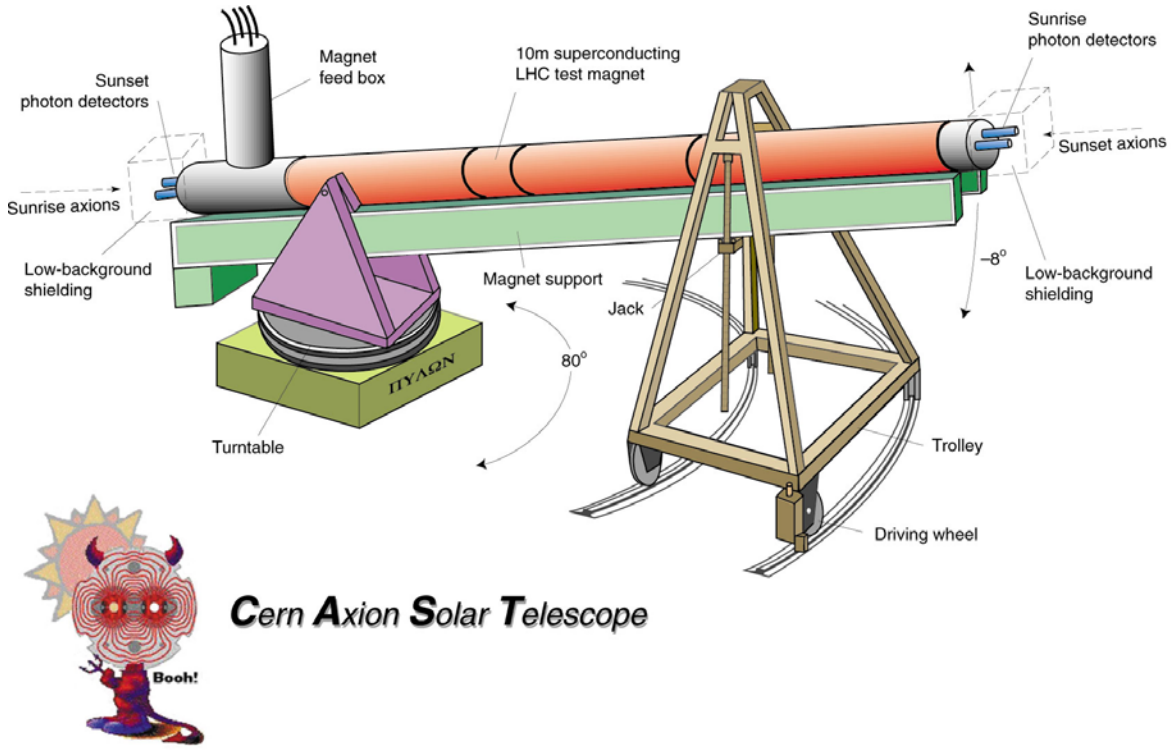
Cryogenics for the
CERN AXION SOLAR TELESCOPE



K. Barth, CERN - AT/ECR

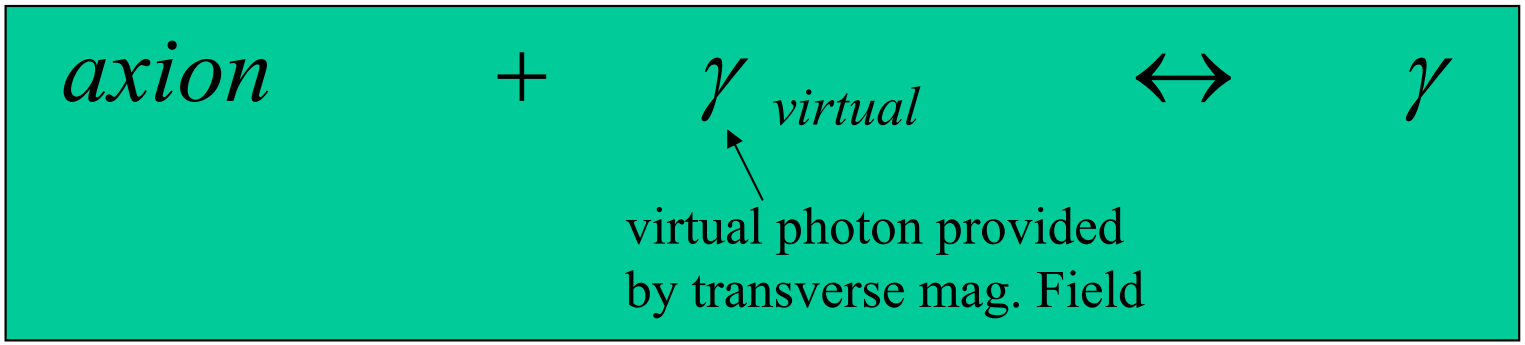
CSOC meeting, Wed. 26.03.2003

Outline

- **Introduction**
  - What does CAST want to detect?
  - How does CAST want to detect?
  - Cryogenics for CAST
- **Safety aspects of CAST cryogenic system**
  - General safety
  - SUH8 cryogenics installation
  - SR8 cryogenics installation
  - Operation
- **Summary**

