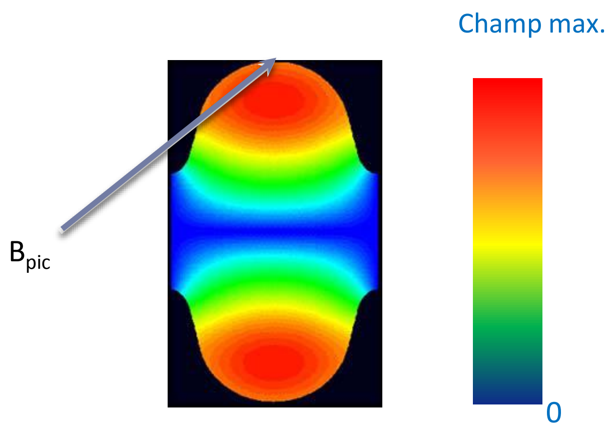
Task 12.2

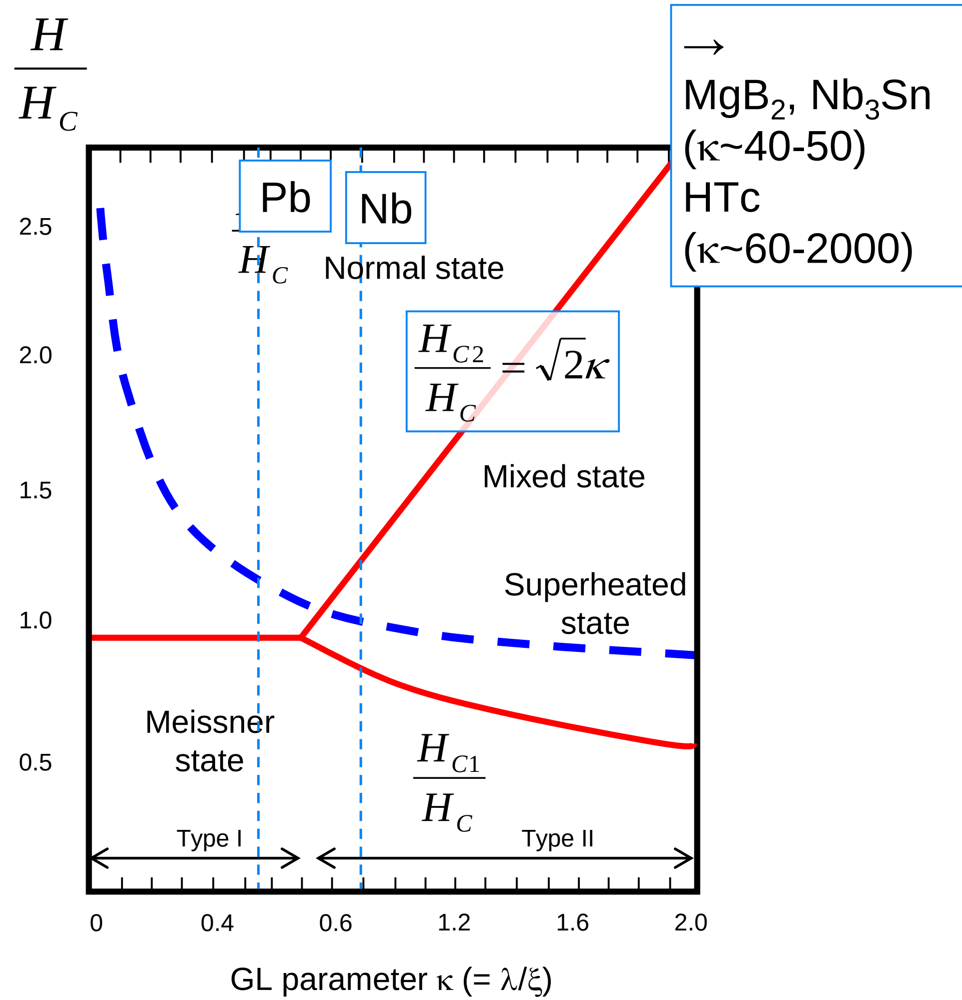
THIN FILMS INTRODUCTION

Ultimate field in SRF ?

