NANOGrav
progress toward detecting a SMBHB stochastic background

slide from Stephen Taylor (Vanderbilt)
ipta4gw.org
Supermassive Binary Black Holes

- Characteristic strain as a function of frequency [Hz].
- Coalescence timescale can be Myrs.
- Signal is present in entire data stream.
- Stochastic GW background.
- Single resolvable binary and binary merger.
- "Memory" offset.
- Oscillatory part.

Stephen Taylor (Vanderbilt)
3 signals: stochastic, sinusoidal, burst

- Stochastic GW background
- Single resolvable binary
- Binary merger

Coalescence timescale can be Myrs
→ signal is present in entire data stream

Signal is present in entire data stream

Characteristic strain

Frequency [Hz]

Memory burst

LISA band

Stephen Taylor (Vanderbilt)
NANOGrav Project white paper: arXiv 1908.05356
Hellings and Downs curve

arrival time correlation

pulsar angular separation [deg]
Hellings and Downs curve

quadrupolar
Hellings and Downs curve

quadrupolar

0° and 180° correlated delays

arrival time correlation

pulsar angular separation [deg]

$N = 50$
Hellings and Downs curve

quadrupolar

90° apart anti-correlated delays

arrival time correlation

$pulsar\ angular\ separation\ [deg]$
http://gravcalc.org/

Andrea Lommen
(Haverford)
and students
NANOGrav: 9 year, 11 year, 12.5 year, 14 year ....
NANOGrav:  9 year,  **11 year,  12.5 year,**  14 year ....

The GW upper limit has stopped going down at the expected rate

**Preliminary (not official)**
Hellings & Downs curve

credit: Sarah Vigeland (U Wisconsin-Milwaukee)
Hellings & Downs curve (emerging?)

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Questions?

credit: Sarah Vigeland (U Wisconsin-Milwaukee)
Supermassive Binary Black Holes

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- Coalescence timescale can be Myrs
  → signal is present in entire data stream

Questions?

Stephen Taylor (Vanderbilt)
Pulsars

Image credit: Bill Saxton

Joeri van Leeuwen

Image credit: Verbiest & Shaifullah (2018)

Long-term timing stability
Less glitchy
Best for precision timing

Astronomy & Space Sciences Colloquium, Cornell University, 10-17-2019

Stephen R. Taylor
Adding pulsars to the Array
an international effort
Adding pulsars to the Array
an international effort