

NEW TRENDS IN HIGH-ENERGY PHYSICS
24-30 SEPTEMBER 2018
Montenegro/Europe
Budva, Becici



Joint Institute for Nuclear
Research

SCIENCE BRINGING NATIONS TOGETHER



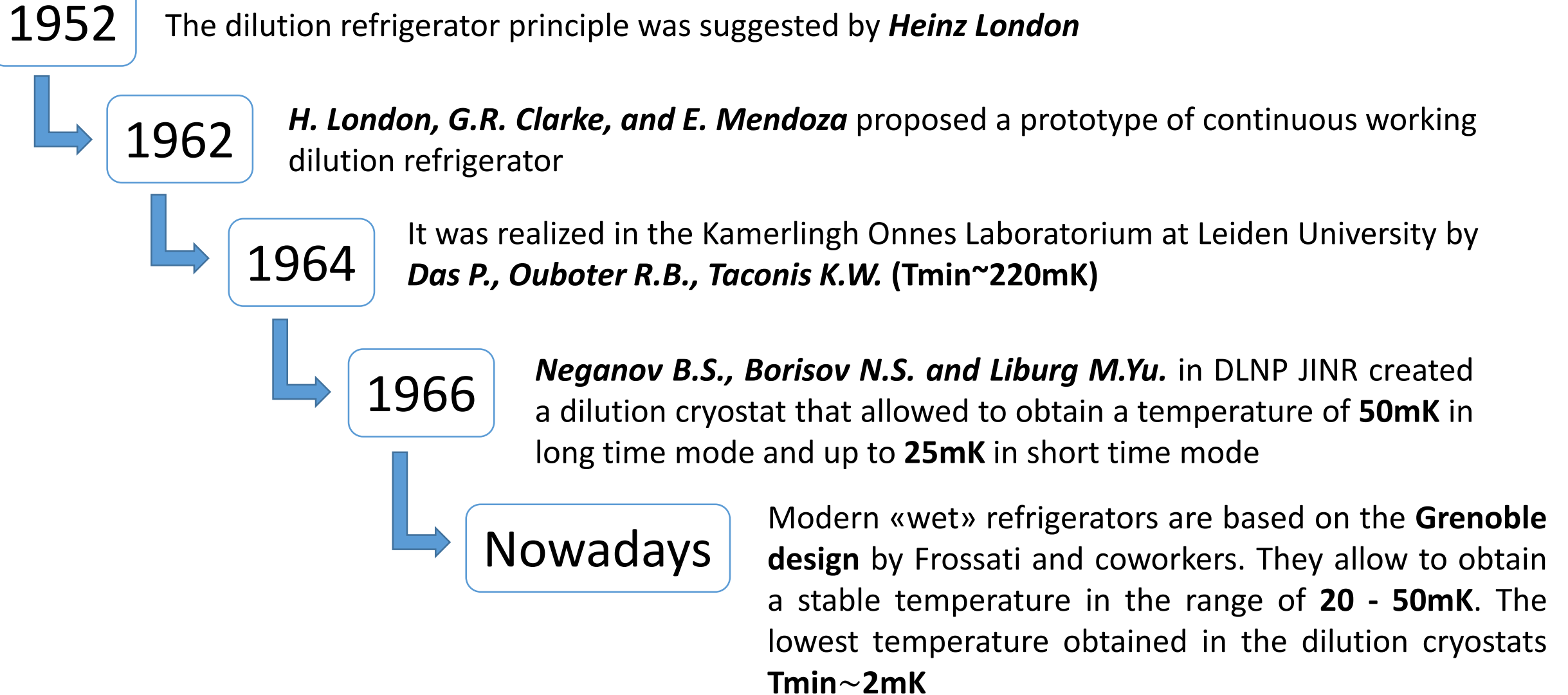
Sector of
Low Temperature

New cryostat for Bonn electron accelerator “ELSA”

