



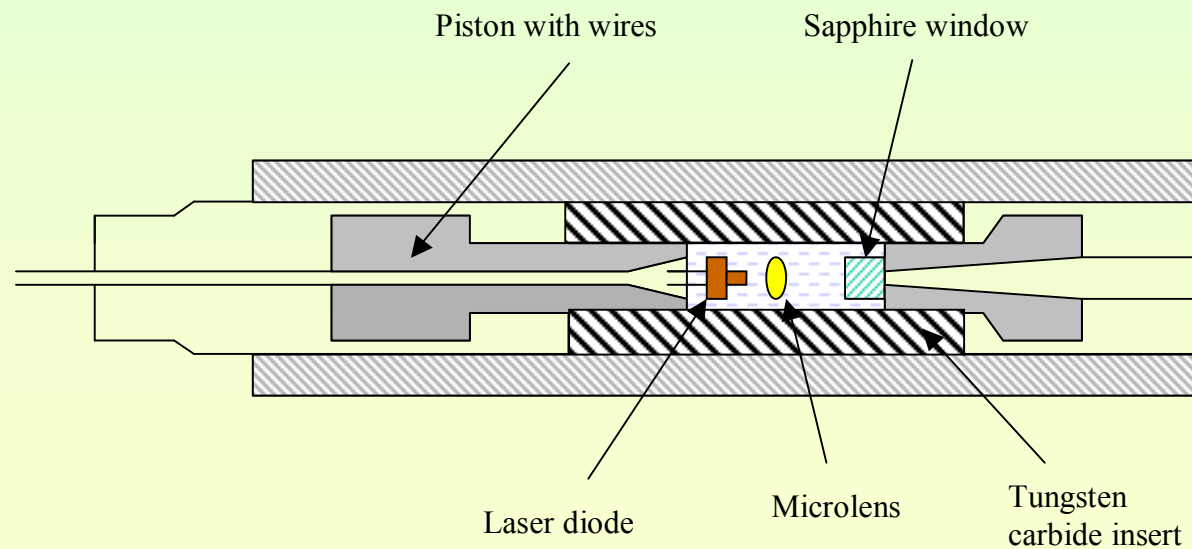
Pressure and temperature tuning of laser diodes

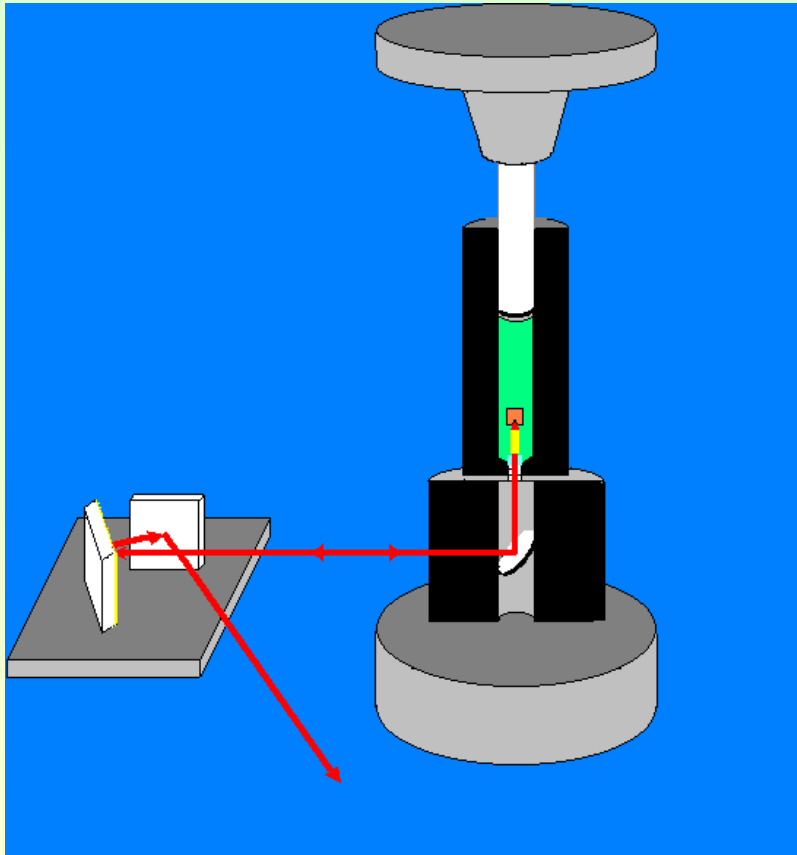
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Pressure tuning fundamentals

