Atom interferometry currently provides state-of-the-art sensitivity for measurements of gravity. However, shot-noise inherently limits the sensitivity and bandwidth. Recently, there has been tremendous interest in using quantum entanglement to reduce shot-noise, improving the capability of these devices. While entanglement-enhanced sensitivities have been demonstrated in proof-of-principle atom interferometers, none of these interferometers has been capable of measuring gravity, or any inertial quantity [1].

We propose and theoretically model a scheme capable of generating entanglement which is compatible with high-precision atomic gravimeters. Through detailed numerical simulation, we demonstrate that our scheme produces spin-squeezed states with variances up to 14 dB below the SNL, and that absolute gravimetry measurement sensitivities between two and five times below the SNL are achievable with BECs between $10^4$ and $10^6$ in atom number [2]. Our scheme is robust to phase diffusion, imperfect atom counting, and shot-to-shot variations in atom number and laser intensity. Our proposal is immediately achievable in current laboratories, since it needs only a small modification to existing state-of-the-art experiments and does not require additional guiding potentials or optical cavities. We also show how this scheme can be improved further by adding a ‘kick’ to the atoms to increase the effective spin-squeezing interactions while also minimising phase diffusion, and also explore how this scheme can be used in conjunction with quantum non-demolition (QND) measurements.