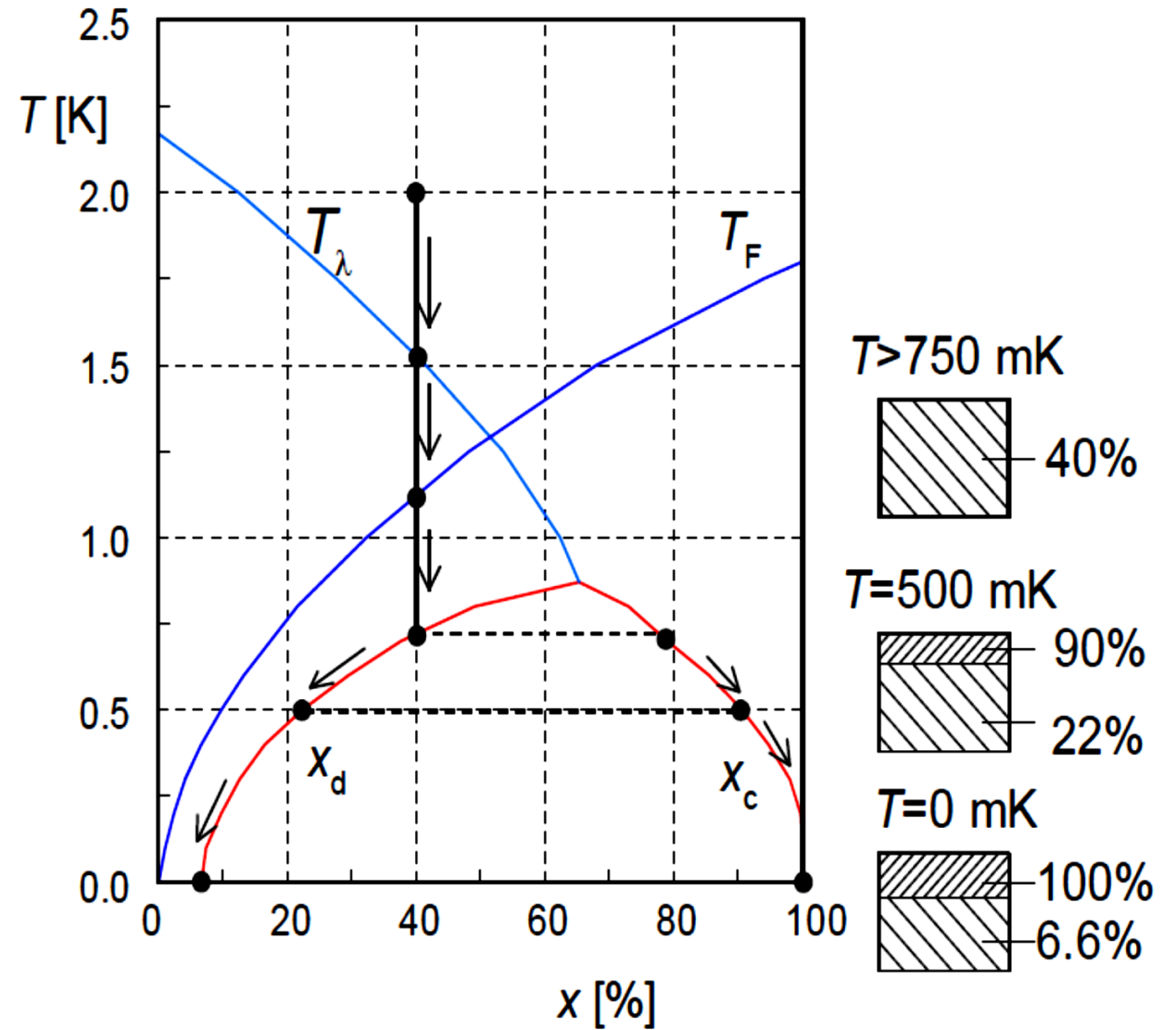
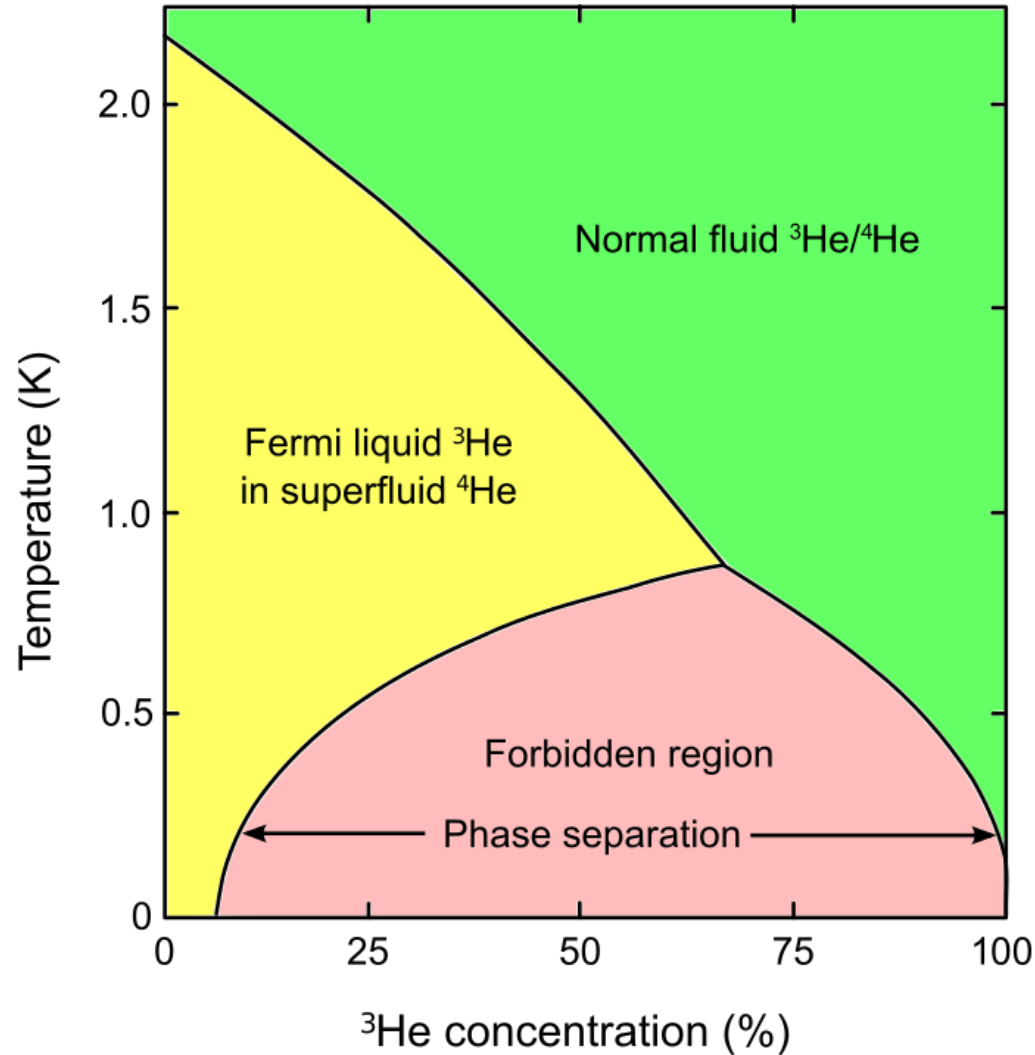
Presented by Ivan Gorodnov

