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Tunable Laser Frequency Selector for Precision Helium Fine Structure Measurements[1] NIMA HASSAN REZAEIAN, DAVID SHINER, University of North Texas — Advances in precision in our helium fine structure measurements require a tunable laser frequency selector. Our current electro-optic frequency modulation technique allows for highly flexible, reliable and precise frequency control. However, it does not filter the unused sideband frequencies from the transition inducing laser beam. Recent data and observation indicate that their presence limits improvement in the transition intervals directly, by modifying the count rates, and indirectly, by limiting our ability to stabilize the intensity of the laser sideband that drives the transition. Our goal is to tunably select (t_s <0.1 s) this sideband and remove the unwanted frequencies so we can split the transition linewidths to values approaching 1 part in 10^5. Our approach uses a narrow band (3 GHz) fiber grating with a fiber based optical circulator to select and isolate the relevant frequency. We have experimented with various techniques to achieve the needed tunability, including both fiber stretching and temperature tuning of a single grating, but favor the following technique. Multiple narrow band gratings in separate fibers are independently temperature stabilized ($\sim$ 0.01 C) to selectively reflect relevant transition channels, while grating selection via routing is made by a MEMS based fiber switch (t_s = 10 ms). An inline fiber amplifier provides net gain for the implementation.

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