Mesa beam discussion

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OWG parallel session

Benefits

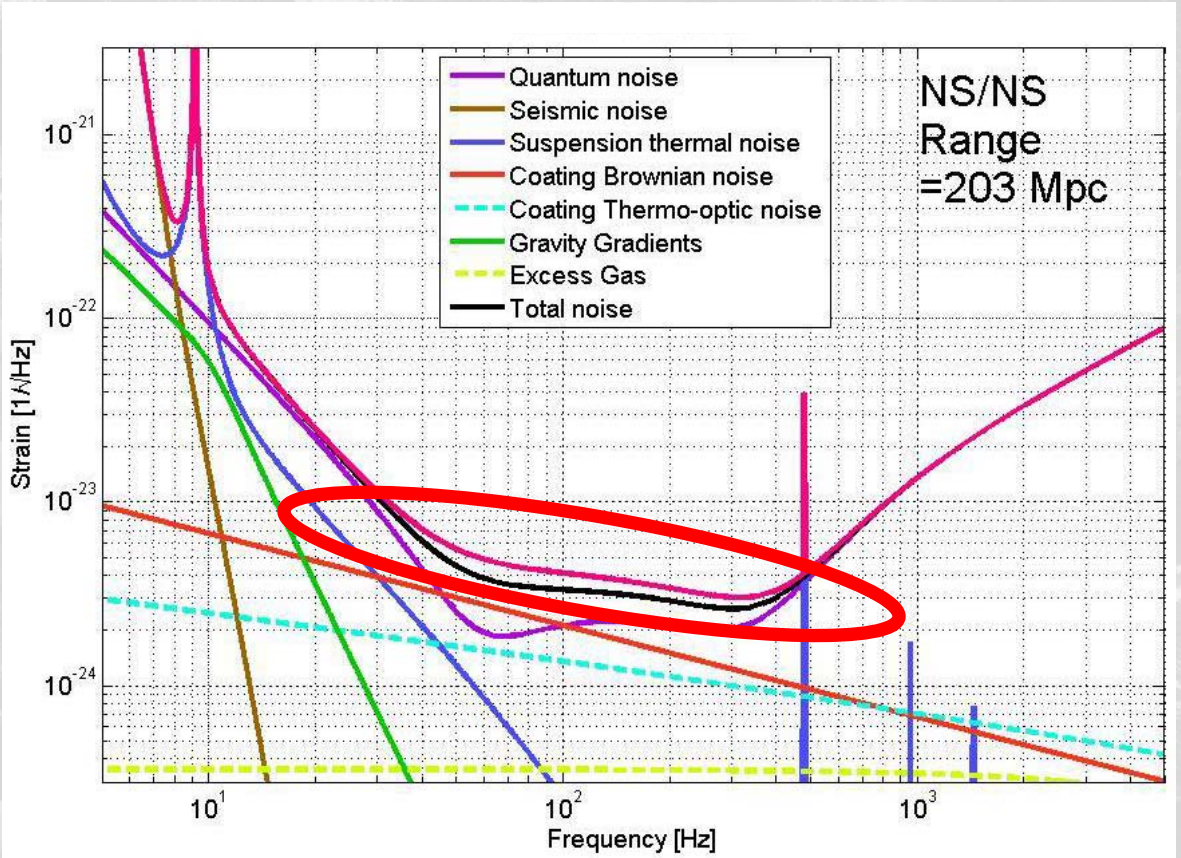
- Ratio of displacement noise Gaussian/ Mesa ~2 for all sources
  - » m/Hz^1/2, single fused-silica test mass, 34cm diam x 20cm thick

- h noise down by x1.8
- @100Hz

- NS/NS range
  - » 170 → 205 Mpc
- BH/BH range
  - » 990 → 1143 Mpc
- Stochastic Ω_{GW}
  - » 2.34e-9 → 1.98e-9

