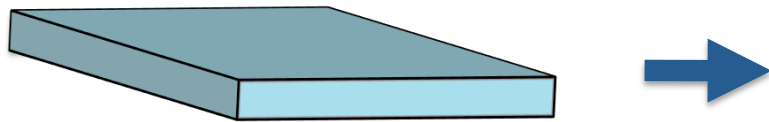


Confined superfluid ^3He : thermodynamic properties

Nanofabrication techniques: precisely defined geometry

Example: slab geometry

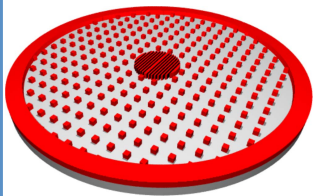


Experimental constraints:

- measure small amount of liquid ($\sim \text{pL}$)
- high control of the surfaces roughness
- ultra-low temperature compatible

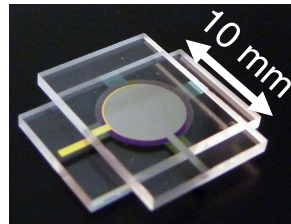
^4He

Heat capacity



Gasparini group

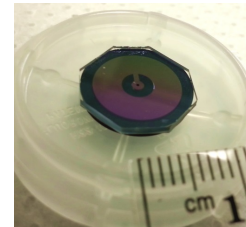
Superfluid nano resonator



Davis group

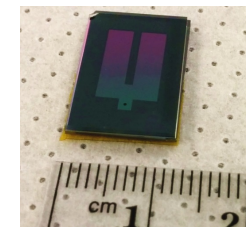
^3He

Torsional oscillator



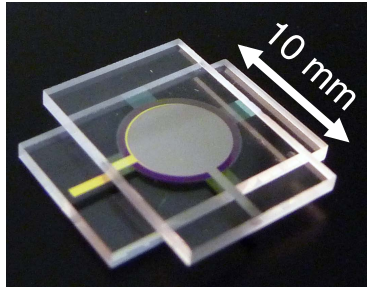
Parpia group

SQUID NMR

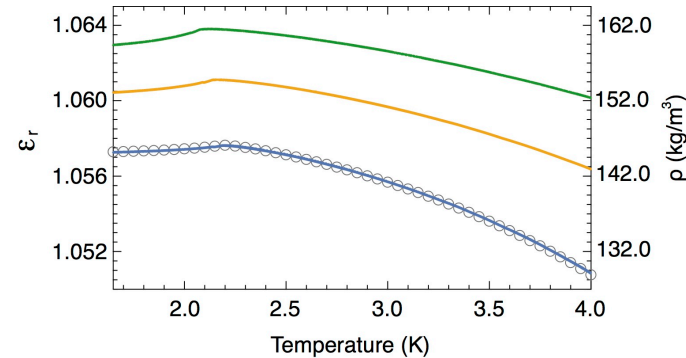


Saunders group

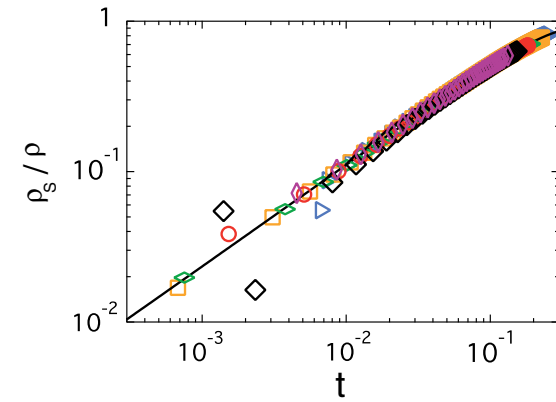
Confined superfluid ^3He : thermodynamic properties



Nanofluidic capacitor



Superfluid nanoresonator



The slab is an ideal geometry for a plan capacitor

=> can we probe the surface states via the **dielectric constant**?

=> coupling to collective mode at high frequency?

