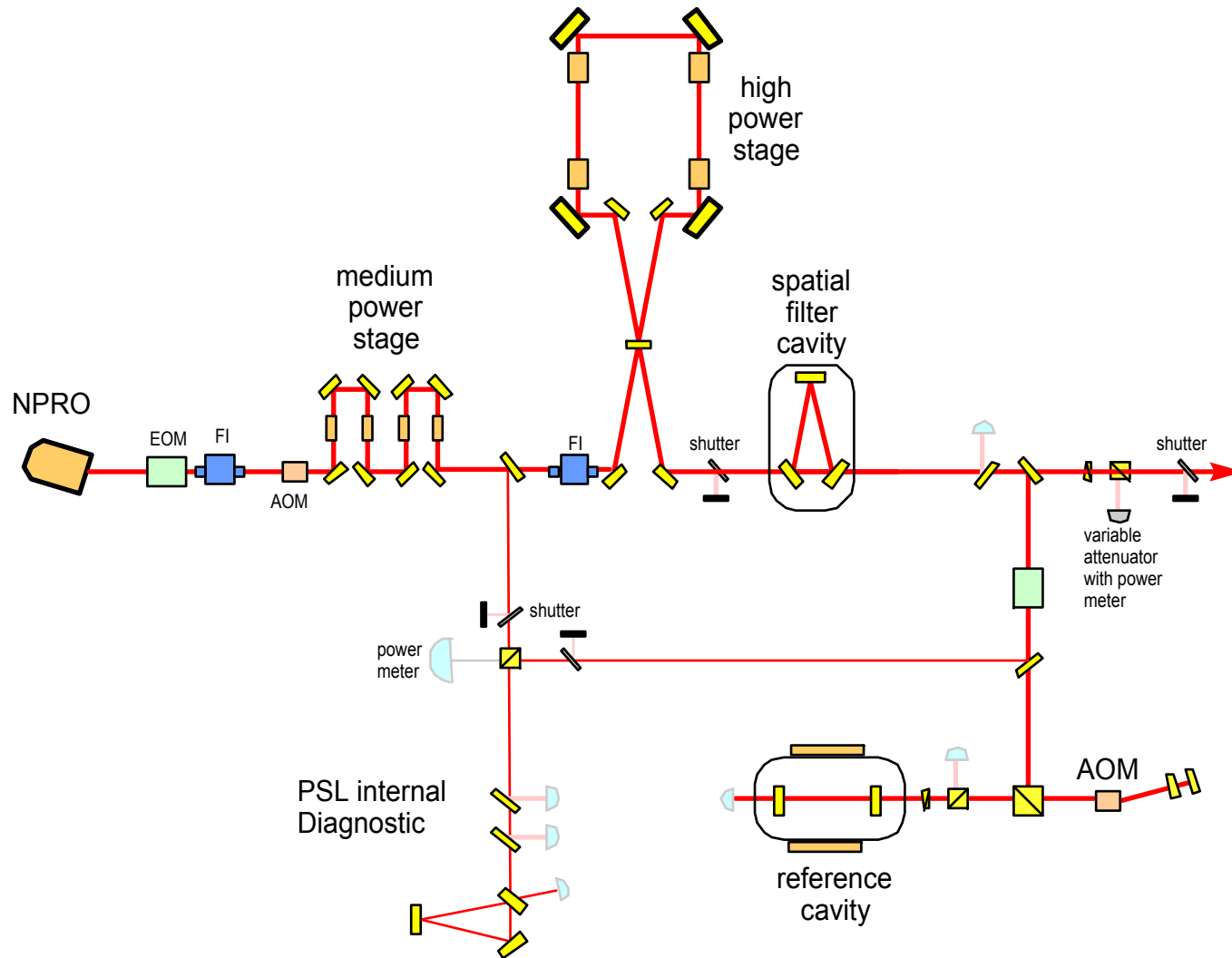




Laser Working Group - close out-

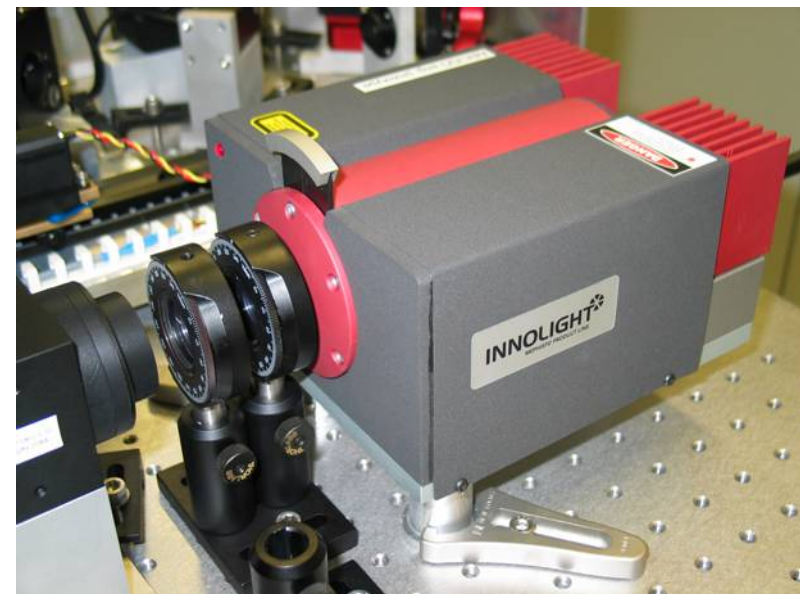
Benno Wilke

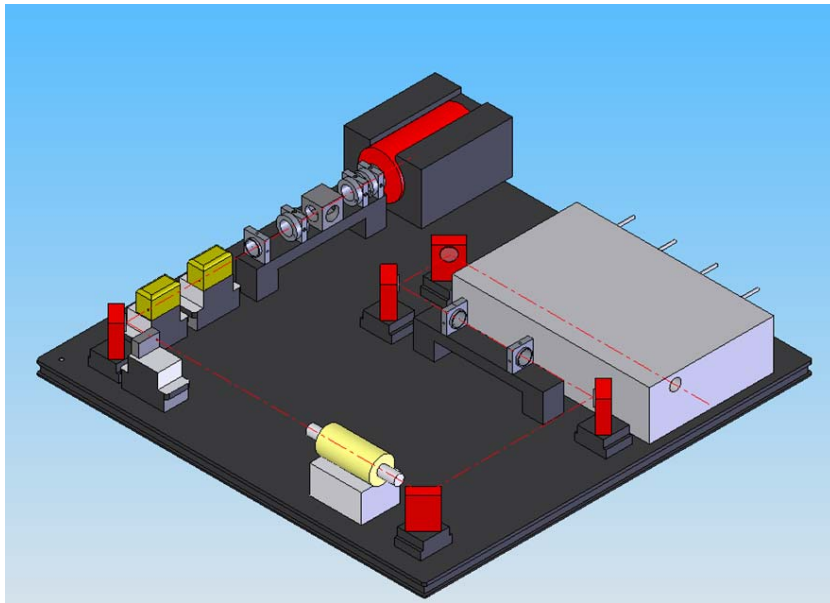
LSC meeting, Baton Rouge March 2007



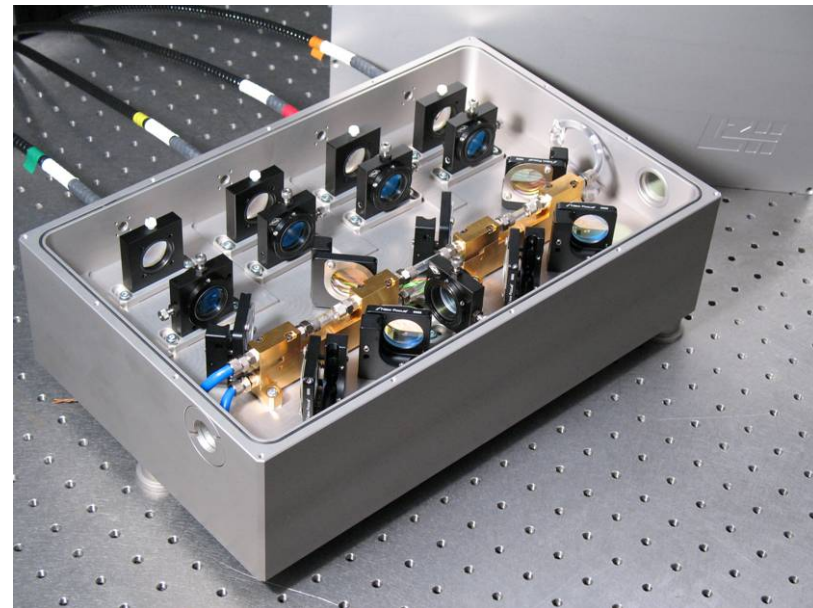
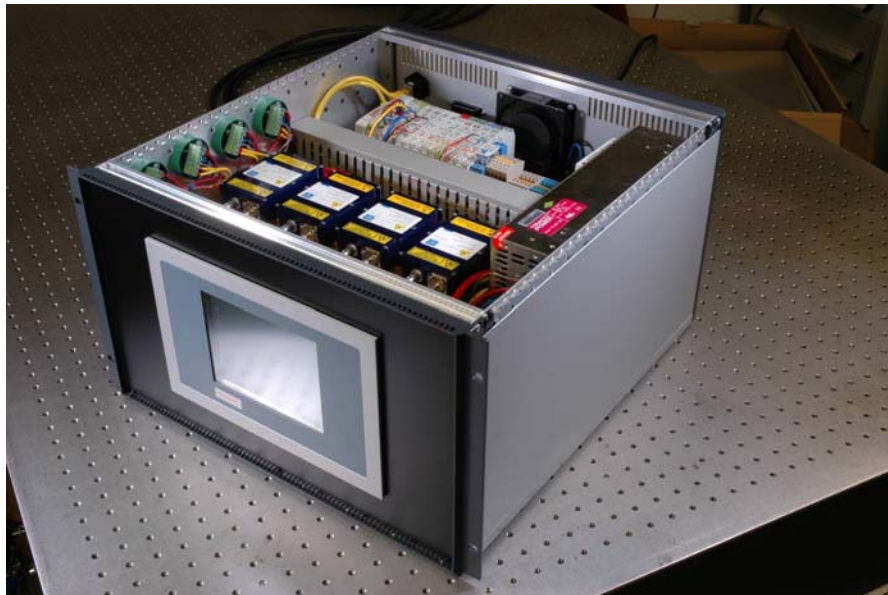


