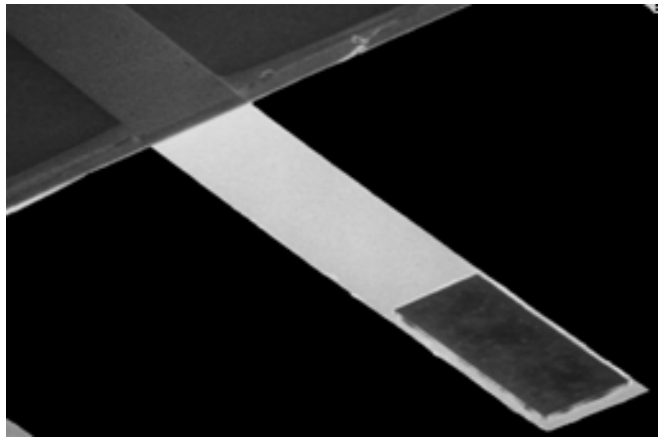
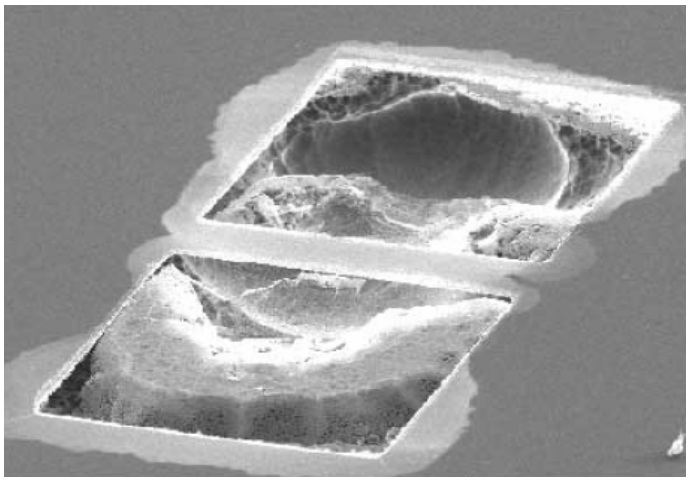
Related experiments



