Phase-delay astrometry of the polar-cap sample at 43 GHz

J.C. Guirado
Universidad de Valencia
E-mail: Jose.C.Guirado@uv.es

J.M. Marcaide
Universidad de Valencia
E-mail: J.M.Marcaide@uv.es

I. Martí-Vidal
Universidad de Valencia
E-mail: I.Marti-Vidal@uv.es

S. Jiménez-Monferrer
Universidad de Valencia
E-mail: Sergio.Jimenez@uv.es

We report on the analysis of the thirteen radio sources of the complete S5 polar-cap astrometry programme at 43 GHz. The astrometric analysis is based on new algorithms developed to facilitate the use of the differential phase delay in global astrometric observations [4]. Also, we will show an overview of the 43- GHz morphology of one of the S5 sources, the quasar 0212+735.

The 8th European VLBI Network Symposium
September 26-29, 2006
Toruń, Poland

1. Introduction

We are conducting a VLBA multi-wavelength astrometric study of the complete S5 polar-cap sample, consisting of thirteen radio sources from the S5 survey [1]. All sources in this sample have large flux densities, well-defined ICRF positions, and relative separations less than about 15°, which allows for astrometric precisions in the range of 20 to 100 μas, depending on the observing frequency. The goal of this programme is to determine the absolute kinematics of all the sources using maps properly aligned through different epochs. Given the variety of source structures in the sample and its completeness, our programme will result in an ultimate check of the standard jet model.

2. Source structure

The maps of all 13 radio sources for the first two epochs at 8.4 and 15.4 GHz have already been published [5,7]. The structure of the sources at 43 GHz are of particular interest, since we have a better chance to refer the astrometric estimates to the core of the radio sources. However, we have found that the core is not the brightest feature for some of the sources of our sample. This is the case of 1928+738 where the brightest feature corresponds to a recurrent emission of components travelling southwards; actually, this motion has already been traced astrometrically at lower frequencies [3,6]. Another example is the quasar 0212+735, whose maps at 43 GHz are shown in Fig. 1. The core of 0212+735 seems to be located westwards of the brightest feature, which shows a south-east motion towards a third stationary component. This has some reminiscence to the motion of the *b*-component in the quasar 4C 39.25 [2]. The astrometric analysis should define a suitable reference point on the structure of these sources, as well as for the rest of the sample, that should facilitate a meaningful interpretation of the morphological changes.

3. Astrometric analysis

For the global phase-delay astrometry of the 43- GHz data, we followed a similar procedure to

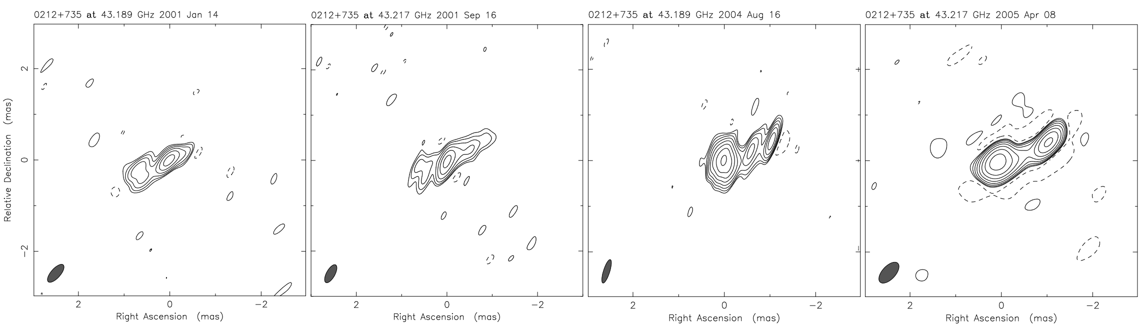

Figure 1: Maps of 0212+735 for all the observed epochs at 43 GHz. Contours are $(-3, 3, 3\sqrt{3}, 9...)$ times the rms for each map (2.7, 3.6, 2.7, and 1.9 mJy/beam for epochs 2001.04, 2001.71, 2004.62, and 2005.27, respectively). Brightness peaks are 0.17, 0.20, 0.42, and 0.38 Jy/beam.

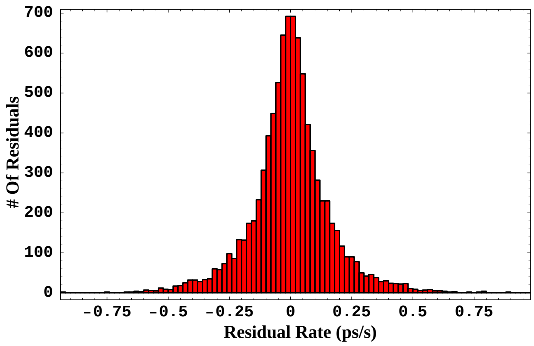

Figure 2: Distribution of the delay rate residuals for the 43- GHz data at epoch 2005.27. See Sect. 3.

that used at lower frequencies [4]. In essence, we used an accurate astrometric model of our interferometric array and the propagation medium to predict the number of cycles between successive observations of the same source. The goodness of our astrometric model can be estimated from the distribution of the delay-rate residuals (Fig. 2). At 43 GHz, the residual rate should be smaller than 0.12 ps/s; we see in Fig. 2 that this is reasonably well accomplished for the data at epoch 2005.27 (rms 0.16 ps/s). The phase-connection based on the astrometric model is not perfect and phase-cycles remained unmodelled in the data. Given the amount of data for each experiment (10 antennas, 24 hours of data, 13 sources, 25 source pairs...) we used an algorithm specially developed to automatically correct for these remaining ambiguities (see [4] for details).

The undifferenced phase delays residuals for all sources at 43 GHz (not shown here) seem to follow a similar trend; in those observing epochs where the atmosphere is well modelled, the scatter of these residuals is small enough to ensure phase-connection via our automatic procedure. However, we have found that the quality of the phase-connection is strongly dependent on the tropospheric modelling, especially at observing epochs when antenna elevations were lower than 30°. In these cases, the phase-connection, as described above, is insufficient to properly model the differenced phase delay to a fraction of the 43- GHz ambiguity. A more careful treatment of the atmosphere is needed in order to exploit the astrometric precision inherent to this frequency.

References

[1] Eckart et al. 1986, A&A, 168, 17

[2] Guirado et al. 1995, AJ, 110, 2586

[3] Guirado et al. 1998, A&A, 336, 385

[4] Martí-Vidal et al. 2007, A&A, submitted

[5] Pérez-Torres et al. 2004, A&A, 428, 847

[6] Ros et al. 1999, A&A, 348, 381

[7] Ros et al. 2001, A&A, 376, 1090

PoS(8thEVN)077