- $dE_g/dp \approx 10\text{meV/kbar}$ in most III-V semiconductors
- With 20kbar pressure cell $\Delta E \approx 200\text{meV}$



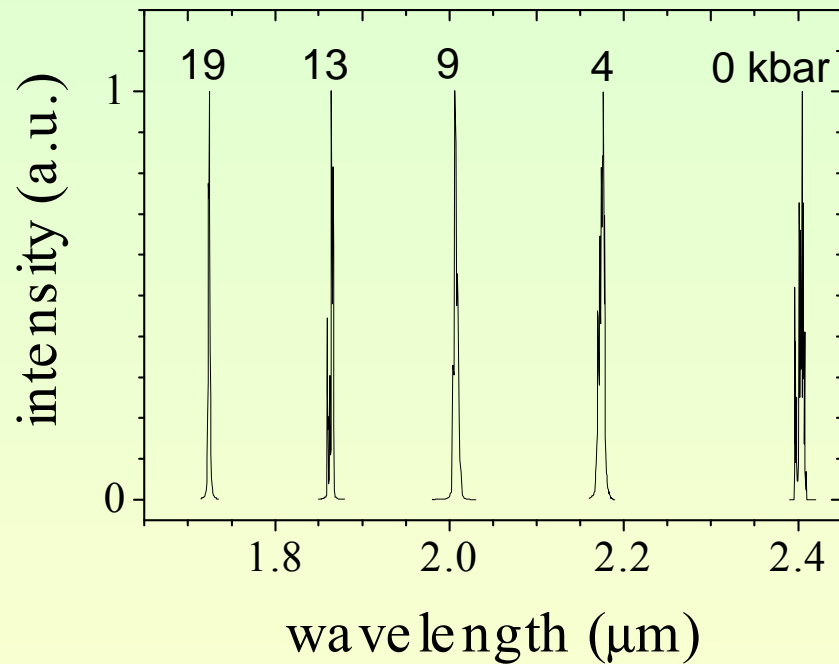


Pressure cell under small hydraulic press; the output beam can be reflected back to the laser by diffraction grating.

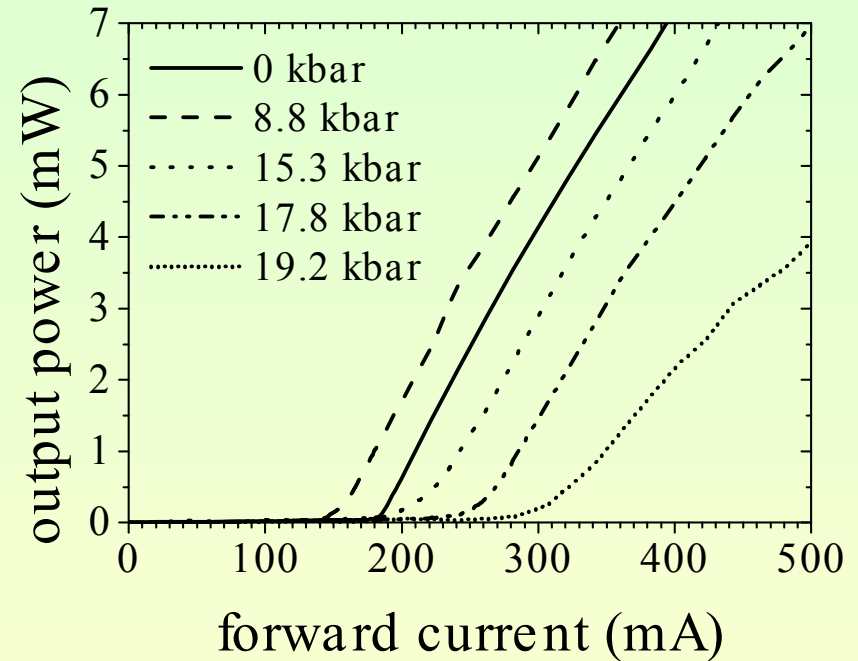
Thus pressure tuning can be combined with external resonator tuning

