Keith Bannister – About me

Hello! My name is Keith Bannister. I'm part astronomer, part instrumentalist, with emphasis on the mental. I work at the Australia Telescope National Facility (ATNF) which is like the National Radio Astronomy Observatory (NRAO) but in Australia. We operate some radio telescopes you may have heard of, like the Murriyang 64m at Parkes, which was the first telescope to detect a Fast Radio Burst (FRB); and the Australian Square Kilometer Array Pathfinder (ASKAP), which was the first telescope to localize a once-off FRB.

I first heard of FRBs in my first group meeting as a PhD student. I was walking into Bryan Gaensler's office with Shami, and they were excitedly talking about this paper reporting something weird, and it had lots of Janskys. I didn't know what a Jansky was, but it sounded impressive to me! That sort of mystery was exactly what I find exciting in science.

I'm most interested in using FRBs as tools to find out things about the Universe that are difficult to find out any other way. It would be great to know what makes FRBs too, but once you know what they are, I feel like you've answered the question, and the party grinds to a halt. But if you can use them as tools, who knows what whacky thing you could measure if the right FRB?

I work with the CRAFT collaboration which primarily uses ASKAP. My favorite results so far have been the measurement of the "Macquart" relation and the measurement of the Hubble constant. Jean-Pierre Macquart was a good friend and enthusiastic collaborator in CRAFT. He died right after publishing his relation now named after him.

Outside of astronomy, I have officially too many kids (Arianne – 14, Soren 13, Huon 10). I like taking them on adventures skiing, sailing, hiking, rock climbing, surfing. I'm building a foiling electric kayak with some friends. I play trombone badly.

The value of large-area surveys

To date, most FRBs with known redshifts have been found in the redshift range $0.1 < z < 1$. We would like to find, and localize FRBs in the nearby universe because:

- It's easier to study their immediate environments
- We have a better chance of identifying prompt, and afterglow emission (if any) at other wavelengths
- We can begin to make a map of the intergalactic medium in the Galactic neighborhood, which might be useful if we get lost.

Large-area surveys also have the advantage that they can find the rarest types of FRBs, e.g. most energetic ones. Setting a constraint on the maximum energy that can be emitted by an FRB helps us understand the emission mechanism.

Large area surveys require instruments with large fields of view. This is where phased array feeds (PAFS) are useful.

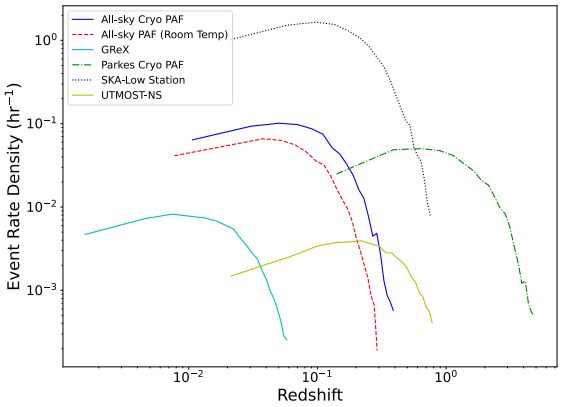
Large area surveys using Phased Array Feeds (PAFs) as aperture arrays

Phased array feeds use many closely-spaced antennas to make a large antenna. At ASKAP and Murriyang we normally install them at the prime focus of a dish, which makes the observations sensitive, but reduces the field of view. We're thinking of doing an FRB survey with some new PAFs we're building. Instead of installing them on a dish, we'll leave them on the ground and point them upwards.

The CryoPAF

This is the CryoPAF. It's designed by my friend Alex Dunning, who is a genius. Everything Alex makes is high-performance, covered in gold, and expensive. Unless it's high-performance, covered in silver and expensive. CryoPAF elements are called "rockets" and are covered in silver to improve their thermal radiation properties. That's me standing next to it. You can see I'm excited about it.

Rui Luo has done some modelling of how many FRBs the CryoPAF would find, both installed on the dish (as is planned), and on the ground pointing upwards (which we might try to wrangle if we can). The CryoPAF will find an FRB about every 10 days at a redshift less than 0.1. Multiple CryoPAFs like this could localize the FRBs too.



"Quasar" and future phased array feeds

We're building and thinking about more phased array feeds after the CryoPAF.

- The "Quasar" PAF will operate at around 3 GHz, it might be useful for finding magnetars in the galactic plane.
- Alex wants to try optimising the CryoPAF to make it work at room temperature. This PAF would have a much larger spacing, and hence collecting area, and only small increase in system temperature.
- This room temperature PAF would be a useful demonstrator for an upgraded ASKAP PAF.