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The Gingin High Power Parametric Instability Experiment

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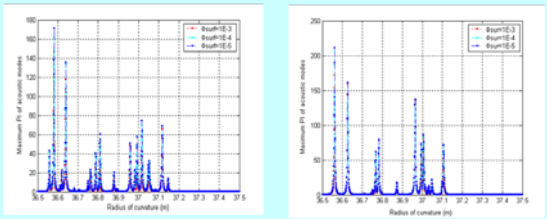
Objectives

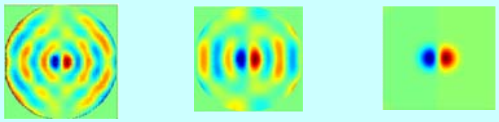
- A 72 m high finesse, high Q-factor suspended optical cavity for studying parametric instability
- Observe parametric instability and test suspension schemes

Modeling Parametric Instability



(a) (b)

Maximum parametric gain vs. RoC
(a) for TEM_{01}; (b) for TEM_{10};

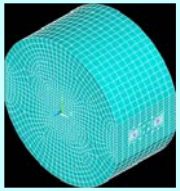


(1) (2) (3)

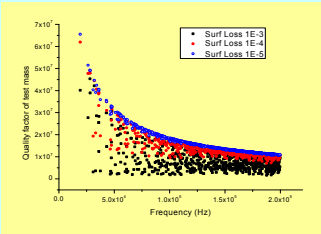
Typical mechanical and optical mode shapes

(1) ω_m=197.35 kHz, Λ =2.0864, ROC=37.118, R= 65.672;
(2) ω_m = 160.35 kHz, Λ = 6.0327, ROC=36.564, R= 346.68;
(3) the field distribution of the TEM01.

Acoustic Mode Modeling including suspension losses

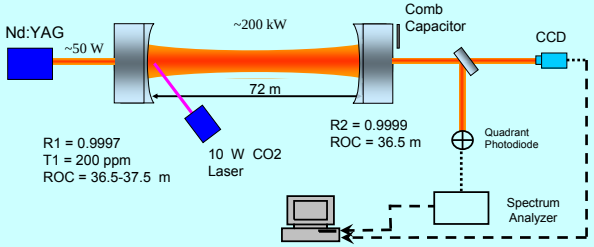


Fused silica test mass (Φ 100 ×50) with flats and holes (Φ 3 ×4) for cantilever-ribbon suspension



Frequency dependant mechanical ***Q*** factors including suspension holes' high surface loss.

Optical cavity design



Optical cavity Parameters:

Cavity length: 72 m

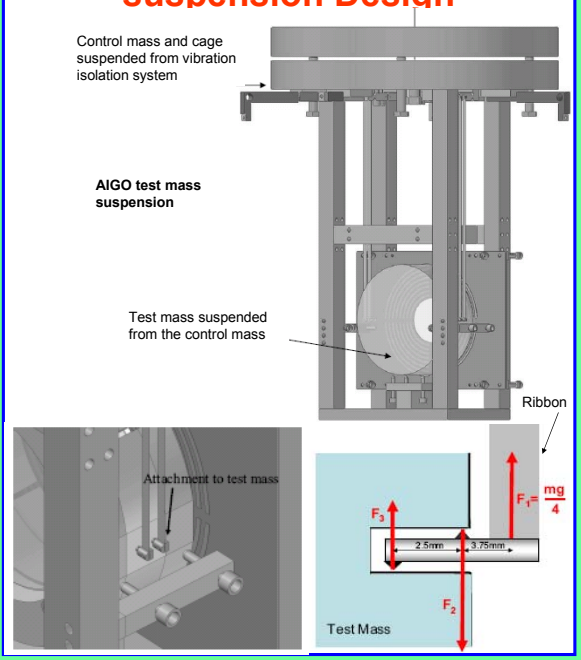
Radius of curvature of test masses: ITM, 36.5-37.5 m
ETM, 36.5 m

Reflectivity: ITM, ~0.9997; ETM, ~0.9999

Transmission: ITM, ~200 ppm; ETM, <100 ppm

Input power: 50 w

suspension Design



Conclusions

1. Ten potentially unstable acoustic modes that have parametric gain between 1 to300.
2. Thermal tuning of the RoC of a test mass to be used to match the resonant condition.
3. Experiment is also a test bed for cantilever-ribbon suspensions.
4. Experiment scheduled to begin late 2009.