

Pulsars

A GBT Pulsar Survey of the Galactic Plane with ALPACA

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Pulsars are unrivaled laboratories for studying a wide range of phenomena in astronomy and physics. Even though we have been finding new pulsars for over 50 years, we have probably only uncovered about 3% of the Galactic pulsar population. Pulsar surveys are sensitivity limited, and the flux of many pulsars varies for intrinsic and extrinsic reasons, so new surveys can uncover scientifically valuable gems, even when re-observing the same area.

Pulsars have a high impact on a wide range of science, including, but not limited to, the detection and characterization of low-frequency gravitational waves from supermassive black holes (likely within the next few years), and the accompanying multi-messenger opportunities; understanding gravity in the strong field regime; the physics of ultra-dense matter; studying the magnetized, ionized interstellar medium; probing plasma and particle physics in ultra-strong magnetic fields; stellar evolution; and potentially advancing our understanding of fast radio bursts.

The GBT has been one of the best pulsar discovery instruments of the last two decades, having discovered all of the most massive known neutron stars, some of the most gravitationally extreme binary systems, and a majority of the new pulsars that have been added to NANOGrav.

We have performed simulations suggesting that the next great GBT pulsar survey should be conducted at L-Band and focus on regions of the Galactic plane not visible to FAST. With careful attention to RFI mitigation, such a survey has the potential to uncover several hundred new pulsars, and dozens of new millisecond pulsars (which are often the most scientifically valuable). However, using the existing single-pixel L-Band receiver, this would take well over 6000 observing hours, probably spread over 10 or more years. *ALPACA on the GBT would be a game changer.* With ALPACA the survey could be completed with less than 1000 telescope hours, and perhaps in as little as two years (in other words, rather than taking the duration of a PhD + 2 postdocs, it could be done on the timescale of master's thesis!).

With ALPACA on the GBT we will be poised to quickly and efficiently complete what could be one of the most successful pulsars surveys of all time.