1. Cooldown matters: cooldown can determine if ambient flux is trapped or expelled
2. Large thermal gradients at T_c promote expulsion of flux : explained by models (M. Checchin and T. Kubo)
3. Slow, uniform cooldown tends towards trapping all flux – even if cavity expels well at large dT/dx.
4. Surface treatments have insignificant impact : bulk matters (Hydride skeletons ?)
5. Some niobium production runs have very poor expulsion – even with large ΔT
6. High temperature treatment can make poorly expelling material expel well even with small ΔT
7. Improvement in expulsion is correlated with grain growth
8. Heavy deformation degrades expulsion behavior
9. Geometry affects expulsion

Magnetic sensors

- Fluxgate/AMR : cavity test
- Magneto Optical Imaging (MOI) : sample characterization

Unification of methods is mandatory to speak the same language

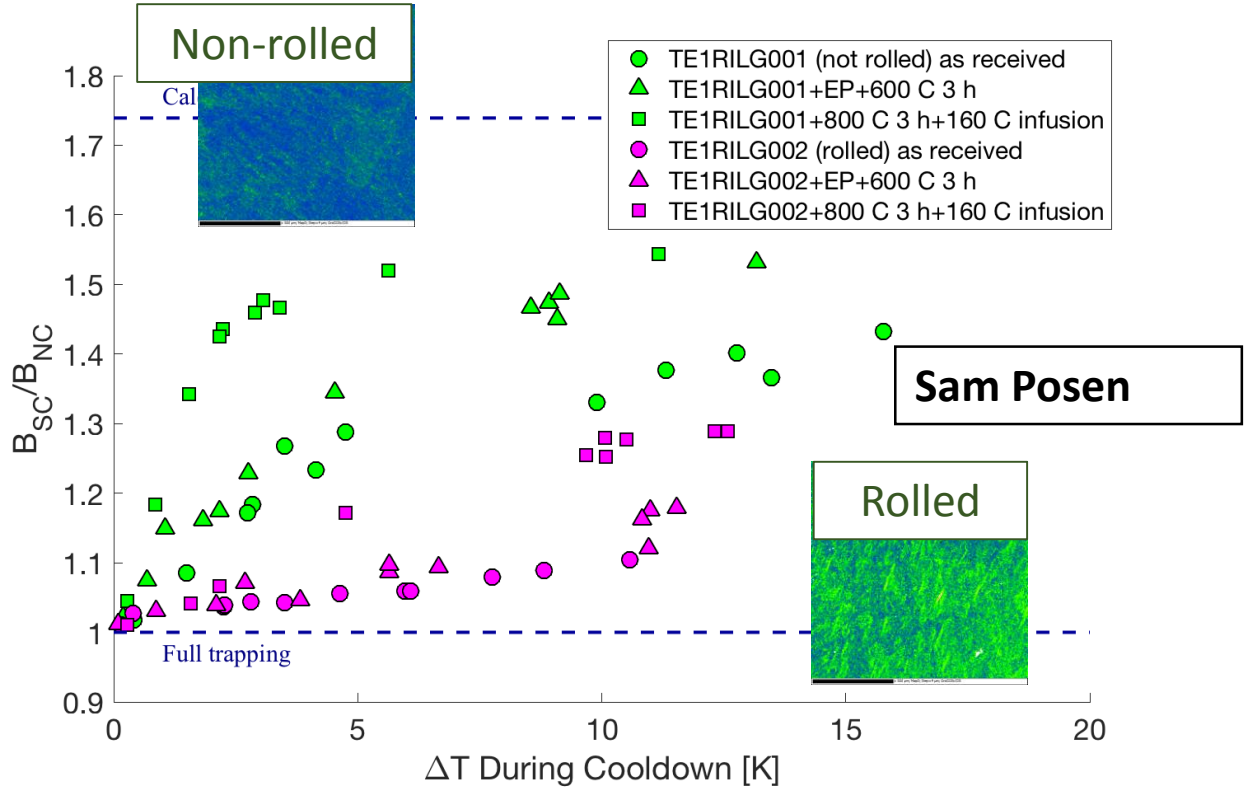
- couple the measurement effort with numerical simulation effort.
- Identify sensitive locations for placing probes.
- Orientation-resolved measurements should be very helpful.

