Present Status of Neutron Sample Environments at High Magnetic Fields and Low Temperatures

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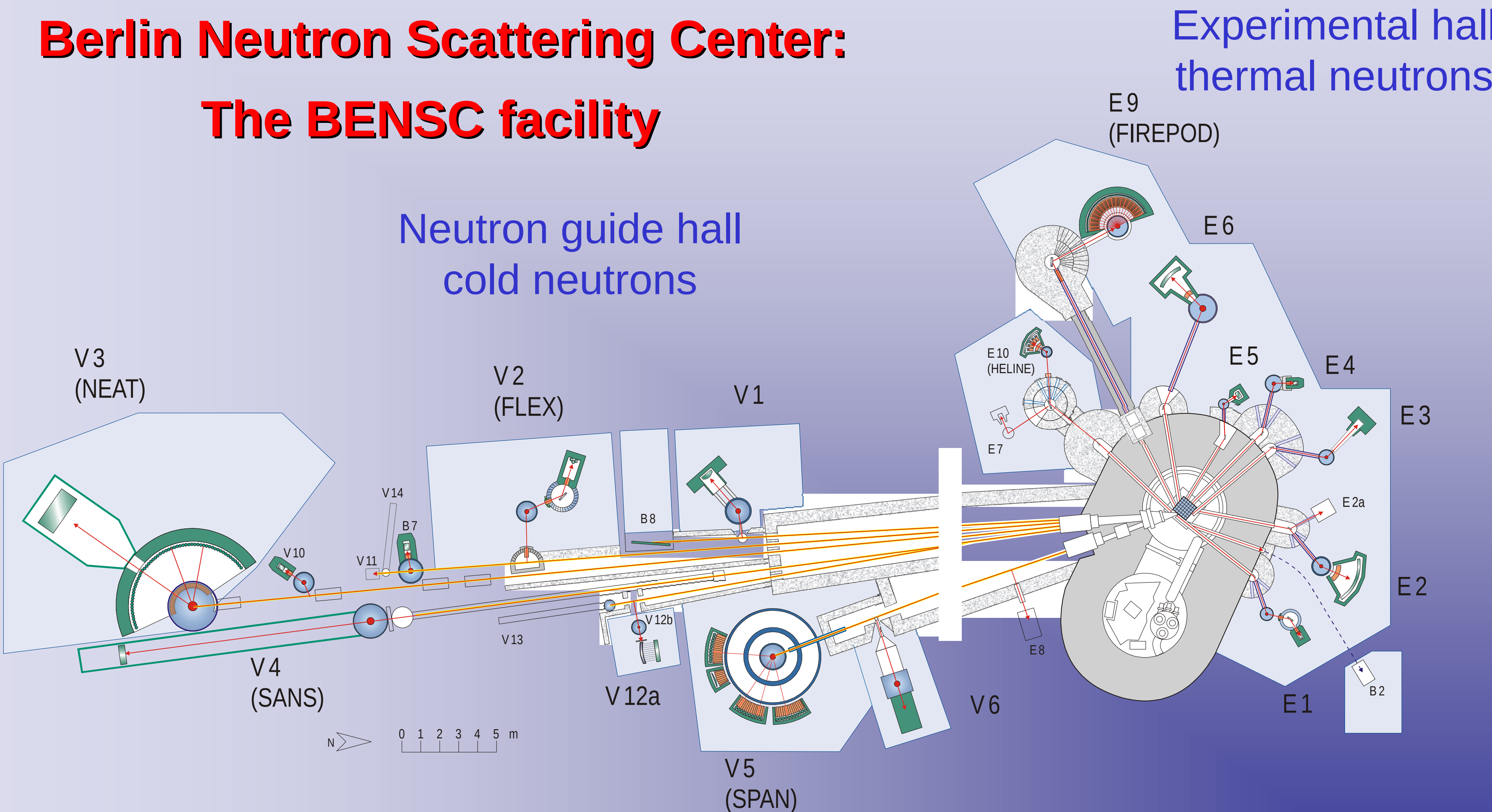
Berlin Neutron Scattering Center:

