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Demonstration of a Superluminal Ring Laser for Precision Metrology using Self-Pumped Raman Gain and Depletion in Two Isotopes of Rubidium[1] ZIFAN ZHOU, MINCHUAN ZHOU, SELIM SHAHRIAR, Northwestern University — A superluminal ring laser (SRL) is one in which the group velocity of light far exceeds the vacuum speed of light, without violating special relativity or causality. Compared to a conventional laser, the sensitivity of such a laser to rotation or a perturbation in the cavity length can be enhanced by a factor as high as a million. Here, we describe our experimental demonstration of an SRL using an atomic vapor containing two isotopes of Rb. In Rb-85, we use the self-pumped Raman gain process to produce a relatively broad gain profile. The self-pumped Raman depletion process in Rb-87 is then used to produce a narrow dip at the center of the gain profile. Comparison of numerical simulation with experimental results show that we have achieved superluminal conditions corresponding to an enhancement in sensitivity by a factor of more than one thousand. Due to the fact that a Raman transition is highly insensitive (sensitive) to the Doppler broadening when the Raman pump and the Raman Probe are co-propagating (counter-propagating), two such counter-propagating SRLs can be realized in the same cavity without any cross talk. Such a pair of SRLs can be used to realize a rotation sensor with sensitivity much higher than that of a conventional ring laser gyroscope.

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