What does CAST want to detect ?

- **AXIONS, possible solution to the "strong CP problem" and prime candidates for the galactic "dark matter".**
- **If AXIONS exist, produced in stellar interiors by "Primakoff Effect":**



- **Energetic AXIONS created from thermal photons in reactions taking place in red giants, supernovae and in inside our sun.**
- **Solar AXIONS energy spectrum reflects inner solar temperature: 1 – 15 keV**
  average energy of emitted solar AXIONS: ~ 4.2 keV

How does CAST want to detect?

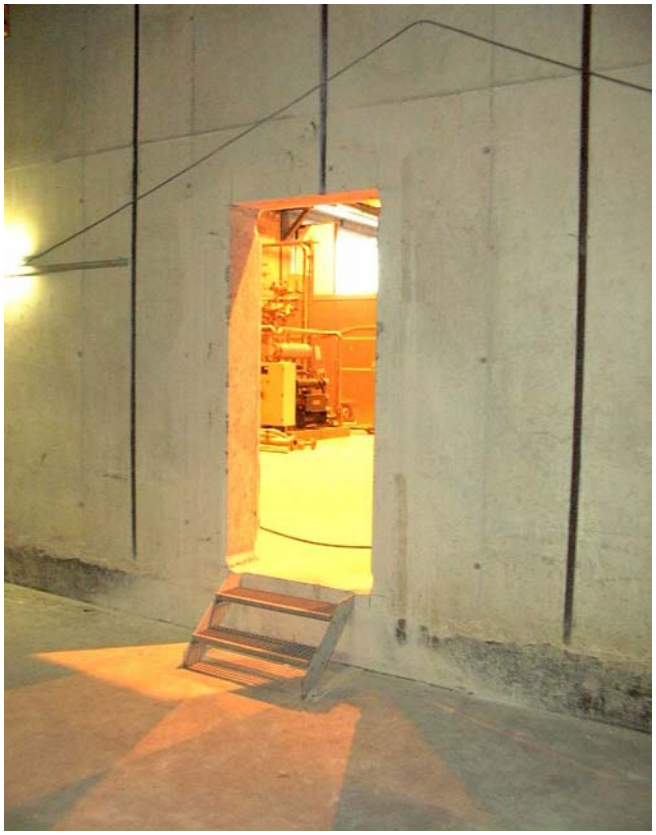
- In a special telescope pointing to core of our sun (inverse "Primakoff Effect")
- Transverse magnetic field acting as catalyst for solar AXION to photon conversion
- Energy of conversion photons is equal to AXIONS total energy $\rightarrow$ focusing into low background x-ray detector
- Solar AXION to photon conversion ~ $(B \times L)^2$
  L: effective length of transverse magnetic field
  AXION telescope in operation at University of Tokyo:
  $(BxL)^2 = 9.2$ Tm
  CAST uses old 10 m LHC dipol prototype:
  B ~ 9.5 T, L= 9.5 m $\rightarrow$ 100 times more efficient

Cryogenics for CAST

- **Former DELPHI cryoplant (800 W@ 4.5K)**
  - Main Helium screw compressor (BP: 1.05 bar, HP 12 bar)
  - He recovery system (Linde purifier & Bauer recovery compr. @ 150 bar)
  - GHe storage (Gas bags @ atm. pressure, He buffers @ 15 bar, cylinders @ 150 bar)
  - LN2 reservoir (working pressure @ 7 bar)
  - Cold box (BP: 1.05 bar, HP 12 bar)
- **Leybold Pumping Group (2 g/sec @ 15.4 mbar)**
- **Former LHC prototype dipole magnet feed box (MFB) connecting pumping group and cryoplant to magnet**

