RadioAstron observations of 3C 345

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The RadioAstron Polarization KSP

Supermassive black holes in the centres of radio-loud active galactic nuclei (AGN) produce collimated relativistic outflows (jets). Space-VLBI observations within the RadioAstron (Kardashev et al. 2013) key science program on AGN polarization provide images at an unprecedented resolution, which enables us to study the magnetic field strength and morphology in the innermost regions of AGN jets. 11 of the brightest and highly polarized AGN were observed during observing periods AO-1, -2, -3, -4 and -5 between July 2013 and April 2018, with continuation approved for AO-6 (Pashchenko et al. 2015; Lobanov et al. 2015; Goméz et al. 2016; Bruni et al. 2017).

3C 345

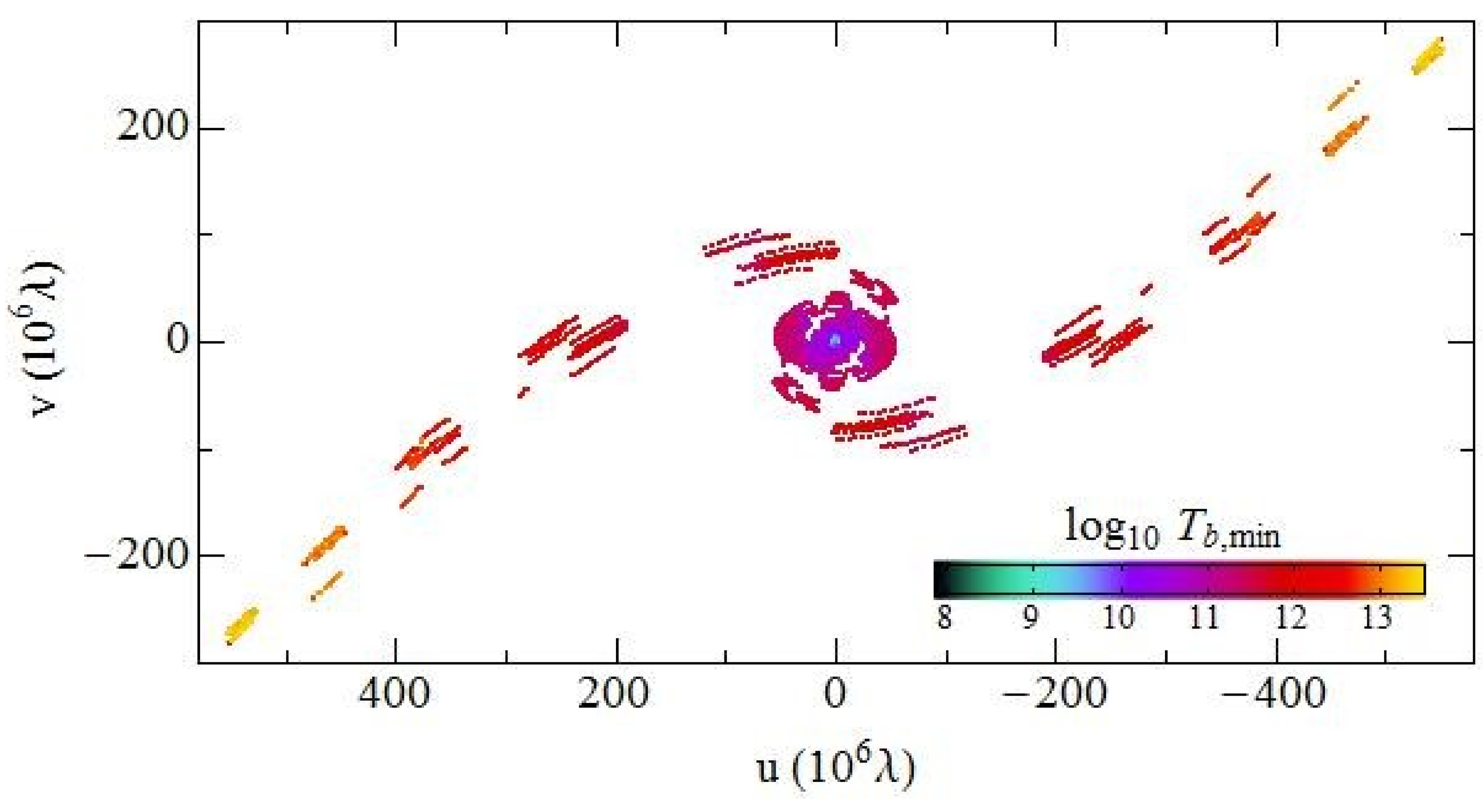
We present here images of the strong blazar 3C 345 (1641+399), a flat-spectrum radio quasar at a redshift of z = 0.59 (Marziani et al. 1996). It is core-dominated and shows a bending jet at lower frequencies (e. g. Ros et al. 2000; Schinzel et al. 2012).

