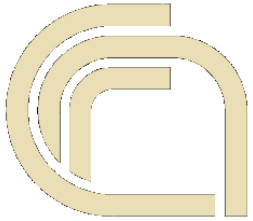


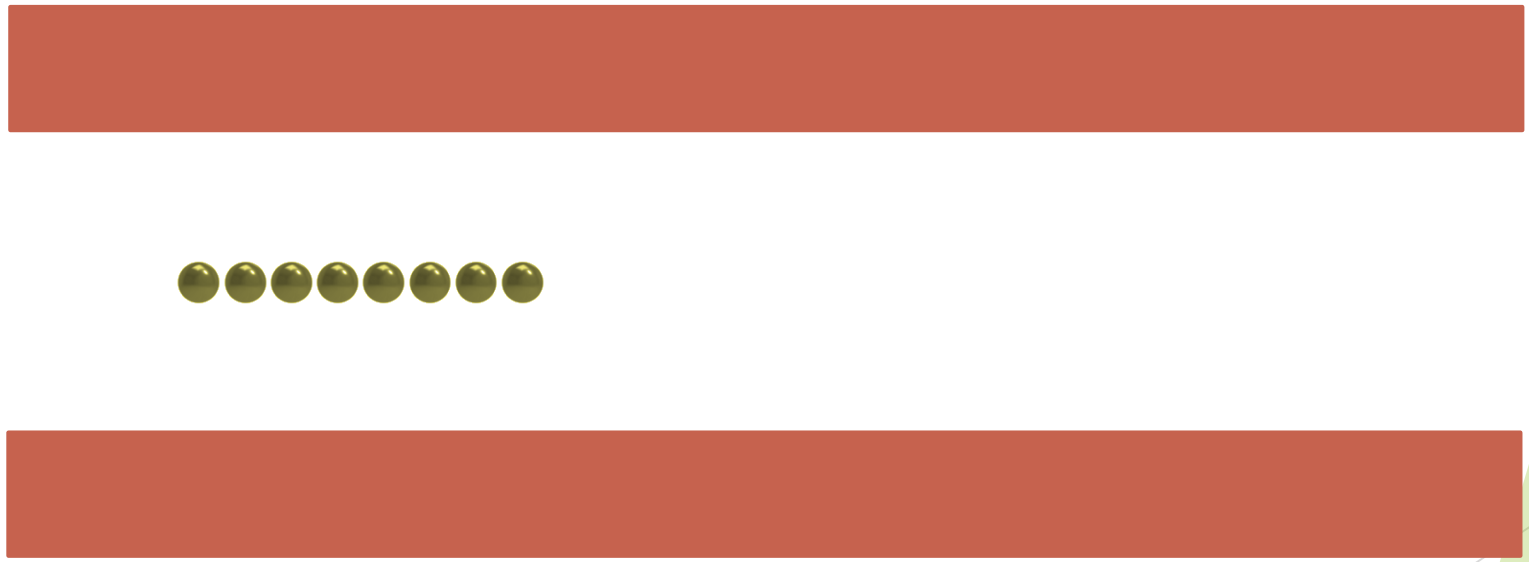
EASITRAIN

ESR6 Project description

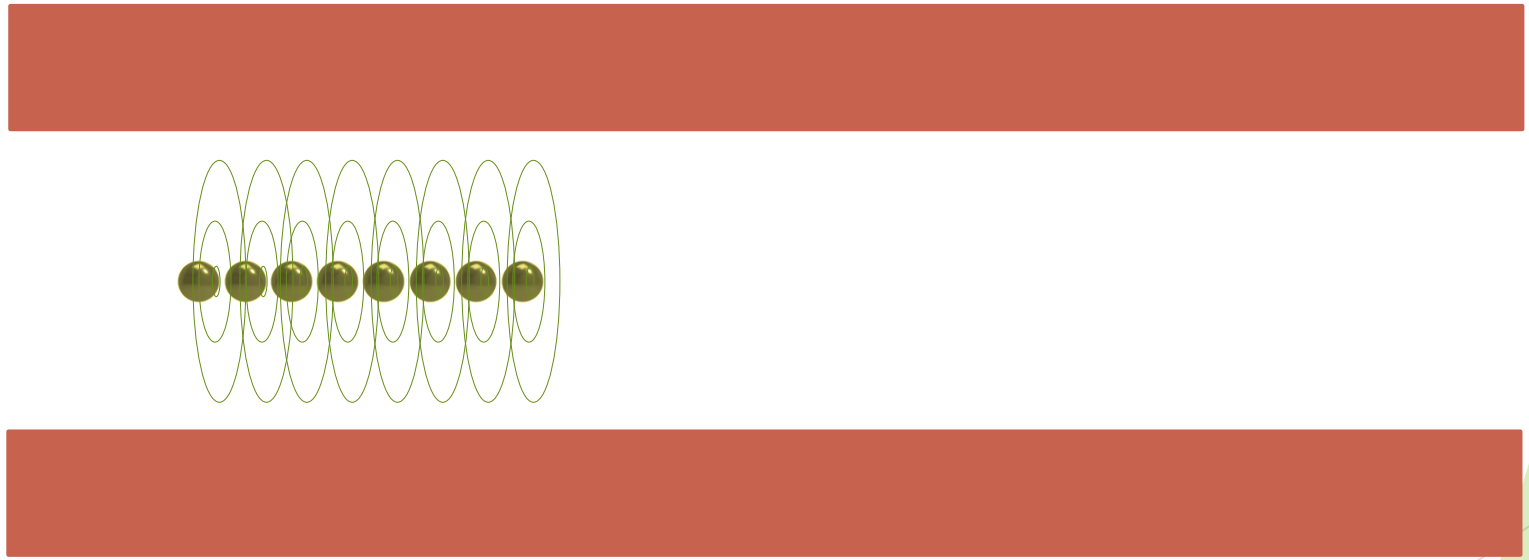
Aisha Saba

(Emilio Bellingeri)