2400 nm InGaAsSb/AlGaAsSb diode laser

Pressure tuning of the emission spectra

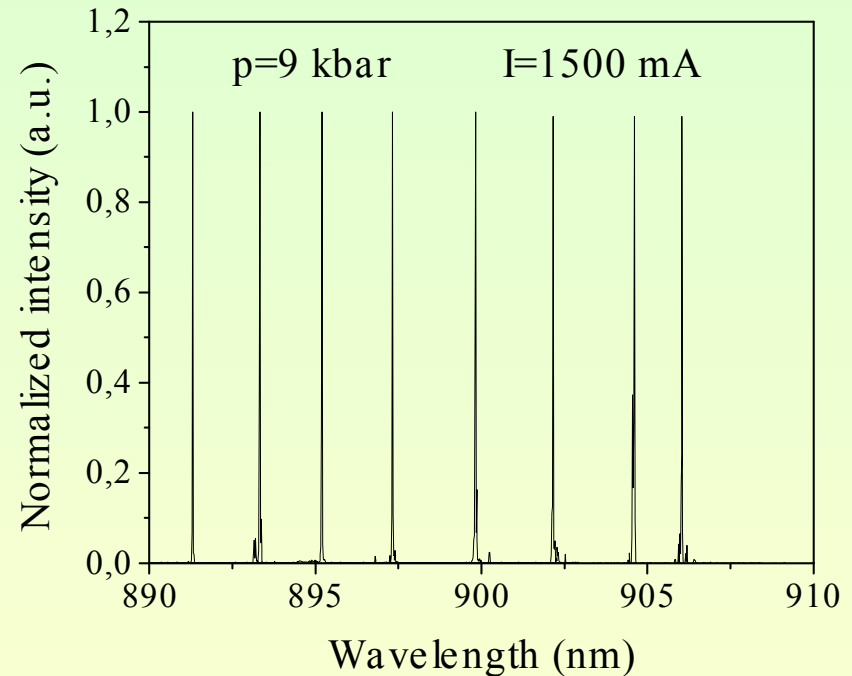
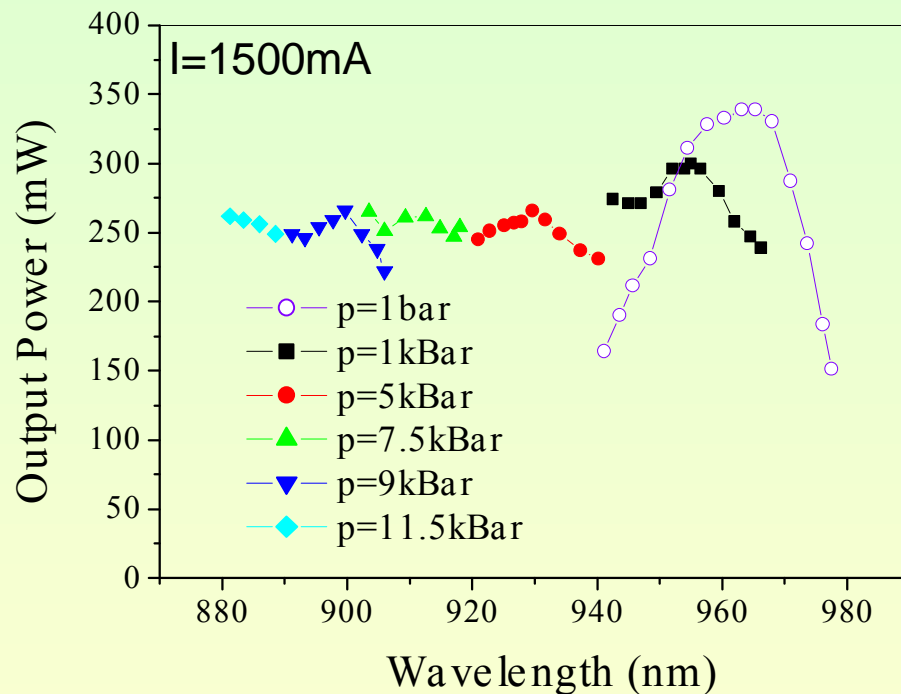


