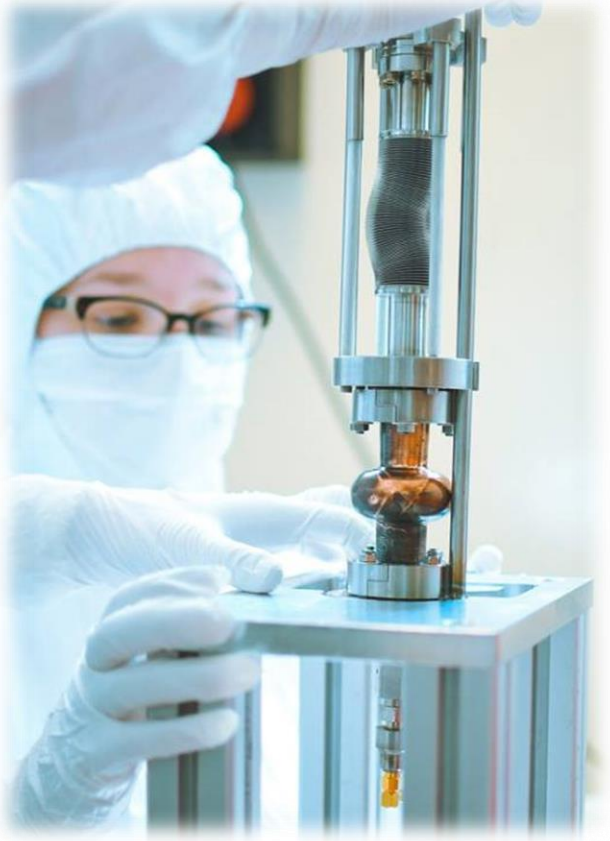
EASITrain

CERN

INFN
Istituto Nazionale di Fisica Nucleare

Mid-Term Review
10 December 2018, Brussels

Advanced surface coating techniques for superconducting radiofrequency cavities



Vanessa Andreina, GARCIA DIAZ

ESR 10, WP 3 (Manufacturing)

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ESR 10, WP 3 - Background

- Background: Master in Physics, Caracas-Venezuela. Master in surface treatments for industrial applications, Padova-Italy
- Host Institution: INFN – LNL
- Contract start date : 01/02/2018
- Supervisor: Dr. Cristian Pira
- PhD University: Ferrara University
- Planned secondments:
  - 1. I-Cube, Electro-hydro forming technique for seamless cavities, early 2019 for 2 weeks.
  - 2. CERN, RF characterization, end of 2019 for 2 weeks.
  - 3. RI, Coated cavities production and efficiency, early 2020 for 2 weeks.

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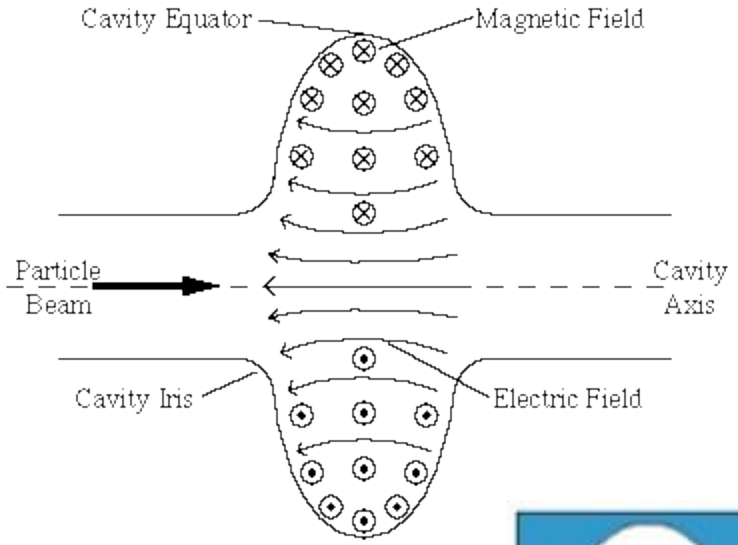
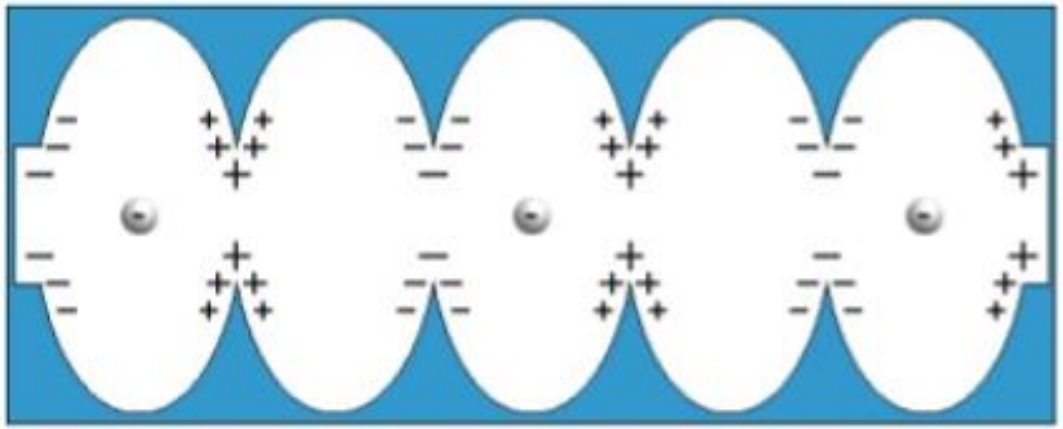
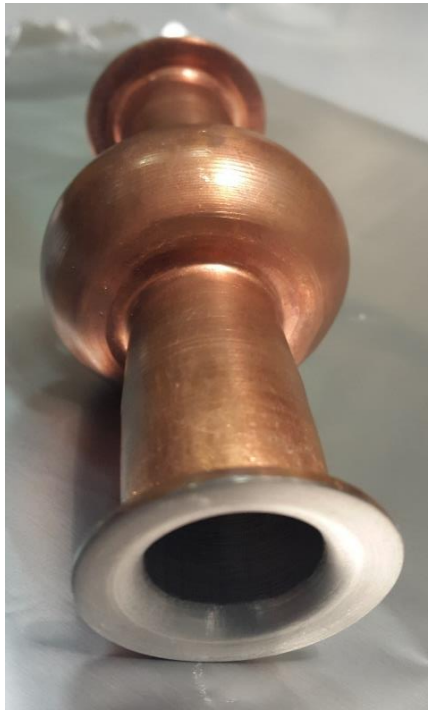
Research, Methodology, Results & Next Steps



Superconducting Radio Frequency Cavities



Nb bulk 6 GHz Cavity



Nb/Cu 6 GHz Cavity

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Research, Methodology, Results & Next Steps

Cavity Fabrication

Collaboration with I-Cube (ESR-09)

