MY PROFESSIONAL LIFE

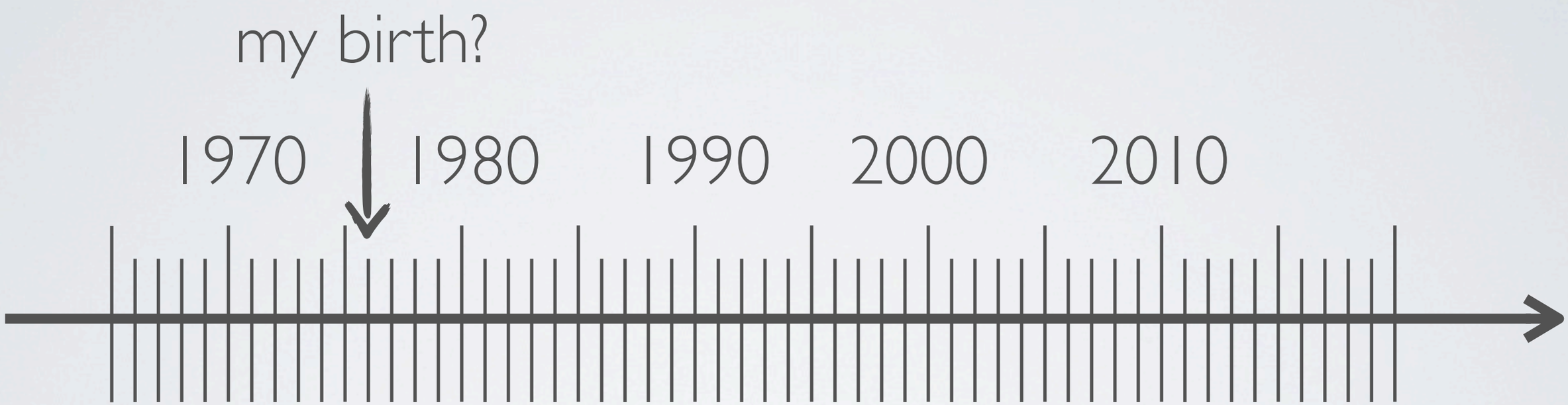
VALENTINA PREVITALI

THE TIMELINE OF MY (professional) LIFE

when did I begin to be a researcher?

THE TIMELINE OF MY (professional) LIFE

when did I begin to be a researcher?

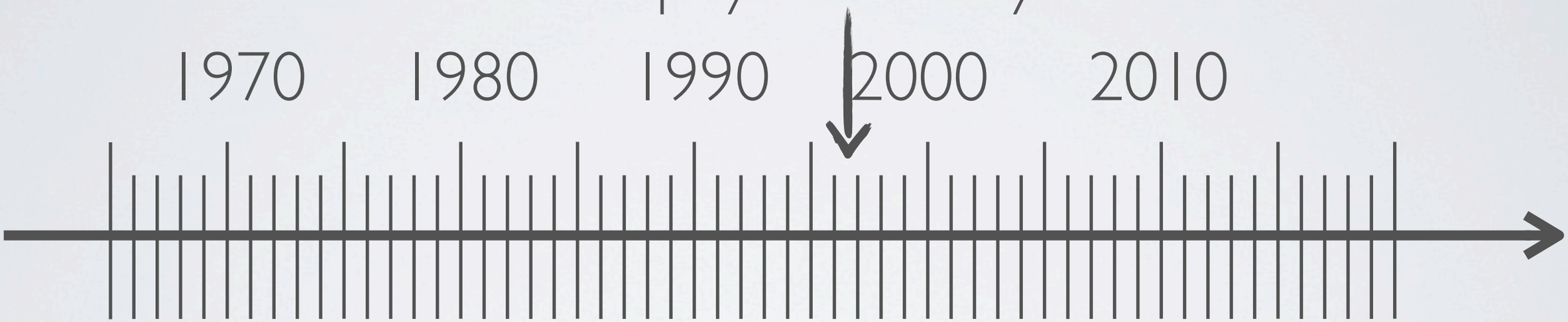


1976

THE TIMELINE OF MY (professional) LIFE

when did I begin to be a researcher?

choice of
physics faculty?



1996

THE TIMELINE OF MY (professional) LIFE

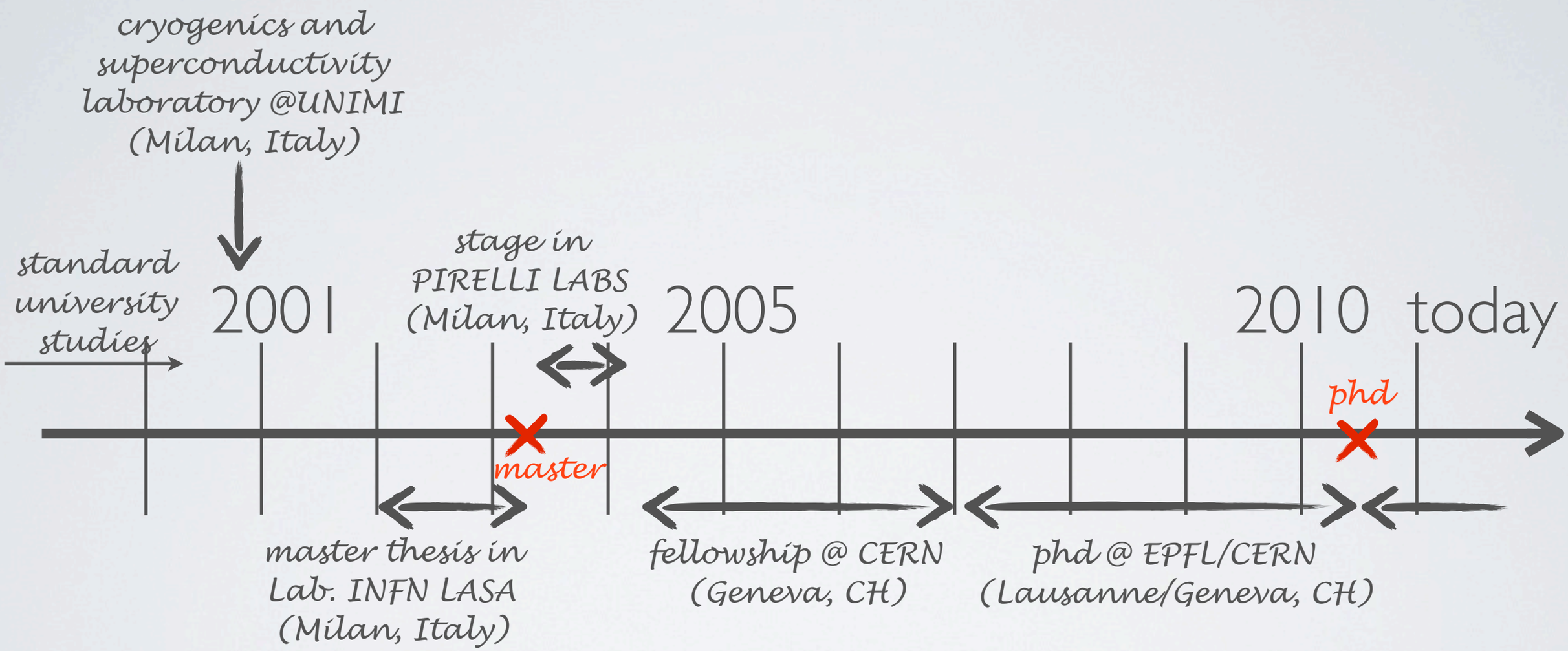
when did I begin to be a researcher?

last year lab:
cryogenics and superconductivity

2001

THE TIMELINE OF MY (professional) LIFE

THE TIMELINE OF MY (professional) LIFE



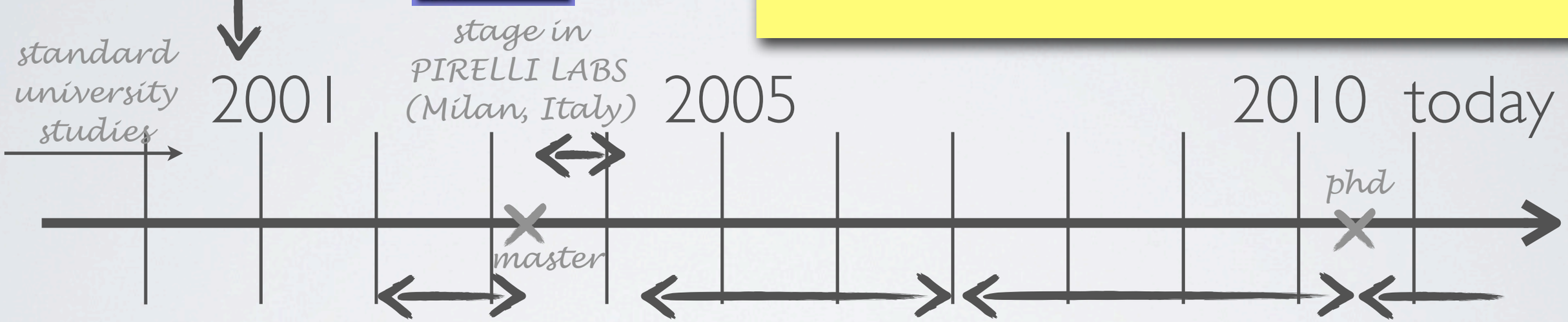
THE TIMELINE OF MY (professional) LIFE

cryogenics and superconductivity laboratory @UNIMI (Milan, Italy)

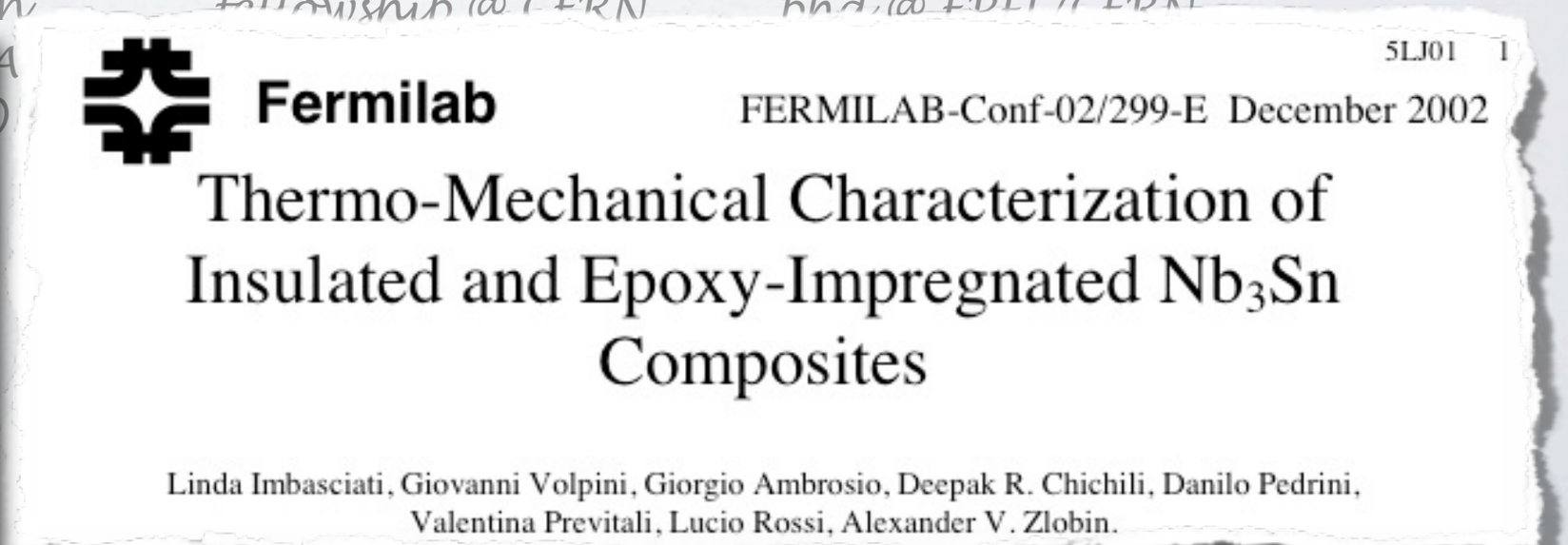
UNIVERSITÀ DEGLI STUDI DI MILANO

INFN Istituto Nazionale di Fisica Nucleare

thermal conductivity measurements at cryogenic temperatures: characterization of Al alloy (thermal shield for ATLAS)



characterization of anisotropic heat conductivity in impregnated Nb_3Sn cables



5LJ01 1

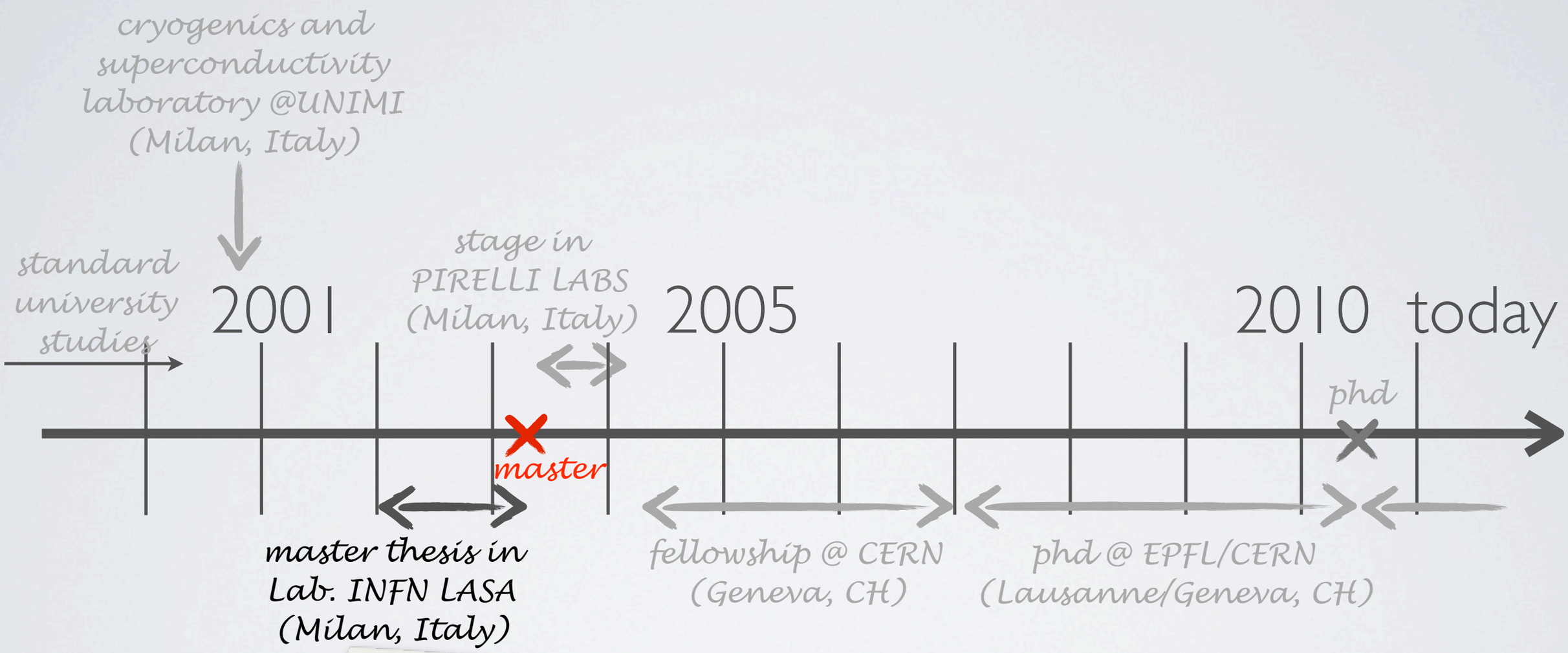
Fermilab

FERMILAB-Conf-02/299-E December 2002

Thermo-Mechanical Characterization of Insulated and Epoxy-Impregnated Nb_3Sn Composites

Linda Imbasciati, Giovanni Volpini, Giorgio Ambrosio, Deepak R. Chichili, Danilo Pedrini, Valentina Previtali, Lucio Rossi, Alexander V. Zlobin.

