Side band beam profile for large perturbations

Erika D'Ambrosio

California Institute of Technology

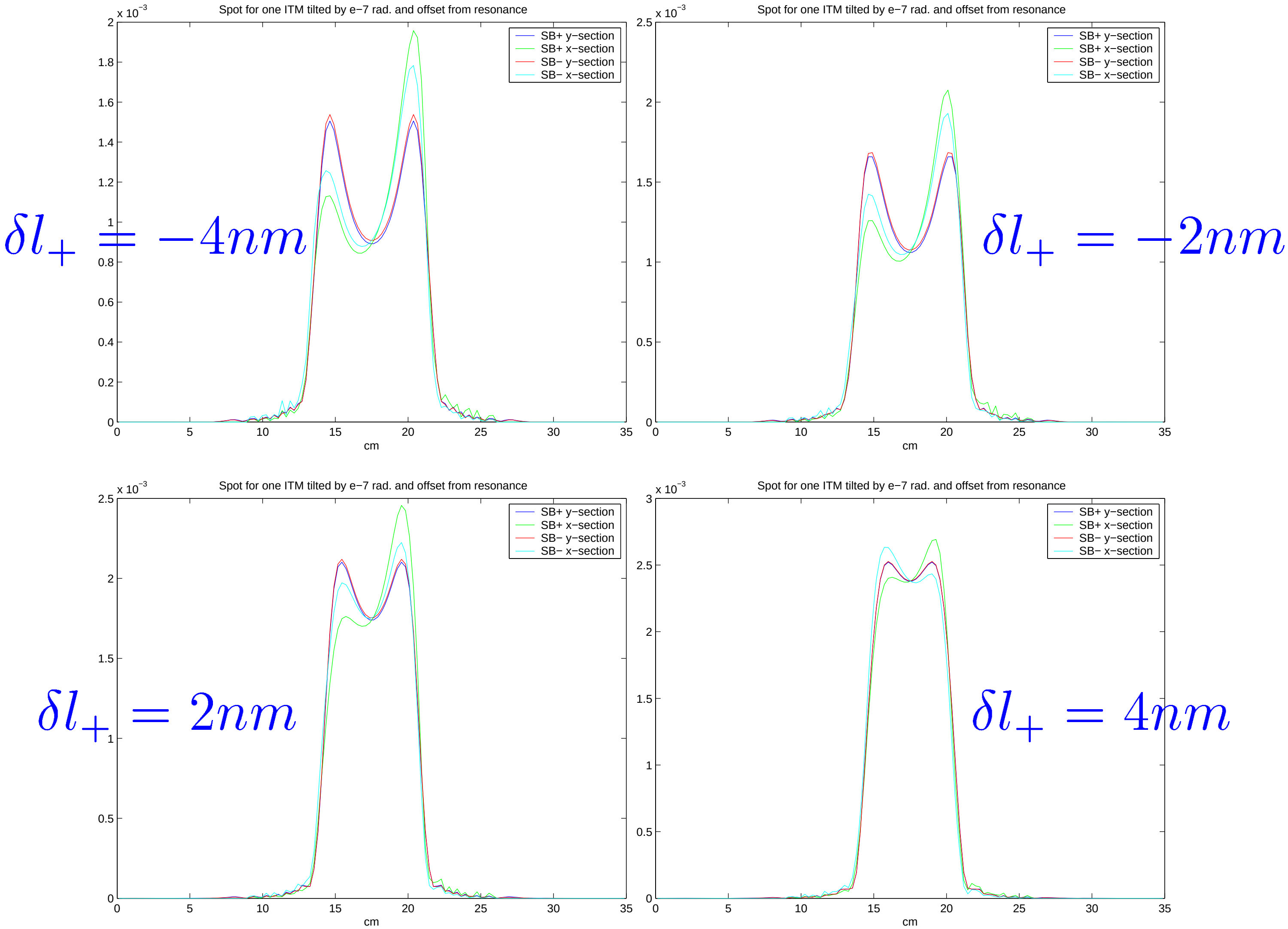
Work in progress on simulating the cold interferometer with no active thermal compensation for optimizing the optical coupling between the recycling cavity and the Fabry-Perot resonators.