The BENSC facility



Sample Environment at HMI-BENSC

Variation of external thermodynamic fields

→ **Temperature** T = 30 mK … 1 K … 300K … 600 K … 2000K

→ **Magnetic Field** H = ~50 µT … 5 T … 15 T … 17.5 T

→ **Pressure** p = <1 mbar … 1 bar … 200 bar … 10 kbar

→ verify combinations of all 3 fields

Low Temperature Systems

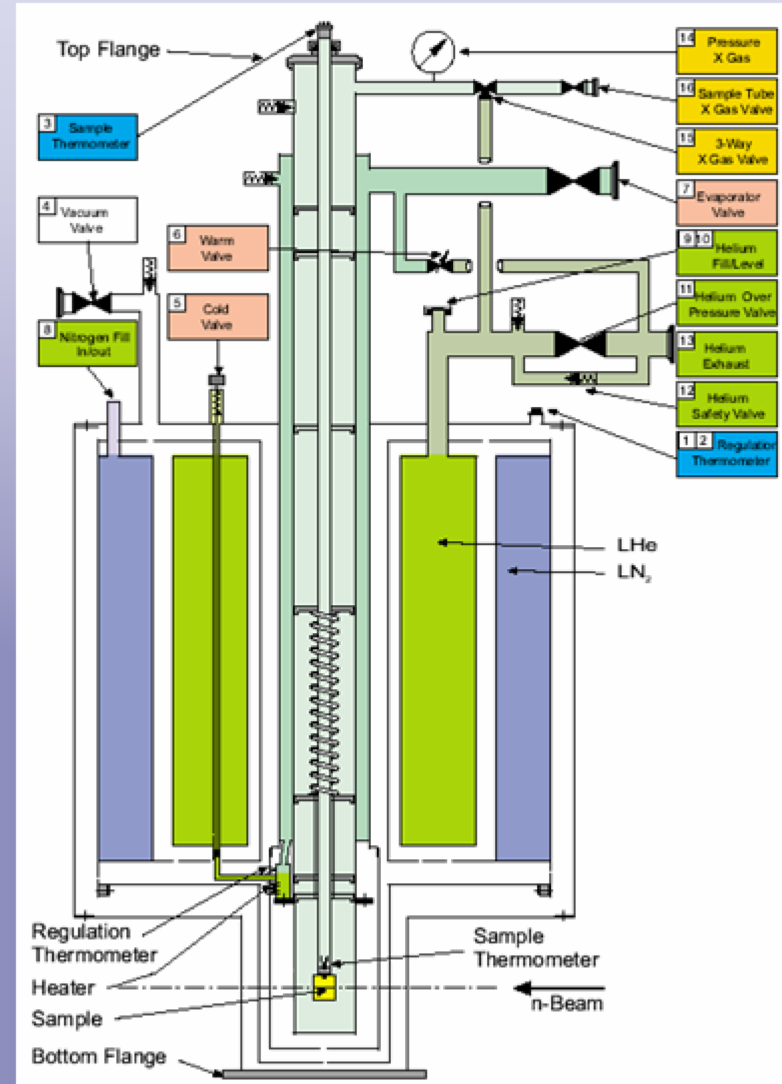
- Gas expansion refrigerator (CCR or PT): 3 K ... 500K
- Orange cryostat: 1.2 K ... 600 K
- CCR plus ^{4}He insert: 1.0 K ... 330 K

- ^{3}He insert: ~350 mK ... 30 K
- ^{3}He / ^{4}He dilution insert: ~20 mK ... <1 K

Orange cryostat

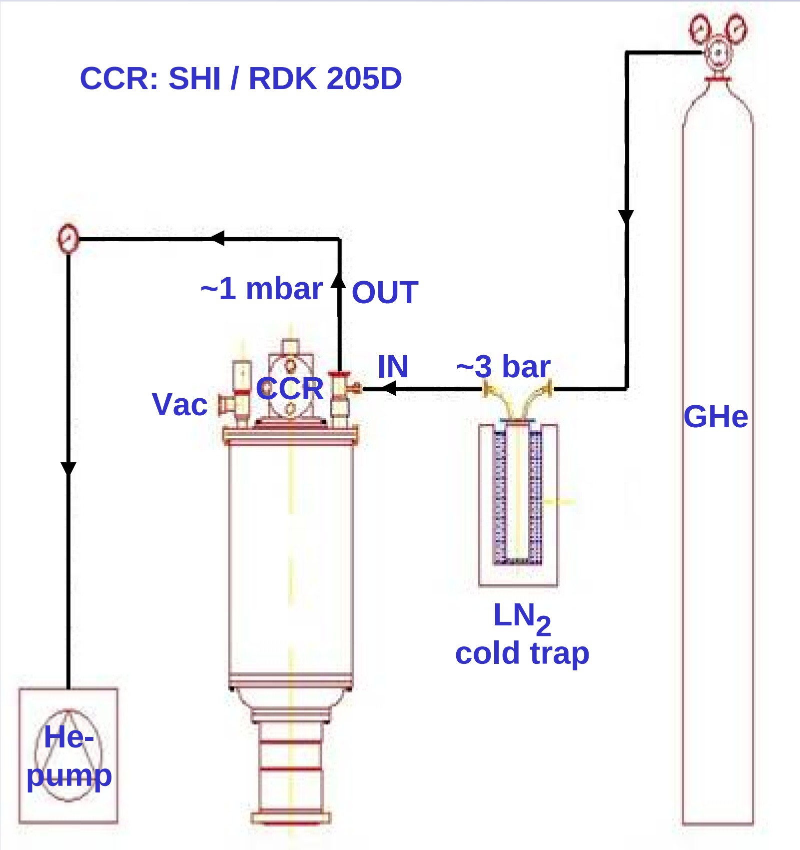
(ILL / AS)

