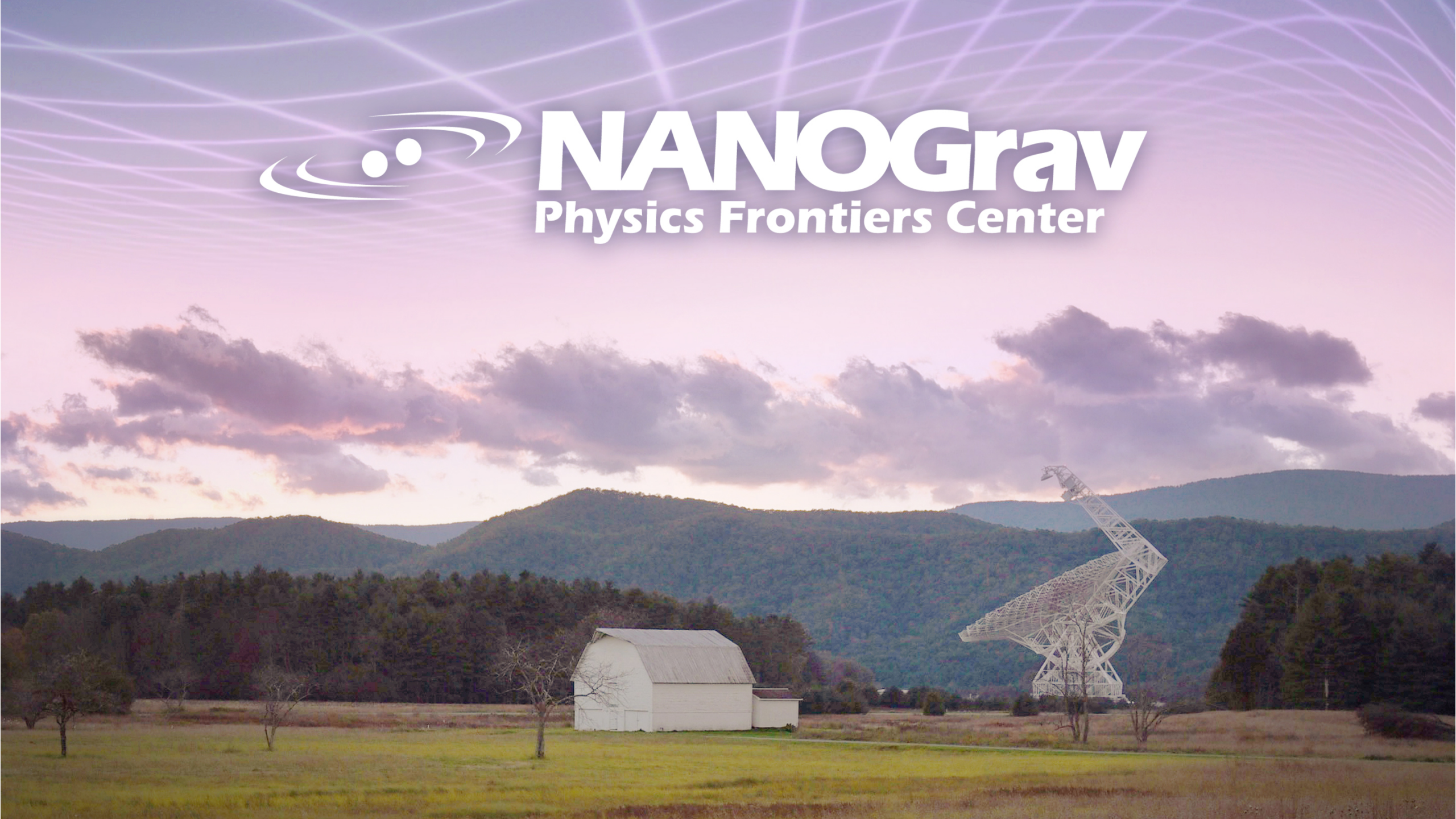
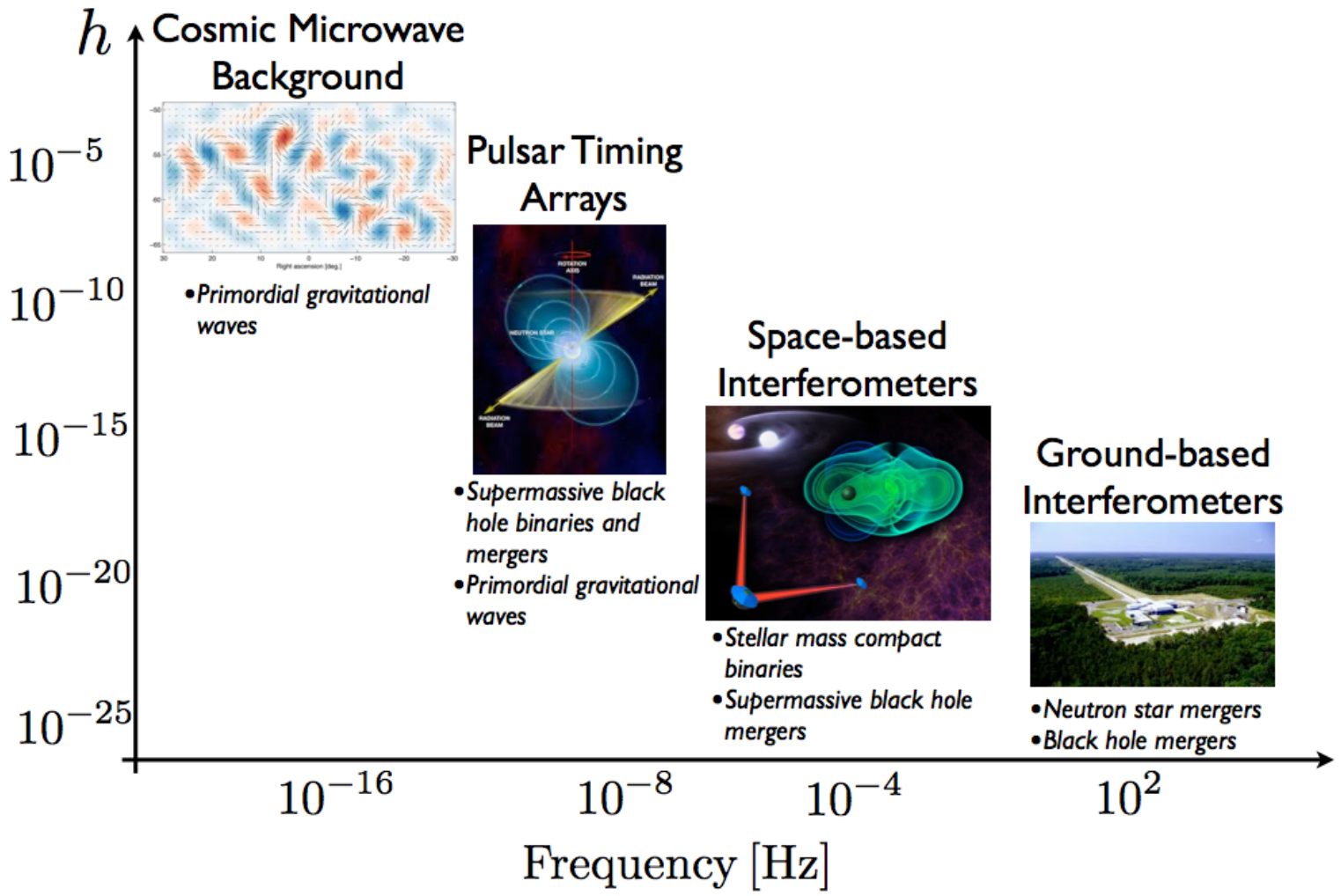

