

# Field dependent losses mechanisms in SRF Nb cavities probed via muon spin rotation

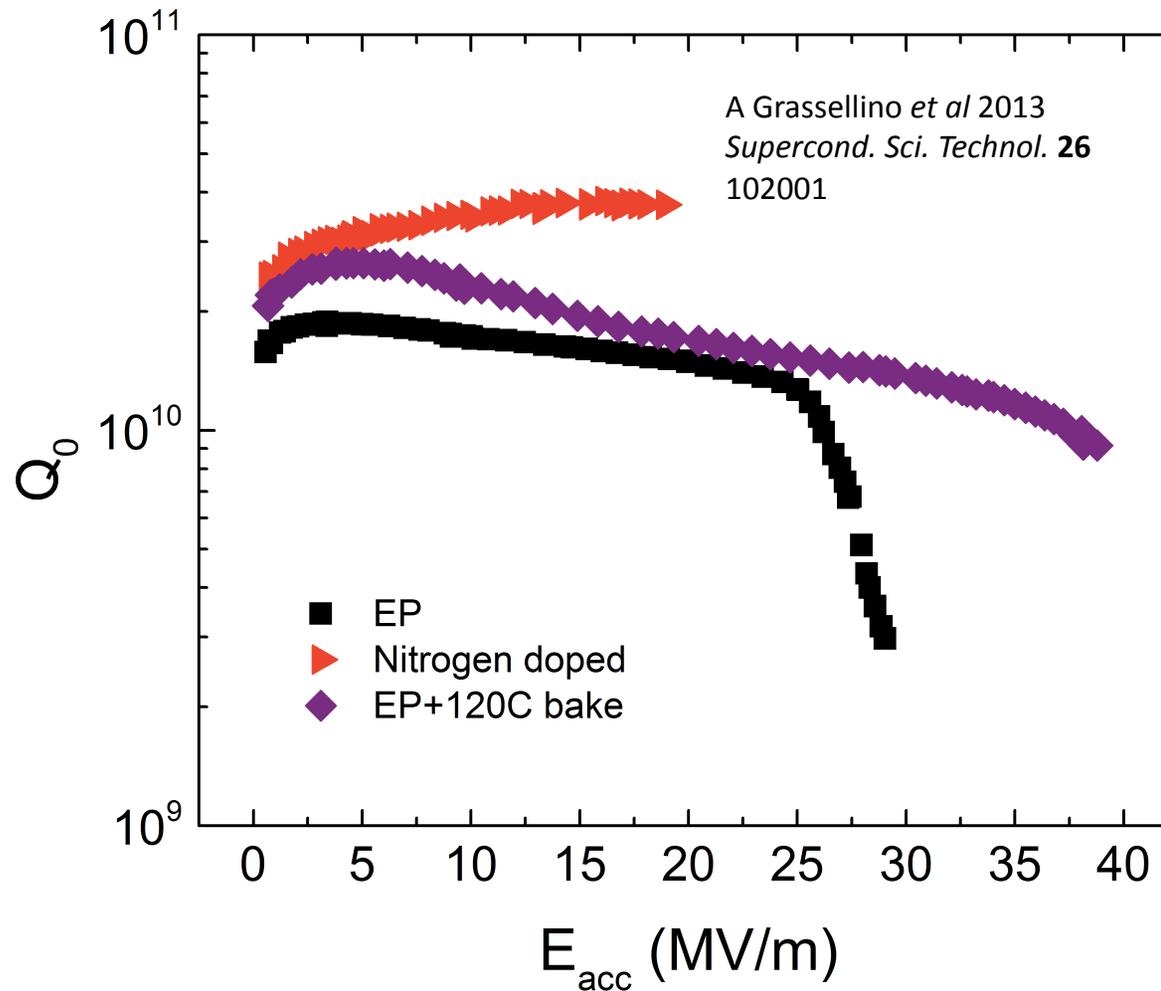
Anna Grassellino

Peoples Fellow, SRF Development Department, Fermilab