Power-current characteristics



700 nm tuning range (210 meV in energy)

Pressure tuning in external resonator of 963 nm tapered lasers from IAF



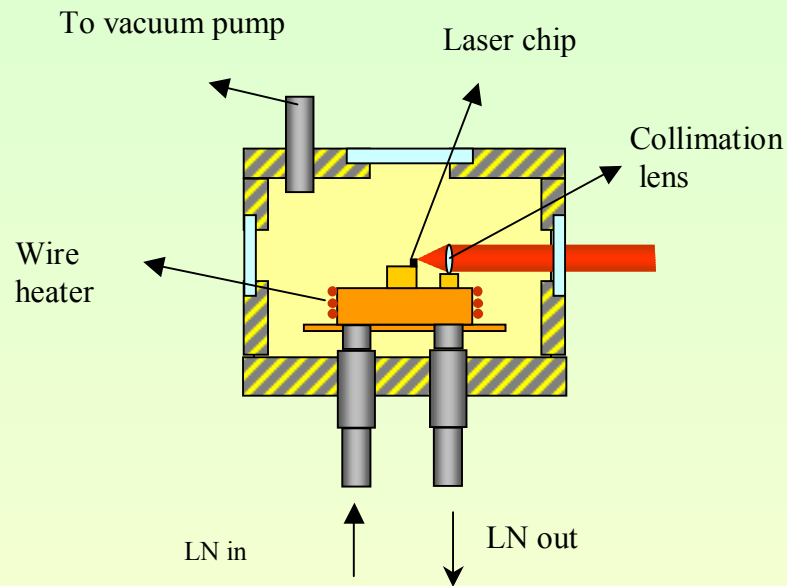
Cell with sapphire window, GRIN lens inside + cyl. outside, 1.5A current, 1200 grooves/mm grating. Up to 11.5 kbar, 100 nm tuning range with 200-300 mW.

Problems with pressure tuning:

- *Special mounting of the LD to reduce strains under pressure*
- *Special microoptics to collimate the beam in the cell (index of liquid increases from 1.35 to 1.55)*
- *Reliability of lasers and pressure cells*
- *Increased thresholds for 600-800 nm lasers (InGaAlP and AlGaAs)*
- *Small pressure coefficients for nitride lasers (3.6 meV/kbar)*

For shorter wavelengths temperature tuning seems better

Development of the temperature tuning method (in the 600-800 nm range)



