

# Towards the LIGOII pre-stabilized laser system

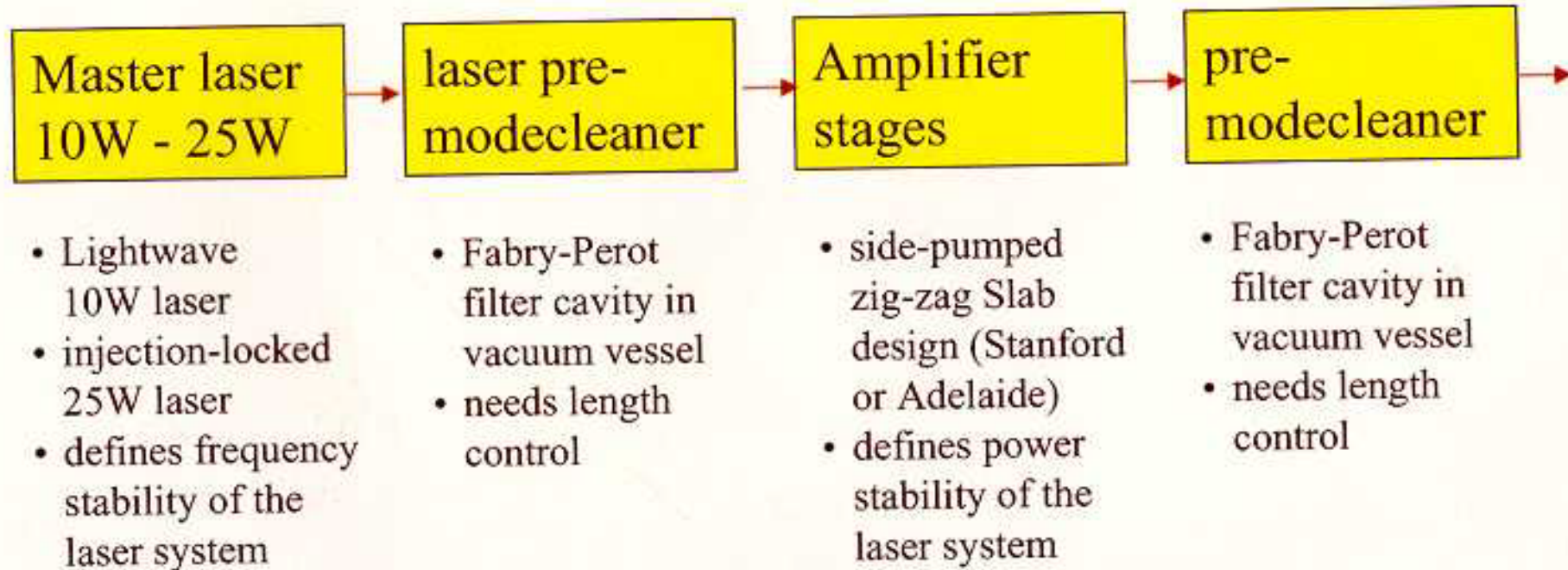
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University of Glasgow