Yale

$\mathcal{F} \simeq 55$

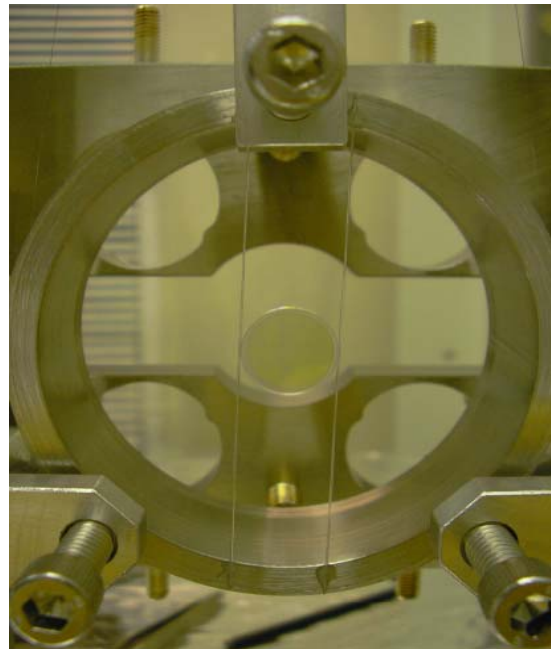


Vienna

$\mathcal{F} \simeq 500$

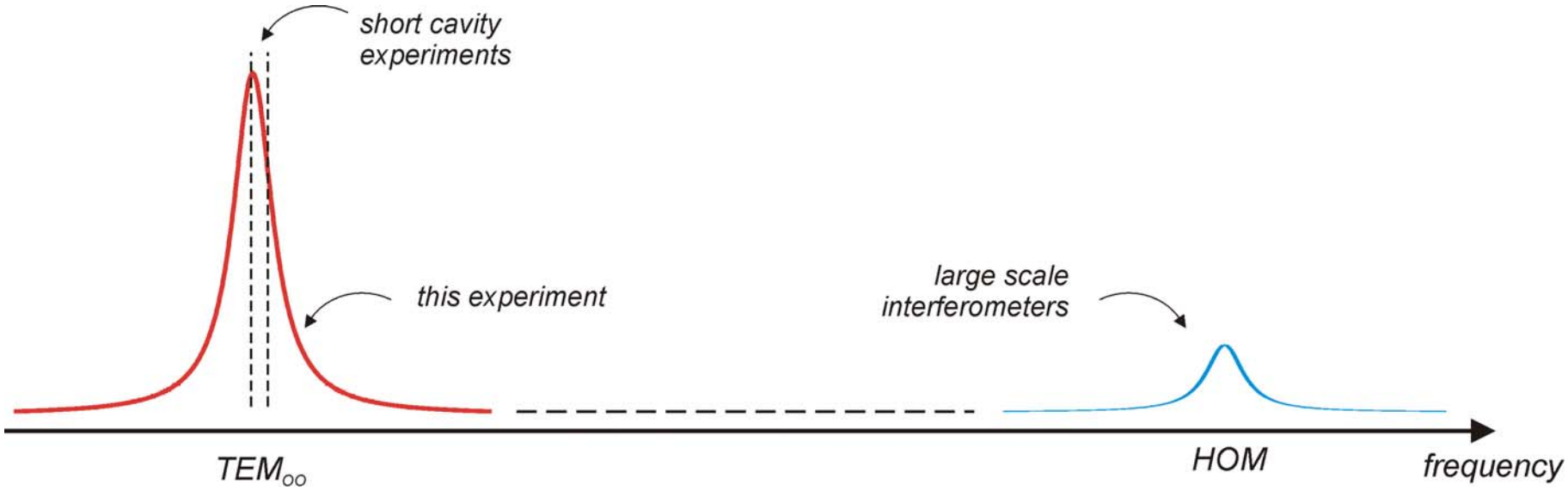
$m_{\text{eff}} \simeq 100$ ng

$P \simeq 1$mW



MIT

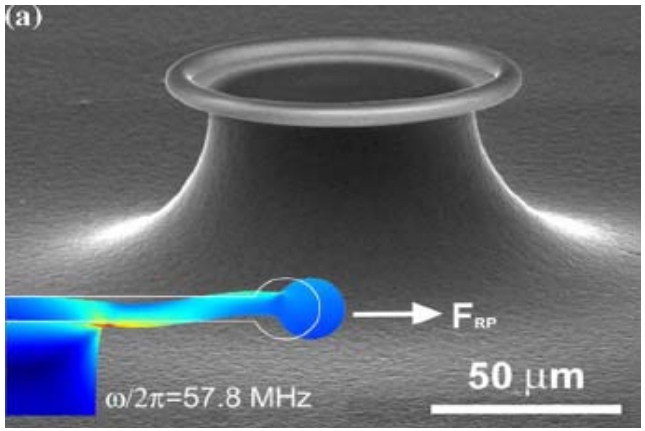
2-mode and 3-mode OAPI



Applications of OAPO

K. Vahala, Caltech

T. Kippenberg, Munich



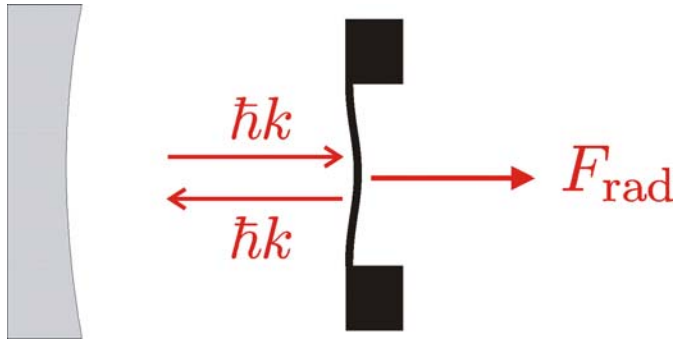
Fused silica micro-toroids on Si:

10s of MHz range

optoelectronics?

"photonic clocks"