Observations

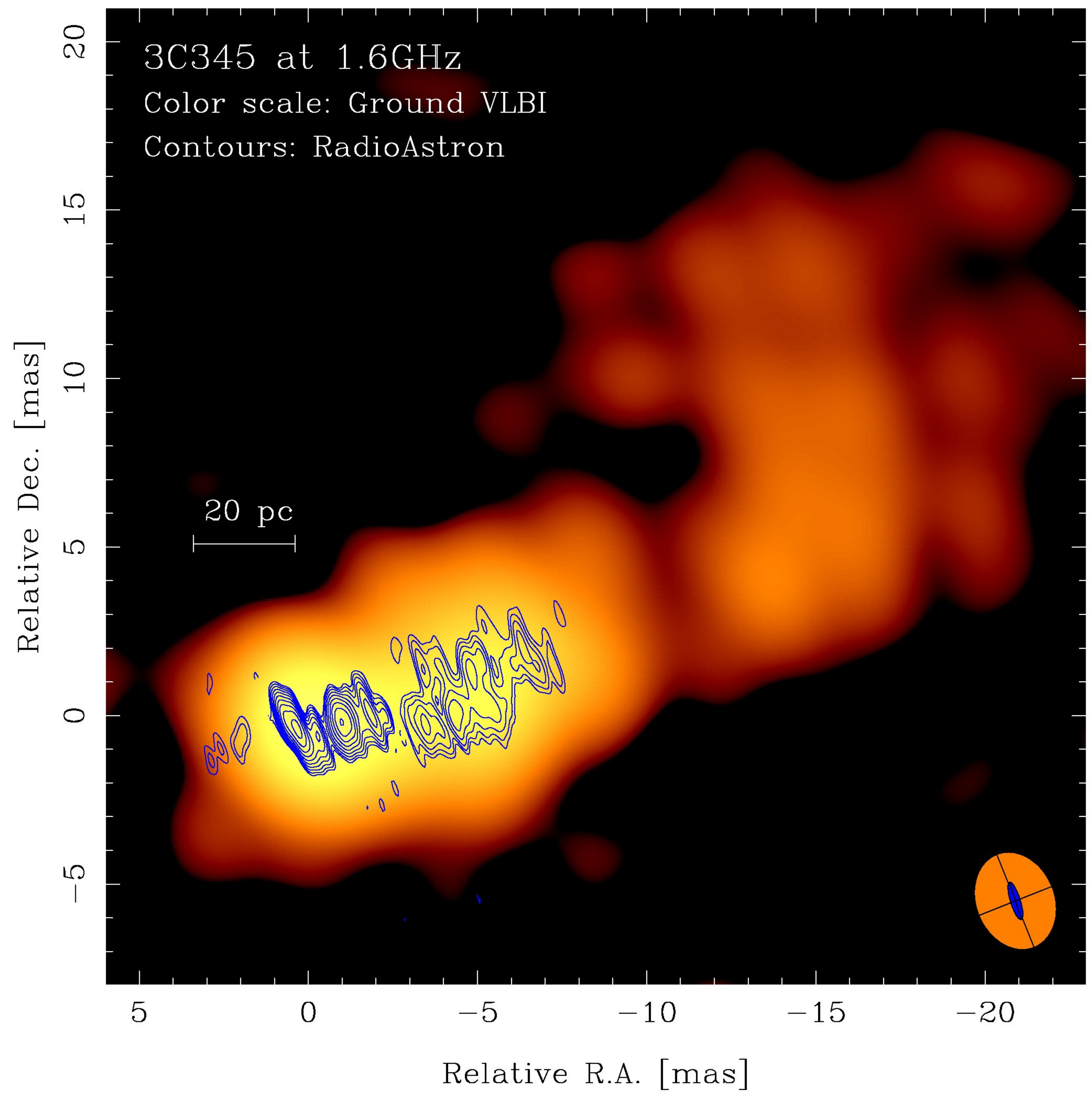
The observations at λ = 18 cm took place on March 30[th] and March 31[st] 2016 during AO-3, and with a total of eighteen antennas from a ground array were observing, complemented by the Spekt-R space telescope. We detect ground-space fringes up to **9 earth diameters.**