- 4 out of 8 Master lasers (2W NPROs) are delivered
- each has to pass a detailed acceptance test
- characterization program
 - power, slope, power in p-pol
 - RIN:
 - noise spectrum 1Hz – 100kHz,
 - time series (60min) rms
 - frequency noise
 - spectrum 1Hz – 100kHz
 - upper limit for drift
 - PZT and slow actuator calibration
 - beam quality
 - higher order mode content
 - beam pointing



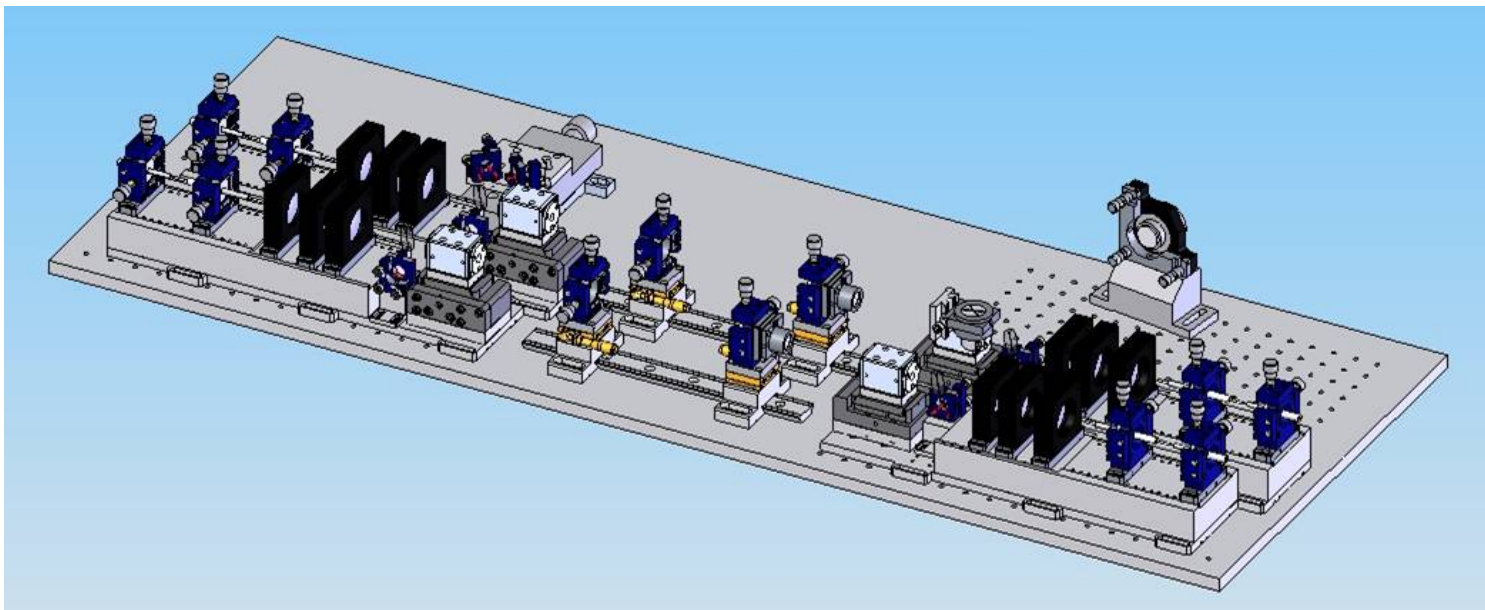
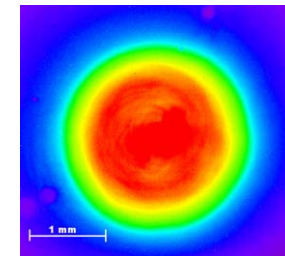


- front end will be assembled on breadboard and delivered in single housing
- AOM and isolators included
- NPRO and amplifier controlled via Beckhoff touchpad
- interface to EPICS





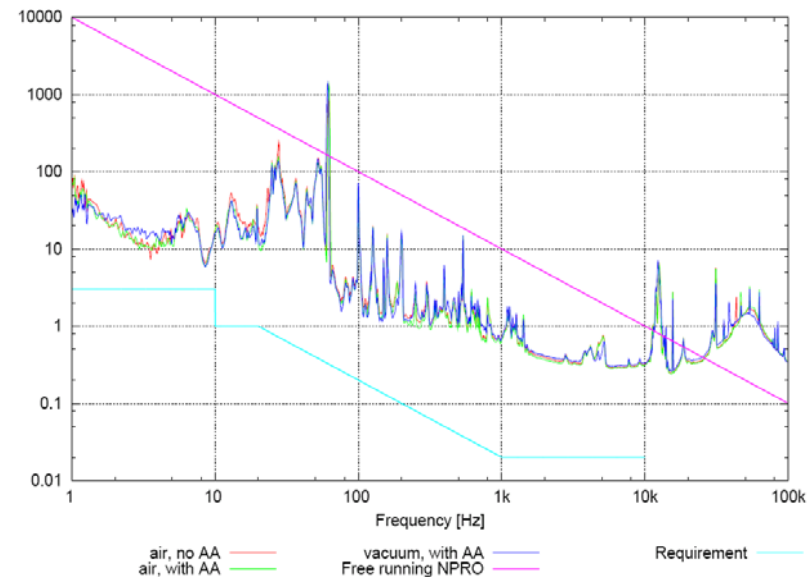
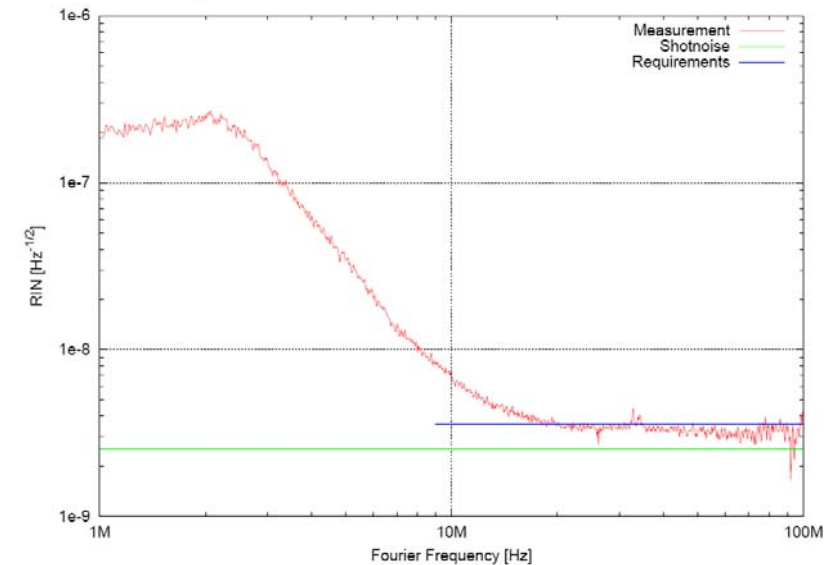
- 7 instead of 10 fibers
 - 7 x 45 W
- new homogenizer
 - higher pump brightness
- new laser head design
- whole resonator on base plate

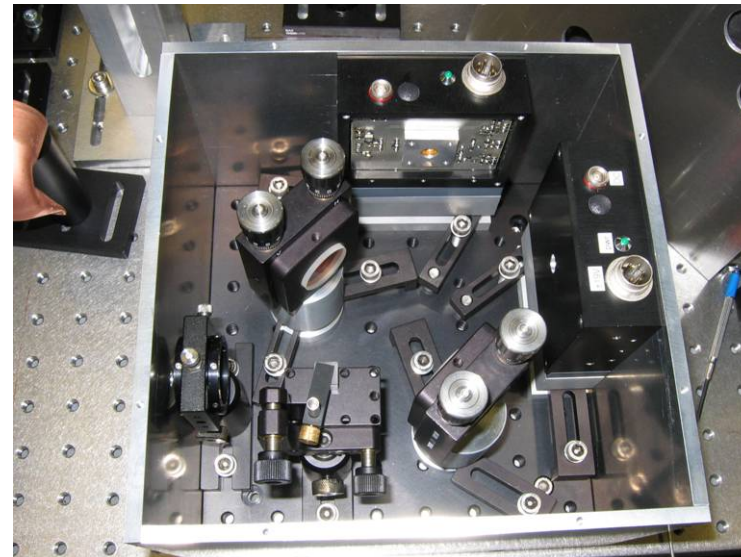
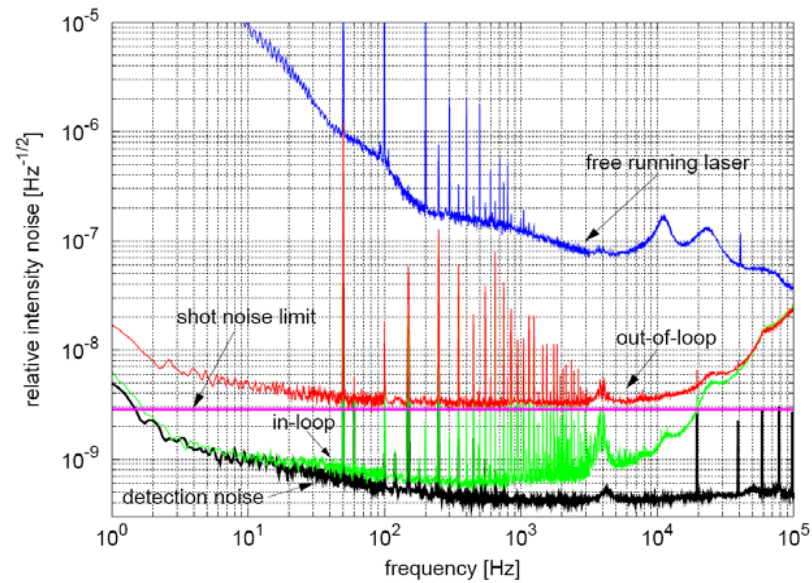
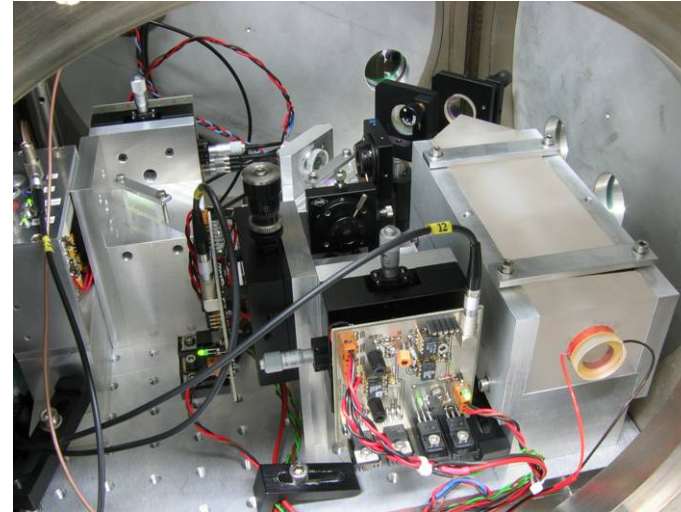
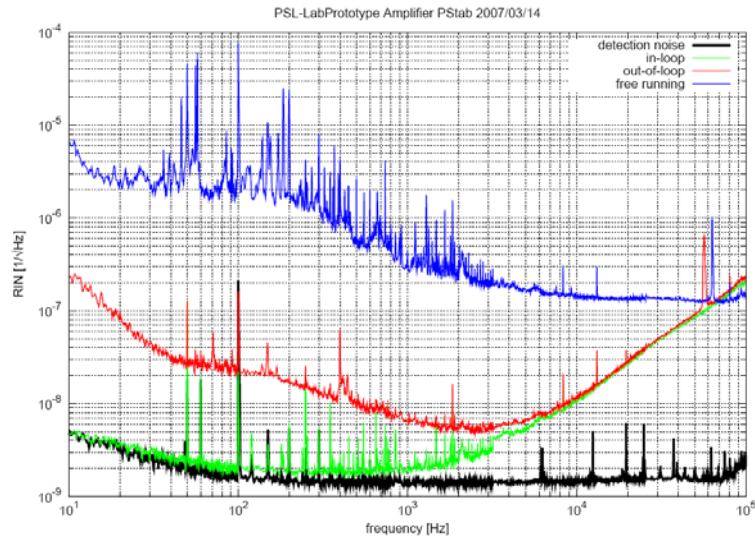