Mechanical Finishing

Improve spinning process → Insert 6 GHz tumbling

Chemical Polishing

PVD process

Study effects of different sputtering parameters

RF Characterization

Collaboration with CERN (ESR-01) and HZB (ESR-08) → Insert Active magnetic shielding

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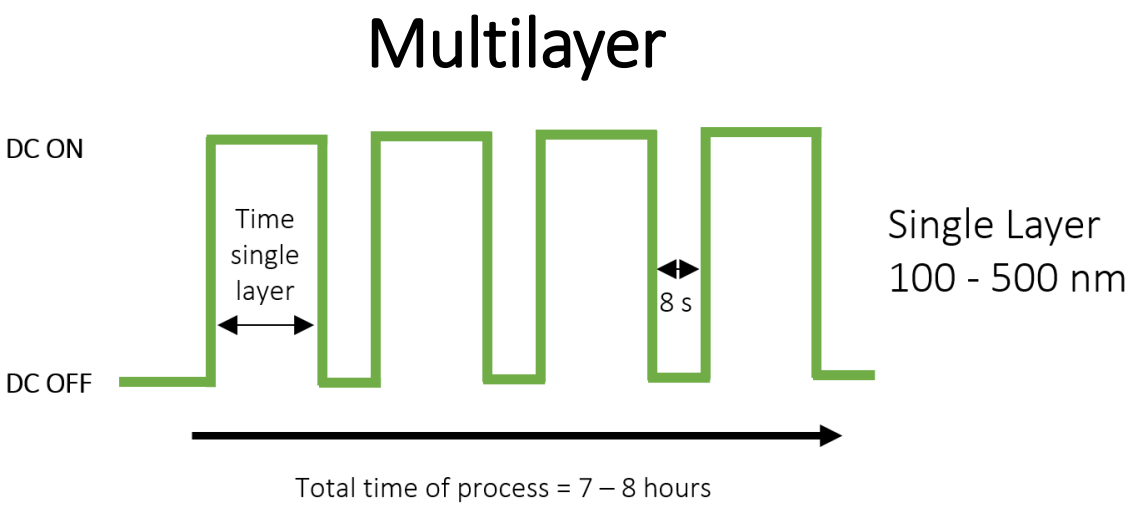
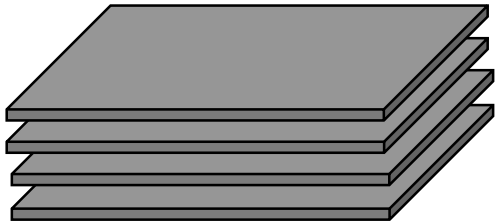
ESR 10, WP 3

Research, Methodology, Results & Next Steps

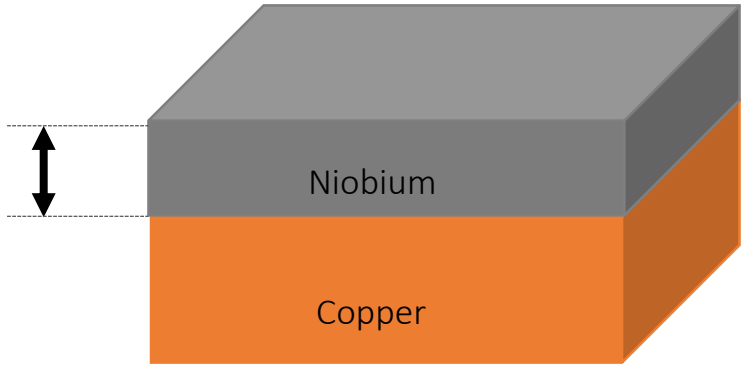
- In order to overcome the Q slope on the Nb/Cu cavities, in this research is used a thick film approach in a multilayer deposition mode



Single Layer
100 - 500 nm



Niobium



Total Thickness (on the cell) = **70 µm**

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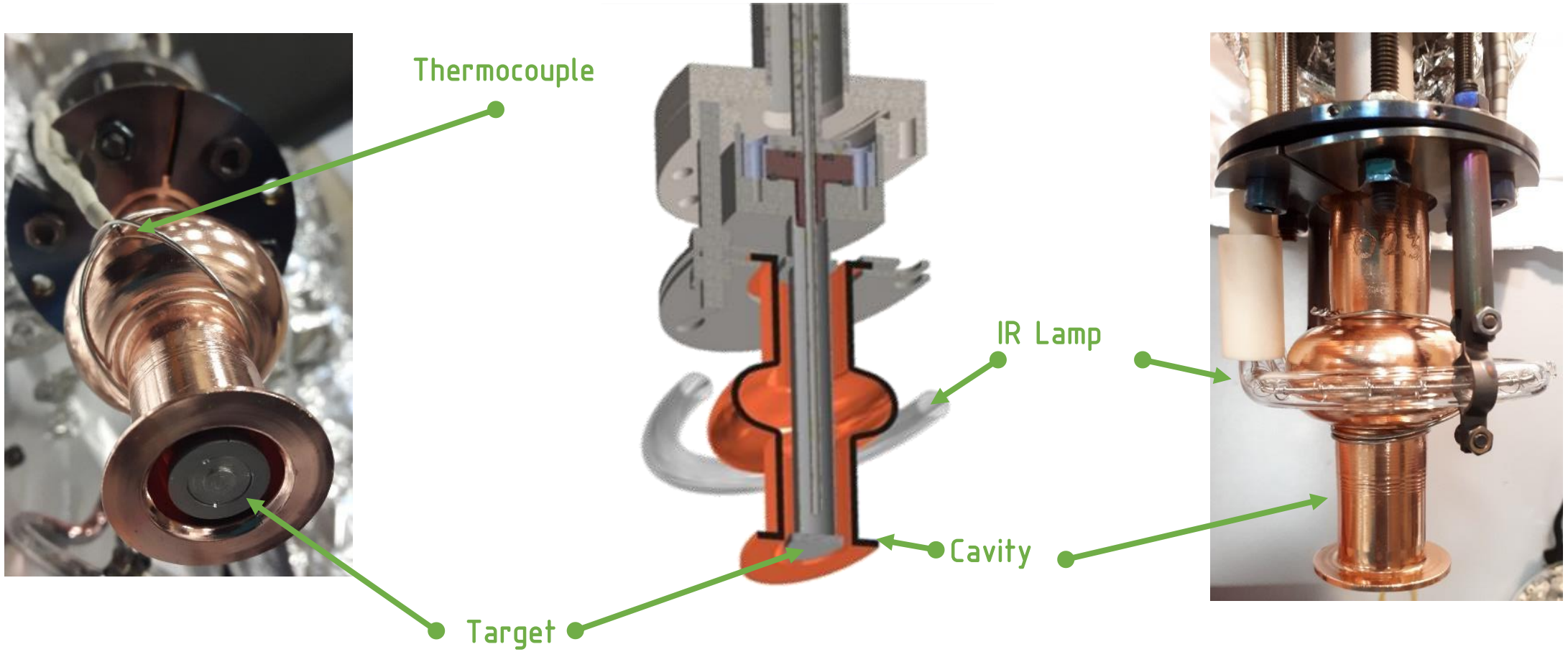

