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Multi-axis quantum gyroscope with multi loop atomic Sagnac interferometry

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Inertial sensors based on matter-wave interference show great potential for navigation, geodesy, or fundamental physics. As known from the Sagnac effect, their sensitivity to rotations increases with the space-time area enclosed by the interferometer. In the case of light interferometers, the latter can be enlarged by forming multiple (fibre) loops. However, the equivalent for matter-wave interferometers remains an experimental challenge. This contribution presents a concept for a multi-loop atom interferometer with a scalable area formed by multiple light pulses. It exploits ultra-cold atomic ensembles, produced with atom-chip technology, combined with symmetric beam splitting and a relaunch mechanism. Due to its scalability, it offers the perspective to achieve high sensitivities to rotations in compact volumes. In addition, it can be extended by adding a second orthogonal beam splitting axis, which enables the detection of multiple rotational components. Following this conceptualization, the experimental design of a multi-axis quantum gyroscope with multi-loop capability based on the previously mentioned ideas is presented.

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