



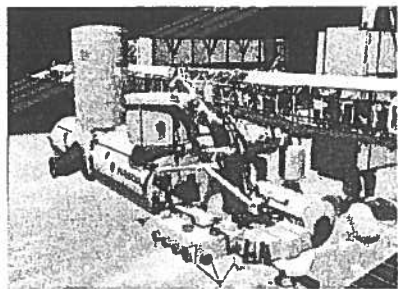
1998 OSA Annual Meeting, Baltimore, MD

**All diode pumped difference frequency
spectrometer employing bulk
periodically poled lithium niobate**

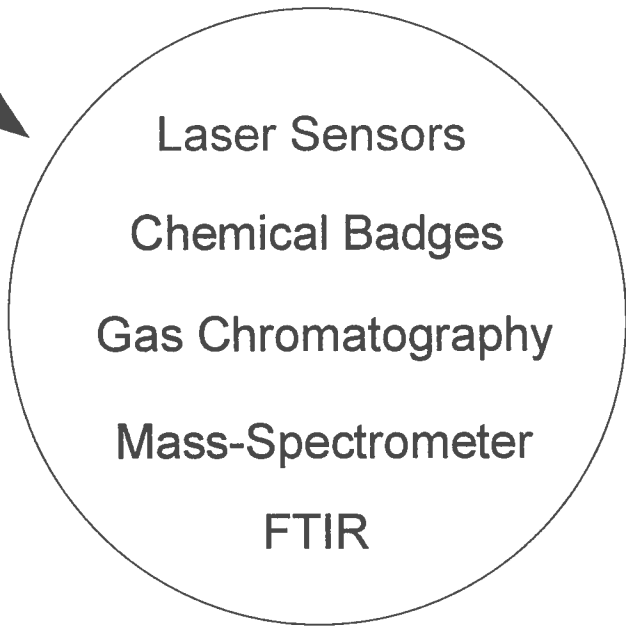
Dirk Richter, David G. Lancaster, Robert F. Curl, Frank K. Tittel

- ▶ Motivation
- ▶ DFG Concept
- ▶ Sensor Characteristics
- ▶ Spectroscopic Results: CH₄
- ▶ Summary