WHAT IS RESPONSIBLE OF FLUX TRAPPING :

- GRAIN BOUNDARIES ? **NO**
  Rolled/non rolled experiment
  presented by S. Posen proved it

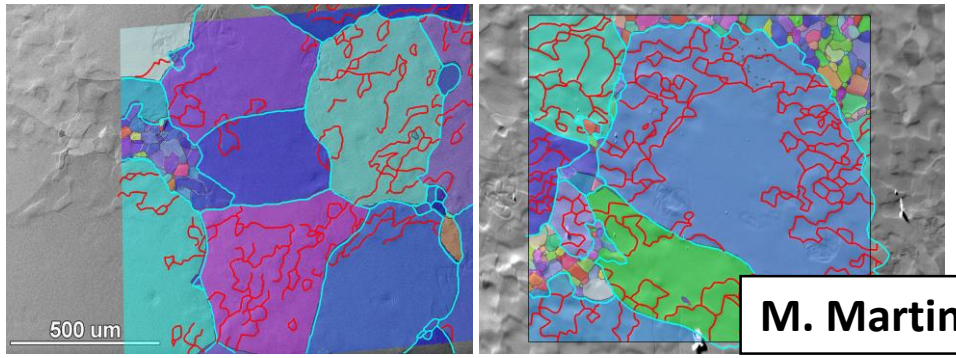
- IMPURITIES ? **NO**
  SIMS analysis on Hot/Cold spot
  presented by M. Martinello

- DISLOCATIONS ? **BEST CANDIDATE**
  Heavily damaged grains (resistant to recristalization)