THE TIMELINE OF MY (professional) LIFE

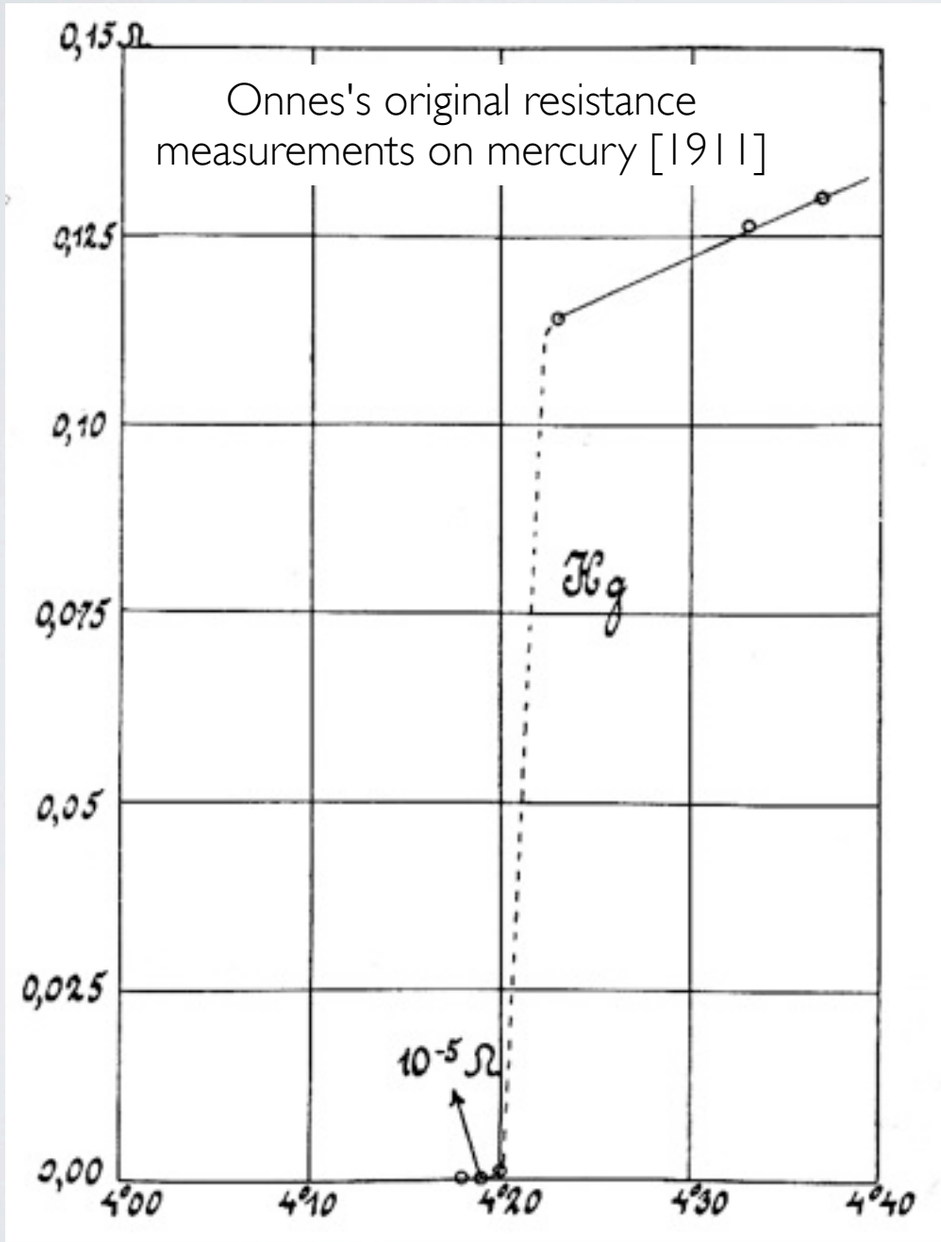


master thesis on MgB_2

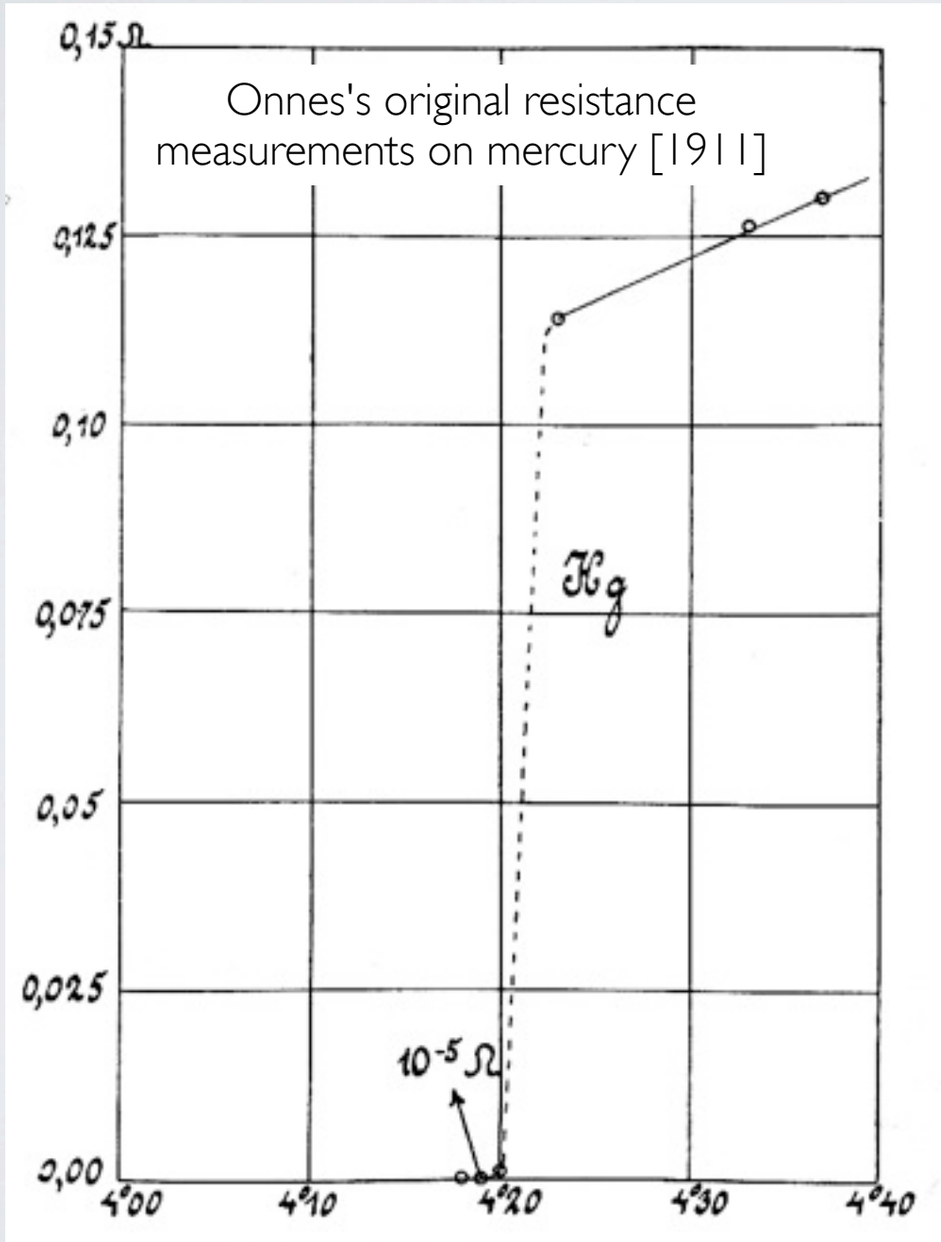
UNIVERSITÀ DEGLI STUDI DI MILANO

INFN Istituto Nazionale di Fisica Nucleare

Superconductivity: from TEXTBOOKS to REAL LIFE



Superconductivity: from TEXTBOOKS to REAL LIFE



a textbook ~ 0.5 Kg

sample holder ~ 10 Kg

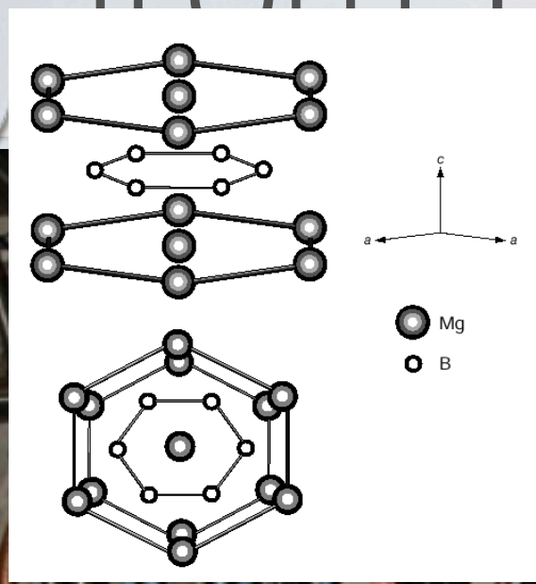
Superconductivity: from TEXTBOOKS to REAL LIFE

SUBJECT: *Electric properties of MgB2 tapes and wires for temperatures between 4.2 and 39 K and in applied magnetic fields between 0 and 12 T*

- practical experience in Lab - starting from problems with soldering Nickel and Copper, passing through the mounting of flat-rolled tapes on round grooves, intrinsic fragility of multi-filamentary wires, optical microscopy inspection, up to cryogenic issues and more...

- extended data analysis: critical current dependence on T and B, adiabatic stability analysis in our flat-rolled samples, performance of the multi-filamentary wire, first measurements of the superconductive properties of MgB2 in the T range of about 20K ...

Superconductivity: from TEXTBOOKS to REAL LIFE



SUBJECT: *Electric properties of MgB2 tapes and wires for temperatures between 4.2 and 39 K and in applied magnetic fields between 0 and 12 T*

practical experience in lab ... problems

MgB2: "discovered" in 2001, my thesis began in 2002. new, challenging topic

INSTITUTE OF PHYSICS PUBLISHING — SUPERCONDUCTOR SCIENCE AND TECHNOLOGY
Supercond. Sci. Technol. **16** (2003) 271–275 — PII: S0953-2048(03)54004-0

Fabrication and properties of monofilamentary MgB_2 superconducting tapes

G Grasso[1], A Malagoli[1], M Modica[1], A Tumino[1], C Ferdeghini[1], A S Siri[1], C Vignola[2], L Martini[2], V Previtali[3] and G Volpini[3]

...n the ...ntrinsic ...opy

T and B, adiab... samples, perfo... measurement... MgB2 in the T...