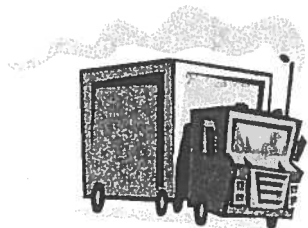
MOTIVATION



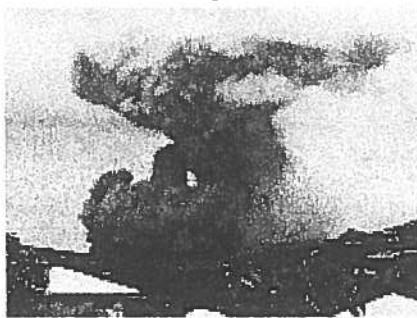
Spacecraft
Habitat
Monitoring



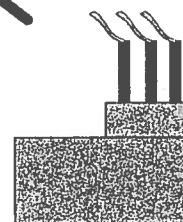
Biomedical
Applications



Urban Emission
Measurements



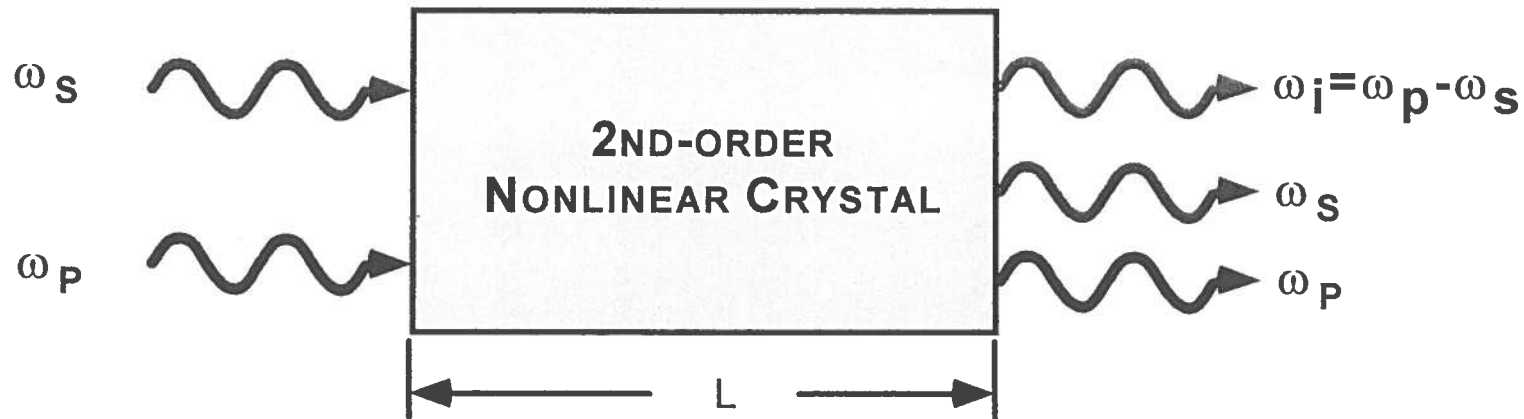
Environmental Monitoring



Industry &
Process Control



CONCEPT OF CW DIFFERENCE FREQUENCY GENERATION IN PERIODICALLY POLED LiNbO_3



POWER: $P = C \cdot P_{\text{PUMP}} \cdot P_{\text{SIGNAL}} \cdot L$

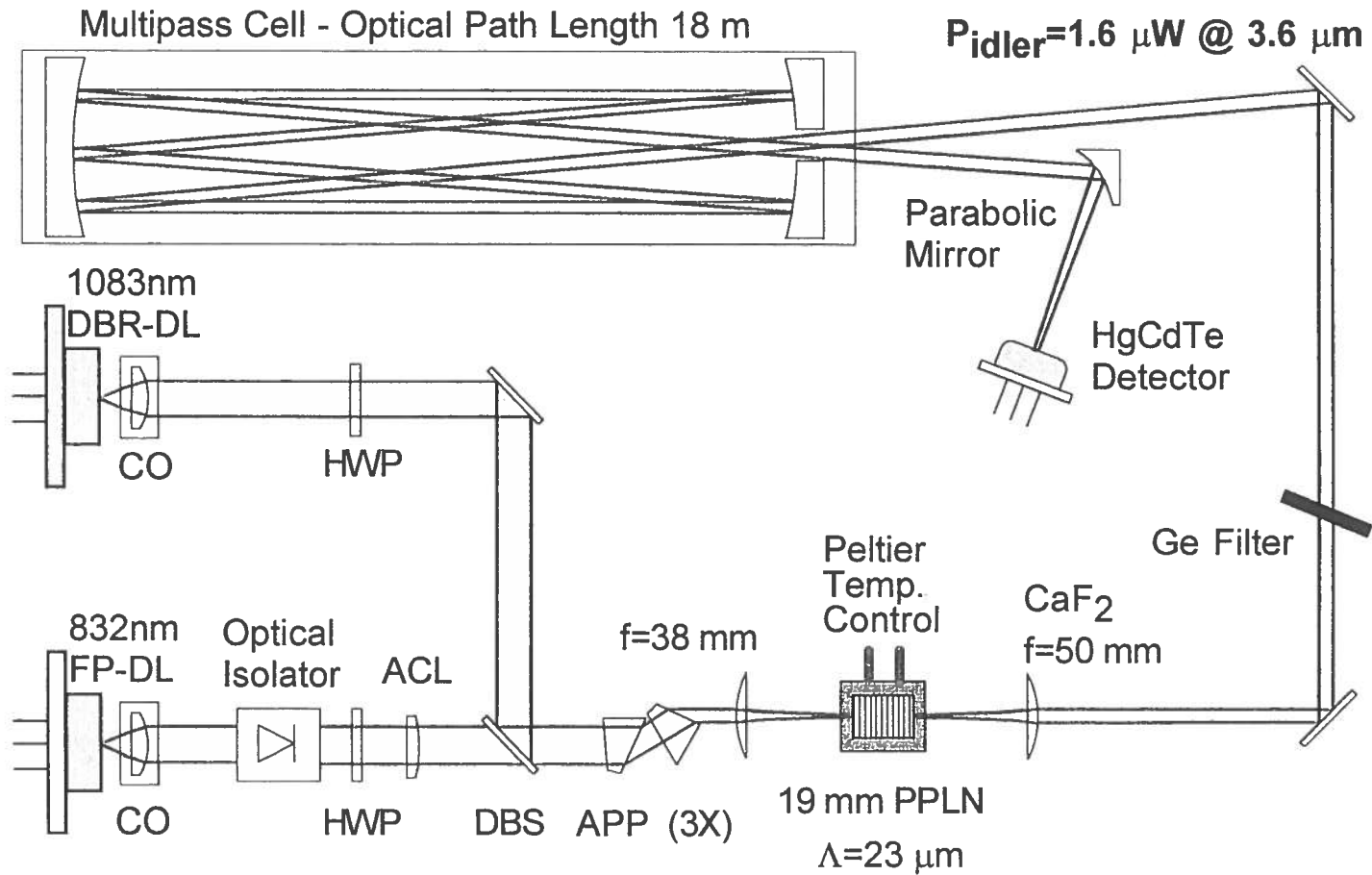
$C \sim 350 \mu\text{W} / \text{cm} \cdot \text{W}^2$

