Solar chameleon detection at CAST

Part II: The optical resonator

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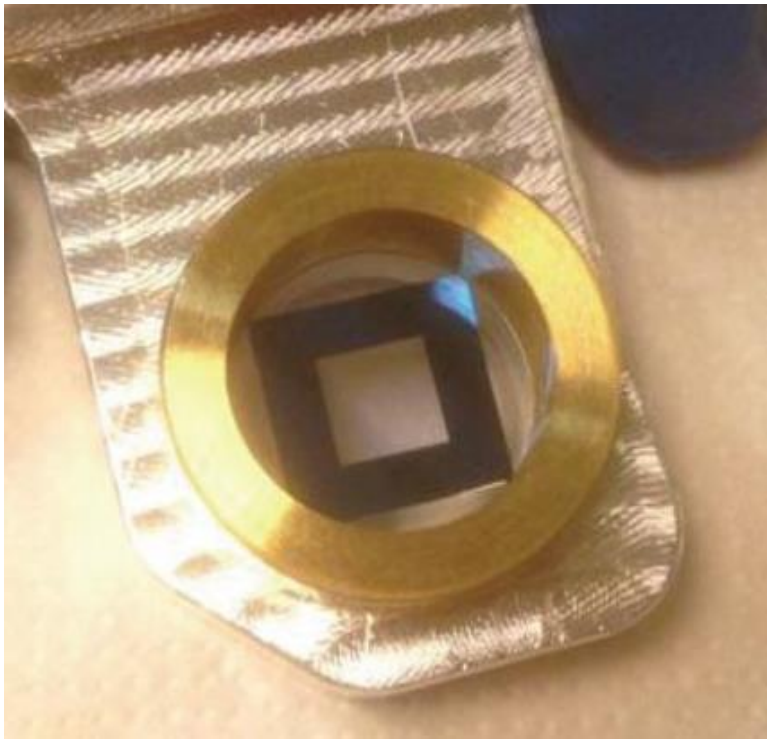
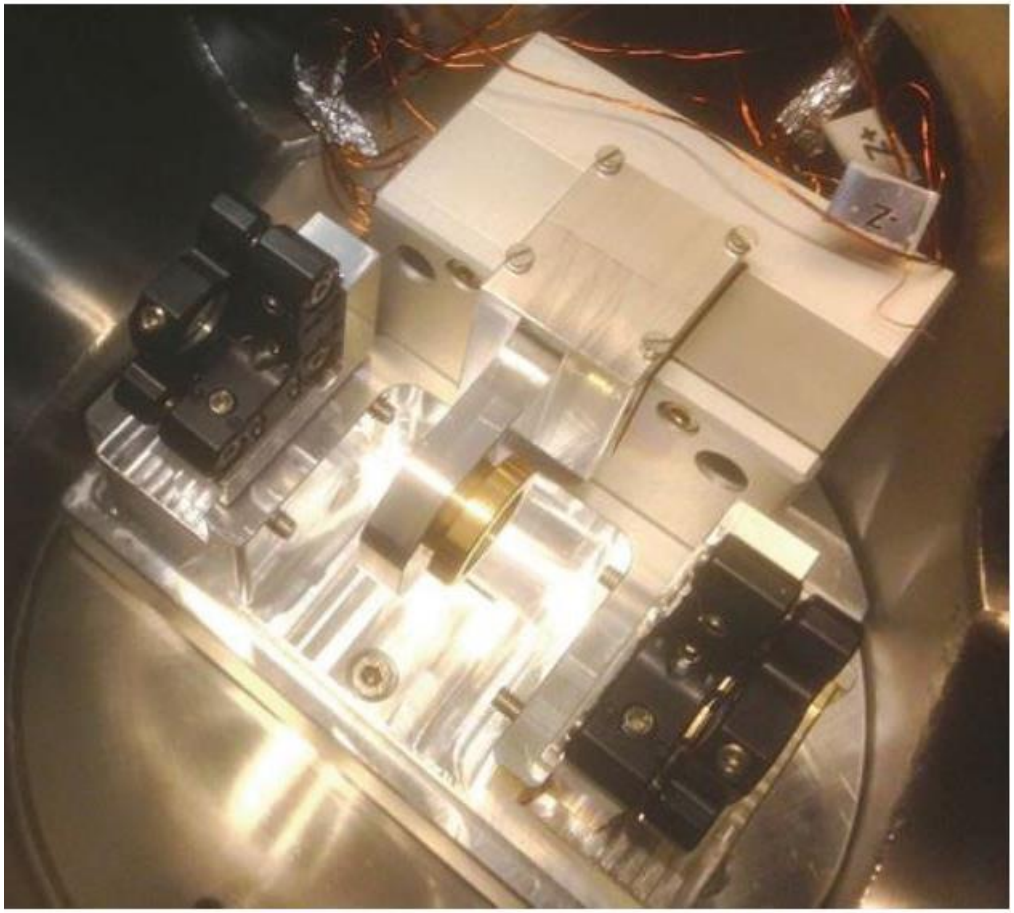
Kinetic WISP detection sensor



