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THE K-BAND CELESTIAL REFERENCE FRAME: FIRST IMAGING RESULTS

Journées October 2019, Paris

ABSTRACT

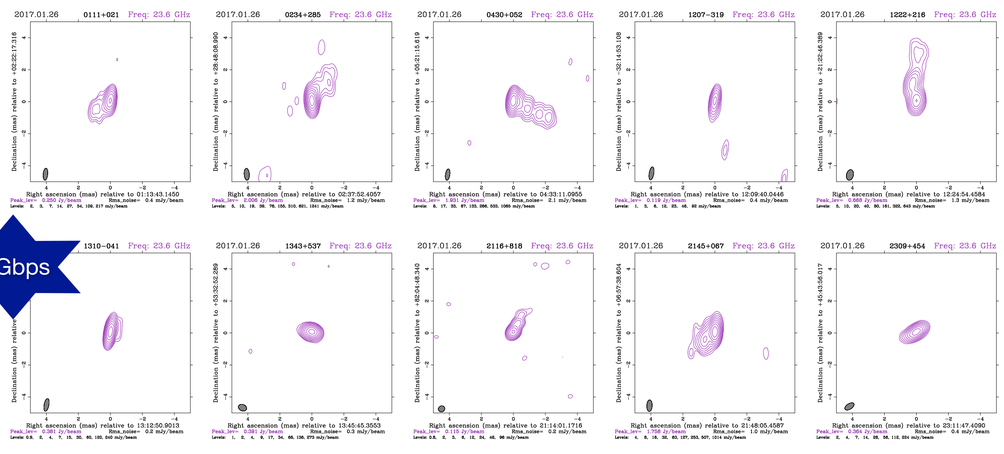
A K-band (24 GHz) celestial reference frame of more than 900 sources covering the full sky has been constructed. K-band observations are motivated by their ability to access more compact source morphology and reduced core shift relative to the standard S/X frequencies. At the standard S/X frequencies, many ICRF radio sources exhibit spatially extended structure, degrading the accuracy of estimated source positions. Our more recent VLBA astrometric observations at 2 Gbps provide sensitive, high-resolution multi-epoch imaging of hundreds of sources at K-band. In this poster we present imaging results from our first VLBA K-band astrometric observations at 2 Gbps. We also present preliminary dual polarisation imaging results from our first 4 Gbps test observations using the VLBA.

BACKGROUND

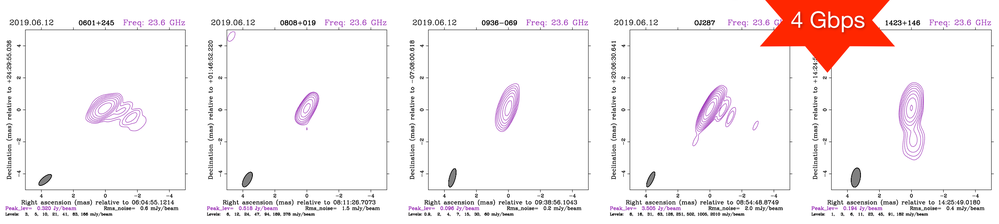
- **A K-band (24 GHz) CRF with more than 900 sources covering the full sky was constructed using > 0.6 million obs. from ~70 sessions from the VLBA and HartRAO-Hobart.**
- **At the standard S/X frequencies, many ICRF radio sources exhibit spatially extended structure that may vary in both time and frequency, degrading the accuracy of estimated source positions.**
- **Factor of three increase in interferometer resolution at K-band should resolve out source structure which is a concern for AGN centroid stability.**
- **More recent VLBA obs. at 2 Gbps provide sensitive, high-resolution multi-epoch imaging of hundreds of sources at K-band. Many of these sources will be imaged for the first time at frequencies above X-band.**
- **These K-band images allow mapping of the intrinsic source structure so that the astrometric quality can be evaluated at higher frequencies.**
- **We successfully demonstrated VLBA dual-polarisation observations using Mark-6 recorders at 4 Gbps. We will improve our imaging science by being early adopters of the Mark-6 dual-polarisation configuration, thereby enabling full polarisation imaging.**