...e on

3328 — IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 13, NO. 2, JUNE 2003

Magnetic Field Dependence of the Critical Current in MgB_2 and Bi-2223 Superconducting Tapes Fabricated by the Powder-In-Tube Method

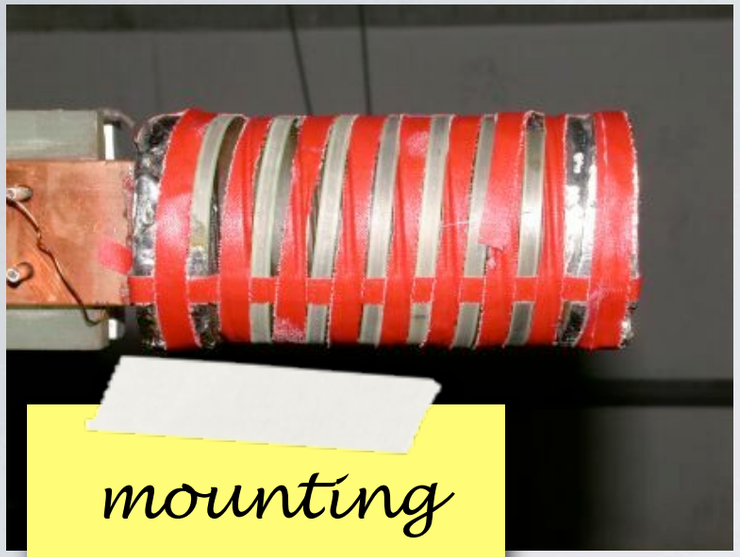
A. Malagoli, A. Tumino, V. Braccini, C. Ferdeghini, A. S. Siri, L. Martini, C. Vignola, V. Previtali, G. Volpini, and G. Grasso

Superconductivity: from TEXTBOOKS to REAL LIFE

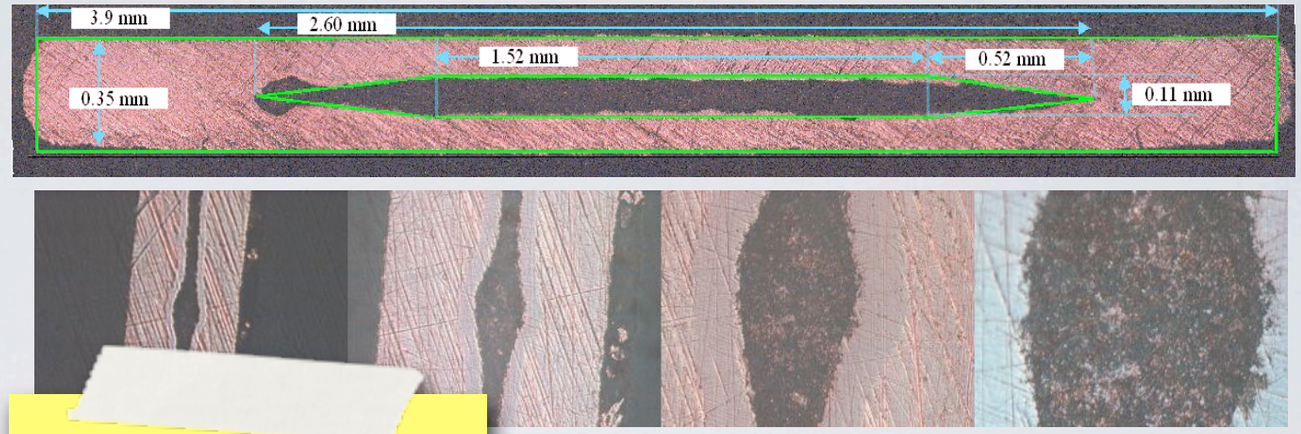
small project: chance to follow all the aspects of a project

SUBJECT: *Electric properties of MgB2 tapes and wires for temperatures between 4.2 and 39 K and in applied magnetic fields between 0 and 12 T*

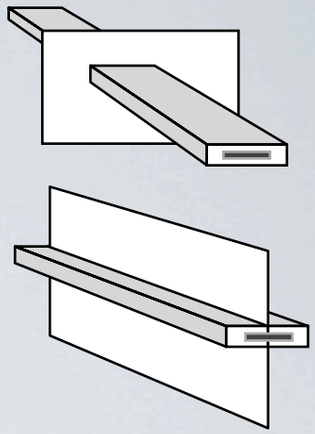
- practical experience in Lab - starting from problems with soldering Nickel and Copper, passing through the mounting of flat-rolled tapes on round grooves, intrinsic fragility of multi-filamentary wires, optical microscopy inspection, up to cryogenic issues and more...
- extended data analysis: critical current dependence on T and B, adiabatic stability analysis in our flat-rolled samples, performance of the multi-filamentary wire, first measurements of the superconductive properties of MgB2 in the T range of about 20K ...



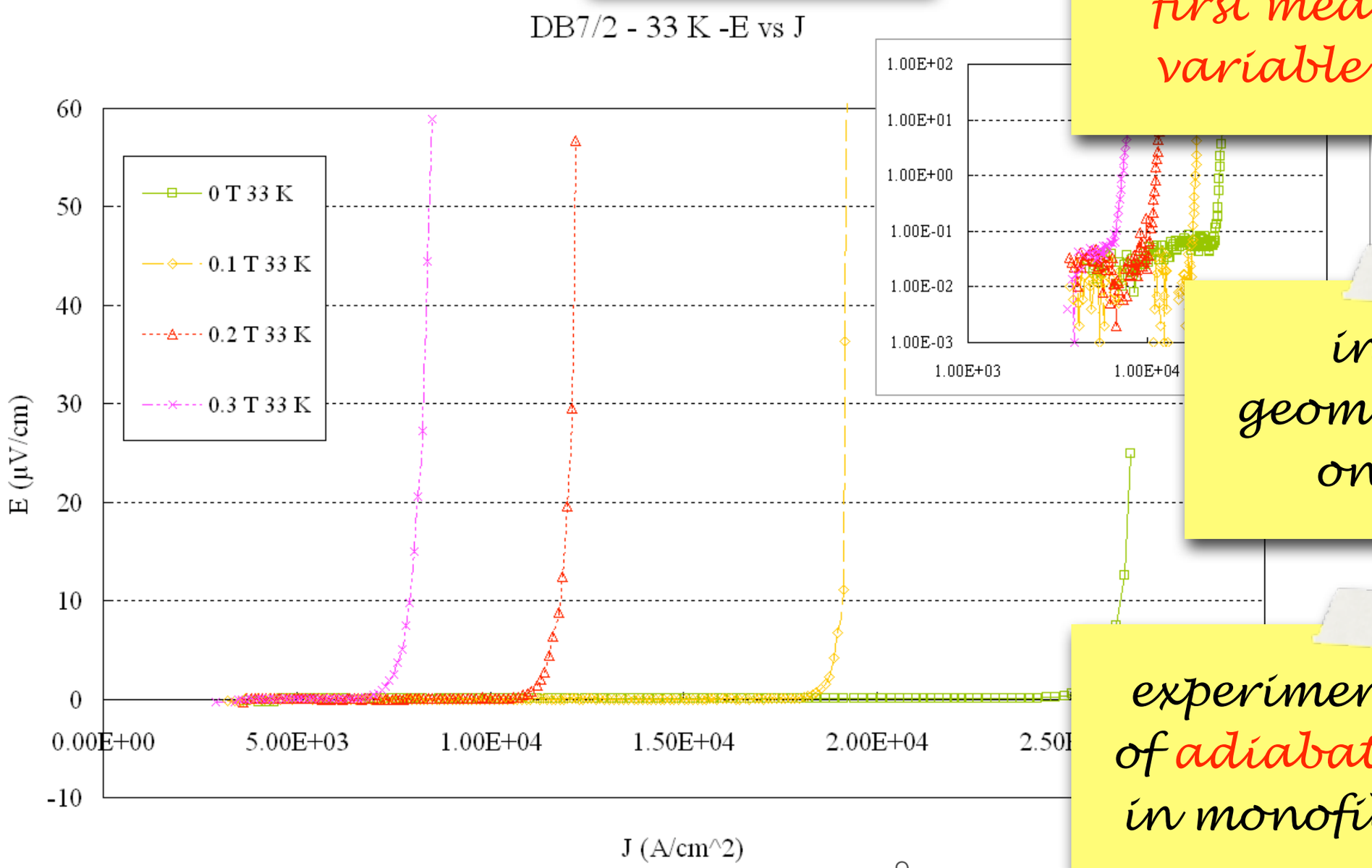
mounting



microscopy



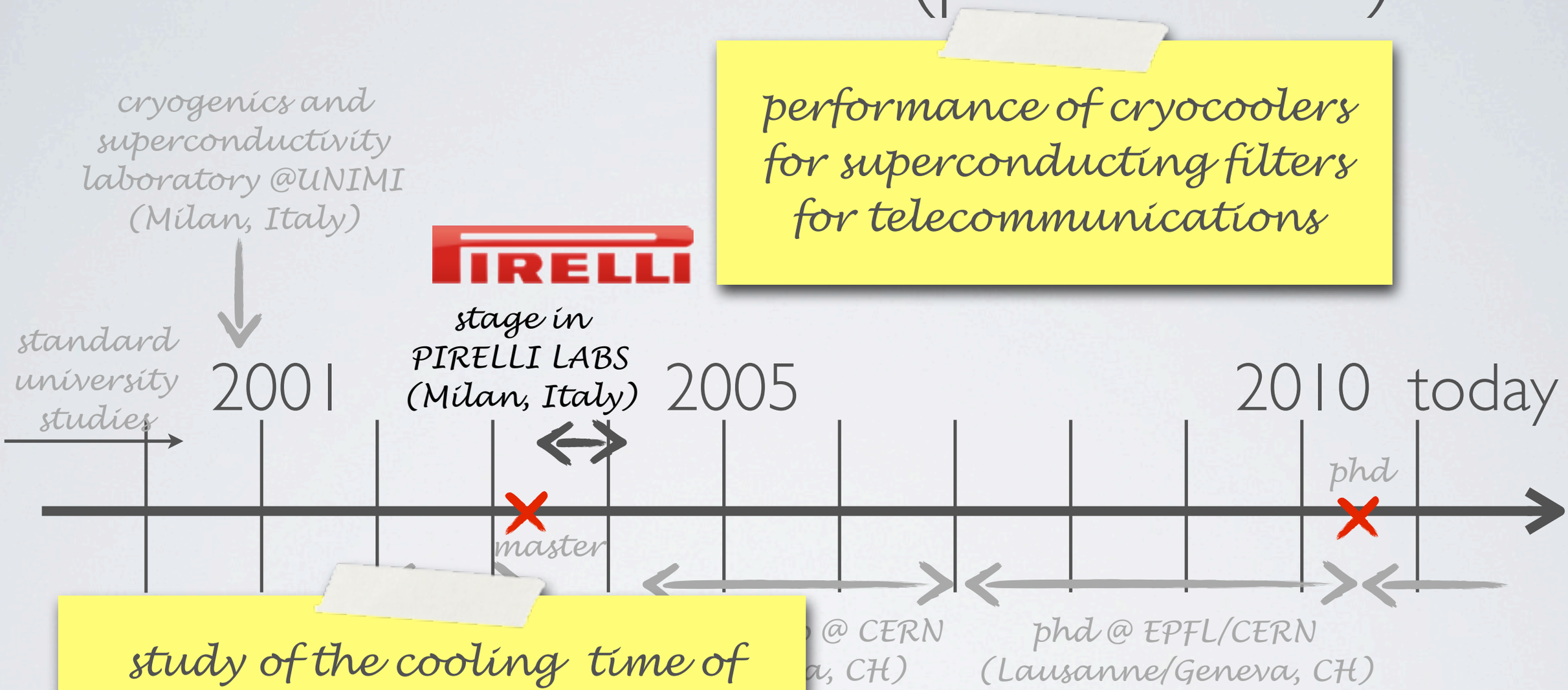
first measurements at variable temperature



influence of geometrical defects on I-V curves

experimental observation of adiabatic stability limit in monofilamentary tapes

THE TIMELINE OF MY (professional) LIFE

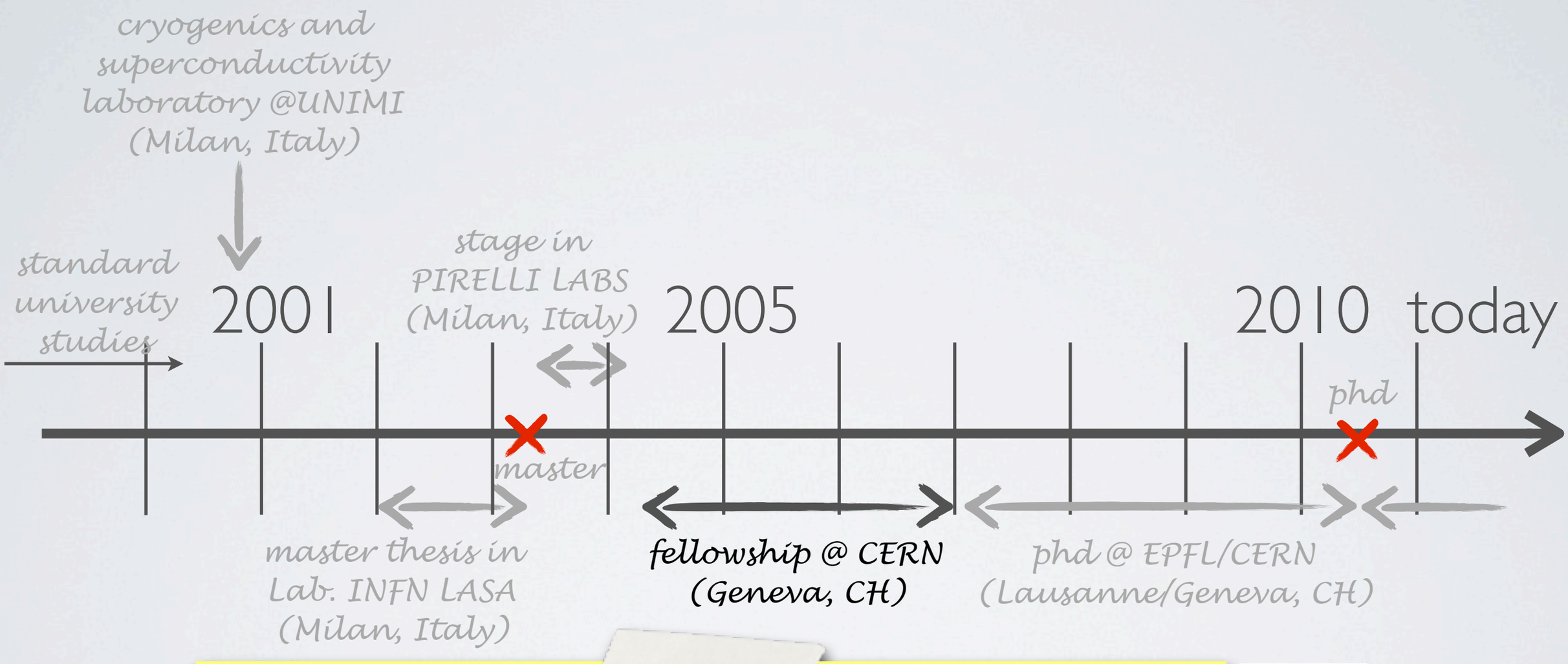


performance of cryocoolers for superconducting filters for telecommunications

study of the cooling time of different cryocoolers for variable heat loads

all material property of Pirelli Labs©

THE TIMELINE OF MY (professional) LIFE



Fellowship in AT-MAS (Accelerator and Technology department - Magnet and Superconductivity group) at CERN

TE-MSC

CERN FELLOWSHIP

- study on deformed samples: flat rolling of round NbTi wires with different degrees of deformation. Jc + magnetization + microscopy measurement of the sample: correlations. Development of a dedicated Matlab software to analyze the microscopy pictures. Study of critical current degradation after cabling and for rectangular correctors cables.