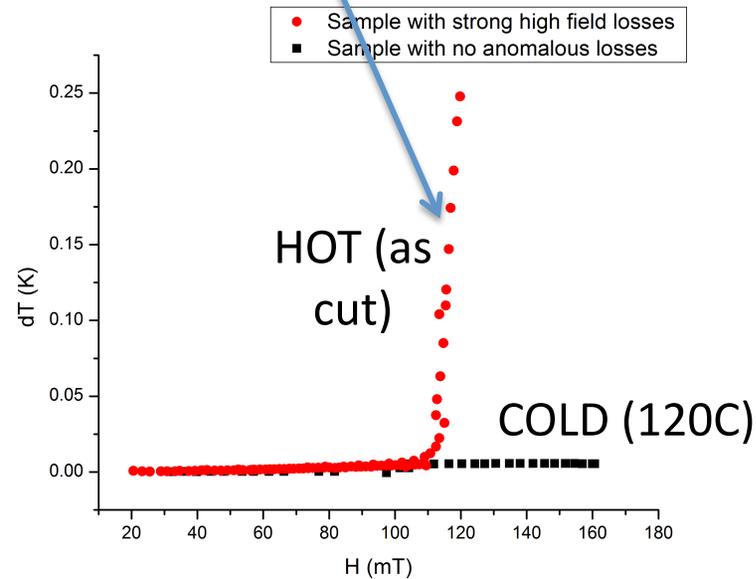
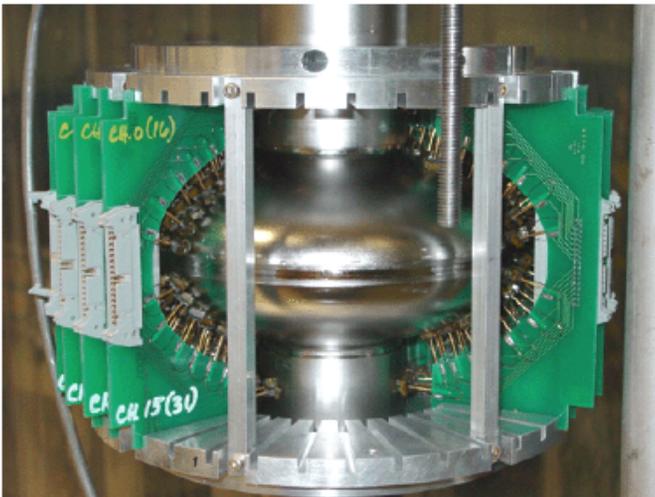
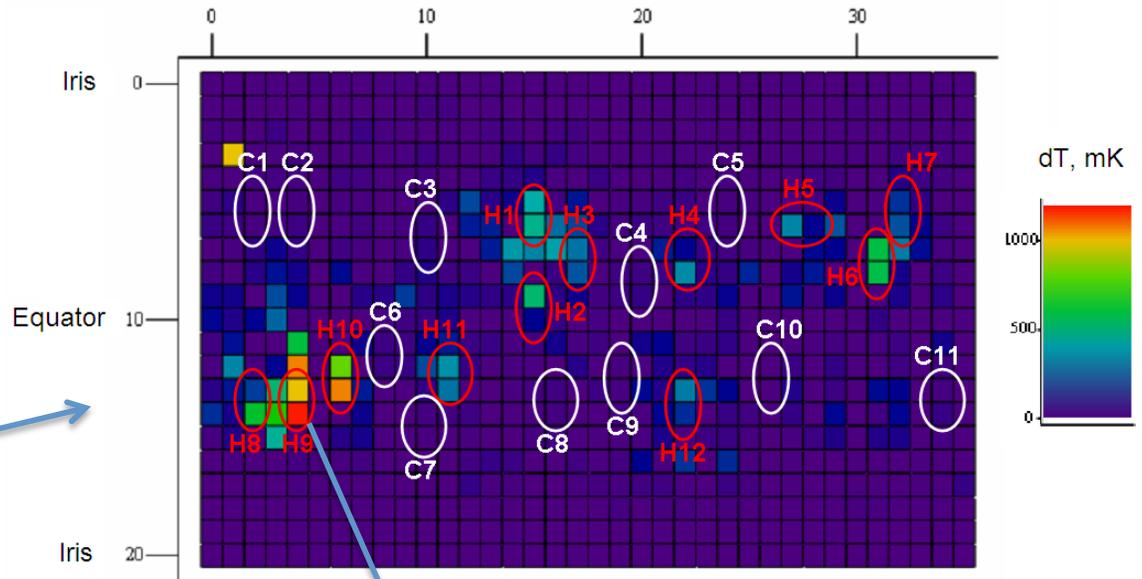
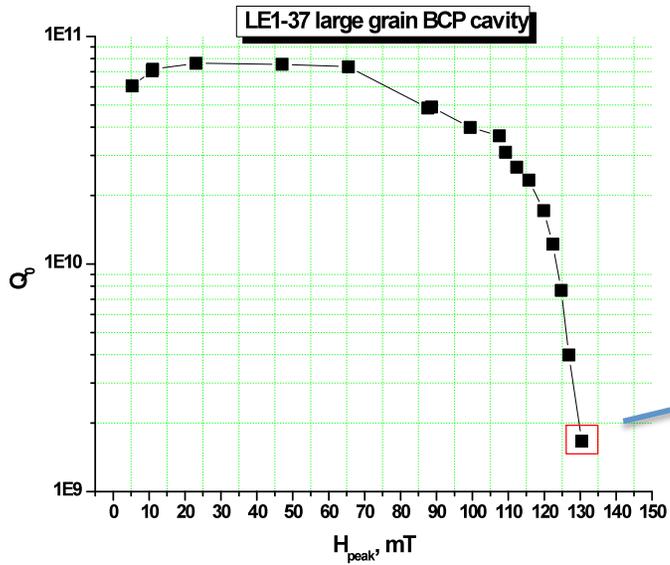
2013 International Peer Review of TRIUMF  
Vancouver, Canada