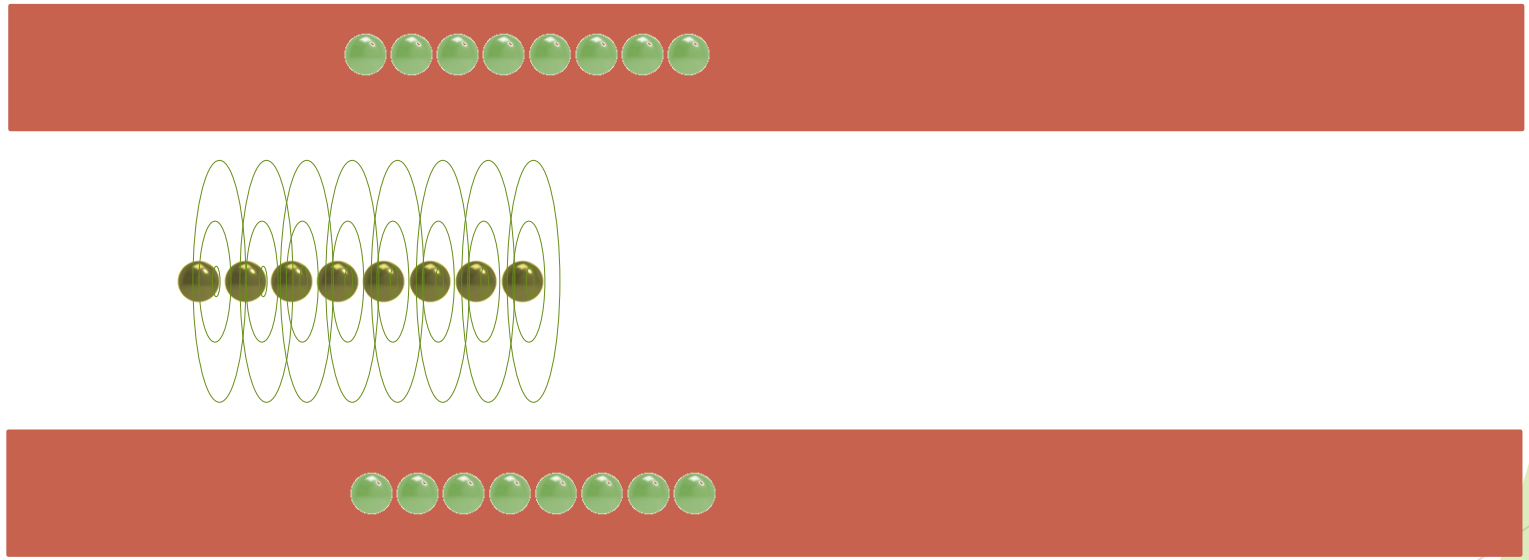
10^{11} protons will circulate in bunches in the ring at v≈c



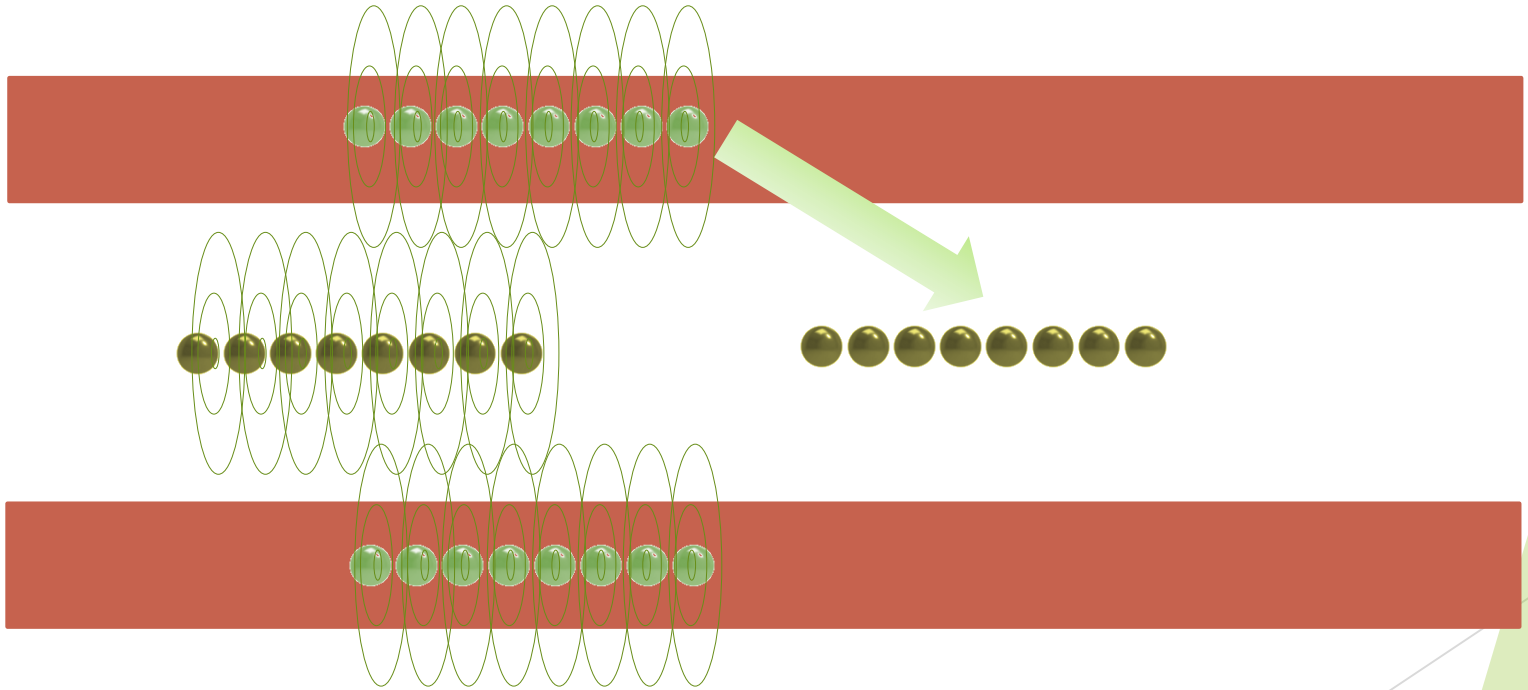
10^{11} protons will circulate in bunches in the ring at v≈c
Proton are charged -> it will produce an EM field



