# Thermal Loading of Optical Components in Interferometric Systems

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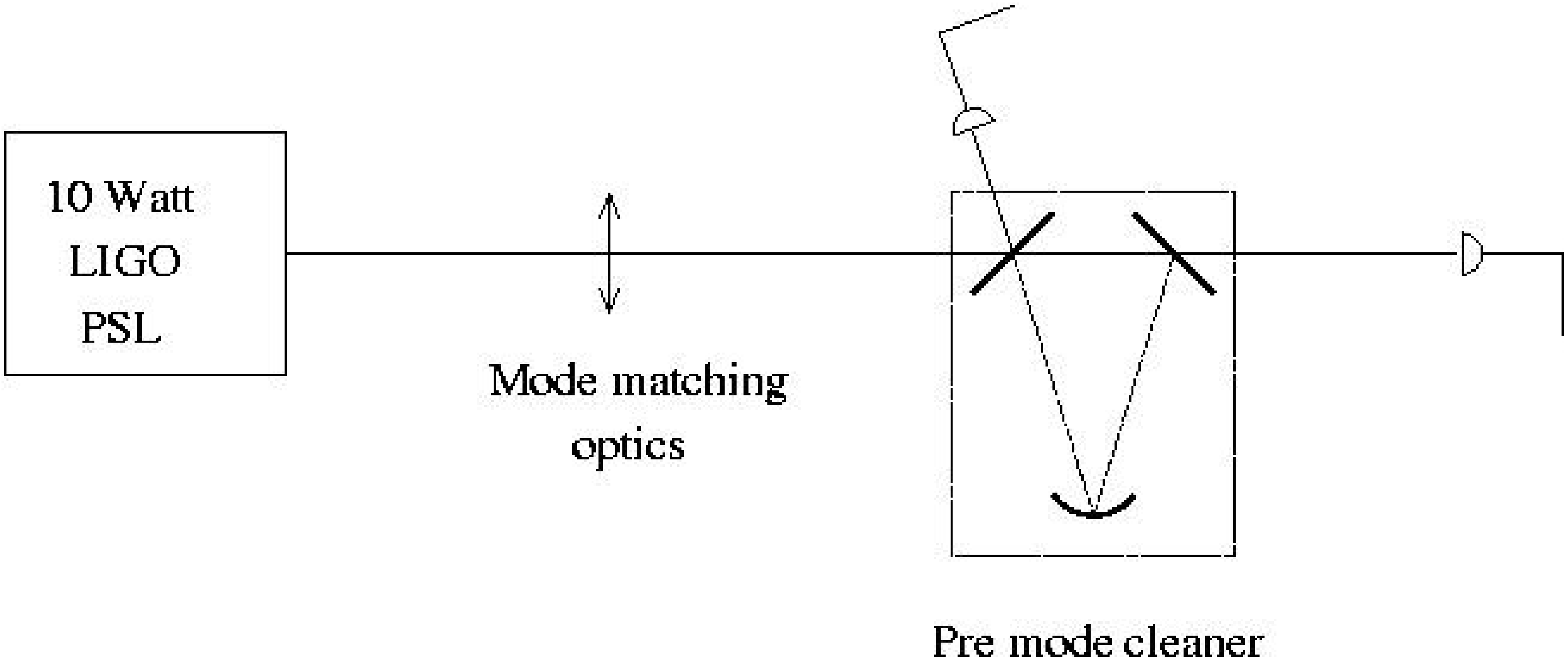
# Simplified Set-up

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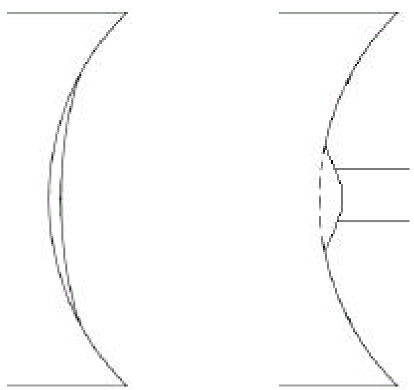
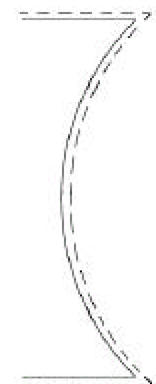
# Expected power absorption effects

- change in radius of curvature due to thermal expansion
  - decreasing mode coupling efficiency $\kappa_{00}$
  - power drop in $P_{transmitted}$
- slow thermal change of mirror surfaces