## My PhD thesis work at TRIUMF

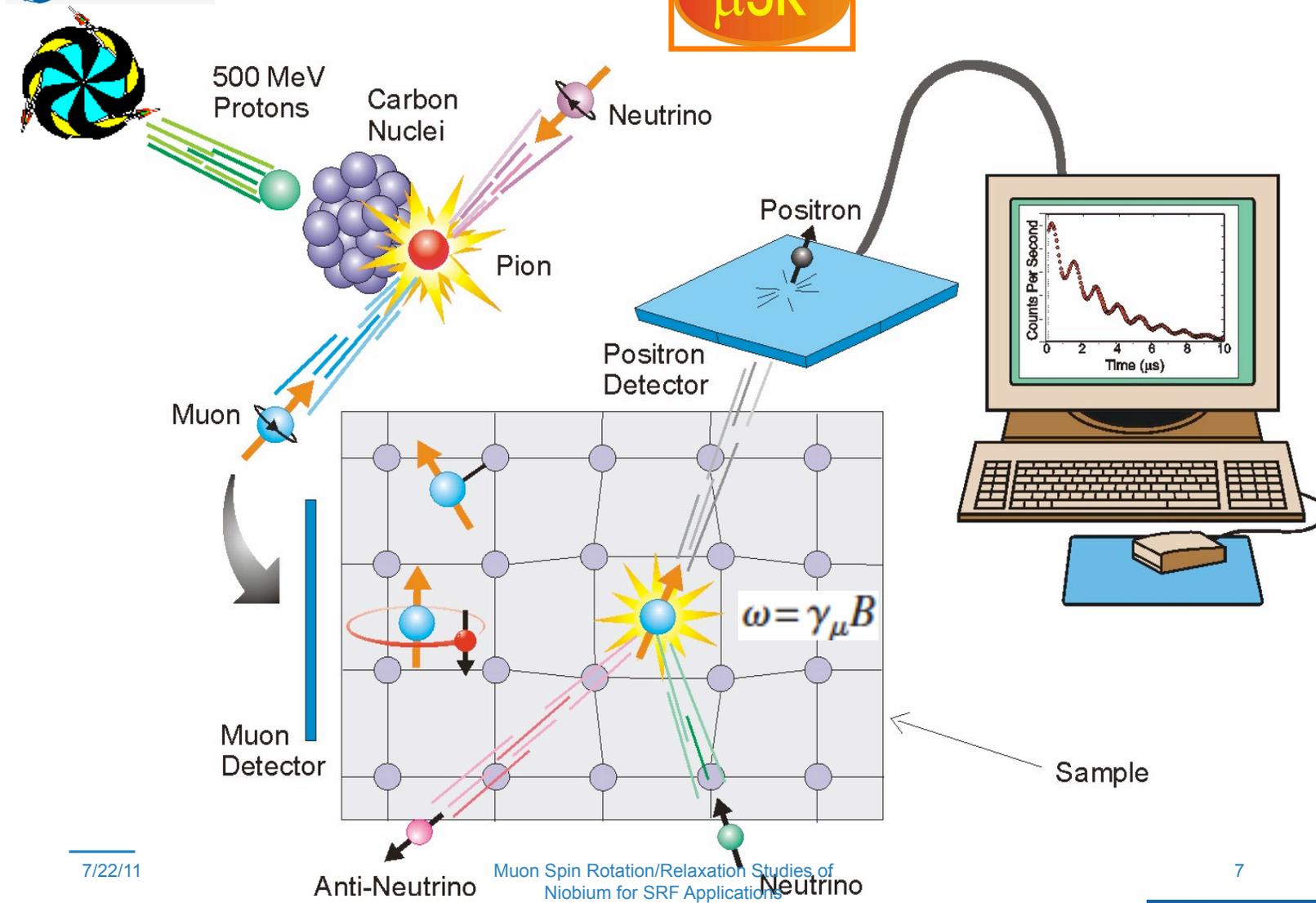
- Supervisors/advisors: Bob Laxdal, Nigel Lockyer and Lia Meringa
- Topic: understanding the origin of field dependent RF losses in superconducting Nb cavities
  - Cavity experiments (studies of RF performance of QWR at different temperature, study of the effect of local heating etc..)
  - Samples studies with muon spin rotation