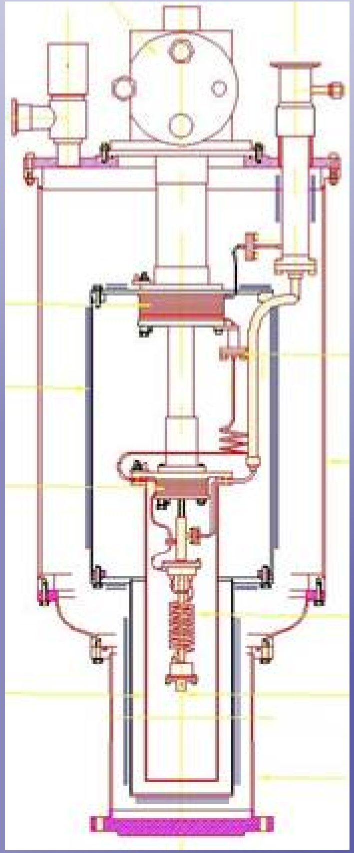
T = 1.2 K ... 600 K

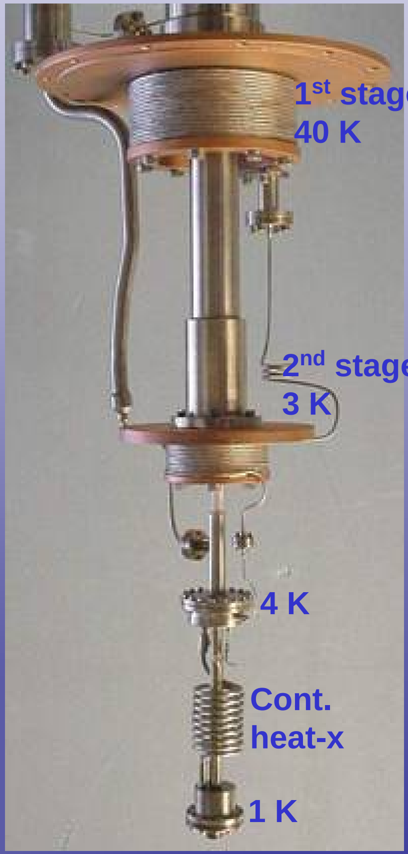


^{4}He evaporation insert (HMI / AS) for closed cycle refrigerators

T = 1.0K – 330K

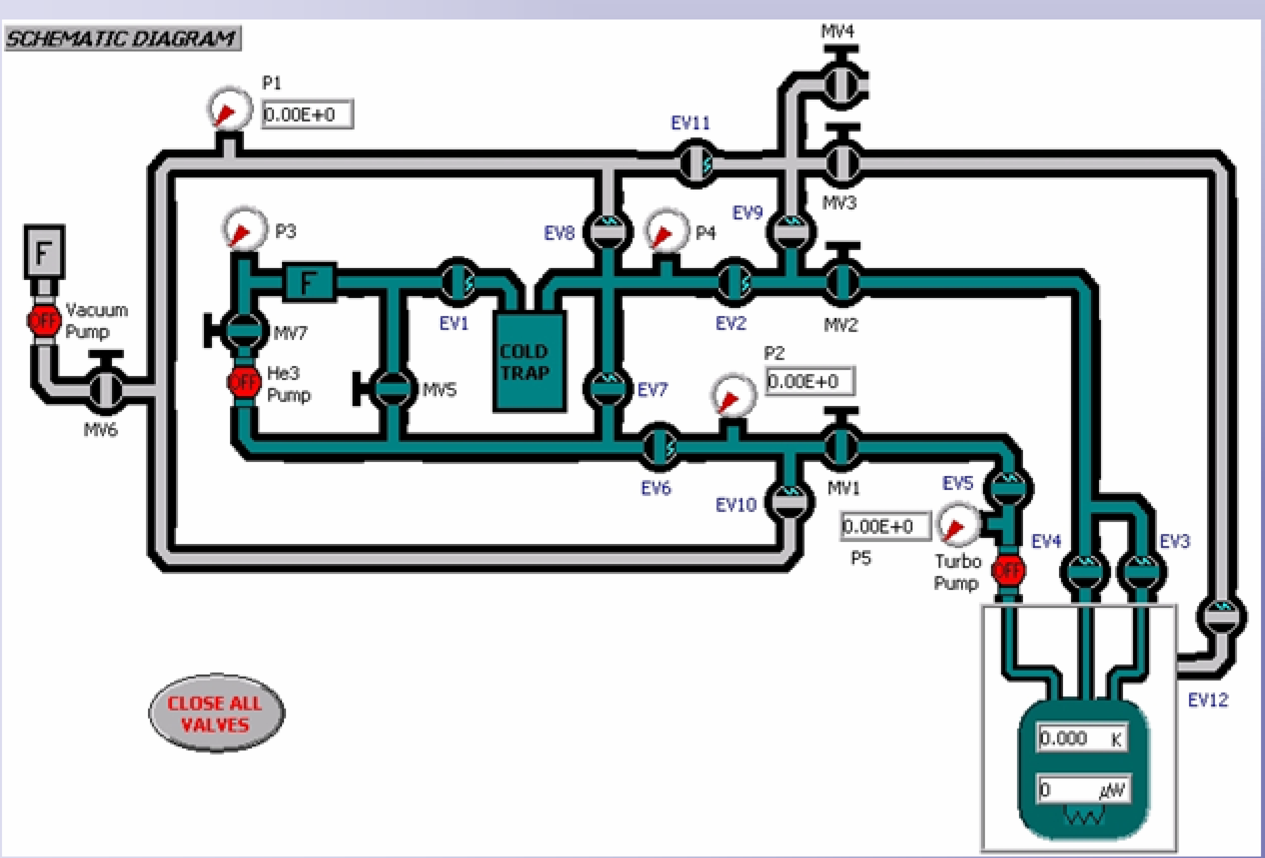






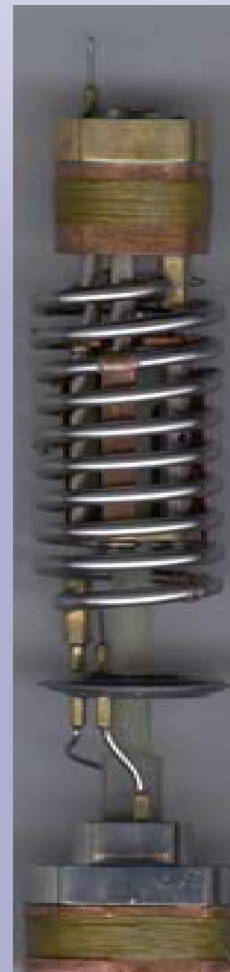
^{3}He evaporation insert (ILL / AS) for Orange-type cryostats