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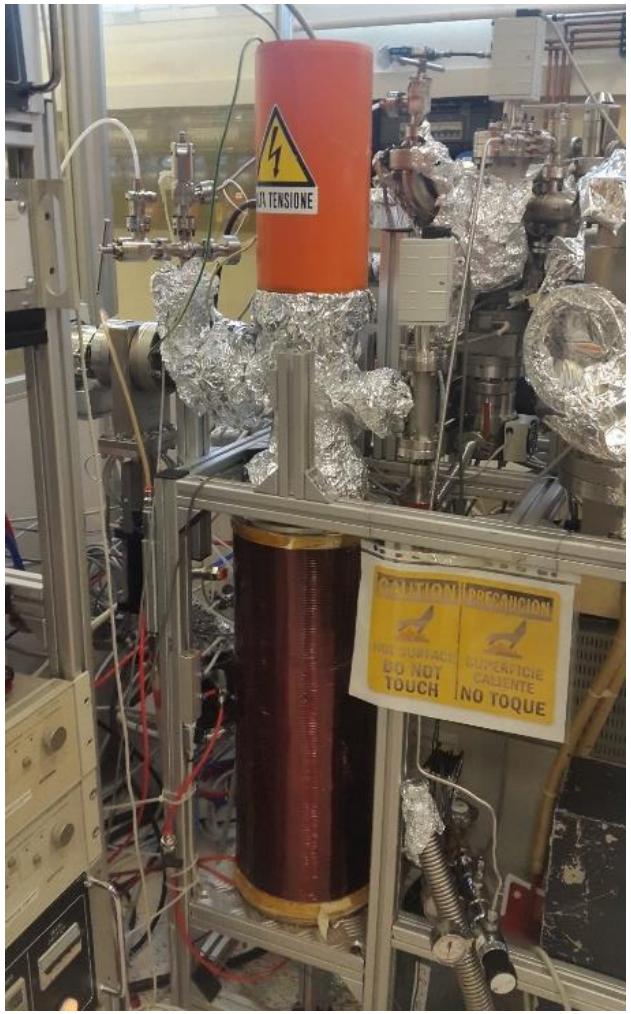


Deposition parameters and system

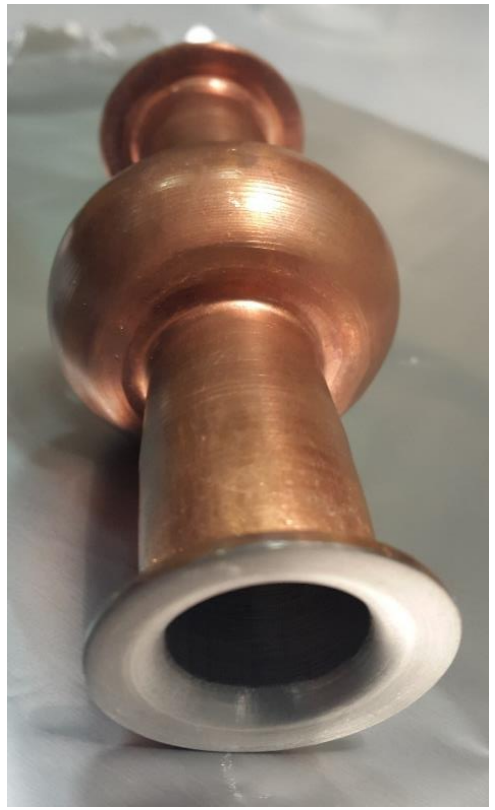
Baking = **600°C** for 48 hours

Temperature = **550 °C**

Base pressure < **2 x 10^{-9} mbar**

Magnetic Field = **830 Gauss**

Current = **1 A**



6GHz Nb/Cu Cavity

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Research, Methodology, Results & Next Steps

RF characterization

At 4,2K and 1,8K

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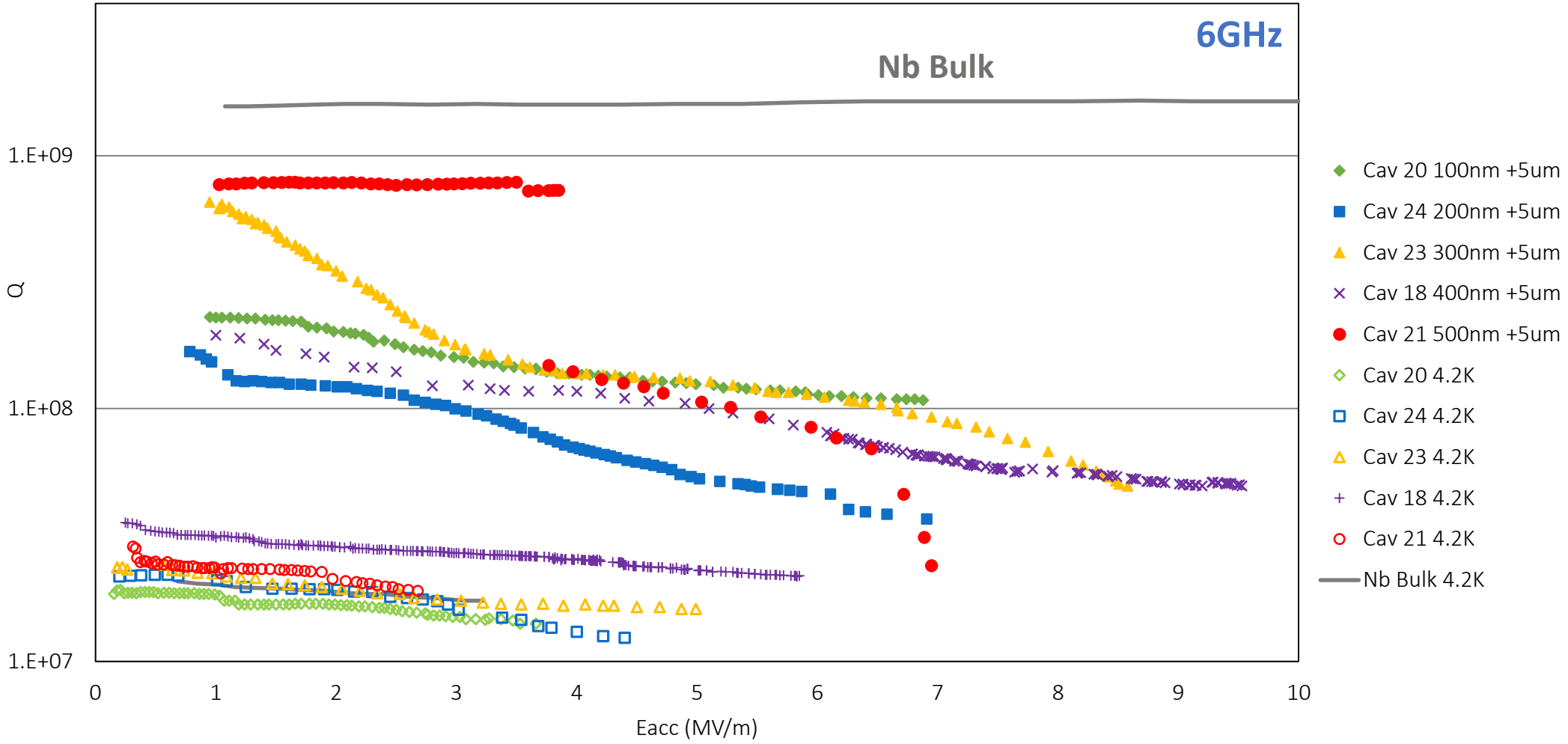