- Why do EP and BCP surfaces produce losses at high field (HFQS)?
- Why does the 120C bake allow to push cavities to higher gradients?
- Why does nitrogen doping lead to a reverse field dependence and higher Q?



Is HFQS related to magnetic flux penetration or flux depinning?



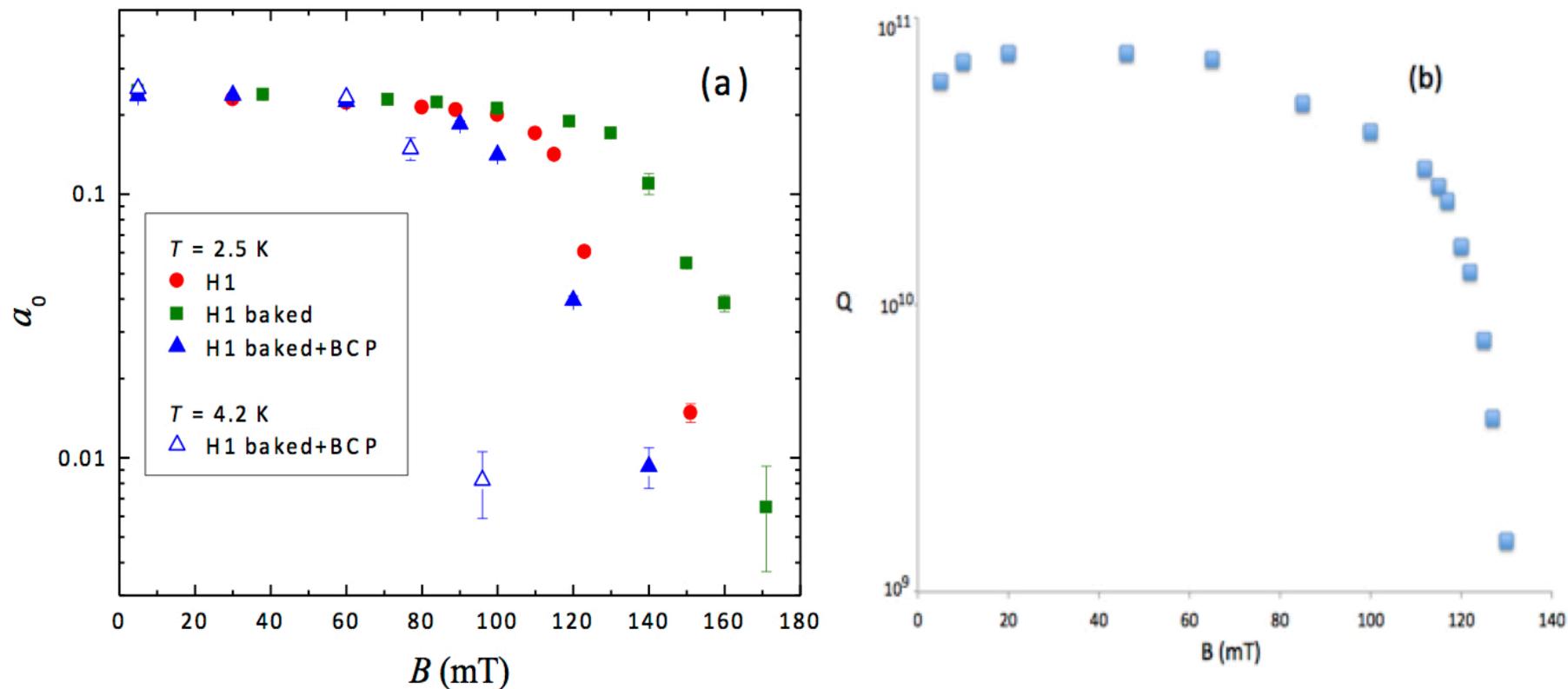
7/22/11

Muon Spin Rotation/Relaxation Studies of Niobium for SRF Applications

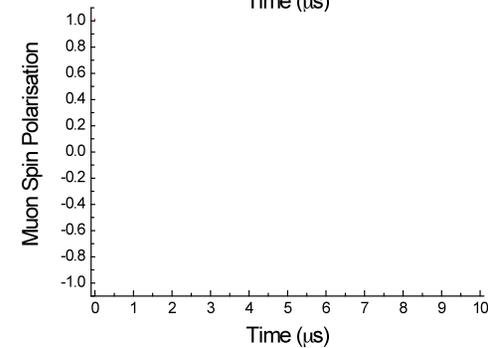
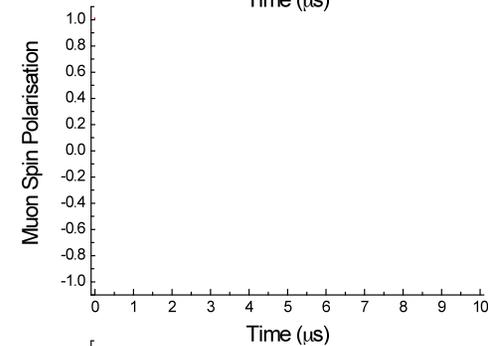
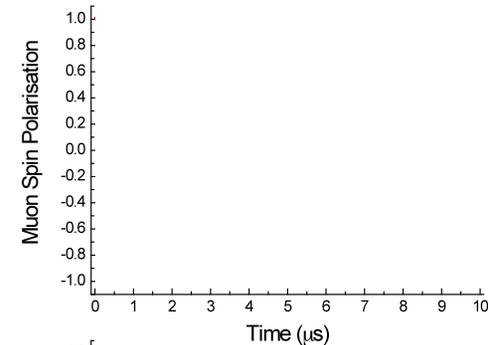
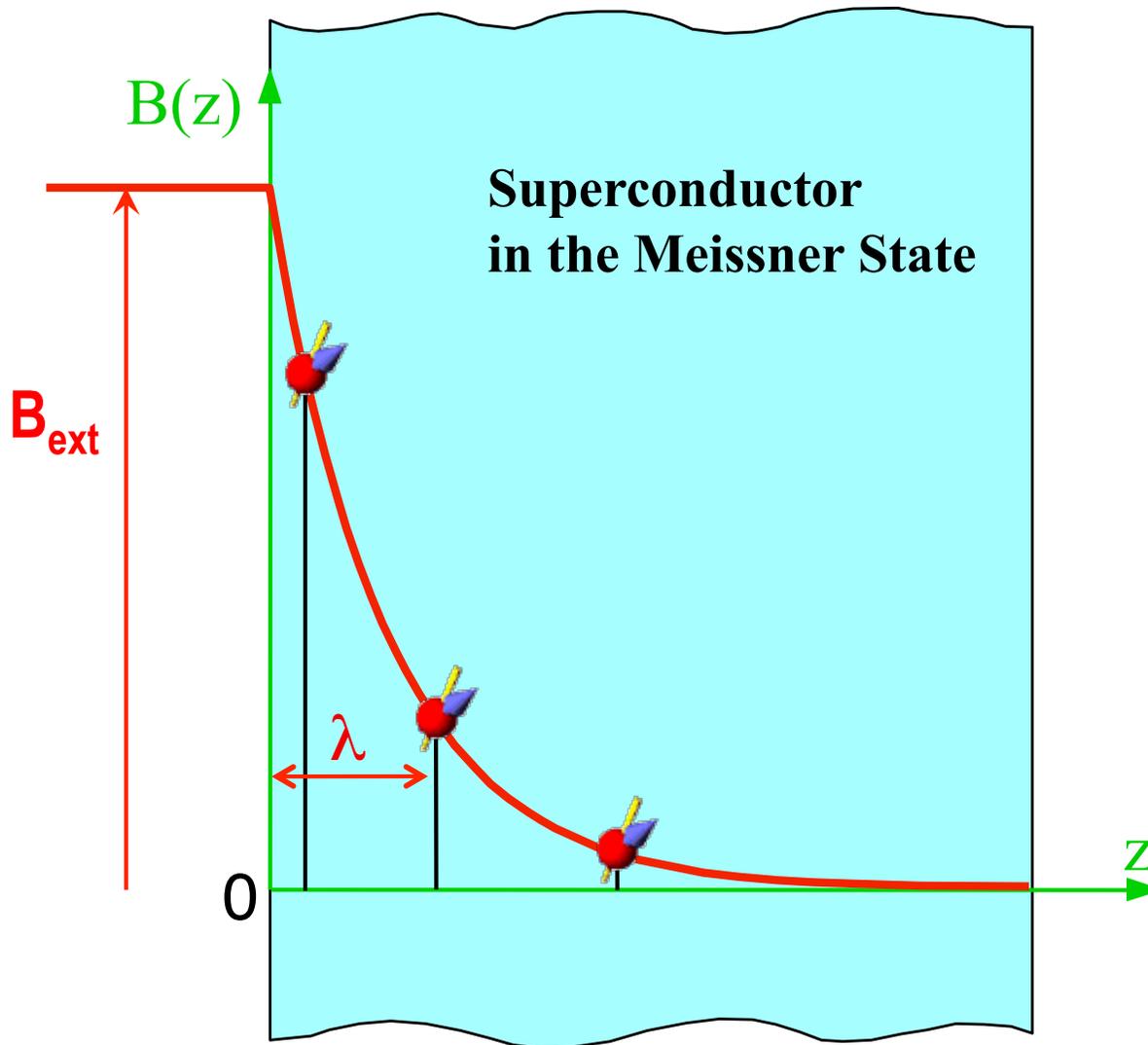
7



