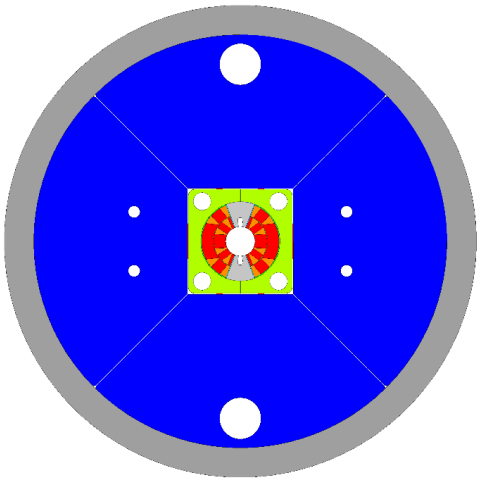
Istituto Nazionale di Fisica Nucleare (INFN), Italy

Quench and protection of high field superconducting magnets for future accelerators (PhD thesis)

Description and issue

Due to the high stored energy, the superconducting dipolar magnets of future high-energy hadronic accelerators (such as the 100 TeV Future Circular Collider) present critical aspects both in relation to the achievement of the required magnetic field (B = 16T) and in relation to the protection systems in the case of transition of the magnet to the normal state (a phenomenon called *quench*). The student is asked to carry out a study of the Quench problems of a model of the 16 T dipoles in development phase.



A cross section of the model under development in INFN. The core of the magnet is a Nb_3Sn coil placed at the centre).

Group/Lab/Supervision

The thesis work will be carried out in the Genova laboratory of the Italian Institute for Nuclear Physics. The development of the model is done in collaboration with CERN, The Quench aspect will be also cover the protection aspects.

Proposed work

This activity involves a basic study of magnet protection methods based on numerical computations, especially a new system being studied at CERN based on the effects of variable-rate dissipation in superconducting cables. This system, called CLIQ (Coupling Losses Induced Quench) is proving to be very promising and will probably be the only way to protect the magnets of the future accelerator. The standard method based on quench heaters shall be studied as well. The chosen protection system shall be constructed and integrated into the magnet.

Required training and competences

For accessing the PhD in Applied Superconductivity (a part of the PhD in Physics of Genova University) a master degree in Physics or Engineering is required.

Acquired competences

In the three years of the PhD activities the student will acquire competences in the design of superconducting magnets. And the use of Finite Element codes (ANSYS™, COMSOL™)

Collaborations/partnership

The development of the model of is done in a framework of collaboration with CERN. The INFN groups involved in this activity are the Genova and Milano sections of INFN.

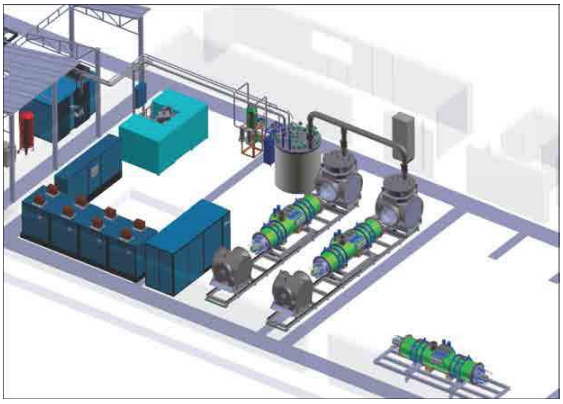
Contacts

P.Fabbricatore pasquale.fabbricatore@ge.infn.it
S.Farinon
stefania.farinon@ge.infn.it

Cryogenic tests of superconducting magnets (PhD thesis)

Description and issue

Development and implementation of the Management & Control System of a test line for superconducting accelerator magnets.



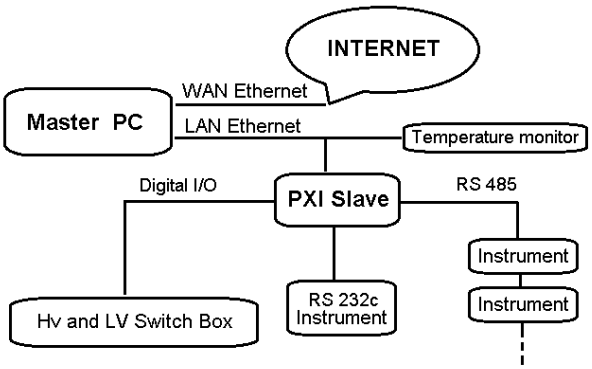
Test station for superconducting magnet under development at the Salerno University under INFN responsibility.

Group/Lab/Supervision

Superconductivity Group @ INFN Salerno.

Proposed work

Implementing in collaboration with a dedicated company of the necessary test steps in the M&CS for recording, analyses and reporting of the cryogenic tests of the superconducting quadrupole modules of the SIS100 synchrotron for FAIR accelerator complex.



Data acquisition and control management

Required training and competences

General physics, cryogenic basic understanding, good LabView programming, electrical and electronic skills.

Acquired competences

Control system for general testing of superconducting elements in cryogenic environments

Collaborations/partnership

INFN is performing this activity in collaboration with GSI (Darmstadt).