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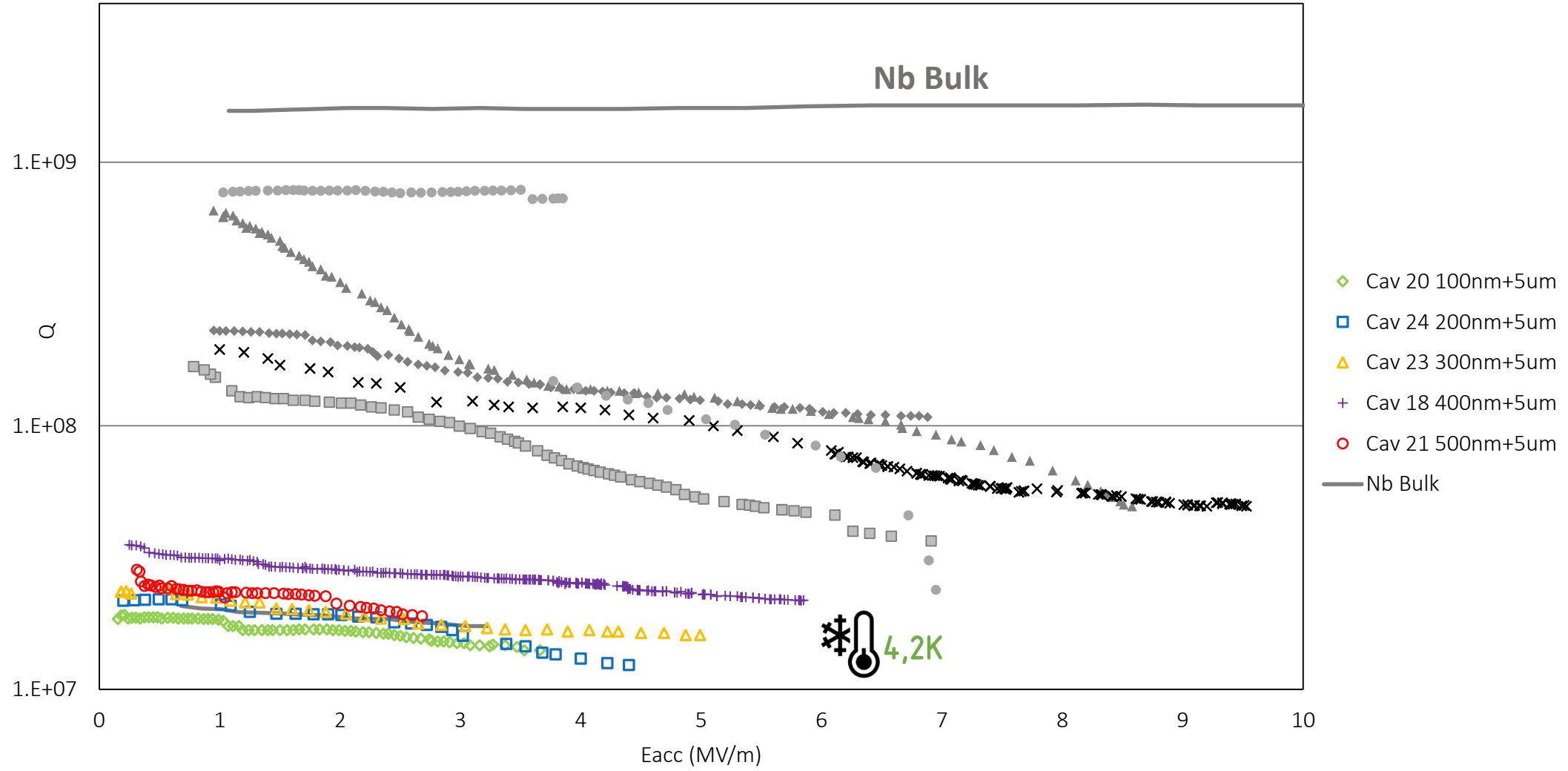

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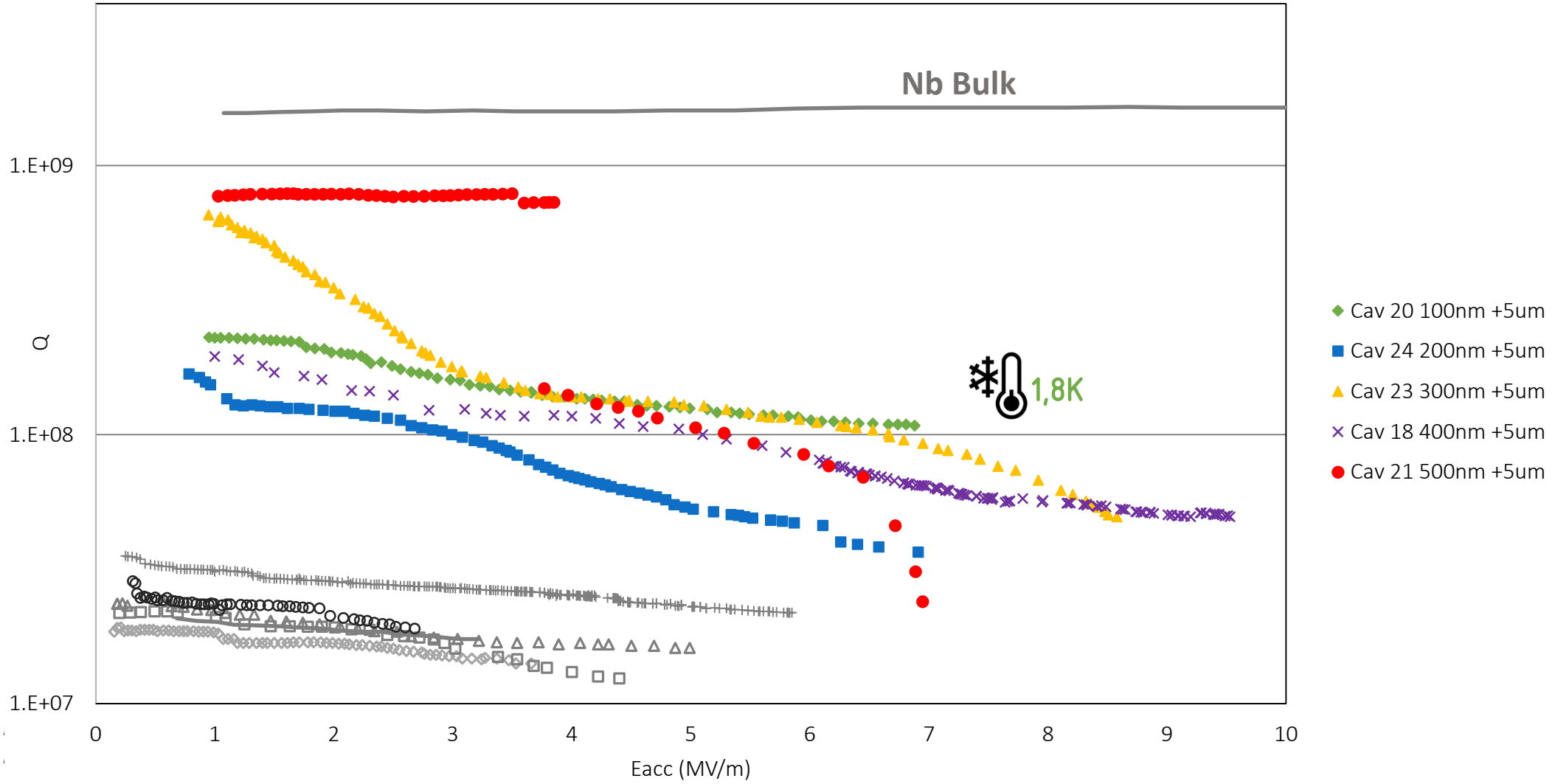