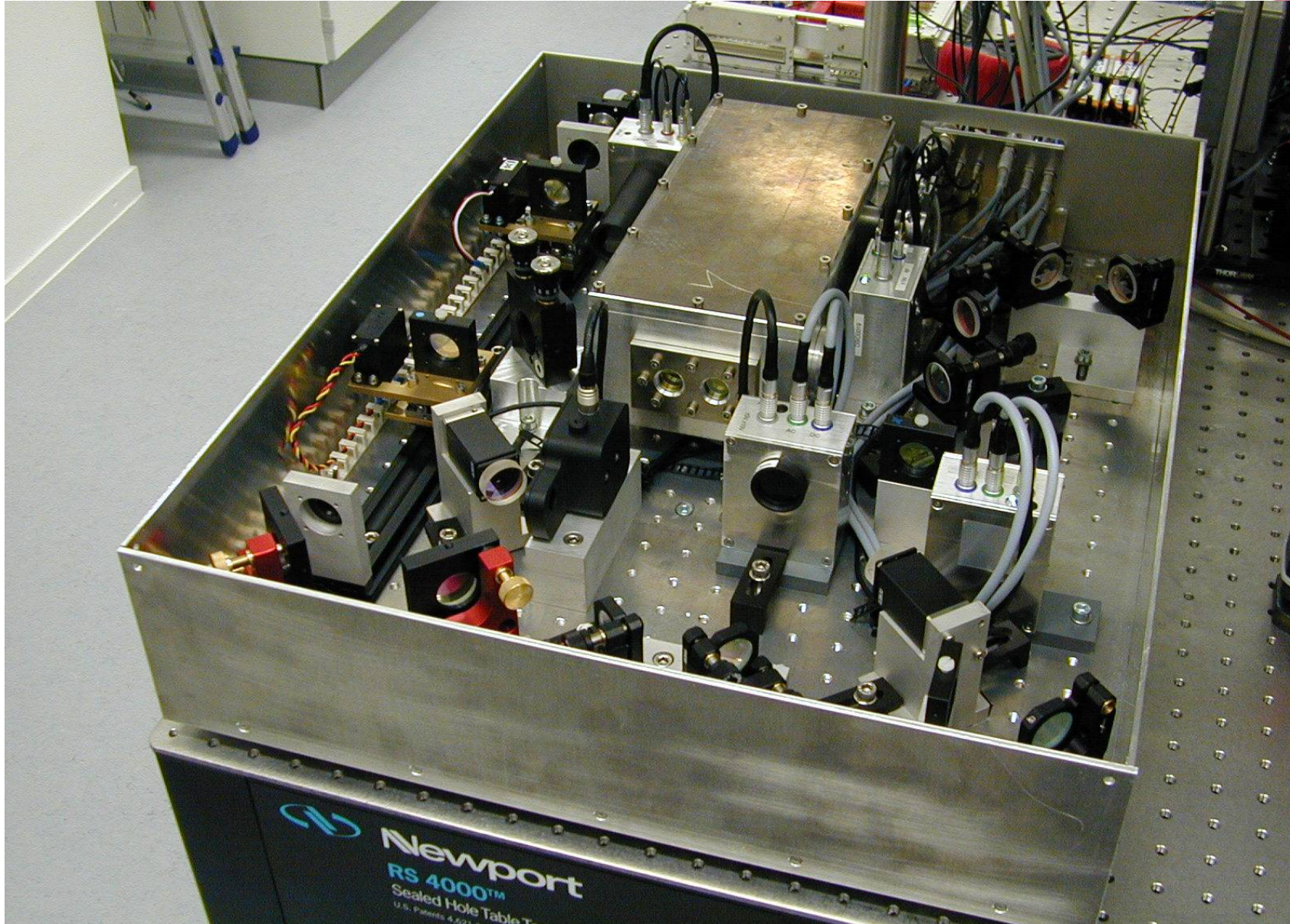
- thermal loading
 - PMC design based on thermal loading experiment by A. Bullington (Stanford)
 - assumption: less than 3ppm absorption
 - allow for a total of 10mW absorbed power
 - finesse 50 (3kW circulating power)
- in sealed housing, vacuum required ?
- rf filtering
 - 4dB @9MHz
 - sufficient? , increase length?

Relative Intensity Noise RF



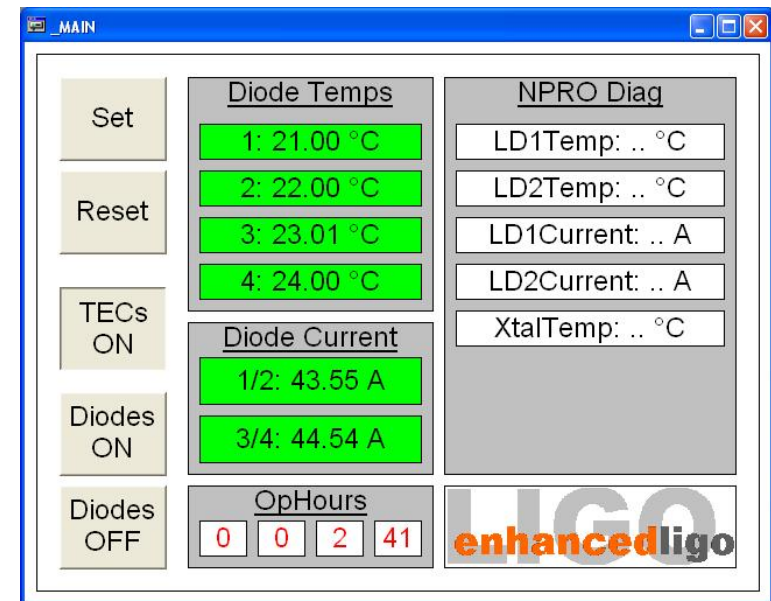
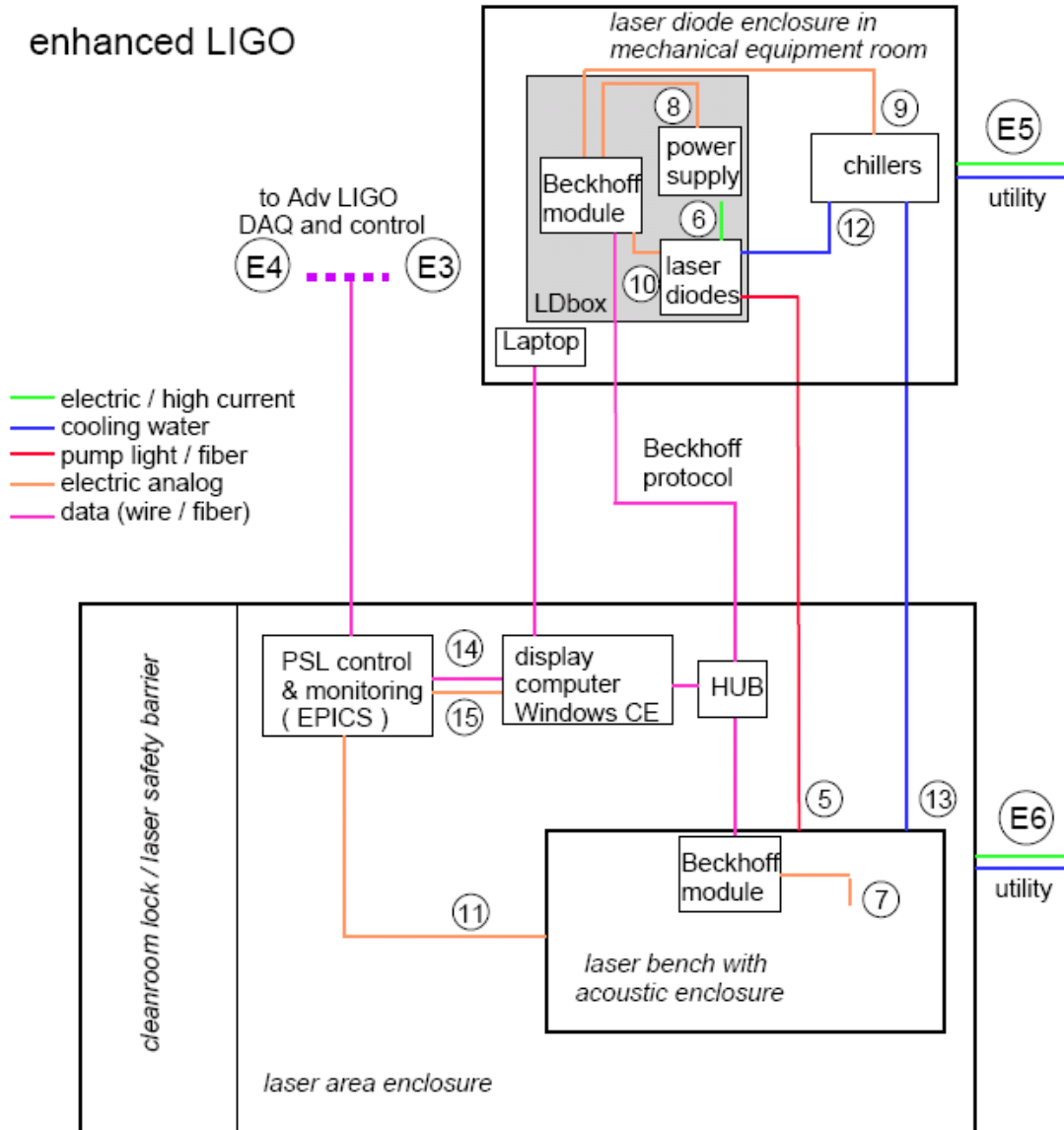


