



Studies of the high-redshift quasar J1715+2147

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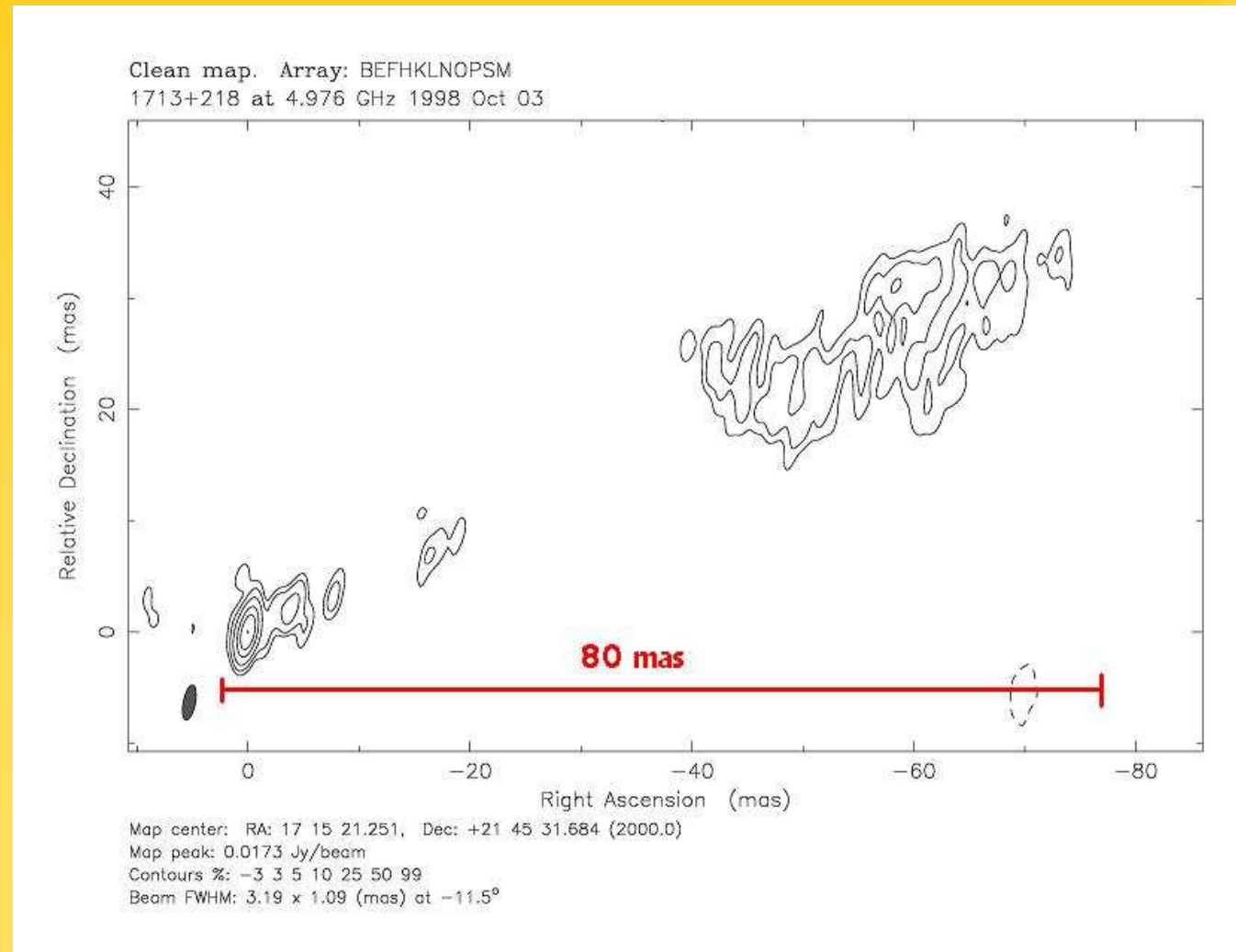


The quasar J1715+2147

The high-redshift quasar **J1715+2145** ($z=4.01$) has an **unusually extended radio jet** structure revealed with VLBI observations. (unpublished)