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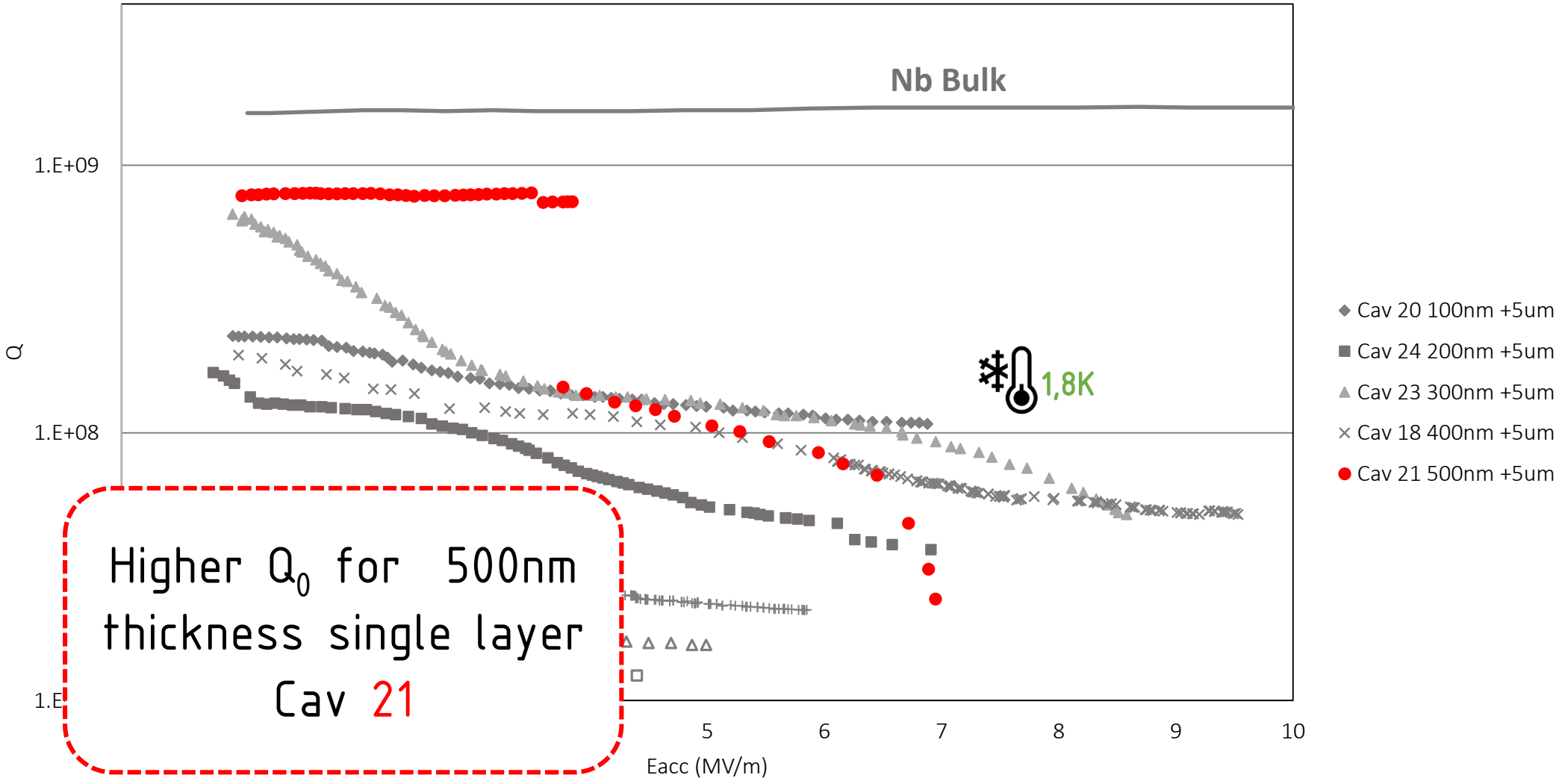
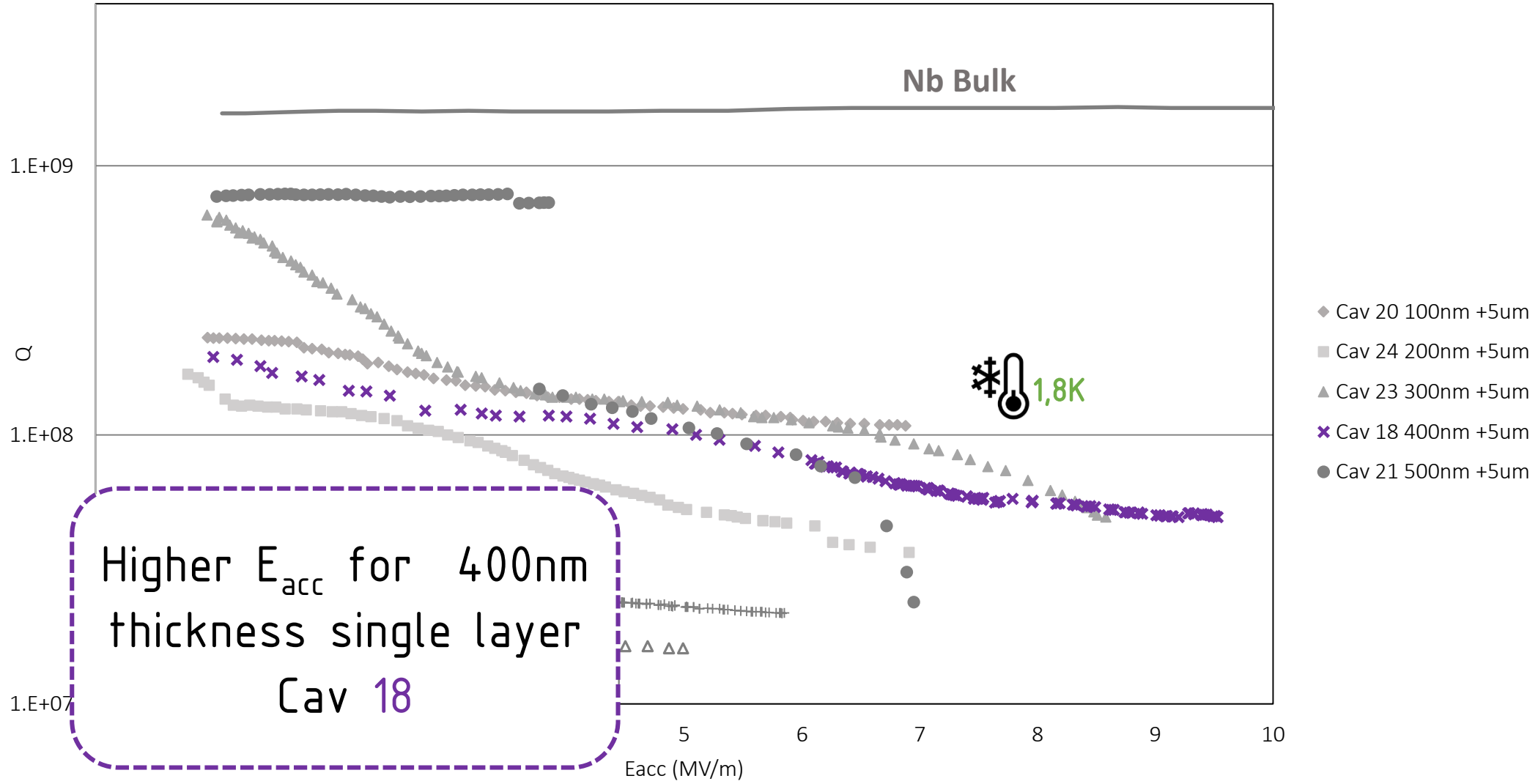