10^{11} protons will circulate in bunches in the ring at v≈c
Proton are charged -> it will produce an EM field
The EM Field will produce an image current in the screen



10^{11} protons will circulate in bunches in the ring at v≈c
Proton are charged -> it will produce an EM field
The EM Field will produce an image current in the screen
The image current will dissipate
Due to the delay, it will affect back the beam causing instabilities.



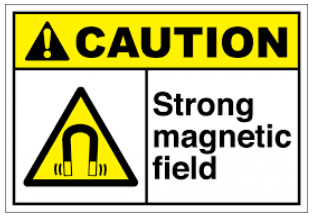
The surface resistance of copper at 50 K may not be sufficiently low to guarantee a safe operational margin for the FCC-hh beams, in particular at injection energy.

Introduction of a HTSC coatings to mitigate the beam impedance

HTS films requirements for beam screen

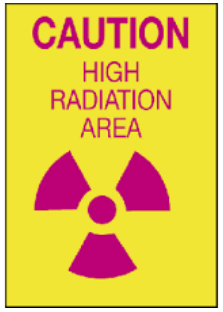
Material under extreme condition !

T=50 K Very high operation temperature (for a superconductor)

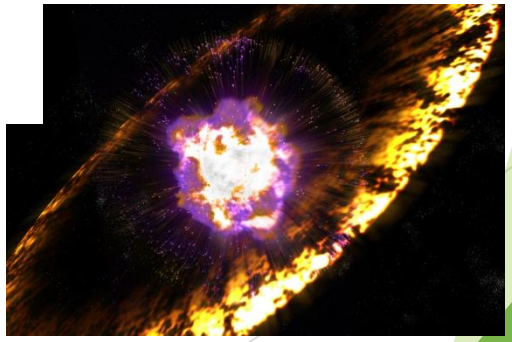


B=16 T Very High magnetic field

ν=1GHz Very high frequency

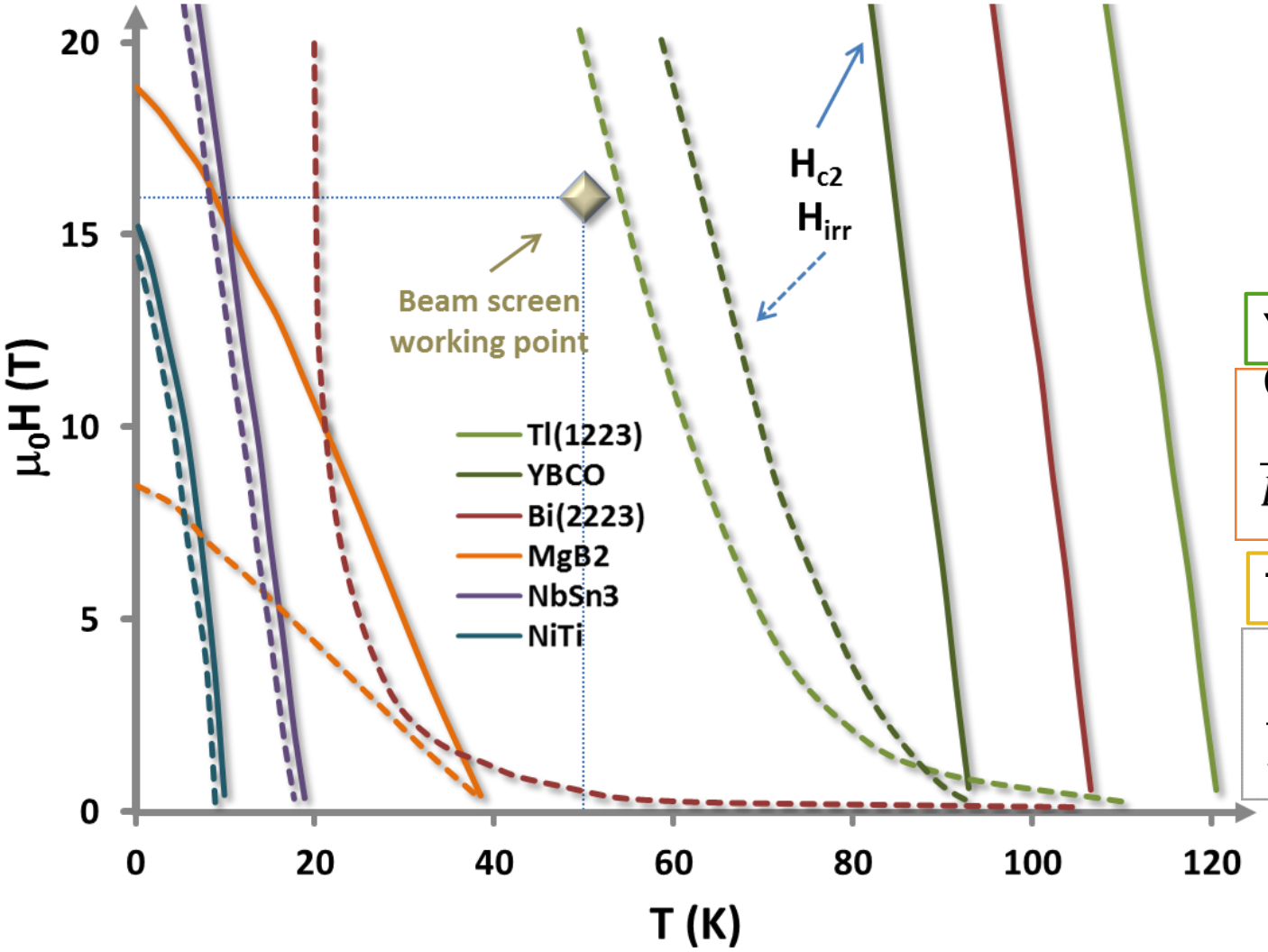


High syncrotron radiation intensity



Boundary materials with 100 TeV particles
(only supernova burst can exceed this energy)

Superconducting materials phase diagram



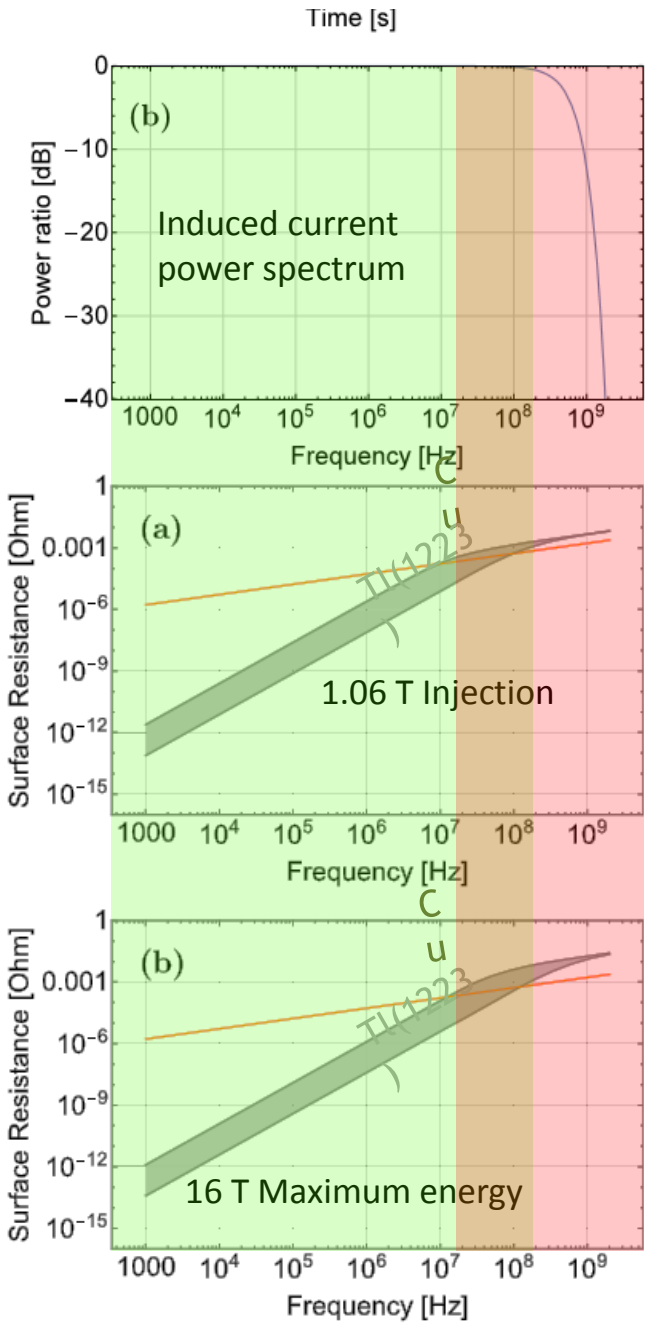
$$R_{fl} \approx \sqrt{\frac{B}{B_{c2}}}$$