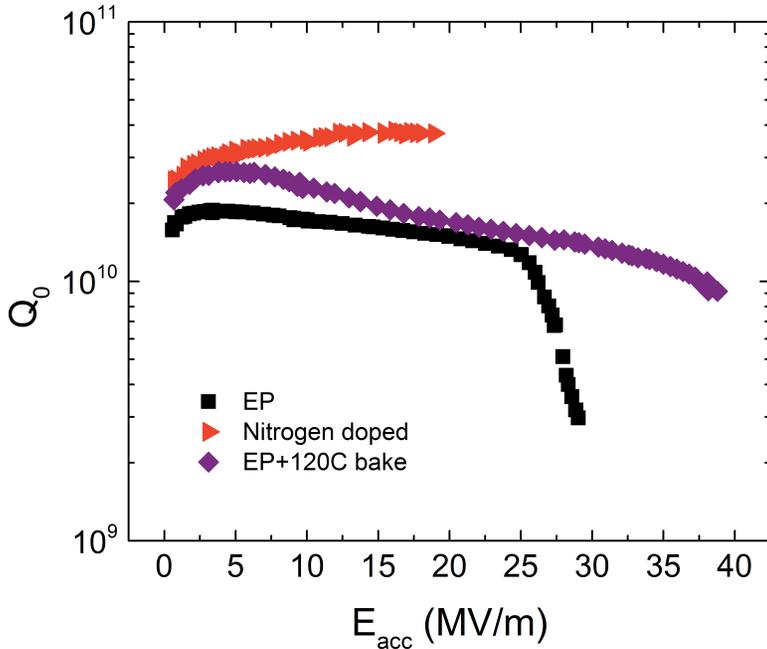
## A. Grassellino et al, Phys. Rev. ST Accel. Beams 16, 062002 (2013)



- Strong correlation between field at which magnetic flux starts being detected by muons and onset of HFQS
- Hinting towards mechanism behind the 120C bake being the increase in surface pinning, effectively delaying flux entry or flux depinning