- participation in NED project: data analysis for a cross-calibration of different facilities in different laboratories for Ic measurements (lasa, twente, cea, cern). Development of a new sample insert to adapt the VAMAS technology to a CERN.

CERN FELLOWSH

again, both "hardware" laboratory and analysis

- study on deformed samples: flat rolling of round NbTi wires with different degrees of deformation, Ic + magnetization + microscopy measurement of the sample: correlations. Development of a dedicated Matlab software to analyze the microscopy pictures. Study of critical current degradation after cabling and for rectangular correctors cables.

- participation in NED project: data analysis for a cross-calibration of different facilities in different laboratories for Ic measurements (lasa, twente, cea, cern). Development of a new sample insert to adapt the VAMAS technology to a CERN.

new! Sofware development for image analysis (Matlab)

DWSH

again, both "hardware" laboratory and analysis

- study on deformed samples: flat rolling of round NbTi wires with different degrees of deformation. Jc + magnetization + microscopy measurement of the sample: correlations. Development of a dedicated Matlab software to analyze the microscopy pictures. Study of critical current degradation after cabling and for rectangular correctors cables.

- participation in NED project: data analysis for a cross-calibration of different facilities in different laboratories for Ic measurements (lasa, twente, cea, cern). Development of a new sample insert to adapt the VAMAS technology to a CERN.

new! conceptual mecanical design (Matcad)

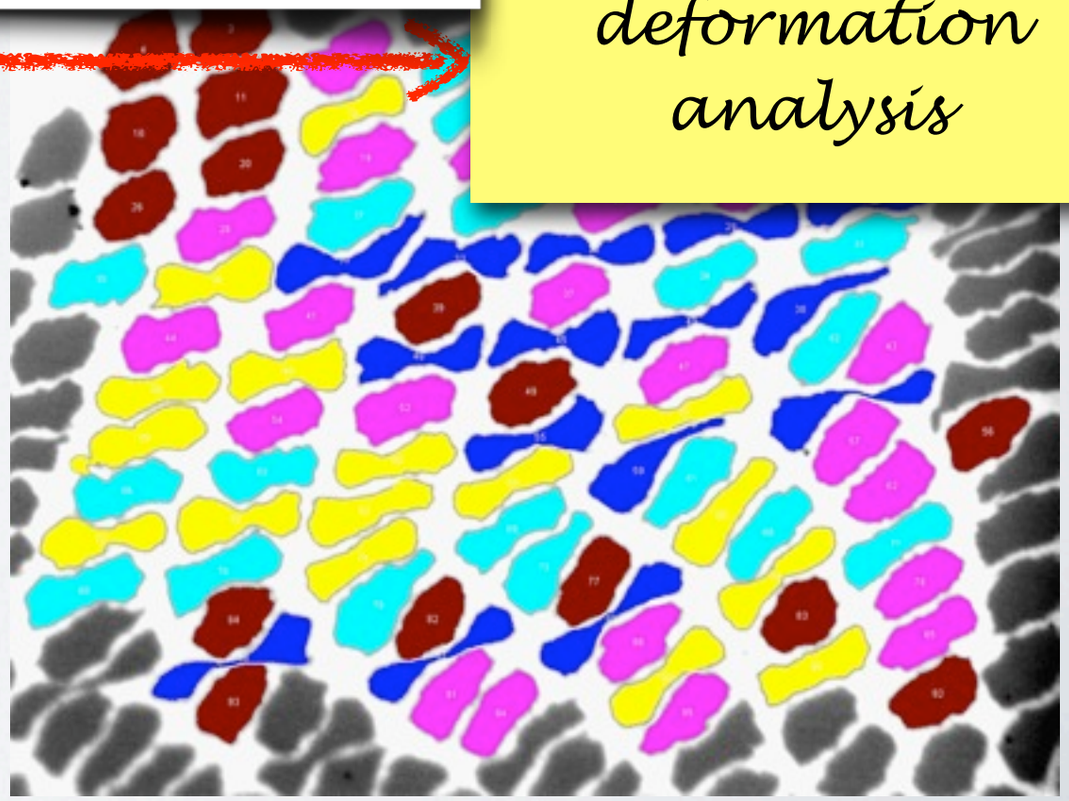
study on Nb-Ti deformed samples

1 -preparation of the samples

3 - final goal: find a correlation and compare with "real" cases (cabled wires, corrector wires)

2a- critical current/ magnetization measurements

2b- microscopy: filament deformation analysis



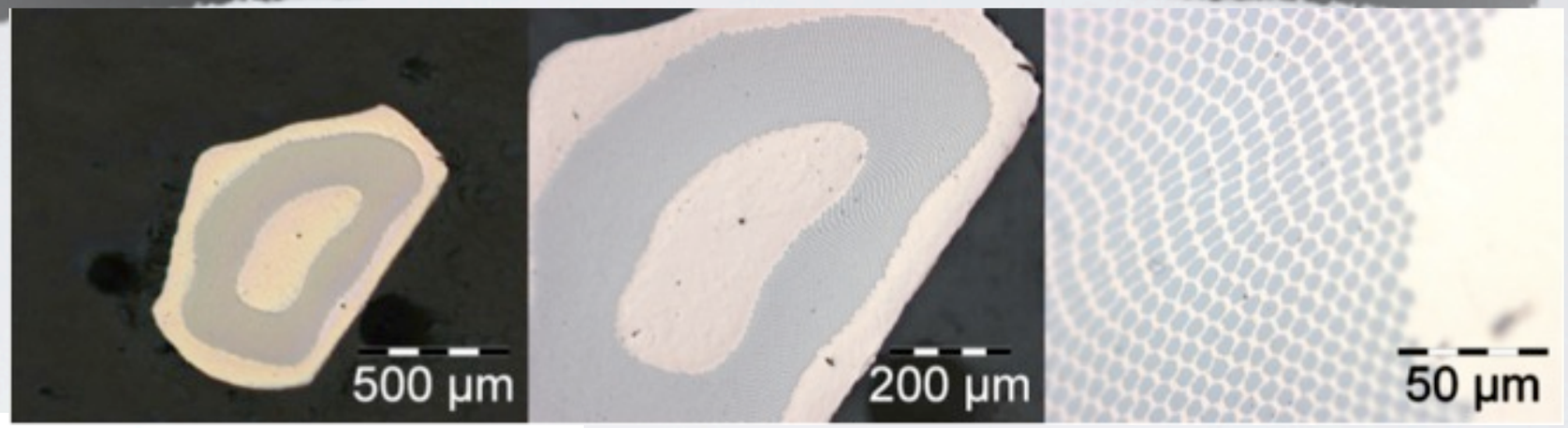
study on Nb-Ti deformed samples

3 - final goal: find a correlation and compare with "real" cases (cabled wires, corrector wires)

IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 16, NO. 2, JUNE

Critical Current Studies on Nb-Ti Deformed-Strands

Valentina Previtali, Thierry Boutboul, Sandrine Le Naour, Daniel Leroy, and Luc Oberli



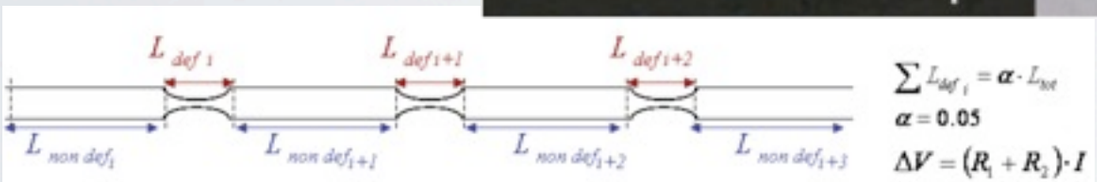
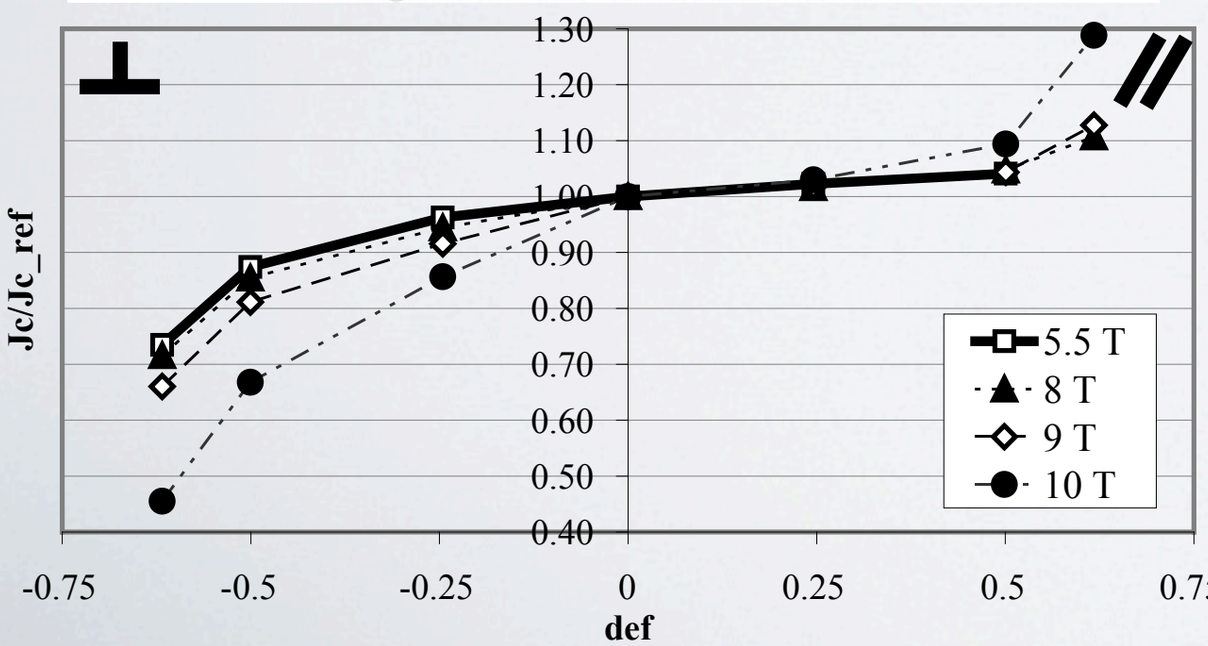


Figure 34: Model of an extracted wire.



with a very simple model for extracted cables and the data from flat-rolled cables, the critical current degradation during the cabling process was reproduced

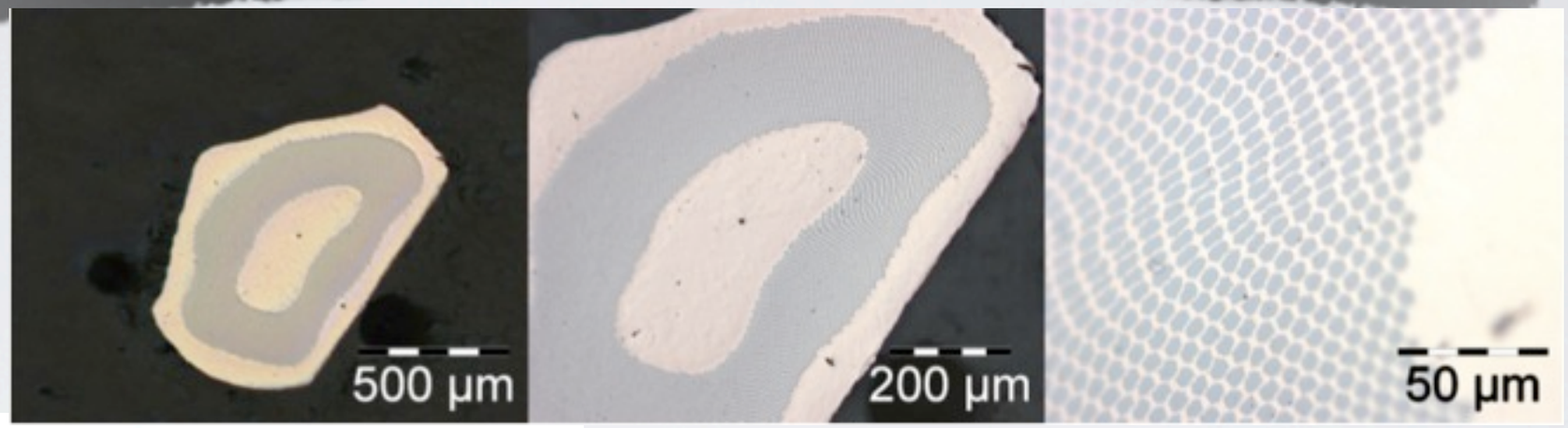
study on Nb-Ti deformed samples

3 - final goal: find a correlation and compare with "real" cases (cabled wires, corrector wires)

IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 16, NO. 2, JUNE

Critical Current Studies on Nb-Ti Deformed-Strands

Valentina Previtali, Thierry Boutboul, Sandrine Le Naour, Daniel Leroy, and Luc Oberli