NANOGrav
Physics Frontiers Center

The North American Nanohertz Observatory for Gravitational Waves (NANOGrav) was formed in 2007 and consists of roughly 140 members, including 65 faculty or senior researchers, 30 postdocs, and 45 graduate students at 55 institutions in the US and Canada. Of these, 51 are Full Members, defined as those making sufficiently significant contributions to warrant authorship on NANOGrav GW dataset and GW analysis papers. In addition, NANOGrav involves roughly 100 undergraduate students annually through its STARS (Student Teams of Astrophysics Researchers) program.

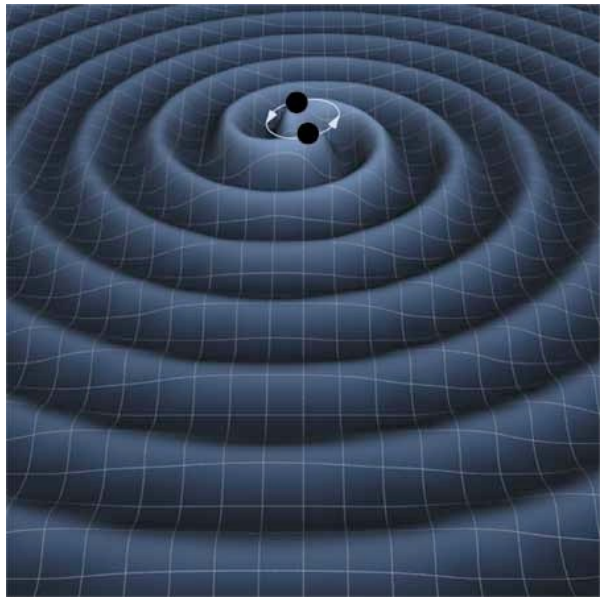
NANOGrav became an NSF Physics Frontiers Center in 2015 (for $14.5M). Includes 15 institutions in the US, with UWM the lead institution.