Results

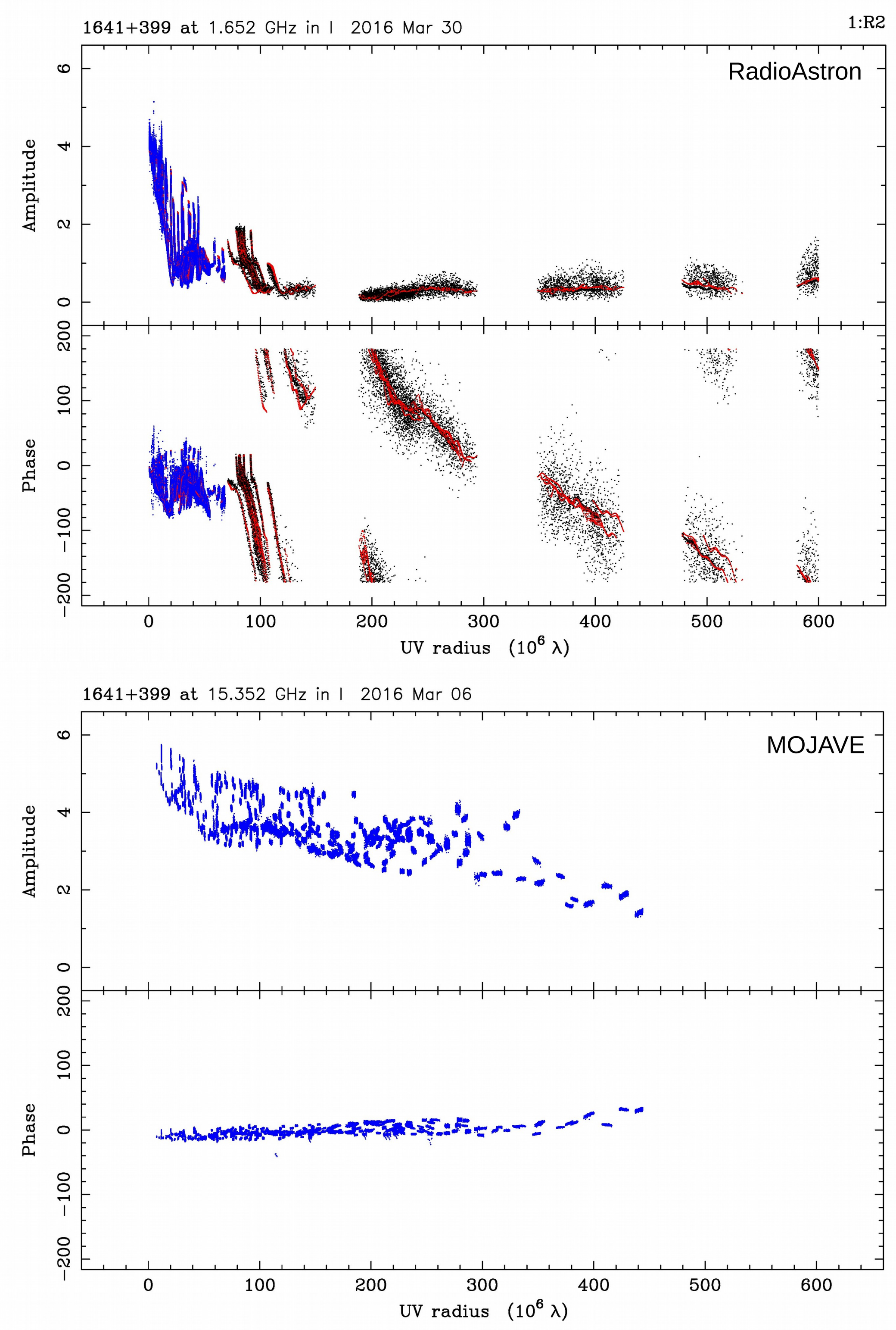
We present here the calibrated visibility data and preliminary images of the source in total intensity.



