## Localisation of fast radio bursts to their host galaxies

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Fast radio bursts (FRBs) are amongst the most energetic objects in our Universe, but despite a number of plausible models, their origin remains a mystery. In the absence of multi-wavelength counterparts to extragalactic FRBs, analyses of their host galaxy environments are presently the most informative path to identifying their progenitor systems. Thanks to recent advances using the Australian Square Kilometre Array Pathfinder (ASKAP) radio telescope we can now localise FRBs with arc-second accuracies to the galaxies they originate from, and in some cases even pinpoint the burst to a region within the galaxy. In addition, localising FRBs to their host galaxies also allows us to use them as probes to trace the ionised gas in galaxy haloes, large-scale structure, and the inter-galactic medium.

Deep optical and radio follow-up observations of the current sample of localised ASKAP FRBs have enabled the study of the types of galaxies and environments that FRBs live in. The sub-arcsecond localisation for FRB 180924 shows that the burst originates in the outskirts of a massive early-type galaxy dominated by old stars [1]. On the other hand, FRB 190608 lives in the outskirts of a late-type spiral galaxy which is moderately making stars. Thus, FRBs typically lie in the outskirts of their hosts, that appear to rule out FRB progenitor models invoking active galactic nuclei (AGN) or free-floating cosmic strings. The stellar population observed in the current sample of host galaxies also disfavours models in which all FRBs come from young magnetars produced by super-luminous supernovae (SLSNe), as proposed for the progenitor of the first repeating FRB 121102 [2]. In addition to constraining the progenitor models, the localisation of FRBs also offers an independent way to study the structure of the Universe by probing the circumgalactic and intergalactic media. The sightline of FRB 181112 passes through the halo of a foreground galaxy, constraining the density and magnetisation of the halo [3]. A detailed optical and spectroscopic analysis of FRB 190608 led to the reconstruction of the matter distribution along its sightline [4]. As FRB host localisations become more routine, we will build a statistical sample for conclusive inferences about FRB progenitors, their environments and will capture a snapshot of the Universe along FRB line of sights.



**Figure 1.** g-band images of the host galaxies of FRB 180924, FRB 181112, FRB 190102 and FRB 190608, over-plotted with the positions of each FRB. The white circle/ellipse represents the total uncertainty in the FRB position.

## References

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