Co-authors: Yury Usov, Nikolay Borisov, Anton Dolzhikov, Mainz team, Bonn team

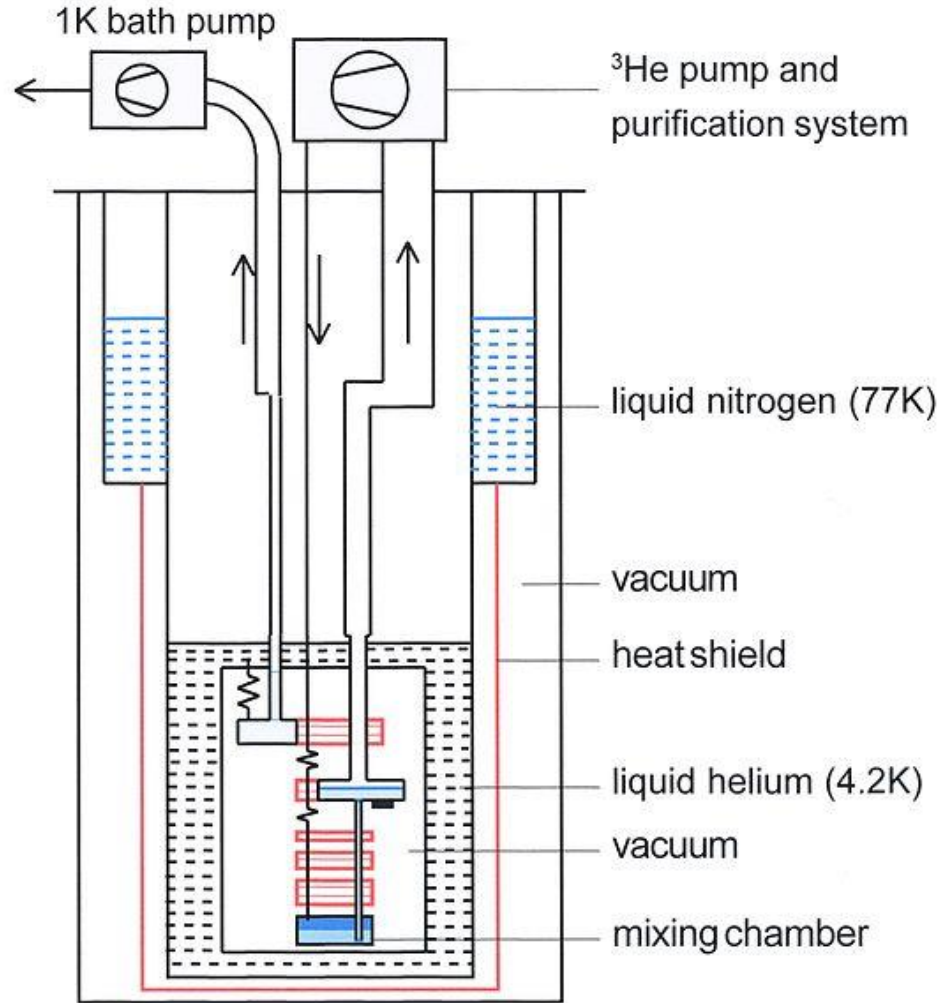
History



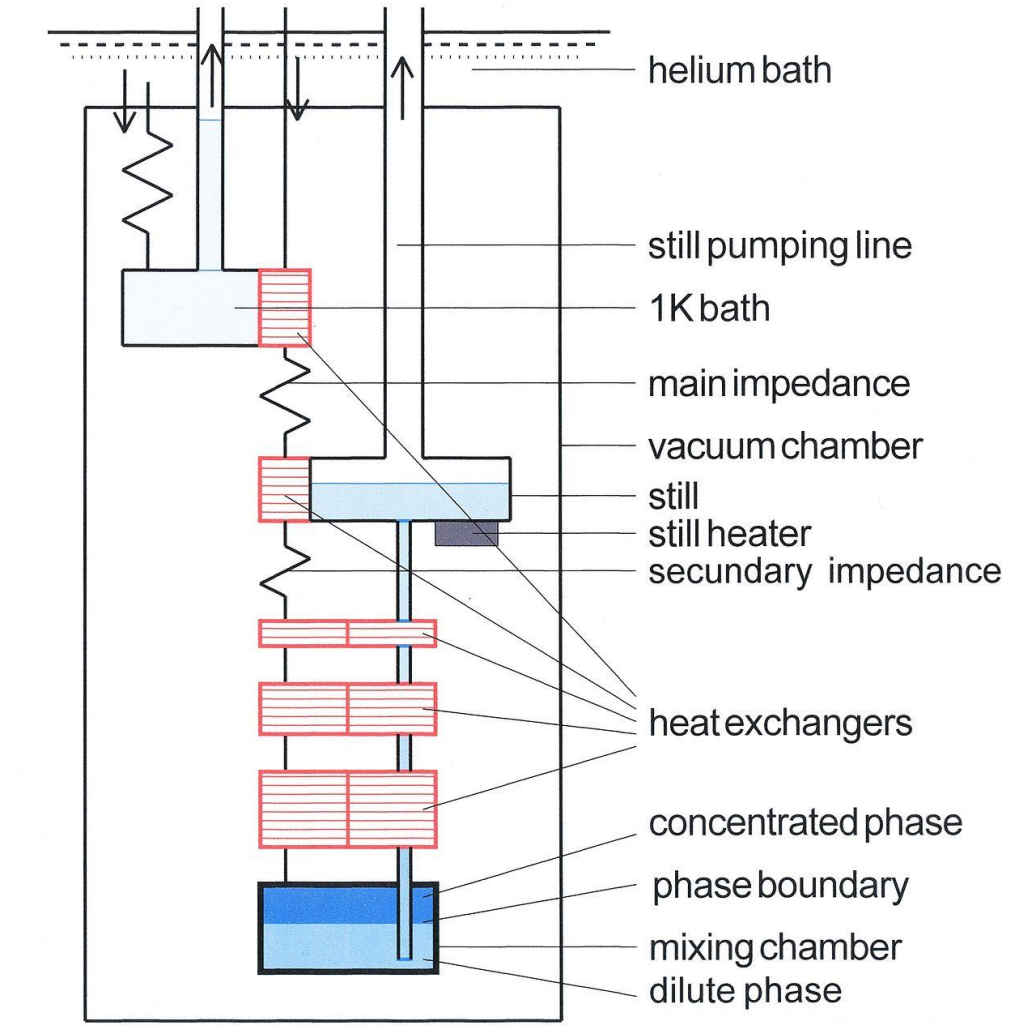
Phase diagram and phase separation of $^3\text{He}/^4\text{He}$ mixture



