Abstract Submitted
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Coupled Resonance Laser Frequency Stabilization[1] SHAUN BURD, HERMANN UYS, CSIR, National Laser Centre, Pretoria, South Africa, MAQCLAB TEAM — We have demonstrated simultaneous laser frequency stabilization of a UV and IR laser, to the same photodiode signal derived from the UV laser only. For trapping and cooling Yb^+ ions, a frequency stabilized laser is required at 369.9nm to drive the $S_{1/2}$-$P_{1/2}$ cooling cycle. Since that cycle is not closed, a repump beam is needed at 935.18nm to drive the $D_{3/2}$-$D_{[3/2]}$ transition, which rapidly decays back to the $S_{1/2}$ state. Our 369nm laser is locked using Doppler free polarization spectroscopy of Yb^+ ions, generated in a hollow cathode discharge lamp. Without pumping, the metastable $D_{3/2}$ level is only sparsely populated, making direct absorption of 935nm light difficult to detect. A resonant 369nm pump laser can populate the $D_{3/2}$ state, and fast repumping to the $S_{1/2}$ ground state by on resonant 935nm light, can be detected via the change in absorption of the 369nm laser. This is accomplished using lock-in detection on the same photodiode signal to which the 369nm laser is locked. In this way, simultaneous locking of two frequencies in very different spectral regimes is accomplished, while exploiting only the photodiode signal from one of the lasers. A rate equation model gives good qualitative agreement with experimental observation.

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