LIGO-G000254-00-D

B. Willke, LSC Hanford 00

# the LIGO II laser system



# the GEO600 laser-team

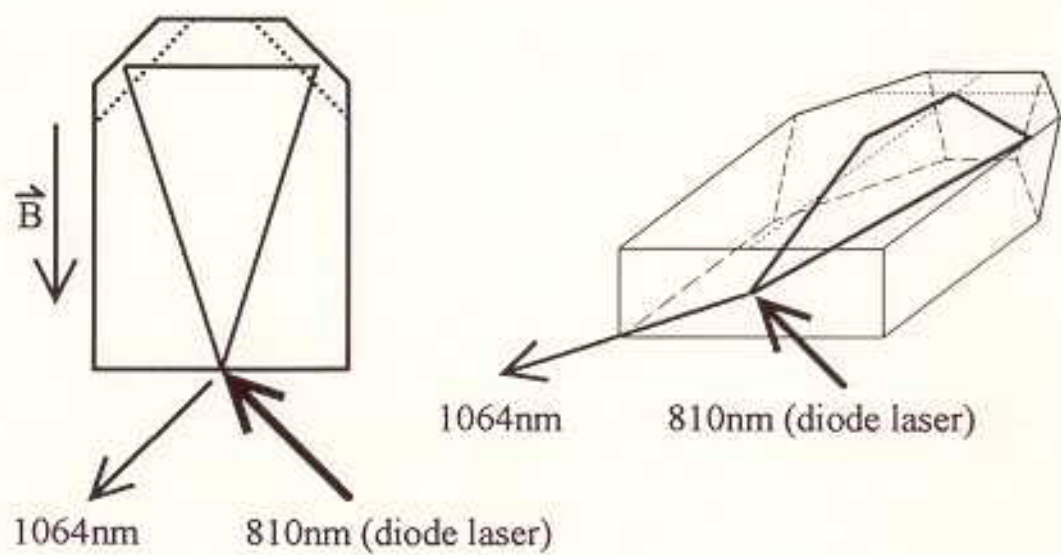
Laser Zentrum Hannover

Max-Planck Institut  
University of Glasgow  
University of Hannover

High-power solid-  
state-lasers design

power and frequency  