17h 15m 21.2s +21° 45' 32"
→ in Hercules

80 mas \approx 560 pc





The quasar J1715+2147

- Moreover, within $1'$ angular separation, there appears **another radio quasar**, approximately in the direction of the continuation of the jet.
- Both of them are **radio sources!** (chance: $\sim 1\%$)
 - Radio loud quasars: $\sim 10\%$ of all quasars
 - Double quasars: $\sim 0.1\%$ of all quasars

Southern source:

$17^{\text{h}} 15^{\text{m}} 21.2^{\text{s}} +21^{\circ} 45' 32''$

Northern source:

$17^{\text{h}} 15^{\text{m}} 18.8^{\text{s}} +21^{\circ} 46' 21''$



Goal

- very rare and potentially interesting phenomenon.
- The two quasars might in principle be **physically related**
 - Or the images might be due to **gravitational lensing**
 - Or **projection**

Goal of the work is to decide which is true



Methods

Comparing radio properties of the two sources

I analysed archive radio interferometric (**VLA**) **data** of the two sources in five radio wavelength bands (**L, C, X, U, K**).

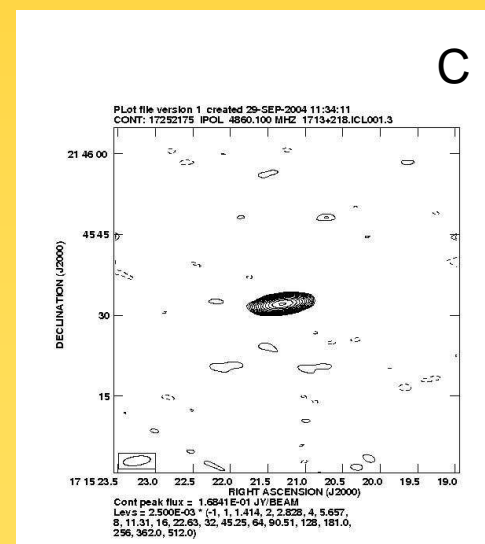
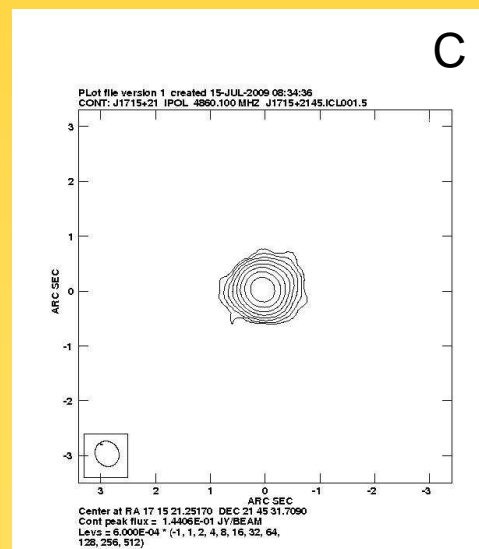
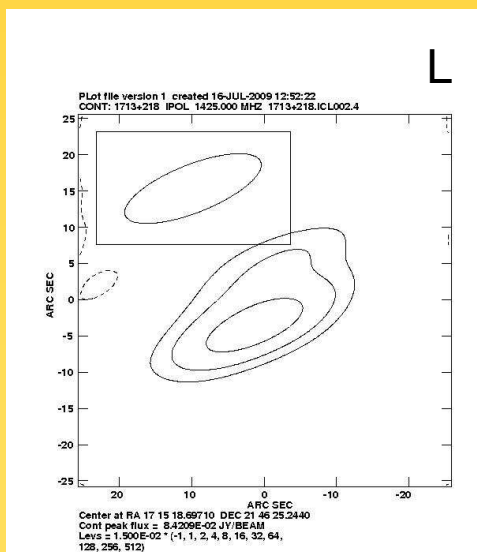
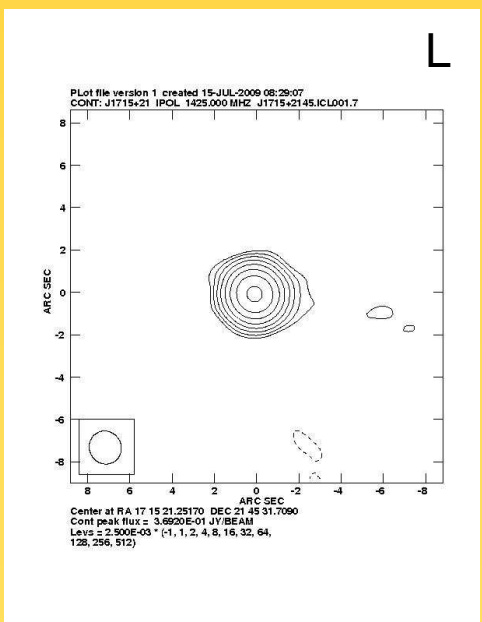
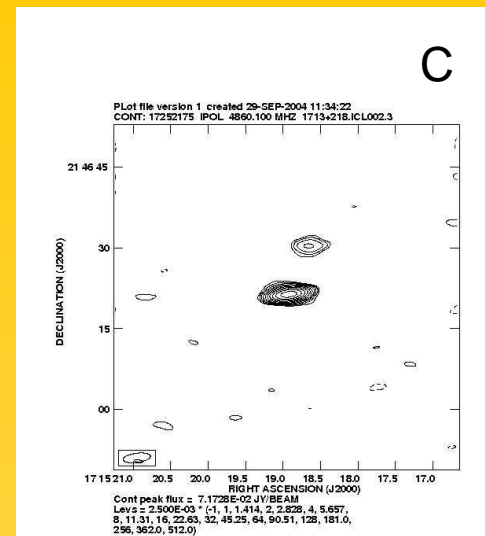
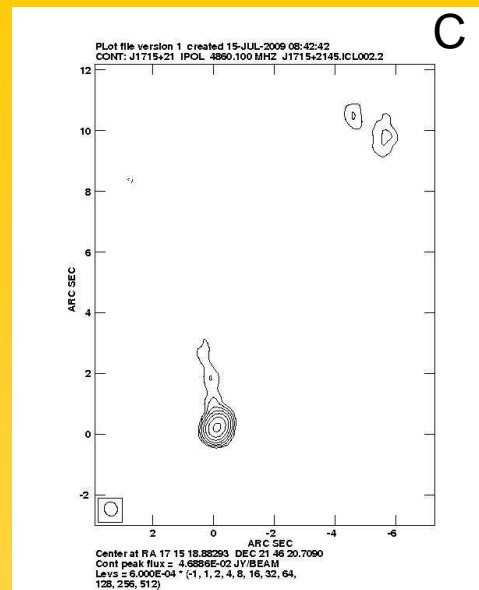
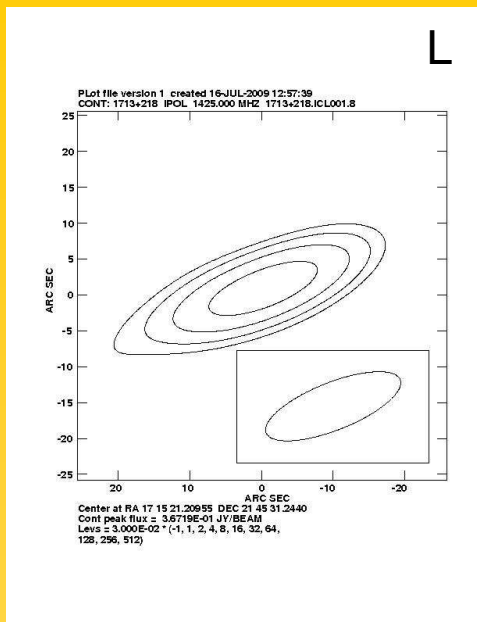
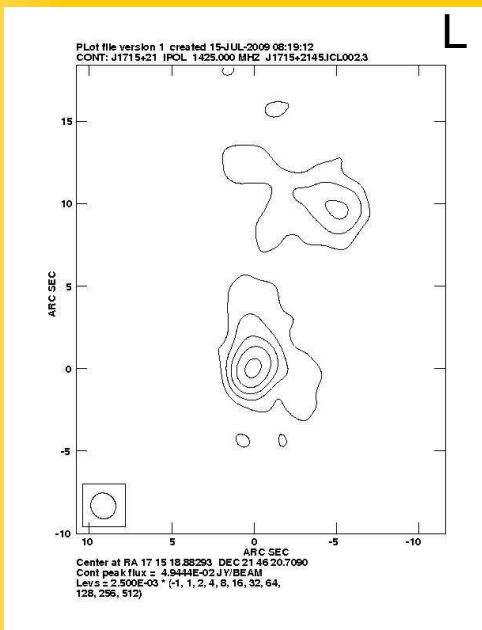
→ 16 radio images in total

- I calibrated the data files and made the image processing with AIPS.
- I estimated the flux densities of the two sources in each wavelength band (JMFIT).
- I compared the radio spectra of the sources.

