Advanced LIGO PSL

- schedule and Adelaide update -

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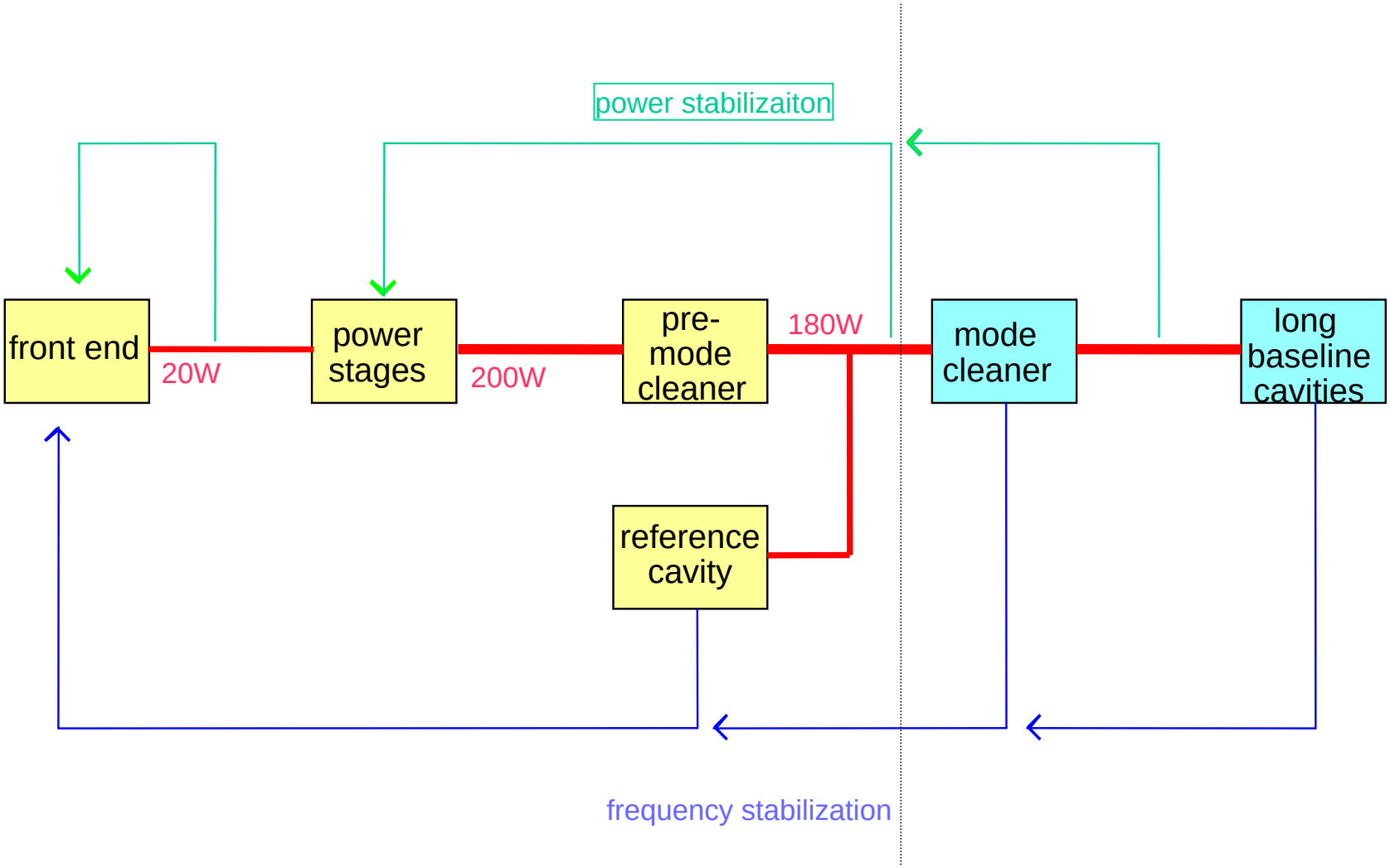
LSC meeting