1.6 μW for 40 and 60 mW pump LDs

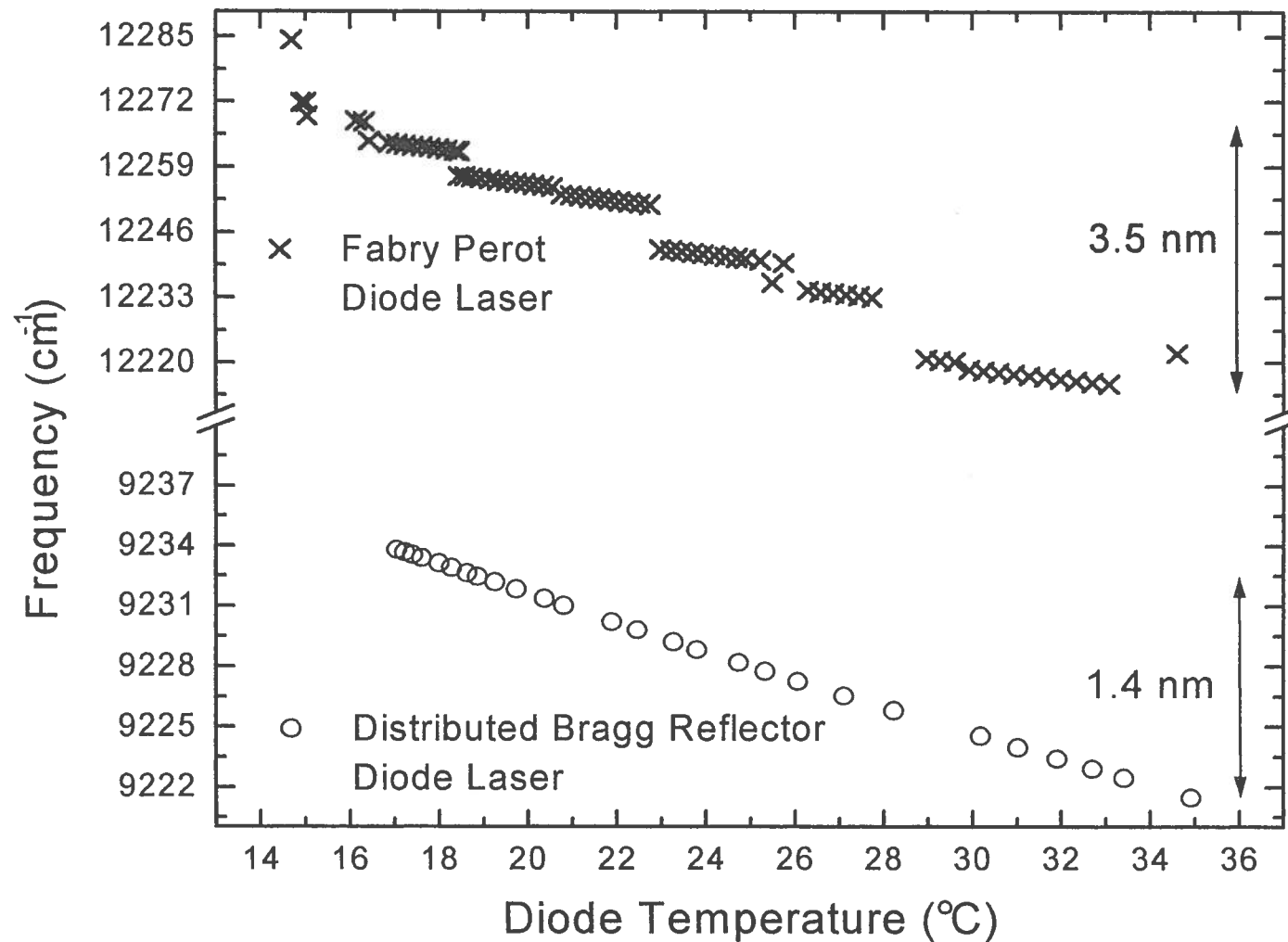
Advantages of Bulk PPLN:

- cost effective
- custom design: multichannel crystal
- QPM from 2.5-5 μm
- alignment insensitive

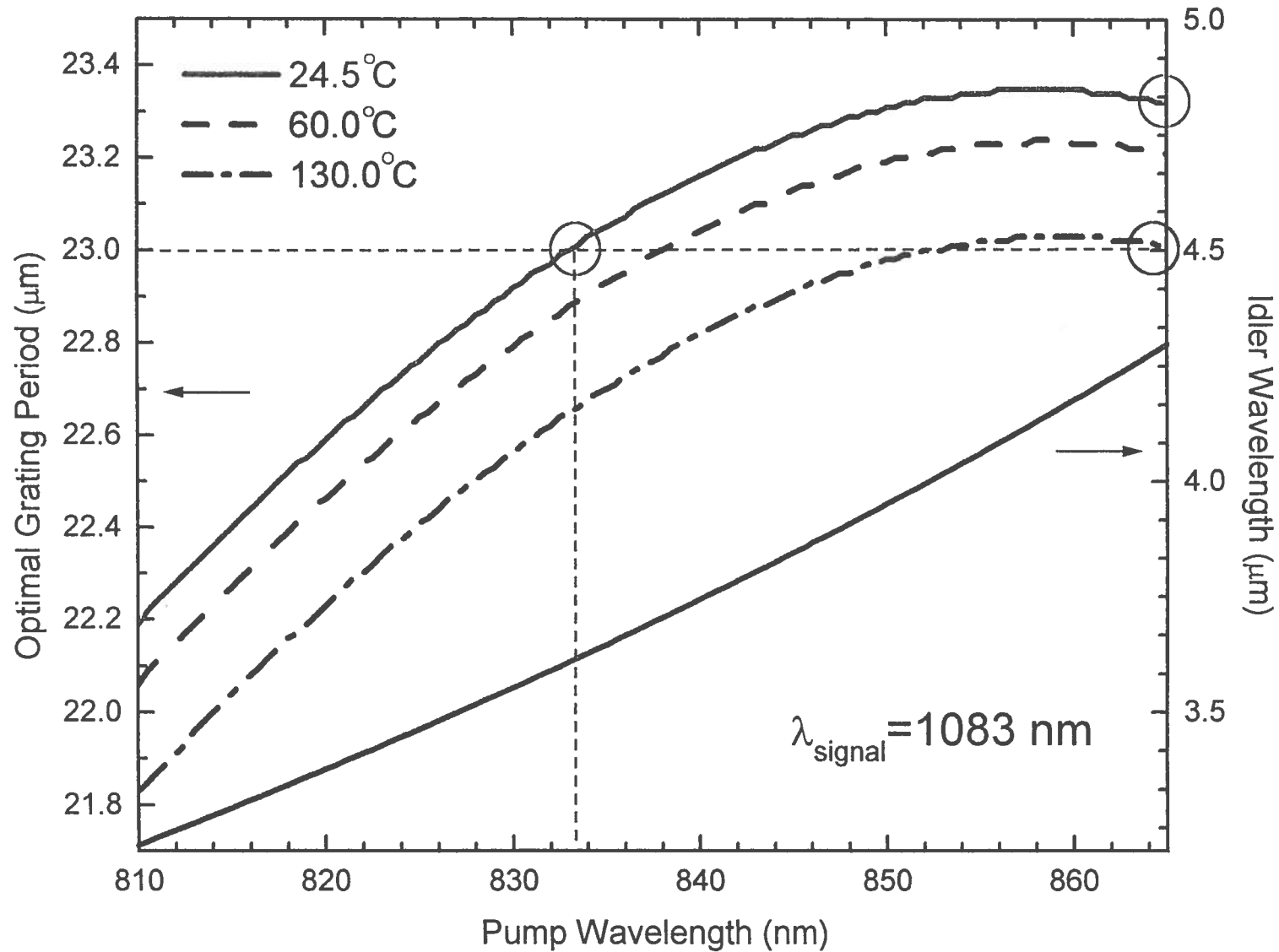
ALL-DIODE PUMPED DFG GAS SENSOR USING PPLN