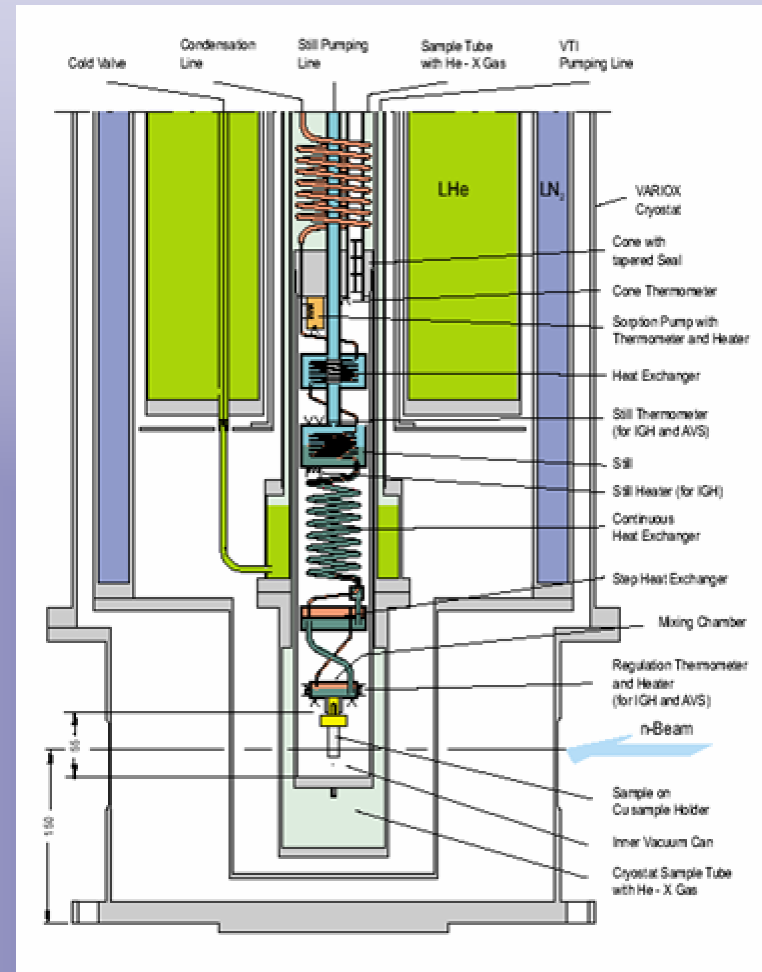
T = 0.35 K ... 330 K



^{3}He / ^{4}He dilution insert (HMI / OI) for Orange-type cryostats

T = 0.03 K ... 330 K





Superconducting Magnet Systems

- Split-pairs in NbTi @ 4.2 K: 5 T ... 9 T (OI, CL, AS ...)

  → CCR cooled („LHe-free") NbTi split-pairs: FRM, ANSO

- Split-pairs in NbTi + $NbSn_3$ @ 2.2 K: 12 T ... 15 T

  → OI's split-pair 15 T cryomagnet: 2 x HMI, ILL, FRM, PSI

  → Rare earth material booster: 15 T → 17.5 T (4 x 6 mm^3)

- Split-pairs in HTS + NbTi + $NbSn_3$ @ 4.2 K: 20 T ... 25 T ???

Range of Cryomagnets at HMI-BENSC

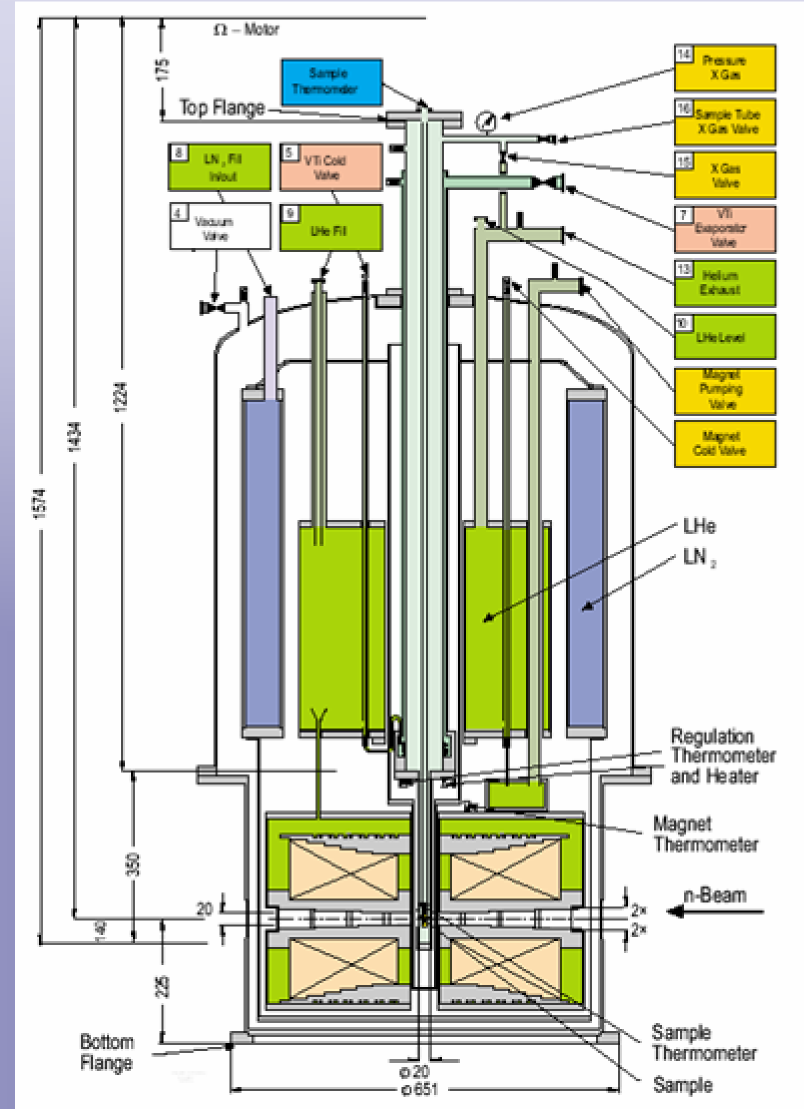
VM-1B
15 T

VM-5 (AS)
6 T warm bore

VM-1 / VM-1B

14.5 / 15.0 T Cryomagnets (OI)

