NOISE IN CAVITY RING-DOWN SPECTROSCOPY CAUSED BY TRANSVERSE MODE COUPLING

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In our cw-CRDS experiments we have often found that the decay time constant drops to a much lower number at some cavity length or some inner pressure of the cavity, which results terrible instability to the sensitivity of our CRDS system. We deduced the cause of this noise is the coupling between the TEM_{00} mode and the higher order transverse modes of the cavity. The coupling will cause an anti-crossing as transverse modes tune with cavity length. A consequence is that the decay of light intensity leaving the cavity is no longer a single exponential decay, but the signal can be quantitatively fit to a model of two-mode beating model. With a 4 mm diameter intra-cavity aperture, the higher order mode is suppressed and the stability of the system improved greatly. One possible coupling explanation is scattering from the mirror surfaces. This assumption can explain some features of our data and the strength of this coupling is estimated by using our experimental data. Remarkably, a scattering intensity between modes of $\sim 10^{-12}$ can produce observable changes in the cavity decay rate.