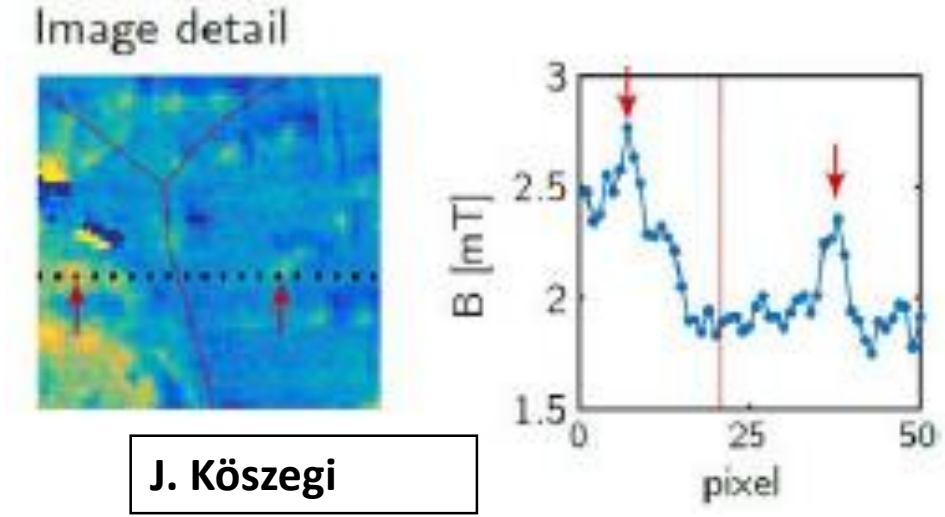


Sam Posen

Cold spot Hot spot



M. Martinello



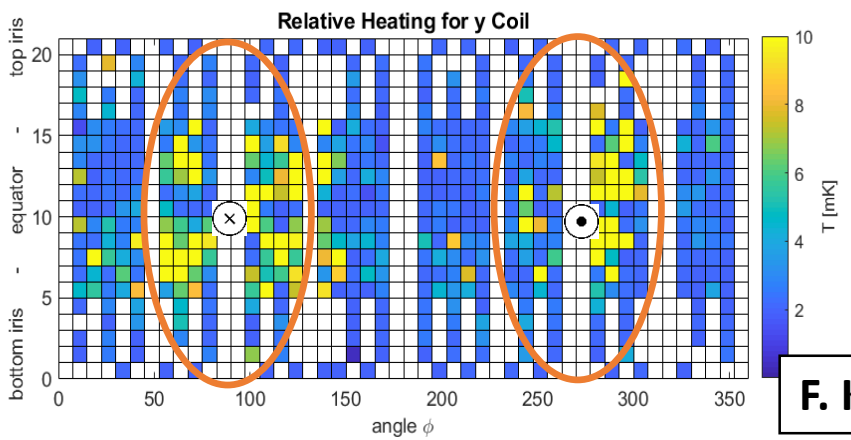
J. Köszegi

Further topics addressed

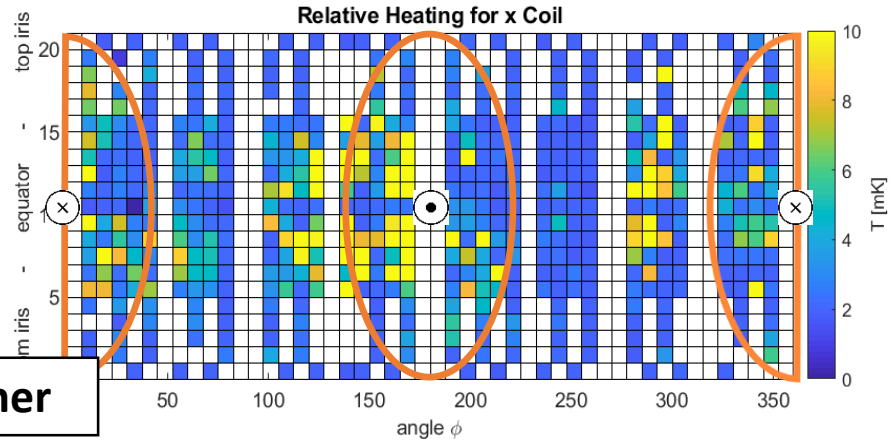
- Phase front/transition dynamics
- Theoretical models for expulsion
- Status of activities at the contributing labs (Nb/Cu and bulk Nb)
- Lessons learned from LCLS-II production, review XFEL statistics
- Thermocurrents?

HOW GEOMETRY IS AFFECTING FLUX TRAPPING:

Coil in Y direction; Q_0 = 6.3E+9

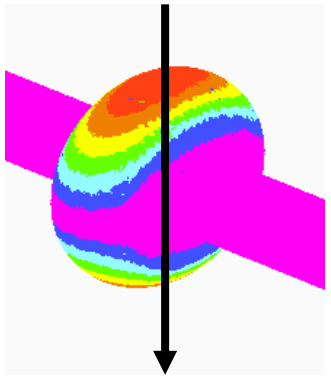


Coil in X direction; Q_0 = 6.1E+9

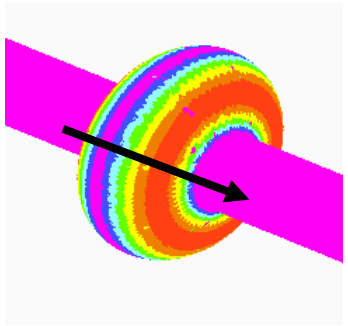


F. Kramer

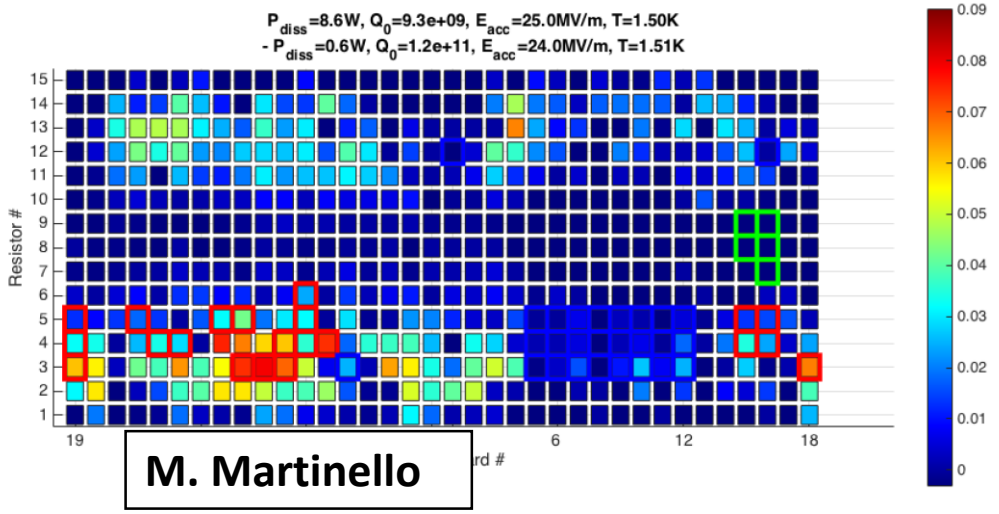
D. Longuevergne



Only normal to surface component is trapped



- T-map acquired after annealing at 975C after fast and medium cool-down



M. Martinello

NEXT STEPS :

- In your opinion, what are the key issues?
- How can we tackle them as a collaboration?
- What infrastructure/ can be contributed?
- Which cavities/samples can be contributed? Separately prepared samples vs. cut outs
- Material specifications ?
- Understanding of angular dependence ?

FUTURE EXPERIMENTS ?

- Flux expulsion is a bulk property ? Only gentle surface treatments tried (Doping, BCP, EP).

Flux expulsion characterization of a formerly Q-diseased cavity : As Hydrides are damaging the surface (surface dislocations)

- Cut-outs of rolled/non rolled experiment after T-map (comparison of hot/cold spot) possible ?

- Are there really no dislocations on a cavity showing full expulsion ? What kind of dislocations are harmful for flux expulsion ?

- Transport measurement ?