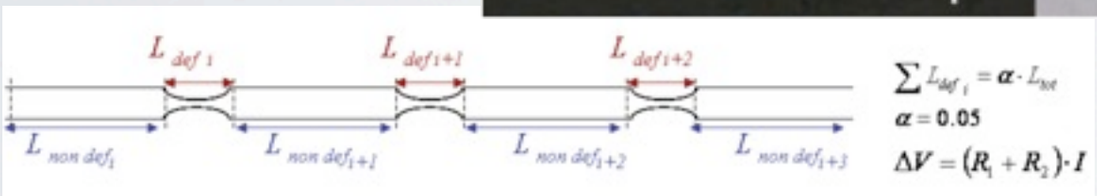
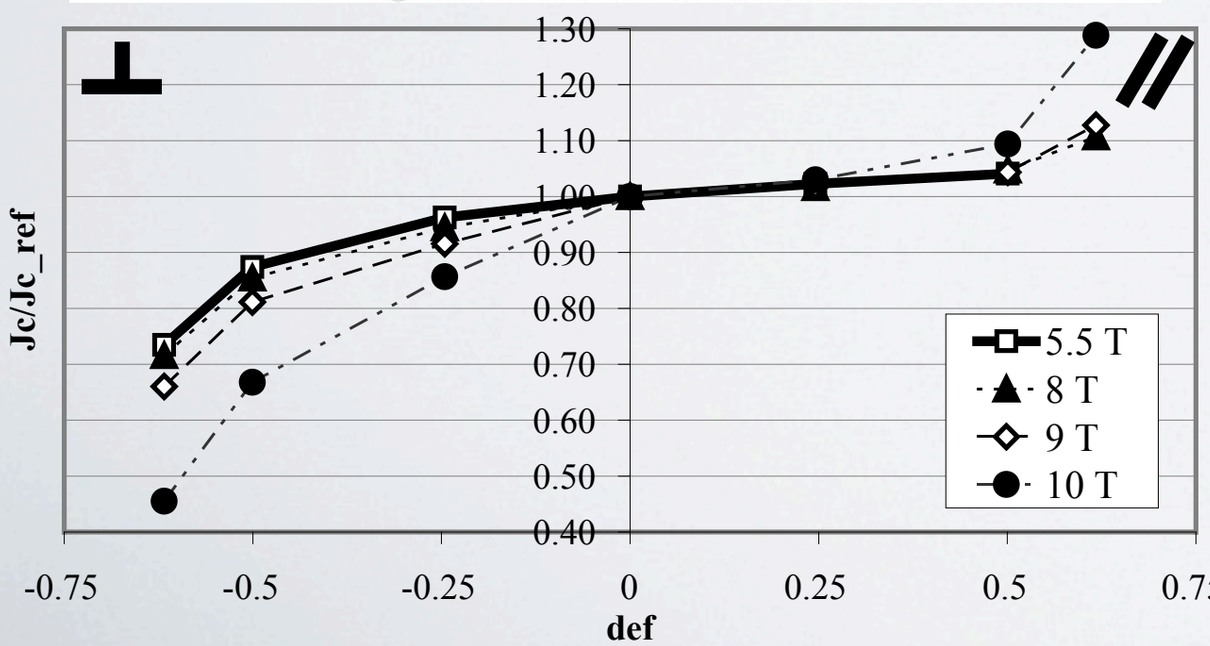


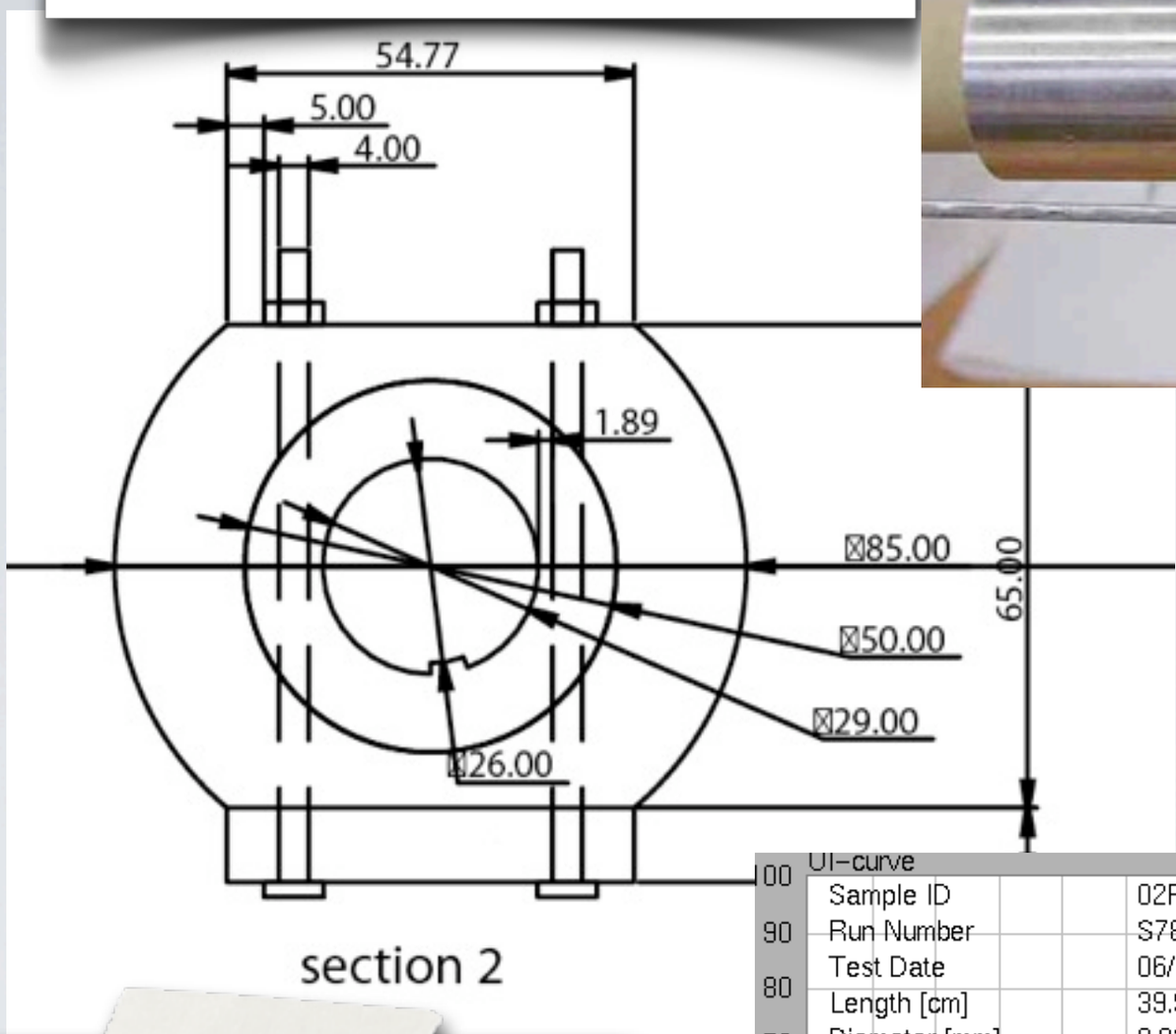
Figure 34: Model of an extracted wire.



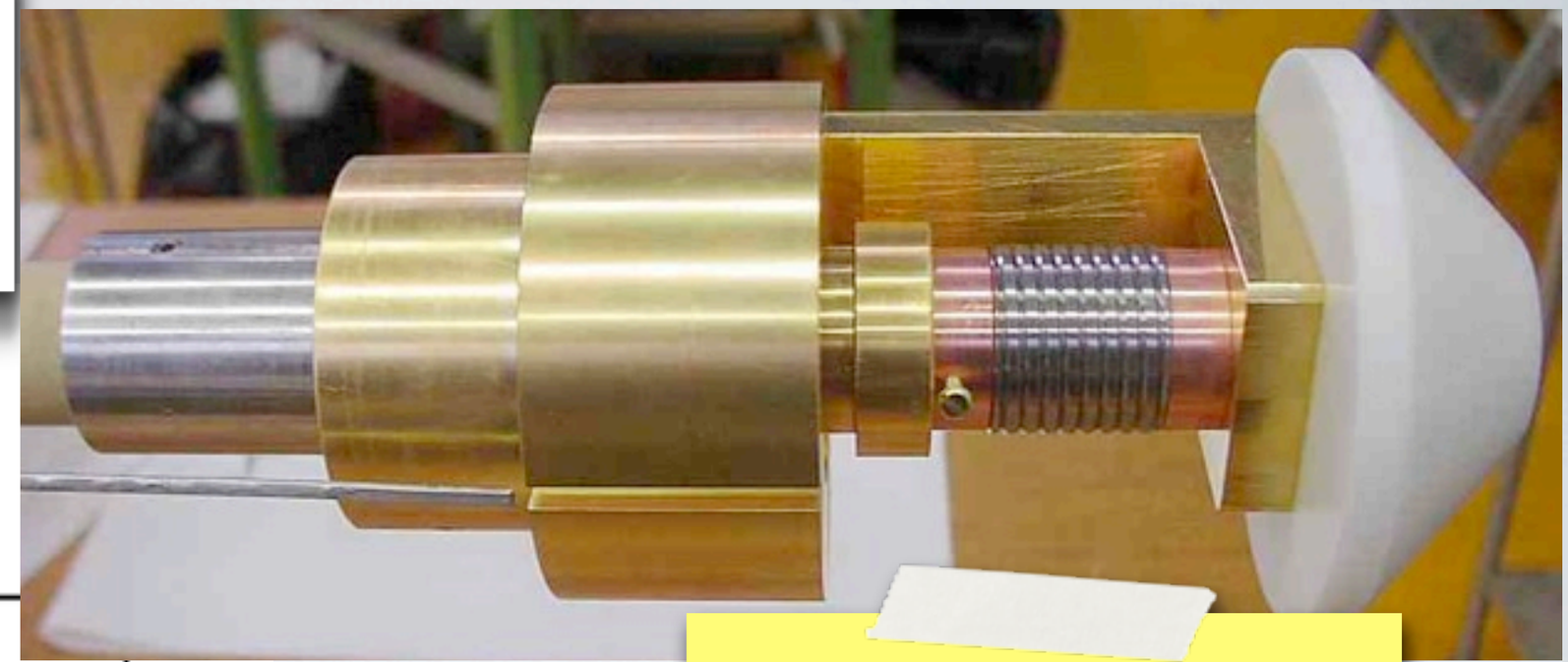
with a very simple model for extracted cables and the data from flat-rolled

<u>remember</u>:
modeling a complex reality using simple bricks is the best satisfaction for a physicist

participation in the NED project

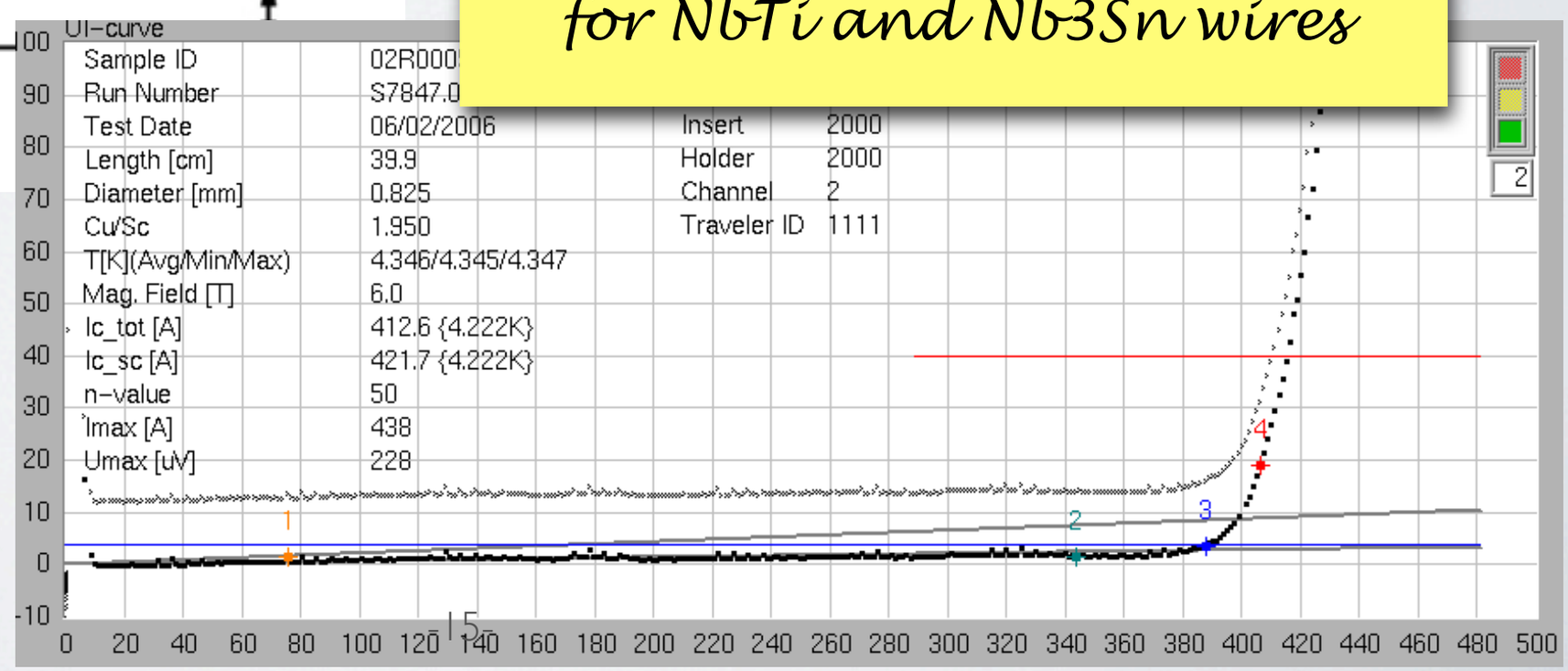


1 - Conceptual design



2 - Follow-up of the production

3 - first measurements both for NbTi and Nb3Sn wires



participation in the NED project

cross calibration program of the NED project: mainly offline analysis of Ic data

Critical Current Density in Superconducting Nb – Ti Strands in the 100 mT to 11 T Applied Field Range

T. Boutboul, S. Le Naour, D. Leroy, L. Oberli, and V. Previtali

EE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 16, NO. 2, JUNE 2006 1265

Critical Current Measurements on Nb_3Sn Conductors for the NED Project

A. den Ouden, T. Boutboul, D. Pedrini, V. Previtali, L. Quettier, and G. Volpini

CTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 15, NO. 2, JUNE 20

Status of the Next European Dipole (NED) Activity of the Collaborated Accelerator Research in Europe (CARE) Project

A. Devred, B. Baudouy, D. E. Baynham, T. Boutboul, S. Canfer, M. Chorowski, P. Fabbricatore, S. Farinon, H. Félice, P. Fessia, J. Fydrych, M. Greco, J. Greenhalgh, D. Leroy, P. Loverige, F. Michel, L. R. Oberli, A. den Ouden, D. Pedrini, J. Polinski, V. Previtali, L. Quettier, J. M. Rifflet, J. Rochford, F. Rondeaux, S. Sanz, S. Sgobba, M. Sorbi F. Toral-Fernandez, R. van Weelderen, P. Védrine, O. Vincent-Viry,

