ATMOSPHERIC EXTINCTION MEASUREMENTS FOR SEVERAL DF LASER LINES NEAR 3.8 μm

J. A. Dowling and P. M. Livingston
NRL Experimental Laser Propagation Field Team*
Naval Research Laboratory
Washington, D. C. 20390

ABSTRACT

A low power, CW, combustion driven, HF/DF laser was used to provide a single line source of radiation for several DF transitions: V, J → V-1, J-1 with V = 1 to 3 and J = 6 to 9. The laser, built by TRW, Incorporated, was operated with a multi-line, TEM_{00} mode output of approximately 1 watt CW. Vibrational non-equilibrium excitation is produced by the reaction of F atoms with D_2 injected into an expanding supersonic flow. The laser system utilizes the reaction $2F_2 + H_2 \rightarrow 2HF + 2F + 38$ K cal/mole to produce atomic fluorine.

Atmospheric pressure recovery from the lasing region conditions of approximately 2 Torr and Mach 1 flow is produced by a 1200 CFM vacuum pump through a NaOH trap used to remove HF/DF reaction by-products from the exhaust. The laser, fluorine supply system, chemical scrubber and vacuum pump are trailer mounted and field portable. The laser output is passed through a modified Czerny-Turner monochromator in order to select a single spectral line for extinction measurements. The single line TEM_{00} output varies from 20 to 100 mw for the various lines.

A 91.5 cm diameter collimating telescope is used to focus the laser output over a 5.1 km atmospheric path to a receiver collector mirror. The

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*The members of the NRL Experimental Laser Propagation Field Team are: W. Agambar, T. V. Blanc, T. H. Cosden, J. A. Curcio, J. A. Dowling, C. O. Gott, S. Hanley, R. W. Harris, R. F. Horton, P. M. Livingston, and G. L. Trusty

entire beam is collected and focused onto a LN_2 cooled InSb detector at the receiver location. An identical detector is used to monitor the transmitted power via a 50% reflecting 412 Hz chopper in the transmitter optical system. The detected, chopper modulated laser output is analog tape recorded at each end of the experiment during a run and at the transmitter end of the path for both detectors immediately before and after the long path measurements. This procedure insures that the relative response of the detectors is constant throughout the measurement.

Several measurements carried out over a 5.1 km path at Cape Kennedy, Florida showed the total extinction coefficient α to vary from 0.10 to 0.17 km^{-1} for P_7 $2 \rightarrow 1$ and from 0.04 to 0.06 km^{-1} for P_8 $2 \rightarrow 1$ for a range of atmospheric water vapor partial pressures between 9 and 17 Torr. Aerosol distributions were measured using a Royco particle counter and these results were used to calculate an effective aerosol contribution to the total atmospheric extinction coefficient. The measured extinction coefficients, after correction for aerosol effects are compared to calculated values.[1-3]

REFERENCES

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