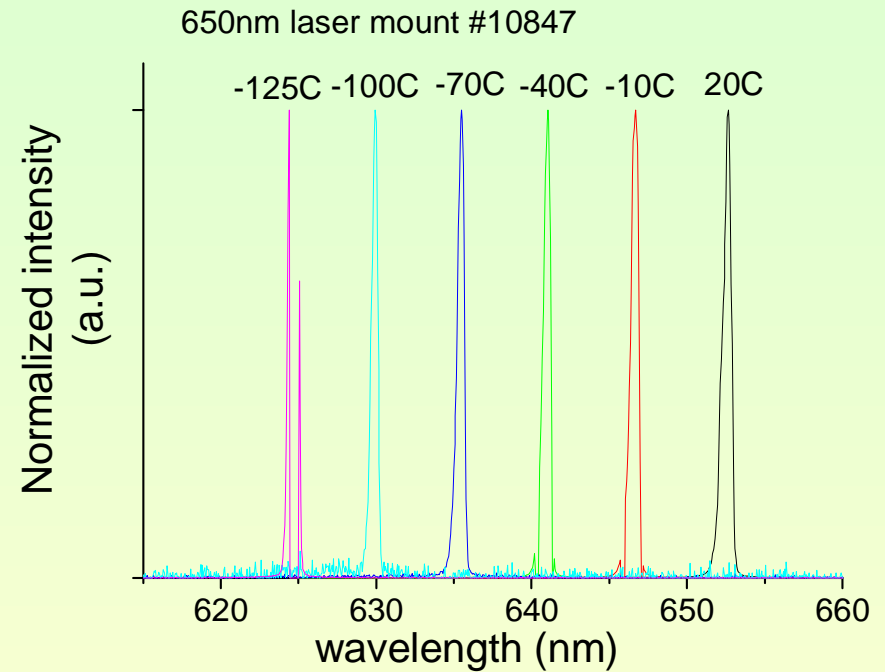
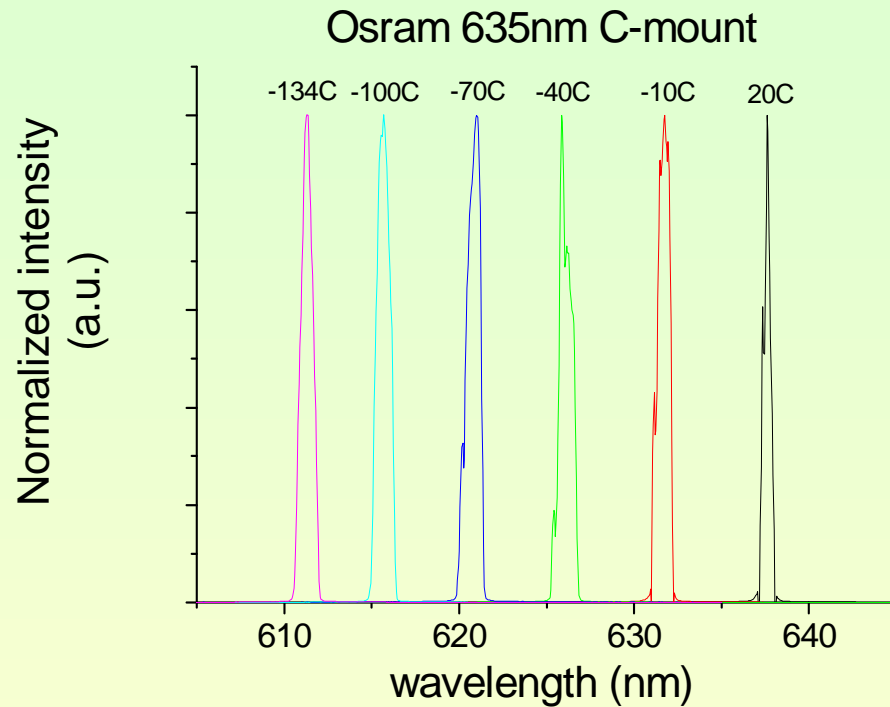
Liquid Nitrogen based cryostat

Benefits of temperature tuning:

- *Standard mounting of LD*
- *Standard microoptics*
- *Reduced thresholds*
- *Increased reliability (?)*

$dE/dT \approx 0.4 \text{ meV/K}$; expected tuning range 80 meV in energy (for $\Delta T=200\text{K}$).

Temperature tuning of red lasers



26-28 nm tuning range for red lasers with reduced thresholds and increased efficiency