Band	Frequency range
20 cm (L)	1.2 - 2.0 GHz
6 cm (C)	4.0 - 8.0 GHz
3 cm (X)	8.0 - 12.0 GHz
2 cm (U)	12.0 - 18.0 GHz
1.3 cm (K)	18.0 - 26.5 GHz

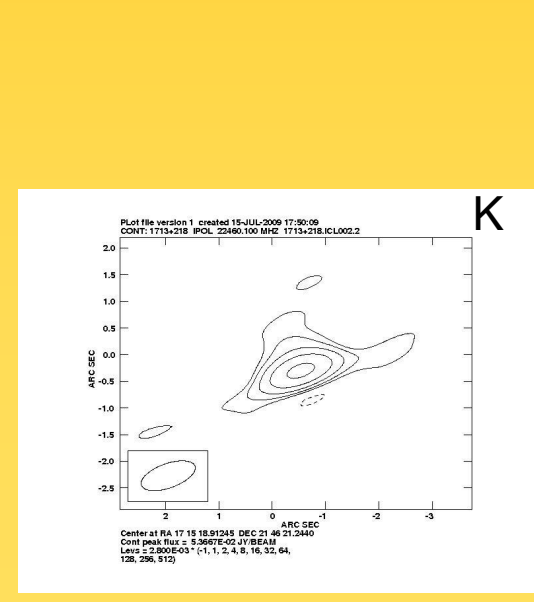
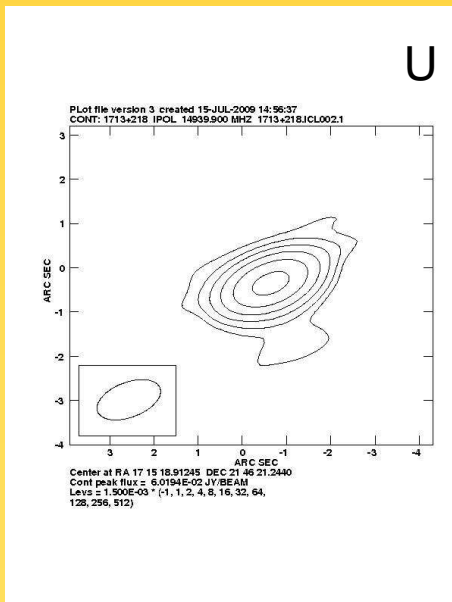
