New coherent sources for atom interferometry in space

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Atomic quantum sensors are a major breakthrough in the technology of time and frequency standards as well as ultra-precise sensing and monitoring of accelerations and rotations. They apply a new kind of optics based on matter waves. Today, atomic clocks are the standard for time and frequency measurement at the highest precisions. Inertial and rotational sensors using atom interferometers have already shown similar potential for replacing state-of-the-art sensors in other fields. With Bose-Einstein condensates, also referred as atom lasers, the traditional experiments with atom interferometers can be greatly improved. Testing of fundamental principles, studies of atomic properties, applications as inertial sensors, and measurements of fundamental constants can benefit from the brightness (intensity and small momentum spread) of these coherent sources. In addition, the coherence properties of condensates may also allow BEC based atom interferometers to approach the Heisenberg detection limit. This corresponds to a measurement precision which scales like 1/N for N atoms and not like 1/ÖN as for independent measurements on N atoms.

We will present the recent progress towards the achievement of new coherent atomic sources, i.e. atom lasers that will be use in space based atom interferometers. We will report on the development of a 0-g coherent atom interferometer (ICE) that will be used to test the ultimate performances of atom accelerometers in space. We will also introduce new concepts of atom accelerometers and gyrometers that take advantage the high collimation and coherence properties of atom laser.