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Serendipitous discovery of a large number of intra-hour variable radio sources with Apertif

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Intra-hour variable radio sources (IHVs) are among the rarest objects in the sky, up to very recently only a handful of such sources were known. IHVs show extreme variations at GHz frequencies, with flux changes up to a factor of a few within timescales of tens of minutes. We report the serendipitous discovery with Apertif of more than twenty of such unique radio sources, increasing the number of known sources of this rare class of objects by an order of magnitude. A unique aspect of IHV sources is that they give an unprecedented detailed view of the ionised interstellar medium in the direct solar neighbourhood. I will present the results on individual sources and discuss statistical properties such as clustering on the sky and the implications thereof.

Propagation of radiation through turbulent interstellar plasma leads to interstellar scintillation of very compact radio sources. Such scintillations are a unique probe of the sub-AU-scale structure of the interstellar medium. Scintillations of a few percent on timescales of a few days or more is commonly seen at centimetre wavelengths, but a very small number of radio sources show much stronger variations on shorter timescales (hours or less). Such extreme variations require propagation through very nearby (d < 10 pc) anomalously dense (n~10^2 cm^-3) plasma clouds. Before Apertif, only a handful of such sources were known, but in the ongoing Apertif survey we have already discovered more than twenty of such unique radio sources. The fact that Apertif detects these sources at relatively long wavelengths, combined with the very short observed timescales of the flux variations, requires scattering in a dense plasma that is likely to be extremely close, in some cases even only at a few lightyears. This may imply that in some cases the plasma screens causing the scintillation are within the Sun's sphere of gravitational influence. The increased sample size allows for the first time to study the statistical properties of IHV sources. Interestingly, IHV sources appear to be clustered on the sky on the scale of a few degrees which has interesting implications for the screens causing the scintillations.

Our results show the potential of deep large-area surveys done with radio telescopes with a large field of view for uncovering rare, interesting sources that are a unique probe of the plasma in the solar neighbourhood.