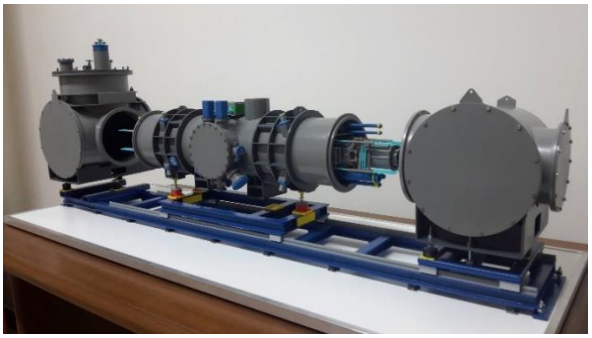
Contact

U.Gambardella
umberto.gambardella@sa.infn.it
A. Saggese
saggese@unisa.it

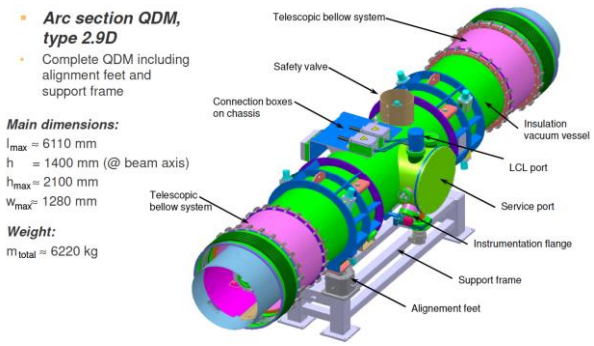
Leak tests in cryogenic equipment (PhD thesis)

Description and issue

Leak test for cryogenic accelerator magnets: techniques and methodologies from room temperature to the cryogenic environment



A cryogenic equipment (a quadrupole module of FAIR SIS100 synchrotron) to be tested at INFN Salerno.



A quadrupole module of SIS100 synchrotron

Group/Lab/Supervision

Superconductivity Group @ INFN Salerno.

Proposed work

Develop and realize suitable systems for checking the isolation vacuum and beam pipe vacuum in superconducting accelerator modules.

Leak detector and RGA at INFN Salerno

Required training and competences

General physics, cryogenic basic understanding, knowledge of vacuum technology,

RGA analyses, leak test with He.

Acquired competences

Vacuum leak check, RGA analyses, UHV techology

Collaborations/partnership

INFN is performing this activity in collaboration with GSI (Darmstadt).

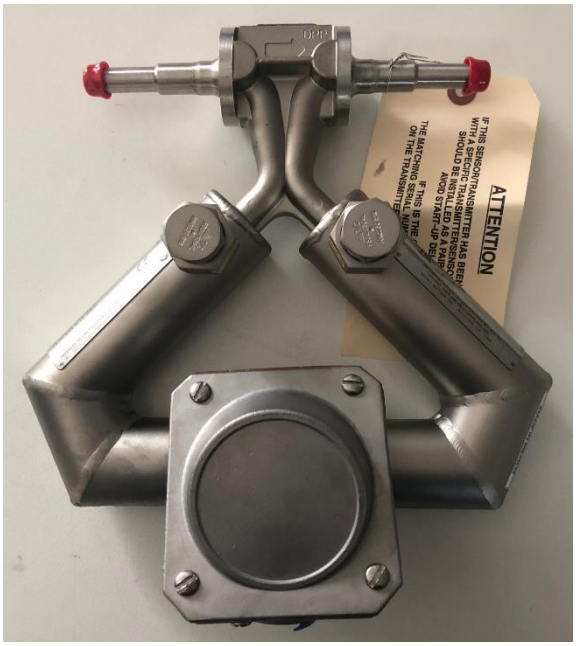
Contact

U.Gambardella umberto.gambardella@sa.infn.it
D. D'Agostino
ddagostino@sa.infn.it

Fluid dynamics measurement at cryogenic temperatures (PhD thesis)

Description and issue

Measurement of cold flow: methods and issues. The facility in Salerno for testing of superconducting magnets is equipped with Coriolis mass flow meter in order measure the He flow in the process lines. The use of this equipment shall be implemented in the tests of the quadrupole module of SIS100 synchrotron.



A Coriolis mass flow meter to be used in the fluid dynamics measurements

Group/Lab/Supervision

Superconductivity Group @ INFN Salerno.

Proposed work

Test among different cold flow measurement techniques in supercritical He cooling pipes. The aim is to measure the supercritical He mass flow in the quadruple modules under test at INFN Salerno and develop methods for obtaining information about the cryogenic thermal loads.

The WEKA mass flow meter to be used in the fluid dynamics measurements

Required training and competences

General physics, Thermodynamics, Cryogenic basic understanding.

Acquired competences

Thermodynamics of cryogenic gas, heat load measurements at cryogenic temperatures

Collaborations/partnership

INFN is performing this activity in collaboration with GSI (Darmstadt).

Contact

U.Gambardella umberto.gambardella@sa.infn.it
G.Iannone
Iannone@sa.infn.it