WP9 MagNet

Marta Bajko

X EUCARD2 Annual Meeting Malta 2016

EuCARD-2 is co-funded by the partners and the European Commission under Capacities 7th Framework Programme, Grant Agreement 312453

MagNet @ CERN IN SM18

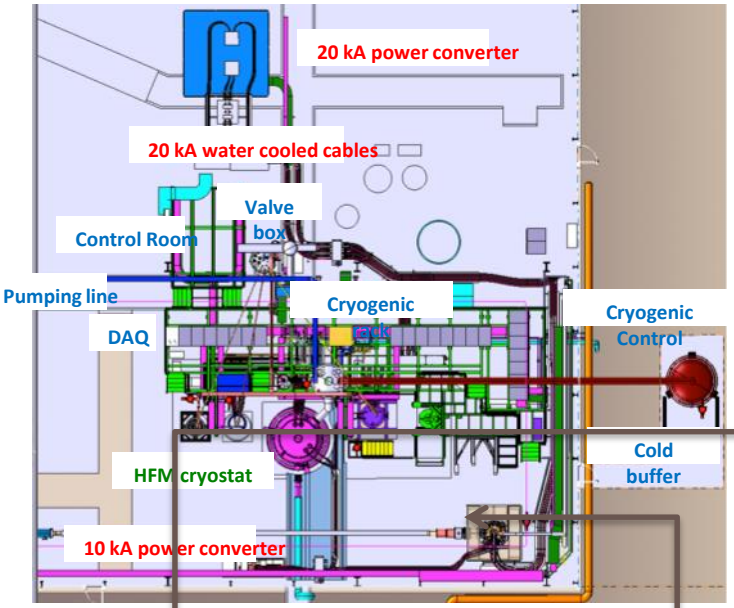
MagNet is hosted at CERN in b. 2173, known as SM18

Is a test stand for superconducting magnet test

INSTALLATIONS for testing @ MagNet

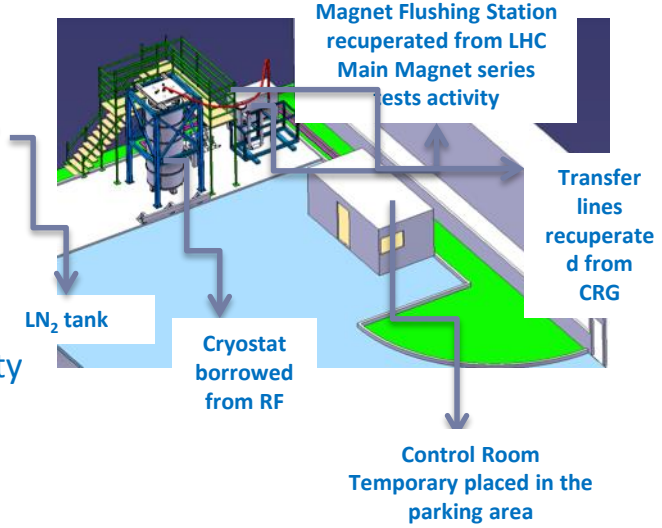
10 operational horizontal benches

To test magnets with their own cryostats allowing the feeding with current up to 17 kA and coolant up down to 1.9 K LHe. Very much optimized for a series test for 2000 magnets in 5 years.



4 vertical cryostats for 20 kA and 300 - 1. 9 K with possibility of variable temperature He gas feeding and a CRYO COOLER FOR 4.2 K

- Long cryostat with 1 insert+ 1 in preparation
- Diode and HTs lead cryostat with 3 inserts
- FRESCA2 magnet test station *to be installed*
- Large cryostat *to be installed*