YBCO

$$\frac{H}{H_{c2}} = \sqrt{\frac{16\,T}{80T}} = 0.45$$

Tl 1223

$$\frac{H}{H_{c2}} = \sqrt{\frac{16\,T}{140T}} = 0.33$$



Tl(1223) estimated surface resistance

$$\nu_0(B_0) = \frac{\rho_n \sqrt{B_0} J_c(B_0)}{\sqrt{\Phi_0} B_{c2}}$$

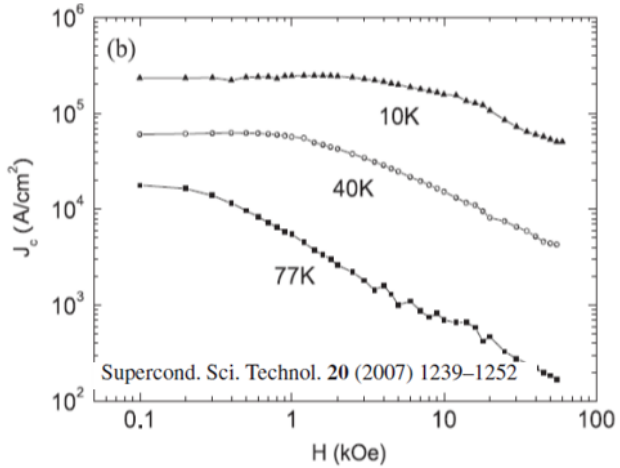
Depinning frequency

$$Z_{sf} \equiv Z_f = Z_n \sqrt{\frac{B_0}{B_{c2}}} \quad \text{for } \nu \gg \nu_0,$$

$$R_{sf} \equiv R_f = \frac{R_n}{\sqrt{2}} \sqrt{\frac{B_0}{B_{c2}}} \left(\frac{\nu}{\nu_0}\right)^{3/2}, \qquad R_n = \sqrt{\mu_0 \rho_n \pi \nu}$$

$$X_{sf} \equiv X_f = R_n \sqrt{2} \sqrt{\frac{B_0}{B_{c2}}} \left(\frac{\nu}{\nu_0}\right)^{1/2} \quad \text{for } \nu \ll \nu_0.$$

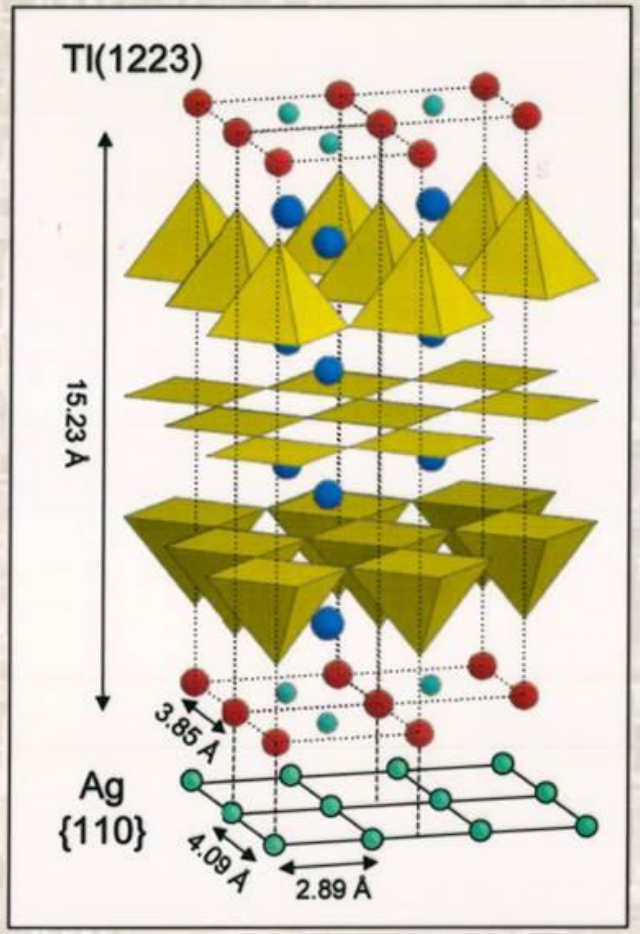
Assuming:
(conservative estimate)
ρ_n = 40 μΩ cm
B_{c2} (50K) = 70T.
J_c ÷ 10^8 to 10^9 A/m^2



At low frequencies, where the most unstable modes are predicted for a copper beam screen, a substantial gain of several orders of magnitude is clearly apparent

S. Calatroni, E. Bellingeri, C. Ferdeghini, M. Putti, R. Vaglio, T. Baumgartner and M. Eisterer, 2017 SUST **30** 075002

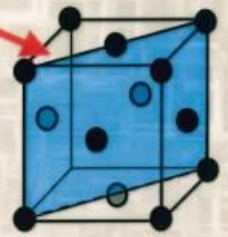
Electrodeposition



Lattice parameter matching of Tl(1223) and silver

The Ag{110} :

