Progress of 10 meters atom interferometer

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Atom fountains are important tools both for the frequency standard and the interferometry. Fountain type atom interferometers (AIs) have been used in precision measurements. One of the main parameters that limits the accuracy of AIs is the integration time between the Raman pulses (that is free fall time of atoms). In order to achieve longer free fall time, it is necessary to develop a large atom fountain which can provide enough space for atoms to undergo a free fall. There are many scientific and technical challenges in the construction of long-baseline AIs. Weak equivalence principle test with microscopic particles based on atom interferometer has made new progress in recent years. We designed and completed a 10-meter atom interferometer, and test the weak equivalence principle using ^{85}Rb-^{87}Rb double-diffraction Raman atom interferometer at a level of 10^{-8}. The precision of weak equivalence principle test is still limited by many factors, such as vibration noise, Coriolis effect, ac Stark shift, background magnetic field noise, etc. To reduce the background magnetic field noise, the improvement of magnetic field shielding system is necessary. After years of hard work, multiple rounds of overall welding, annealing and tests, the technical bottleneck of the long-baseline magnetic shielding is overcome, and the active compensation technologies inside and outside magnetic shielding layer are developed. As a result, the fluctuation of the magnetic field of interference area is compressed to 10 nT level. Recently, we demonstrate the experimental realization of a large atom fountain, the fountain height exceeds 12 m, the free fall time of atoms for the Mach-Zehnder type atom interferometer in the 10-meter uniform magnetic field area is 2.8 s. The differential gravity measurement data of ^{85}Rb and ^{87}Rb atoms is 5.1×10^{-10}.

Keywords: Atom Interferometry, Weak Equivalence Principle testing, .

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