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Bloch oscillations and quench dynamics of interacting bosons in an optical lattice EITE TIESINGA, JQI/NIST, KHAN MAHMUD, LEI JIANG, JQI, PHILLIP JOHNSON, American University — We study the dynamics of interacting superfluid bosons in a one dimensional vertical optical lattice after a sudden increase of the lattice potential depth. We show that this system can be exploited to investigate the effects of strong interactions on Bloch oscillations. We perform theoretical modelling of this system, identify experimental challenges and explore a new regime of Bloch oscillations characterized by interaction-induced matter-wave collapse and revivals. In addition, we study three dephasing mechanisms: effective three-body interactions, finite value of tunneling, and a background harmonic potential. We also find that the center of mass motion in the presence of finite tunneling goes through collapse and revivals, giving an example of quantum transport where interaction-induced revivals are important. We quantify the effects of residual harmonic trapping on the momentum distribution dynamics and show the effects of interactions on the temporal Talbot effect. Finally, we analyze the prospects and challenges exploiting Bloch oscillations of cold atoms in the mean-field regime for precision measurement of the gravitational acceleration g.

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