SUH8 – He compressors / purifier

SUH8 – He Gas Bags



access from compressor room to gas bags

installation of gas bags

Connection piping of gas bags

SUH8 – He buffers / LN2 reservoir

Separation of 4 former LEP2 buffers and connection to CAST cryoplant

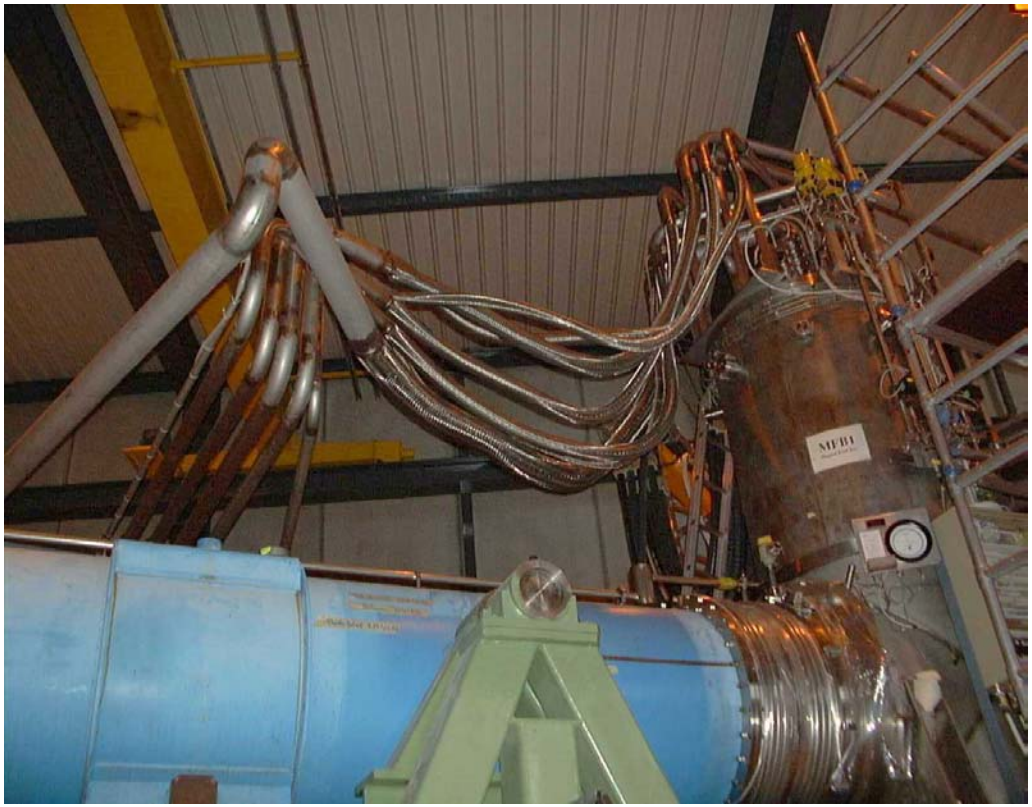
Removal of 6000 l LN2 reservoir behind SUH8 and reconnection cryoplant

Routing of He and LN2 piping into SUH8

SR8 – TCF 200 Cold Box & Leybold Pump

SR8 - MFB

SR8: Transfer Lines CB - MFB



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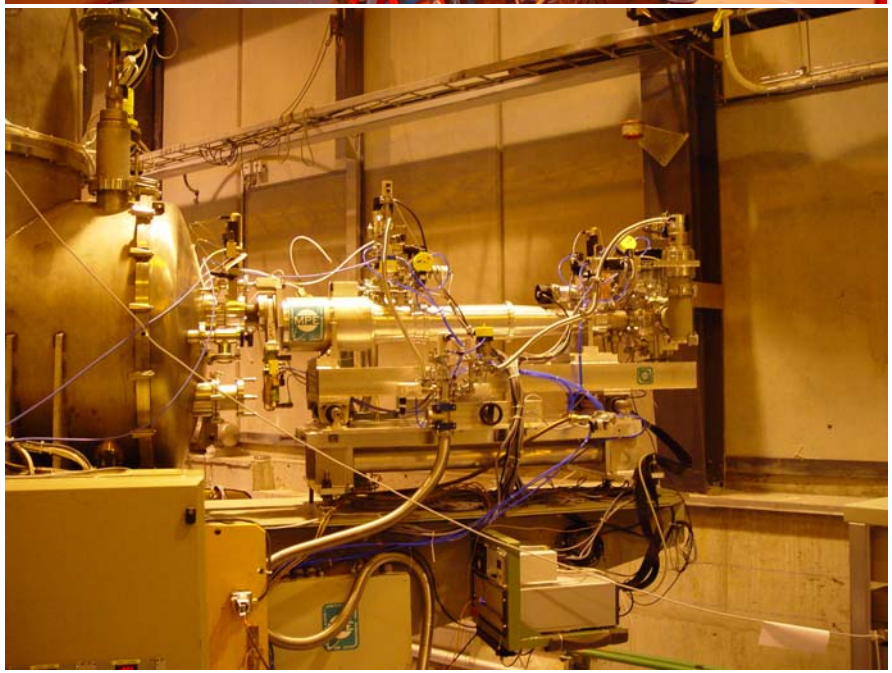


