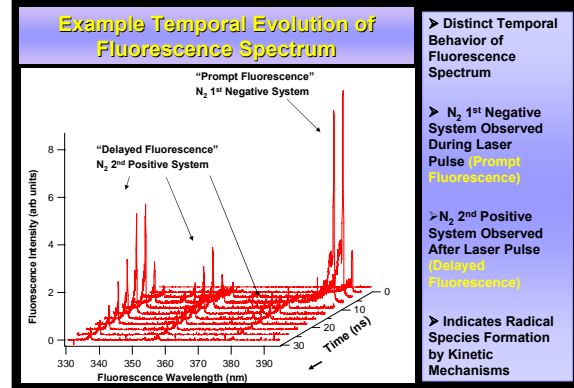
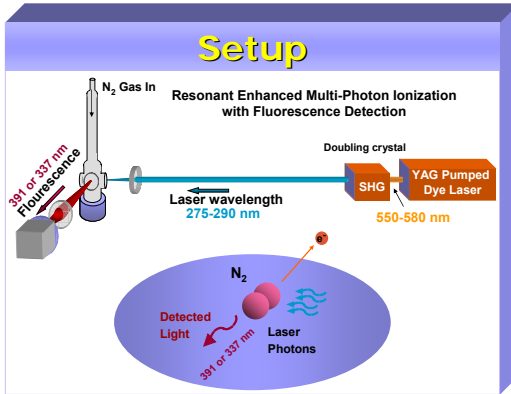


# Laser Diagnostics of Energized Atmospheric Air

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**Experiment:** The time dependent behavior of molecular nitrogen ions, following pulsed photoionization of near atmospheric pressure N<sub>2</sub>, has been investigated using multi-photon laser techniques and kinetic modeling. Measured time dependent fluorescence spectra, during and after pulsed laser resonance-enhanced multi-photon ionization of N<sub>2</sub>, together with a coupled rate equation model, allowed for the determination of the absolute densities of N<sub>2</sub><sup>+</sup> and N<sub>4</sub><sup>+</sup> as these species evolved.



### Prompt Fluorescence: N<sub>2</sub>(B) State Density

- Pressure Dependent
- Dies Quickly After Laser Pulse

**Proposed:** Rapid N<sub>2</sub>(a or b) Quenching During Laser Pulse, N<sub>2</sub>(a or b) + N<sub>2</sub> → N<sub>2</sub>(a') + N<sub>2</sub> Causes [N<sub>2</sub>(a')] > [N<sub>2</sub>(a or b)]

3-Photon Photoionization from N<sub>2</sub>(a') State Creates N<sub>2</sub><sup>+</sup>(B) + e<sup>-</sup>

$$N_2(a') + 3h\nu \rightarrow N_2^+(B) + e^-$$

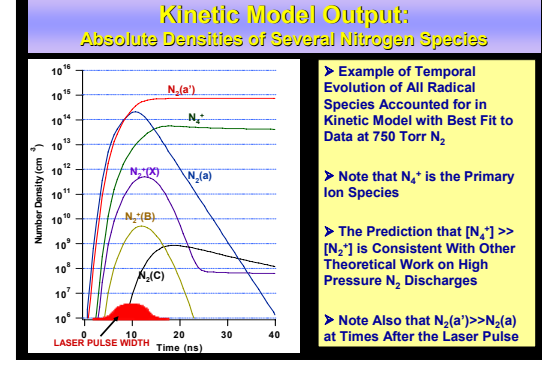
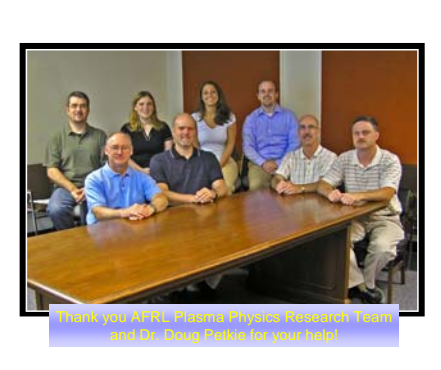
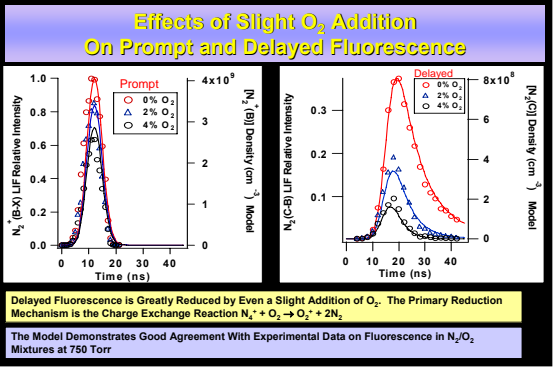
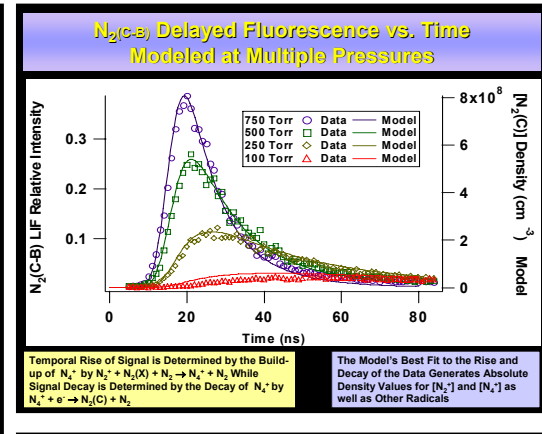
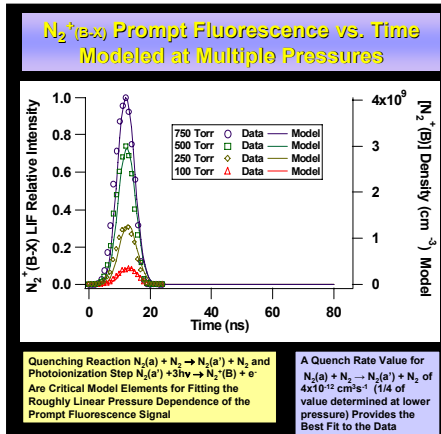
### Delayed Fluorescence: N<sub>2</sub>(C) State Density

- Rises Well After Laser Pulse
- Decays Slowly

**Proposed:** N<sub>4</sub><sup>+</sup> Forms "Slowly" by

$$N_2 + (X) + N_2(X) + N_2 \rightarrow N_4^+ + N_2$$

N<sub>4</sub><sup>+</sup> Recombines "Slowly" With Electron by

$$N_4^+ + e^- \rightarrow N_2(X) + N_2(C)$$


## Present Status

- Conducted Spectral and Temporal Analysis on Fluorescence Induced During REMPI of Near Atmospheric N<sub>2</sub> Gas
- New Proposed Mechanism Explains Prompt and Delayed Fluorescence Several Published Rates for N<sub>2</sub> Radical Reactions Verified Under Atmospheric Pressure Conditions
- Electron-Ion Recombination, N<sub>4</sub><sup>+</sup> + e<sup>-</sup>, Produces N<sub>2</sub>(C) with a Branching Ratio of 0.02%

## Future Research and Applications

- Better Determination of Reaction Rates of N<sub>2</sub> Radicals At Near Atmospheric Pressure Should be Possible
- The Role of N<sub>4</sub><sup>+</sup> in Applications of High Pressure Energized Nitrogen Can Be Examined

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