Livingston, Mar 2002

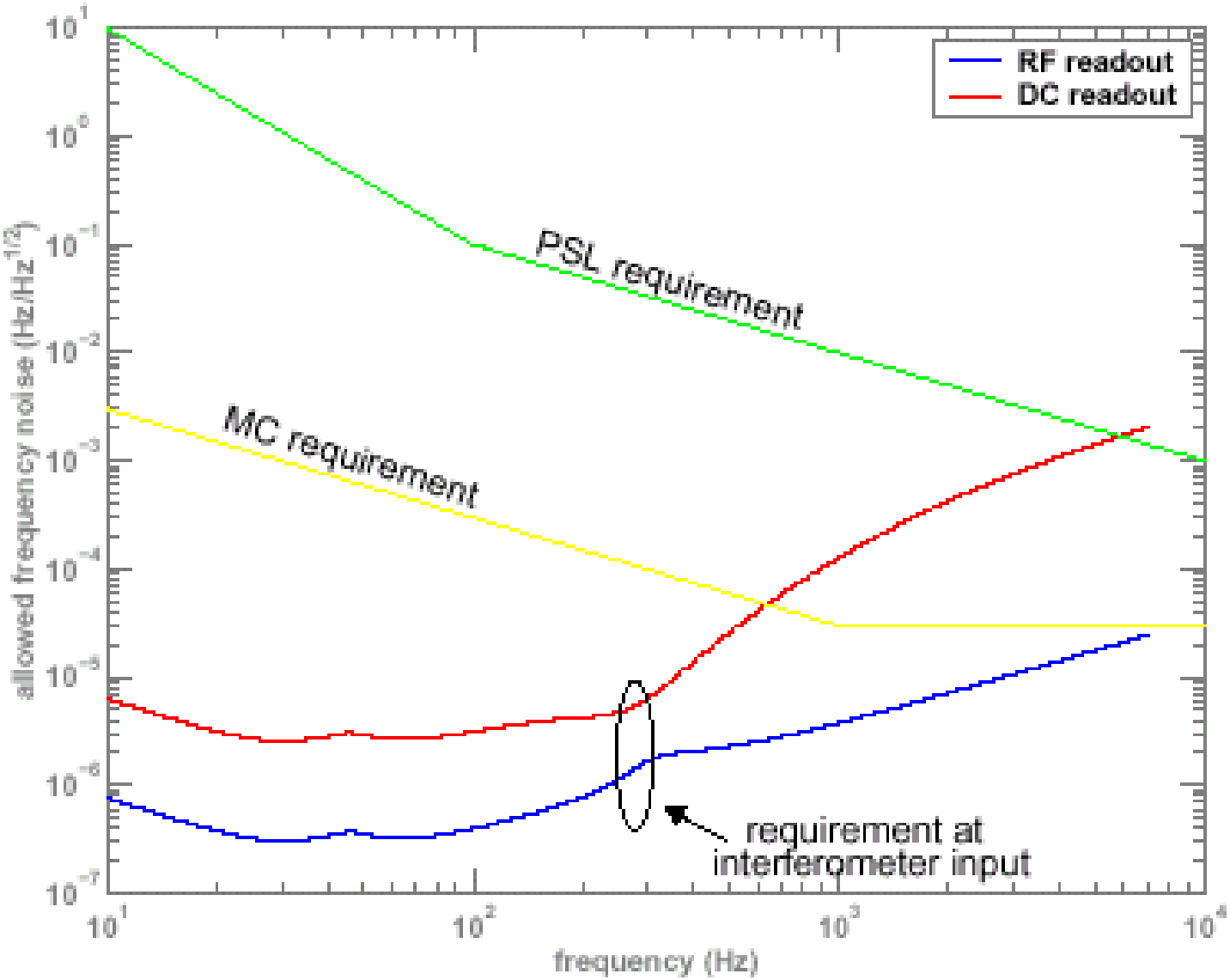
LIGOII PSL – subsystem layout



Output power	
TEM_{00} mode	165 W
Higher order mode power	< 5 W
Stability. long term, over any 24 hr period	+/– 1%
Intensity stability	
gw band	see Figure 9
control band, 0.1 Hz < f < 10 Hz	< 0.1% rms
Frequency stability	
gw band	see Figure 8
control band, 0.1 Hz < f < 10 Hz	< 5 kHz rms
Technical AM at the modulation frequency	TBD
Modulation inputs	
power	10 kHz BW, +/–1% range
frequency, wideband input	BW: <20° lag at 100 kHz, range: DC-1Hz: 1 MHz p-p; f >1 Hz: 10 kHz p-p
frequency, tidal input	range: 50 MHz p-p speed: time constant < 30 min

Table 2: Primary requirements for the pre-stabilized laser (PSL).