- Si_3N_4 micro-membrane (5x5 mm, 100 nm) by Norcada Inc., Canada
- Density 3.2 g/cm^3 (~1 g/cm^3 of vacuum chamber window)
- Effective mass (dependent on density of medium) > total energy

S. Baum et al., “Detecting solar chameleons through radiation pressure” (Sep 2014)

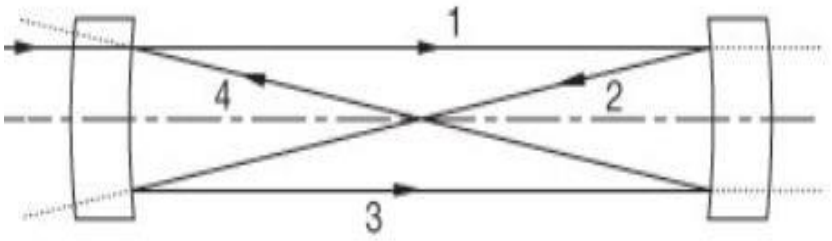
Opto-mechanical resonator



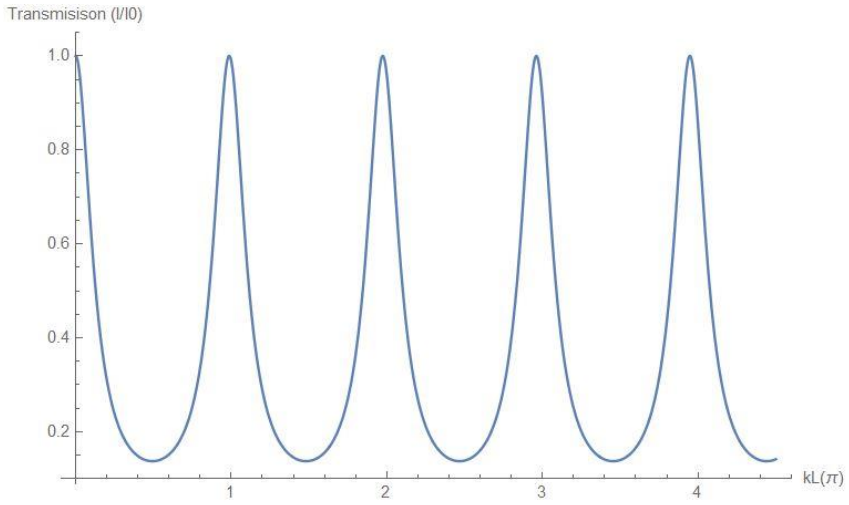
- 1046 nm (IR) solid-state continuous-wave laser
- 85 mm frequency-locked Fabry-Perot cavity
- Vacuum chamber ($<10^{-4}$ mbar)
- Membrane placed at node of resonator

S. Baum et al., “Detecting solar chameleons through radiation pressure” (Sep 2014)

Fabry-Perot cavities



$$T = \frac{(1-R_1)(1-R_2)V}{(1-\sqrt{R_1R_2}V)^2 + 4\sqrt{R_1R_2}V\sin^2(kL)}$$



- Membrane mechanical modes coupled to TEM modes of cavity
- Detuning curve for calibration
- Finesse (FSR/FWHM) of 60000 enhance force sensitivity of 5×10^{-14} N/Hz$^{-.5}$

http://www.thorlabs.de/tutorials.cfm?tabID=21118