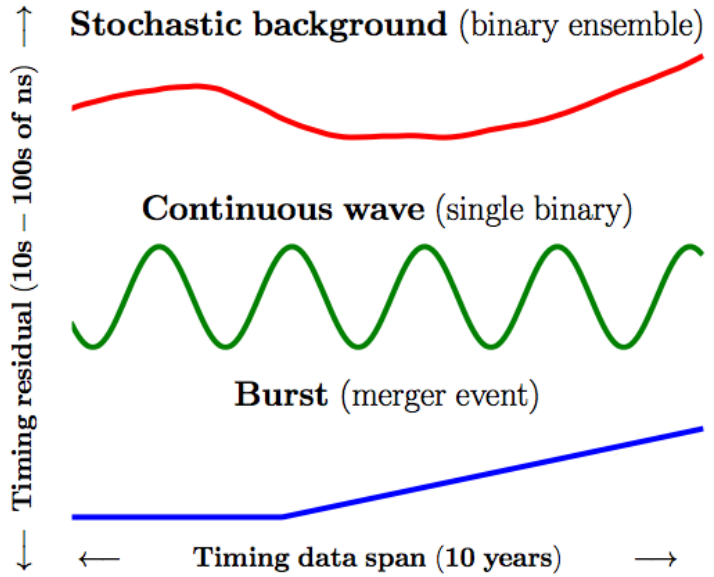
The spectrum of gravitational wave astronomy



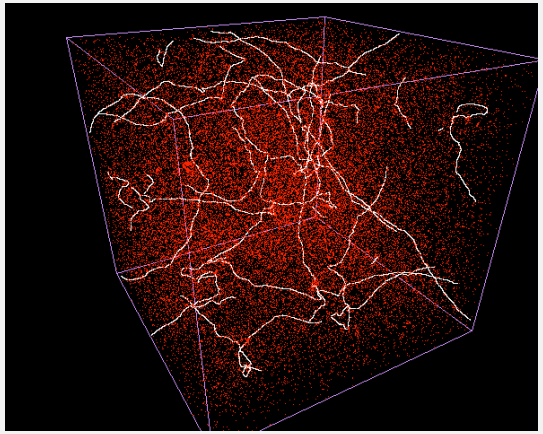
Gravitational wave sources

The most promising sources are supermassive binary black holes (SMBBHs):





Other sources at nanohertz frequencies include cosmic strings, inflation, and phase transitions in the early universe.