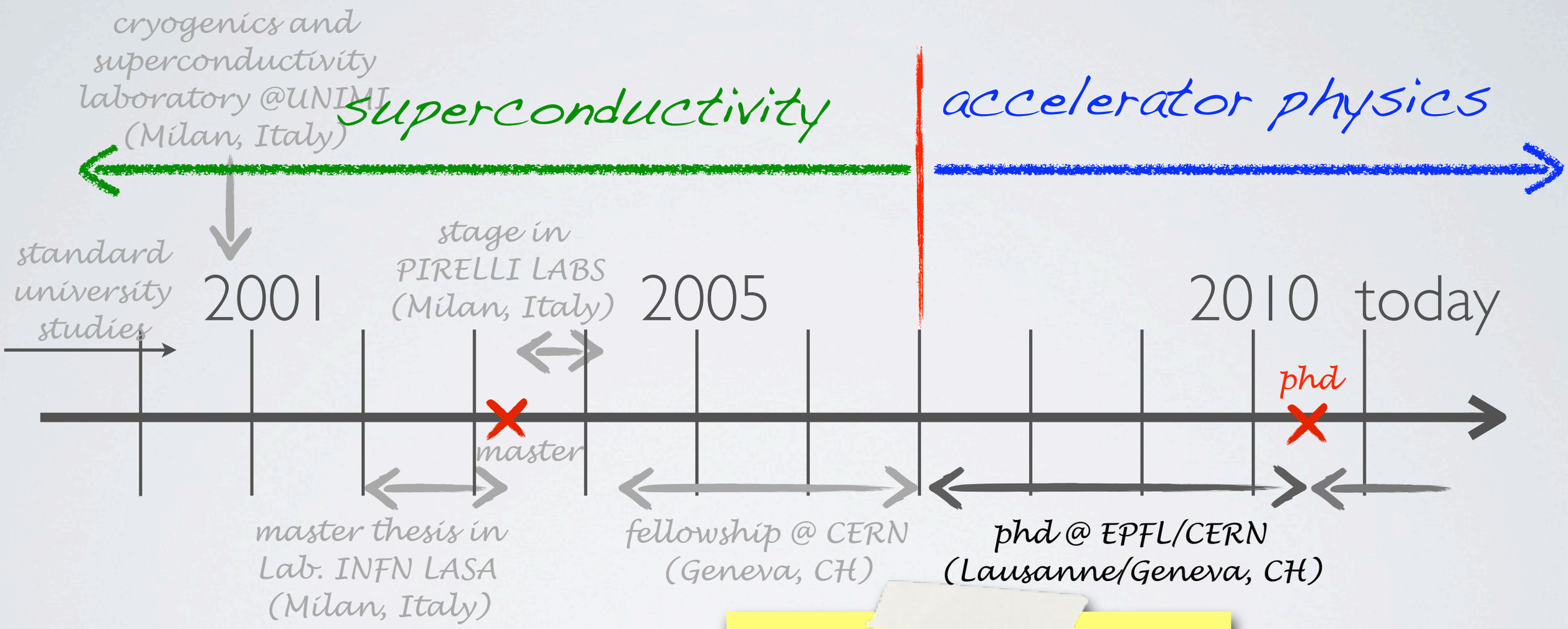
epartmental Report CERN/AT 2006-1 (MAS)

OVERVIEW AND STATUS OF THE NEXT EUROPEAN DIPOLE (NED) JOINT RESEARCH ACTIVITY

A. Devred[1,2], B. Baudouy[1], D.E. Baynham[3], T. Boutboul[2], S. Canfer[2], M. Chorowski[4], P. Fabbricatore[5], S. Farinon[5], H. Félice[1], P. Fessia[2], J. Fydrych[4], V. Granata[6], M. Greco[5], J. Greenhalgh[3], D. Leroy[2], P. Loverige[3], M. Matkowski[4], G. Michalski[4], F. Michel[1], L.R. Oberli[2], A. den Ouden[7], D. Pedrini[5], S. Pietrowicz[4], J. Polinski[4], V. Previtali[2], L. Quettier[1], D. Richter[2], J.M. Rifflet[1], J. Rochford[3], F. Rondeaux[1], S. Sanz[8], C. Scheuerlein[2], N. Schwerg[2,9], S. Sgobba[2], M. Sorbi[6,10], F. Toral-Fernandez[8], R. van Weelderen[2], P. Védrine[1] and G. Volpini[6]

remember:
being in a large collaboration means more publications, but not necessarily more fun/satisfaction.

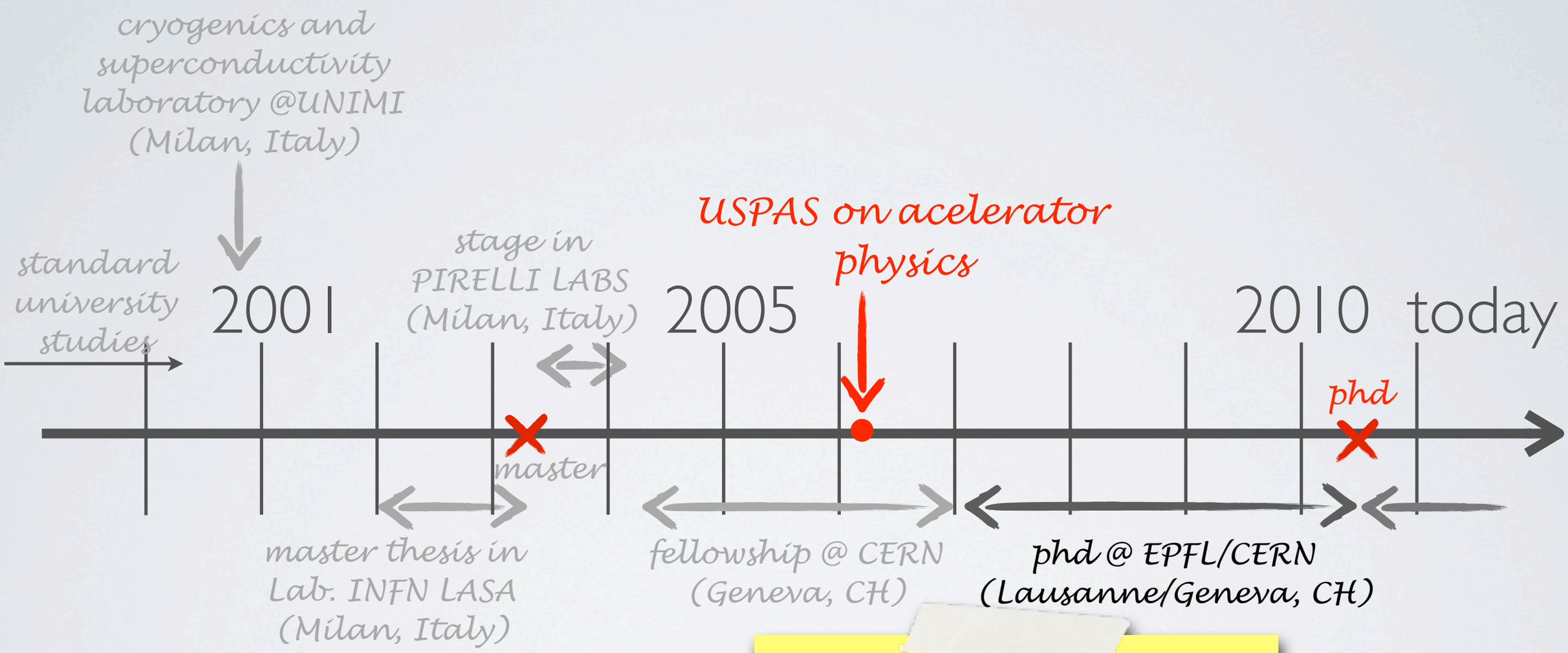
THE TIMELINE OF MY (professional) LIFE



phd in accelerator physics, crystal collimation

postdoc on crystal collimation

THE TIMELINE OF MY (professional) LIFE

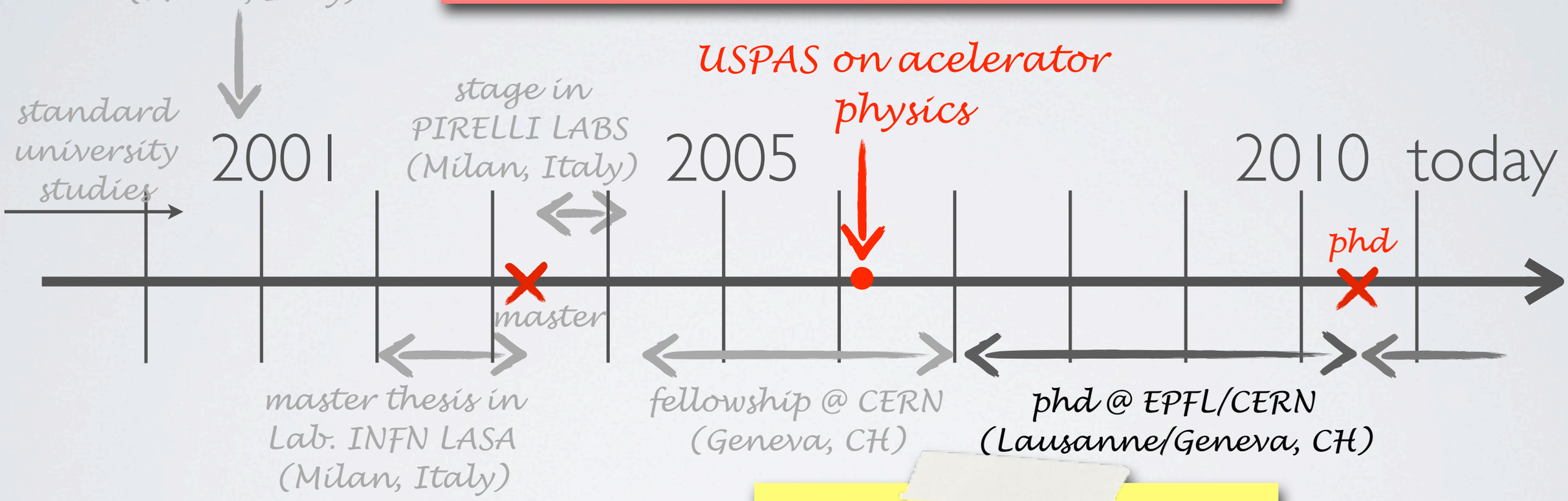


phd in accelerator physics, crystal collimation

postdoc on crystal collimation

THE TIMELINE OF MY (professional) LIFE

remember:
You don't know "a priori" what you really like - you just recognize it .



phd in accelerator physics, crystal collimation

postdoc on crystal collimation

CRYSTAL COLLIMATION STUDIES

- analytical studies: miscut angle studies, optics studies for characterizing the most suitable location for crystal installations, definition of a new optical quantity "g" (madx simulation).

- simulations: implementation and further development of a crystal code in 6d-tracking code Sixtrack (FORTRAN), simulations of the UA9 experiment and first optimization of the LHC crystal collimation system, development of a code for impact parameters studies in function of the emittance growth (C).

- control room experience and data analysis: participation in beam test both in Tevatron (2 months stay) and in SPS (summer 2009 and 2010), extended data analysis of different detectors (ionization chambers, scintillators, cherenkov), comparison with simulations.

CRYSTAL COLLIMATION STUDIES

a completely new world!

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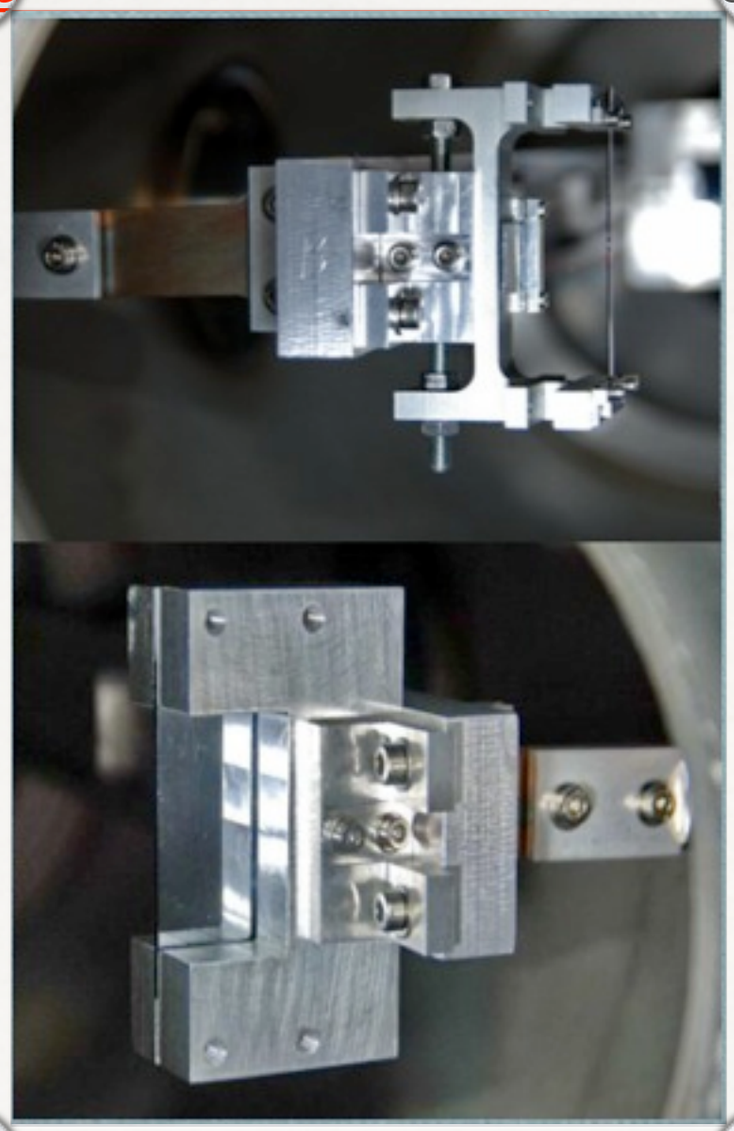
CRYSTAL COLLIMATION STUDIES

a completely new world!

- analytical studies: miscut angle studies, optics studies for characterizing [illegible]on for crystal installations, definition of a new [illegible]dx simulation).



