Pulsar Searching and Timing with NANOGrav: Toward a Detection of the Gravitational-Wave Background

The North American Nanohertz Observatory for Gravitational Waves (NANOGrav) pulsar timing array (PTA) is poised to detect nHz-frequency gravitational waves (GWs) within a few years to a decade, opening a window to the low-frequency end of the GW spectrum. The first detection is likely to be a stochastic GW background (GWB) from a population of coalescing supermassive black hole binaries (SMBHBs). Through precision timing of millisecond pulsars (MSPs), PTAs measure differences between the predicted and observed pulse arrival times. After accounting for noise intrinsic to the PTA, the timing residuals will display a correlated low-frequency signal in the presence of a GWB; for an isotropic GWB, this correlation is given by the Hellings-Downs curve. GWB detection with PTAs nominally requires long timing baselines (years to decades) and timing precision of order 100 ns. However, NANOGrav has reached the "intermediate regime," where the effect of a GWB signal is comparable to that of non-GW noise sources and the SNR grows faster with the number of MSPs in the PTA than with the timing baseline. Adding more bright, stable MSPs to the array is therefore essential to decreasing the time-to-detection of the GWB, and has become the primary goal of many pulsar search campaigns. I will describe the process of pulsar timing in the context of the NANOGrav PTA, and the thus-far successful effort to add new MSPs to NANOGrav through large-scale pulsar surveys and targeted searches.

Physics Colloquium

with Megan DeCesar

PostDoctoral Fellow at Lafayette College

Thursday
Sep. 14,
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At 4:10PM
In LL. 316

Refreshments at 3:45PM

Megan DeCesar *is a NANOGrav Physics Frontiers Center Postdoctoral Fellow at Lafayette College. She earned her bachelor of science in astronomy and astrophysics from Penn State University, her Ph.D. from the University of Maryland, and was a postdoctoral research associate at the University of Wisconsin-Milwaukee's Center for Gravitation, Cosmology, and Astrophysics before joining the NANOGrav collaboration as a postdoc at Lafayette. She works primarily on radio pulsar searching and timing, with the goal of detecting gravitational waves from supermassive black holes with the NANOGrav pulsar timing array. Her other interests include X-ray and gamma-ray pulsar astrophysics, and the study of millisecond pulsars in globular clusters.*