beam diagnostic setup

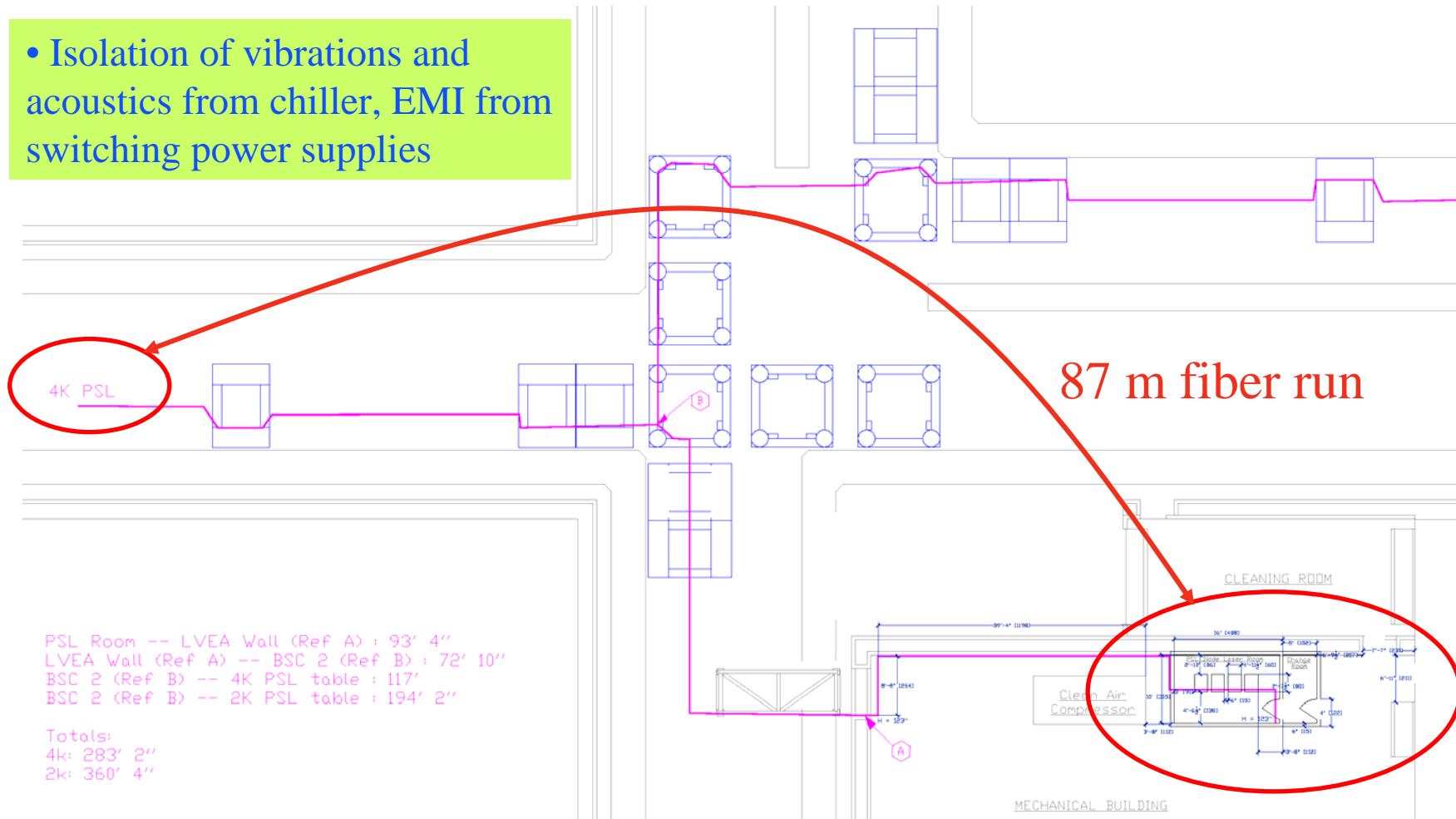




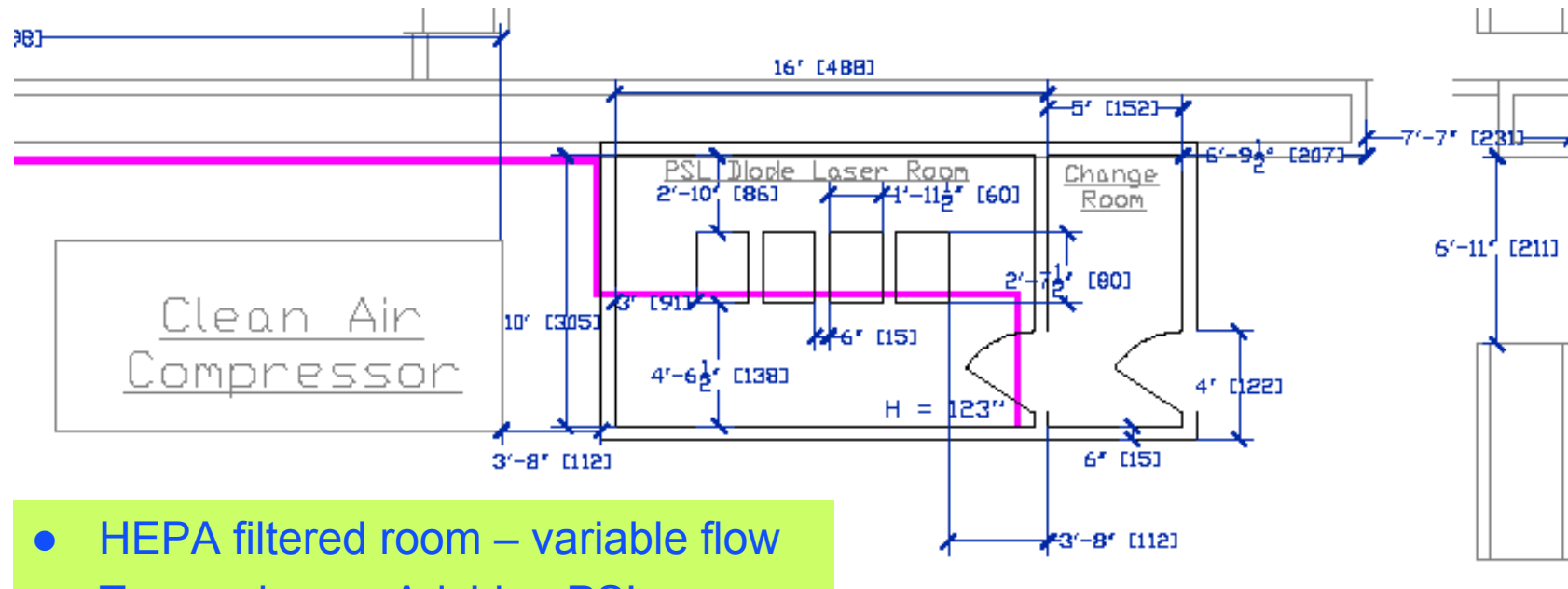
enhanced LIGO



- Isolation of vibrations and acoustics from chiller, EMI from switching power supplies



Diode room detail (LHO)



- HEPA filtered room – variable flow
- Two racks per AdvLigo PSL
- Portable HEPA panel for pump diode box maintenance
- Ante room for gowning/laser safety

- Fibers and cables in overhead tray
- Video/phone/network connections
- Room temperature monitor
- Dust monitor
- Smoke detector –control room alarm



Laser Safety

LIGO-T070010-02-D

Advanced LIGO

03/12/2007

Advanced LIGO Pre-stabilised Laser Safety Plan

Peter King (ed.)

Distribution of this document:
LIGO Science Collaboration

This is an internal working note
of the LIGO Project.