NANOGrav
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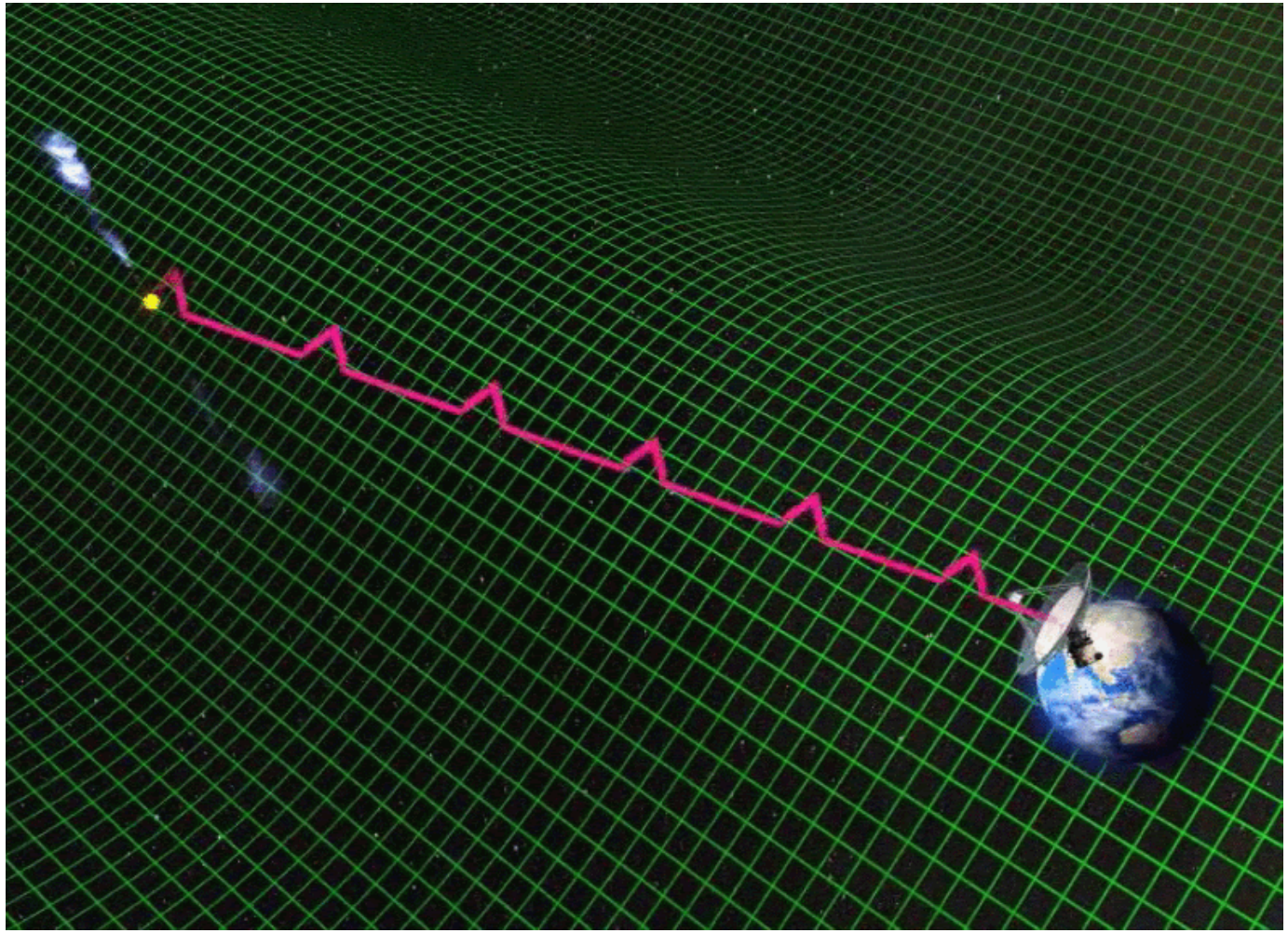
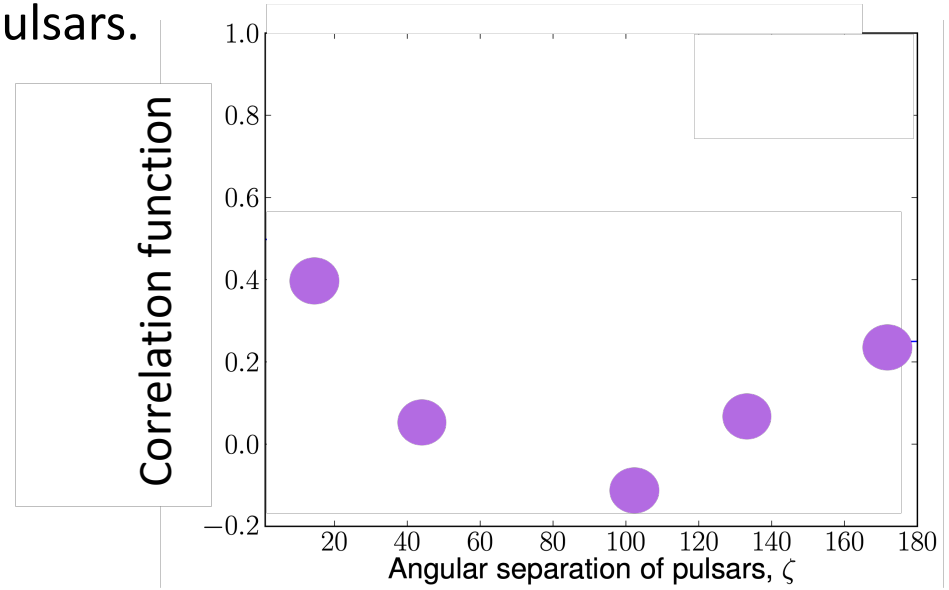
Effect of a gravitational wave on radio pulses



Building a Galactic-scale Gravitational-wave Detector

- Need to observe an ensemble of ultra-stable millisecond pulsars to extract the correlated signal from the noise.

- GW perturbations are correlated among different pulsars.



