A method for Killing the parametric instabilities dead

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Parametric instability workshop

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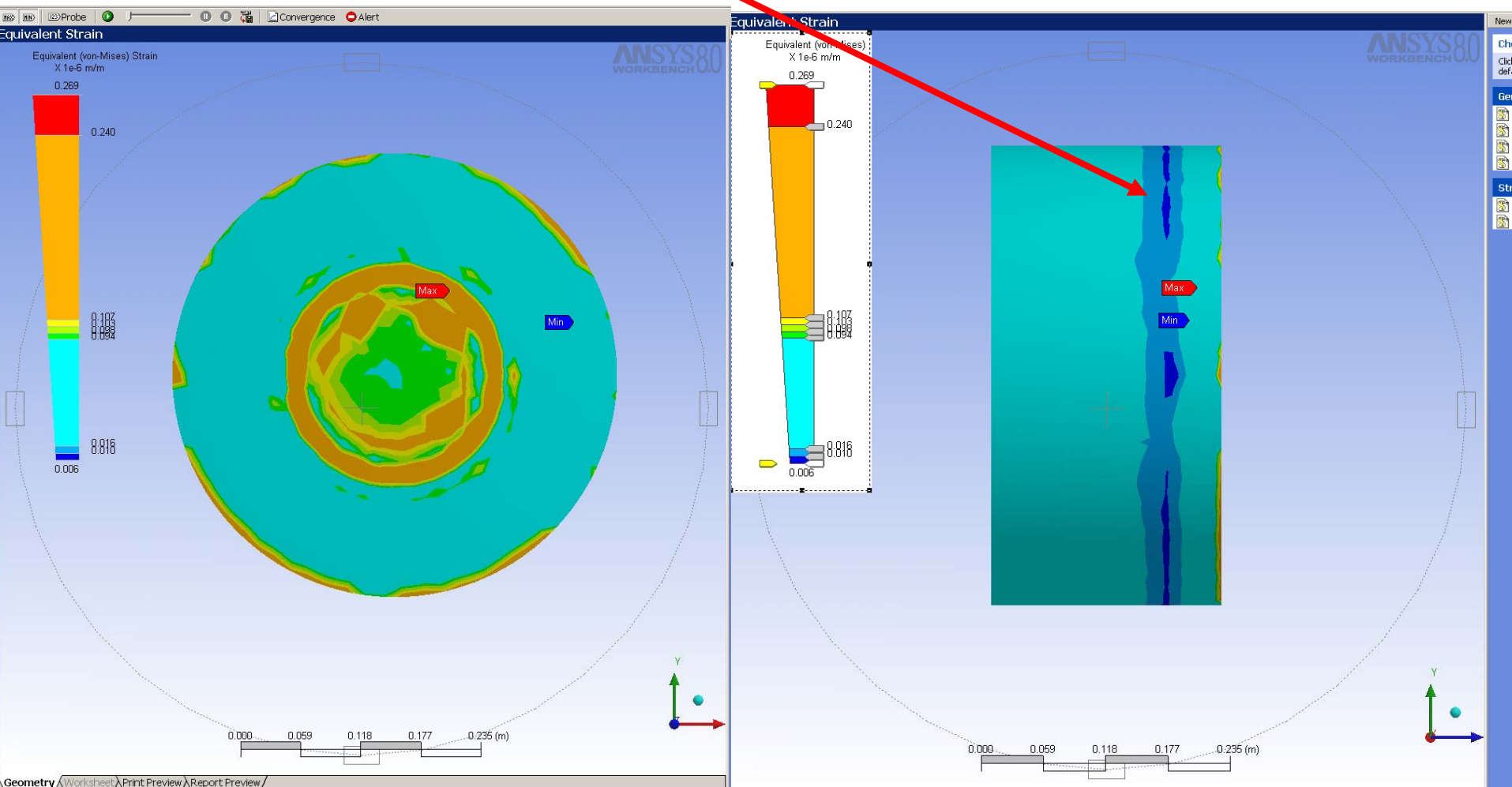
Getting rid of mirror resonances