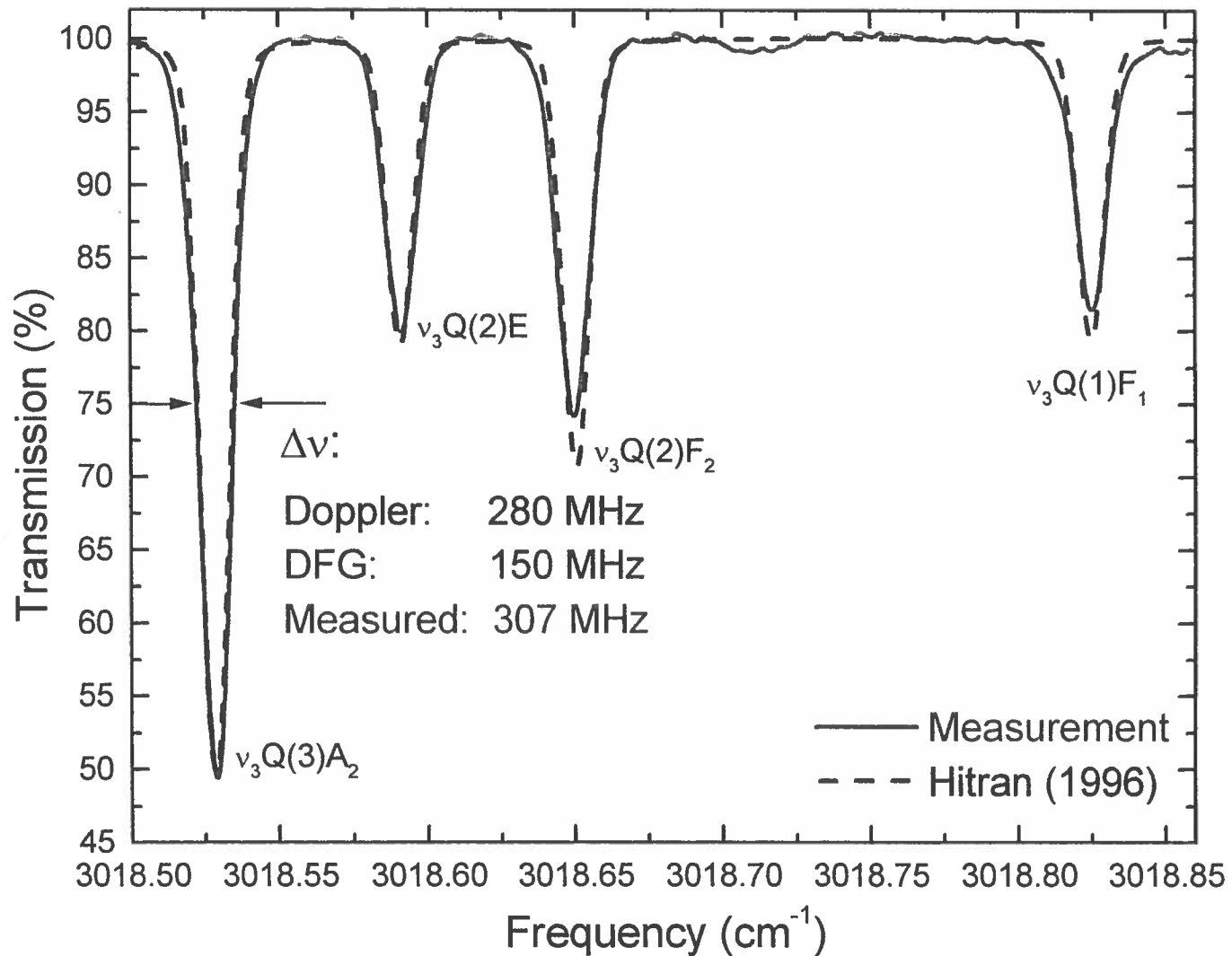
DIODE LASER WAVELENGTH TUNING CHARACTERISTICS: FREQUENCY VS. DIODE LASER TEMPERATURE