from: AdvLIGO Sys. Desg. LIGO-T-010075-00-D



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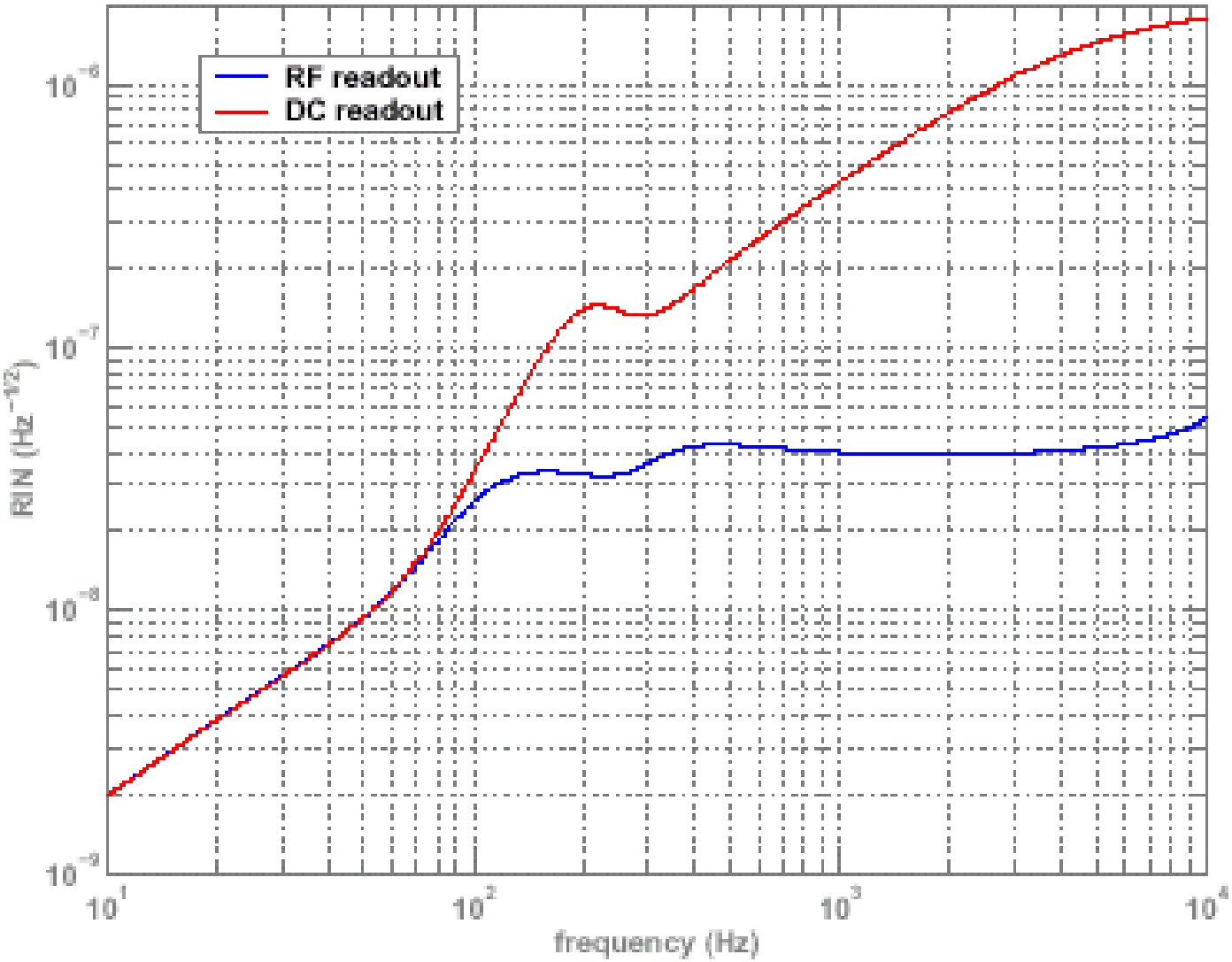

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LIGOII Laser – project plan

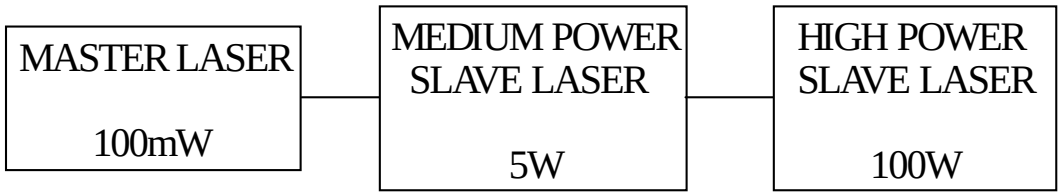
• concept phase	Jan01 - Jul02
• lab-version phase	Aug02 – Feb04
• longterm test	Feb04 – Feb 05
• shipment of pathfinder	Sep05
• final version phase	Feb04 – Jun05
• fabrication	Jun05 –Jun08
• shipment of PSL1	Nov06

100 W prototype

- 100W output power
- TEM_{00} power – visibility cavity
- RIN 10-10kHz
- RIN 10MHz – 40MHz, measured at 10mA
- frequency noise
- pointing – quadrant photo diode
- phasefront fluctuations
- efficiency, cost
- robustness, maintainability
- scalability