- SC phase diagram
  - **SRF => Meissner state mandatory !**
  - Type I => only low T_C
  - Nb highest H_{C1} (180 mT)
  - « superheating field », favorized (?) by B// surface; metastable state

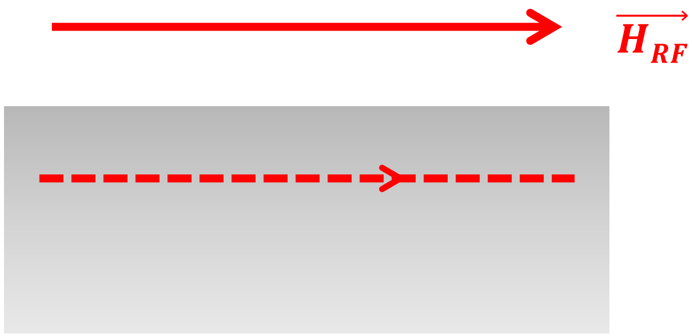


B field mapping in an elliptical cavity



Vortex penetration

- Ideal case
  - field // surface, => surface barrier (Bean Livingston)
  - Vortex // surface start to enter @ $H_{SH} > H_{C1}$
  - @ $H_{SH} > H_{C1}$ Vortex oscillate in RF → dissipations
  - Most favorable SC : Nb_3Sn, MgB2 (high T_C, high H_{SH})



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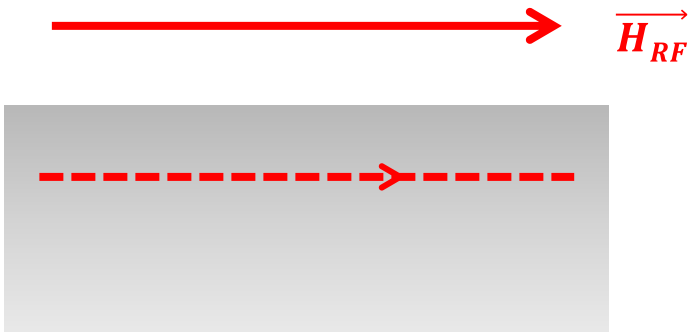
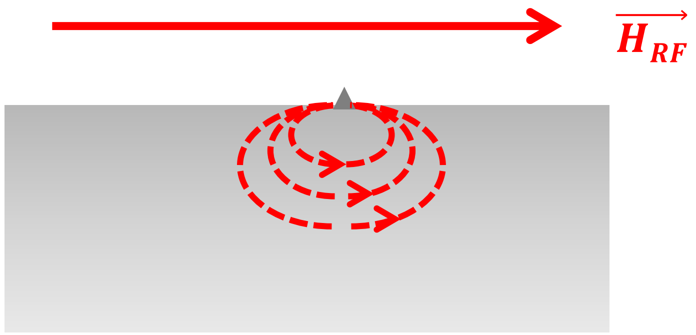


- Defect at surface
  - Early vortex penetration (bundle) @ H_{C1} (or less !)
  - Formation of current loops
  - Avalanche
  - Oscillations in RF => dissipations
  - What kind of defects do we fear ???