1 Supercritical He feed Box with 20 kA powering capacity
1 LN2 test station without powering capacity

EuCARD² Approved MagNet projects

1. FOSxCRYO (Fiber Optic Sensors FOR CRYogenic ApplicatiOns and Superconducting Magnets)
Project leader: Dr. Andrea Cusano UNIversity of Sanio (IT)
7 members (It + Hu)

ongoing

2. ThMo_Nb_3Sn (NUMERICAL MODELLING OF NB_3SN MAGNETS FOR PARTICLE ACCELERATORS)
Project leader: Dr. Fabrizzio Bellina UNIversity of Udine (IT)
5 members (IT+ USA)

finished

3. AMIT_Mag HeBP (AMIT Magnet Helium Bath Performance)
Project leader: Dr. Fernando Toral CIEMAT (SP)
5 members (all SP)

Finished
see talke of F. Toral

4. ContSysTempSens (Control System for Temperature Sensors)
Project leader: Dr. Vardaine Szarka Angela University of Debrecen (HU)
4 members (all HU)

ongoing

5. AHTDRMC (Analysis of the Heater Tests Data from the Nb_3Sn-model magnet)
Project leader: Dr. Tiina Mary Salmi (FI)
4 members (all FI)

ongoing

6. Electromagnetic and Thermal Analysis of Nb_3Sn Cables and Magnets for Particle Accelerators (MagTin2016)
Project leader: Dr. Dr. Fabrizzio Bellina UNIversity of Udine (IT)
4 members (all IT)

New Proposal arrived

Project proposals

APPLICATION FORM

For each item you can refer to the **Guidelines for Application (Encl. 1).** Please use capital letters.

1) Experiment

Experiment Title **Electromagnetic and Thermal Analysis of Nb_3Sn Cables and Magnets for Particle Accelerators**

Experiment Acronym *(max 20 characters)MagTin2016*

(You are not allowed to use acronyms that infringe existing trademarks, registered patents and other similar rights)

Proposed test period March 2016 – Dec. 2017

Is it a new experiment in the test facility? X Ye

2) Group Leader

Family Name	Bellina
First Name	Fabrizio
Nationality	Italian

Just approved….

Goals of measurements

The proposed research activity has three main targets: the first one is the acquisition of experimental data to be used for the SC numerical modelling. The second one is the increase of efficiency and applicability of the THELMA code, to enable new and more complex analyses on accelerator magnets. The third target of the research activity is the experimental and numerical analysis of the quench behaviour and AC losses in Nb_3Sn Rutherford cables of the LHC upgrade, with possible extrapolation to the magnets.

To be carried out, the proposed activity needs the essential contribution of CERN as regards the manufacturing of samples, the data acquisition setting-up and the experiment execution, as described in detail herein and in the attached activity Gantt diagram.

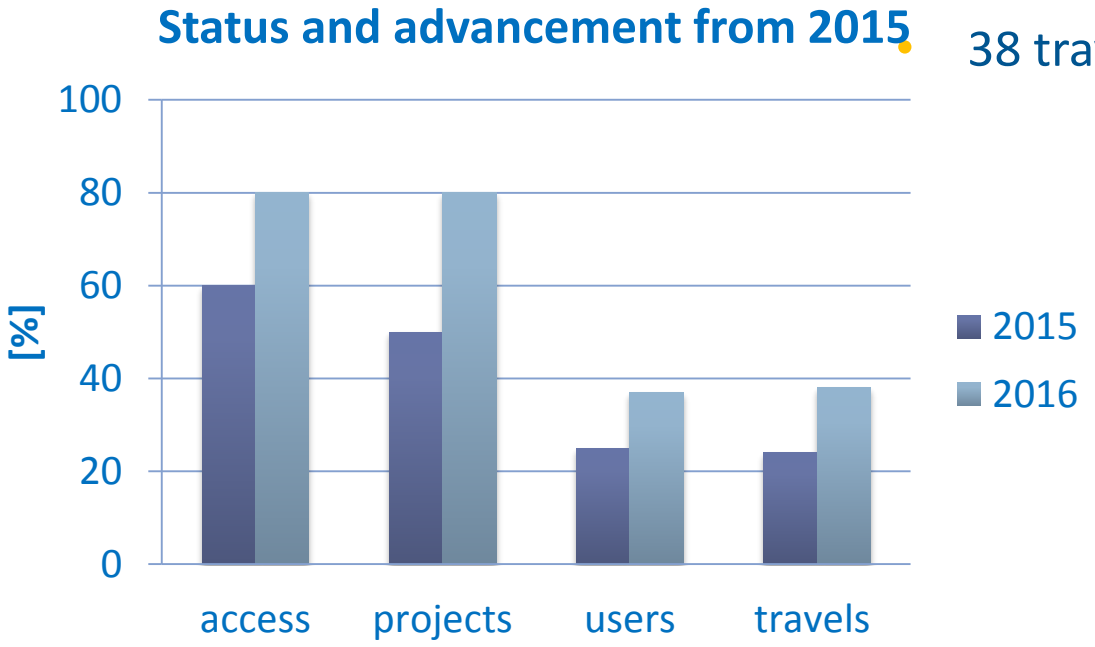
Acquisition and analysis of experimental data about Nb_3Sn Rutherford cable and its insulation

