

# High performance SRF accelerator structures development

Our goal is development of high  $Q_0$  and  $E_{acc}$  cavities at reduced cost in a sustainable way using medium grain niobium with relaxed specifications

Present limitations:

- With high RRR one could build cavities with gradients up to  $\sim 42$  MV/m but low  $Q_0$
- Alloying with nitrogen and titanium improves the  $Q_0$  but lowers the  $E_{acc}$ , reasons are not understood

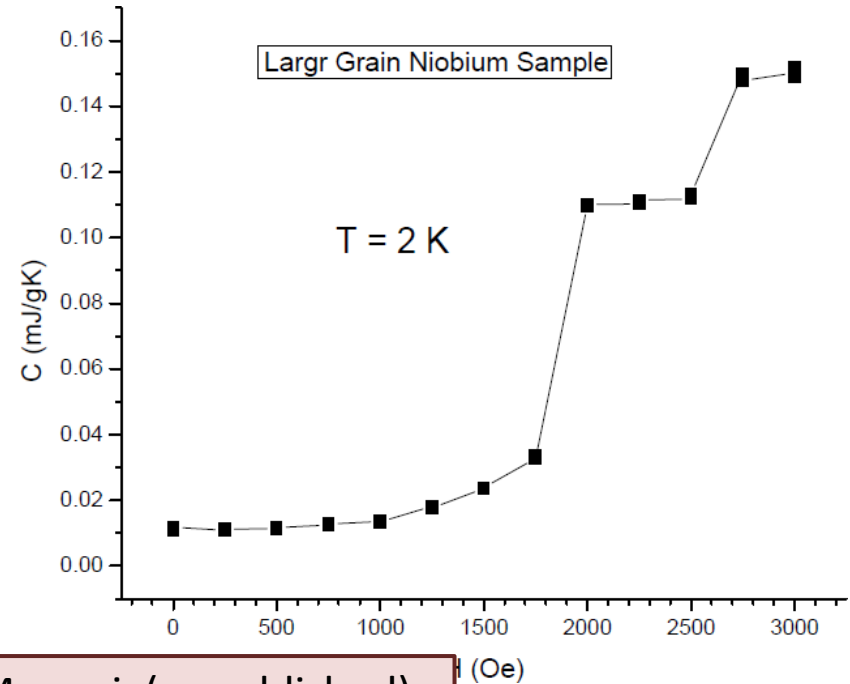
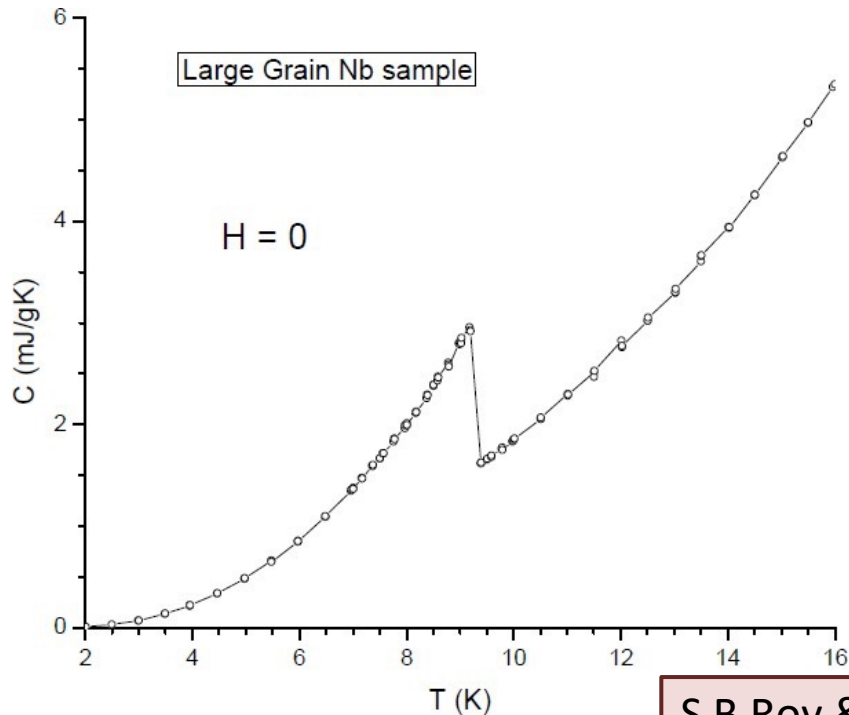
What do we know;

- In general, the cavities mostly quench at high magnetic field region (near the equator) due to first flux penetration where residual stresses are high and copious hydrogen is present
- Magnetic flux reduces thermal conductivity and increases specific heat there by reducing the thermal diffusivity considerably
- We do not have thermal conductivity and specific heat data for niobium with different interstitials and process conditions

R&D proposal;

- Identify collaborators with Quantum Design PPMs with thermal conductivity and specific heat options ( $\sim 1M\$$ )
- Hire a graduate student and generate the required data so that process conditions could be optimized to achieve high performance accelerator structures reliably

# Temperature and magnetic field dependence of heat capacity of superconducting large grain Niobium



S B Roy & G. Myneni (unpublished)

During cavity operation heat is deposited in the sc layer of  $\sim 60$  nm  $\tau$  (1.5 GHz)  $\sim 6.6 \times 10^{-10}$  s

$$\text{Thermal diffusivity}_{2K} \alpha_{2K} \sim k/\rho C = 2333 \text{ cm}^2 \text{ s}^{-1}$$

Thermal Diffusivity  $\text{cm}^2 \text{s}^{-1}$

$10^5$   
 $10^4$   
 $10^3$   
 $10^2$   
 $10^1$   
 $10^0$

0.1

1

10

T(K)



Ingot niobium  
Roy, Myneni

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