APR15-2015-001198

Abstract for an Invited Paper
for the APR15 Meeting of
the American Physical Society

Atom Interferometry for Detection of Gravitational Waves: Progress and Prospects

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Gravitational wave astronomy promises to provide a new window into the universe, collecting information about astrophysical systems and cosmology that is difficult or impossible to acquire by other methods. Detector designs based on atom interferometry offer a number of advantages over traditional approaches, including access to conventionally inaccessible frequency ranges and substantially reduced antenna baselines. Atomic physics techniques also make it possible to build a gravitational wave detector with a single linear baseline, potentially offering advantages in cost and design flexibility. In support of these proposals, recent progress in long baseline atom interferometry has enabled observation of matter wave interference with atomic wavepacket separations exceeding 10 cm and interferometer durations of more than 2 seconds. These results are obtained in a 10-meter drop tower incorporating large momentum transfer atom optics. This approach can provide ground-based proof-of-concept demonstrations of many of the technical requirements of both terrestrial and satellite gravitational wave detectors.