stabilization

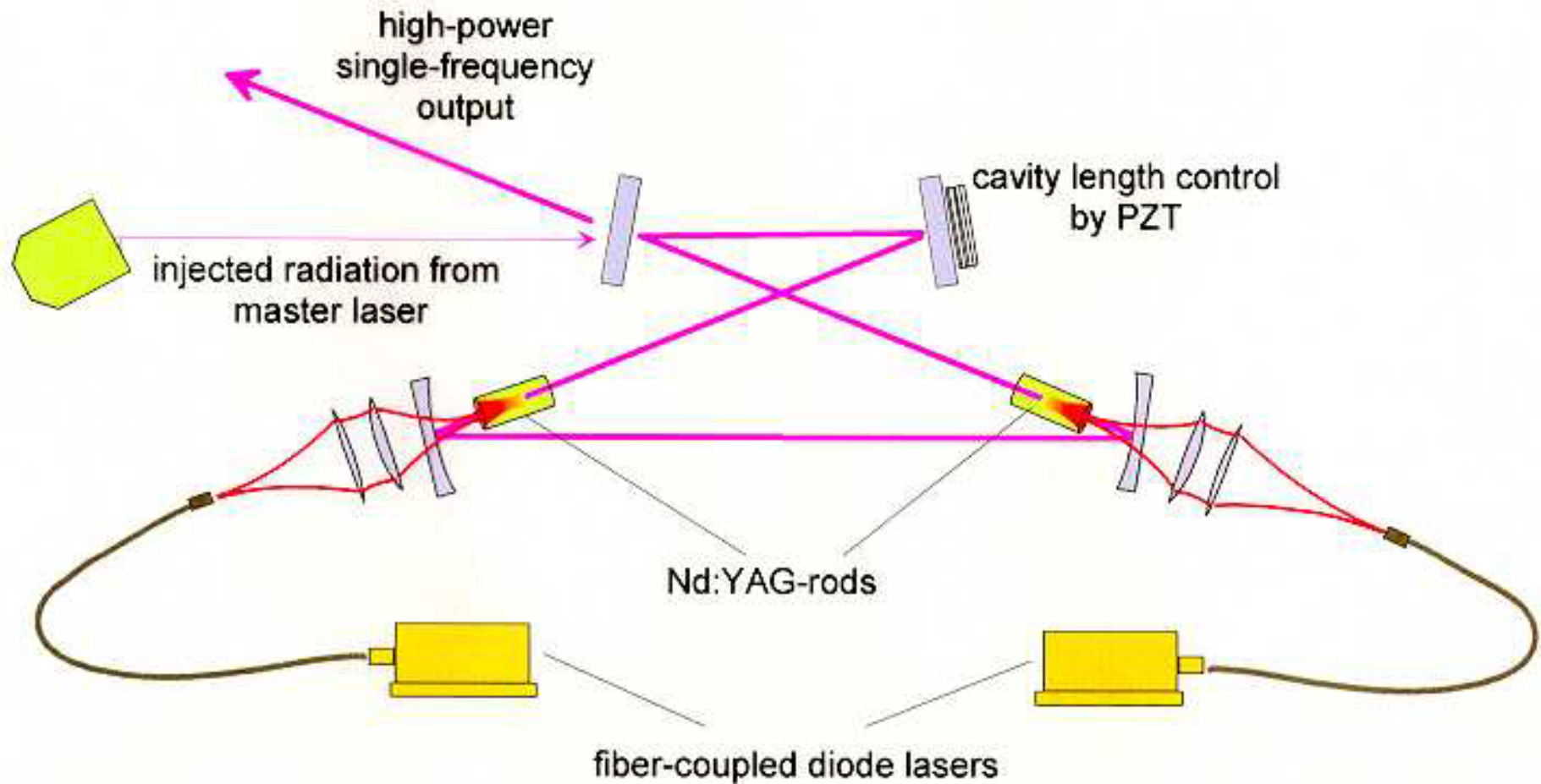
GEO600 pre-stabilized laser



Monolithic Nd:YAG ring laser



## End-pumped slave laser for maximum passive stability



I. Zawischa

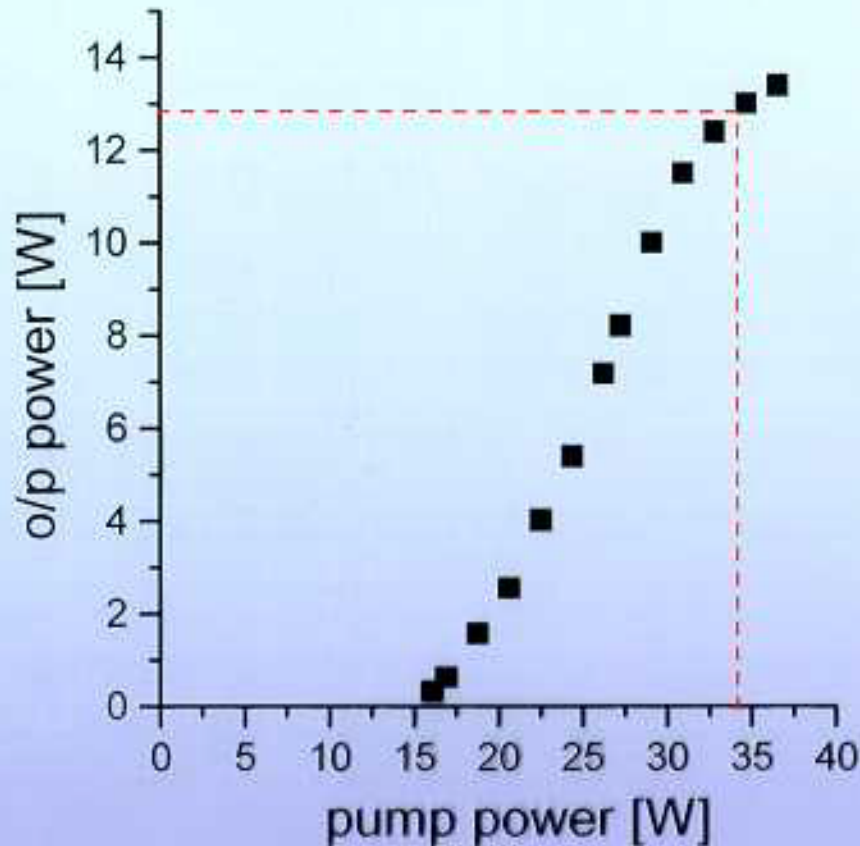
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SFB 407 / B7

