TRP Technology Activities for Space-borne DIAL Instruments

- **ESA "Garnet" Activities**
- **Frequency Detection Units (FDU)**

ESA ITT 1 – 4131

Water Vapour DIAL Transmitter: (Compositionally adjusted) Nd:Mixed Garnet Laser

a) ASTRIUM GmbH, Uni Hamburg, TU Berlin

b) CESI Milan, Quanta System, Galileo Avionica

Water Vapour DIAL Transmitter: Nd:Mixed Garnet Laser

Principal Specifications

Wavelength	***[Group A, Group B]***
Energy per pulse	***100mJ/pulse/wavelength***
Repetition rate	***25 Hz***
Spatial beam quality	***$M^2 < 2$***
Linewidth	***<160MHz***
Spectral Purity	***99.9% of energy contained within ..***
Wavelength Accuracy	***<+/- 60 MHz (>1 minute)***
Wall plug efficiency	***>2%***

A) 935.906, 935,561, 935,684, 935,85nm [Vacuum]
B) 943,248, 942,442, 943,083, ***940 nm*** [Vacuum]

Results
Astrium GmbH
KO 14-04-03

Wavelength group	Group B (942nm)
Crystal Used [Pure Garnet]	Nd^{3+}: GSAG
Optical-Optical efficiency	>34%
Cooling	Active/Passive
Pump energy [300 msec]	114mJ @ 20 Hz
Output energy/pulse	31 mJ
Wall plug efficiency	circa 14%
DFB Seed lasers [FBH/Eagleyard]	20-400 mW
YSAG	***[shifted weak peak] 935nm***
	[Shifted strong peak] 942nm

Results
CESI Milan
KO 14-04-03

- YAG_{1-x}YSGGx and $YSAG_{1-x}$ GGGx (mixed Garnet)
- QCW Diode pumping achieved
- Crystal growth in Italy
- Latter stages of contract
- Crystal quality needs improvement

Future Needs and possibilities

- Refine and improve crystal growth
- High power (reliable) bar technology
- Grow larger crystals [YSAG and YGG]
- Establish ground full system test with FDU
- Increase output energy and damage threshold
- Develop crystals for CW systems

ESA ITT 1 – 4188

Tuneable Frequency Stabilisation Scheme (FDU)

a) Observatoire de Neuchatel, EPFL [CH]

b) Intune Technologies, TCD [IRL]

c) Sageis-CSO [F]

Tunable Frequency Stabilisation Scheme
Principal Specifications

Two Principal components

- ***Injection Seed laser***

Frequency stability[14 seconds]	***<50MHz***
Instantaneous Linewidth [1msec]	***<1MHz***

- ***Frequency Detection Unit***

Drift over lifetime (2 years)	***< 60MHz***
Optical Power	***>10 mW***
Mass	***<20 Kg***
Electrical power	***<50W***

Results
Intune Technologies [Irl]

- Project completed in June 2005
- Used commercial ECDL and off-line position check
- Excellent integrated spectroscopic knowledge TCD
- Demonstrated 3 simultaneous line locking
- System is contained in standard 18 Inch rack unit
- Design is incorporating new laser sources

FP available to those interested

Results
Observatoire de Neuchatel [CH]

- Final stages of project
- Substantial in-house experience with laser diode frequency control
- In-house developed ECDL's
- Novel on-line implementations trials
- Off-line locking using novel virtual line implementations

FP in January

Results
Sageis-CSO [France]

- IASI experience (1.55micron DFB)
- Strong interferometric experience (wavemeter)
- PHARAO experience from ACES

FP in January 2006

ESA CCN's

- Implementation of DFB's (all 3)
  - Lower thermal sensitivity
- Implementation of PCF (Holey fibers) (ON)
  - Alternative absorption cell
- Offset frequency locking
  - Implementation using passive frequency comb (ON)

Future Plans and prospects

- Continue development and qualification of DFB's
- Development of Waveguide lasers
- New Holey fibers at 942/935nm
- New "Off-line" laser implementations