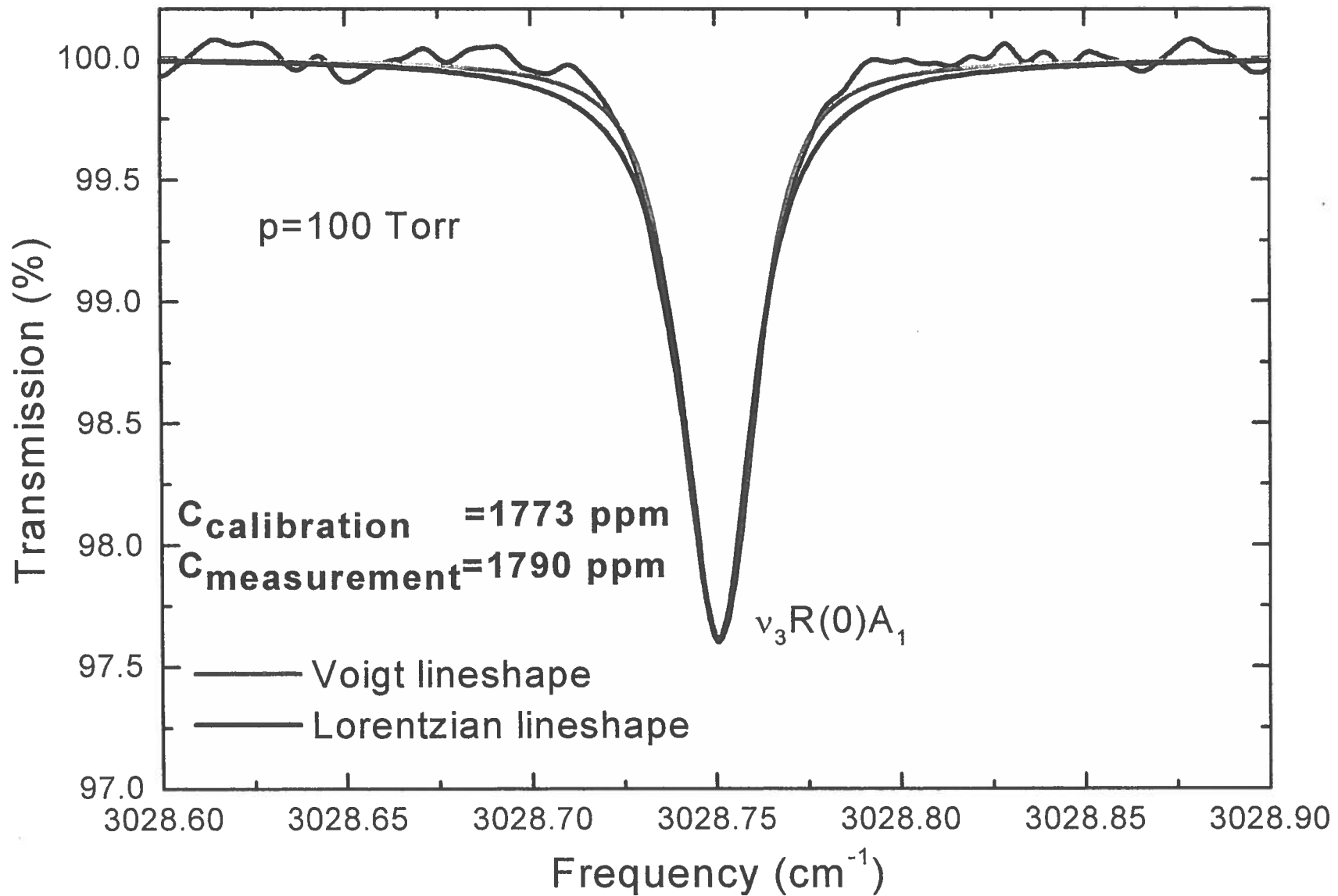
Computed Tuning Characteristics of a Quasi-Phase Matched PPLN Crystal