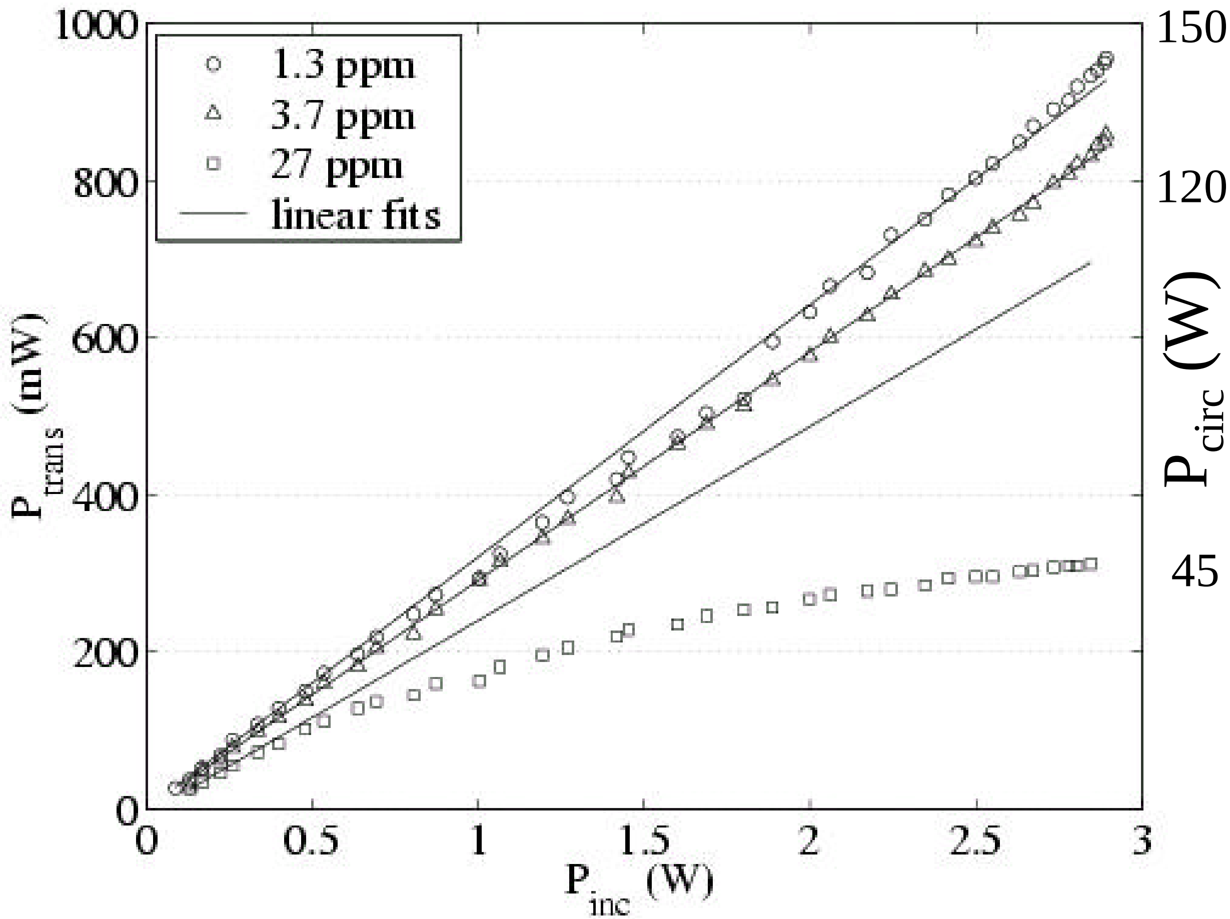


$$\kappa_{00} = f(\omega_e , \omega_{inc} , R_e , R_{inc})$$



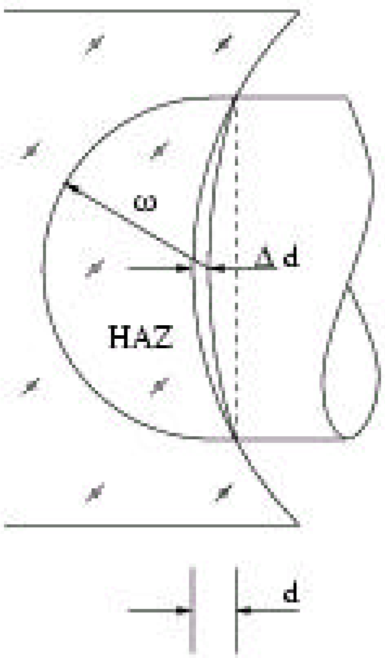
# Power measurement $P_{trans}$ vs. $P_{inc}$