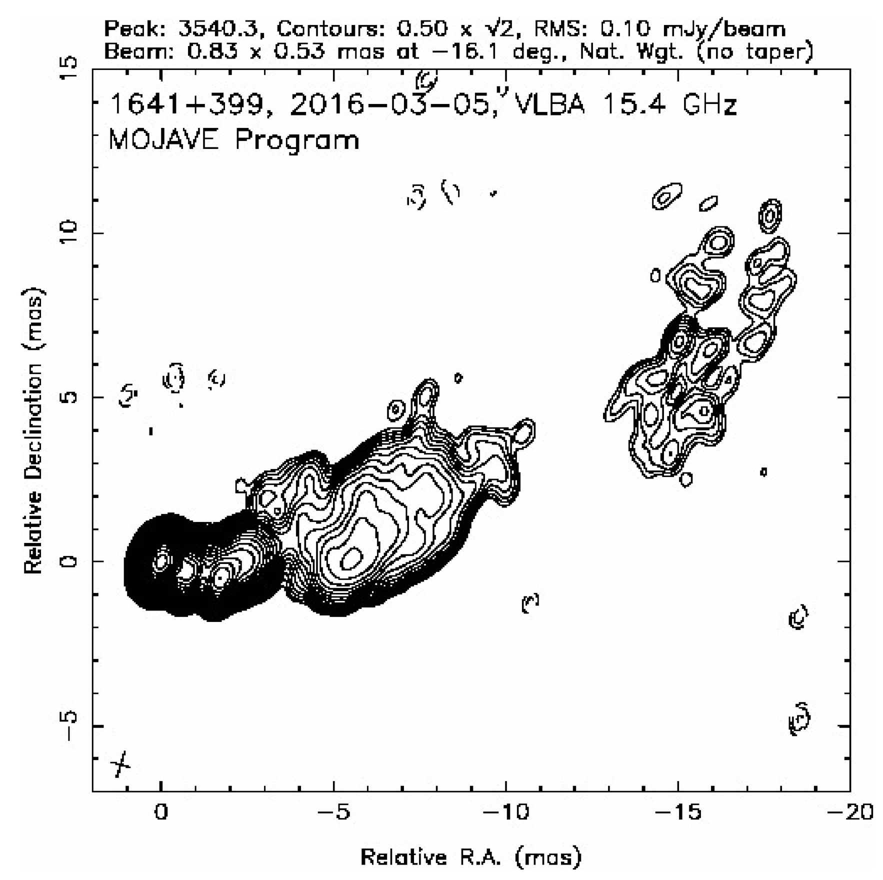
Top: UV coverage with RadioAstron, with the color scale indicating the minimum brightness temperature inferred from the visibility amplitudes (Lobanov 2015).These measurements imply a brightness temperature in excess of 3.4×10^{13} Kelvin in the most compact regions of the jet.
Bottom: 3C 345 at 1.6 GHz with RadioAstron, overlaid as contours over the ground array image obtained from the same observation. The respective synthesized beams of the two images are shown in the lower right corner. The beam minor axis is 2.326 mas (15.6 pc) for the ground array, and 0.283 mas (1.9 pc) with RadioAstron. We used a uniform weighting scheme.



Comparison of L-band RadioAstron to MOJAVE data



Top: Visibility Amplitude and phase as a function of UV radius for 3C 345. *Upper panel*: L-band data with RadioAstron. The black data points correspond to the space baselines, red shows the source model (blue contours in the figure at the bottom panel in the left hand side of the poster); *lower panel*: At 15 GHz observed with the VLBA in the MOJAVE survey (see Lister et al., 2009, 2018) at March 5[th], 2016. The RadioAstron data show more extended structure.



Left: Clean map obtained using natural weighting from the MOJAVE survey at 15 GHz observed nearly simultaneously to our RadioAstron observations. The resolution is comparable to our L-band RadioAstron image, which consistently recovers the inner jet structure seen by MOJAVE.

Conclusions

Correlated visibilities between ground and the space telescope have been found up to a projected baseline distance of ~9 earth diameters. 3C 345 was successfully observed with RadioAstron with sub-mas resolution, corresponding to a projected distance of 1.9 pc or ~5000 gravitational radii for a black hole mass of $4\times10^{9}\,M_{sol}$ (Lobanov 1998). The visibility data imply the presence of emitting regions with the brightness temperature in excess of 3.4×10^{13} K. These results in total intensity suggest promising future findings also for the polarization data.

References

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