K-BAND IMAGING RESULTS

- VLBA astrometry x 24h, UD001B, 26 Jan 2017, 23.6 GHz
- 2 Gbps, 16 IF's x 32 MHz, RCP, 32 x 1 MHz channels/IF



- VLBA test x 4h, TK006, 26 Jan 2019, 23.6 GHz
- 4 Gbps, 4 IF's x 128 MHz, RCP and 4 IF's x 32 MHz, LCP 256 x 0.5 MHz channels/IF, full stokes I images



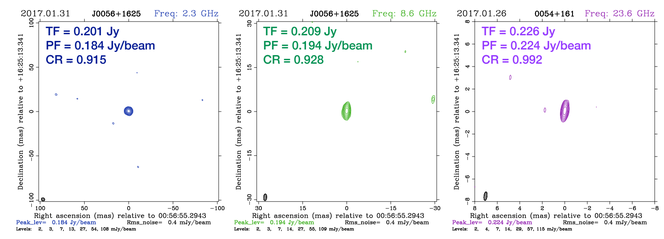
1. standard data reduction (see Petrov et al. 2019, MNRAS 485, 88) using AIPS (Bridle & Greisen 1994)
2. additional atmospheric corrections using multi-band delay
3. imaging using DIFMAP (Shepherd, 1997)

K-BAND VS S/X-BAND

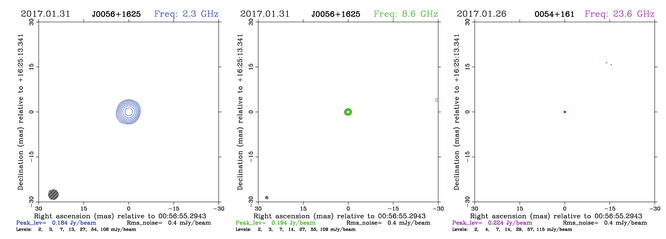
TF: Total Flux (Jy)
PF: Peak Flux (Jy/beam)
CR: Compactness Ratio (= TF/PF)

Image credit: S- and X-band images, Leonid Petrov, Alexandr Pushkarev and Yuri Y. Kovalev
www.astrogeo.org

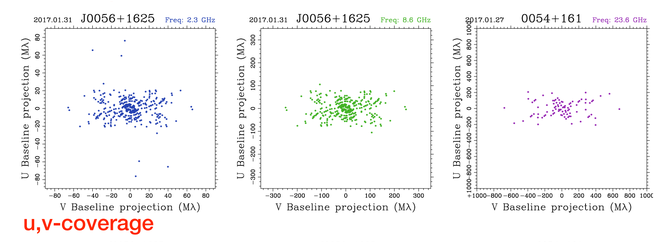
J0056+1652



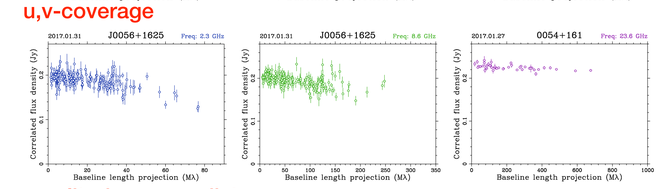
Contour plots with equal beam minor axis