T = 1.4 K ... 300 K

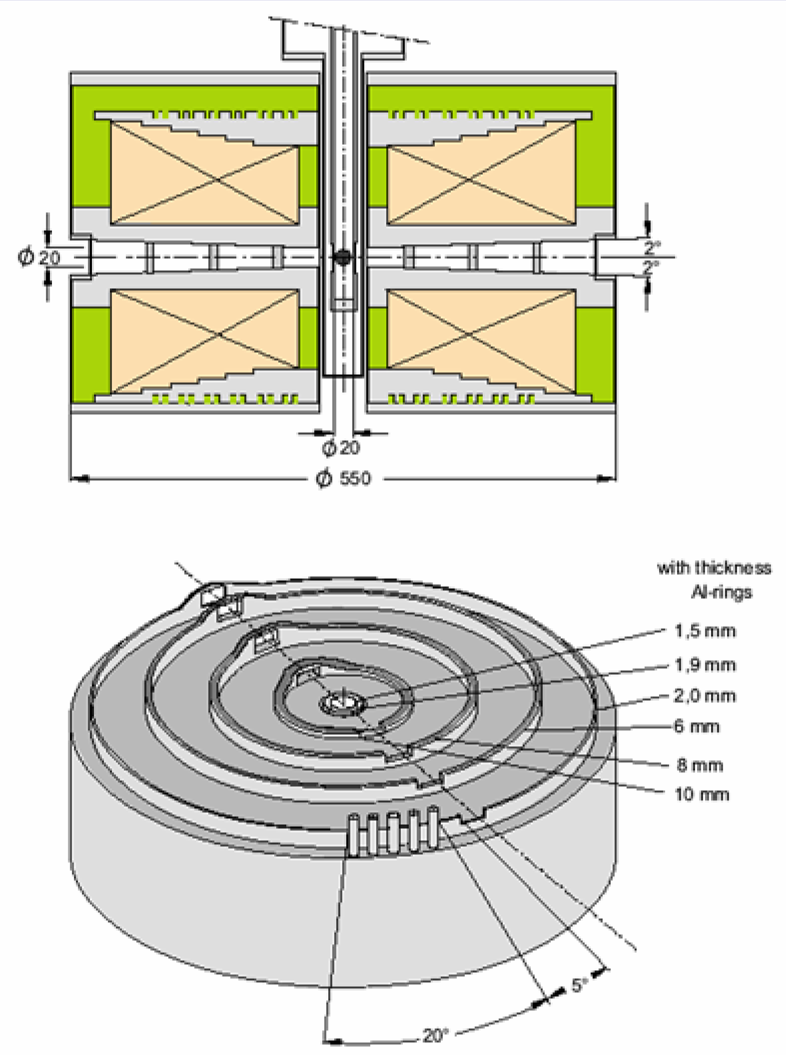


Magnet structure

14.5 / 15.0 T

Cryomagnets (OI)

VM-1 & VM-1B



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Dilution Stick Insert (30mK – 300K)

Dy-booster Insert (+2.5T / 1.5-80K)

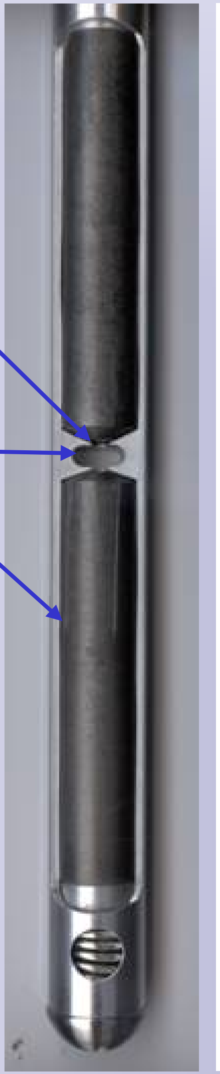
Dilution stick and Dy-Booster (OI / HMI)

