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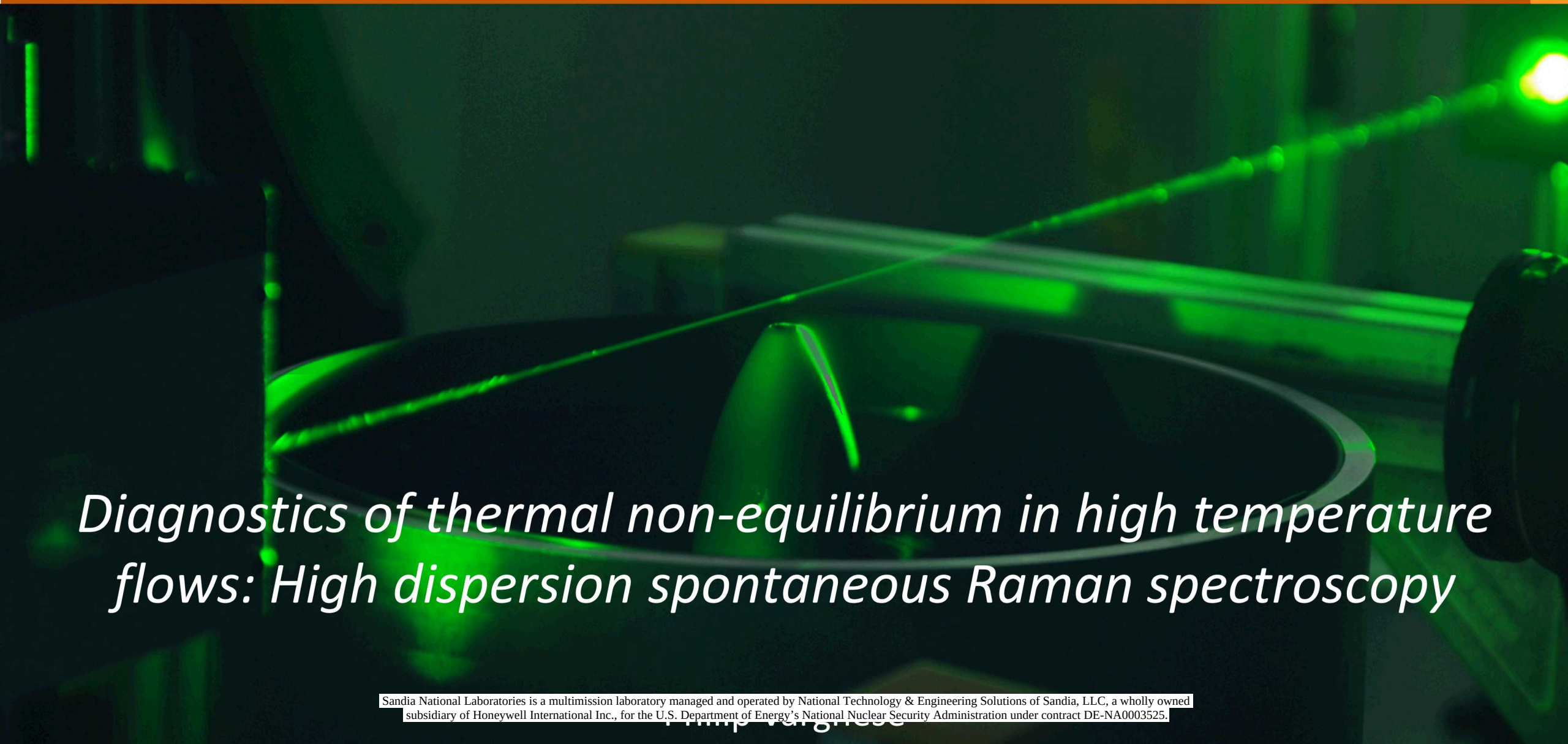

Diagnostics of thermal non-equilibrium in high temperature flows: High dispersion spontaneous Raman spectroscopy