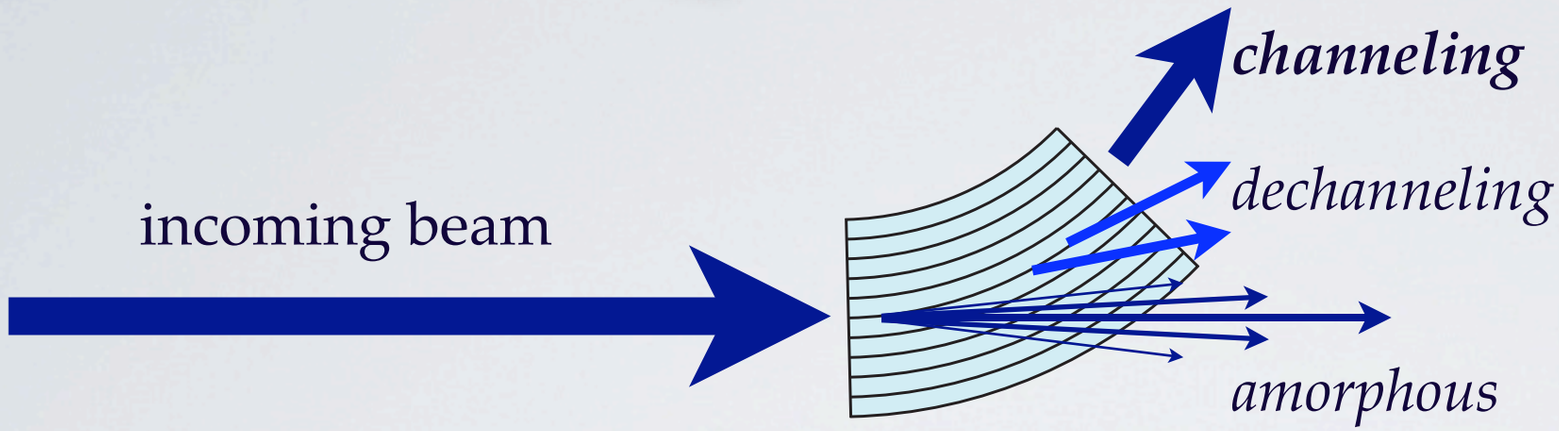
- [illegible]atic[illegible] code [illegible]rac[illegible] [illegible]tin[illegible] [illegible]stem, [illegible]fo[illegible] [illegible]f the

for a complete review on the last crystal collimation results, please see my presentation tomorrow morning on the UA9 experiment

- [illegible]ce and data analysis: participation in beam test [illegible]nths stay) and in SPS (summer 2009 and 2010), [illegible]of different detectors (ionization chambers, scintillators, cherenkov), comparison with simulations.

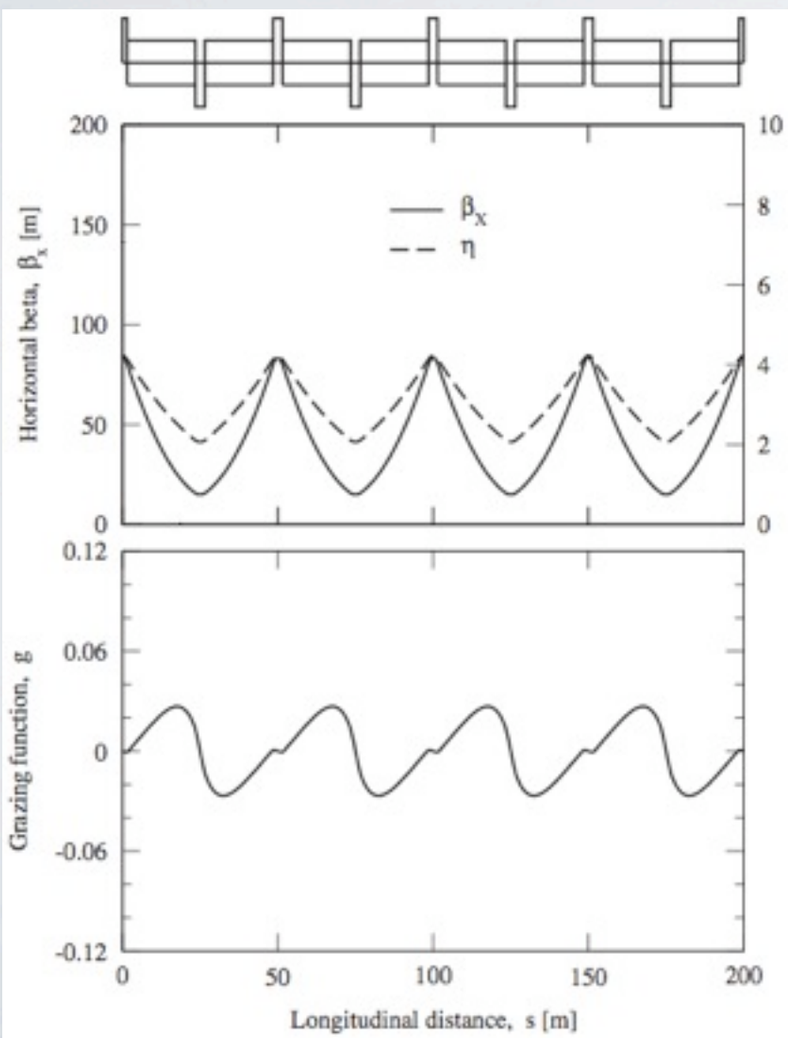
optics studies

crystal collimation: the idea is to extract the halo of the beam using the channeling process.



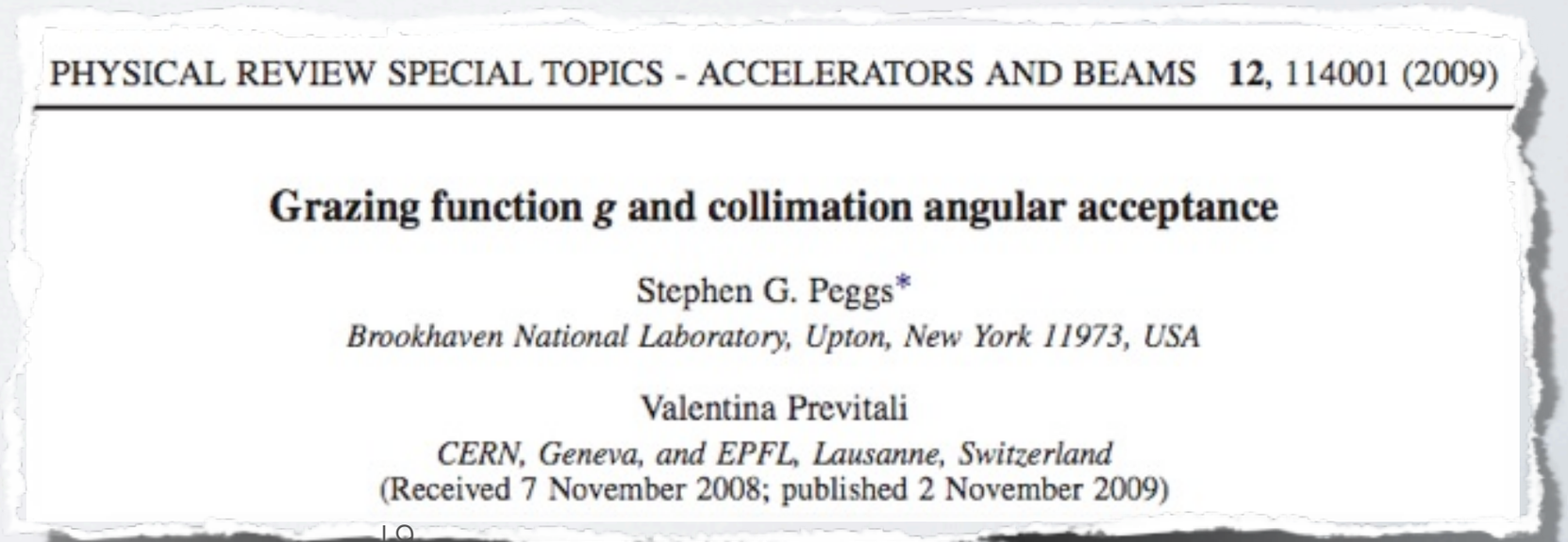
Channeling effect:

- efficiency: up to 80%
- kick: 100-500 μrad
- acceptance: 2-20 μrad (depends on energy)



is the impacting halo divergence within the acceptance?

a natural spread in angular distribution for particle grazing the crystal surface exists ➔ extensive theoretical studies on the expected angular spread have been done


PHYSICAL REVIEW SPECIAL TOPICS - ACCELERATORS AND BEAMS **12**, 114001 (2009)

Grazing function *g* and collimation angular acceptance

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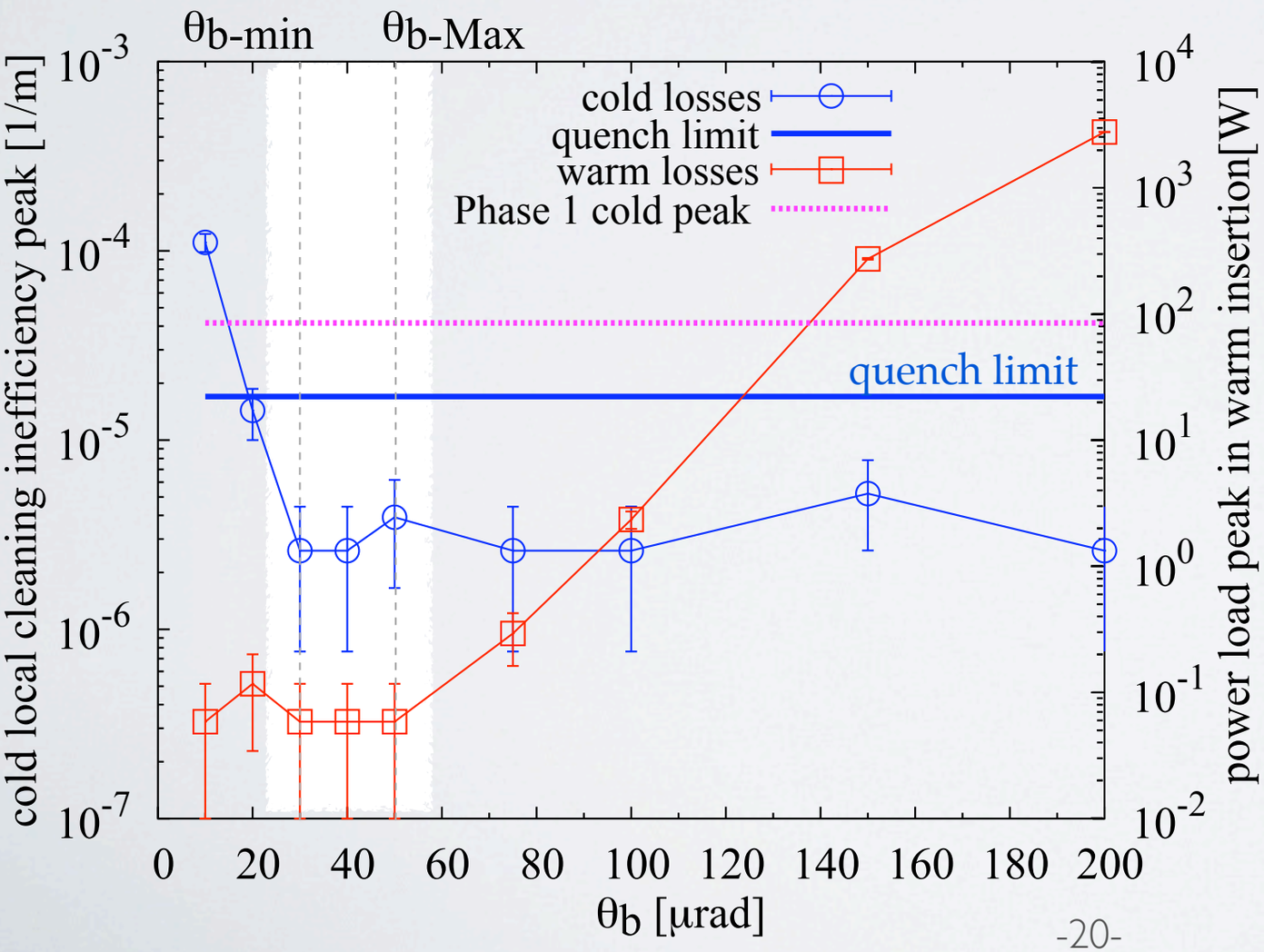
CERN, Geneva, and EPFL, Lausanne, Switzerland
(Received 7 November 2008; published 2 November 2009)

simulations

The "state of the art" tracking code SixTrack (currently used at CERN for collimation studies) is a full 6D tracking code, which treats the interaction for amorphous collimators. For the first time, a **Montecarlo routine describing the crystal was coupled to a massive parallel simulation code for fine evaluation of far away losses**



- ☑ code adapted (variables, change of coordinates, output..)
- ☑ implementation of edge effects in the code (amorphous layer and miscut angle) particularly important in a circular machine

both SPS and LHC have been simulated

control room

TEVATRON

Fermilab

first experience in control room - and in the US

control room

TEVATRON

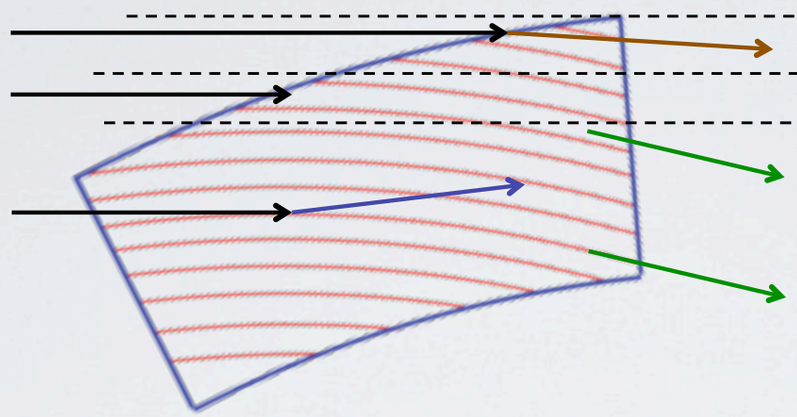
Fermilab

first experience in control room - and in the US

<u>remember</u>:
in control room, things do not work exactly as you expect from theory: and that's part of the fun!