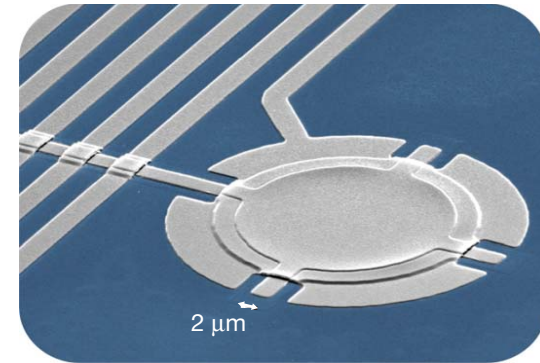
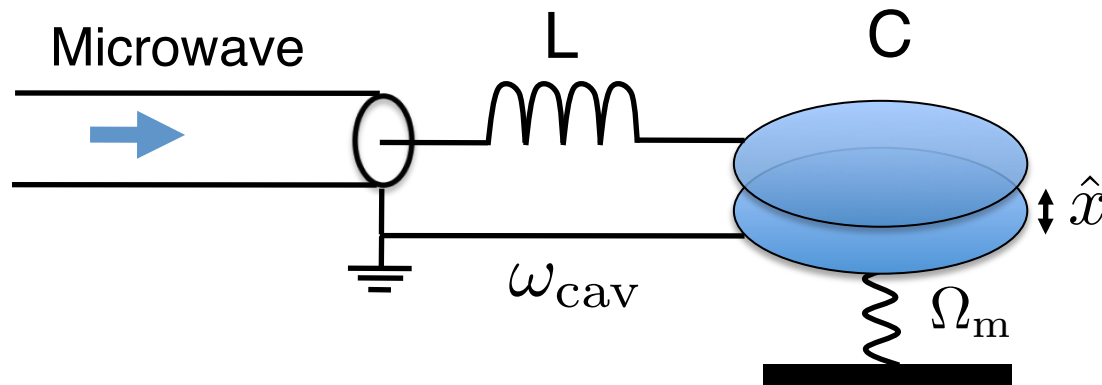
Superfluid nanomechanical resonators

=> Helmholtz resonators: **superfluid fraction & thermal conductivity**

=> Ultrasonic resonators: **sound velocity & attenuation**

talk: August 11th at 4:20pm

Microwave optomechanical scheme

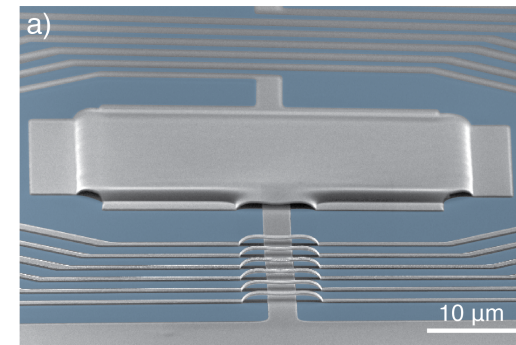


Teufel *et al.* *Nature* **475**, 359 (2011)

Nanomechanical resonators

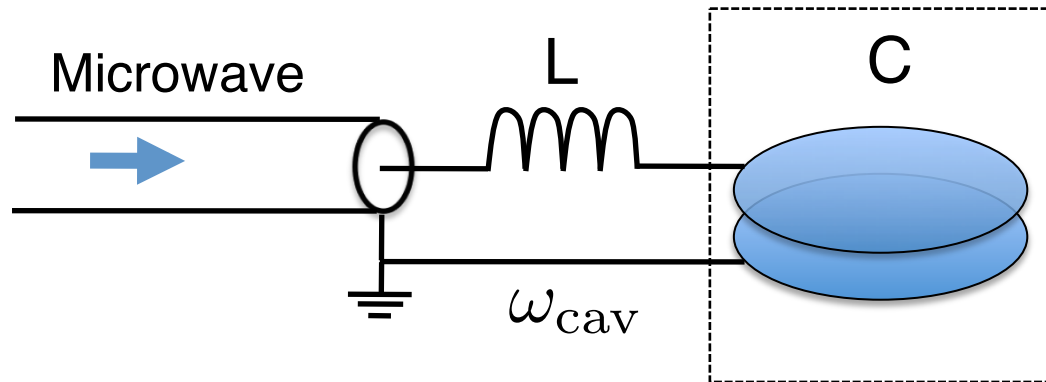
- Vibrating string/beam
- Vibrating Membrane
- Trampolines

Superfluid nanomechanical resonators



Suh *et al.* *Science* **344**, 1262 (2014)

Microwave optomechanical scheme



Very high quality factor

Dissipation (phonons, rotons)

$$\rightarrow Q_m \sim 10^{10} \quad (T \sim 10 \text{ mK})$$

L. A. DeLorenzo *et al.* *New J. Phys.* **16**, 113020 (2014)