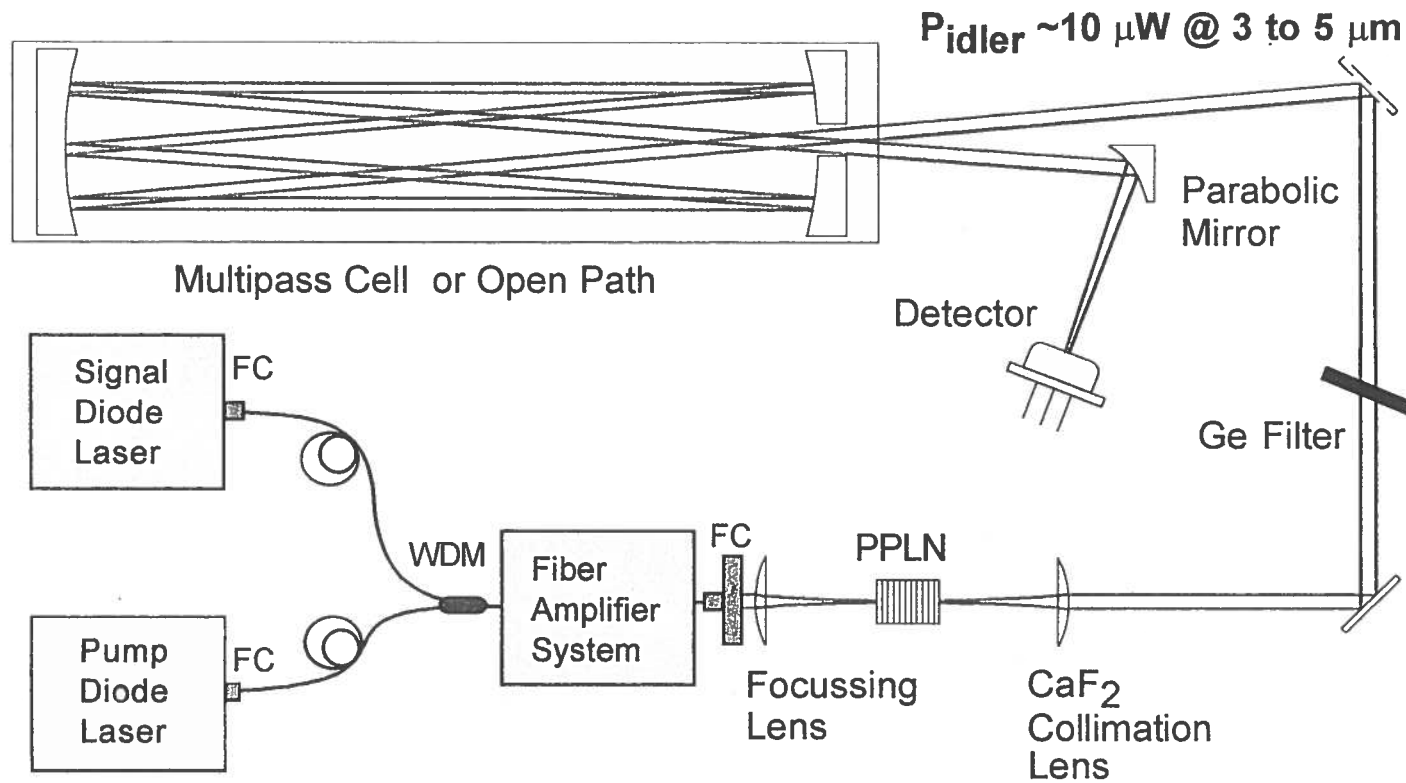
CH₄ SPECTRUM IN THE Q-BRANCH AT 3.31 μm



METHANE INTERFERENCE FREE ABSORPTION LINE AT 3.3 μm OBTAINED WITH A CALIBRATED GAS SAMPLE



NEXT GENERATION: FIBER COUPLED DIODE LASER PUMPED DFG GAS SENSOR



SUMMARY

Diode laser based trace gas sensor:

- ▶ Compact tunable mid-IR light source
- ▶ High resolution and sensitivity
- ▶ High nonlinear optical conversion efficiency
- ▶ Real-time data acquisition and analysis

Outlook:

- ▶ Fiber-coupled / Fiber-amplifier
- ▶ Longer mid-IR wavelengths using GaAs

Robert F. Curl

Frank K. Tittel

David G. Lancaster

Dirk Richter



<http://www.ruf.rice.edu/~lasersci/>