Compact USS sources
with e-MERLIN and the e-EVN

Megan Argo (Manchester), Rachel Steadman (Manchester, summer student 2014), Zsolt Paragi (JIVE), Hans-Rainer Klöckner (Oxford), Huub Röttgering (Leiden)
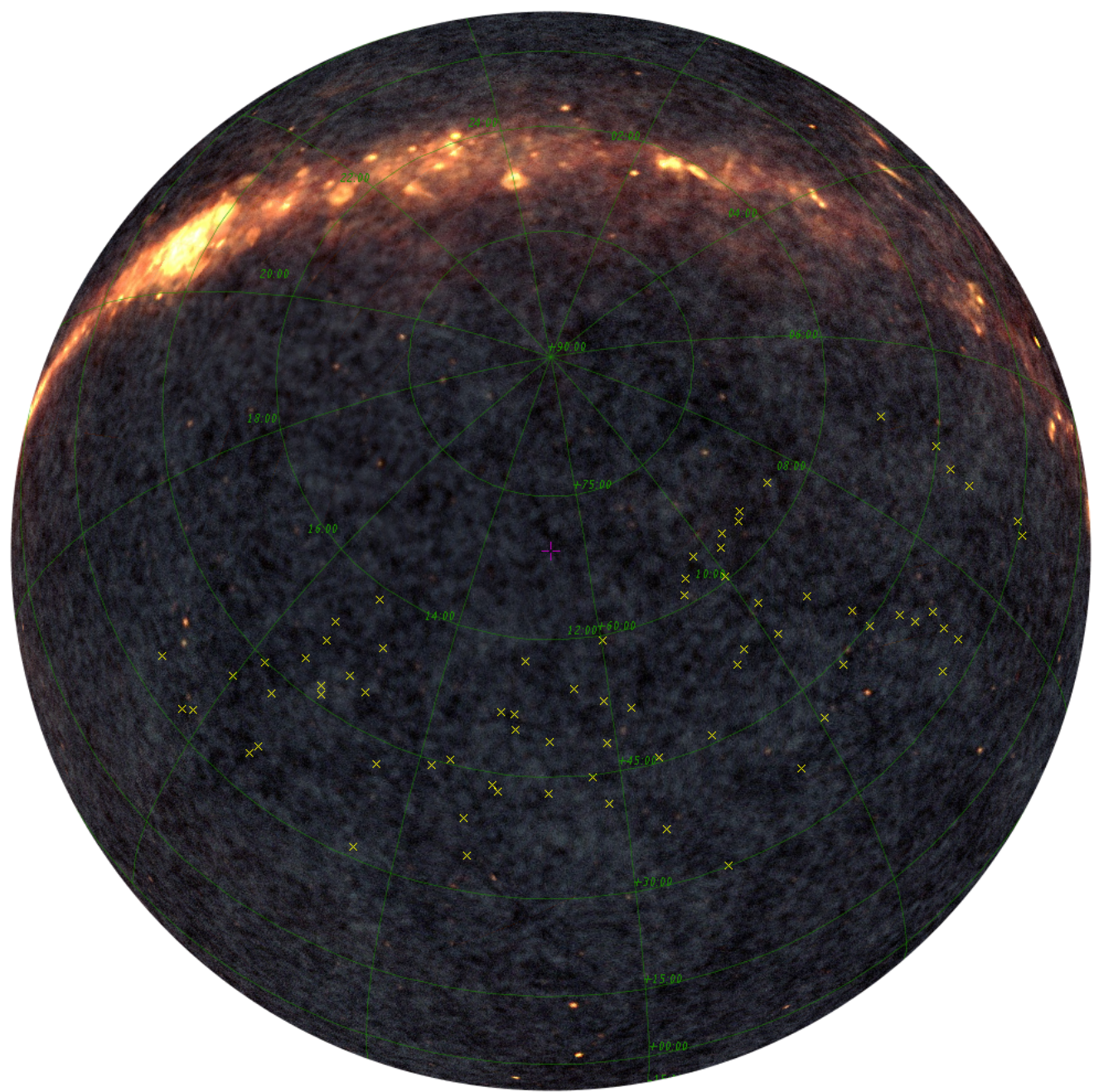
Figure 1: The sample. An all-sky plot from Aladin, using the Planck map as a background, illustrating the sky distribution of our sample.

We describe ongoing efforts to investigate a sample of otherwise unidentified ultra-steep spectrum radio sources. These sources are compact on arcsecond scales, counterparts in other wavebands are rare and the nature of these sources is, as yet, unknown. Suggestions for their nature include high-redshift radio galaxies located at or near the epoch of re-ionisation, Galactic pulsars, young obscured radio galaxies, and quasars with steep spectrum cores. A recent VLBI study of a small sub-sample (Argo et al 2013) have shown that a significant fraction are compact on mas scales but with less than 30% of the flux recovered, suggesting source structure on intermediate scales to which VLBI is insensitive. While the sample size in the previous study was too small to draw statistical conclusions, the full sample consists of 73 sources selected from four large catalogues. These sources are widely distributed across the survey overlap area, are compact on arcsecond scales, and have low-frequency spectral indices steeper than -1.2 between 74 and 330MHz.