Schematic diagram of dilution refrigerator



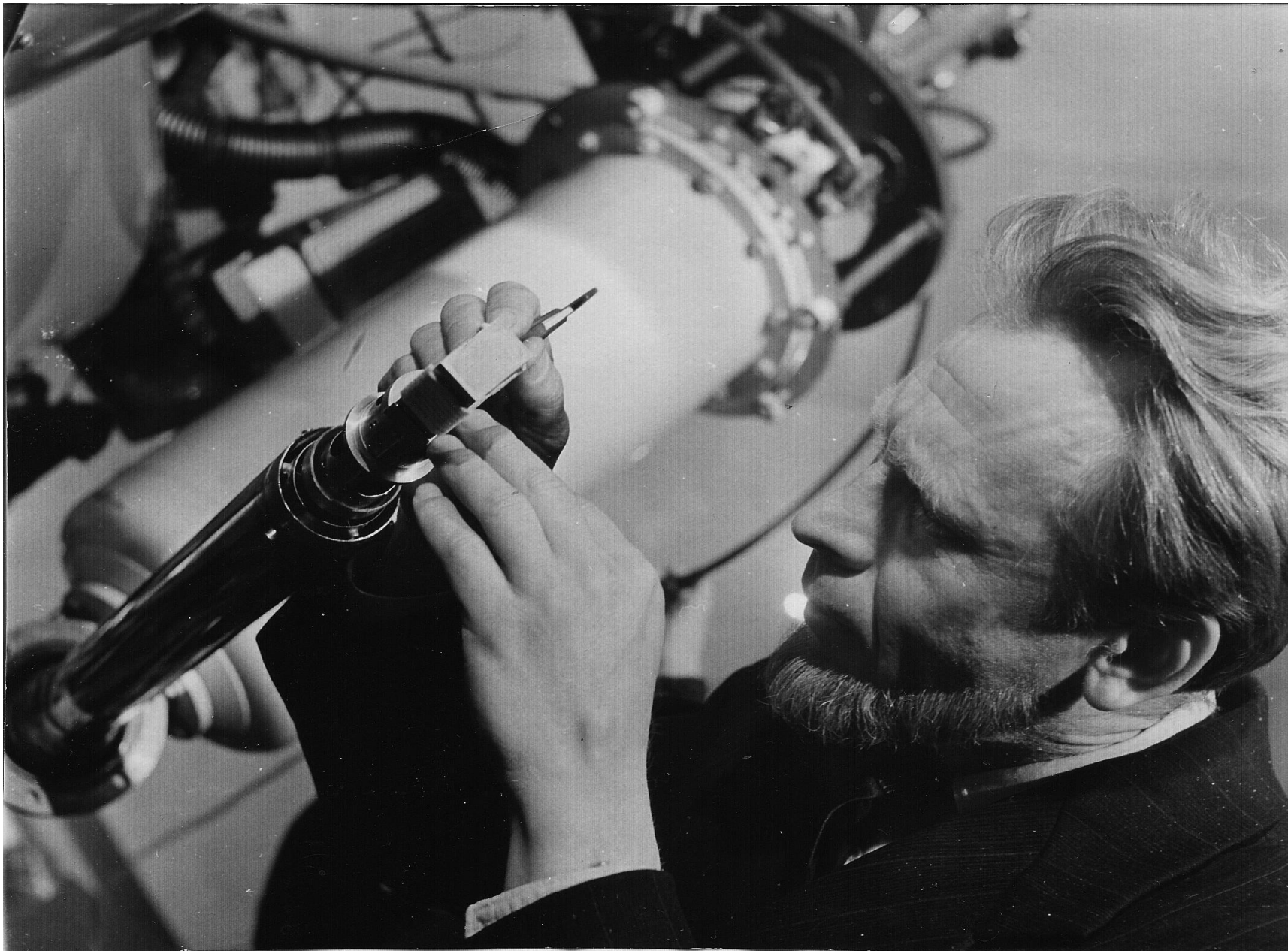
Low temperature part



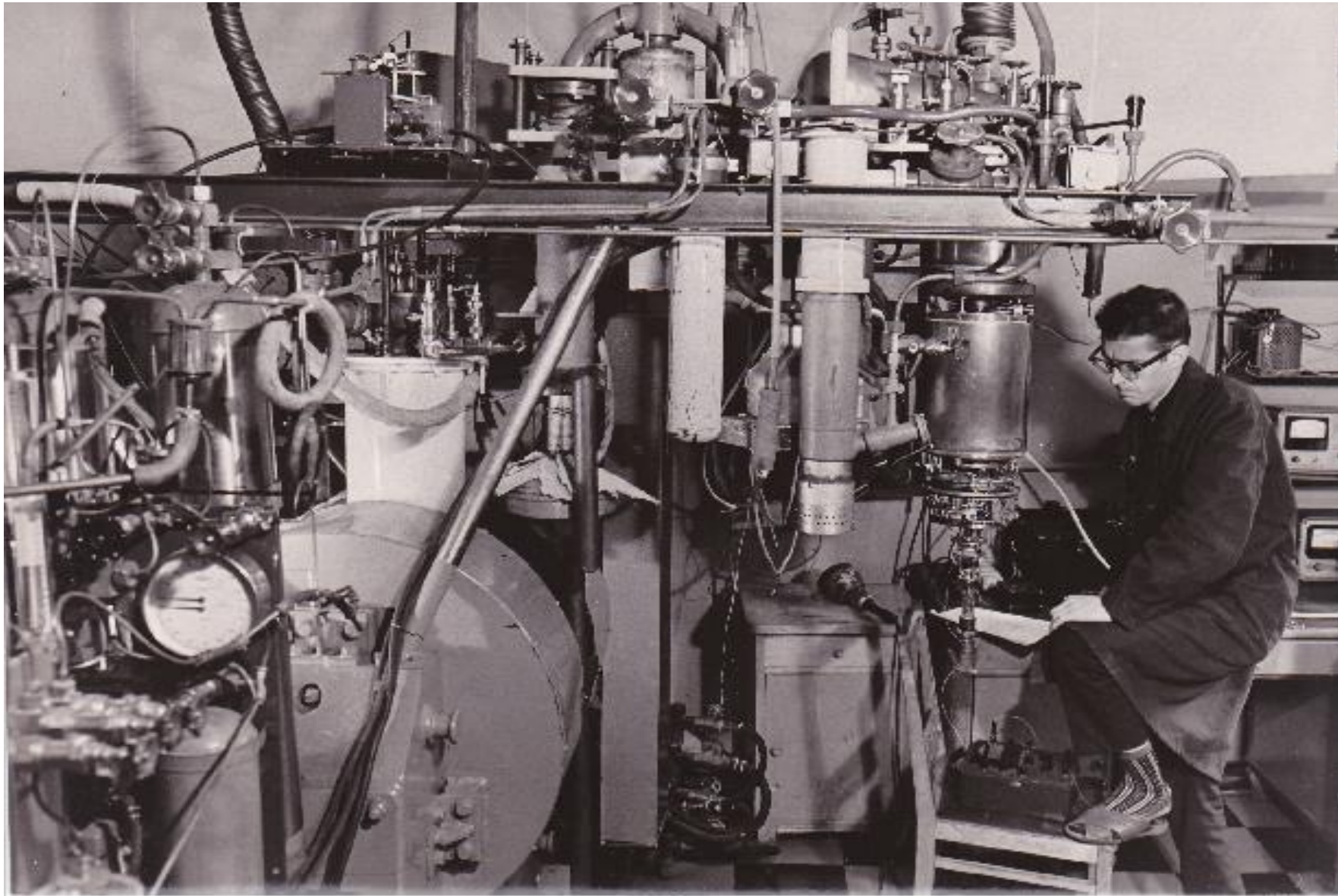
1. ³He absorbs energy when it dissolved into diluted phase.

