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Synchronous Spin Exchange Comagnetometry[1] JOSHUA WEBER, DANIEL THRASHER, SUSAN SORENSEN, ANNA KORVER, THAD WALKER, University of Wisconsin - Madison — Comagnetometry is achieved using synchronous spin exchange optical pumping of two Xe isotopes with Rb. Both isotopes are simultaneously polarized transverse to a pulsed bias magnetic field through spin exchange collisions with polarized Rb atoms. The bias field is applied as a sequence of alkali 2πn pulses, which allows the magnetometer to operate at near spin exchange relaxation free sensitivity. The Rb atoms are optically pumped transverse to the bias field, greatly suppressing the alkali fields contribution to bias instability. The Rb polarization is simultaneously modulated at the nuclear magnetic resonance of each Xe isotope as well as at a third frequency, which enables lock-in detection far from 1/f electronic noise. With this technique we approach photon-shot-noise-limited detection of longitudinal-relaxation-limited Xe linewidths of less than 10 mHz. Furthermore, the bias magnetic field is stabilized to the probe noise detection limit using the magnetic field fluctuations detected by one of the isotopes. With magnetic noise suppressed, the second isotope is used to detect non-magnetic interactions.

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