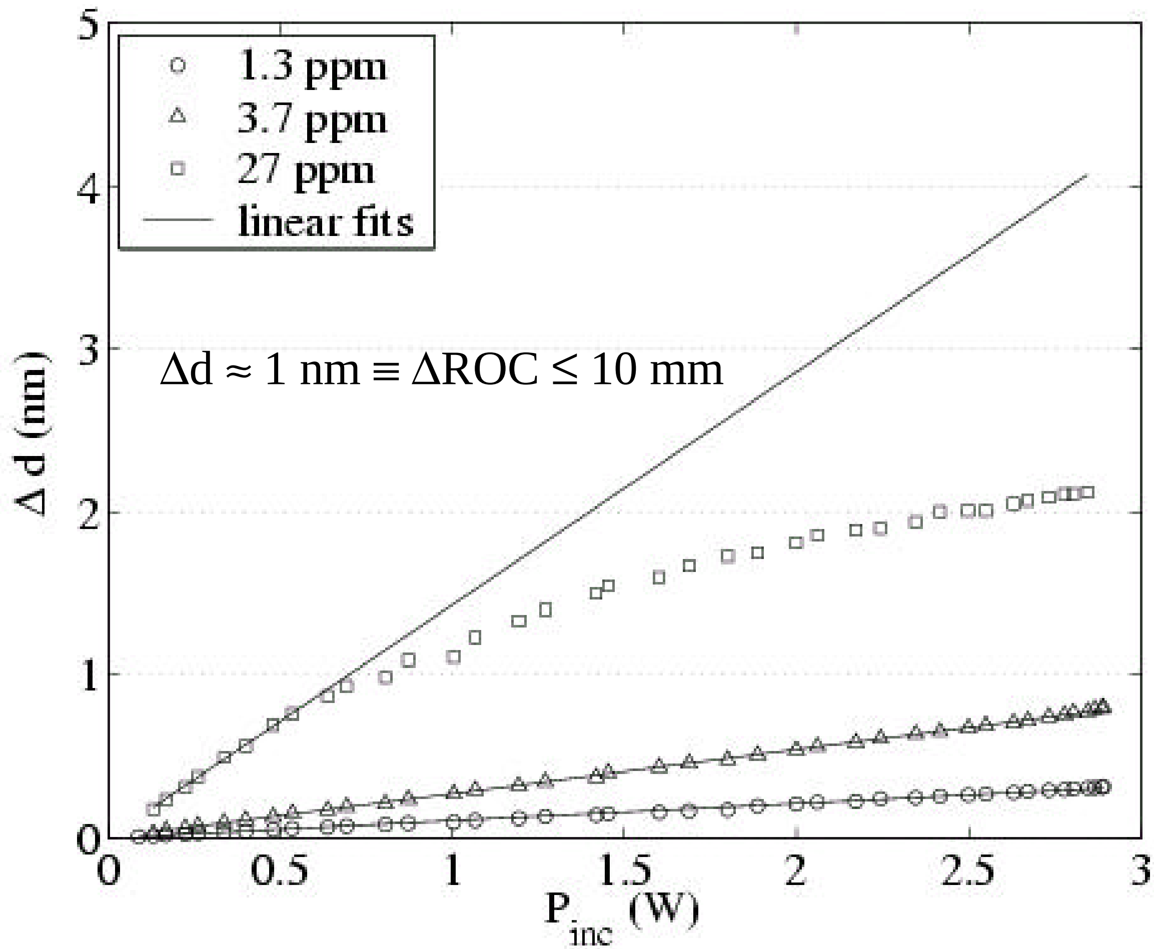
- slopes of fits within 19 %,
- 27 ppm mirror roll-off: ≈0.5 W



# $P_{trans}$ converted into a change $\Delta d$

- Slopes up to different absorptions



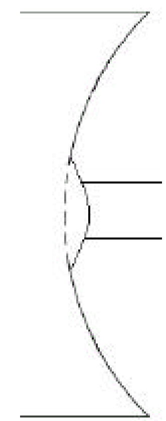



# Possible explanations

- changed impedance match conditions due to higher absorption
- change in coupling efficiency $\kappa_{00}$ due to change in radius of curvature
- absorption of radiation by water vapor
- light from the $TEM_{00}$ mode is scattered into higher order modes

# Light from the TEM$_{00}$ mode is scattered into higher order modes

- absorbed power leads to a dimple on mirror surface
- due to scatter light inside the cavity is propagating in higher order modes
- coupling efficiency degrades with 1/(modenumber$^2$) $\quad \kappa_{00} \rightarrow \kappa_{mn}$
- incident light is not longer transmitted but reflected



# Summary

- it is possible to increase (by ppm's) absorption loss of mirror coating by depositing a chrome layer
- the cavity was driven to sub linearity due to power absorption in the curved mirror
- sub linear behaviour is most likely up to the fact that at higher power levels light is scattered into higher order modes which leads to a significant decreased coupling efficiency

# Future work

- increase mode and impedance matching to reach critical power earlier
- test chrome coated mirrors
- also use untreated low loss mirrors
- determine intracavity loss with ring-down measurement
- monitor reflected power to observe locking mode
- change average power levels by chopping incident beam