Astropulse: a Multibeam Sky Survey for Microsecond Transient Radio Signals using Arecibo Observatory

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We use the Arecibo telescope to search for brief, wideband radio pulses on timescales of microseconds to milliseconds. Such pulses could come from exploding primordial black holes, RRATs (rotating radio transients), pulsars, or new phenomena yet to be discovered. If black holes explode via the Hawking process, the resulting fireball might lead to a single EMP once the black hole has dwindled to a mass of 10^{11} g. We observe a bandwidth of 2.5 MHz centered on 1420 MHz, and we can detect single pulses of strength 14 Jy μs at a 0.4 μs time resolution. This will improve on previous surveys by a factor of 15, allowing us to look 4 times deeper into space. When the survey is finished, we will be able to establish a limit of $3 \cdot 10^{-14}$ pc^{-3} yr^{-1} on 0.4 μs events with energy 10^{32} erg. Our data comes from a seven-year and continuing commensal sky survey, of which the most recent data uses Arecibo's new 7 beam receiver. The survey covers 30% of the whole sky and comprises 100 terabytes of data. We search for both single pulses and regularly repeating pulses, with dispersion measures ranging from 50 pc cm^{-3} to 800 pc cm^{-3}. Because our time resolution is better than 50 μs, we must use coherent dedispersion, which is computationally intensive, requiring 10^{20} floating point operations in total for the project. We utilize the distributed computing power of SETI@home, delegating computational sub-tasks to hundreds of thousands of volunteers' computers. Both SETI@home and Astropulse operate within the BOINC framework. (Berkeley Open Infrastructure for Networked Computing.) Our full computational power has been realized recently, and we have begun to deal in earnest with RFI, due to nearby radar for instance.