

Absolute frequency measurement of the molecular iodine hyperfine transition at 647 nm  
(National Tsing Hua Univ.<sup>a</sup>) Yao-Chin Huang<sup>a</sup>, Yu-Chan Guan<sup>a</sup>, Jow-Tsong Shy<sup>a</sup>, Li-Bang Wang<sup>a</sup>

Molecular iodine ( $I_2$ ) has played an important role in optical frequency standards for many applications. The most striking element of the iodine absorption spectrum is the long series of the B-X system in the range from the green to near-IR and has very strong strength and narrow linewidth in the region close to the dissociation limit. Molecular iodine is commonly used for frequency stabilization of laser.

Iodine absorption lines at 647 nm are very close to the doubling wavelength ( $2 \times 323$  nm) of the 2S-3P transition of atomic lithium (Li). Therefore, these iodine lines can be frequency references for Li atom research, e.g., the development of laser cooling and the measurement of hyperfine intervals. The frequency references at 647 nm using a simple iodine cell are particularly helpful for atomic physics laboratories where no optical frequency combs are available.

In this work, we perform Doppler-free saturation spectroscopy in an iodine vapor cell using modulation transfer spectroscopy. The effect of pressure shift is investigated by changing the cold finger temperature and extrapolating the absolute transition frequency at zero pressure. The saturated absorption signal is used to lock the laser frequency, and the absolute frequency of the transition lines are measured by an optical frequency comb. A frequency stability of  $5 \times 10^{-12}$  at a 200 s integration time is achieved when the light source is stabilized to the P(46) 5-4  $a_{15}$  line. To our knowledge, there are no precision measurements around this wavelength, and our results provide useful input for the theoretical predictions.