2. $Q = n \times [H_d(T) - H_c(T)] \approx 82nT^2$. Q - heat absorbed by n moles of ³He.

3. Distillation in the «Still» at 0.7K.



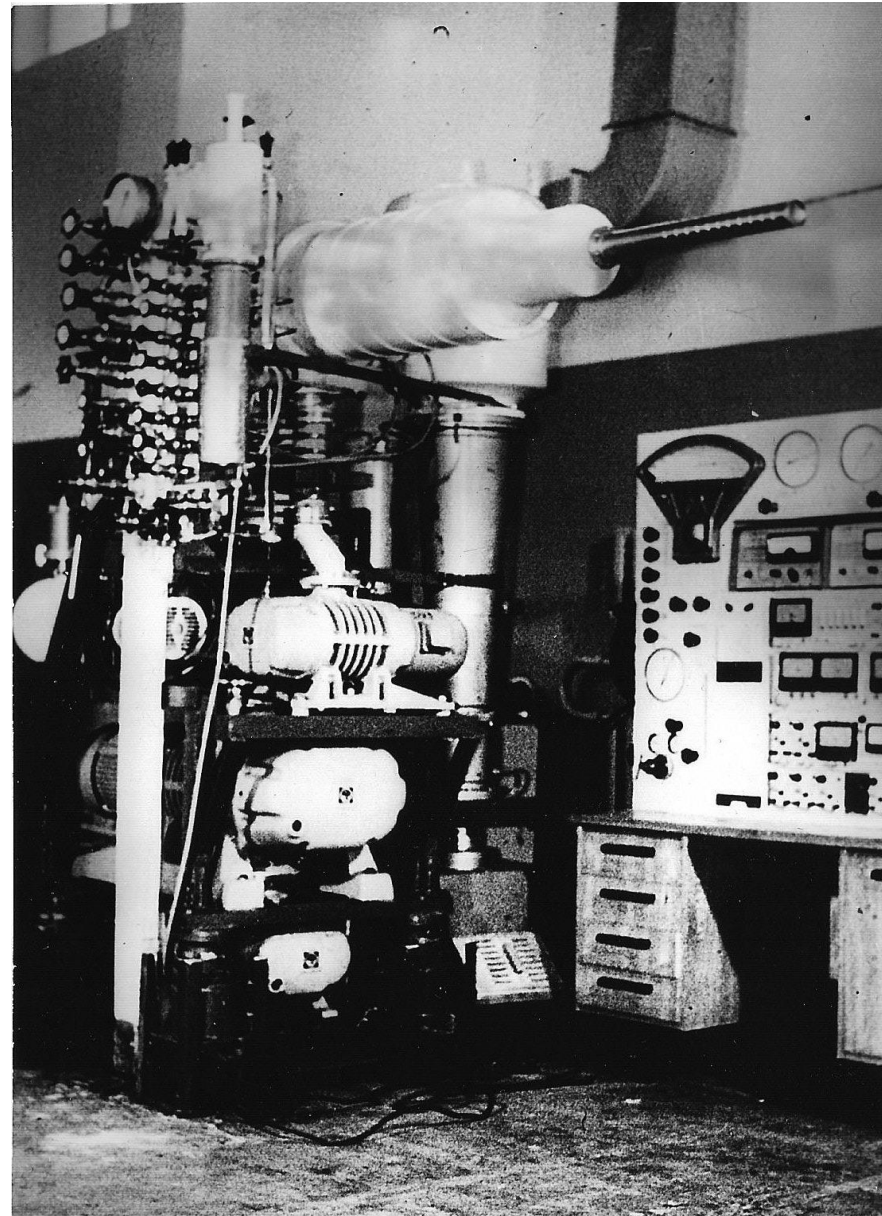
B.S.Neganov during tuning of 1K Dynamic Polarized target (app.1965)



A combine setup including a 1K dynamic polarized target and a dilution refrigerator where an ultra low temperature 5 mK was reached (1966)