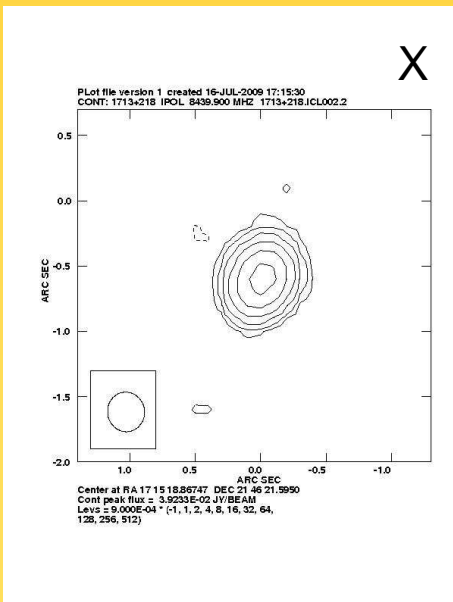
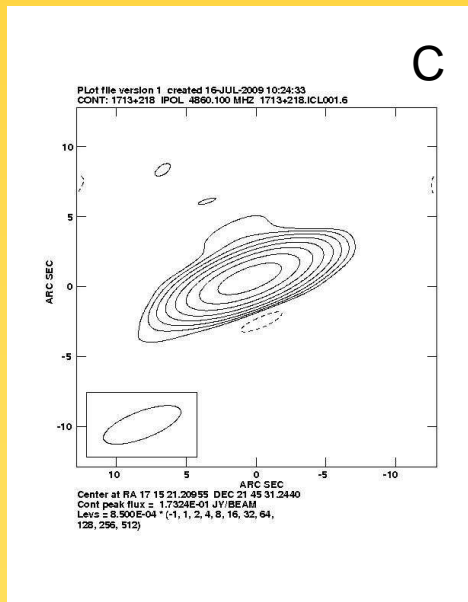
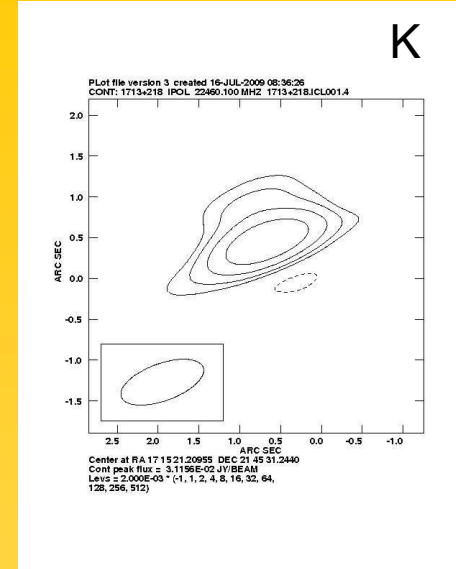
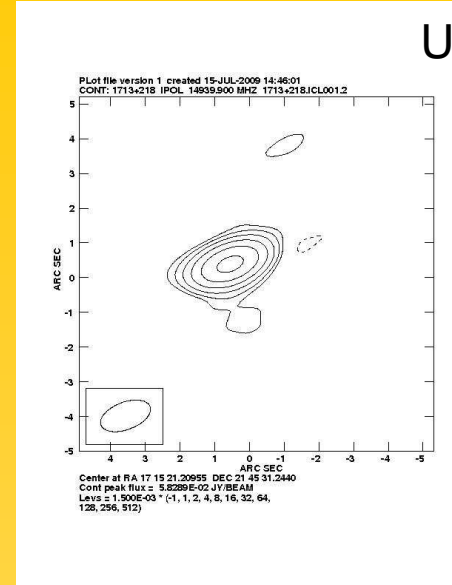
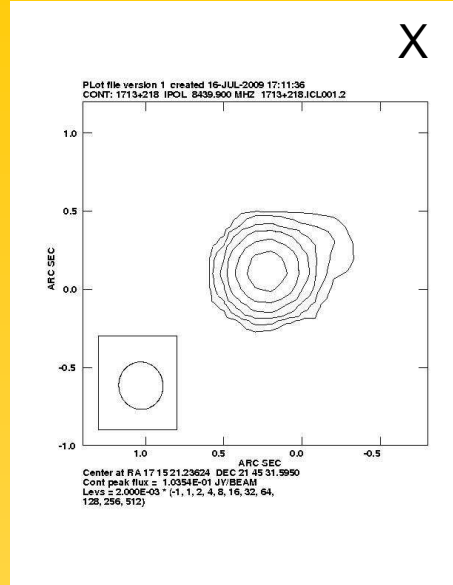
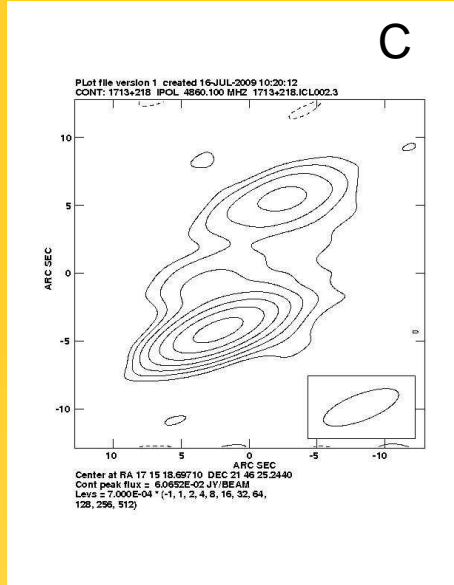