{110} plane



Initial Ag

Cold Rolling
20% reduction at each pass

Recrystallization
Vacuum 800 °C

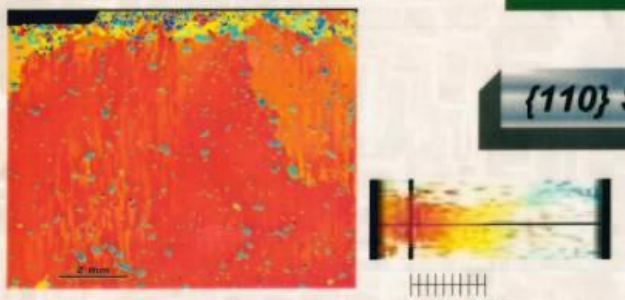
{110} textured ribbons

Bridgman technique

Orienting by X-ray
Laue method

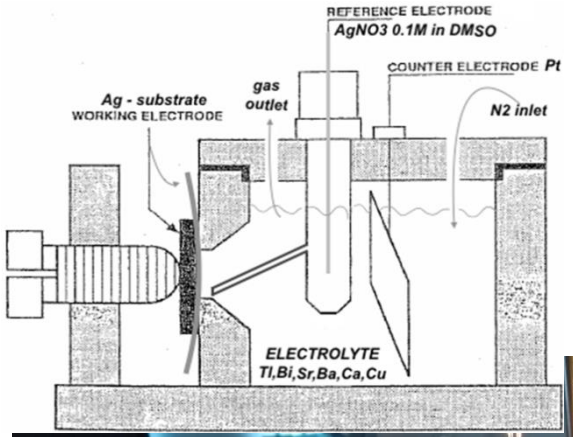
cutting
(electroerosion)
polishing and chemical etching

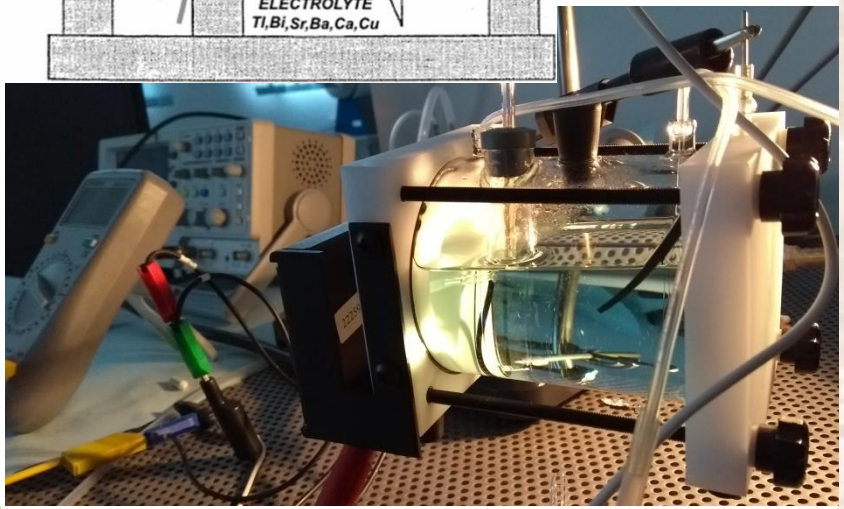
{110} Single crystal

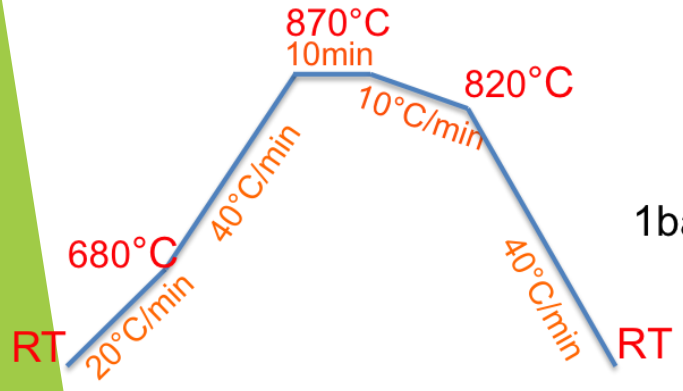


Electron Back Scattered Diffraction map (EBSD)

