Section I - General Information

Submitted for Sep 1 2014.

This proposal has not been submitted before.

Proposal Type: Large
General Category: Pulsars
Observation Category: Galactic
Time Requested this semester: 130
Hours Next Semester: 130
Hours already used for this project: 0
Additional Hours required to complete project:
Minimum Useful Time: 30 minutes
Expected Data Storage: over 500 GB

Proposal Title: An Improved Single-Source Detector for the North American Nanohertz Observatory for Gravitational Waves

ABSTRACT:

The North American Nanohertz Observatory for Gravitational Waves (NANOGrav) is a collaboration of scientists and students that uses many radio pulsars as a type of Galactic-scale detector in an effort to be the first to directly detect gravitational waves (GWs). The current NANOGrav observing program is optimized for the detection of a stochastic background of GWs from unresolved sources in the Universe, but not robust for the detection of resolvable, individual GW sources. In this proposal, we request an increased observing cadence for five of the best-timed NANOGrav pulsars in an effort to boost our sensitivity to individual GW sources as shown in recent studies and simulations described in the accompanying text. These measurements will be crucial for understanding largely unconstrained astrophysical processes influencing the population of potential GW sources, such as merging supermassive black-hole binary systems.

Outreach Abstract:

Los pulsares han demostrado ser laboratorios excepcionales para la comprensión de la física gravitacional en ambientes extremos. Estamos proponiendo a observar cinco pulsares que son parte del grupo ”North American Nanohertz Observatory for Gravitational Waves” (NANOGrav), que es una colaboración de científicos y estudiantes tratando de ver directamente las ondas gravitacionales. NANOGrav ahora sirve para detectar las ondas gravitacionales de todos sistemas orbitales de los agujeros negros en el Universo, pero no sirve bien para detectar y entender las ondas gravitacionales de sistemas individuales. Ahora estamos tratando de mejorar las observaciones de NANOGrav para detectar estas ondas gravitacionales de únicos sistemas y entender la física de los agujeros negros.
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This work is not part of a thesis.

Remote Observing Request

☐ Observer will travel to AO
☒ Remote Observing
☐ In Absentia (instructions to operator)

Section II - Time Request

The following times are in LST.

For these observations night-time is not needed.

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<th>Begin – End Interval–Interval</th>
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As we discuss in our attached proposal, we prefer to observe five radio pulsars, each for one hour per observing epoch, for 26 epochs during each semester for each source or 52 epochs for the whole observing year (52 x 5 = 260 hours total for all five sources). There were only four entries allowed in the proposal cover sheet, though all five pulsars and their LST ranges are listed in the “List of Targets” below.

However, we are very flexible about when and how these sessions are scheduled during the semester/year, as these pulsars need not be observed within the same day or at equally spaced epochs. Moreover, we can be scheduled for “filler” time and observe any of these pulsars in sessions as short as 30-minutes using a single receiver. The key point is that any additional data on these five pulsars, beyond the standard NANOGrav observing program, will increase our sensitivity to localized GW sources. Our ideal program, with 52 observing epochs per pulsar per year, would double our sensitivity to such GW sources as described in the attached proposal justification.

### Next Semester Time Request

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**Time Constraints (Must Be Justified in the Proposal Text)**

Same as described above for the first semester.

### Section III - Instruments Needed

| 430 G       | L-wide | S-low |

**Atmospheric Observation Instruments:**

**Special Equipment or setup:** We will also continue to use the PUPPI data acquisition system currently operating at Arecibo Observatory for high-precision, real-time measurements of TOAs from each pulsar.

### Section IV - RFI Considerations

**Frequency Ranges Planned**

| 420-440 |
| 1150-1800 |
| 1700-2400 |
This proposal requires coordination with Punta Salinas radar within the band 1222-1381 MHz.

This proposal requires coordination with GPS L3 at 1381 MHz.

Section V - Observing List

Target List

PSR J0030+0451 - 00h30m, 04d51m, 23:31-01:29
PSR J1640+2224 - 16h40m, 22d24m, 15:18-18:03
PSR J1713+0747 - 17h13m, 07d47m, 16:05-18:22
PSR J2043+1711 - 20h43m, 17d11m, 19:21-22:06
PSR J2317+1439 - 23h17m, 14d39m, 21:56-00:38