A 2-crystal high-power CW and Q-switched Nd:YLF laser at 1314nm

R.C. Botha¹,²,³, H. Strauss², W.L. Combrinck¹, and H. von Bergmann³

1. Space Geodesy Programme, HartRAO, South Africa, roelf@hartrao.ac.za
2. Laser Sources Group, CSIR National Laser Centre, South Africa
3. Laser Research Institute, Stellenbosch University, South Africa

Corresponding Author:
R. C. Botha
roelf@hartrao.ac.za
Diode end-pumped operation of Nd:YLF at 1314 nm

Absorption Spectra wavelength (nm)

Emission Spectra wavelength (nm)

Single crystal results

Initial dual crystal setup

Resonator Folding Mirror (flat) is highly reflective @ 1314 nm for s-type waves only: Nd:YLF crystals thus rotated that s-polarisation is vertical.
Include thermal lens in modelling

RATIONALE
- Used a Curved-flat type resonator
- Pump size 0.5mm at waist
- Unabsorbed pump light to next Nd:YLF crystal
- Modelled for strong (f ~ - 600 mm) thermal lens

RESULTS
1. Initially stable TEM00 operation
2. Change to multimode
3. Change to unstable
4. Max output power 18 W

→ Still a thermal lensing problem
Refine thermal lens model

**RATIONALE**
- Used a Curved-flat type resonator
- Pump size 0.5mm at waist
- Pump through resonator folding mirror
- Modelled for strong \( f \sim - 300 \text{ mm} \) thermal lens

**RESULTS**
- Initially stable TEM00 operation
- Slight beam degradation at 120 W pump power
- Max output power 23.5 W

→ Slight thermal lensing issue at 120 W of pump power
Verify thermal lens

RATIONALE

- Use a curved-curved type resonator
- Pump radius 0.7 mm at waist
- Varying L1, L2 at full power gives rollover effect indication of for better mode-matching
- Modelled for strong \( f < -350 \text{ mm} \) thermal lens at 120 W pump power

RESULTS

- Rollover effect and PSST model now accurately matches
- Thermal lens at \( F \sim -250 \text{ mm} \) per crystal, pumped at 60 W per crystal
- Max output power 19 W
Pulsed with AOM
Diagnostic Setup

2-crystal Nd:YLF Laser

LM200 Power Meter

HR @ 805 nm
i = 45°

R = 90% @ 1314 nm

R = 85% @ 1314 nm

Pyrocam III

HR @ 1314 nm

Pump light beam dump

Lens f= 200 mm

HR @ 1314 nm

Chopper wheel
Knife edge

Integrating sphere

Tektronix DPO-4104 Oscilloscope

PDA255
Resonator layout: CW and Pulsed
Conclusion

Operation of Nd:YLF (0.5% at. doping) at 1314 nm

- gives good beam quality at low incident pump powers (< 60 W), but…
- beam quality severely degrades at pump powers > 60 W, due to strong thermal lens behaviour here
- Thermal lens $f \sim -250$ mm per crystal at 120 W total pump power
- Expect 25 W @ 1314 nm CW
Future Experimental Work

- Curved flat resonator for thermal lens of – 250 mm
- CW laser full characterisation

- Insert AOM for pulsed laser, optimise resonator length
- 20 kHz PRF and down (< 4 kHz lower limit?)
- Pulsed laser full characterisation

- Increase pump power to 150 W and repeat, IF no fracture occurs
The end...