Motivations and previous investigations

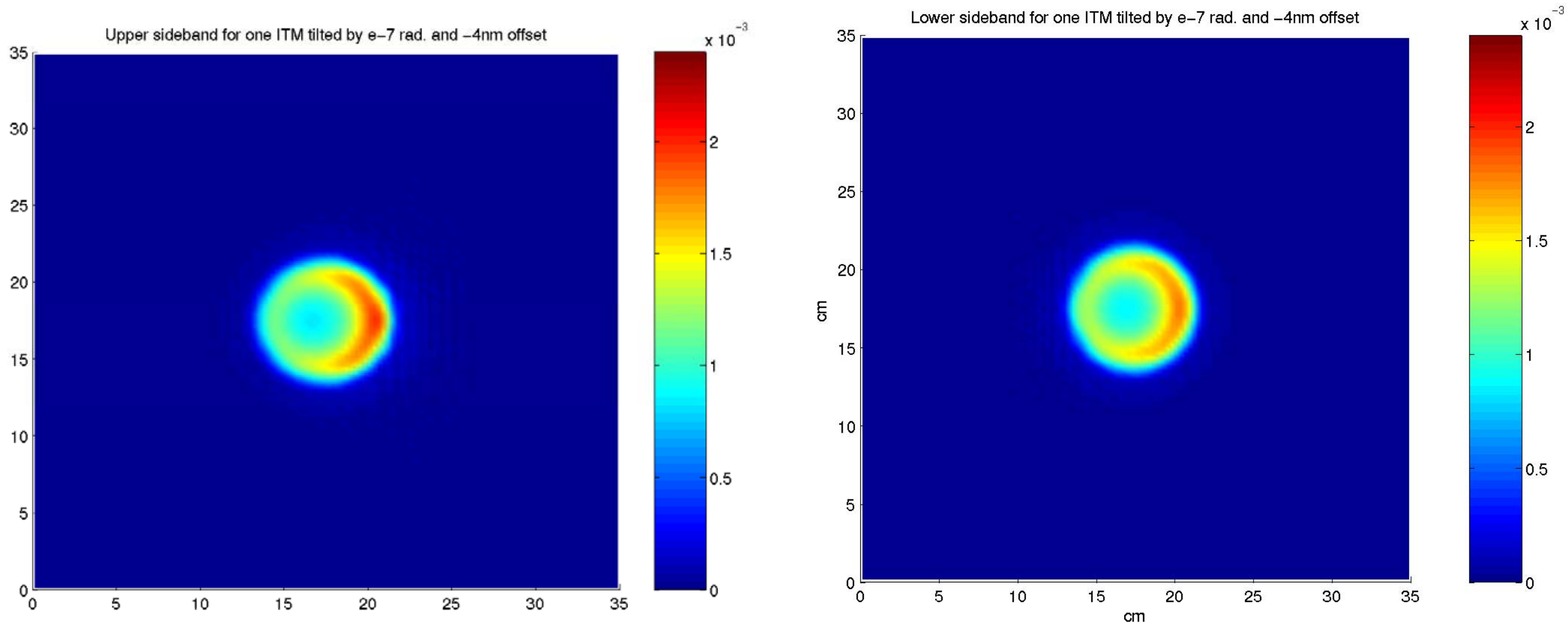
- The FFT model predicts a larger spot size for the resonating side bands than for the carrier.
- Small perturbations can make the side band intensity distribution change a lot, due to the fact that **the recycling cavity is unstable when the absorbed power is not enough to make the ITM substrate behave as an equivalent lens**, in such a way that the curvature of the mirrors be partially counteracted by its focusing effect. The shape of the side band beams is particularly sensitive to l_+.

  I also investigated the numerical results for small variations in l_- and misalignment. The combination of these three kinds of perturbation is also very interesting; **the impact of misalignment is stronger when the shape of the side bands is farther from a Gaussian distribution**. This happens for values of l_+ close to the one corresponding to the carrier maximum circulating power.