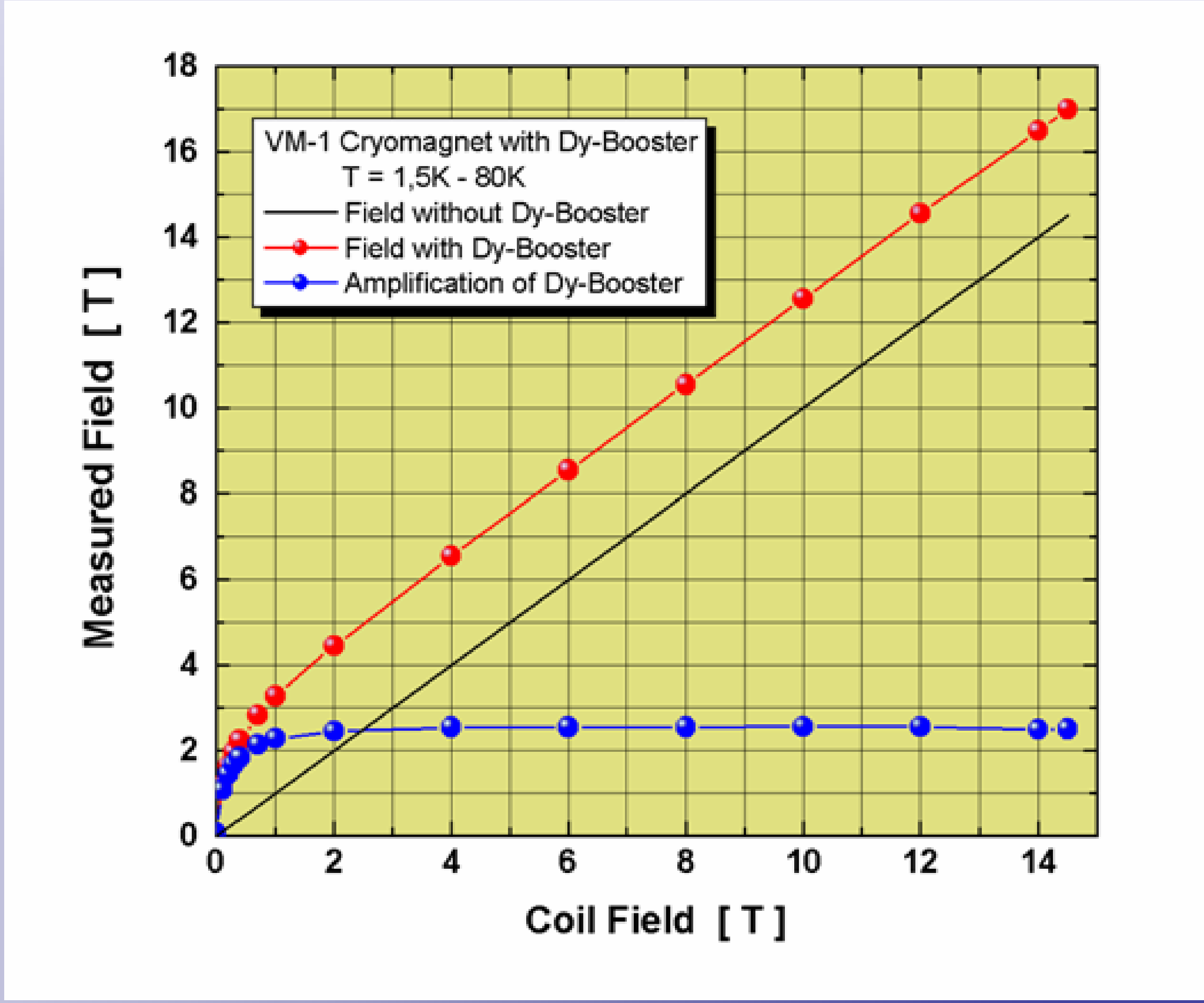
2.5 T field enhancement by Dy-booster

Pole dia 4 mm

Gap 6 mm

Lenght 120 mm dia 16 mm





VM-1 with DS-2 Insert on Triple Axis Spectrometer V2

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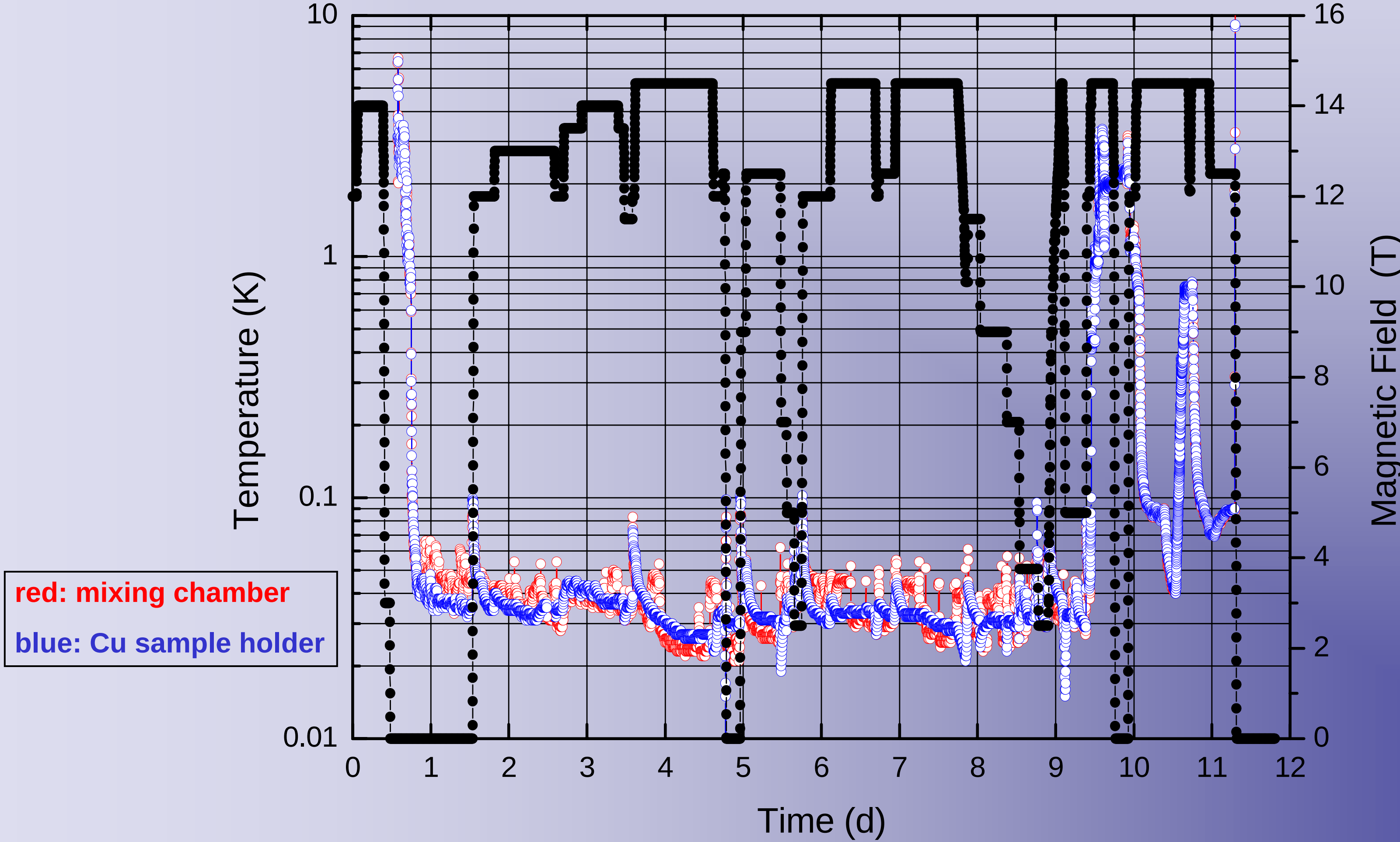
User experiment with VM-1 & DS-2 on Spectrometer V2