End-pumped ring laser



# Laser for GEO600: Properties of the Slave

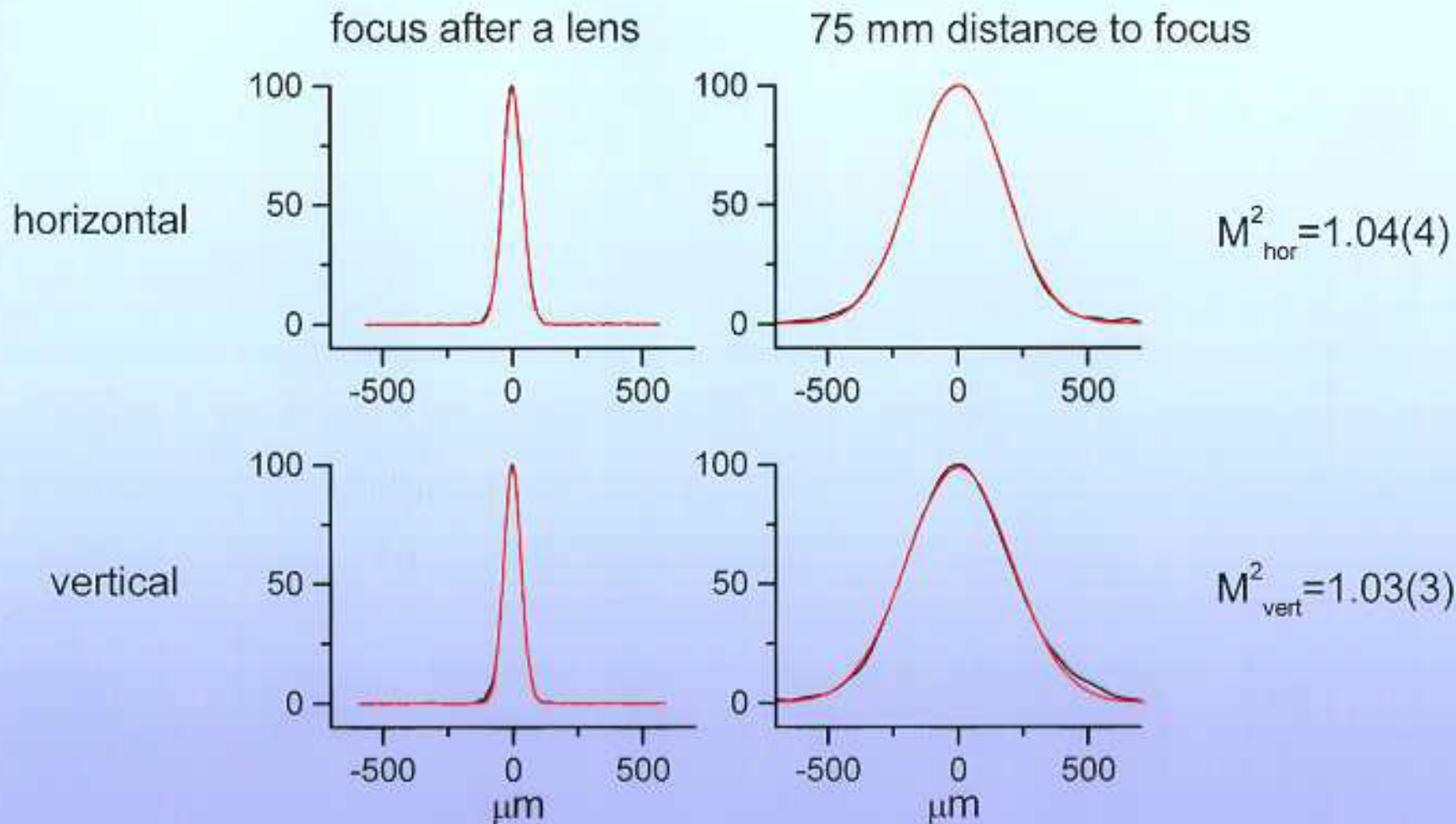


degree of polarization  
99%

state of polarization  
99% linear horizontal

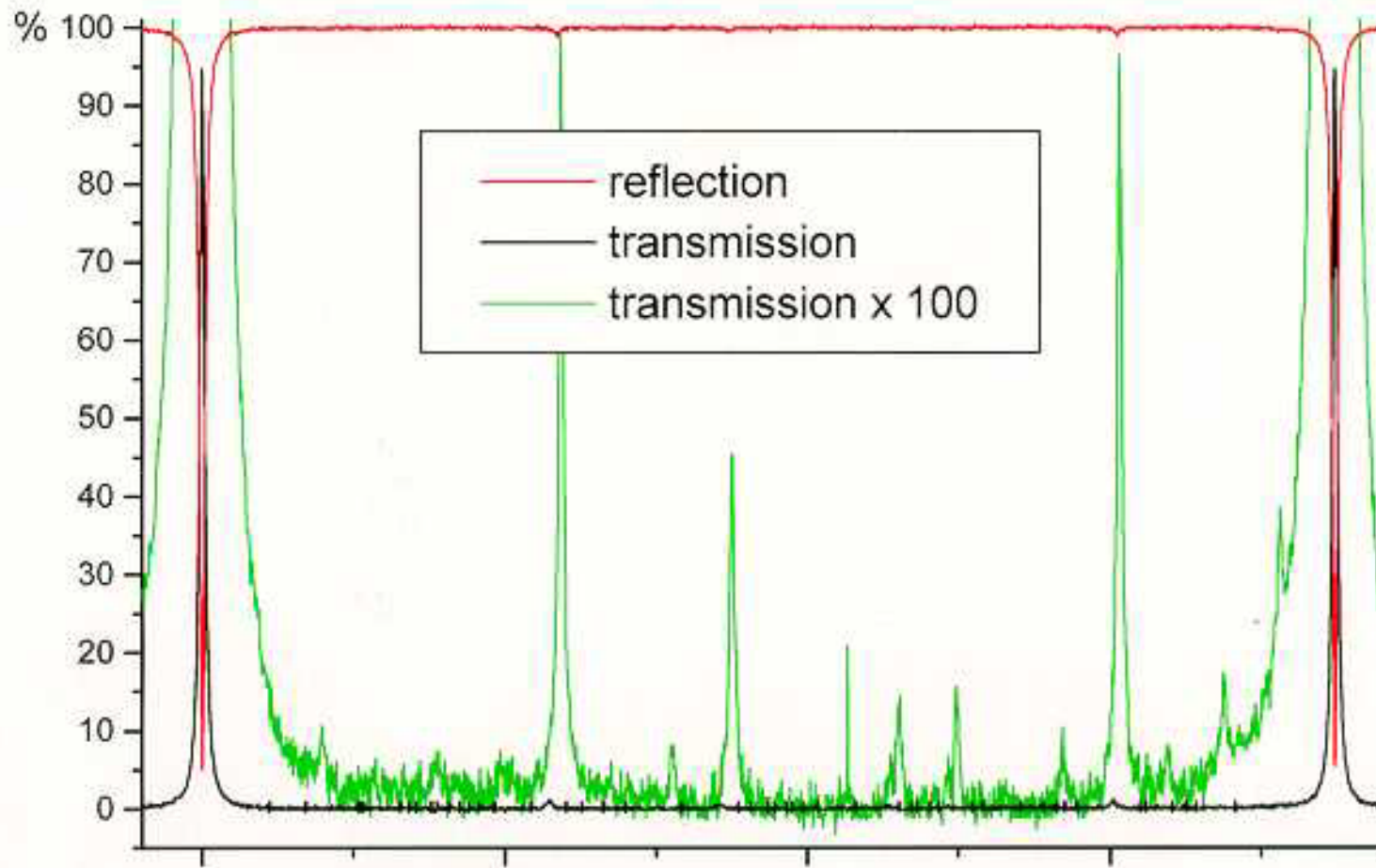
output beam waist  
horizontal 280 $\mu$ m  
vertical 310 $\mu$ m