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PEOPLE MATTER

*Forschung
Entwicklung
Beratung*



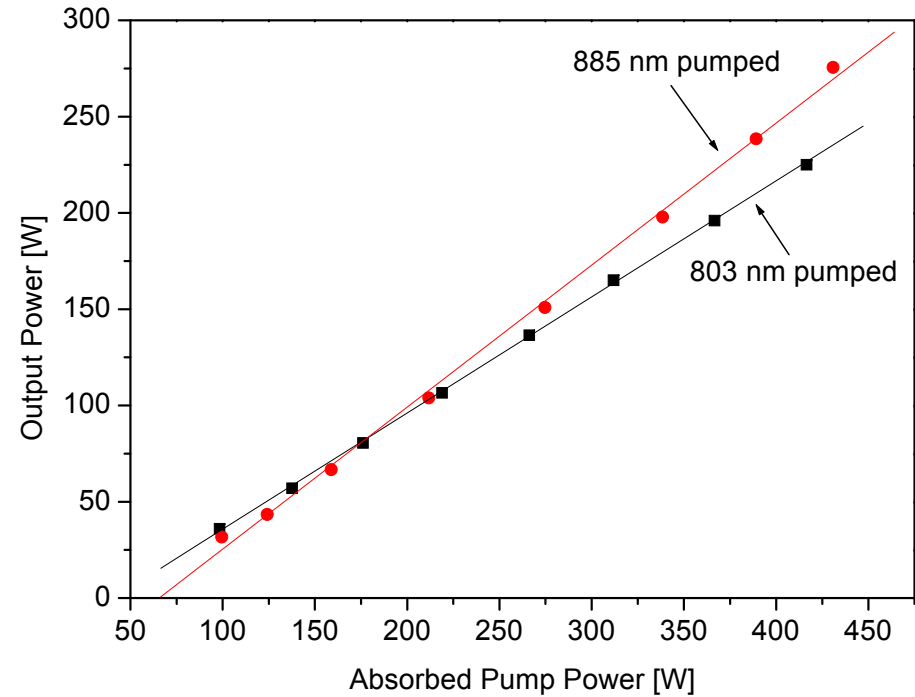
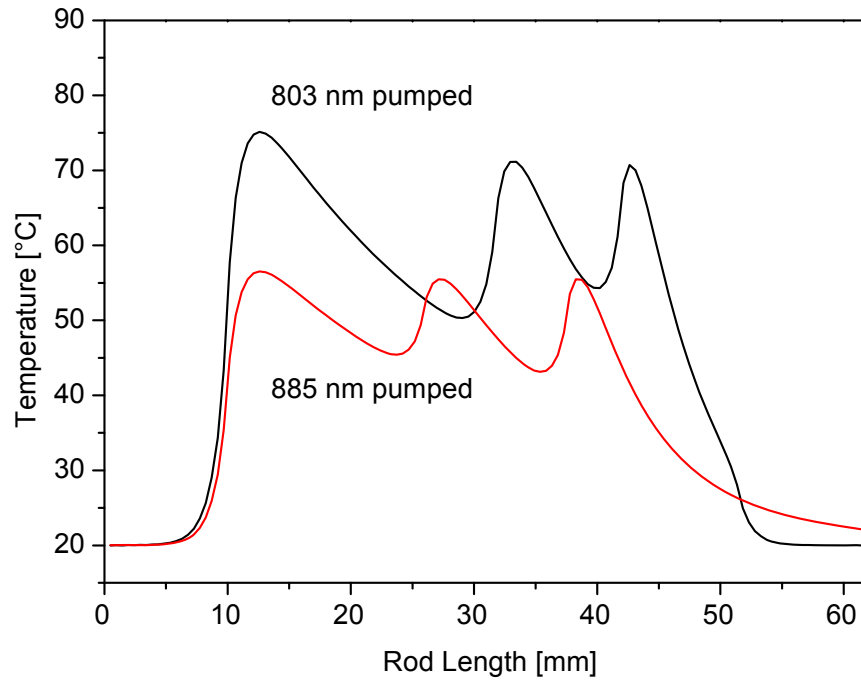
LZH LASER ZENTRUM HANNOVER e.V.

New development on high power solid-state (& fiber) lasers @LZH

*Maik Frede
for the SSP-Group*

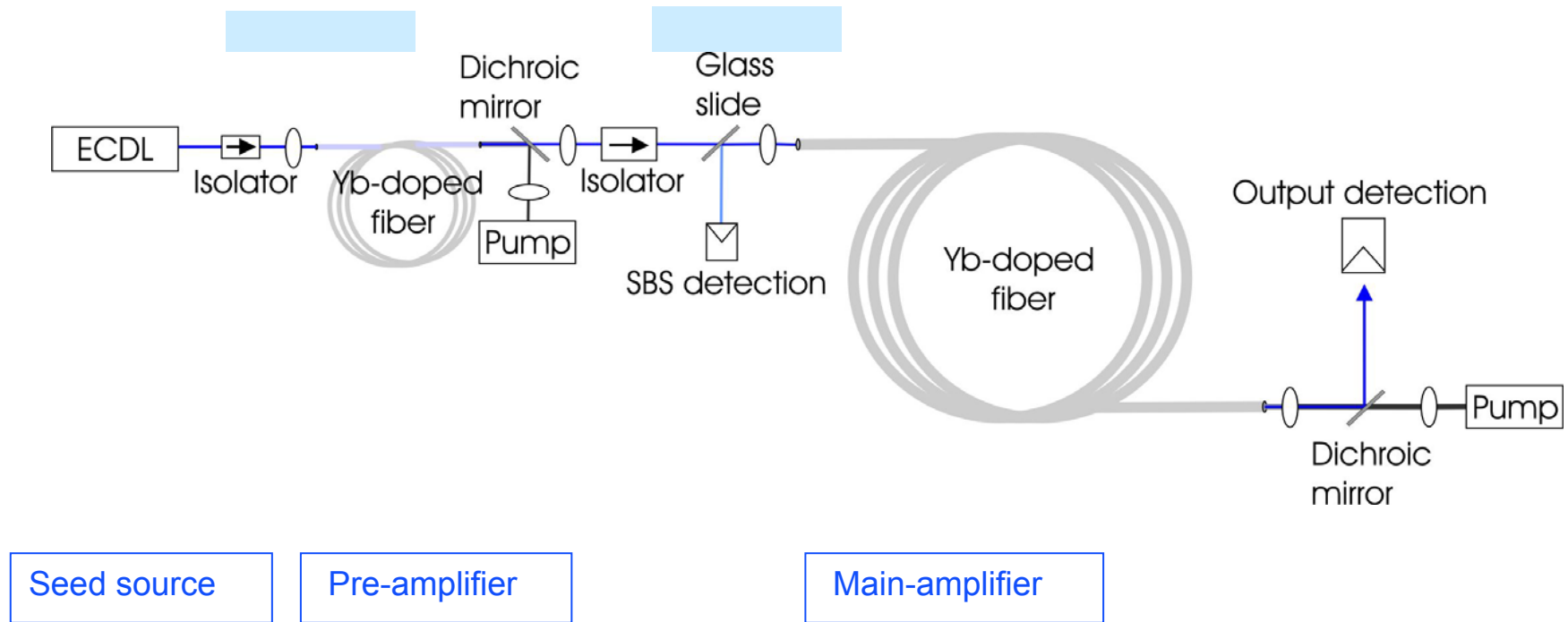
LSC March 2007

Combination of 885nm Pumping & Multi-Segmented Rods



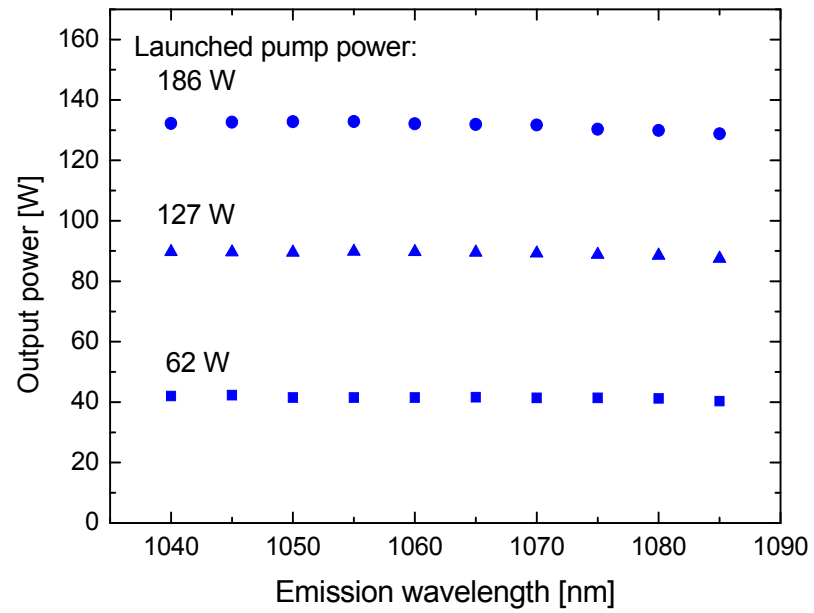
- Temperature Reduction by ~ 30 %
- 276 W Output Power, 75 % Slope Efficiency

Tunable Fiber Laser MOPA

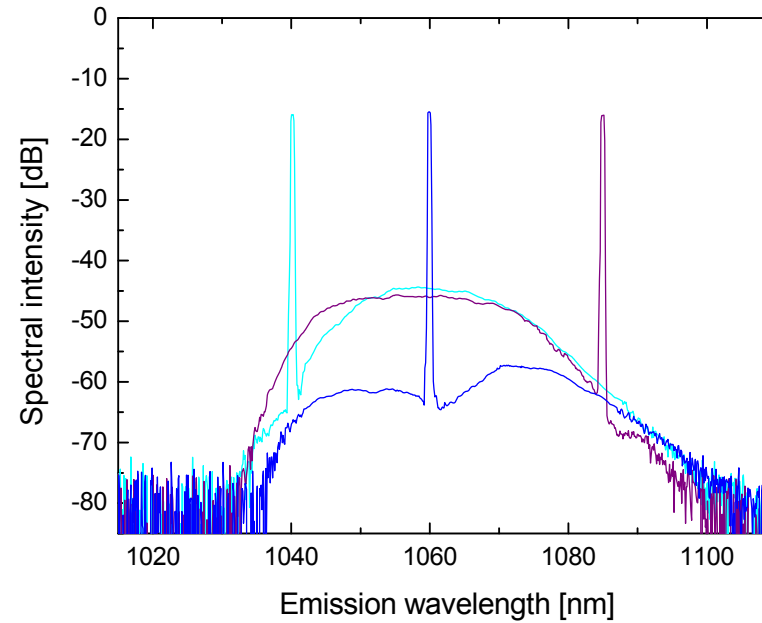


Results: Output-Power (tuneable)