For a detailed coupled electromagnetic and thermal analysis of a SC cable and magnet, both the electromagnetic and the thermal properties of the strand and the cable must be known. However, while a careful characterisation of the electrical properties of the strand is usually available in terms of critical current, *n* index and so forth, other

Status of the TNA MagNet 2016

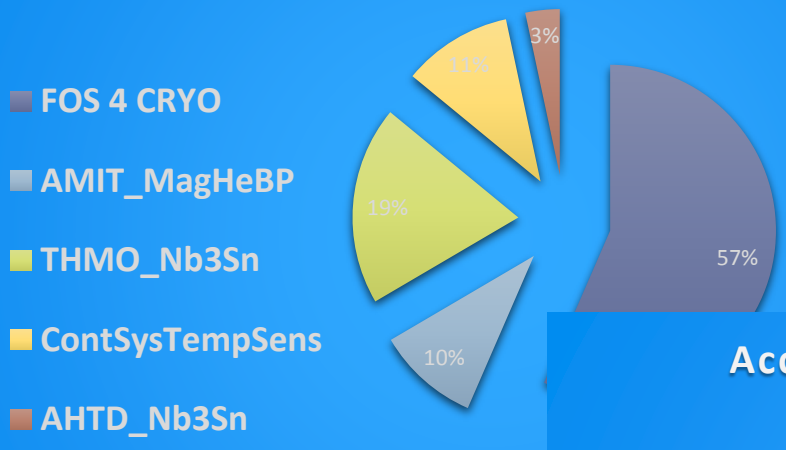
STATUS in 2016

- 1540 (over 1920) accesses given
- 6 (over 8) projects
- 10 universities and institutes
- 5 countries (IT, SP, HU, USA, FI)
- 22 (over 60) users
- 38 travels to CERN



Access distribution in MagNet

Access distribution by PROJECTS in MagNet



Access distribution by INSTITUTES in MagNet

JOURNAL publications

Example:FOS x CRYO team

Sensors and Actuators A 189 (2013) 199–203

Contents lists available at SciVerse ScienceDirect

Sensors and Actuators A: Physical

journal homepage: www.elsevier.com/locate/sna

Impact factor: 1.769

Fiber Bragg Grating sensors to measure the coefficient of thermal expansion of polymers at cryogenic temperatures

Marco Esposito[a,h], Salvatore Buontempo[a,f], Angelo Petriccione[b], Mauro Zarrelli[b], Giovanni Breglio[c,f], Andrea Saccomanno[c], Zoltan Szillasi[d,f], Alajos Makovec[e,f], Andrea Cusano[g,f], Antonella Chiuchiolo[g,f], Marta Bajko[h,f], Michele Giordano[b,f,*]

IEEE Photonics Journal
An IEEE Photonics Society Publication

Open Access

Impact factor: 2.32

Fiber Bragg Grating Cryosensors for Superconducting Accelerator Magnets

Volume 6, Number 6, December 2014

4424 Vol. 40, No. 19 / October 2015 / Optics Letters Letter

Optics Letters

Impact factor: 3.292

Cryogenic-temperature profiling of high-power superconducting lines using local and distributed optical-fiber sensors

Antonella Chiuchiolo,[1,2] Luca Palmieri,[3] Marco Consales,[1] Michele Giordano,[4] Anna Borriello,[4] Hugues Bajas,[2] Andrea Galtarossa,[3] Marta Bajko,[2] and Andrea Cusano[1,*]