Higher Q_0 for 500nm thickness single layer Cav 21

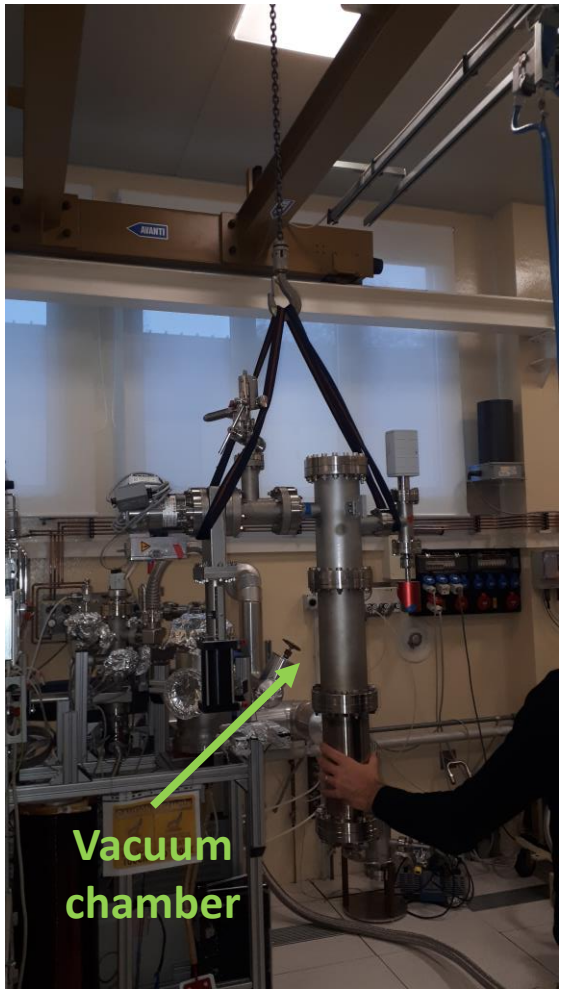
Research, Methodology, Results & Next Steps



Higher E_{acc} for 400nm thickness single layer Cav 18

Research, Methodology, Results & Next Steps

Refurbishing of deposition system



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Research, Methodology, Results & Next Steps

- Vibro-tumbling and active shielding techniques are being studied and will be installed as a part of our protocol

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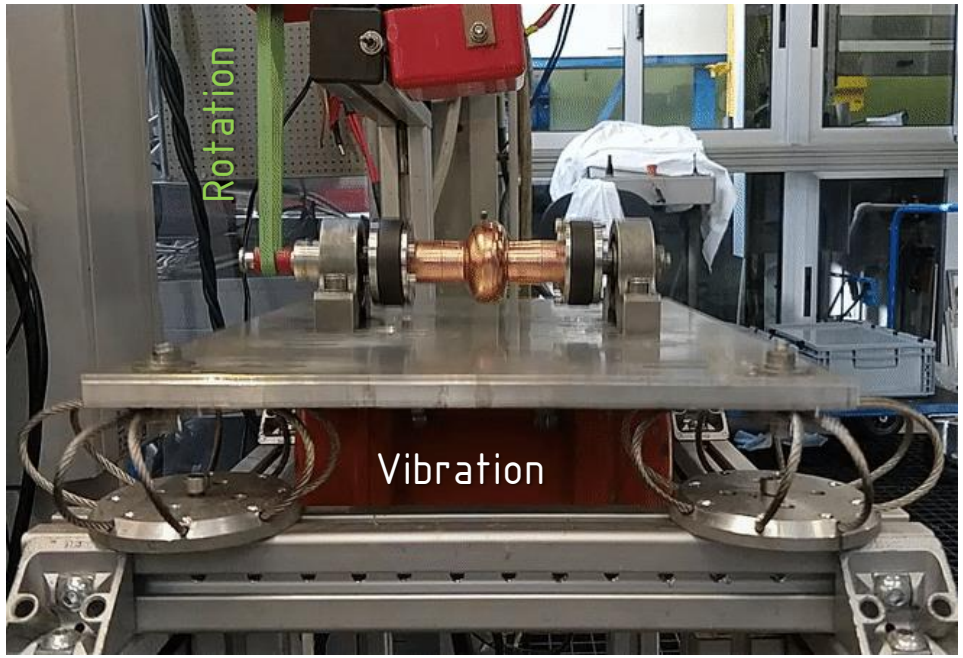