L and C band images





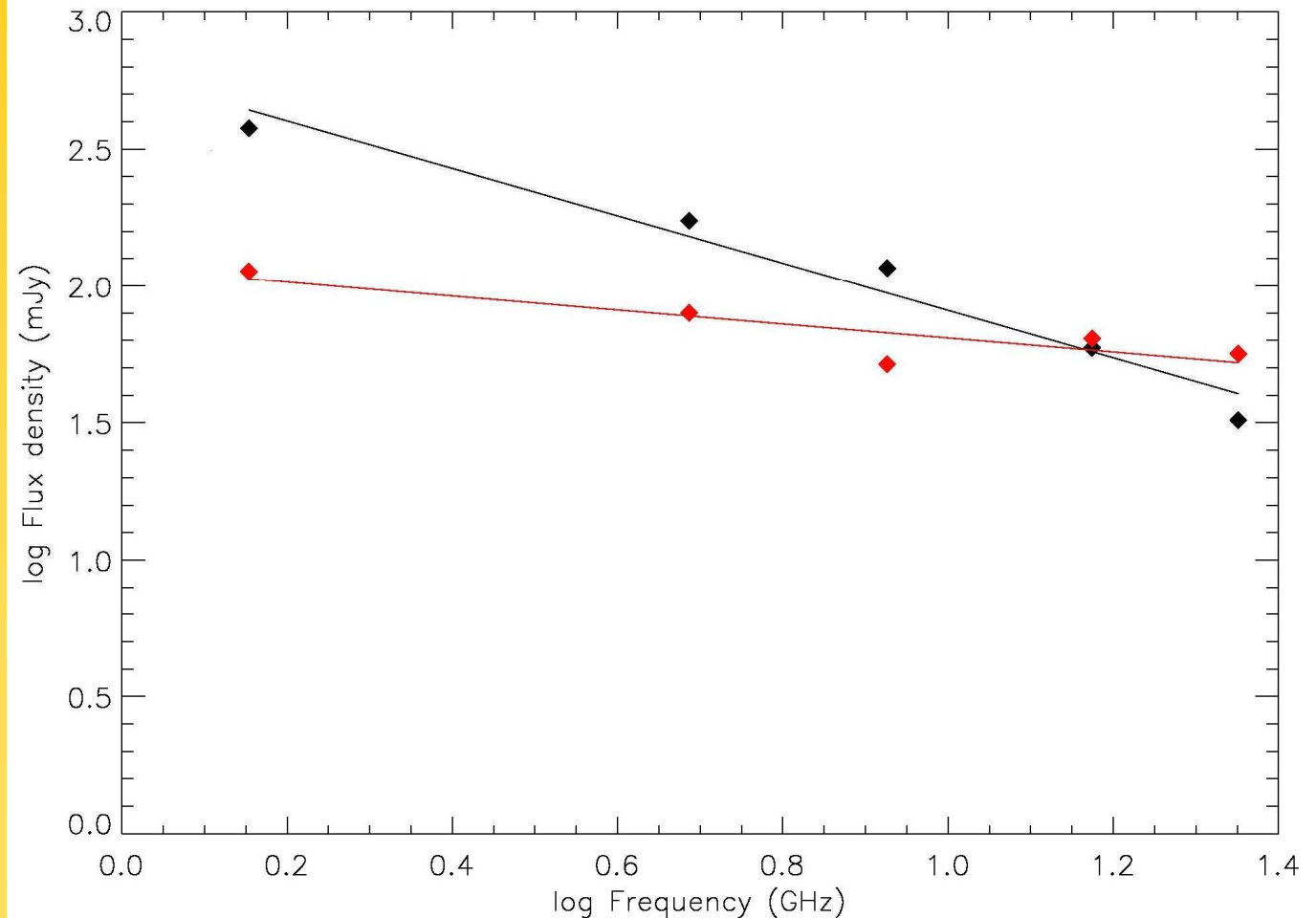
C, X, U, K band images



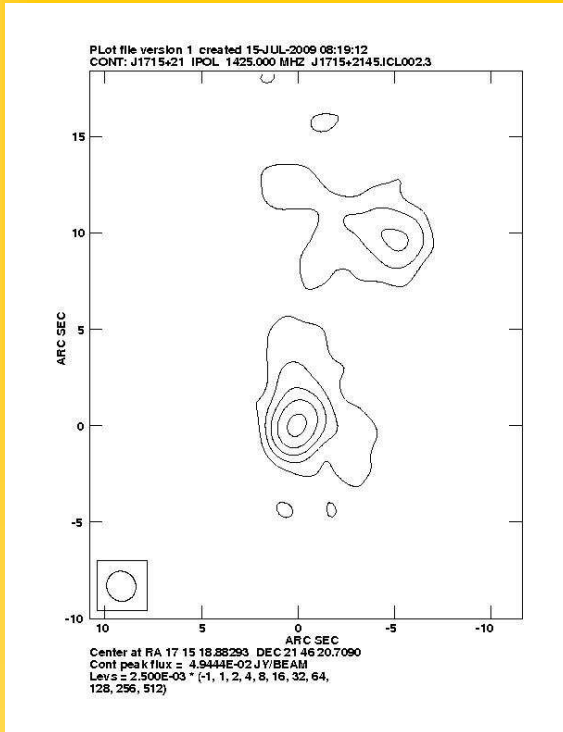
Spectral indices

According to the flux densities measured in the different bands, the **spectral