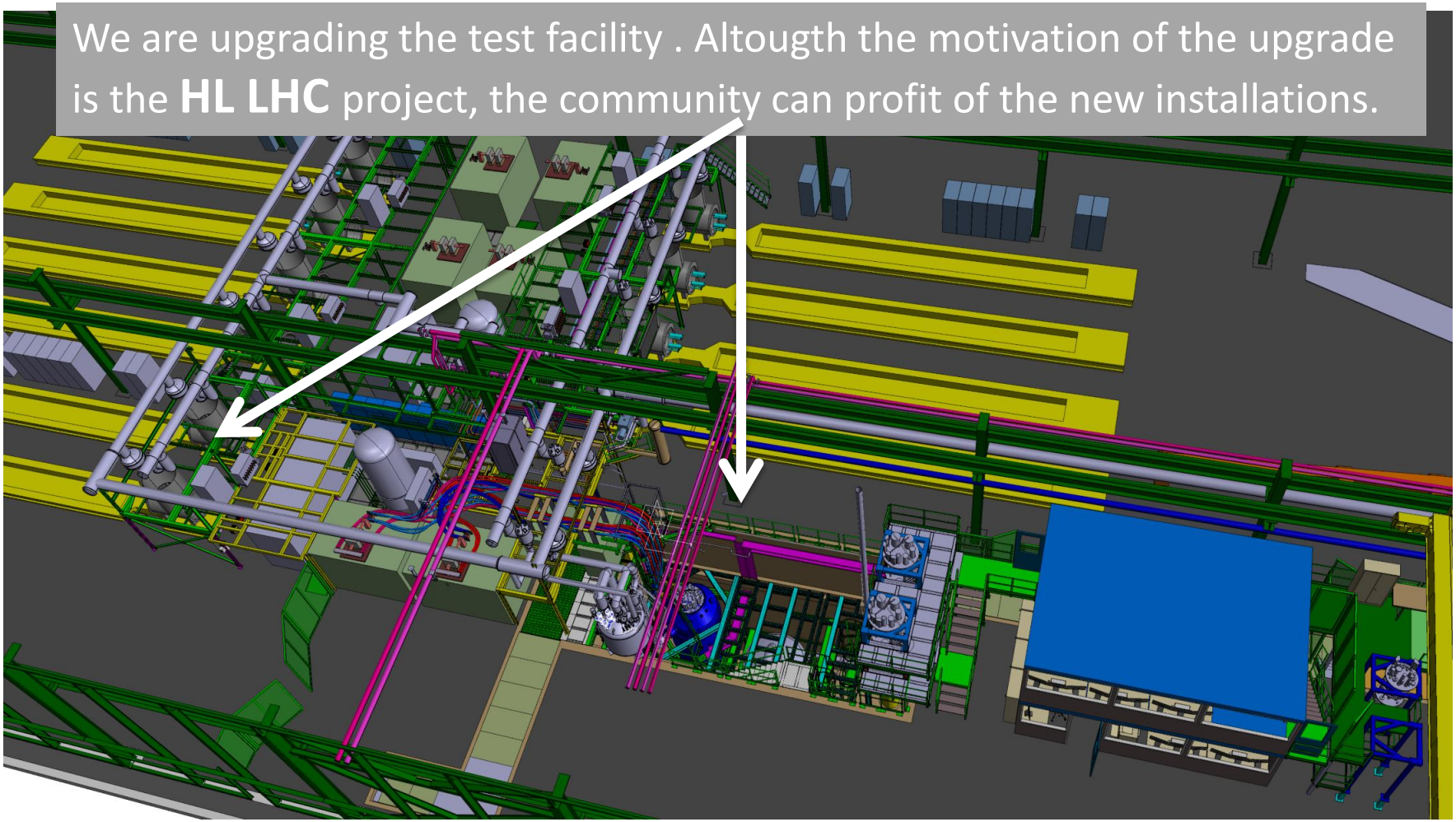
EuCARD² CONFERENCE publications

Example:FOS x CRYO team

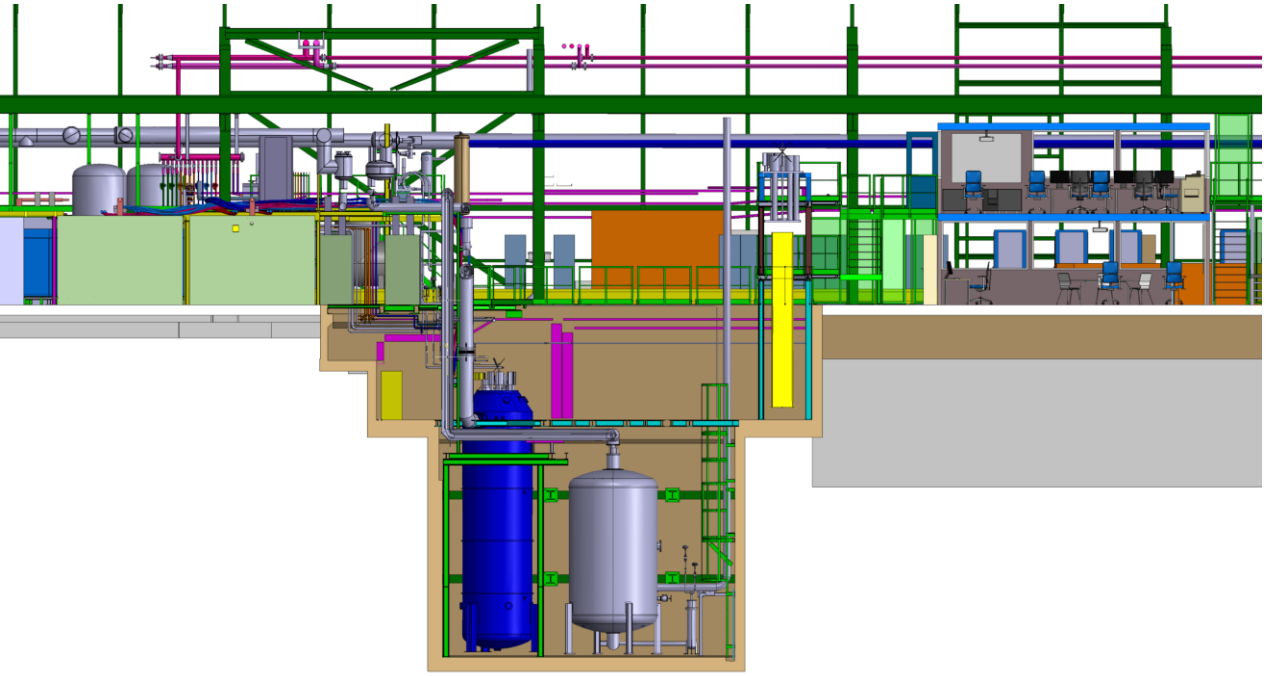
- **"Fiber Bragg Grating Sensors Based Monitoring System for Superconducting Accelerator Magnets"**
  A. Chiuchiolo, M. Bajko, J. C. Perez, H. Bajas, M. Consales, M. Giordano, G. Breglio, A. Cusano ; *Photonics Conference, 2014 Third Mediterranean* , vol., no., pp.1,3, 7-9 May 2014
- **"Fiber Bragg Grating Sensor as Valuable Technological Platform for New Generation of Superconducting Magnets"**
  A. Chiuchiolo, M. Bajko, J. C. Perez, H. Bajas, P. Viret, M. Consales, M. Giordano, G. Breglio, A. Cusano; Proc. SPIE 9157, 23rd International Conference on Optical Fibre Sensors, 91579I (June 2, 2014)
- **"Fiber Optic Cryogenic Sensors for Superconducting Magnets and Superconducting Power Transmission lines at CERN"**
  A. Chiuchiolo, M. Bajko, J. C. Perez, H. Bajas, M. Consales, M. Giordano, G. Breglio, L. Palmieri, A. Cusano, *Proc. SPIE* 9286, Second International Conference on Applications of Optics and Photonics, 92864B (August 22, 2014)
- **"Structural Health Monitoring of Superconducting Magnets using Fiber Bragg Grating Sensors"**
  A. Chiuchiolo, M. Bajko, J. C. Perez, H. Bajas, M. Guinchard, M. Giordano, G. Breglio, M. Consales, A. Cusano, Proc. of EWSHM - 7th European Workshop on Structural Health Monitoring, Jul 2014, Nantes, France. (2014).
- **"Cryogenic temperature monitoring in superconducting power transmission line at CERN with hybrid multi-point and distributed fiber optic sensors"**
  A. Chiuchiolo, L. Palmieric, M. Consales, M. Giordano, H. Bajas, A. Galtarossa, M. Bajko, A. Cusano
  Proc SPIE, *24° International Conference on Optical Fibre Sensors, Brazil (September 2015)*
- **"Advances in Fiber Optic Sensors Technology Development for temperature and strain measurements in Superconducting magnets and devices"**
  A. Chiuchiolo, H. Bajas, M. Bajko , L. Bottura, M. Consales, A. Cusano, M. Giordano, J. C. Perez
  24th International Conference on Magnet Technology, Seoul, Korea (October 2015), in press on IEEE Transactions on Applied Superconductivity