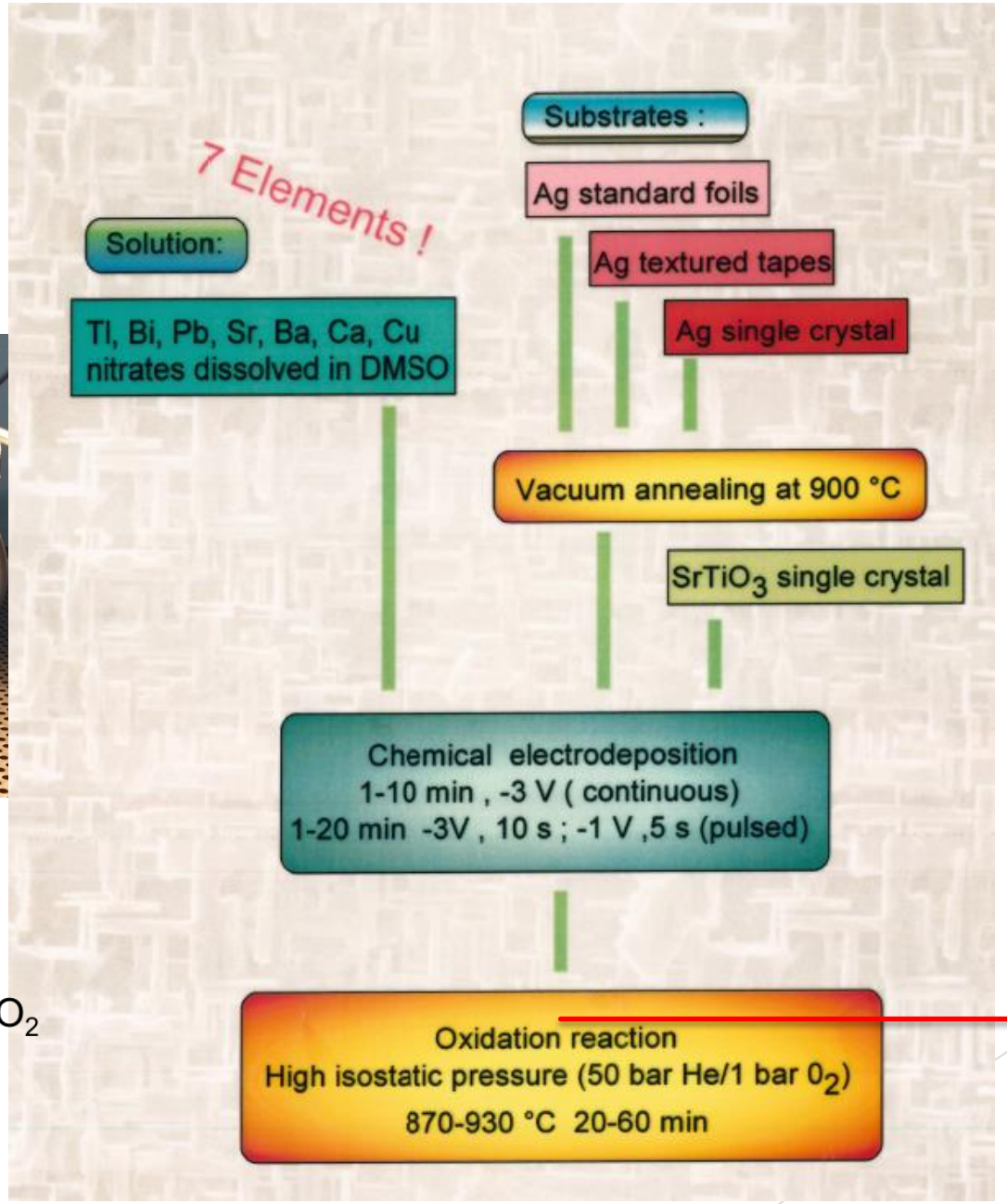
The misorientation angle is less than 4° (normal direction)


REFERENCE ELECTRODE
AgNO3 0.1M in DMSO
COUNTER ELECTRODE Pt
Ag - substrate
WORKING ELECTRODE
gas
outlet
N2 inlet
ELECTROLYTE
Tl,Bi,Sr,Ba,Ca,Cu