indices** of the two sources **are different**, so they are not gravitationally lensed.

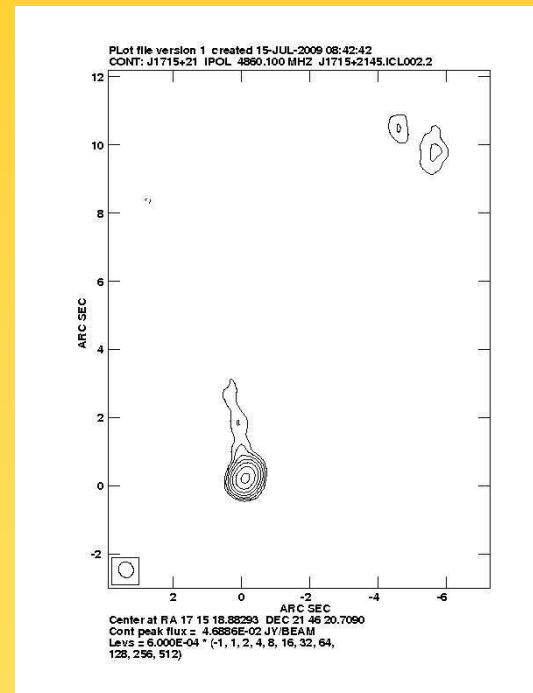
- Black line:
southern source
 $\alpha \approx -0.86$
- Red line:
northern source
 $\alpha \approx -0.25$