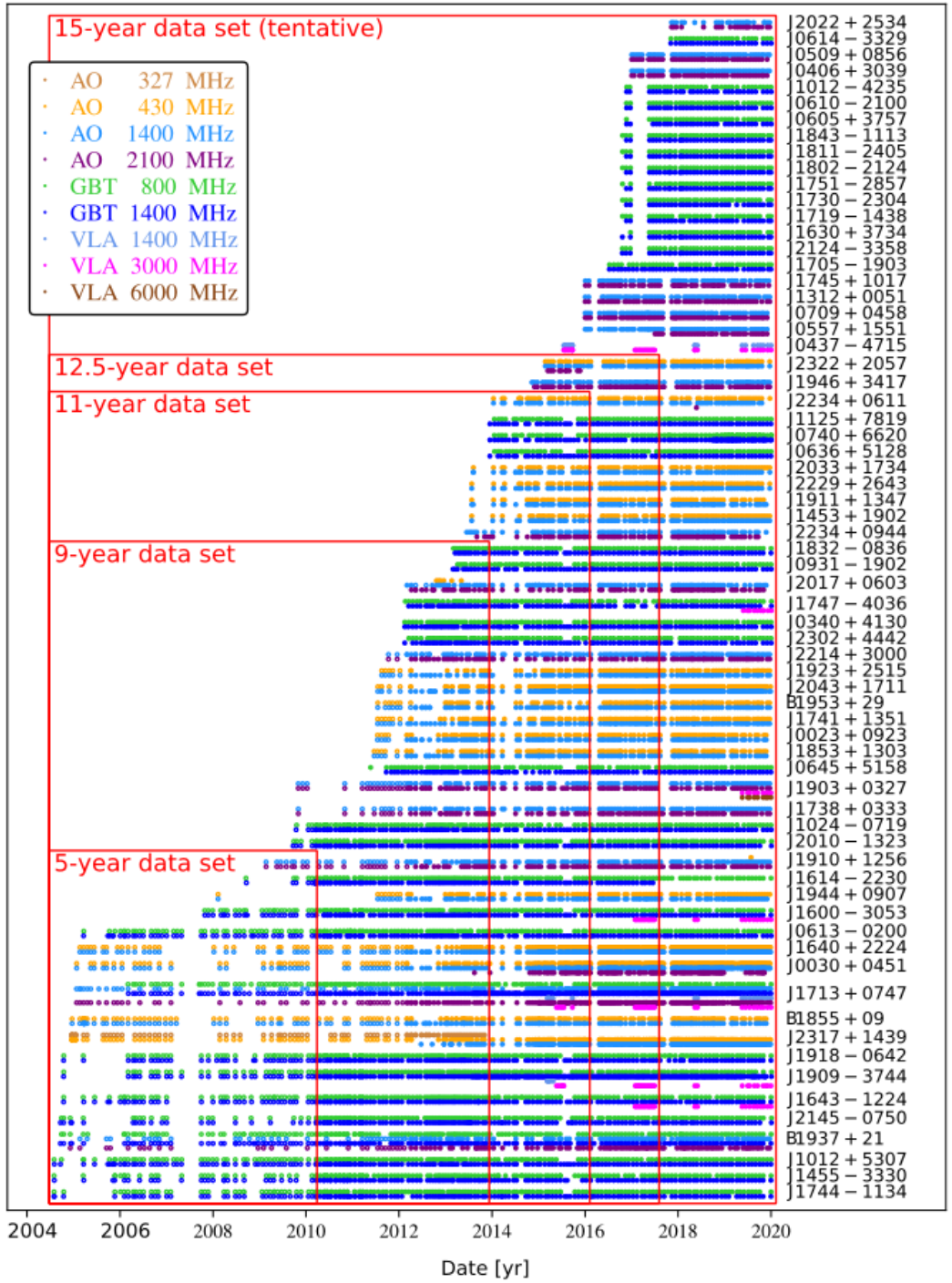
The Arecibo Observatory and the Green Bank Telescope

Our measurements are made with the two most sensitive radio telescopes in the world

Arecibo Observatory

Green Bank Telescope

NANOGrav data releases



Credit: David Nice

About our work

Work is truly interdisciplinary.

Requires detailed understanding of:

- GW signals and their sources
- properties of neutron stars, our celestial clocks
- propagation of pulses through the interstellar medium
- characteristics of the radio telescopes
- software designed to make the measurements
- algorithms for GW searches
- searching for additional pulsars
- the long term curation of the data products

Work requires close collaboration of:

- Theorists
- Data analysts
- Cosmologists
- SMBBH astrophysicists
- NS astrophysicists
- Radio astronomers
- Cyber-I experts

This makes the work a lot of fun! Rationale for PFC…

NANOGrav PFC Management