correspondence

Uncertain future for US pulsar timing array efforts

To the Editor — This issue of *Nature Astronomy* highlights the importance of radio-astronomical pulsar measurements for the detection and characterization of very long wavelength (nanohertz frequency) gravitational waves[1,2], a regime not probed by any other method. Such measurements are critical to realizing one of the National Science Foundation's (NSF) '10 Big Ideas': multi-messenger astrophysics. This has been recognized through the award of a NSF Physics Frontiers Center to the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) collaboration. Pulsar timing experiments are just beginning to probe astrophysically plausible gravitational wave strengths and are likely to make a detection within the next five years[3].

Accurate timing of radio pulses from pulsars contributes uniquely to other areas of physics as well, including the study of matter in its densest state, tests of general relativity in the strong-field limit and the evolution of massive stellar systems (see references in ref.[4]). A glance at the astrophysics preprint server will affirm that radio studies of pulsars and related phenomena are a vital, growing part of astrophysics, with a strong US presence.

Between them, the 300-m Arecibo radio telescope and the 100-m Robert C. Byrd Green Bank Telescope (GBT) account for nearly all observational pulsar research by American scientists, and they also provide the greatest sensitivity to the International Pulsar Timing Array effort. They both offer large collecting areas at frequencies < 2 GHz, sensitive receivers, and state-of-the-art digital data analysis systems necessary for precise pulsar timing. Upgrades over just the past few years have more than doubled their sensitivities. NANOGrav's gravitational-wave investigations rely on continued observations with the GBT and Arecibo, with the combined timing and pulsar searching observations using roughly 20% of the available time on each telescope.

Sadly, continuity of science operations at both of these telescopes is in serious jeopardy. Over the past three years, NSF support for GBT operations has decreased from 95% of the operating budget to 65%, with further reductions to 30% expected. NSF recently announced a funding profile for Arecibo that will gradually decrease support from its current level of US$8 million per year to US$2 million per year by 2022. The situation is, in fact, dire: complete closure of both facilities is a very real possibility if additional funding cannot be found to make up the shortfall.

Our community understands that NSF support for facilities may cease when they have fulfilled their mission or have been replaced by more capable instruments. But that is not the case here. Arecibo and the GBT remain world-class, oversubscribed, and without peer[5]. The only other US telescope operating in a similar frequency range, the Jansky Very Large Array, has neither the sensitivity nor the available time to replace either facility[6]. Collaboration with astronomers using less sensitive European and Australian telescopes augments work done at Arecibo and the GBT, but it is no substitute for maintaining a strong American radio astronomy program. Large radio telescopes in China and South Africa — FAST and MeerKAT — will begin pulsar timing experiments in a few years, but their timeline and ultimate sensitivity remain unclear. Moreover, access to these telescopes for US-based scientists will be, at best, limited to many fewer hours than in current observing programs, offering scant opportunity for US leadership.

In summary, there are no plans to build suitable replacements for the GBT or Arecibo — let alone anything that improves upon their performance — in the US, and their closure would effectively sound the death knell for US pulsar astrophysics, low-frequency gravitational wave astrophysics, and the many other areas where these instruments provide unique capabilities for US astronomers. These two telescopes must remain operational.

A version of this letter has been signed by 91 members of the NANOGrav collaboration and 96 other scientists. A full list of the authors and signatories of this letter is available at http://go.nature.com/2AbypCz. ❐

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