

The Henryk Niewodniczanski Institute of Nuclear Physics Polish Academy of Sciences

# Cryogenic stand at IFJ PAN for testing superconducting magnets and RF cavities

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- Introduction
- Concept of new building
- Installation diagram
- Helium recovery system
  - helium gas bags
  - helium recovery compressor
  - high presure gas storage
- System for the helium liquefaction
  - helium circulating screw compressor
  - helium analyzer
  - helium cooling and cleaning system
  - helium condenser
  - 1000 liter helium liquefaction dewar
- Test stand (cryostat)





**Purpose of the presentation:** 

- concept of the building for test stand and liquefaction of helium.
- presentation of existing infrastructure
- exchange of experience

#### DESCRIPTION OF CONCEPT NEW BUILDING. GROUND FLOOR





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#### DESCRIPTION OF CONCEPT NEW BUILDING FIRST FLOOR







### **Installation DIAGRAM**











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 Helium bags are approved for long term storage of this gas in extreme environments.
Manufactured from PVC coated polyester base cloth, which gives high abrasion and UV resistance.









- Requirements:
  - volume 2x 16m<sup>3</sup>
  - diffusion as small as possible
- Problems to solve:
  - is it capacity sufficient?
  - how to measure amount of gas?
  - protection against very cold gas (quench)









#### HELIUM RECOVERY SYSTEM: HELIUM RECOVERY COMPRESSOR





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# HELIUM RECOVERY SYSTEM: HELIUM RECOVERY COMPRESSOR 200bar



# NEW COMPRESSOR COMPAIR H5437 HE BOUGHT IN 2014

- 4 COMPRESSION STAGES

- 90° VEE CONFIGURATION FOR EXCELLENT BALANCE
- INTAKE FILTER/SILENCER WITH REPLACEABLE ELEMENT, HIGH EFFICIENCY SILENCER OPTION AVAILABLE

- INTEGRAL HIGH EFFICIENCY CORROSION RESISTANT AND WITHDRAWABLE INTER AND AFTERSTAGE COOLERS

- LOW LIFT CONCENTRIC VALVES WITH POLYMER PLATES ON 4TH STAGE
- ALL COMPRESSION PARTS REMOVABLE WITHOUT MAJOR STRIPDOWN
- DIRECT VALVE ACCESS VIA VALVE COVER
- REPLACEABLE LINERS
- SPIN ON OIL FILTER







#### **COMPRESSOR INSTALLATION**





# HELIUM RECOVERY SYSTEM: HELIUM RECOVERY COMPRESSOR 200bar



#### **COMPRESSOR INSTALLATION**





# HELIUM RECOVERY SYSTEM: HELIUM RECOVERY COMPRESSOR 200bar



- OPERATING PARAMETERS
- COMPRESSOR:

OUTPUT - 77 m<sup>3</sup>/hour PRESSURE - 200 BAR SPEED OF ROTATION - 985/MIN COOLING - WATER

#### • ELECTRIC MOTOR

POWER - 30KW SPEED - 2880/MIN VOLTAGE - 400V/3/50HZ COOLING - AIR FAN

#### • PROBLEMS TO SOLVE

WE DO NOT KNOW HOW MUCH GAS IS RELEASED DURING QUENCH, COMPRESSOR CAPABILITY MAY BE INSUFFICIENT.



# HELIUM RECOVERY SYSTEM: HELIUM RECOVERY COMPRESSOR 200 bar









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**CURRENT STATE:** 

- TWO PROTOTYPE FRAMES WITH 12 CYLINDERS
- CAPACITY 50DM<sup>3</sup>
- PRESSURE 150 BAR









# **REQUIREMENT: 24 BUNDLES of HELIUM CYLINDERS**

- PRESSURE CYLINDERS 200BAR
- CAPACITY- 80DM<sup>3</sup>
- EXECUTION BY: ISO 9809-1, 2010/35/EU
- DIAMETER 267MM
- GROUPPED IN UNITS OF NINE CYLINDERS

Total capacity: 24x9x0,08x200x0,8/0,75 = ~3700 liters LHe

PROBLEMS TO ANSWER: Is it enough? Reserved space to double



Frame for 80dm<sup>3</sup> new cylinders









**HELIUM LIQUIFEIR** 







# HELIUM LIQUIFEIR Requirements:



HELIUM LIQUEFIER SYSTEM FOR FULLY AUTOMATED OPERATION WITH OR WITHOUT LIQUID NITROGEN PRECOOLING, HAVING THE CAPACITY OF:

- AT LEAST 17 L/H OF LIQUID HELIUM WITHOUT LIQUID NITROGEN PRE-COOLING
- AT LEAST 35 L/H OF LIQUID HELIUM WITH LIQUID NITOGEN PRE-COOLING, WHEN OPERATING WITH PURE GAS.
- POSSIBILITY of LIQUEFACTION of IMPURE GAS FROM RECOVERY

ROTARY SCREW HELIUM COMPRESSOR.

OUTPUT FOR COLD GAS (20K).

INTERNAL PURIFIER ALLOWS TO LIQUEFY HELIUM WITH IMPURITIES UP TO 10% (AIR)

#### **QUESTION: PISTON EXPANSION ENGINE ?**



HELIUM LIQUIFEIR Problems to solutions



- Do we choose good type of helium liquifier?
- Sufficient capability?

## HELIUM LIQUIFIER Scheme (by Upsala University)







**HELIUM LIQUIFEIR** 







**CRYOSTAT** 





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#### CRYOSTAT TEST STAND IN ISTITUTO NAZIONALE DI FISICA NUCLEARE SEZIONE DI MILANO



#### **TEST ARENA**



#### CRYOSTAT TEST STAND IN ISTITUTO NAZIONALE DI FISICA NUCLEARE SEZIONE DI MILANO



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**Vartical Cryostat** 

Insert



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#### CRYOSTAT TEST STAND IN ISTITUTO NAZIONALE DI FISICA NUCLEARE SEZIONE DI MILANO





CRYOSTAT (by Upsala University)





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**CRYOSTAT** 





#### LOCATION: CRYOSTAT IN THE BUILDING

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# **CRYOSTAT Problems to answer**



- Qench protection
- Cable cooling
- Cooling time for magnet
- Amount and flow of helium gas for cooling, for test operation, for quench
- Total amount of gas for runnig facility capacity of helium bags, high pressure gas storage
- Electrical power for testing equipment
- Capabilities of cooling system, separated or common?