



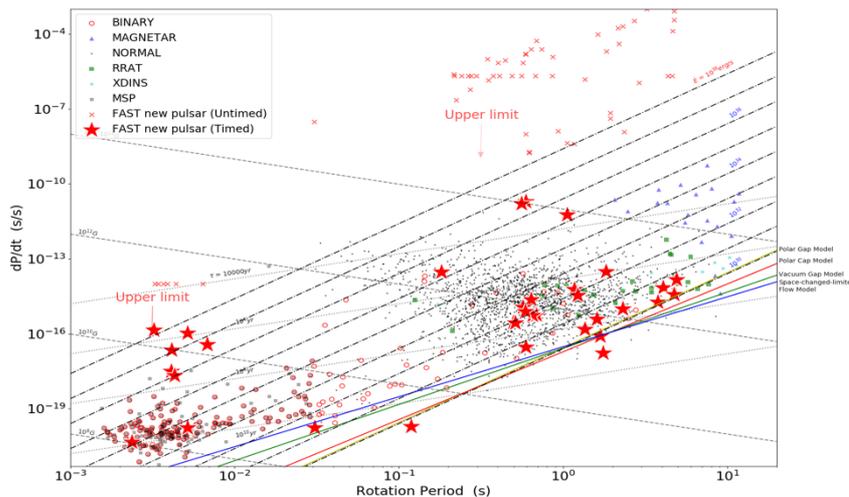
## Transient Sciences from the Five-hundred-meter Aperture Spherical radio Telescope

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Inspired by the visionary efforts of building Arecibo, the Five-hundred-meter Aperture Spherical radio Telescope (FAST) was among the final four competing concepts for the Square Kilometer Array (SKA) and was formally established as a stand-alone project in 2007. Through much trials and tribulation, FAST has seen its construction commenced in 2011; first light achieved in 2016; and normal operation started in 2020. We will release the first internationally open call-for-proposal in April 2021. With a gain of 16 K/Jy, FAST is the most sensitive radio telescope in L-band.

I report here a few early highlights in transient science from FAST, particularly from the Commensal Radio Astronomy FasT Survey (CRAFTS), which is an unprecedented large-scale commensal survey enabled by a novel calibration technique. A high-cadence electronic CAL signal is injected at the highest sampling rate required by the observational modes, e.g., every 49.3  $\mu$ s, thus allowing a real time calibration of the system temperature as well as preserving sufficient range of clean power spectrum for pulsar search. CRAFTS is the first large-scale survey on any major telescope that realizes simultaneously recording four data streams, namely, pulsar, Galactic HI, extra-galactic HI, and transient-triggered events.



**Figure 1.** The P-Pdot diagram. Published pulsars were taken from the PsrCat [2]. The FAST discoveries with timing solutions are shown in red stars, those without in the red crosses.

new pulsars, including more than 40 milli-second pulsars, one double-neutron-star (DNS) system, more than 5 new high DM ( $>1000$  pc cm<sup>-3</sup>) FRBs including one repeater that has been localized.

The ongoing FAST programs, including CRAFTS, globular cluster survey, Fermi sources, etc. start to probe the portion of the transient population, which may be difficult to access by other telescopes, before the advent of SKA.

### References

- [1] Li, D., Wang, Pei, Qian, Lei 2018, "Considerations for a Multi-beam Multi-purpose Survey with FAST", IEEE Microwave, 2018, Vol. 19, Issue 3, p112-119
- [2] Manchester, R.~N., Hobbs, G.~B., Teoh, A. et al. 2005, "The Australia Telescope National Facility Pulsar Catalogue", AJ, 129, 1993. doi:10.1086/428488

Testing of the CRAFTS concept [1] started 2018. At the beginning of 2020, it was formally approved as one of the five major FAST surveys. CRAFTS aims to observe all the sky visible to FAST between declination  $-14^\circ$  and  $+66^\circ$ , roughly 57% of the whole sky, in drift scan mode. The hexagon footprint of the 19-beam focal plane array spans about 21' in DEC in one drift, corresponding to about 5300 hours required for the full survey. CRAFTS has discovered more than 150