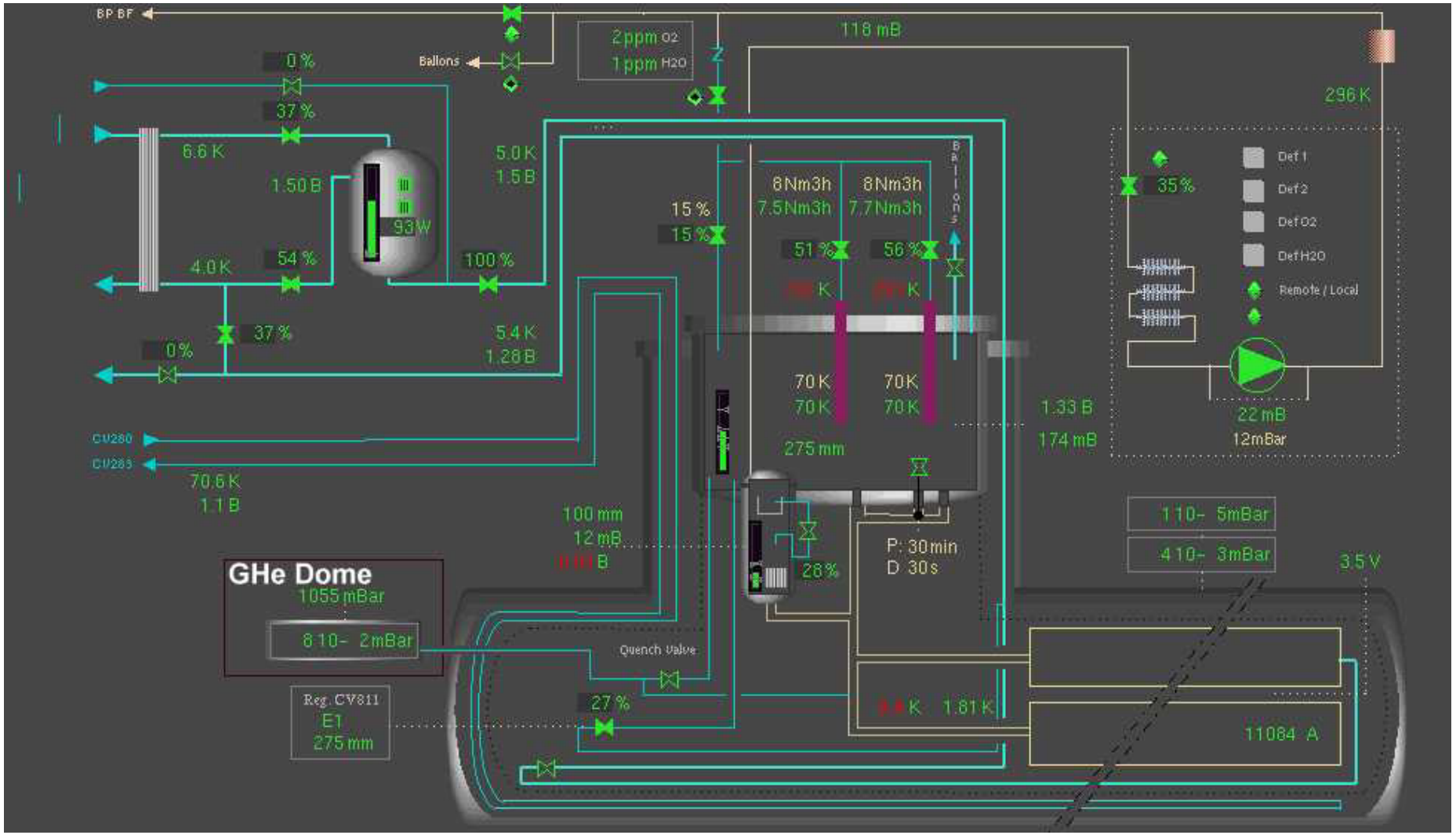
Safety Aspects of Cryogenics System for CAST