# Laser for GEO600: Properties of the Slave



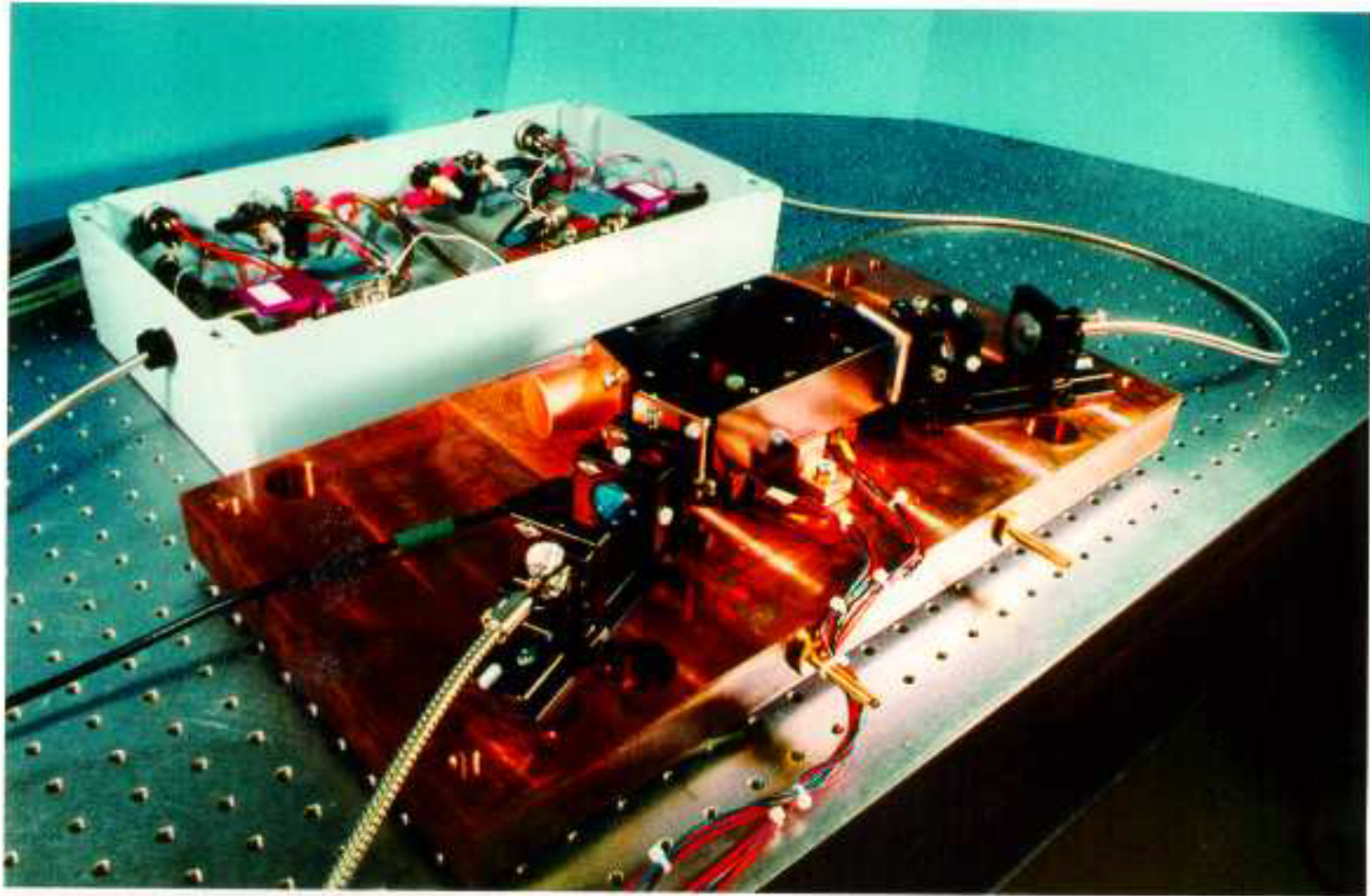
# GEO 600 Slave Laser Prototype II

## Transmission through cavity



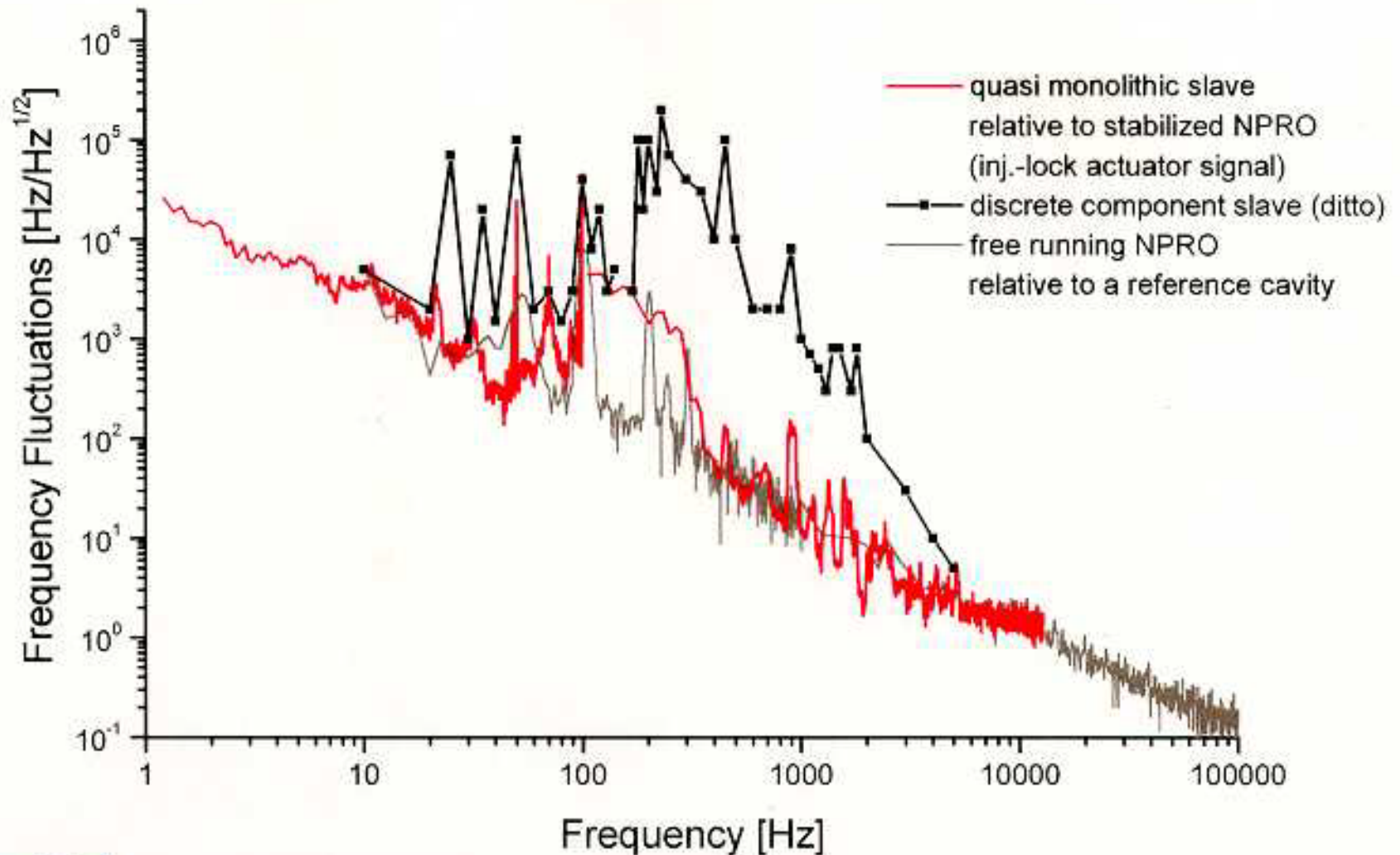


# GEO 600 Slave Laser Prototype II

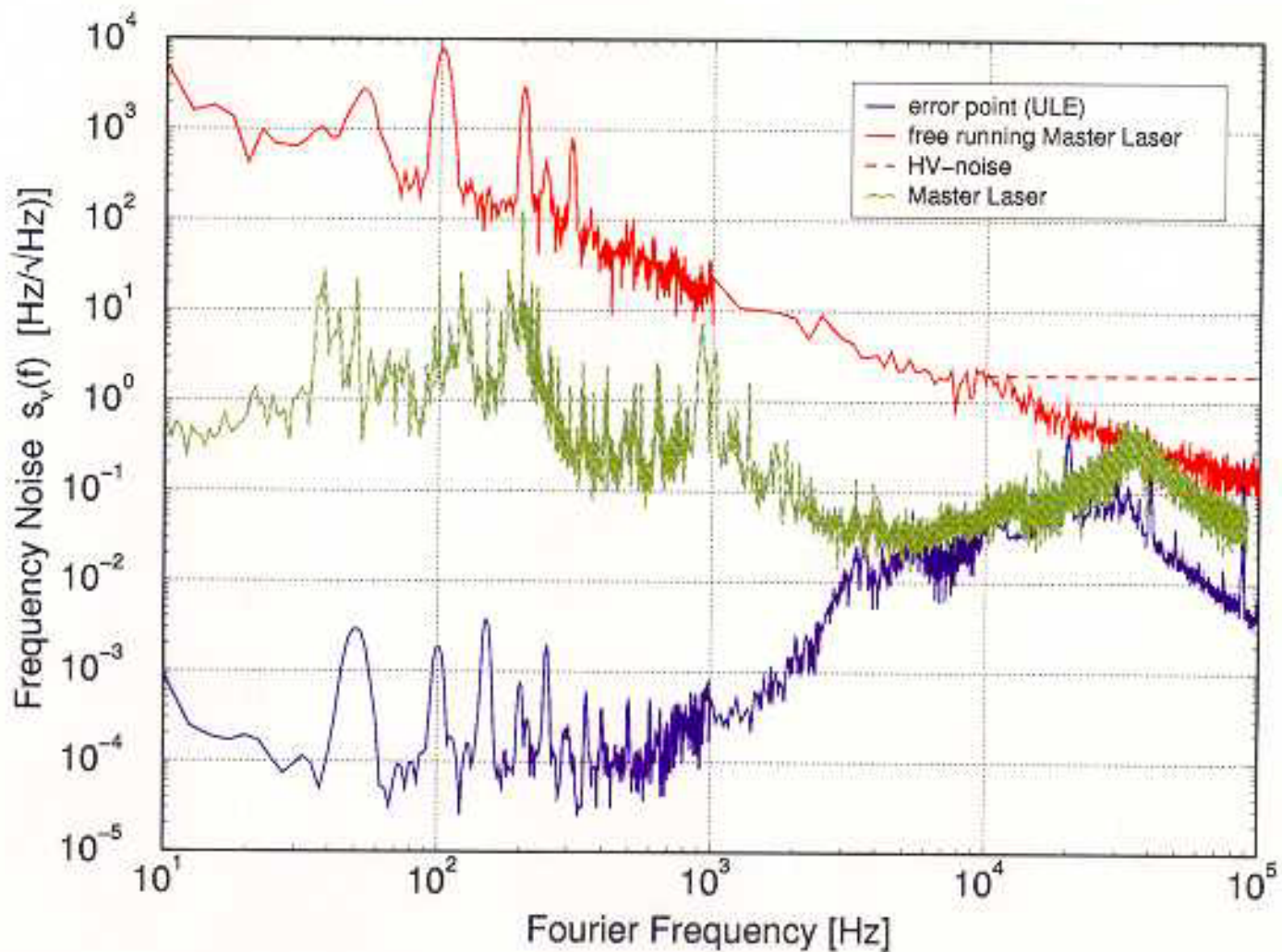


# GEO 600 Slave Laser Prototype II

## Frequency Stability

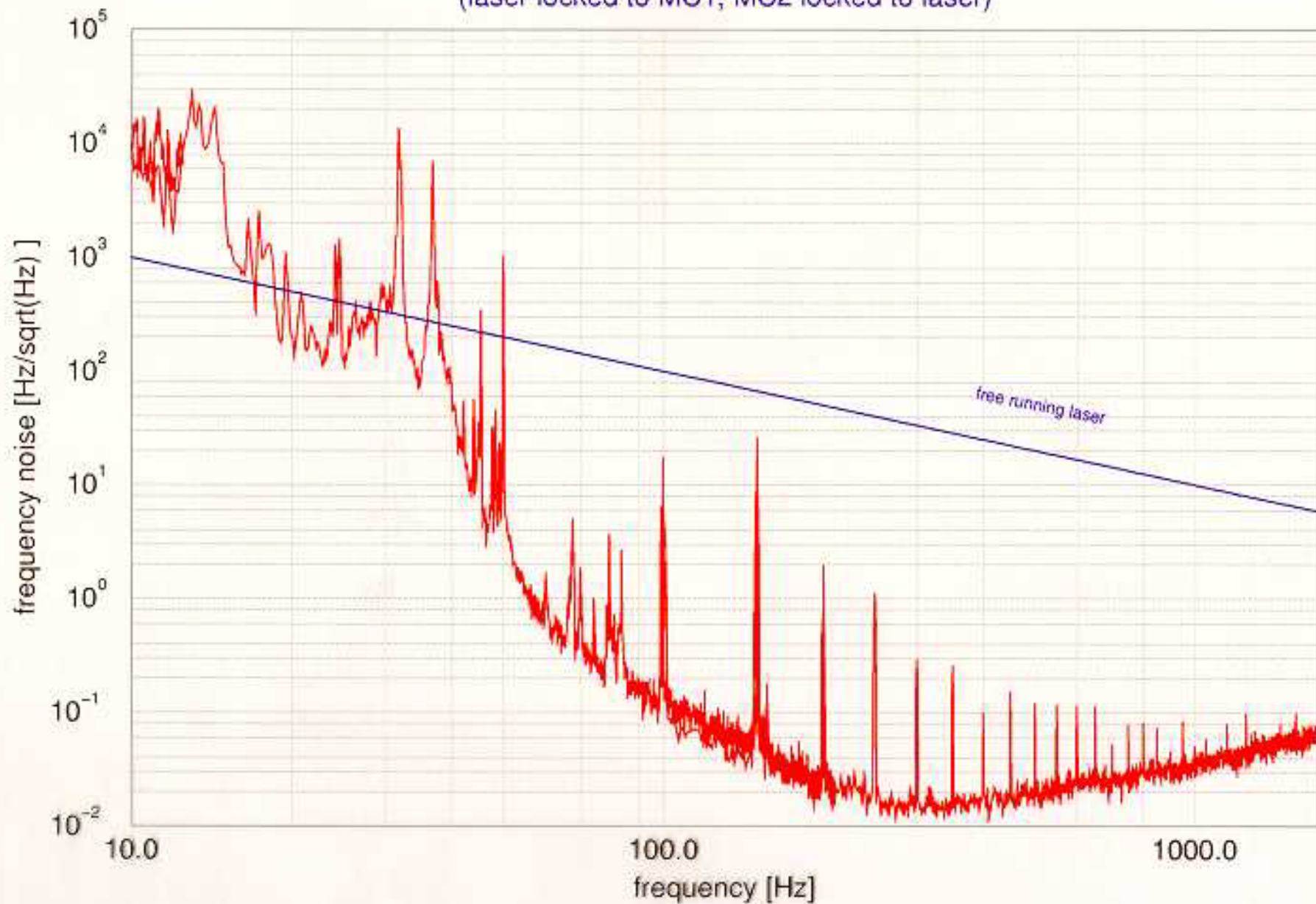


