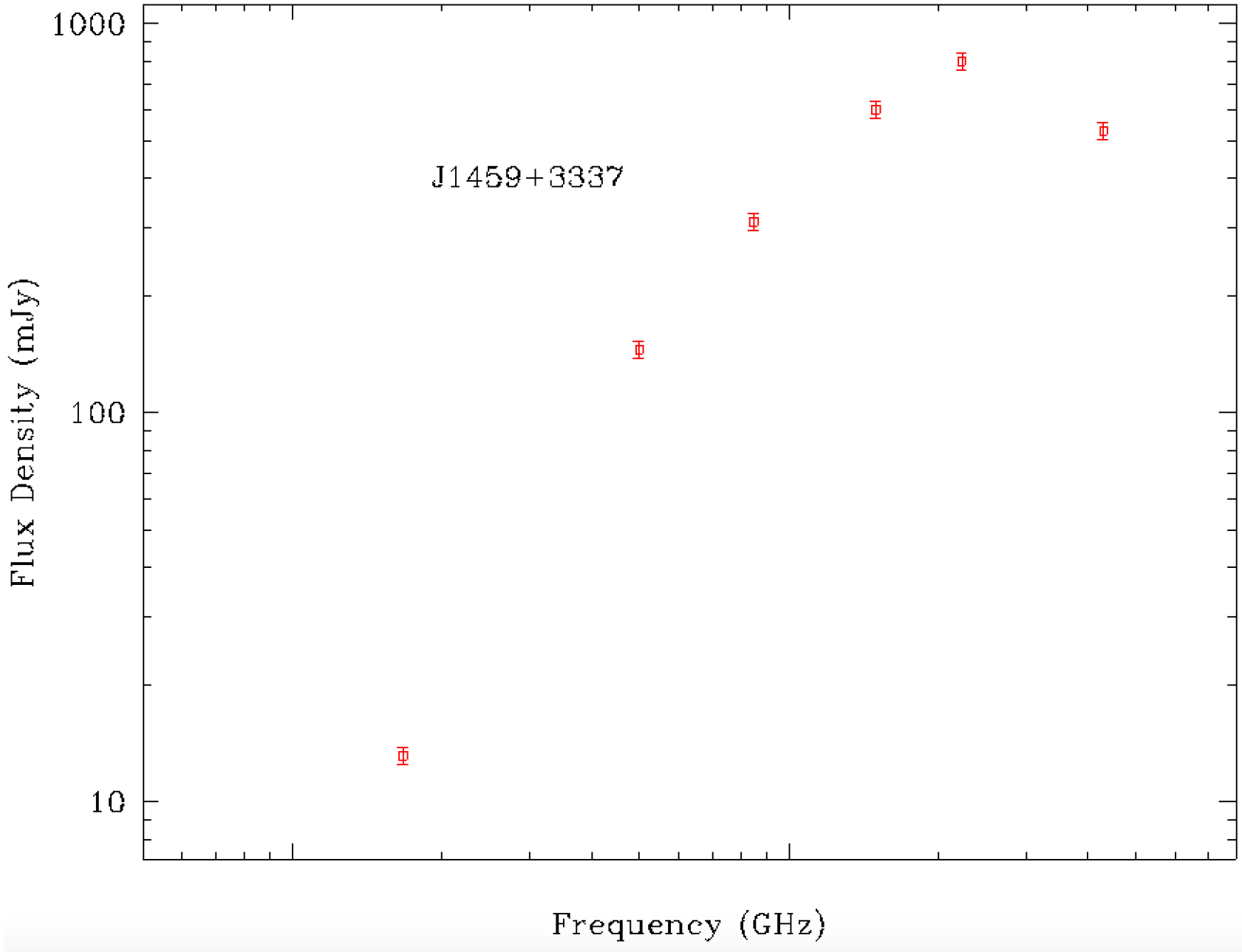




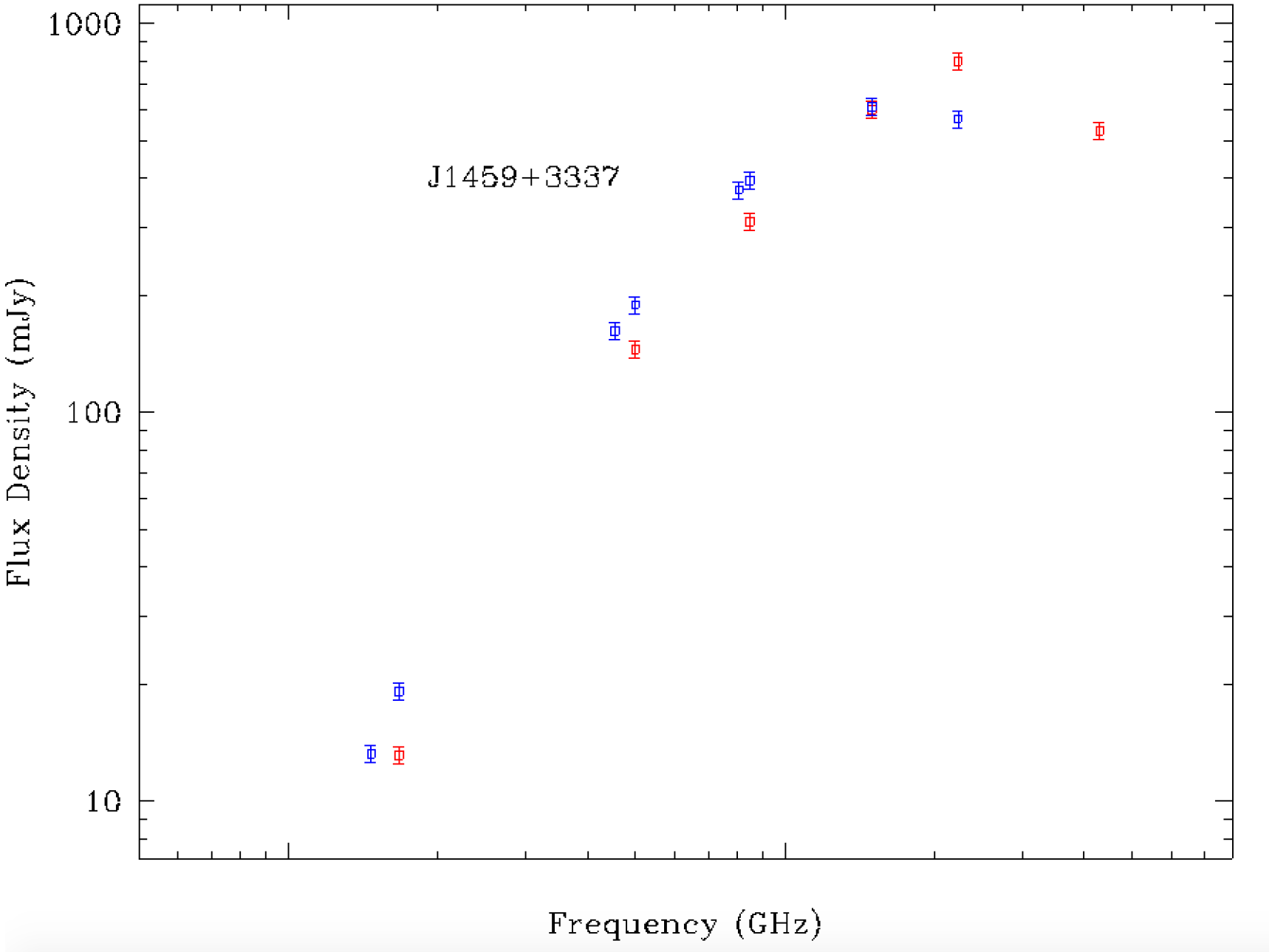
The source: J1459+3337

Radio data from Edge, 1996



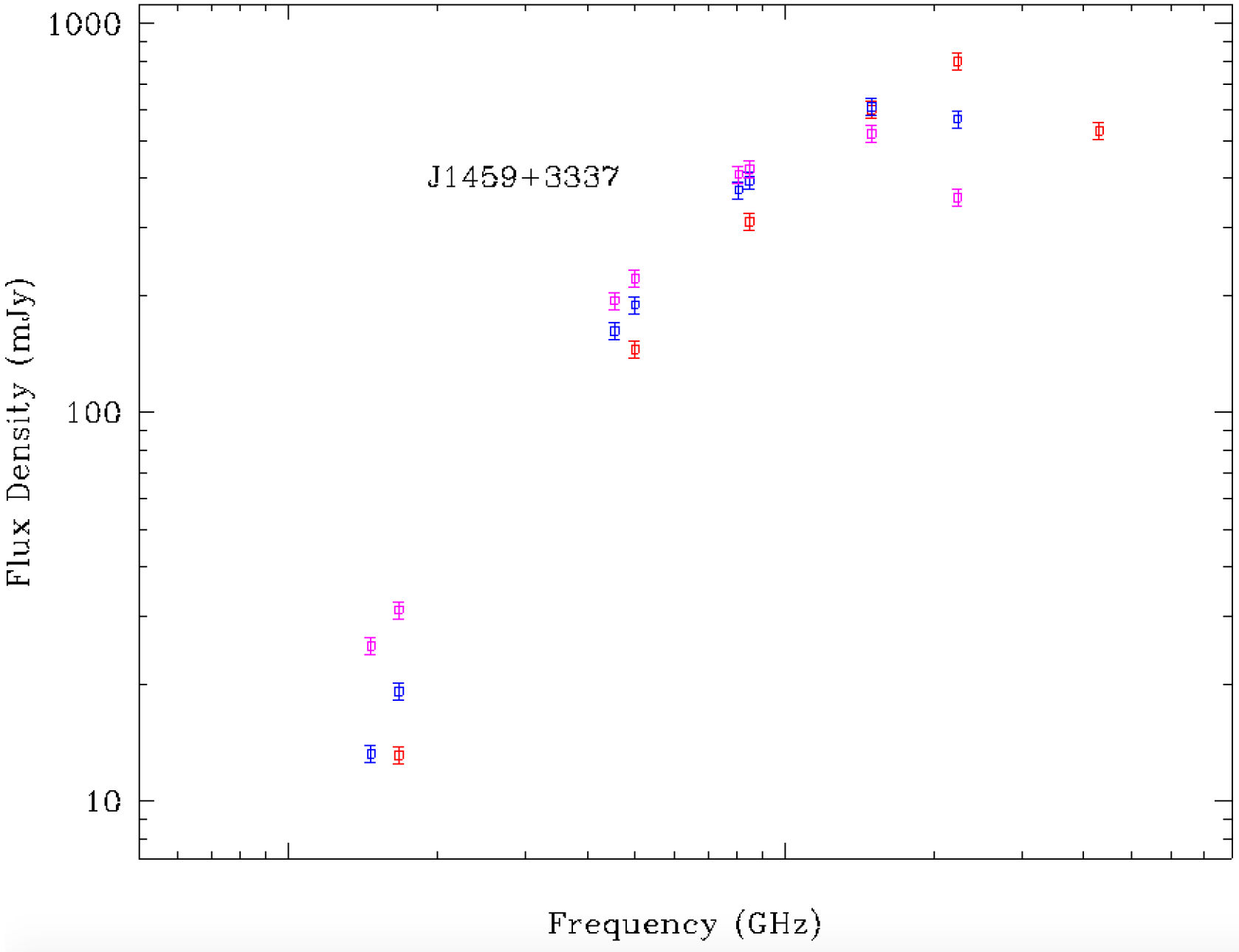
The source: J1459+3337

Radio data from Edge, 1996 ; 1999



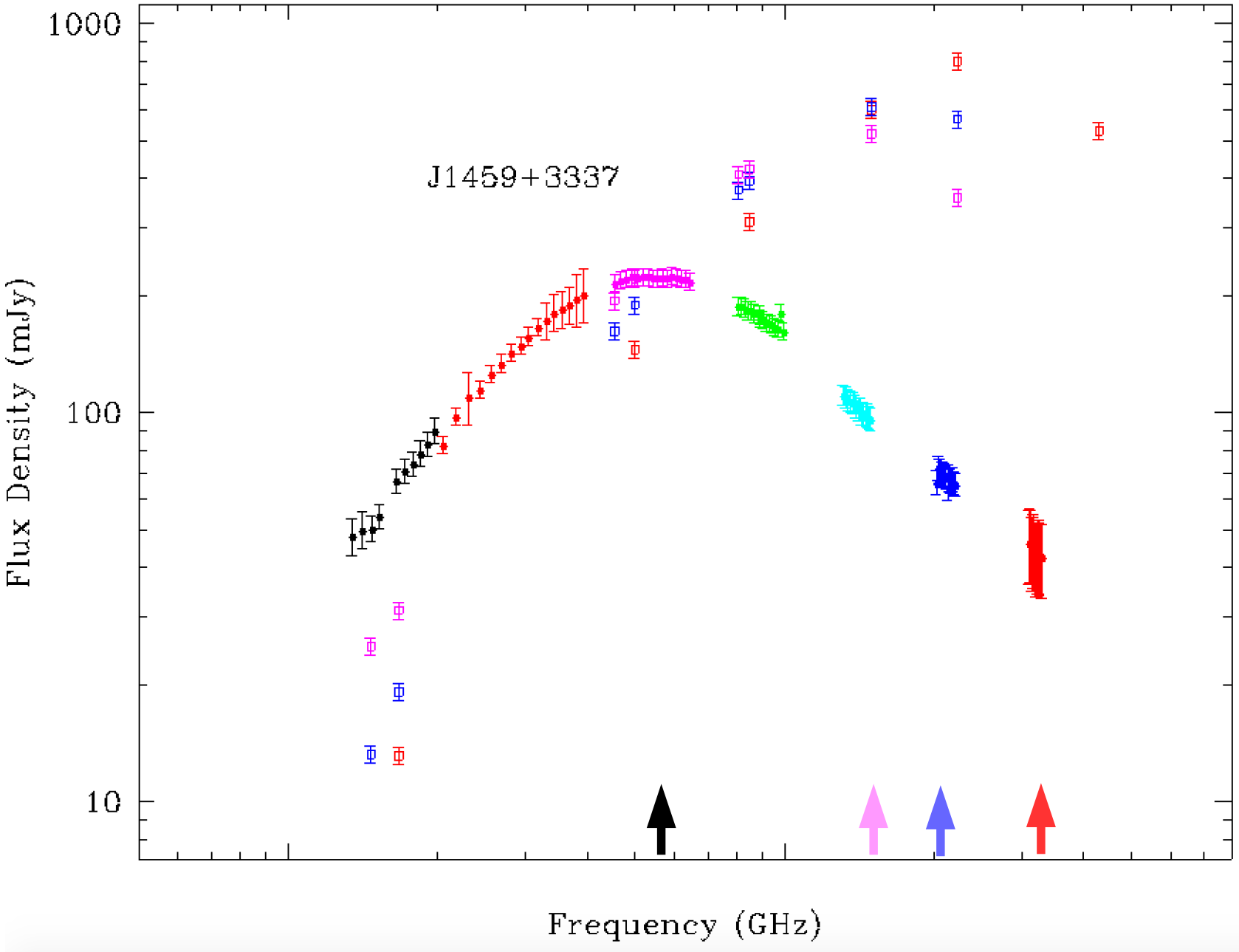
The source: J1459+3337

Radio data from Edge, 1996 ; 1999, 2003