Laser development at Adelaide

- use injection-locked chain of lasers:



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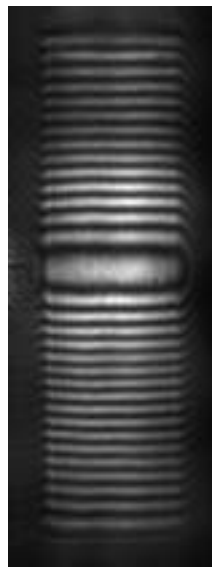
Medium power slave laser

- 5W prototype developed
- long-term injection-locking demonstrated
- diffraction-limited output
- frequency and intensity noise of injection-locked laser meets LIGO 1 specifications

- 10W brass-board being constructed for Gingin Test Facility, TAMA project and injection-locking of high power slave laser. Have obtained 13.5W multimode from 40W pump.

Interferogram of 40W-pumped, lasing slab:



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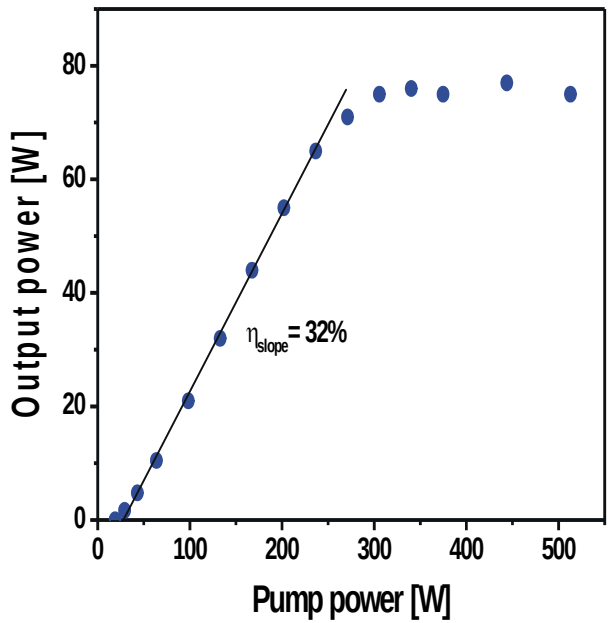
High power slave laser

- uses stable/unstable resonator
- 100W-pump proof-of-principle tests completed

  - demonstrated efficiency, operation of stable/unstable resonator and injection-locking

- 500W-pump laser being tested



Initial results:

Saturation due to loss of mode control caused by horizontal negative thermal lens, which is produced by non-uniform pumping of side faces.

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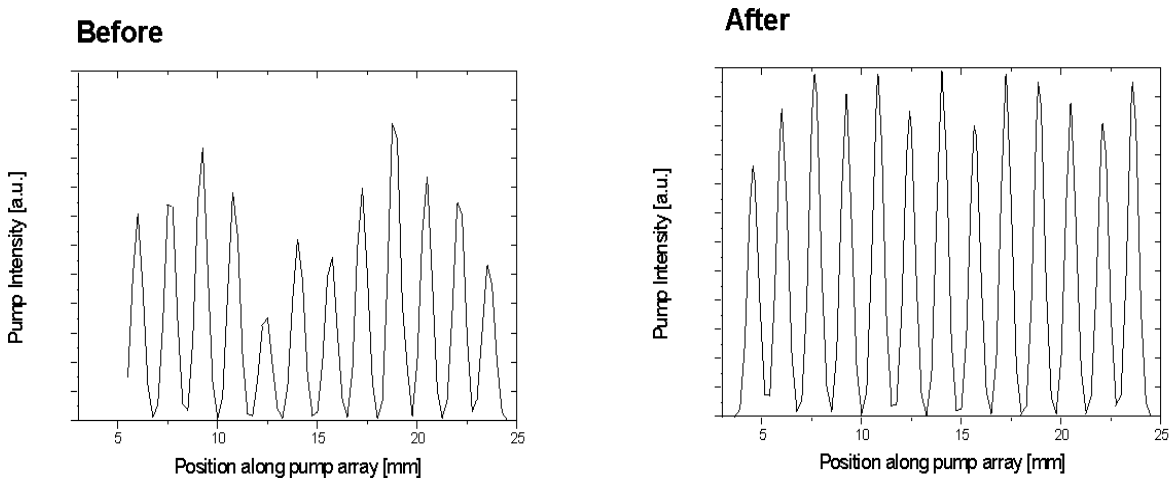
Thermal lens reduced

Strength of negative thermal lens significantly reduced by

- adjusting coupling of fibres to pump diodes



- using optical waveguide to homogonize pump distribution in horizontal direction

Laser head has recently been reassembled.