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Spin and motion entanglement of neutral atoms with optical frequency combs QUDSIA QURAISHI[1], VLADIMIR MALINOVSKY, JASON ALEXANDER, VIOLETA PRIETO, CHRIS ROWLETT, PATRICIA LEE, Army Research Laboratory — Optical frequency combs, emitted by ultrafast modelocked pulsed lasers, are excellent tools to perform quantum coherent control. The spectral purity, large bandwidth and high pulse powers makes these sources attractive for precision control of multi-level atoms. We envisage using pairs of OFC modes to drive stimulated Raman transitions between the two hyperfine clock states of ^{87}Rb confined on an atom chip. The Raman transitions will be driven using an all optical, four photon technique, whereby the first photon pair drives off-resonantly to the intermediate state $^2S_{1/2}$ |F=2, m_f=0> and then a second photon pair resonantly drives to $^2S_{1/2}$ |F=2, m_f=+1>. Co-propagating Raman fields impart only a spin flip whereas non-copropagating fields transfer two photon recoil momentum to the atoms, thus entangling the internal spin with the external motion of the atoms. For site dependent control, we plan to use the high AC Stark shifts produced by the high intensity pulses.

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