Main-amplifier output power characteristic

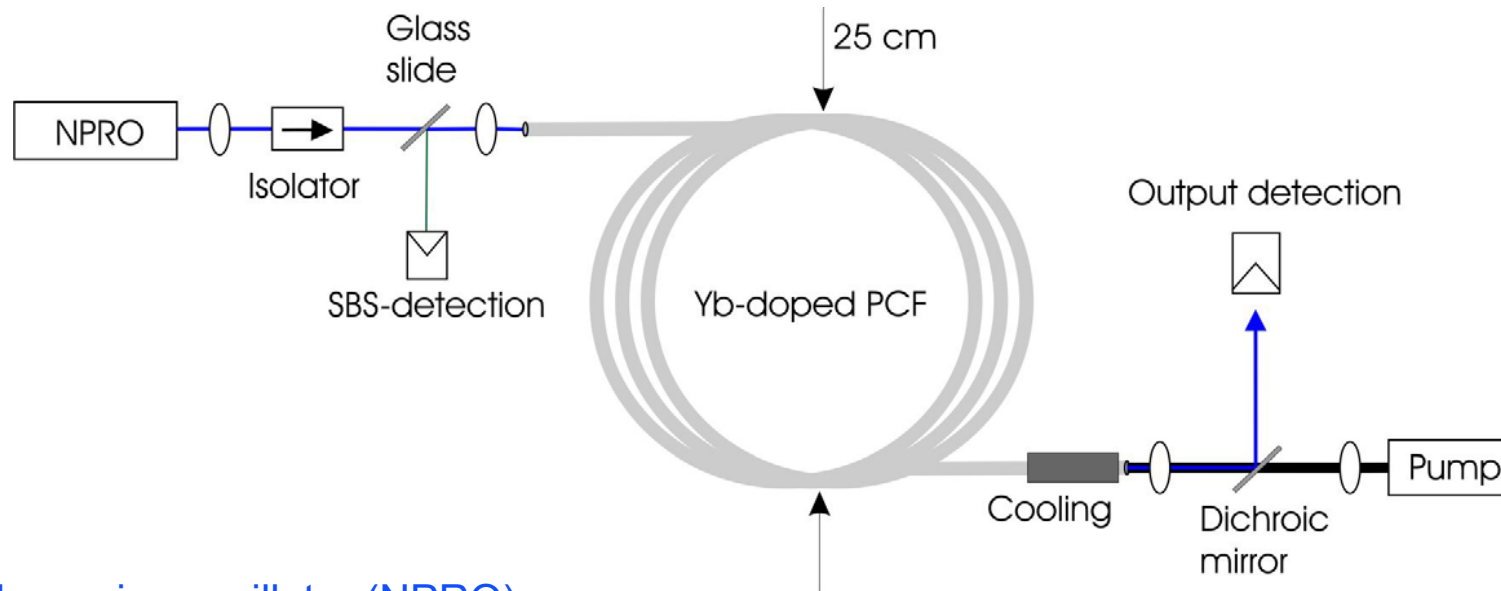


Main-amplifier emission spectra



Max. output power 133 W
> 129 W from 1040-1085 nm

Single-Frequency Master-Oscillator Fiber Amplifier



Non-planar ring oscillator (NPRO)

Em. wavelength	1064 nm
Max. seed power	1.5 W

Crystal Fibre A/S DC-225-22-Yb

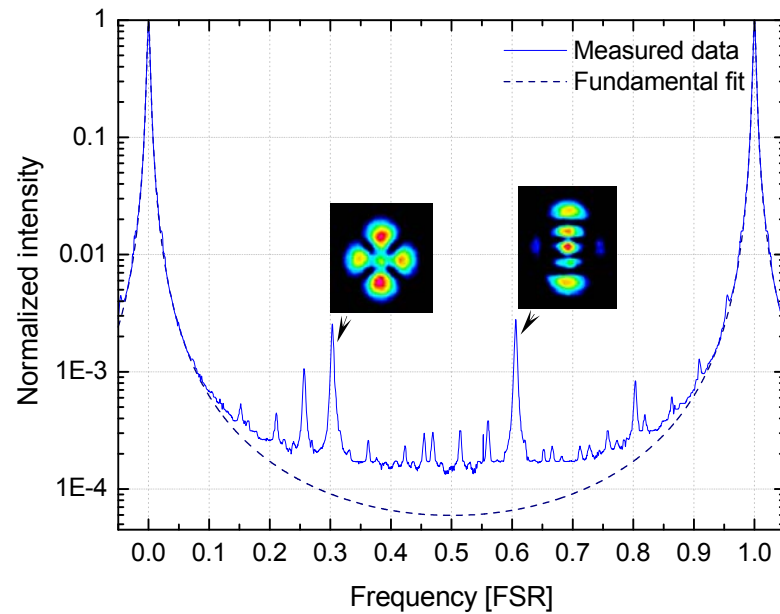
Cladding diameter	225 μm
Mode field diameter	22 μm
Length	4.2 m

Pump module: Laserline LDM 200-200

Fiber diameter	300 μm
Maximum power	218 W
Emission wavelength	976 nm
Emission linewidth	2.5 nm

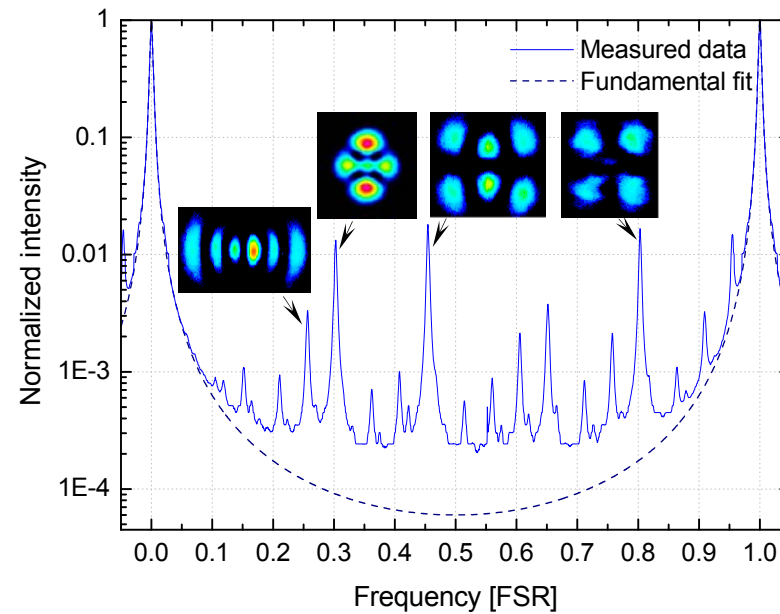
Beam Quality (measured)

Fabry-Perot ring-cavity scan at 28 W



98% fundamental gaussian at 28 W
Indiv. higher-order mode < 0.25%

Fabry-Perot ring-cavity scan at 148 W



92.6% fundamental gaussian at 148 W
Indiv. higher-order modes < 1.8%

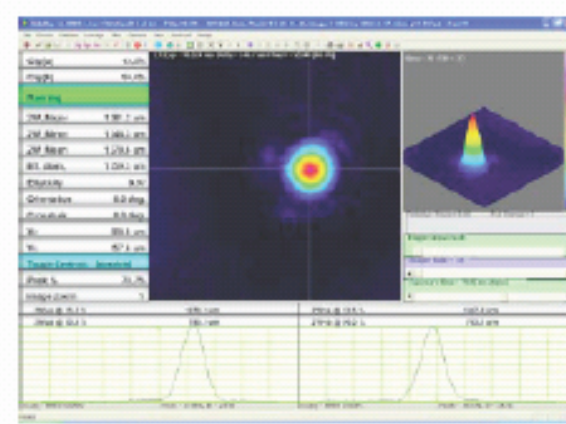
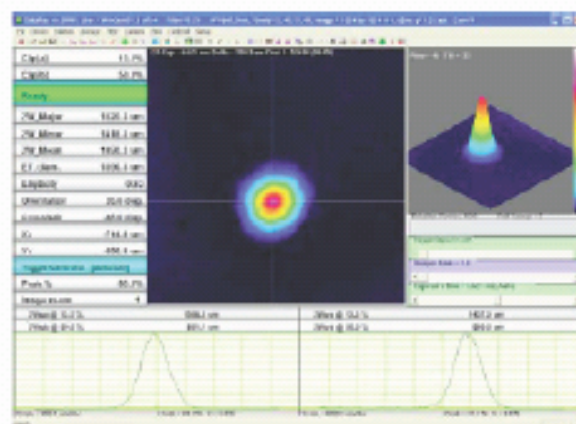
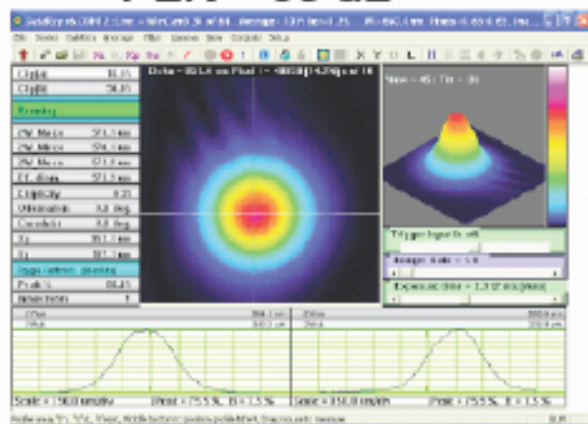
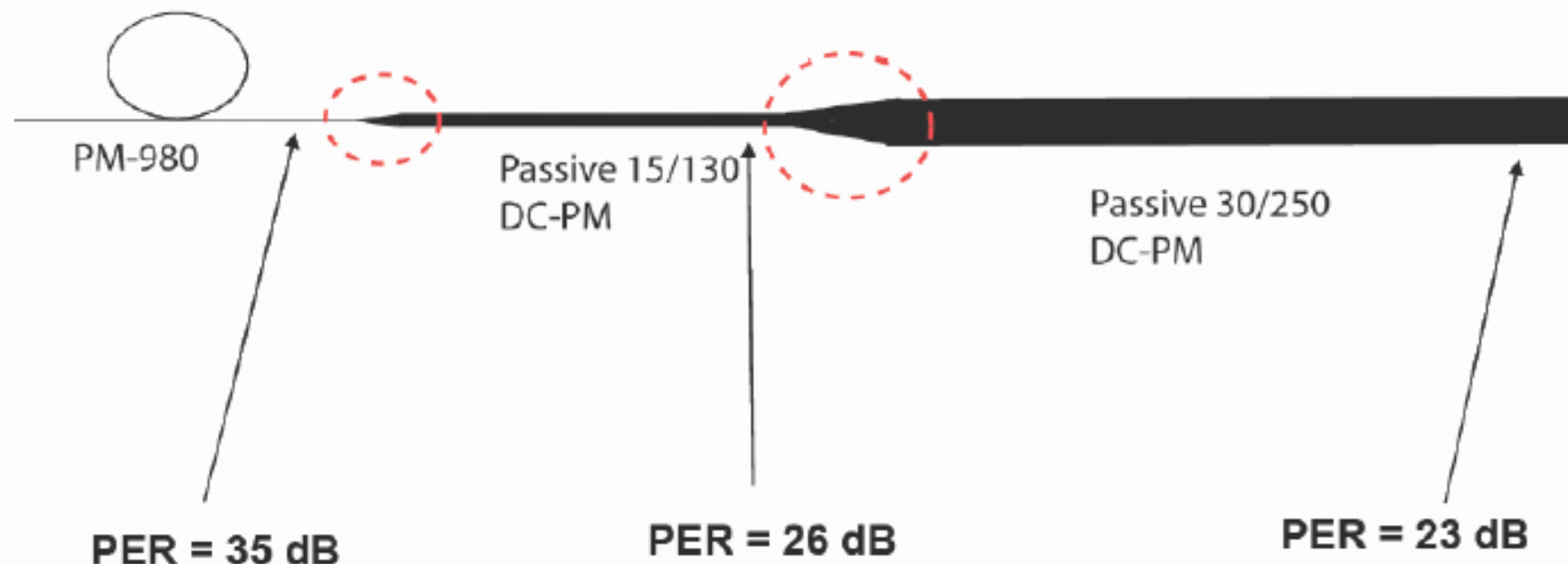