# FREQUENCY NOISE: MASTER LASER



# frequency noise laser

(laser locked to MC1, MC2 locked to laser)



# 180W LIGOII PSL - development program

## 2001

- **upgrade injection-locked pre-stabilized laser to 25W**
- test and improve amplifier design (Stanford)
- test and improve stable-unstable amplifier design (Adelaide)
- **start rod-oscillator program**

## 2002

- preliminary design review (decision on high power stage)
- **build high power stage**
- build pre-modecleaner
- **integrate front-end, high power stage and pre-modecleaner to lab-version LIGOII PSL**

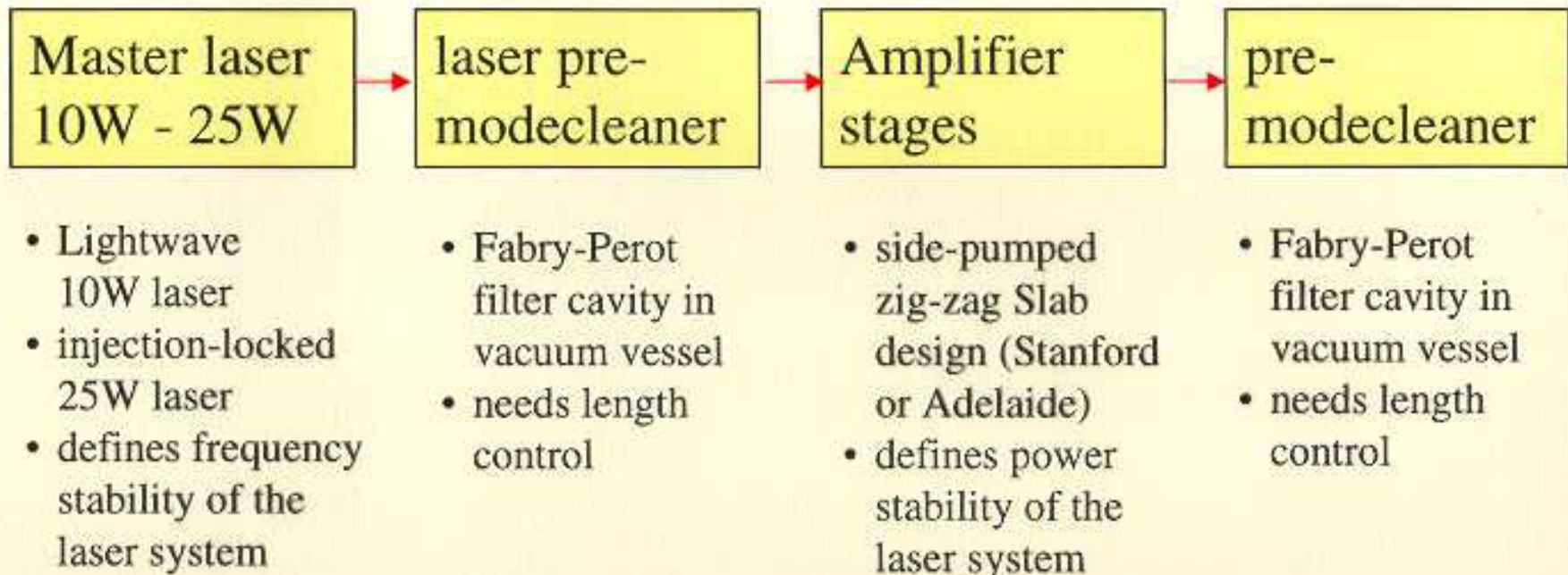
## 2003

- **continue system integration**
- **power stabilization**
- test of lab-version PSL on suspended cavity
- final design review
- **start fabrication of final laser systems**