Quantum optics and radiation pressure



non linear $\chi^{(3)}$ media **radiation pressure**

optical length $n(I)L$ $\leftrightarrow$ physical length $L(I)$

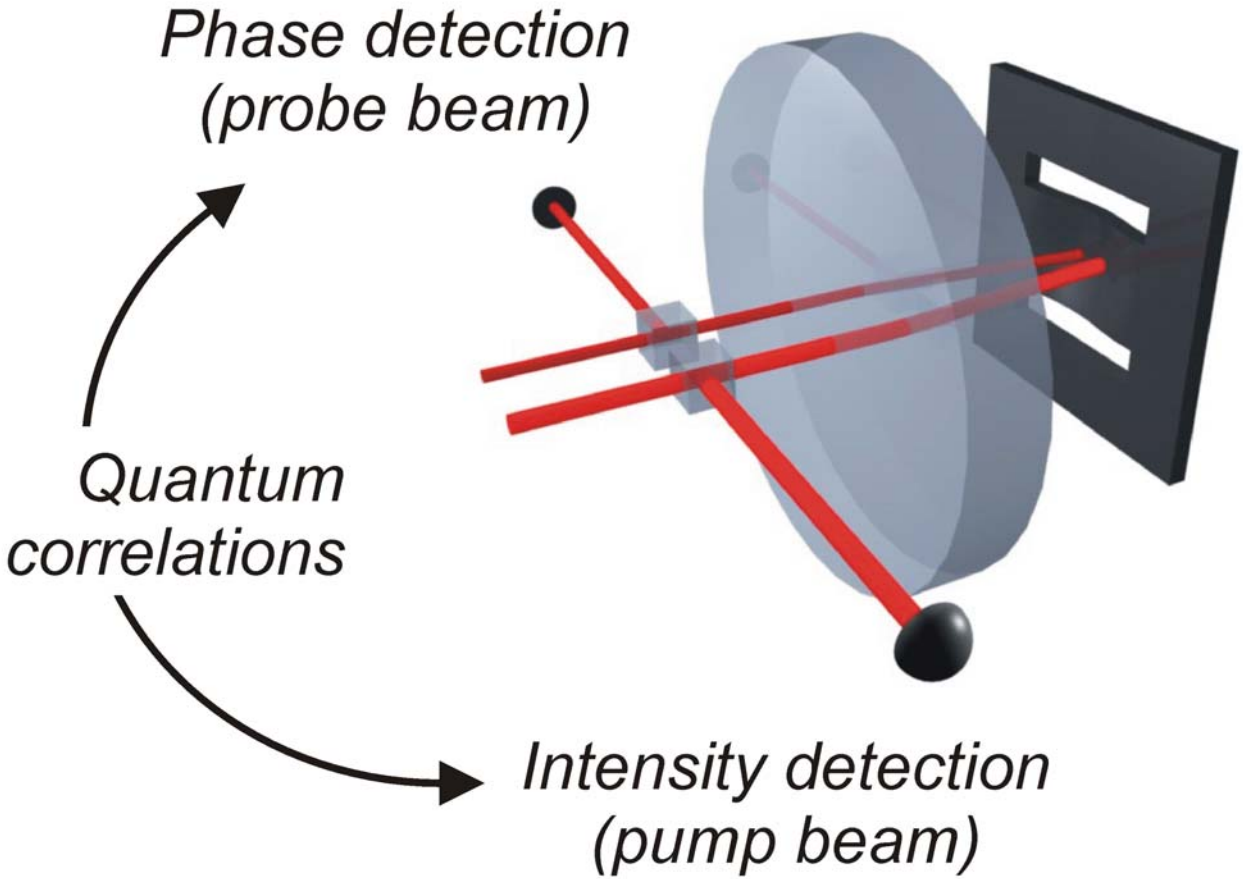
$\delta n(I) = n_2\,\delta I$ $\delta L(I) = 2\chi(\Omega)/c \times \delta I$