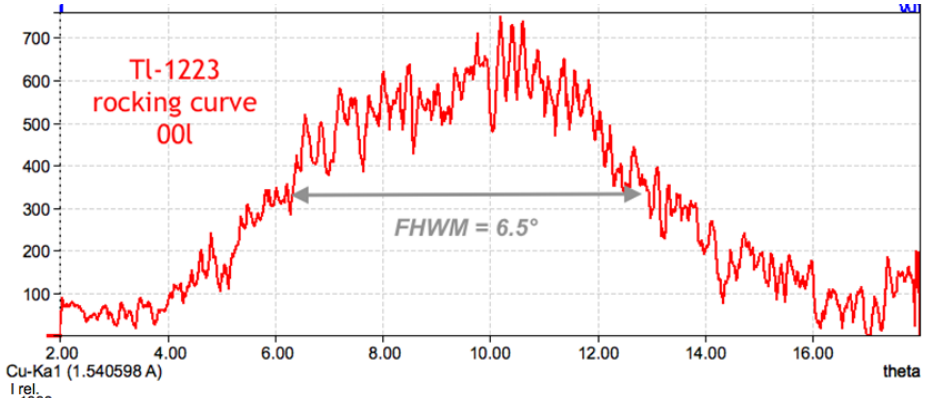

870°C
10min
820°C
10°C/min
40°C/min
680°C
40°C/min
RT
20°C/min
RT

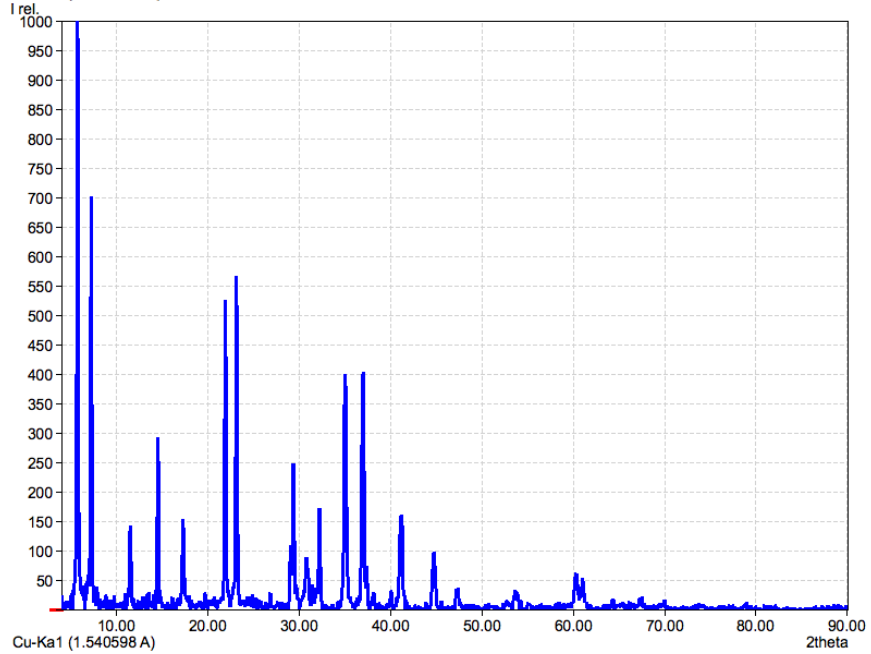
1bar / 5.0 O_2

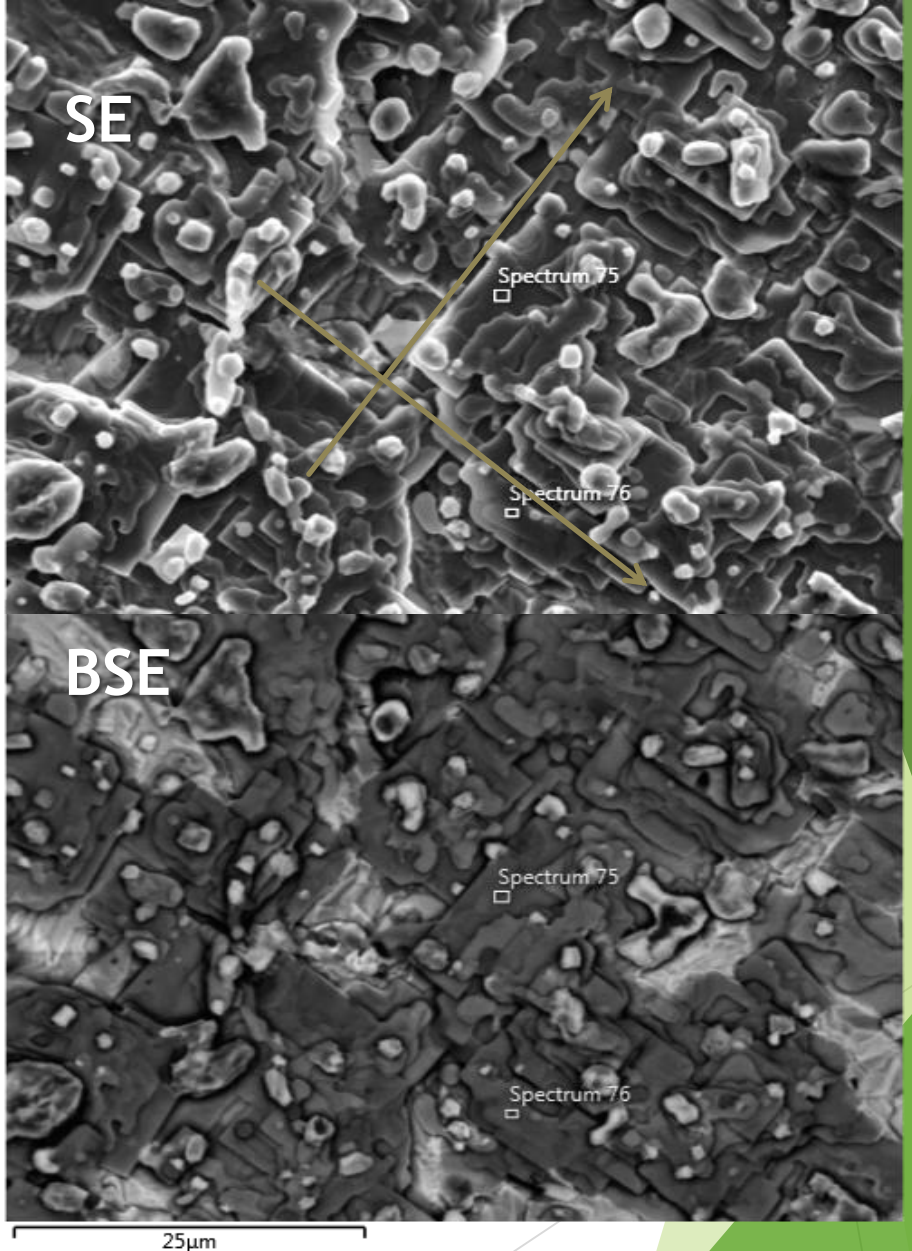

7 Elements !
Substrates :
Ag standard foils
Ag textured tapes
Ag single crystal
Solution:
Tl, Bi, Pb, Sr, Ba, Ca, Cu
nitrates dissolved in DMSO
Vacuum annealing at 900 °C
$SrTiO_3$ single crystal
Chemical electrodeposition
1-10 min , -3 V (continuous)
1-20 min -3V , 10 s ; -1 V ,5 s (pulsed)
Oxidation reaction
High isostatic pressure (50 bar He/1 bar 0_2)
870-930 °C 20-60 min

As rolled Ag ribbon

c axis texture
on Ag grain local epitaxy







Thank you for your attention