CAVITY ENHANCED VELOCITY MODULATION SPECTROSCOPY

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Velocity modulation spectroscopy has traditionally been used with a unidirectional multipass White cell to obtain several passes through a plasma in order to obtain strong signals from the absorption of ions, but the total number of passes allowed by this type of setup is limited to $\sim$8. By placing an optical cavity around an N_2^+ plasma and locking the cavity to a Ti:Sapphire laser, the effective number of passes has been increased to several hundred. Demodulating the signal from the transmitted light at twice the plasma frequency (due to the symmetric nature of the cavity) gives a 2^{nd} derivative lineshape for ions and a Gaussian lineshape for excited neutrals. N_2^+ and N_2^* have been observed to be 78° out of phase with one another. The different lineshapes and phases allow for discrimination and separation of the ion and neutral signals. The high intensity laser light within the cavity causes the transitions to saturate, which allows for the observation of lamb dips; this opens the door to sub-Doppler spectroscopy, as well as to studies of ion-neutral collisional rate coefficients.