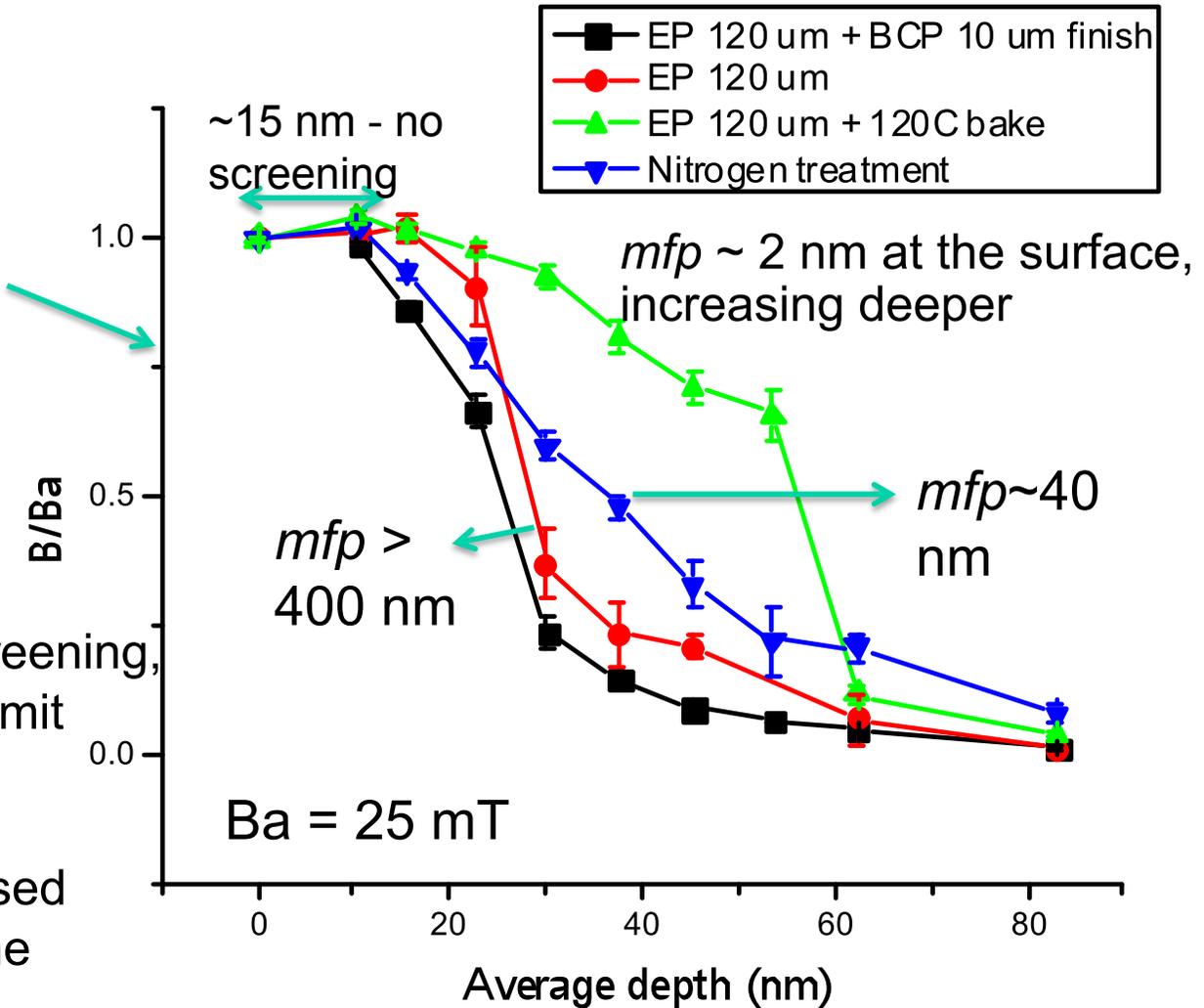
$$\omega_{\mu}(z) = \gamma_{\mu} B_{loc}(z)$$



BCP and EP unbaked -> strong screening, excellent fit provided by the clean limit Pippard/BCS model

EP+120C bake-> strongly suppressed m.f.p., gradient of the m.f.p. from the surface, dirty limit

N-doped -> intermediate purity!



Fit by Gaussian model for the field at the muon site – approximate, qualitative comparison

- TRIUMF has pioneered Muon Spin Rotation experiments on SRF cavities cutouts that have brought new insights on the physics of niobium RF surface resistance
- Technique is and will be applied for several important cavity studies: Meissner screening,  $\text{Nb}_3\text{Sn}$ , multilayers...
- Excellent training at TRIUMF, work of thesis on MFQS and continued studies have lead to improved understanding in the SRF field and actual new surface processing technique to increase cavity Q