Sensitivity to misalignment decreases when the beam gets smaller

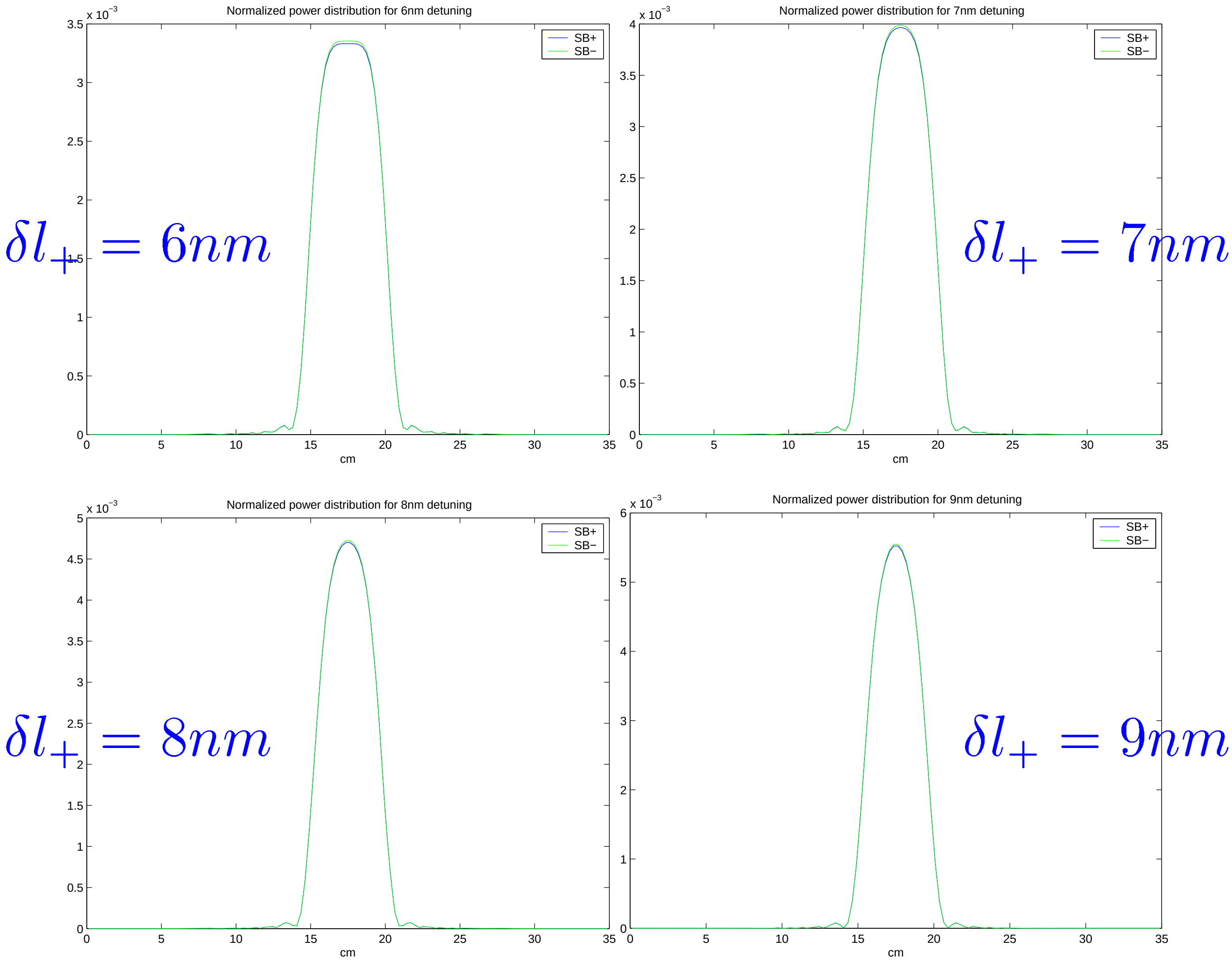


Power distribution for one ITM misaligned and $\delta l_+ = -4nm$

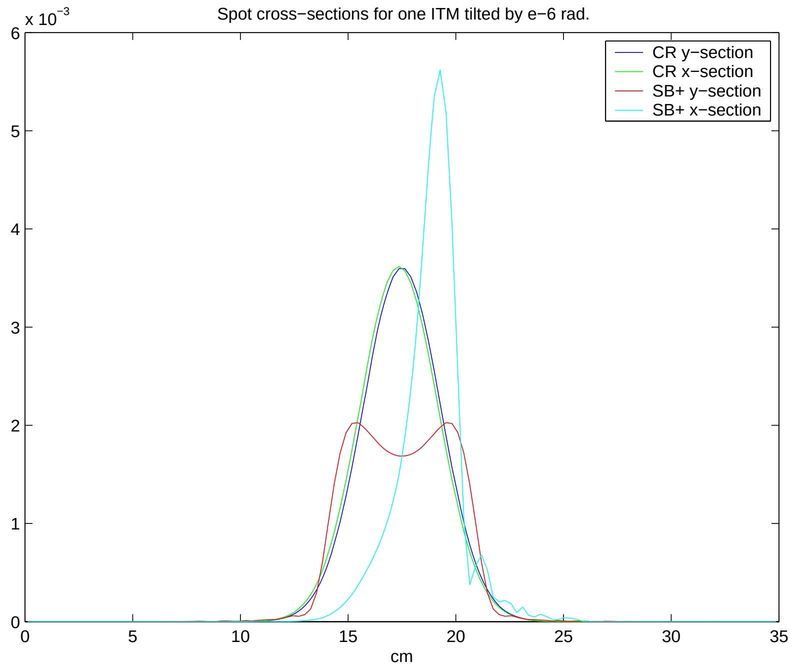


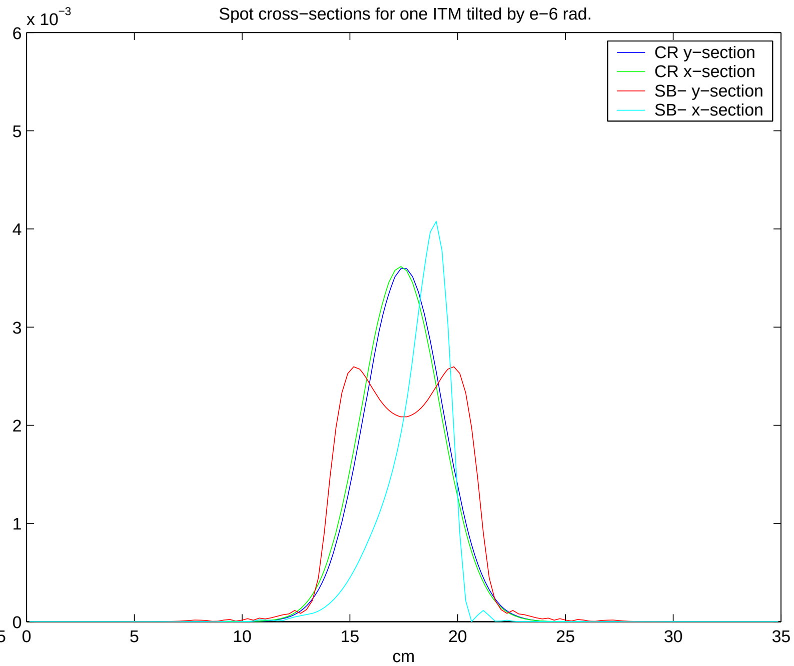
The side bands are much affected by misalignment, when their shape is far from a Gaussian distribution. Only a portion of the travelling light corresponds to constructive interference and builds power up. This portion is associated to a certain section on the transverse plane that changes with l_+. Therefore the cavity is considered unstable .