(strong) λ-dependance no λ-dependance

close to an atomic resonance (strong) Ω-dependance

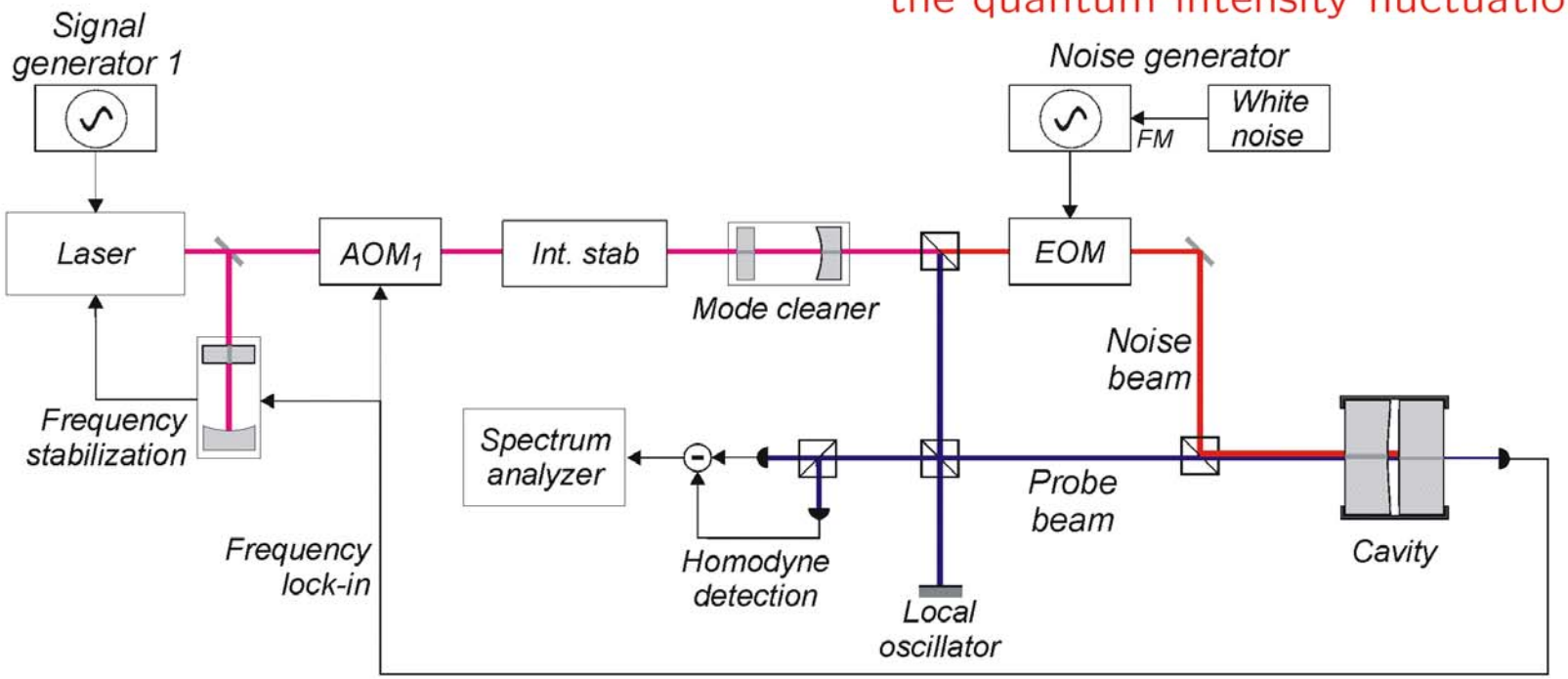
no Ω-dependance close to a mechanical resonance

QND measurement



Experimental setup

An additional **noise beam** mimics the quantum intensity fluctuations



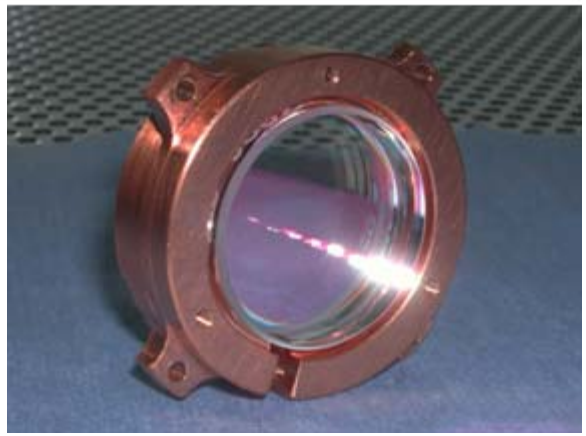
Ti:Sa laser at 810 nm

High-finesse cavity: $\mathcal{F} \simeq 230\,000$

coating by LMA, Virgo Lyon

$\rightarrow$ **expected sensitivity**

at the $10^{-20}\,\mathrm{m}/\sqrt{\mathrm{Hz}}$ level



Experimental progress (required!)

Temperature:

cryogenic operation

Resonator:

$h \geq 4w_0$ $\rightarrow 10$ MHz, $1\,\mu$g

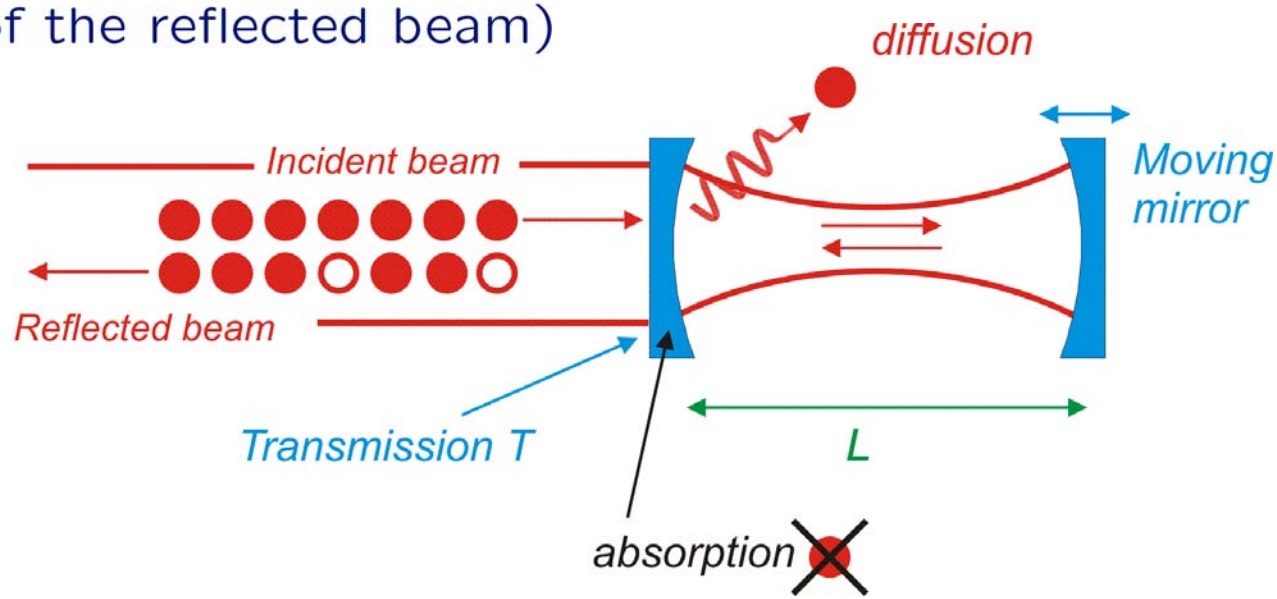
5 μm coatings

Cavity:

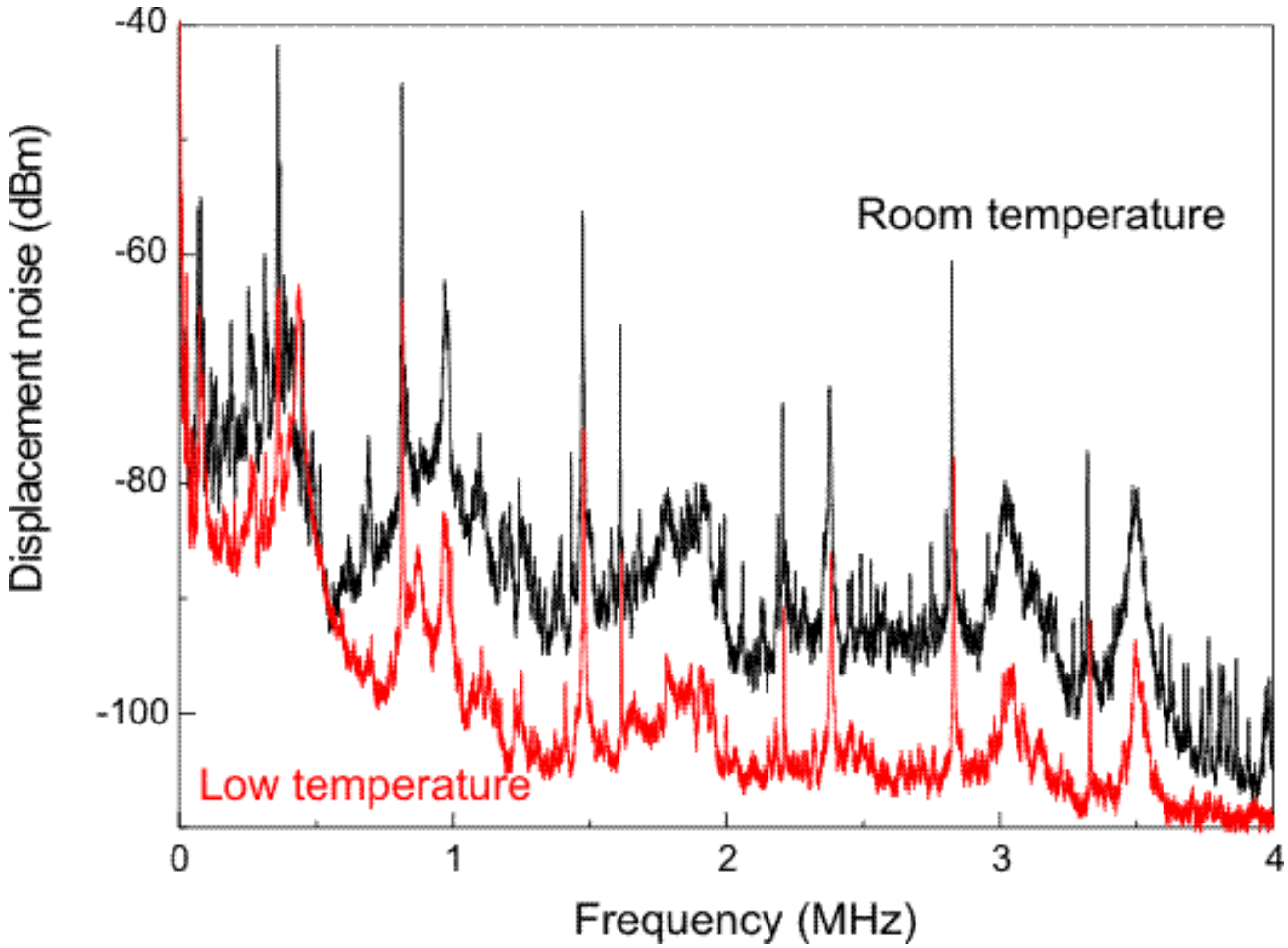
$T + A + D \ll 1$ (high finesse)