- GHe pressure vessels (1 bar to 150 bar)
- Piping containing LHe and LN2
- HP & MP compressors (using BREOX)
- Access to instrumentation on MFB
- Magnet quenches during operation
- Operation outside normal working hours

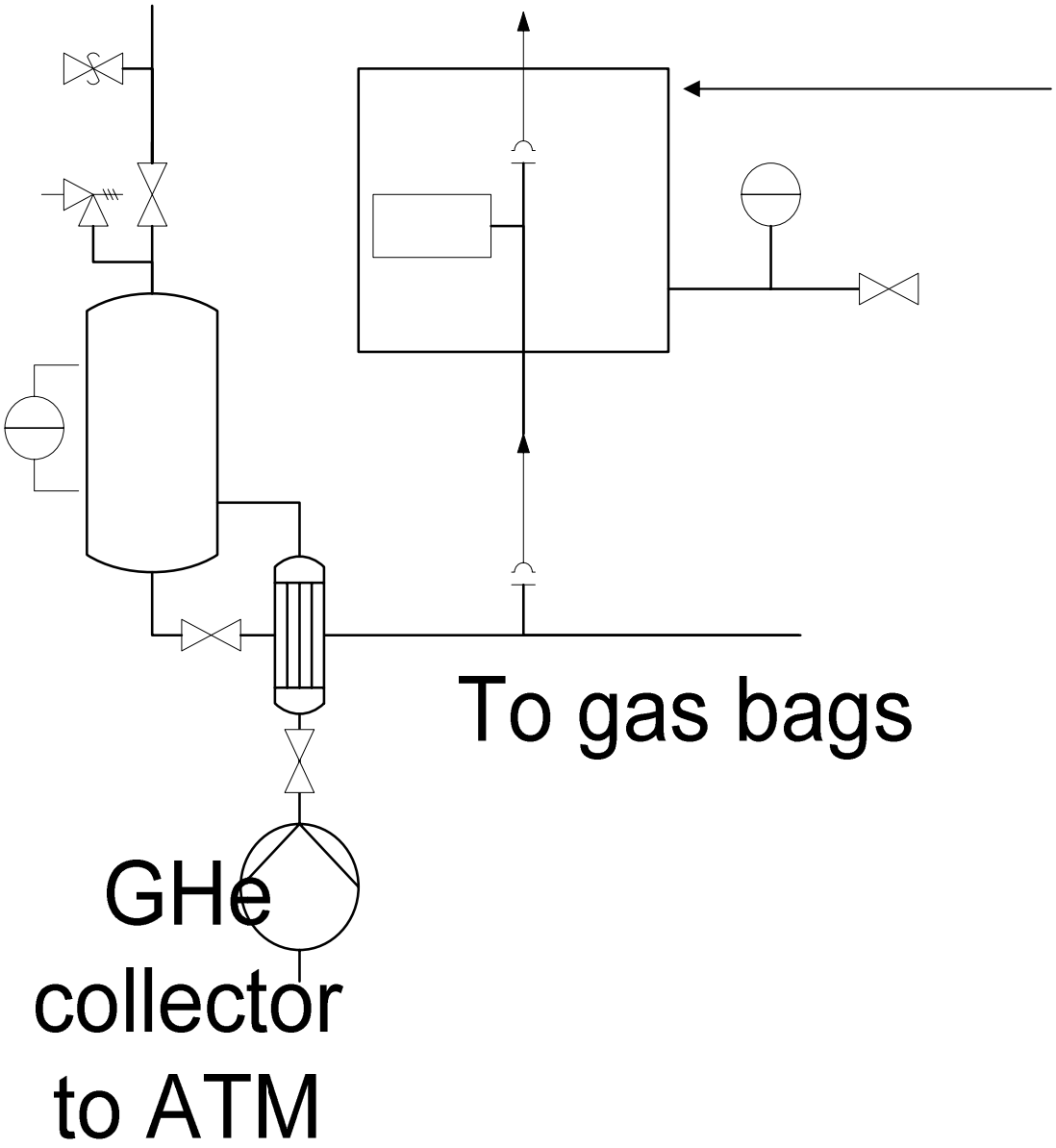
SUH8 – Protection against BREOX incidents
(1) Liquid

SUH8 – Protection against BREOX incidents
(2) Vapor

Magnet cooling



Magnet quench protection



GHe Dome

Magnet quench recovery

MFB access