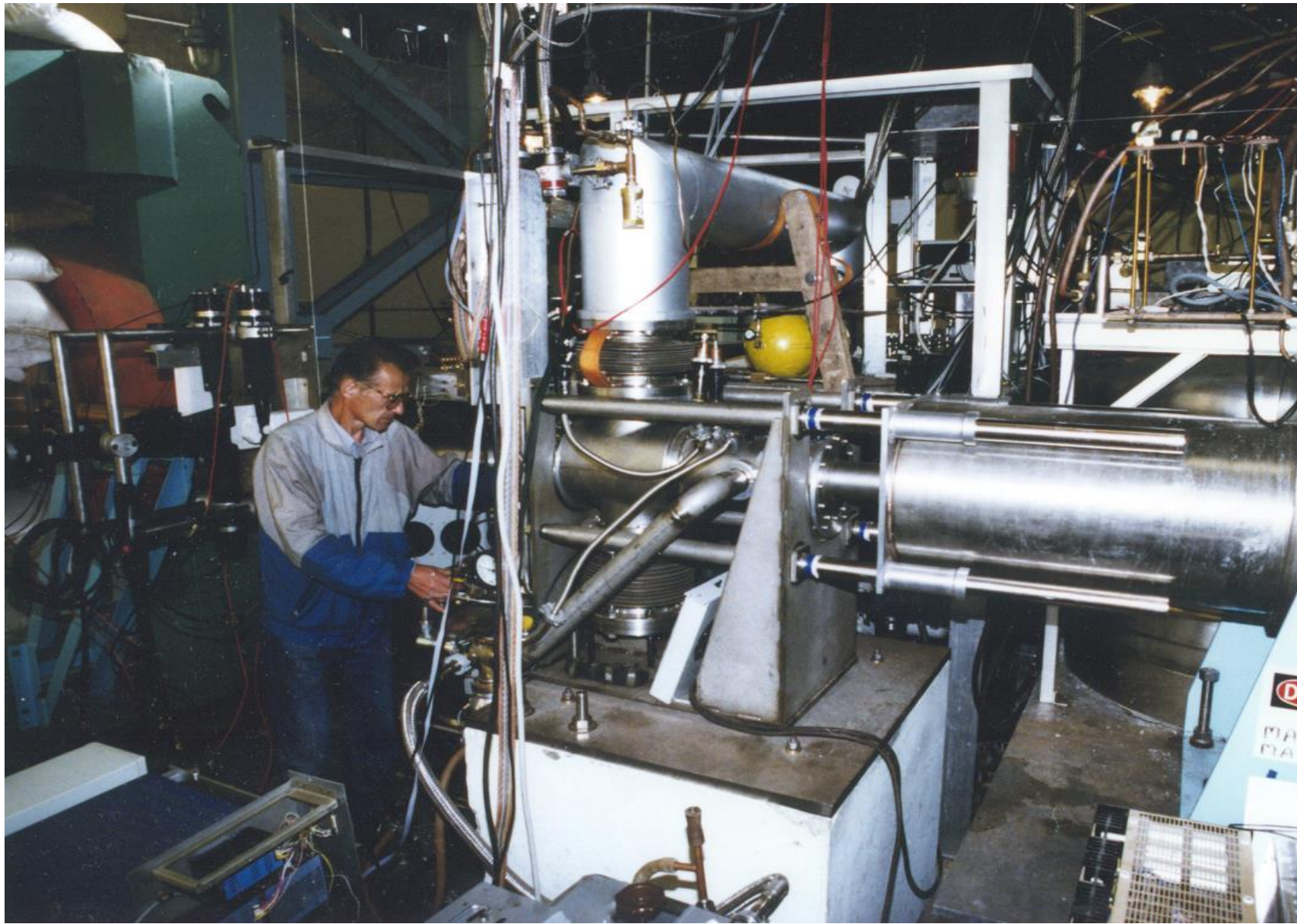
The first Frozen Polarized Target (1975) during tests preparation (B. Neganov and N. Borisov)



Second FPT before transportation to IHEP (Protvino) – 1978



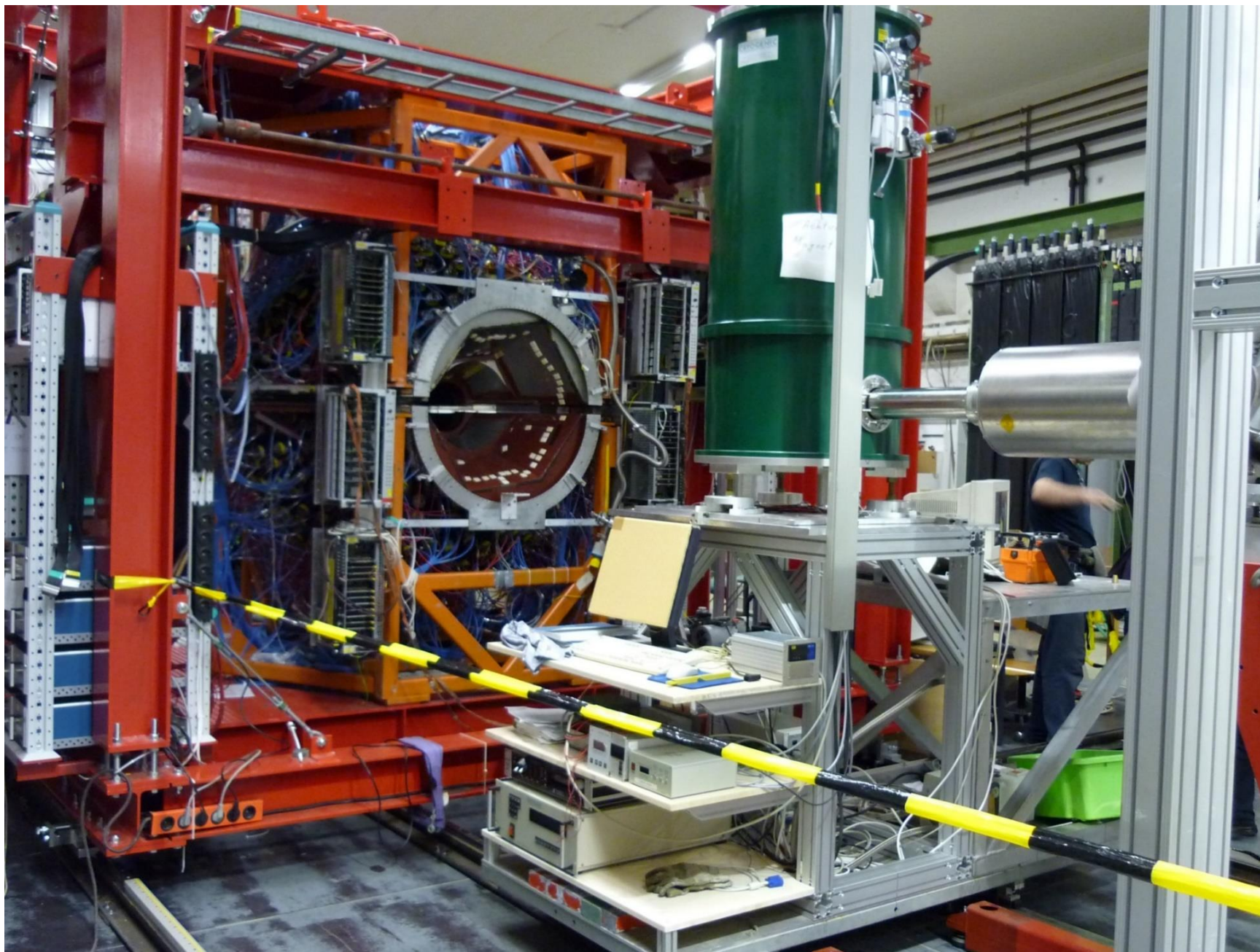
Target with a frozen nuclear polarization for experiments at low energies in Prague.
NIM A 345, (1994) 421-428.