Vibro-tumbling

Reproducibility issue

Active magnetic shielding

Understand trapped magnetic flux

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Research, Methodology, Results & Next Steps

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- **Deposition of different thickness in multilayer mode and N – doping**
- **Implementation of post sputtering treatments such as baking before RF characterization**

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Training, conferences and Workshops

- Tesla meeting (Milano, February)
- FCC week (Amsterdam, April)
- EASITrain Lectures Spring (CERN, March)
- EASISchool (Wien, September)
- 8th International Workshop on Thin Films and new ideas for pushing the limits of RF superconductivity (Legnaro, October). Member of the organizing committee.
- TTC/ARIES topical workshop on flux trapping and magnetic shielding (CERN, November)
- Safety courses. English and Italian Course

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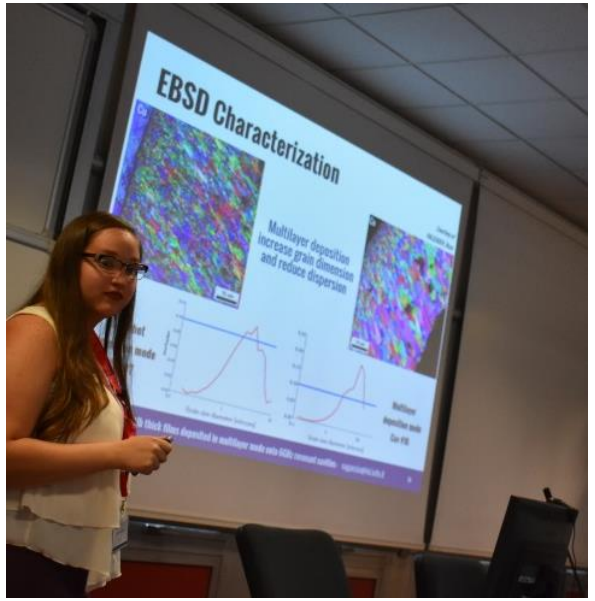
Outreach, Dissemination & Networking

- **Presentation in conferences:**
  - FCC week
  - 8th International Workshop on Thin Films and new ideas for pushing the limits of RF Superconductivity



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- **Guidance to cryogenic laboratory during Thin Film Workshop at LNL-INFN**

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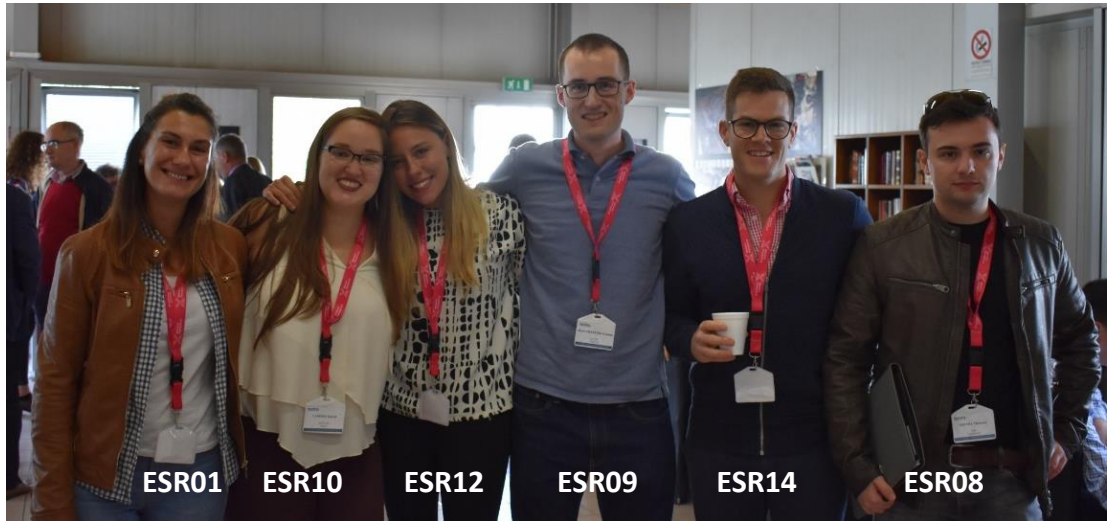

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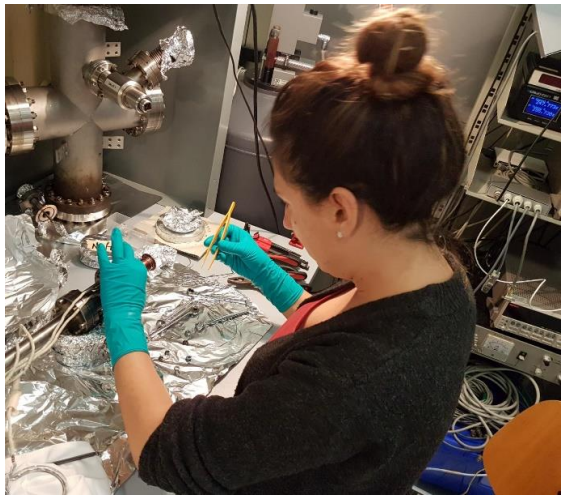
- **Guidance during ESR01 secondment at LNL-INFN**



ESR 01
Dorothea Fonnesu

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Outreach, Dissemination & Networking

- **Constant dissemination in social media: Twitter**

Vanessa Garcia @vangar29 · 9 oct.
Today is the second day of the 8th International Workshop on Thin Films and New Ideas for Pushing the Limits of RF Superconductivity! @INFN_ LNL
ESR14 Stewart Leith and ESR09 Jean-François Croteau are presenting there works today! @EasiTrain @MSCActions

Vanessa Garcia @vangar29 · 8 oct.
8th International Workshop on Thin Films and New Ideas for Pushing the Limits of RF Superconductivity
Presentation on thick films deposited onto 6 GHz copper cavities by multilayer...
instagram.com/p/BorDnB8iNpk/...

Vanessa Garcia @vangar29 · 25 sept.
For the next generation of particles accelerators, it is necessary to reduce costs for the sustaintability of the projects. A much cheaper alternative, are copper cavities coated with niobium (already installed in upgrades of the LHC)
@EasiTrain #EasiTrain
Traducir Tweet

Vanessa Garcia @vangar29 · 3 sept.
This is how #EASITrain summer school begins! @EasiTrain @Mariecurie_alum
Interesting and amazing lectures for this week ❤️
Traducir Tweet

Vanessa Garcia @vangar29 · 3 ago.
In a couple of days I'll be explaining more of rf characterization for 6 GHz copper cavities coated with Niobium
@EasiTrain
Traducir Tweet

Vanessa Garcia @vangar29 · 10 oct.
Today is the last day of the 8th International Workshop on Thin Films and New Ideas for Pushing the Limits of RF Superconductivity here in Legnaro! A fabulous conference with great speakers! And last but not least delicious Italian food! Great organization!