Contour plots on a 30 x 30 mas scale

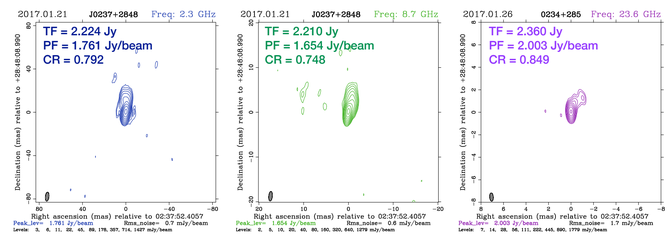


u,v-coverage

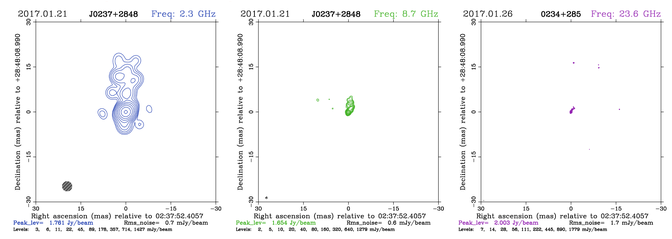


amplitude vs. u,v-distance

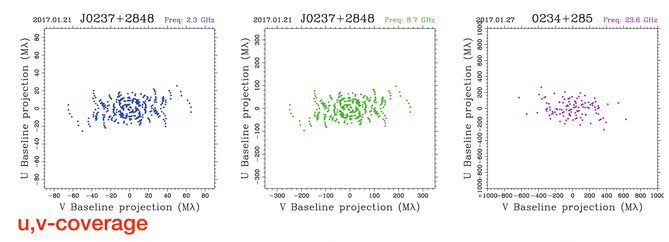
J0237+2848



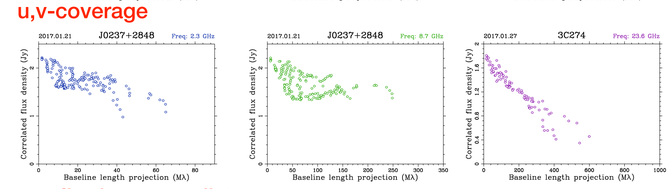
Contour plots with equal beam minor axis



Contour plots on a 30 x 30 mas scale

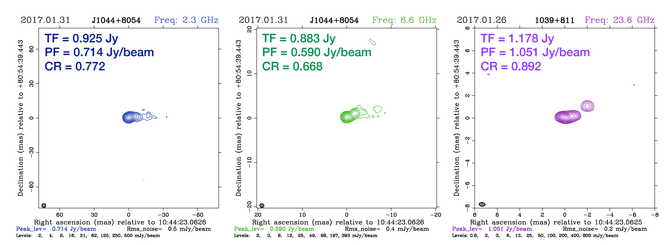


u,v-coverage

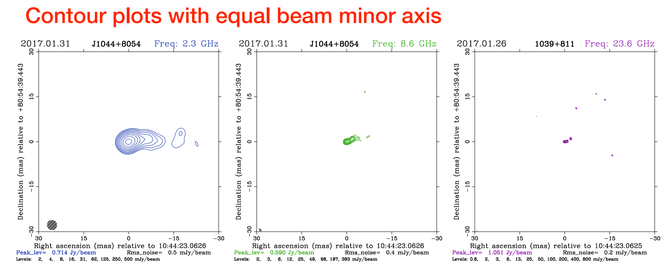


amplitude vs. u,v-distance

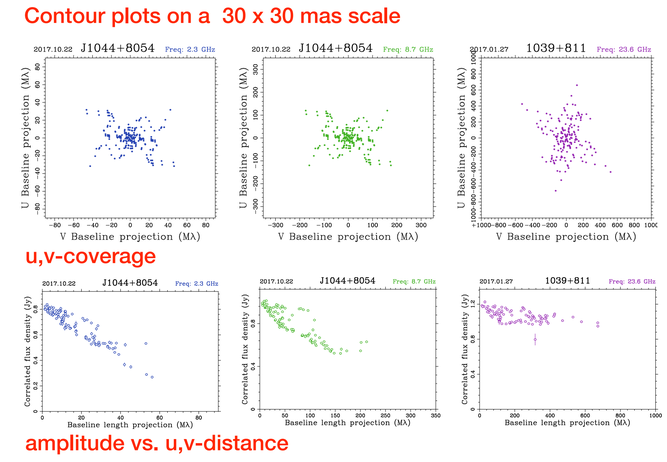
J1044+8054



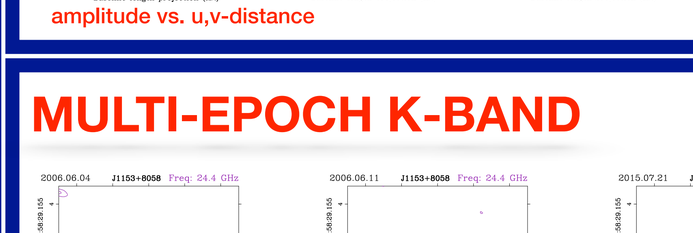
Contour plots with equal beam minor axis



