MID-IR DIRECT ABSORPTION/DISPERSION SPECTROSCOPY OF A FAST ION BEAM

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The direct absorption/dispersion ion beam instrument in the near-IR has been extended into the mid-IR using a difference frequency generation (DFG) laser created from combining a Ti:Sapphire laser with a Nd:YAG laser in a periodically poled lithium niobate (PPLN) crystal. The Nd:YAG laser is locked to an iodine hyperfine transition using a dither lock with 3f demodulation, while the Ti:Sapph laser is measured with an optical frequency comb for absolute frequency determination of the mid-IR beam to <1 MHz. Detection of ions within the beam is done using NICE-OHMS (noise immune cavity enhanced optical heterodyne molecular spectroscopy) together with velocity modulation of the ion beam for near shot noise limited sensitivity.

Initial studies are being done with a hydrogenic plasma in an uncooled cold cathode discharge source to observe H_3^+ in the ion beam to test the system. Once the instrument is fully characterized in mid-IR operation, we will implement a continuous supersonic expansion discharge source to enable observation of rotationally cold molecules and enable spectroscopy of more complex molecular ion systems.