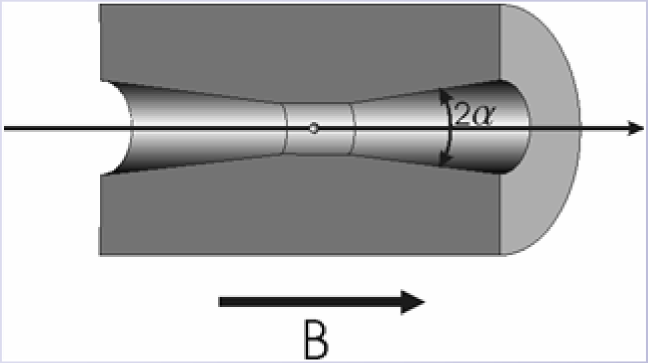
Enderle et al. on $CuGeO_4$, March 2001



The N40T Project

- Solenoid coil with resistive Cu technique: 40 T
  - → electric power of 40 MW (80 kA @ 500 V)
  - → cooling power by water (5°C → 20°C, 30 bar, 400 Liter/sec)
- Horizontal NHMFL "Florida Bitter Magnet": no solenoid
  - → tapered bore with scattering angle ~25°
- F. Mezei's new conception of adjustable wavelenght:
  - → ballistic beamline and TOF diffraction technique

40 T Magnet configuration



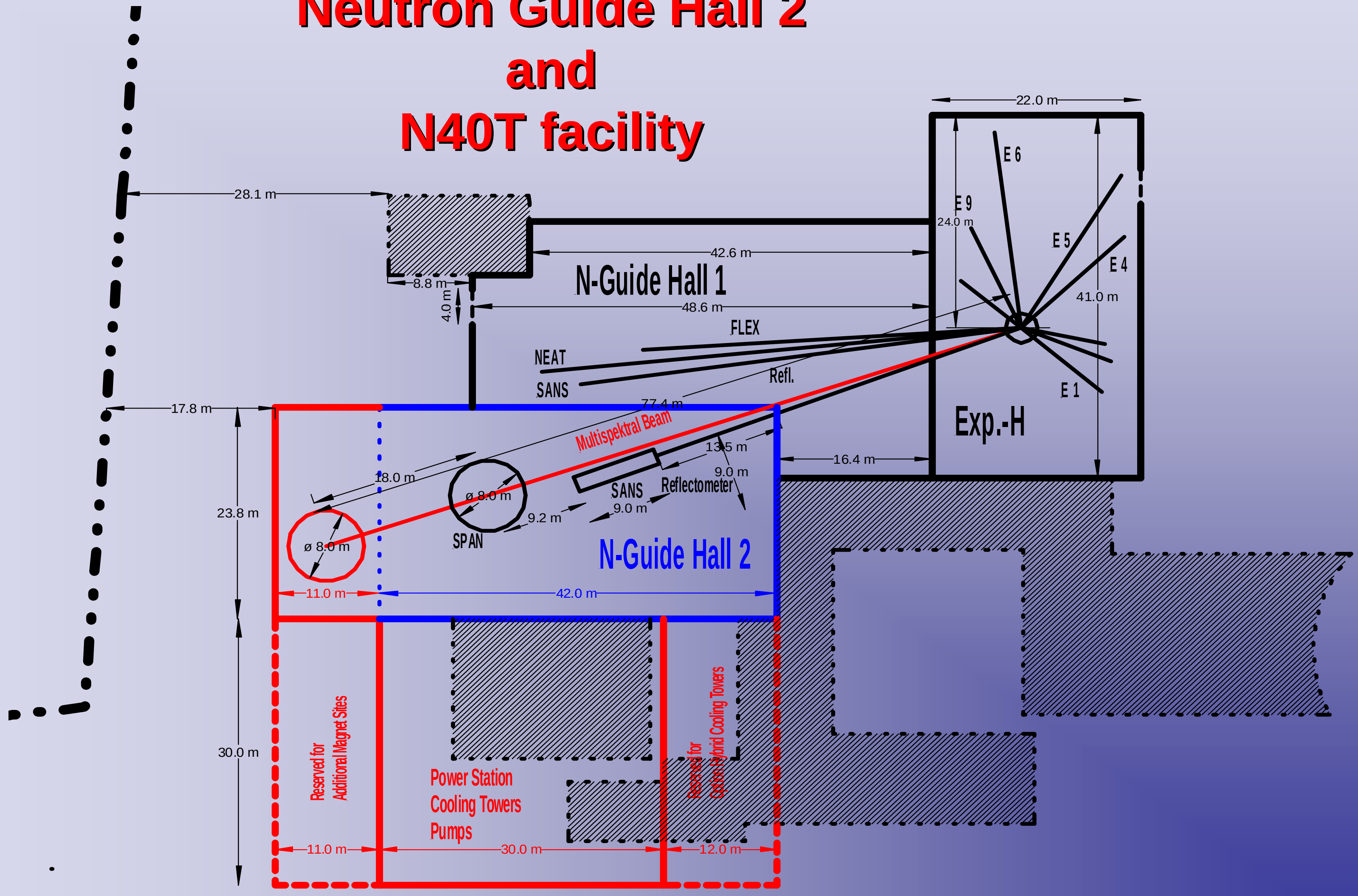
Horizontal tapered solenoid
("Florida Bitter Magnet" of NHMFL, Tallahassee)

