3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Precision localisation of FRBs with VLBI

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Extended Abstract

Fast radio bursts (FRB) are millisecond duration, extremely bright bursts of extragalactic origin. Despite a known population of 1000 sources, we still do not know their progenitors, let alone the emission mechanism generating these flashes in the radio band. Most FRBs have only been seen once while some FRBs burst repeatedly, the so-called repeating FRBs.
Despite the large rate of ∼10000 FRBs per sky per day, finding FRBs is hard. The ideal combination of a large field of view and lots of observing time plus powerful processing capabilities can, at this point, only be met by a small number of current facilities. Amongst those are the Australian SKA Path Finder Array (ASKAP) and the Canadian HI Mapping Experiemnt FRB project (CHIME/FRB).To date, ASKAP detected 51 FRBs, while CHIME/FRB recently published their first FRB catalogue (492 sources [1]). Amongst the FRBs detected by CHIME, 18 are repeating FRBs.
One key aspect needed to understand the nature of FRBs is their precise location. The current astrometric precision of CHIME (∼ 10 arcmin) is too low to assign a host galaxy to a given FRB, while ASKAP has been able to determine 12 FRB host galaxies [2, 3]. Although this is a great step forward, simply knowing what type of host galaxies FRBs are emitted from is not quite sufficient – it is the local environment, e.g. star forming or not; association with a persistent counterpart or not – that can give us insights on the type of objects that we can expect to emit FRBs. The astrometric precision required for such environmental studies is of order milliarcseconds, a resolution that can only be achieved with VLBI.
In this talk I will discuss the latest results of our ad-hoc VLBI campaign called PRECISE. In this project we regularly observe repeating FRBs with an interferometric array consisting of dishes that are also part of the EVN. Consisting mostly of 30m-class telescopes with ample time, we spent roughly as much time on FRB follow-up in 2021 as all three annual EVN-sessions combined. This can be thought of as an implementation of 'EVN-light'. As of late, we doubled the number of repeating FRBs with a milliarcsecond-localisation. One of our targets, FRB20200120E [4], proved to be in a globuar cluster, challenging models that invoke a young magnetar formed via a core-collapse supernova as FRB progenitors [5].

References

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