Contour plots on a 30 x 30 mas scale

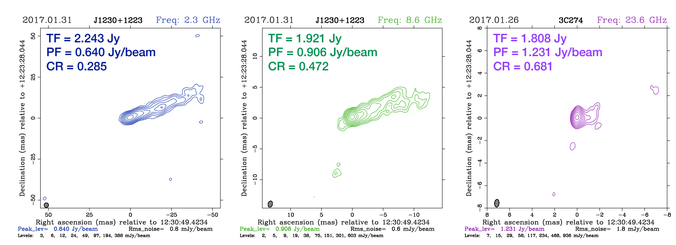


u,v-coverage

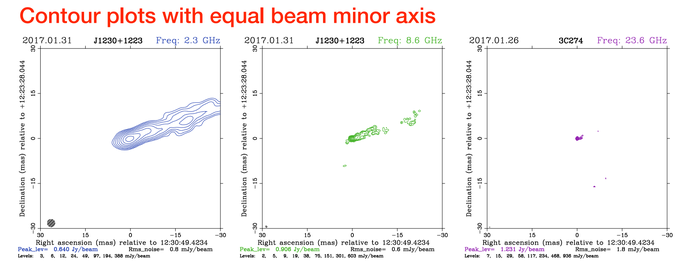


amplitude vs. u,v-distance

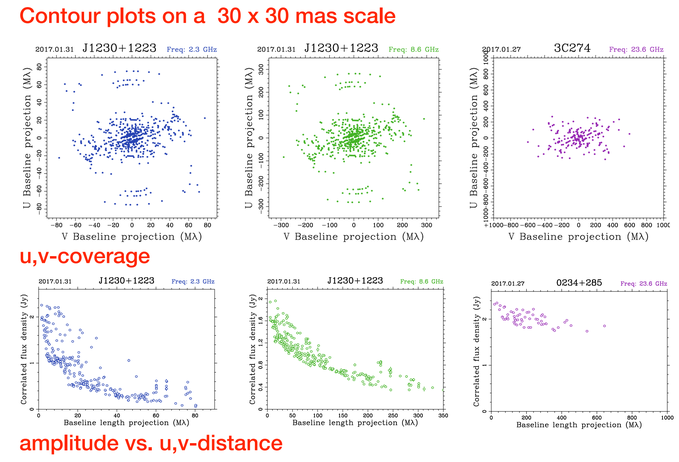
J1230+1223 (3C274)



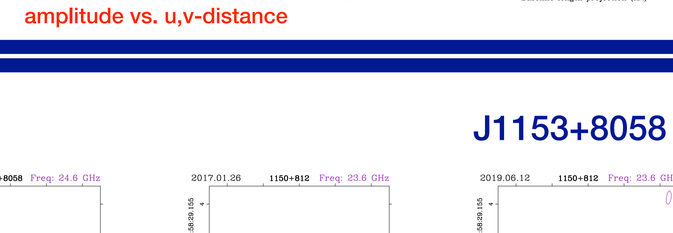
Contour plots with equal beam minor axis



Contour plots on a 30 x 30 mas scale



u,v-coverage



amplitude vs. u,v-distance

MULTI-EPOCH K-BAND

J1153+8058

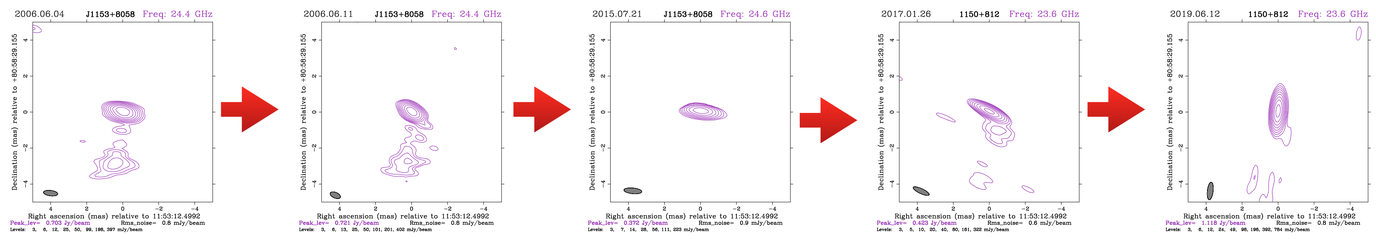


Image credit: Yuri Y. Kovalev, www.astrogeo.org

Image credit: de Witt et al. 2016 IVS GM

UD009B

TK006

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