The reconstruction of the Saclay-Argonne frozen spin proton polarized target to movable polarized target for high energy spin physics experiments, NIM A 372, (1996) 349-351.
This project was supported by INTAS grants in 1993 and 1995.

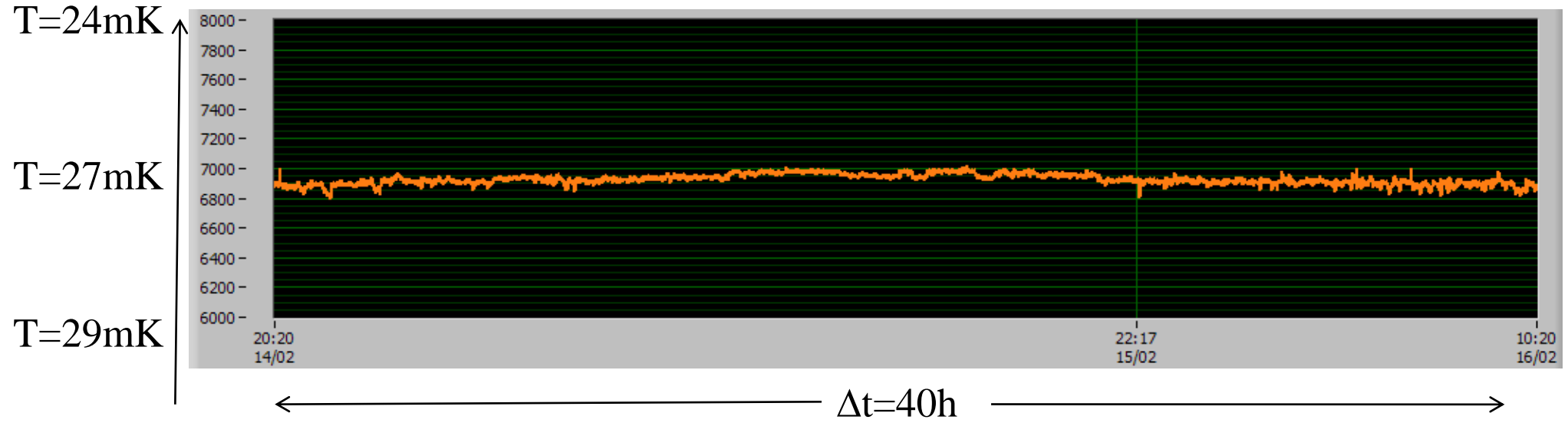


Frozen Polarized Target at MAMI C (Mainz) - 2010

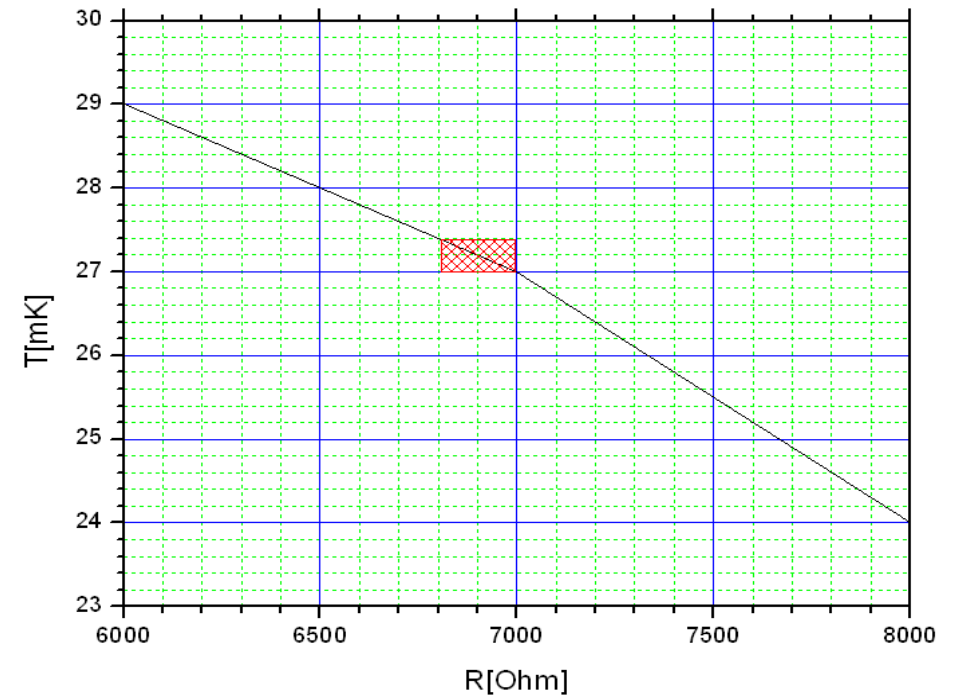


Crystal Ball and Superconducting magnet at MAMI C (Mainz)

Cryostat performance



Temperature stability:
 $\Delta T \sim \pm 0.2\text{mKelvin}$ (one day)
(typical one week measurement period).