$T \gg A, D$ (fidelity of the reflected beam)

$\Omega_c/2\pi \gg 1$ MHz



Cryogenic operation



The thermal noise spectrum moves **as a whole**!

Monitoring quantum **mechanical** fluctuations?

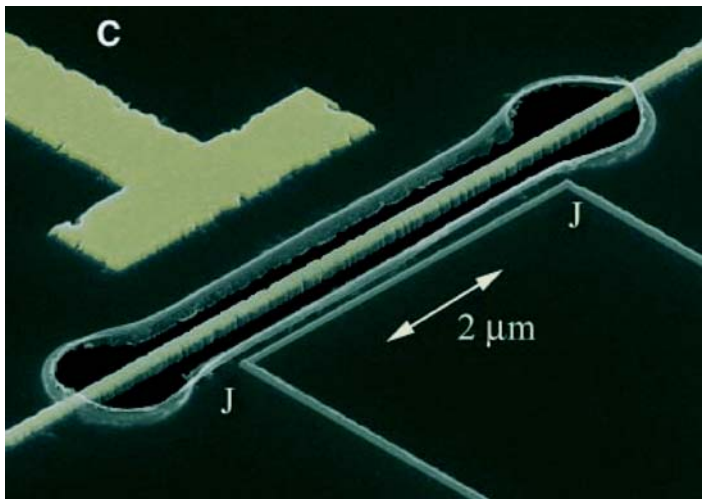
40 mK at 1 GHz

Low temperature : $k_B T \ll \hbar\Omega_M$

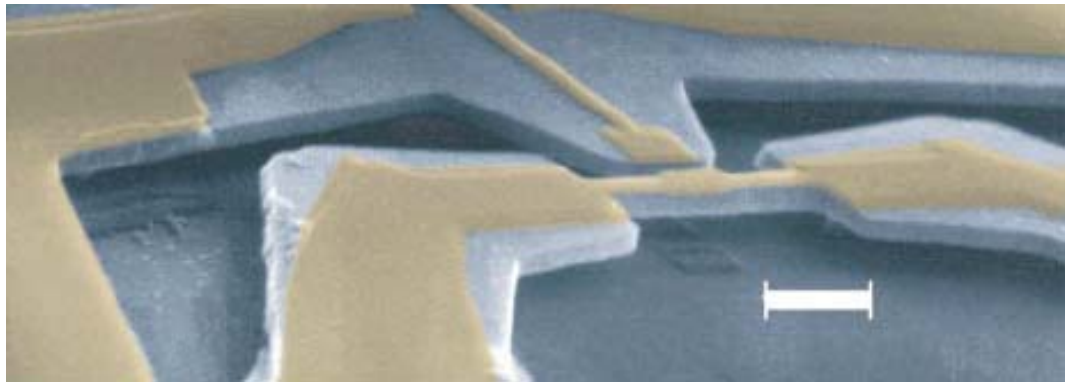
Sensitivity: $\frac{\Omega_M}{Q} S_x[\Omega_M] \ll \frac{1}{M\Omega_M^2}\frac{\hbar\Omega_M}{2}$

$10^{-16}\,\mathrm{m}/\sqrt{\mathrm{Hz}}$ required

LPS Maryland



UCSB



State-of-the-art (Nov. 2006)