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Abstract. The VSOP mission is a Japanese-led project to image radio sources with sub-milliarcsec resolution using an orbiting 8 m telescope, HALCA, along with global arrays of Earth-based telescopes. The orbit of HALCA generates VLBI baselines that are typically two to three times longer than can be obtained with solely ground-based VLBI (Hirabayashi et al. 1998). Approximately 25% of the observing time was devoted to a survey of the brightest, compact AGN at 5 GHz—the VSOP AGN Survey. From the Survey data we have generated high resolution images, and fit simple models to the primary radio components. From the model-fit parameters the core brightness temperature of the individual sources has been calculated. A significant fraction of the sources have core brightness temperatures in excess of 10^{12} K in the source frame.

1. The VSOP Survey

The general description of the VSOP AGN Survey is given by Hirabayashi et al. (2000). A typical observation of an individual source is about 3 to 4 hours in length, and uses approximately 3 ground radio telescopes (GRTs) in conjunction with HALCA. Survey data were obtained using ground telescopes having S2 or VSOP format recorders, or by extracting data from general observing time (GOT) observations, the latter primarily involving VLBA telescopes. Depending upon the recording format, the data were correlated at one of three correlation centers, Socorro (New Mexico), Mitaka (Japan), or Penticton (Canada).

2. The Initial Imaging Results

Data reduction of the first 102 sources from the Survey has now been completed. Two examples of Survey images are given in Figure 1. For each of these QSOs a greyscale image is presented, with the contours showing the resolution after the space-ground baselines have been subtracted from the data. In addition to the images, peak brightness temperatures for the cores of the individual sources have been determined. Histograms depicting the distribution of these brightness temperatures in the observer's and source frame are shown in Figure 2. As can be seen from the histogram, about 46% of the sources have core brightness temperatures in the source frame in excess of 10^{12} K. This is the theoretical upper limit on the brightness temperature for sources radiating incoherent synchrotron radiation (Kellermann & Pauliny-Toth 1969). Above this limit inverse Compton scattering leads to rapid cooling of the electron-photon plasma. Hence, in the absence of a large x-ray flux, explaining the high brightness temperatures seen on the histograms requires other mechanisms, such as relativistic Doppler beaming.

References

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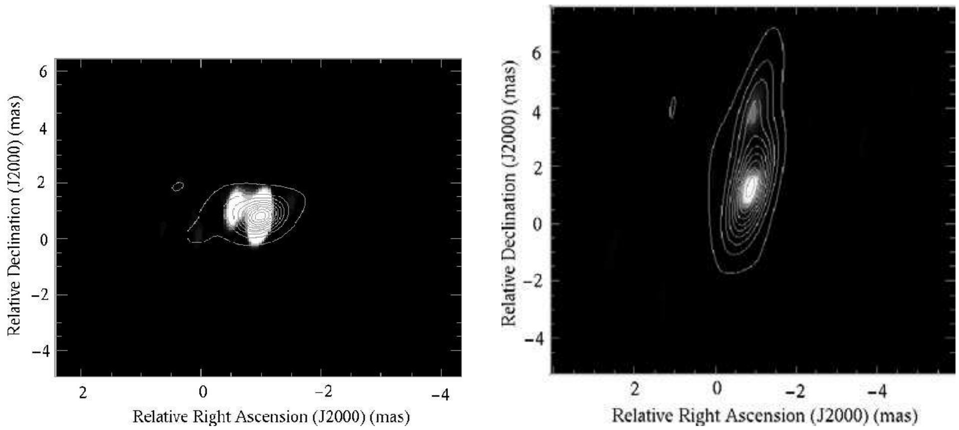

Figure 1. Left: VSOP Survey image of J0609−1542. GRTs used for this observation were Hartebeesthoek, Hobart, Kashima, Mopra, and Shanghai. Beamsize = 1.0×0.3 mas with a position angle of $-6.7°$. Right: VSOP image of J0741+3113, extracted from a GOT experiment. Data from Mauna Kea, North Liberty, and St. Croix VLBA GRTs were used to make this image. Beamsize = 0.8×0.2 mas with a position angle of $-23.4°$. In both images, the contours indicate the resolution with space-ground baselines removed.

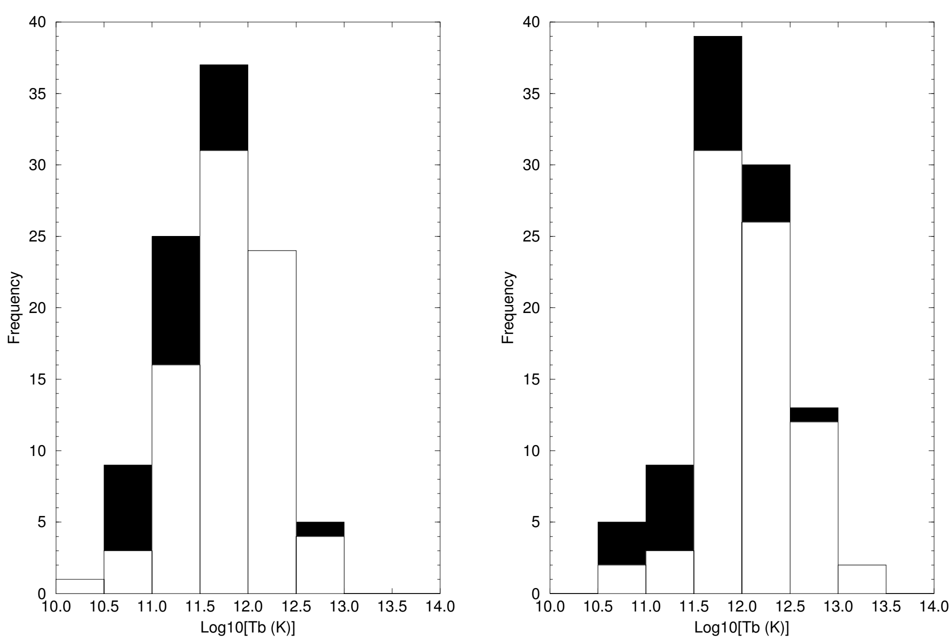

Figure 2. The number distribution of core brightness temperatures in the observer's frame (left) and source frame (right). The shaded portions of the histograms represent lower bounds on the brightness temperature of unresolved cores.