Philip Varghese

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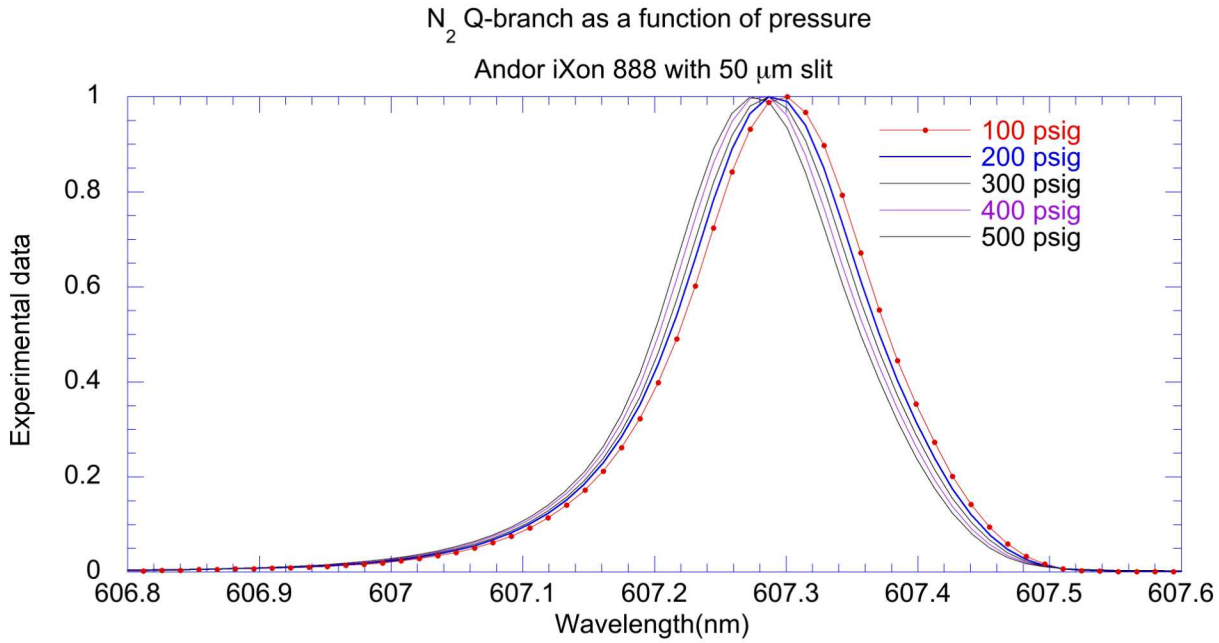
Outline

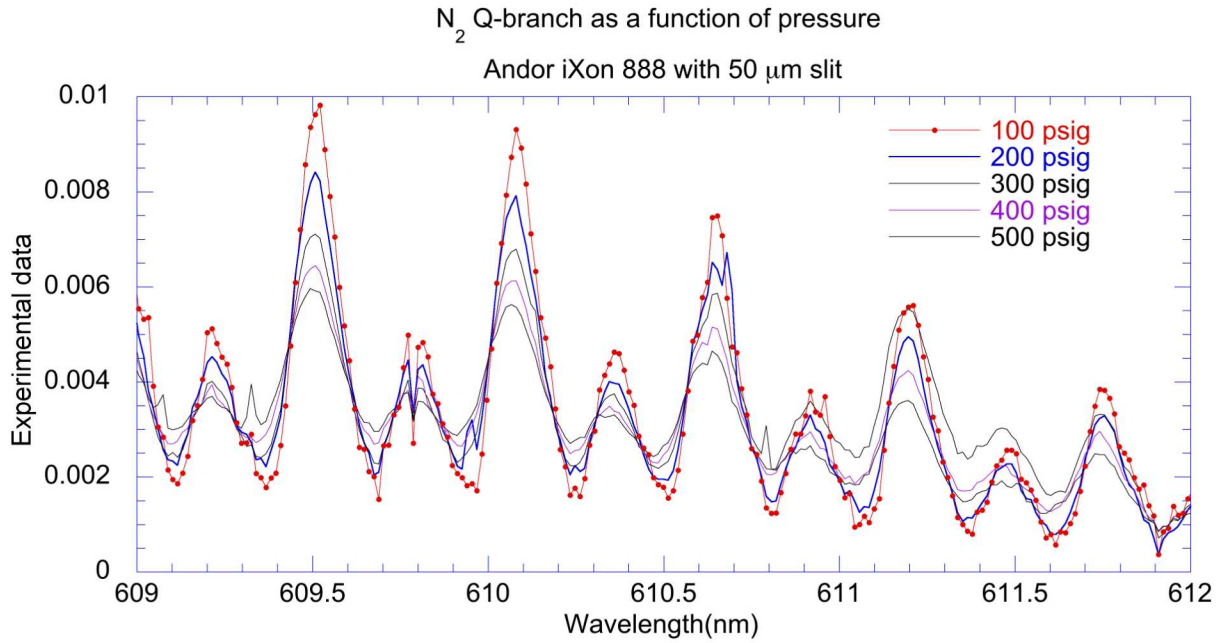
- Motivation for study of non-equilibrium flow
- Theoretical background
- Experimental description
- Representative results
- Effects of high density on precision thermometry
- Conclusions

Density Effects

- At high densities one departs from the isolated line approximation
- Collisions “mix” the states – leads to “pressure narrowing”
- Rule of thumb:
  Significant when collision line widths → line separation
- Tends to be most manifest in Q-branches because of small line separation
- The entire spectrum has to be modeled to account for coupling of transitions

High Pressure Measurements at SNL





- Time-averaged measurements in side-scatter, 0.75 m spectrograph, 1200 g/mm grating, x3 magnification before camera. Nd: YAG laser at 532 nm, 10 Hz, weakly focused, pulse energy (~200 mJ) limited by window damage threshold
- High dispersion measurements in a room temperature cell
- Density (pressure) effects:
  - Shift in Q-branch peak, blended width almost independent of density
  - S-branch transitions continue to broaden
- Experiments in collaboration with Elijah Jans, Caroline Winters, Sean Kearney