Vanessa Garcia @vangar29 · 25 sept.
Science is to understand what is behind of each aspect of nature. Particle accelerators are looking for what is inside of the most tiny particles! The @EasiTrain project is studying the most important aspects of part accelerators
SC RF cavities
Cryogenics
SC wires
Magnets
...
Traducir Tweet

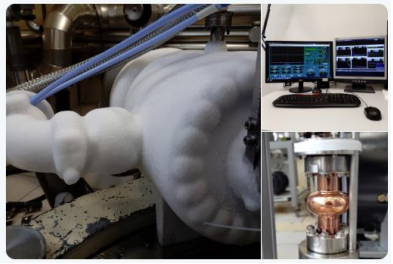
Vanessa Garcia @vangar29 · 8 oct.
The 8th international Workshop on Thin Films and New Ideas for Pushing the Limits of RF Superconductivity has started! @INFN_ LNL
Stay tuned!

Vanessa Garcia @vangar29 · 8 oct.
instagram.com/p/Boq0h14nuOy/...
About my presentation at thin film workshop @INFN_ LNL @EasiTrain

Vanessa Garcia @vangar29 · 25 sept.
But the elements that actually accelerate the particles are the Super Conductive Radio Frequency Cavities. These are usually made by Niobium because of its wonderful superconductive properties. But...
@EasiTrain

Vanessa Garcia @vangar29 · 7 oct.
Tomorrow is the date for the 8th international Workshop on Thin Films and New Ideas for Pushing the Limits of RF Superconductivity
Traducir Tweet

Vanessa Garcia @vangar29 · 26 jul.
I've been showing some of our work in @INFN_ Legnaro with 6GHz copper cavities. But it all comes down to this part: measuring their performance at low temperature
@EasiTrain
Traducir Tweet



Vanessa Garcia @vangar29 · 21 sept.
See you in October for the 8th International Workshop on "Thin films applied to Superconducting RF: Pushing the limits of RF Superconductivity" in Legnaro National Laboratories of the INFN, ITALY, from October 8 to 10, 2018
Traducir Tweet

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Outreach, Dissemination & Networking

- Constant networking due to constant collaborations between lab and industry or others research groups.
- Wide networking during workshops and conferences.

8th International Workshop on Thin Films and new ideas for pushing the limits of RF Superconductivity

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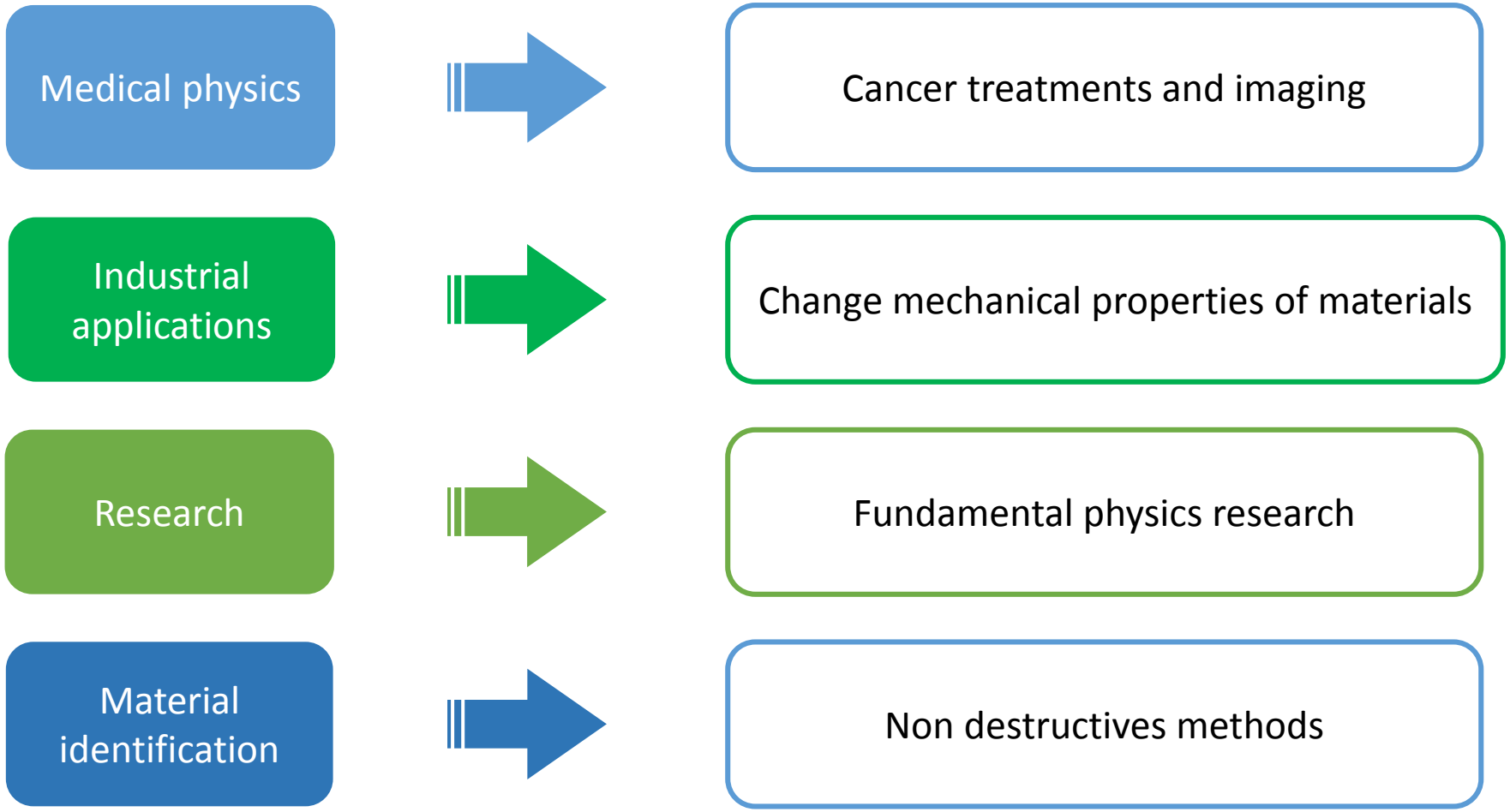
Impact



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Impact

Learned:

- How to push myself out of the comfort zone
- Different languages
- How to work in a international and collaborative environment
- Different cultures
- Give presentations

… and still learning

- Being where I want to be in the scientific field
- Traveling and getting to know a lot of people

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Conclusions

- The project at INFN-LNL has started successfully.
- The PhD has started at Ferrara University.
- The project has been an opportunity to be part of a scientific community.
- Conferences and workshop are fundamental for the networking.
- Dissemination is a fundamental part of being a scientist.

Being a Marie Curie Fellow in EASITrain has been an incredible experience!

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Thank you!

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