High efficiency, cost effective, many identical parts

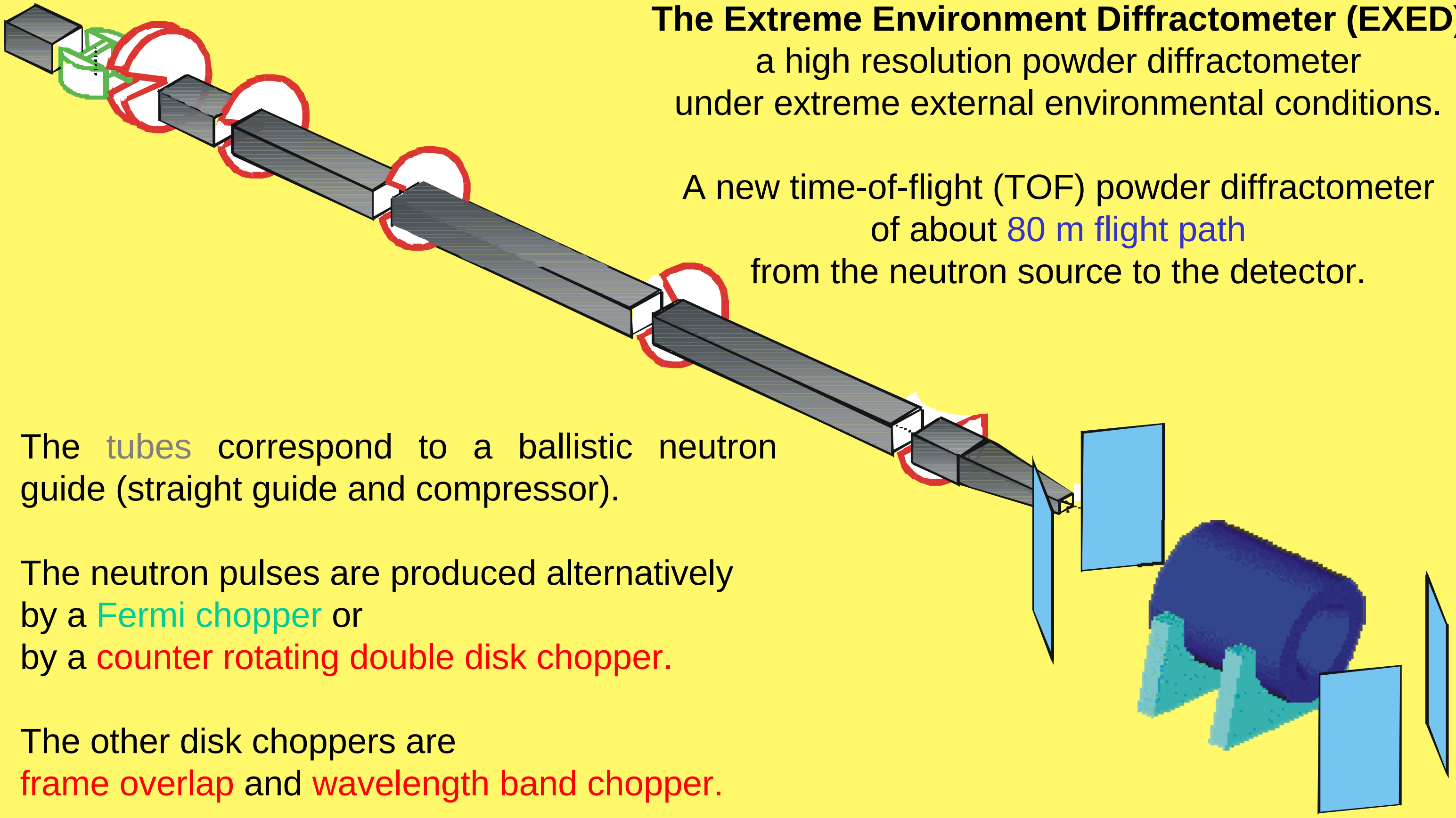
No magnet technology development at HMI, supply in cooperation with NHMFL:

Design study by H. Schneider-Muntau & Y. M. Eyssa → B ~ 38 T @ α ~ 13°

Neutron Guide Hall 2 and N40T facility



Time-of-flight Neutron Guide and Extreme Environment Diffractometer (F. Mezei)



The Extreme Environment Diffractometer (EXED)
a high resolution powder diffractometer
under extreme external environmental conditions.

A new time-of-flight (TOF) powder diffractometer
of about 80 m flight path
from the neutron source to the detector.

The tubes correspond to a ballistic neutron guide (straight guide and compressor).

The neutron pulses are produced alternatively
by a Fermi chopper or
by a counter rotating double disk chopper.

The other disk choppers are
frame overlap and wavelength band chopper.

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N40T facility at BENSC