- Using simulations and Levin's recipe Calum Torrie and Andri Gretarsson
- applied pressure on the mirror surface using:
- A) A mesa beam profile and Ansys
- B) A Gaussian profile and a semi analytic calculation
- Looked for null action areas on the mirror outer surface on which to apply a damper to kill mirror resonances
- These studies were made to eliminate the mirror resonance peaks in the sensitivity curve and to design heavy composite masses

TN neutral band, Calun

- A clear no action band is present (<<%)



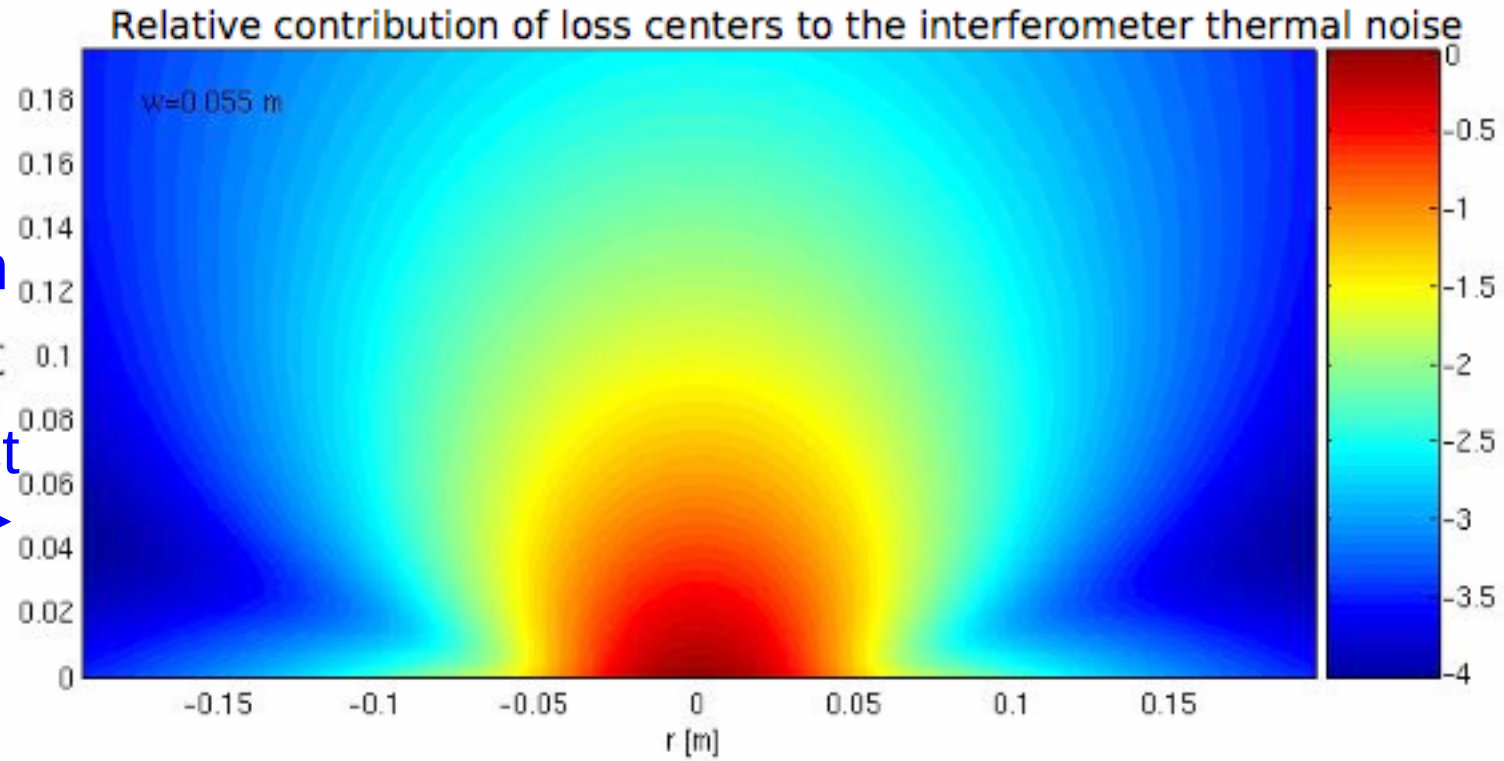
Contribution of ballast and interface thermal noise