High Power, Single Frequency Ytterbium Fiber Amplifier





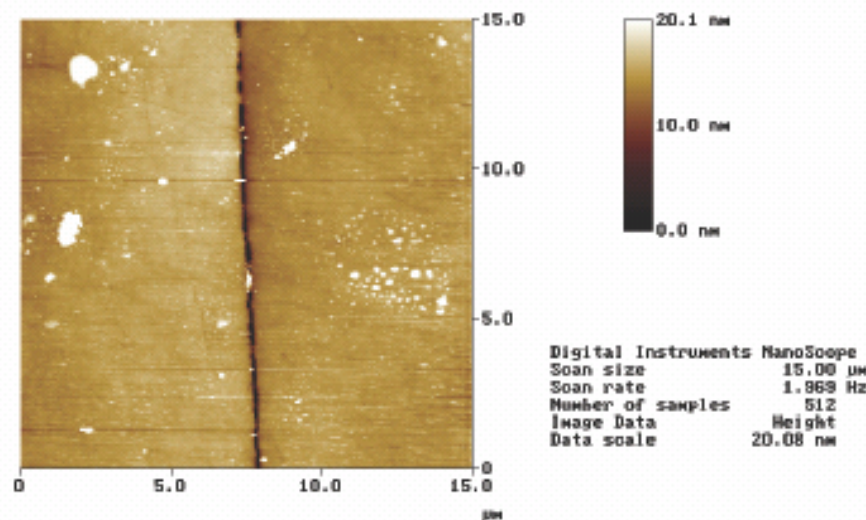
Increasing Reliability – Tapers





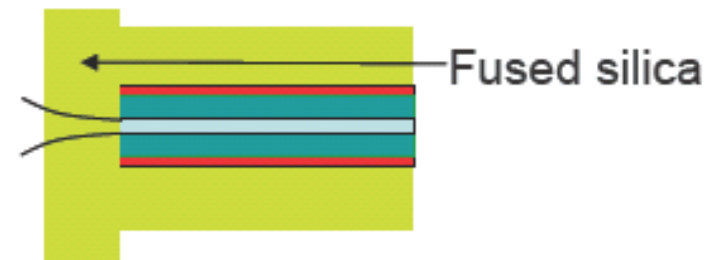
Increasing Reliability -- Silicate Bonding

- No high temperature processes
- Bond is as strong as substrate in silica/silica bonds
- Low optical absorption



bond.013

Courtesy of Sheila Rowan



Fiber in capillary bonded to optical flat



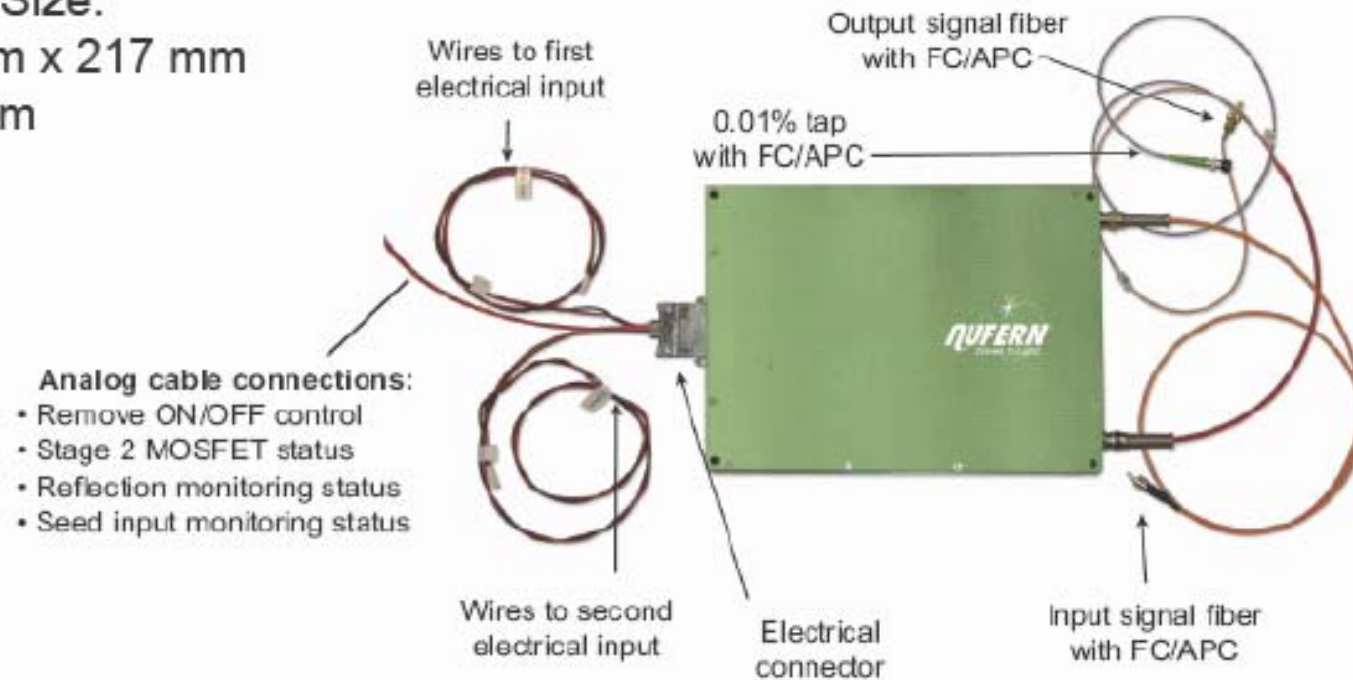
Bond reflection below -50 dB.





Nufern 10W PM Amp Layout

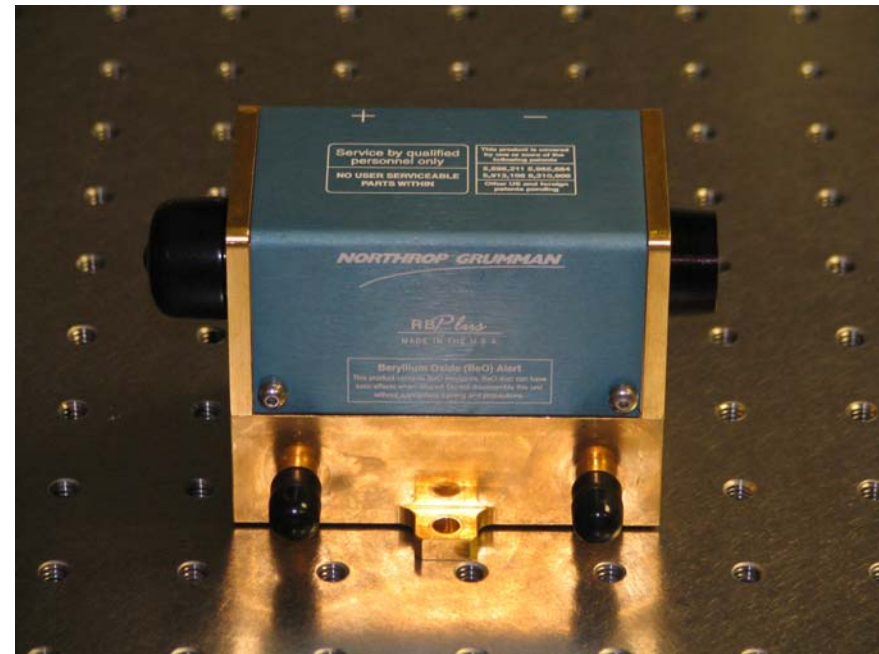
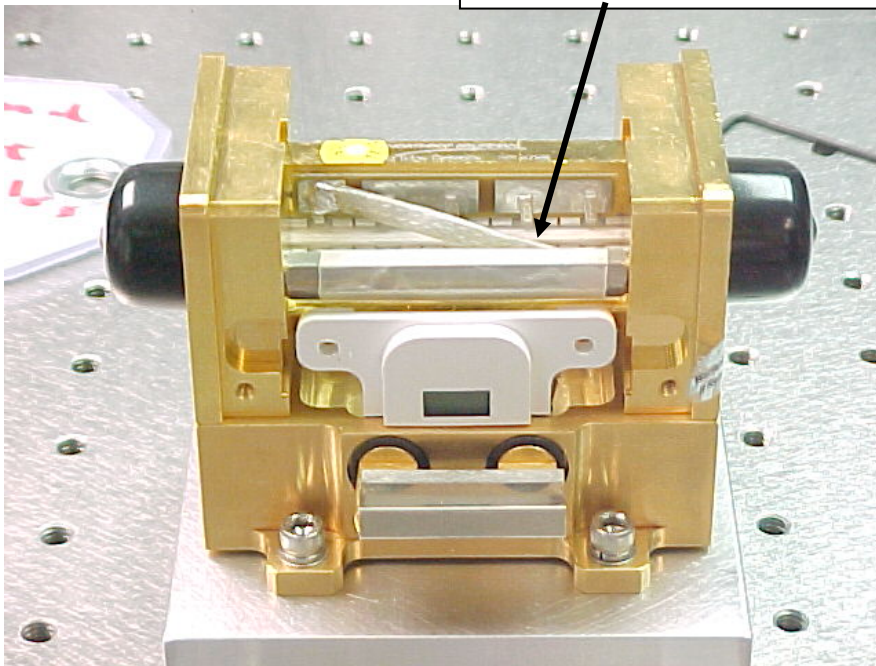
Actual Size:
294 mm x 217 mm
x 50 mm