Our current observational efforts are designed to examine their morphologies on intermediate spatial scales, investigate whether their spectral indices stay steep above 1.4 GHz, and create a sample of sufficiently compact sources for further VLBI follow-up. Many more such sources are likely to be discovered in surveys planned or already under-way with telescopes such as LOFAR and the MWA, and this new information will allow us to more thoroughly investigate this class of enigmatic sources and narrow down the possibilities for their origin.
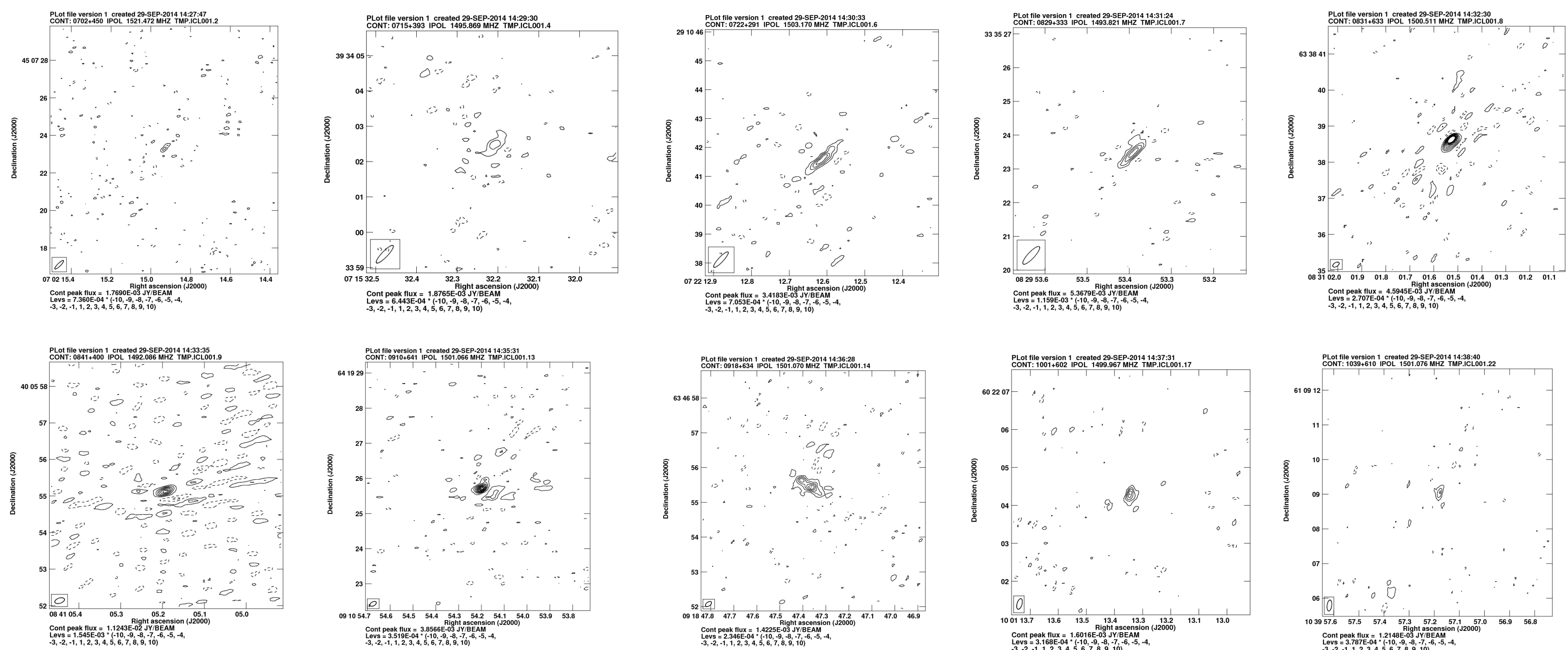

Figure 2: e-MERLIN source detections. A sub-sample of the e-MERLIN detections made so far at 1.4 GHz. Of the sources observed in this programme so far, roughly one third have been detected.

An initial survey of just five sources with the eEVN showed that there is variety in the source properties at resolutions of a few milliarcseconds (Argo et al 2013). A further survey of 50 of the sample using e-MERLIN in snapshot mode (above) has given us more of an idea about how compact these sources are as a population (if they are indeed a homogeneous population), although with poor image fidelity. Further observations with the JVLA and e-MERLIN are planned, before further follow-up with the EVN.

Previous study: Argo, Paragi, Röttgering, Klöckner, Miley & Mahmud 2013 MNRAS 431 L58