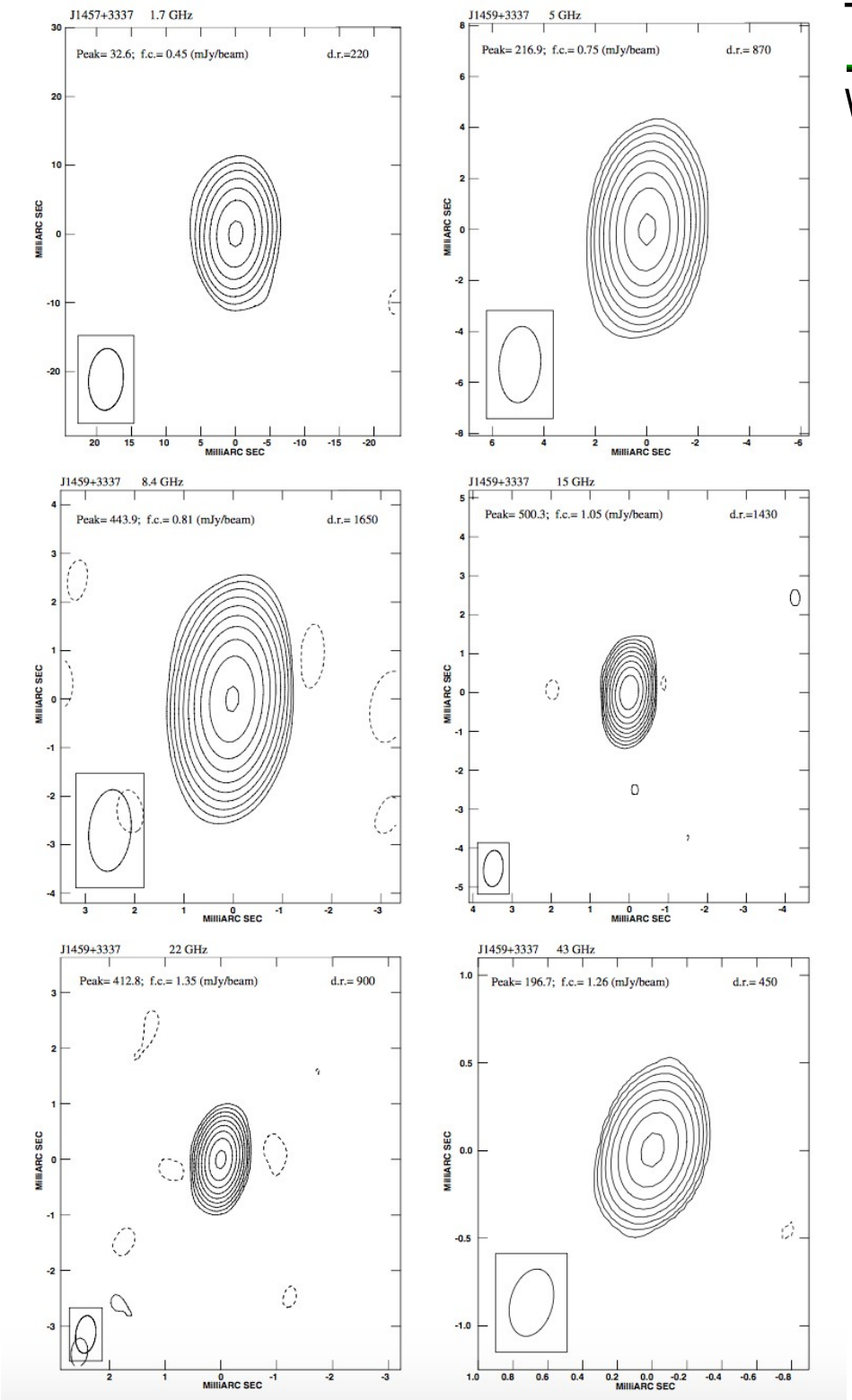
The source: J1459+3337

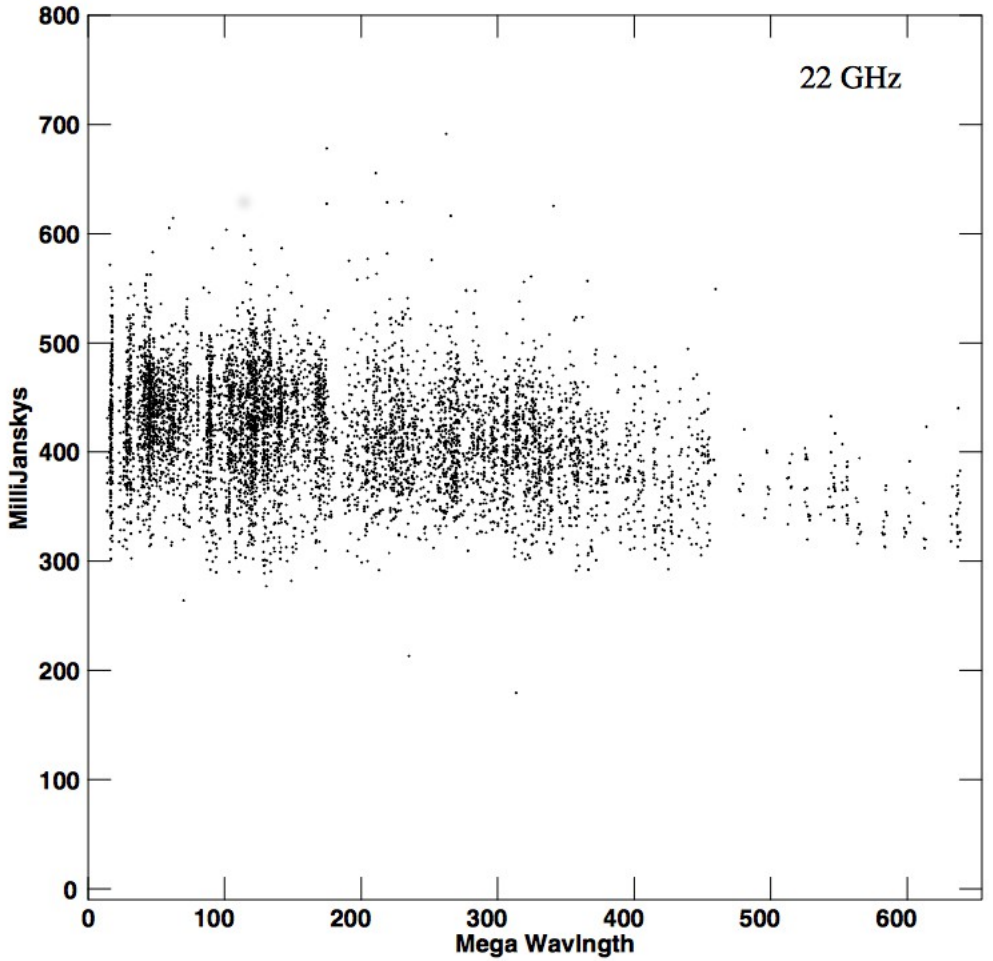
Radio data from Edge, 1996 ; 1999, 2003, 2012 it is classified as largely variable



The source: J1459+3337

VLBA 2005





Paradigm from J1459+333:

Barely resolved (0.36x0.14 mas) at the highest observing frequency

Age ~ 70 yr

IF single homogeneous component,