Contract between JINR and HISKP for production of ^3He - ^4He dilution cryostat (concluded in 2015)

Agreement / Contract No 40960106

between

**Joint Institute for Nuclear Research (JINR)
Dubna, Russia**

and

**Rheinische Friedrich-Wilhelms-Universität (RFWU),
Helmholtz-Institut für Strahlen- und Kernphysik (HISKP)
Bonn, Germany**

concerning

design, production and test of an ^3He - ^4He Dilution cryostat
for the CBELSA/TAPS- experiment in the SFB/TR-16

10. Legal Addresses and Bank Requisites


Helmholtz-Institut für Strahlen- und Kernphysik (HISKP),
Nussallee 14-16, Bonn, 53115, GERMANY.
Tel.: 0049-228-732201, Fax: 0049-228-732205

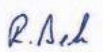
Joint Institute for Nuclear Research (JINR),
Joliot-Curie, 6 Dubna, Moscow Region, 141980, RUSSIA.
Tel.: 007-09621-62287/ 63404/ 65576 Fax: 007-09621-65004

Bank Requisites:


Beneficiary: Joint Institute for nuclear Research;
Beneficiary's bank: MDM Bank (OJSC), Russia, Moscow;
Beneficiary's account: 40807978900140027653;
SWIFT : MOBWRUMM
Corr. bank : Deutsche Bank AG 12, Taunusanlage, 60262, Frankfurt/Main,
Germany, account: 1009474149.
SWIFT: DEUTDEFF

for Rheinische Friedrich-Wilhelms Universität Bonn : Chancellor Dr. R. Lutz

Date: 20.07.2015 Signature: 
Rheinische
Friedrich-Wilhelms-Universität
Der Kanzler
im Auftrag
(Dr. Impekoven)

for Helmholtz-Institut für Strahlen- und Kernphysik : Prof. Dr. R. Beck,
Date: 14.7.2015 Signature: 
Prof. Dr. R. Beck
Helmholtz-Institut für Strahlen- und
Kernphysik der Universität Bonn
Nussallee 14-16
D-53115 Bonn

for Joint Institute of Nuclear Research (JINR): Prof. Dr. V. A. Matveev

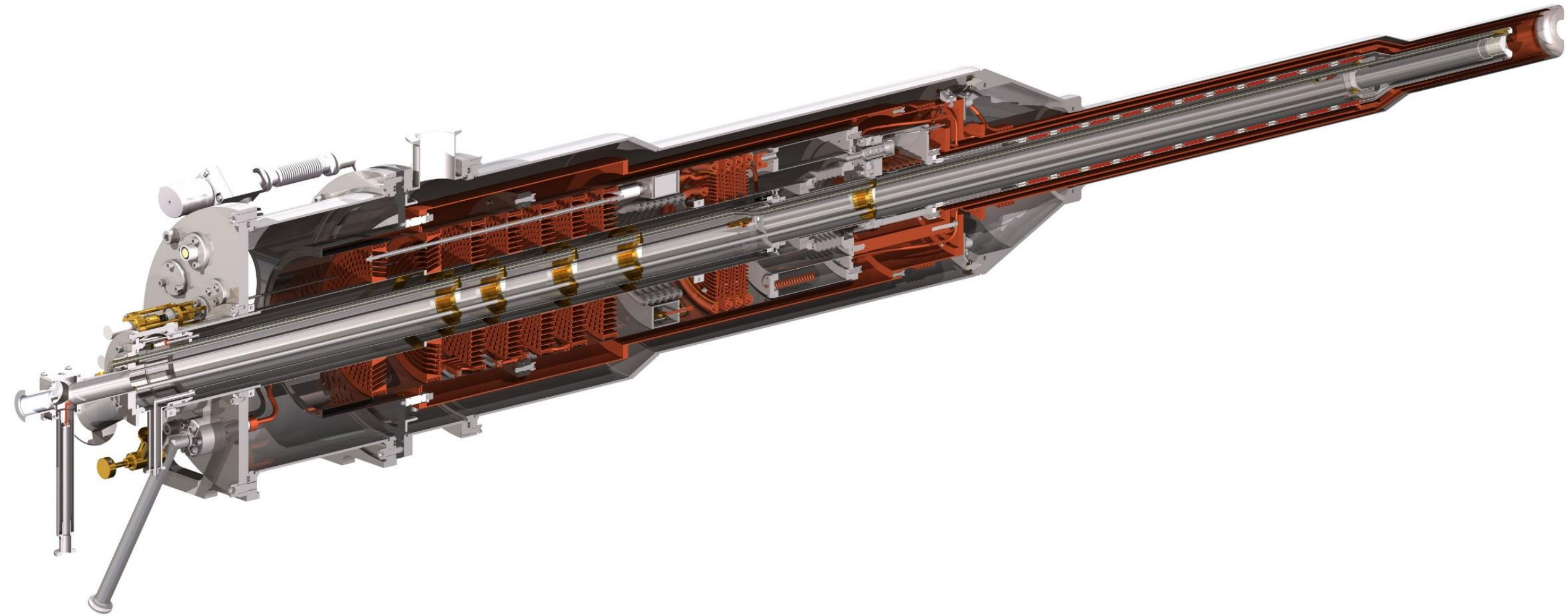
Date: Signature: 



Technical information about HISKP Bonn cryostat:

- **Mixing chamber temperature < 30 mK is guaranteed in continuous operation; goal for the base temperature is 25 mK.**
- **Cooling power at 300 mK is > 30 mW at a ^3He -circulation rate of 10 mmol/sec.**
- **Temperature of the integrated holding or polarizing coil is 1.3 K. A supply for 50 Amperes to this current coil is guaranteed. The design should make a coil current of 100 Ampere possible.**
- **Cryostat ^4He consumption is < 4 Liter/hour.**
- **Target size: diameter - 20mm, length - 20mm**
- **Evaporator temperature ~ 1.2 K, Separator temperature ~ 4 K.**
- **Angle for outgoing particles: $0^\circ \gg \theta > 160^\circ$.**

Cross-section of Bonn dilution cryostat



Technical realisation of Bonn dilution cryostat





The map of JINR's frozen polarized target activities

