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The Science of Gravitational Waves with Space Observatories

JAMES THORPE, NASA Goddard Space Flight Center

After decades of effort, direct detection of gravitational waves from astrophysical sources is on the horizon. In addition to providing insight about gravity itself, gravitational waves hold immense promise as a tool for general astrophysics. In this talk I will provide an overview of the science enabled by a space-based gravitational wave observatory sensitive in the milli-Hertz frequency band including the nature and evolution of massive black holes and their host galaxies, the demographics of stellar remnant compact objects in the Milky Way, and the behavior of gravity in the strong-field regime. I will also summarize the current status of efforts in the US and Europe to implement a space-based gravitational wave observatory.