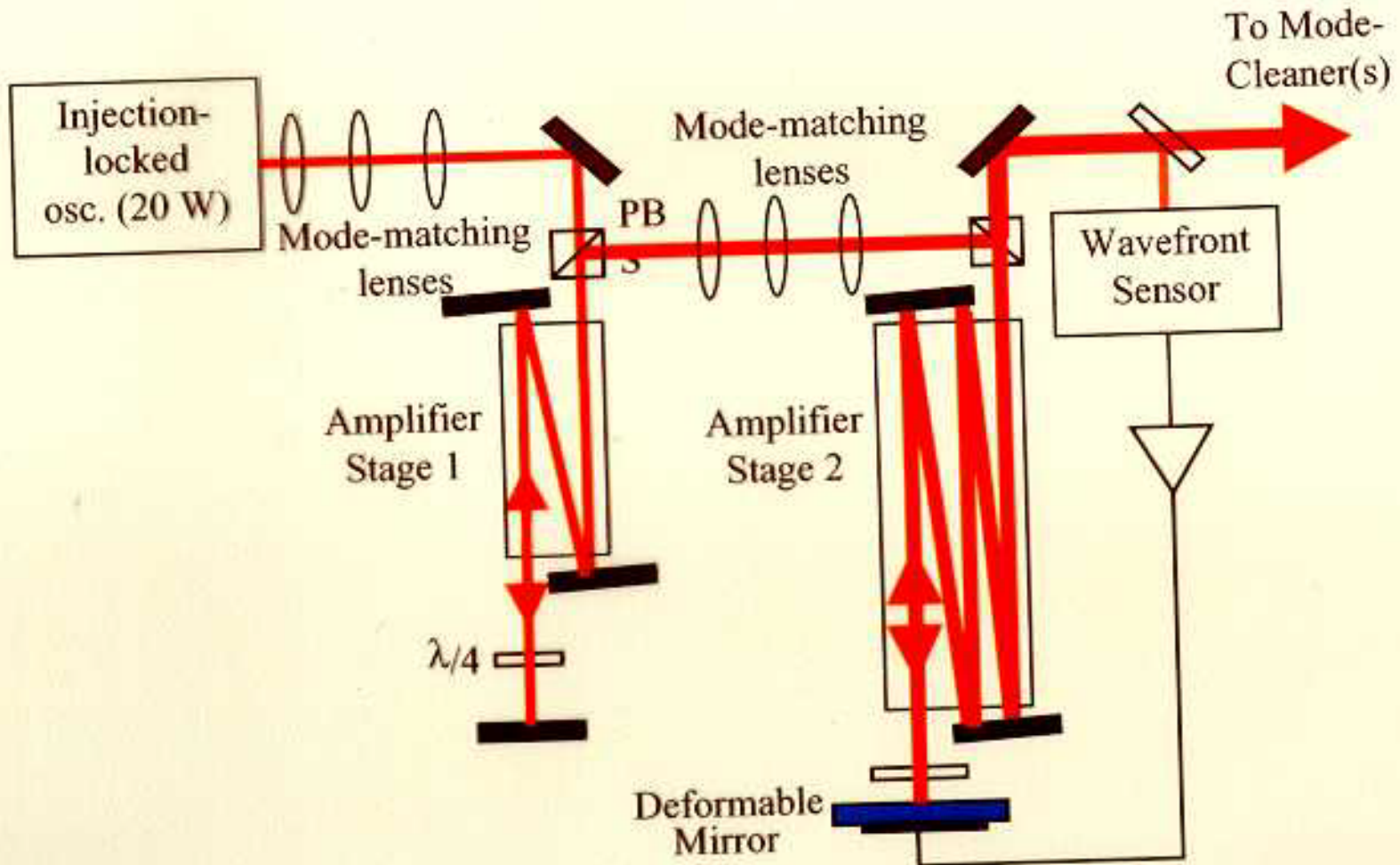
## 2004

- long term test of lab-version PSL
- **continue fabrication of final laser systems**

# the LIGO II laser system



# possible concept



## LZH-GEO group - commercial vendor

- freedom to choose the front-end and high power concepts according to physical reasons
- laser design, system integration (front-end, high power stages, pre-modecleaners, modulators and isolators) and pre-stabilization will be done at one place → stabilization actuators are part of the laser design
- lower costs



# the LIGOII laser-team

Laser Zentrum  
Hannover

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University of Glasgow  
University of Hannover

High-power solid-  
state-lasers design

power and frequency  
stabilization

Stanford  
Adelaide

GEO600 pre-stabilized laser

LIGO Lab

LIGOII pre-stabilized laser

# summary

- frequency stabilized master-laser (10W class) in hand
- 25W class injection-locked front-end in preparation
- first results of lab-version of power amplifiers (100W class) are expected end of 2000
- final amplifier concept could be chosen end of 2001
- design of high power stages and integration with front-end in Hannover → lab-version LIGOII laser
- test of this lab-version PSL on suspended interferometer in summer 2003 (including power stabilization test)
- final design fixed and start of final laser manufacturing