H ~ 0.16 G, i.e. @ GHz frequencies, $\gamma \sim 10^2$.

If use the ν_P – LS relation, the expansion speed is too large.

The radio luminosity substantially decreased (would quickly fade away)

It does not follow the conventional simplified picture/evolution model

The Ugly news (did we learn something?)

- Even "genuinely young objects" cannot be described by a simple evolution model.
- Assumptions are far too simplistic (homogeneous component in terms of relativistic electrons & H field) (homogeneous ambient medium)
- Large space parameters (environment plays a fundamental role), difficult to explore
- Little information from other bands (ID, z, ... It is difficult to convince other communities to invest time in studying young radio sources.....)

Take home messages/questions

The evolution of the *very young* radio source is generally fast

Variability does not necessarily mean bad/ugly source

~ 10pc.... mas scale resolution is required. Spectral shape: observe optically thin emission. Interaction of plasma with what?

Are many young radio sources short lived objects?

(amount of cold gas to fuel for the AGN, stability of radio jet, etc.)

Do they end most as MSOs (MPS, Joe) / transient RL AGNs (Alexandra) /Faders (AM,MKB)? Which is the failure rate? (must be high)

Are they recurrent on their own?

Small total energy budget, large losses (high H fields, high radiation fields, adiabatic expansion), need an efficient & long lived mechanism for giving FR-*