What is ongoing today @ MagNet

We are upgrading the test facility . Altougth the motivation of the upgrade is the **HL LHC** project, the community can profit of the new installations.



The upgrade of MagNet



Installation of an additional **VERTICAL** cryostat for **1.9 K** and **4.2 K** operational temperature and up to 3**0 kA** powering capacity for magnets up to **5 m** long and **800 mm** outer diameter operation end of **2016.**

Horizontal benches will also be updated to **20 kA** powering capacity… only for ARIES.

The **SERVICES** are also upgraded:

- increase of **LHe** production with **35 g/s** …. Only for ARIES
- increase of **demineralized water** production with **100 m³/h** already for EUCARD2
- Increase of **powering** with **2 MVA** Only for ARIES
- A **new control room** for vertical and horizontal test stands already for EUCARD2

EuCARD²

Next projects… not yet submitted

on optical fibers

- Fiber Optic Fischer connectors qualification at 4.2 and 1.9 K for cryogenic test facilities instrumentation
- Novel Fiber Bragg Grating sensors for Nb_3Sn coils heat treatment monitoring
- Radiation hardness study of FBG based sensors for cryogenic temperature

University of Padova

Fischer CONNECTORS

Università degli Studi del Sannio

OPTOELECTRONICS group University of Sannio

iPCB ISTITUTO PER I POLIMERI COMPOSITI E BIOMATERIALI

National Research Council (CNR)

INFN

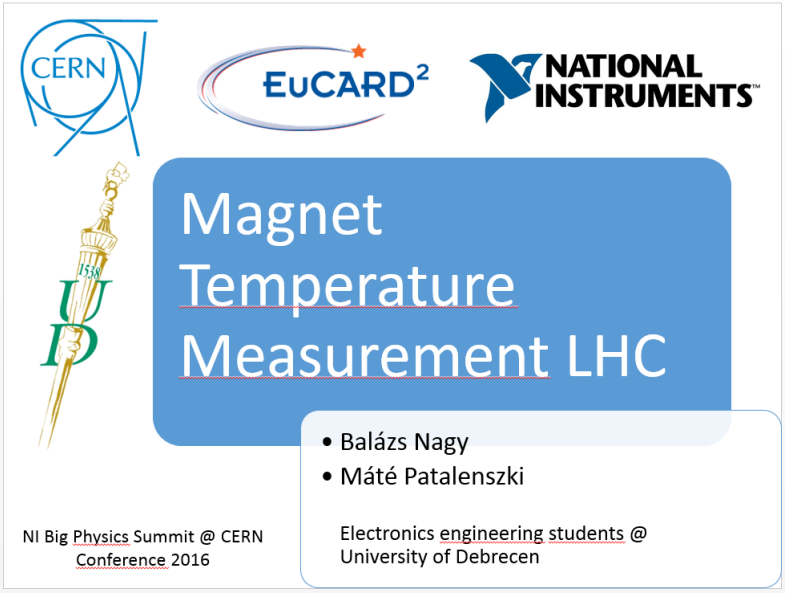
National Institute of Nuclear Physics

University of Debrecen

Next projects… not yet submitted

Development for an instrument for high voltage test

- Testing of a new hardware with a dedicated software handling High Voltage test in cryogenic environment to levels up to 3 kV and with ultiplexing capacity for different channels.



NATIONAL INSTRUMENTS

University of Debrecen

The work done within EUCARD2 was presented by the same team in the “NI Big Physics Summit @ CERN 2016.

Thanks for your attention