Reprinted from: www.nufern.com/images/sub_assemblies_class/assembly_class_pdf7.pdf

**LSU's Amplifier
Model: RBA25
Manufacturer: Cutting Edge Optronics/
Northrop Grumman Corp.**

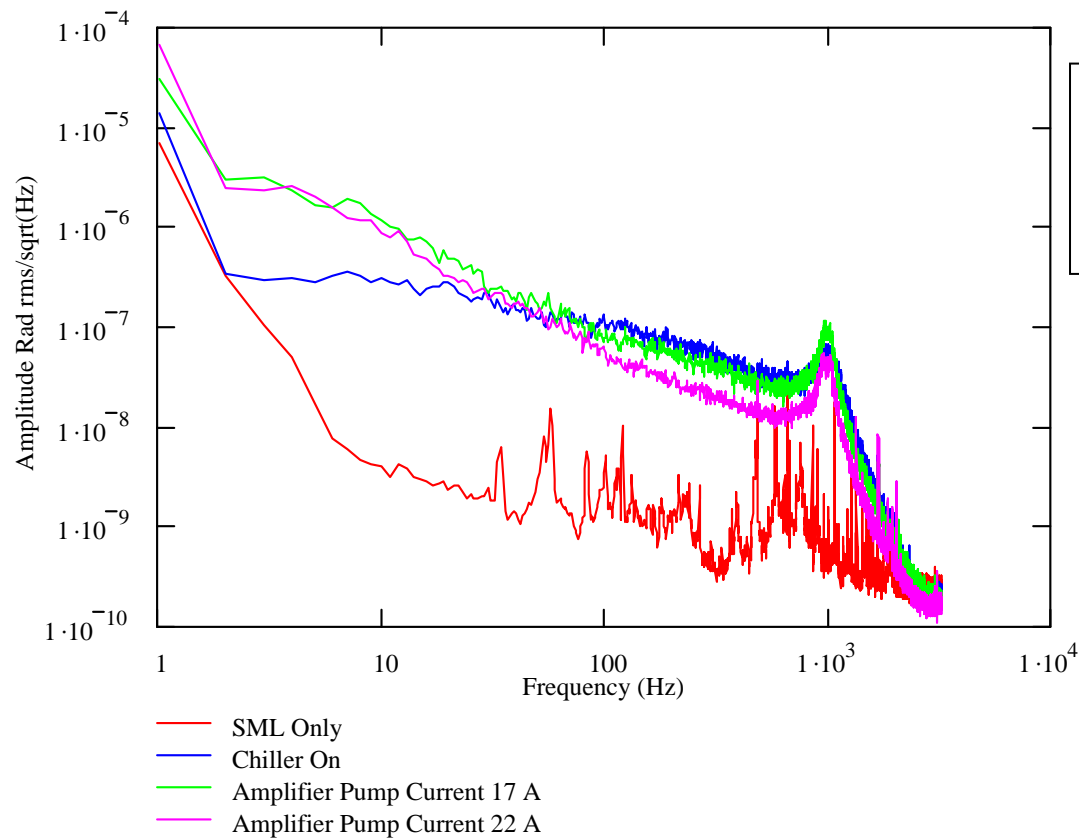
Diode Bar (5/15)



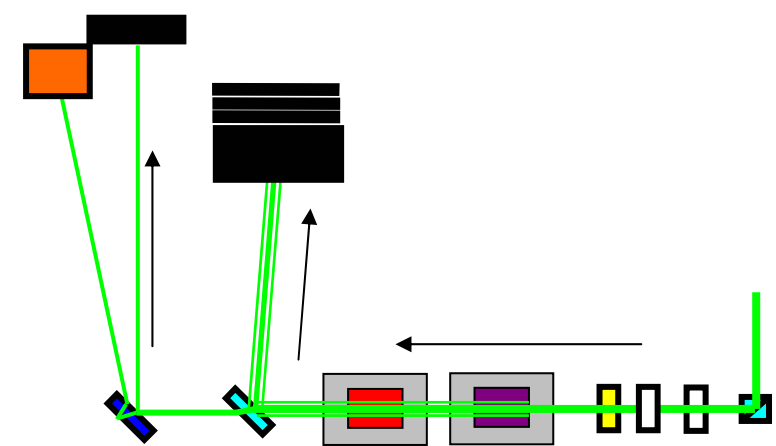
Crystal rod: 2 mm dia by 80 mm length
Water cooled (68 psi/1GPM water flow)

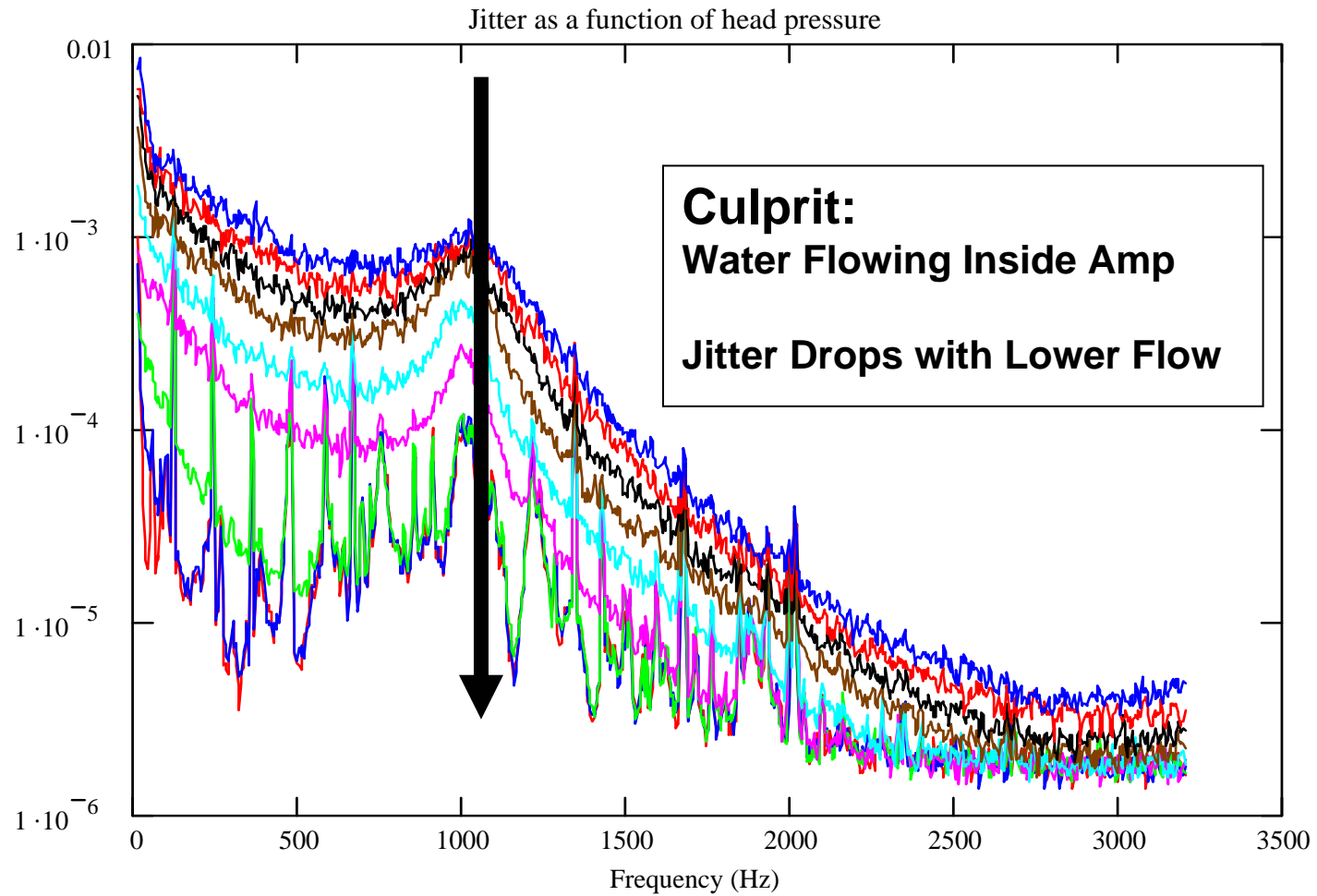
Angular Jitter

A Magnitude of Problems



- Jitter peaks >10x above MOPA
- Bump at 1 kHz
- Single Pass





- Jitter of SML only
- Pump pressure 12 psi, no flow registered
- 15 psi, no flow
- 20 psi, ~0.25 gpm
- 25 psi, <0.4 gpm
- 30 psi, 0.6 gpm
- 35 psi, 0.6 gpm
- 40 psi, 0.75 gpm
- 45 psi, 0.82 gpm