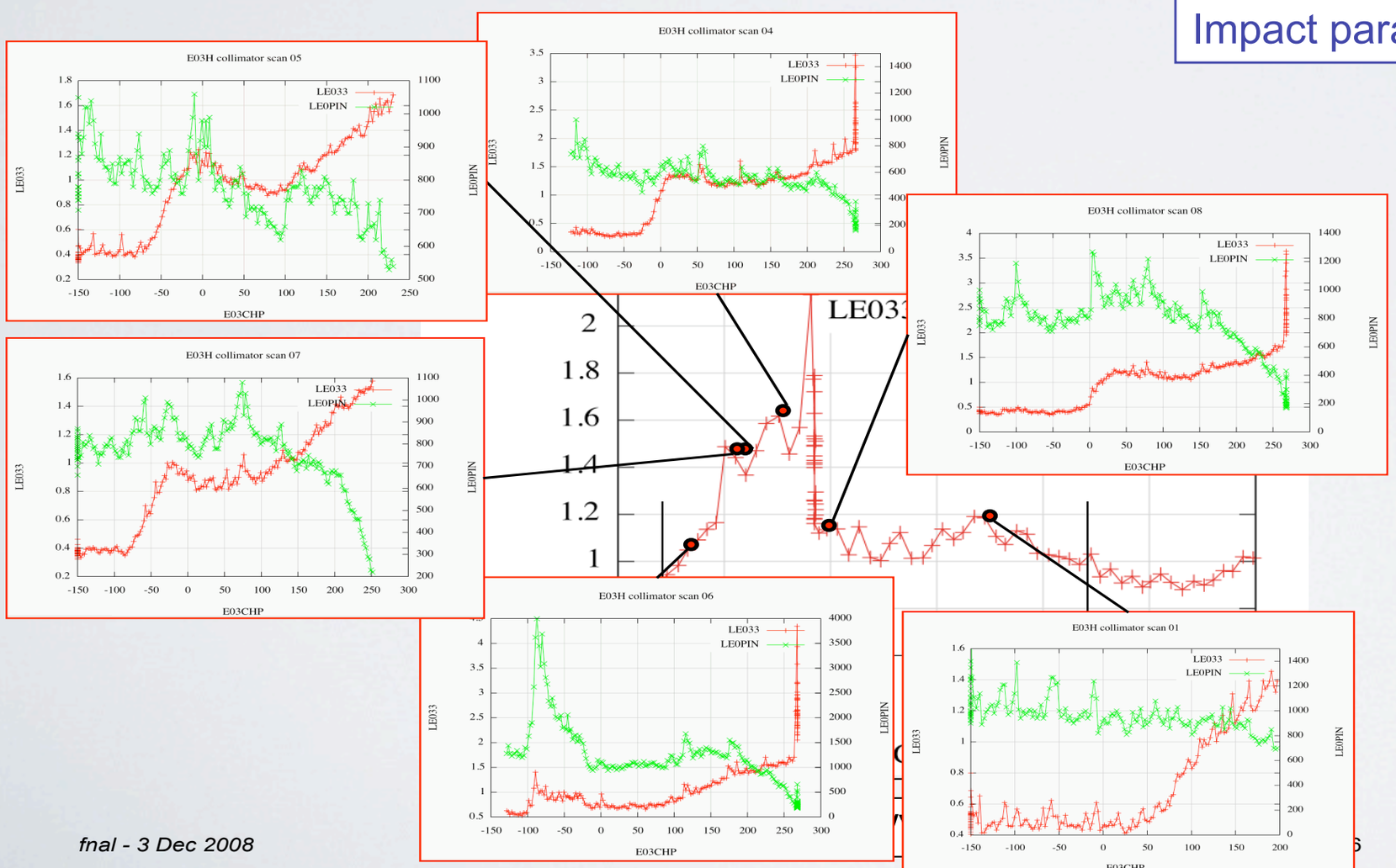
control room

1.In this region the particles are not aligned: amorphous layer.
Impact parameter 0μm < λ_0< 5 μm



2. In this region the particles are aligned: channeling with **reduced channeling angle** (<410 μrad).
Impact parameter $\lambda \sim \lambda_0$ parameter.
The width of this region is $\Delta\lambda$~0.25 μm

3. In this region the particles are aligned for Volume Reflection / Volume Capture.
Impact parameter $\lambda > \lambda_0$



main outcome:
an extended data analysis took us to the miscut angle theory, which could partially explain the observed features

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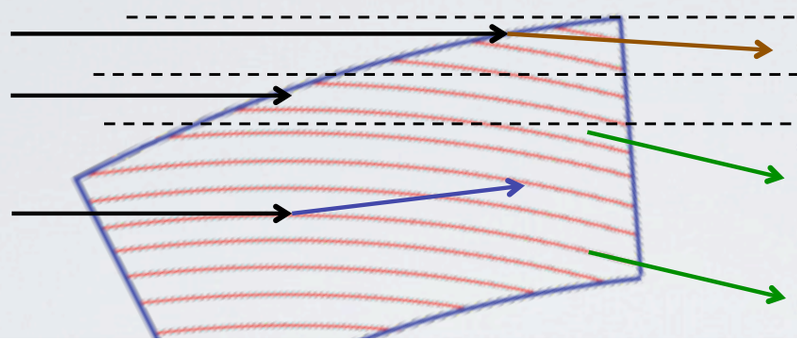

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PACO9

CRYSTAL COLLIMATION STUDIES
AT THE TEVATRON ~ T980 ~

N.V. Mokhov, G.E. Annala, A. Apyan, R.A. Carrigan, A.I. Drozhdin, T.R. Johnson, A.M. Legan,
R.E. Reilly, V. Shiltsev, D.A. Still, R.J. Tesarek, J. Zagel, FNAL, Batavia, IL 60510, U.S.A.
S. Peggs, BNL, Upton, NY 11973, U.S.A.
V. Previtali CERN, Geneva and EPFL, Lausanne Switzerland
R.W. Assmann, S. Redaelli, W. Scandale, CERN, Geneva, CH-1211, Switzerland
S. Shiraishi, Univ. of Chicago, Chicago, IL 60637, U.S.A.
Y.A. Chesnokov, I.A. Yazynin, IHEP, Protvino, Moscow Region, RU-142284, Russia
V. Guidi, INFN-Ferrara, Italy
M. Prest, INFN-Insubria, Italy
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INFN
BROOKHAVEN NATIONAL LABORATORY
IHEP
EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

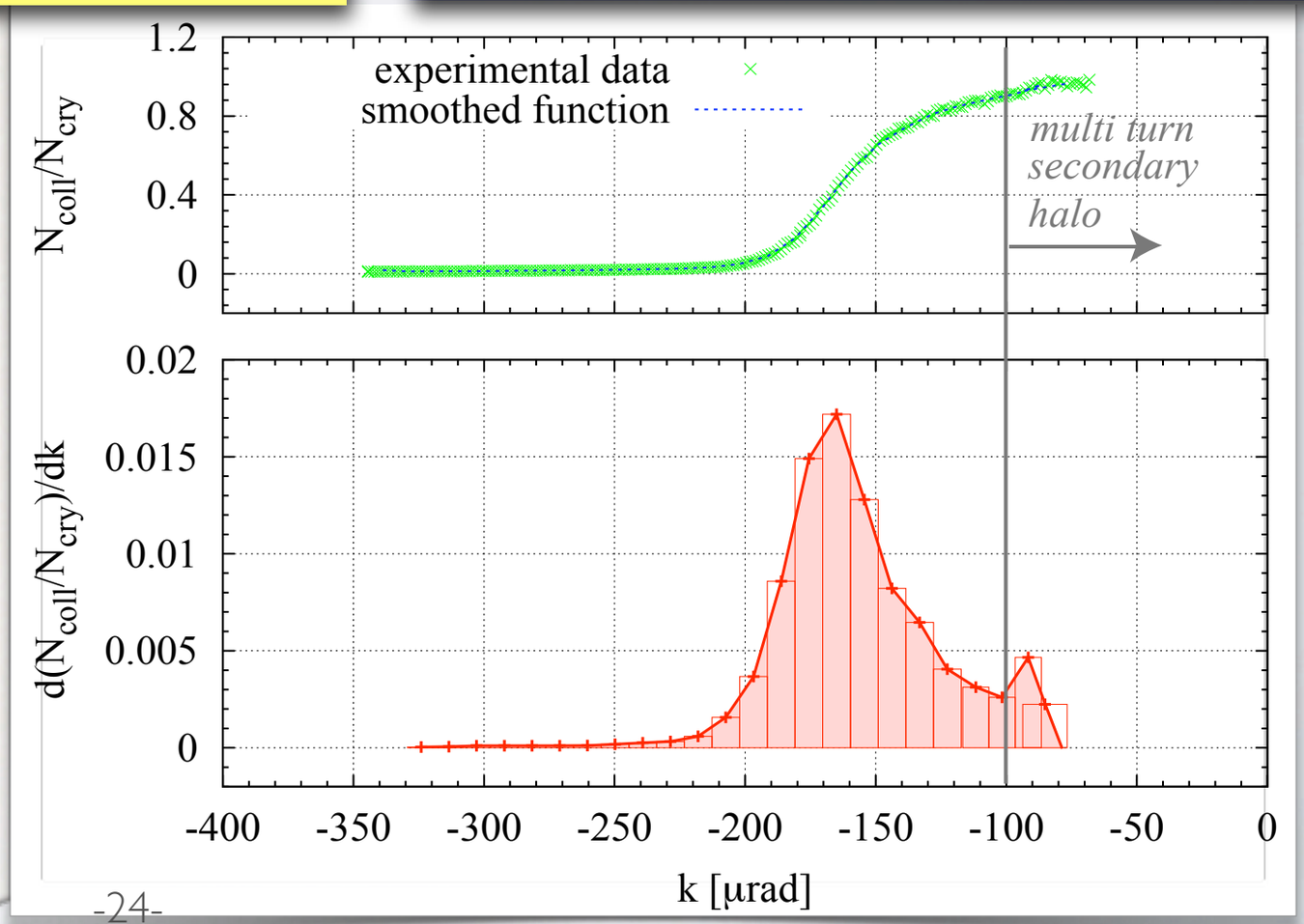
main outcome:
an extended data analysis took us to the miscut angle theory, which could partially explain the observed features

control room

SPS

participation in most of the MDs of UA9 experiment, over 2 years

main outcome:
the "collimator scan" procedure was invented, new way to measure the channeling efficiency in circular machine



Physics Letters B 692 (2010) 78–82

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First results on the SPS beam collimation with bent crystals

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Proceedings of PAC09, Vancouver, BC, Canada WE6RFP021

BEAM LOSS PREDICTIONS FOR THE UA9 CRYSTAL COLLIMATION EXPERIMENT

Valentina Previtali, CERN, Geneve, and EPFL, Lausanne, Switzerland
Ralph Assmann, Stefano Redaelli, CERN, Geneva, Switzerland
Igor Yazvnin, IHEP Protvino, Moscow Region

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remember:
being in a large, international collaboration gives you the unique opportunity to be exposed to different ideas

PROSPECTS FOR INTEGRATING A HOLLOW ELECTRON LENS INTO THE LHC COLLIMATION SYSTEM*

Jeffrey Claiborne Smith (SLAC, Menlo park, Calif
Ralph Assmann, Valentina Previtali (CERN, Gen
Vladimir Shiltsev, Alexander Valishev (Fermilab, Bata

Proceedings of PAC09, Vancouver, BC, Canada WE6RFP022

SIMULATIONS OF CRYSTAL COLLIMATION FOR THE LHC

Valentina Previtali CERN, Geneve, and EPFL, Lausanne, Switzerland
Ralph Assmann, Stefano Redaelli, CERN, Geneva, Switzerland
Igor Yazvnin, IHEP Protvino, Moscow Region

STUDIES ON COMBINED MOMENTUM AND BETATRON CLEANING IN THE LHC

R. Assmann, G. Bellodi, C. Bracco, V. Previtali, S. Redaelli, CERN, Geneva, Switzerland
T. Weiler, CERN and University Karlsruhe, Germany

A LESSON FOR THE FUTURE

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remember:
modeling a complex reality using simple bricks is the best satisfaction for a physicist

remember:
in control room, things do not work exactly as you expect from theory: and that's part of the fun!

remember:
things are different from what you expect

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being in a large collaboration means more publications, but not necessarily more fun/satisfaction.

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You don't know "a priori" what you really like - you just recognize it . Need to try!

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Bad/good aspects of being in a large collaboration

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What I enjoy of my work

Bad/good aspects of being in a large collaboration

Any change is a risk/chance

WHICH WAY?

- crystal collimation (SPS experiment, data analysis, LHC installation/tests follow up):
  - be useful and operational from the very beginning - BUT NOT 100%
  - see the "end" of the project which I followed from the beginning

SLAC / FNAL

- **Space charge studies in PS/ PSB upgrade options:**
  - advanced beam dynamics studies (continue learning!)
  - understand the problem of the emittance growth at the flat bottom of PS can have an important impact on the LHC injector upgrade (Booster)

LBNL

- Crab cavities (simulations, software design, beam tests in SPS/LHC):
  - advanced beam dynamics studies (continue learning!)
  - I find the beam-beam effect studies particularly interesting, but also more practical tasks like participating in the assembly, designing the control software and following the first beam test

BNL

- FAST feedback system for SPS?
- Nb_3Sn magnets development?
  - Missing laboratory experience. Available for studies on materials (not only superconductors, but also insulation, impregnation...

WHICH WAY?

PRELIMINARY!

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VERY PRELIMINARY!

my purpose, in this meeting, is to meet people, ideas, proposals, and identify interesting projects and work possibilities for my future.

THANKS

- to all of you, for your kind attention
- to all my mentors/supervisors:
  L. Rossi
  G. Volpini
  T. Boutboul
  R. Assmann
  L. Rivkin
  W. Scandale
- to my family
- … and to many many colleagues and friends who helped me during this 10 years of my professional (and not only) life:

  Emanuele, Danilo, Chiara, Matteo, Thomas, il Pedro, Mirarchi, MS, Dean Still, Gerry Annala, Nikolai Mokhov, Vladimir Shiltsev, Steve Peggs, Tom Markievicz, Guido, Tatiana+Stefano+Clelia Redaelli, Ciccio+Sere, Berna + Mari, il Fede, Artu+Aurelie, Pierre, Christian Scheuerlein, Bobo, Roncarolo, GRD, A. Flacco and many more...