TN neutral band, Andri

- Extending Levin-type calculations into the optic bulk shows that even for large spot sizes, the effect of interface loss and ballast material intrinsic loss may be manageable

Null action band

$<10^{-4}$ effect

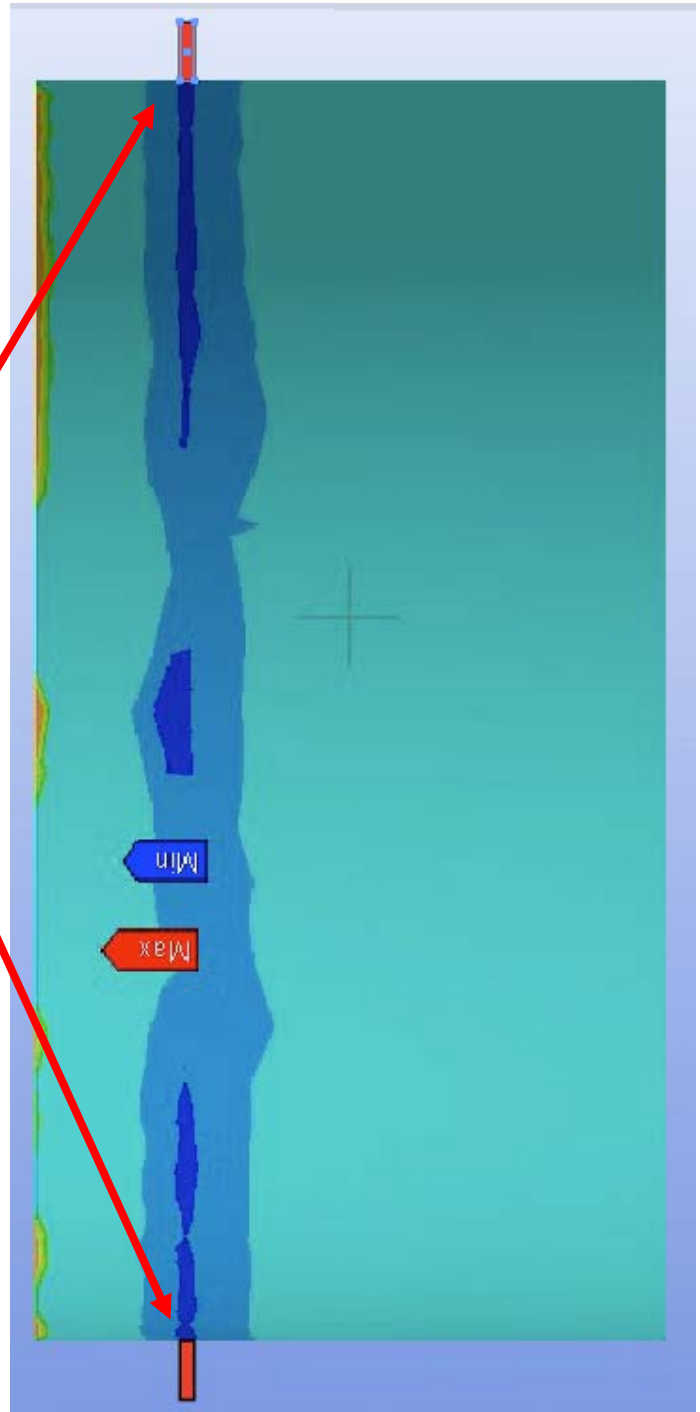


Damping allowances

- Loss is 10^{-4} on the neutral ring and limited on a small mass fraction
- => can tolerate $10^{3} \sim 10^{4}$ losses without TN performance degradation
- effective damping on mirror modes

Damper design

- Heat shrunk 1x5 mm aluminum ring



Getting rid of mirror resonances

- The null action band has less than a percent surface strain energy density than the laser spot area
- A soft aluminum damping ring can be applied in this area
- A moderately high mechanical quality mirror can be obtained without dissipation for the beam profile action

Testing the idea

- Tests to be performed in the TNI on existing TNI mirrors
- Application of a ring does not damage the mirror
- Measurement of the Q factors and TN performance before and after application of the ring will fully determine the effectiveness and the TN cost of the ring.
- The measurement will test the feasibility of composite masses with an optical mass wedged inside an inertial donut mass