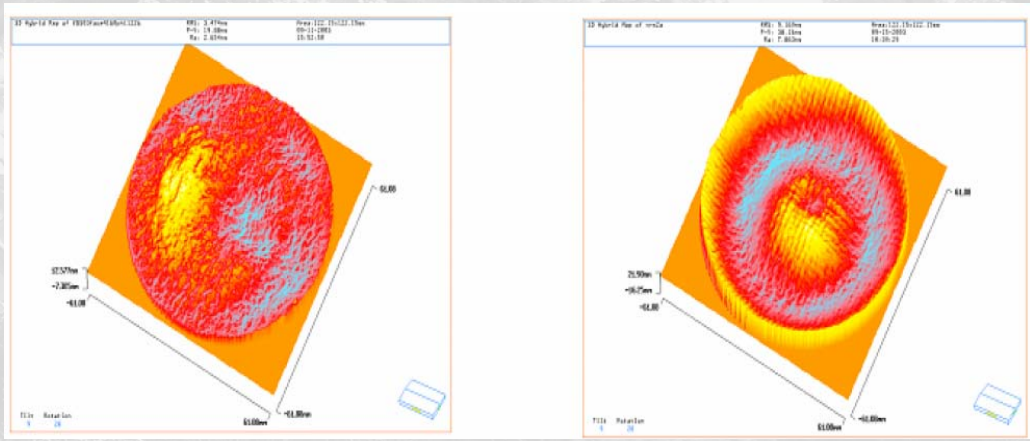
- Event rate
  - » Up by ~1.75

- Thermal effects less significant

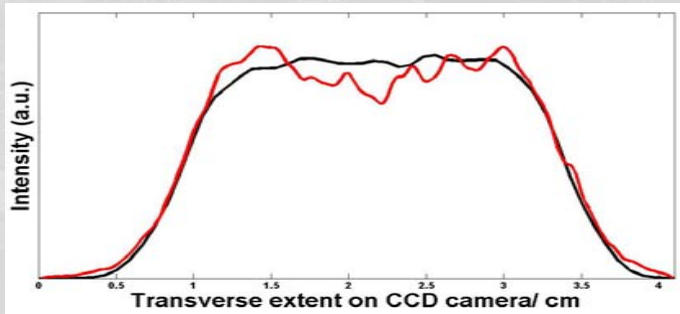


Achievements so far

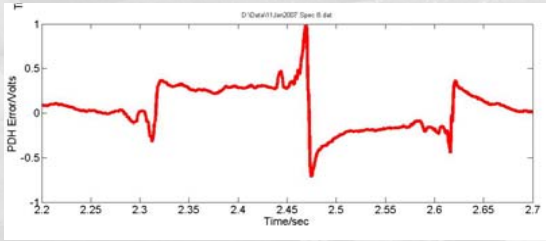
- Mirror manufacture
  - » demonstrated for flat-flat configuration
  - » full size concentric feasible



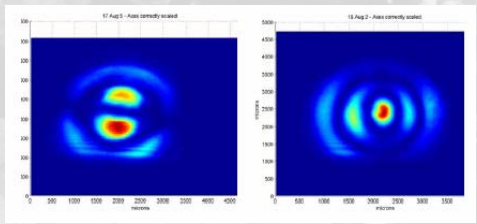
- Resonated mesa mode
  - » injected Gaussian beam, produced mesa beam
  - » theoretical efficiency ~94%