There seems another radio source

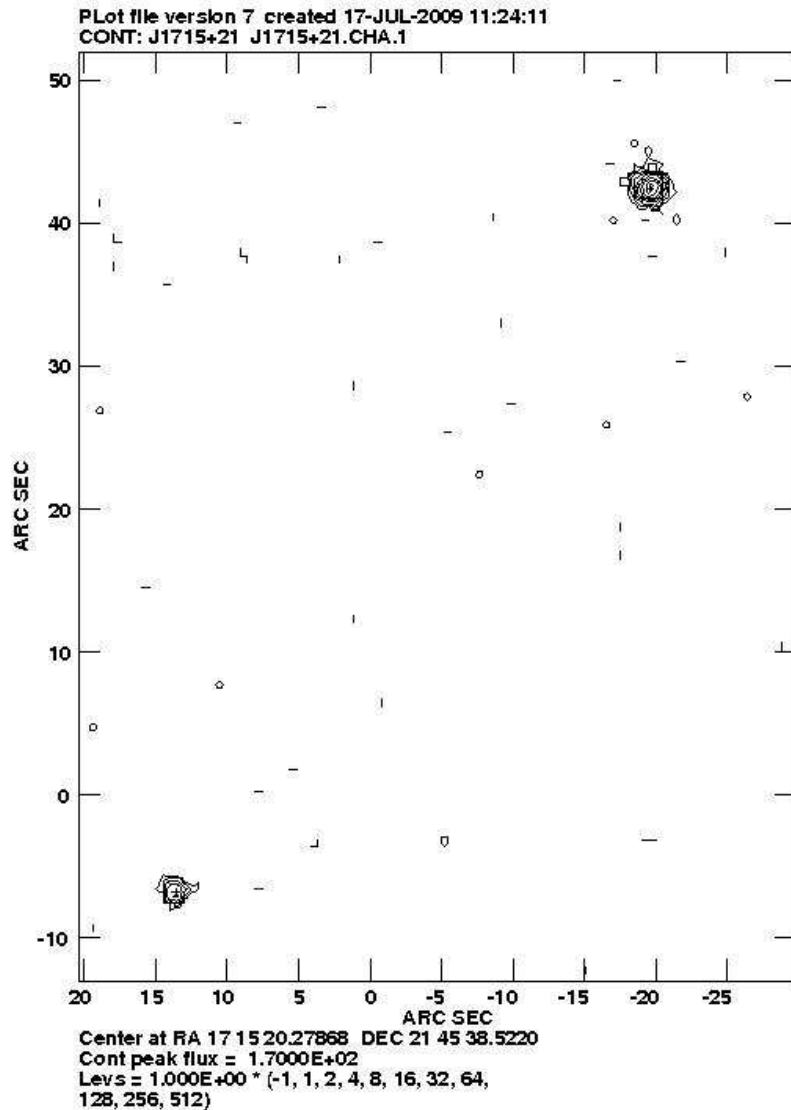


Another radio source is visible in the L and C band VLA images, next to the northern quasar.



- about **10 arcseconds** north-west from it
- it might be a jet component

Chandra data



- I collected information at other electromagnetic wavebands from archives
- The two quasars are clearly visible at the **Chandra X-ray** measurements.
- The **northern source** is clearly **more luminous**
→ not gravitationally lensed sources

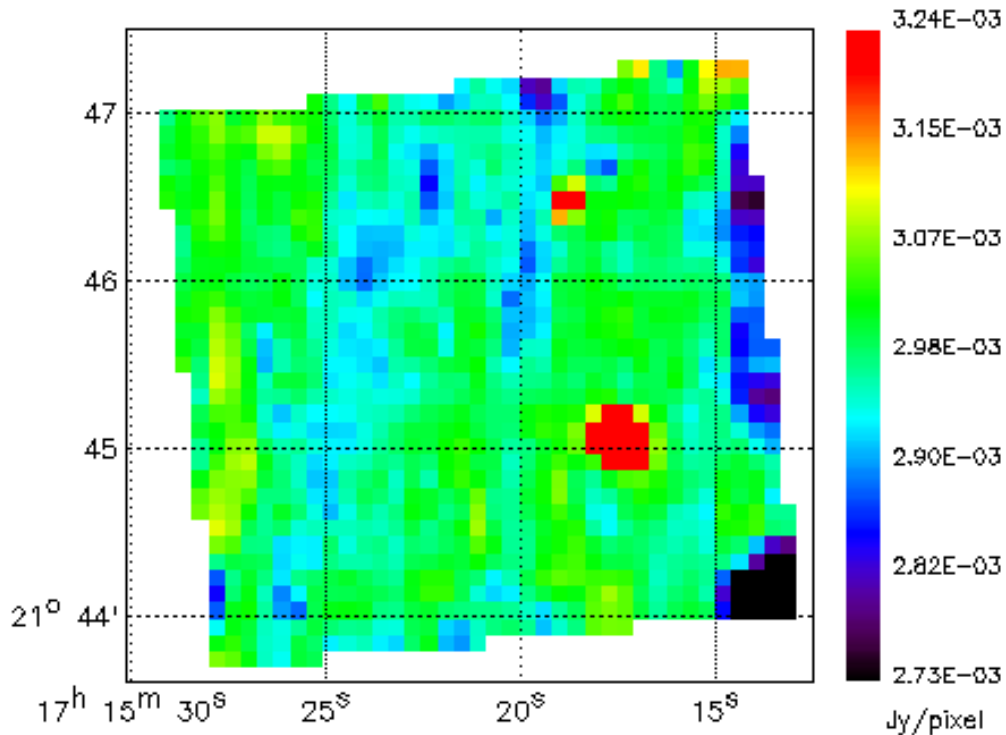


ISO data

GB1713+2148 06-MAR-1998 CAM01

(RA,Dec)=(17h15m21.30s,+21°45'33'') (J2000) TDT No. 84200805

CAM Filter centre: 6.70 μm -- PFOV: 6.0 arcsec, Polar: HOLE



OLP_10 - CALG_70 - CAM Browse V3.2

- Only the northern quasar is visible at **6.7 μm**
- also testifies against the gravitational lensing
- high saturation



Results

- Although there is no measured spectroscopic redshift available for the northern quasar (optically fainter)
- based on photometric information, the two quasars are most likely at different redshifts.
- Both the gravitational lensing interpretation and the physical association are ruled out
 - the two apparently nearby radio quasars are the result of a **projection**.



Thank you for the attention!