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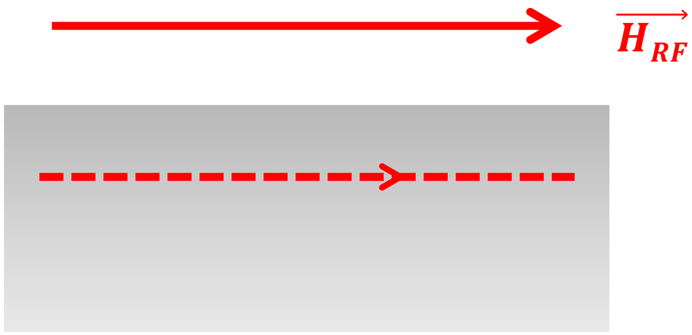

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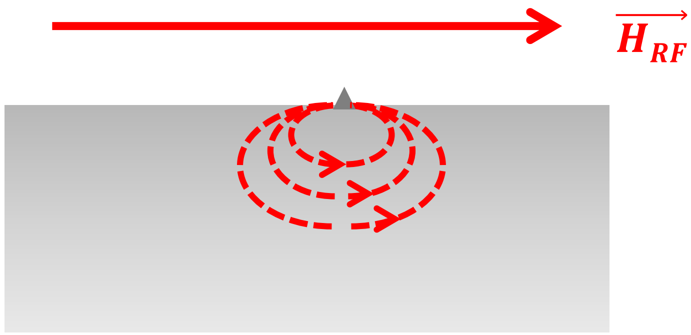
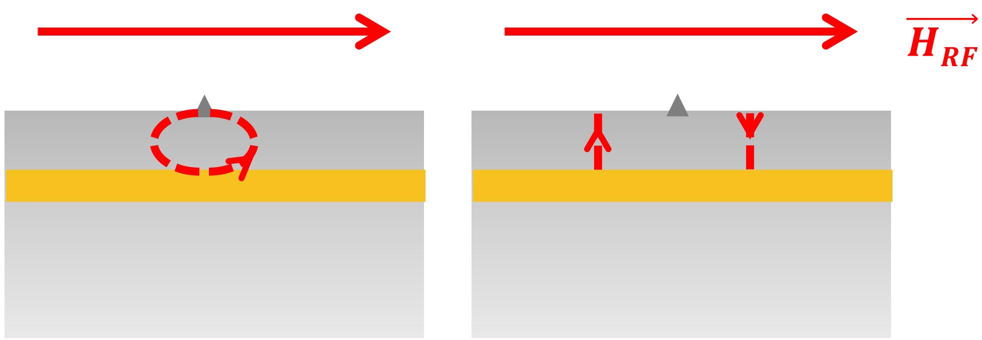


- Dielectric layer
  - Small ⊥ vortex (short -> low dissipation)
  - Quickly coalesce (w. RF)
  - Blocks avalanche penetration
  - => Multilayer concept for RF application
  - Most favorable SC : Nb_3Sn, MgB_2, NbN…



Structure of the task 12.2

Niobium on copper (µm)

- After ~ 20 years stagnation : new revolutionary deposition techniques (HPIMS)
- Great expectations in cost reduction
- No improved performances/ bulk Nb

Subtask 1

Higher Tc material (µm)

- Based on superheating model.
- Higher field and lower Q0 expected

Higher Tc material (nm), multilayer

- Based on trapped vortices model (Gurevich)
- Higher field and lower Q0 expected
- Recent experimental evidences

Subtask 2

Specific characterization tools needed

Better understanding of SRF physics needed

Subtask 3

Structure of the session

- Introduction (CZA)
- Thin film deposition
  - HiPIMS coatings for SRF applications , G. Rosaz, CERN
  - A15 thin films development for SRF applications, K. ILyina
  - Multilyers deposition by ALD, Grenoble INP (presented by CZA)
- Thin film characterization
  - RF characterization of superconducting samples, S. Eckert , HZB
  - Multilayer characterized by magnetometry, M. Aburas, CEA Saclay

Task 12.2 Conclusion

- Very challenging upstream, discovery, R&D
- Many difficulties to (propose and) follow a realistic schedule
  - In particular hiring qualified student/post docs = important source of delays
- The foreseen program and the collaborations started will be pursued beyond the end of EUCARD2
- Although we did not manage to complete the full program:
  - Many encouraging results
  - Strong hope to complete the program in a close future
- Future :
  - EUCARD3 (ARIES) covers only a little of the work to be done
  - Other funding sources are mandatory