The most influent perturbation on the shape of the beam is l_+



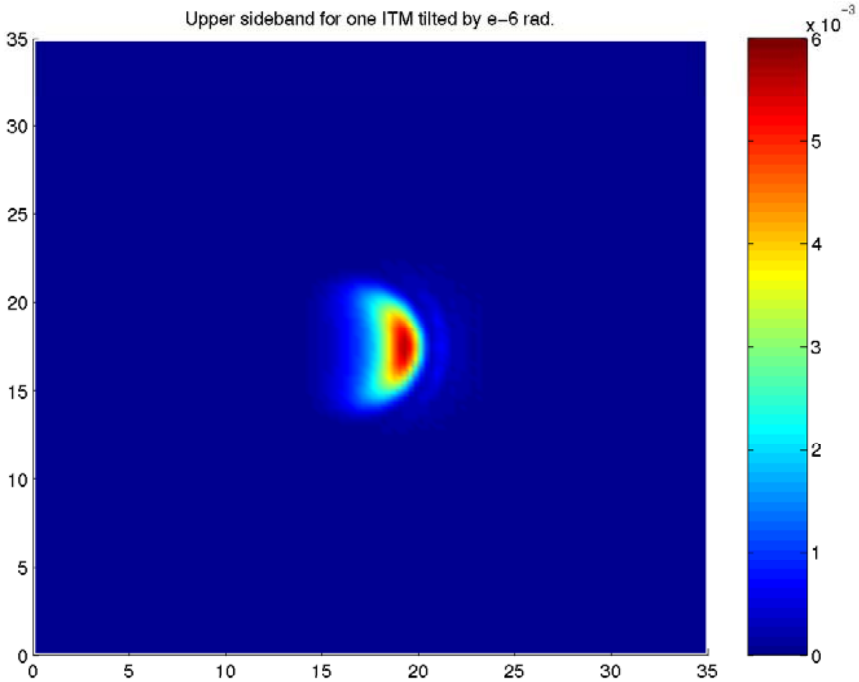
Side band power distribution for a large ITM tilt

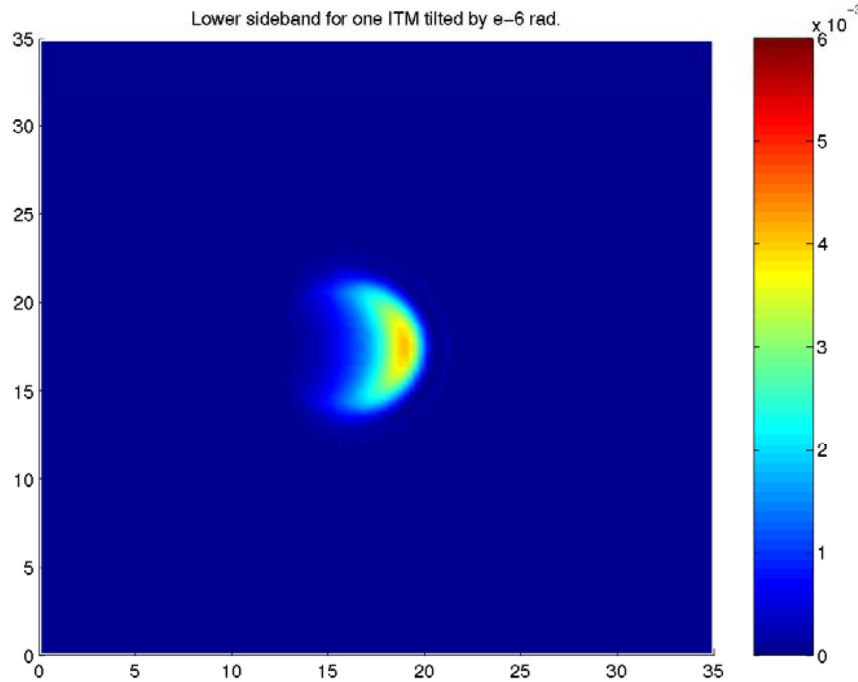




Another possibility that has been checked in order to look for the cause of a very small side band spot size is a large misalignment. When one ITM mirror is tilted by 1μrad the carrier is sligthly but evidently affected. The beam profile of the side bands is significantly modified by this perturbation.

For large tilt the side band intensity is peaked in a small area





Large misalignment makes the side band light peaked off the optical axis, with an equivalent small width.