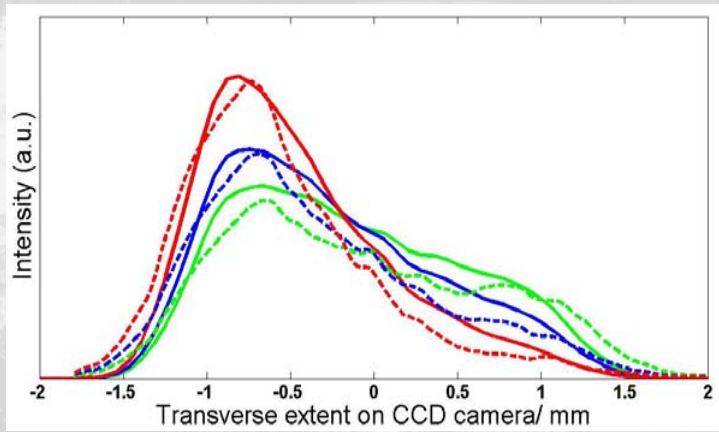


- PDH locking



- Tilt sensitivity
  - » ~x3 worse than equivalent Gaussian

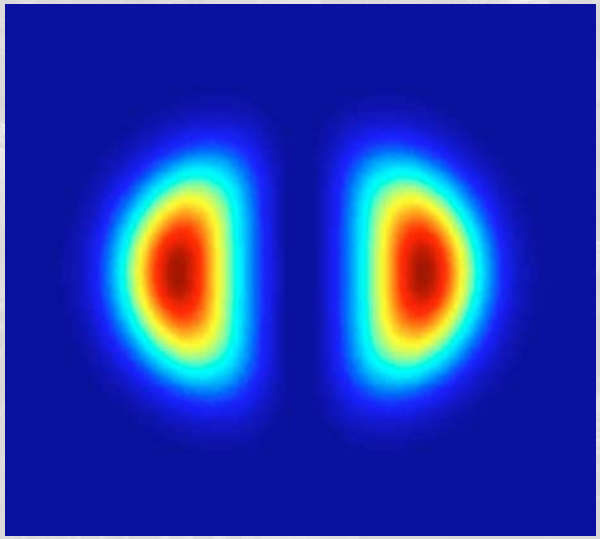


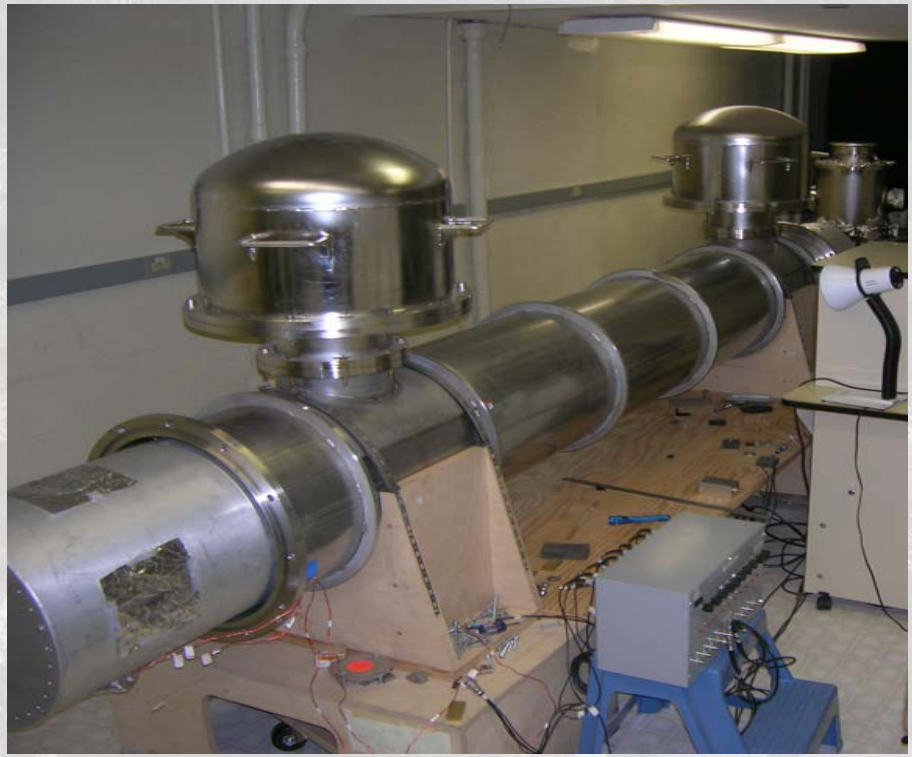


- HOM

To do with present setup

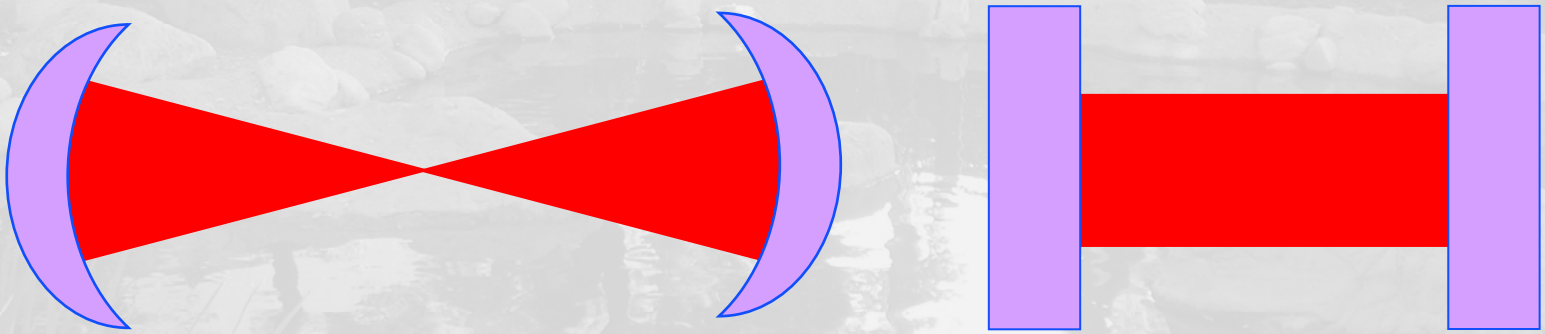
- Examine coupling to Gaussian modes
- Differential wavefront sensing
- Anything else?





To do with an improved set up

- Test a second mirror manufacturing technique
  - » magnetorheological finishing – QED
- Concentric vs. Flat-Flat configuration
  - » possible radiation pressure instabilities



The future

What must we demonstrate to be ready for a full scale detector?

- IFO control – readout, lock acquisition, angular stability
- Recycling
- Mirror manufacture – figure, scatter, absorption....
- Thermal issues
- Radiation pressure stability, Parametric instability
- Measure thermal noise directly

How best to achieve this?

- Simulation
- Medium baseline IFO (~150m)
- Pathfinder optics