

# **Working Group Report: Cryogenic System**

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Project X Collaboration Meeting  
September 9, 2010



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- Cryogenic Working Group (WG)
  - Topics discussed
  - Modifications to the cryogenic section of the ICD-2v2
  - Issues that need resolution
  - Summary



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- 16 Registered participants
  - Six presentations
    - Px cryogenic system overview (A. Klebaner, FNAL)
    - Px cryogenics RD&D plan (A. Klebaner, FNAL)
    - XFEL cryogenic system (Bernd Petersen, DESY/XFEL)
    - SPX cryogenic system (Joel Fuerst, ANL)
    - 12 GeV Upgrade cryogenic system (Dana Arenius, TJNAF)
    - Px cryogenic segmentation (Jay Theilacker, FNAL)
  - 1 Joint session with Cryomodules and Integration groups
  - Many valuable discussions



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- 17 years of HERA and 10 years of FLASH operation experience
  - All 80 to 100 cryomodules in a single segment
  - 5% cryomodule technical (Eacc) contingency ( 76 + 4)
  - Estimated time to swap cryomodule– 3 weeks
    - 1 week to warm-up + 1 week to replace + 1 week to cooldown

■ **Arkadiy's questions:**

**1. Range of pressures during normal operations ?**

-> 31 mbar +/- 0.3 mbar ( 1%)

**2. Timescale ? -> Hours ! From FLASH experience we expect very stable conditions**

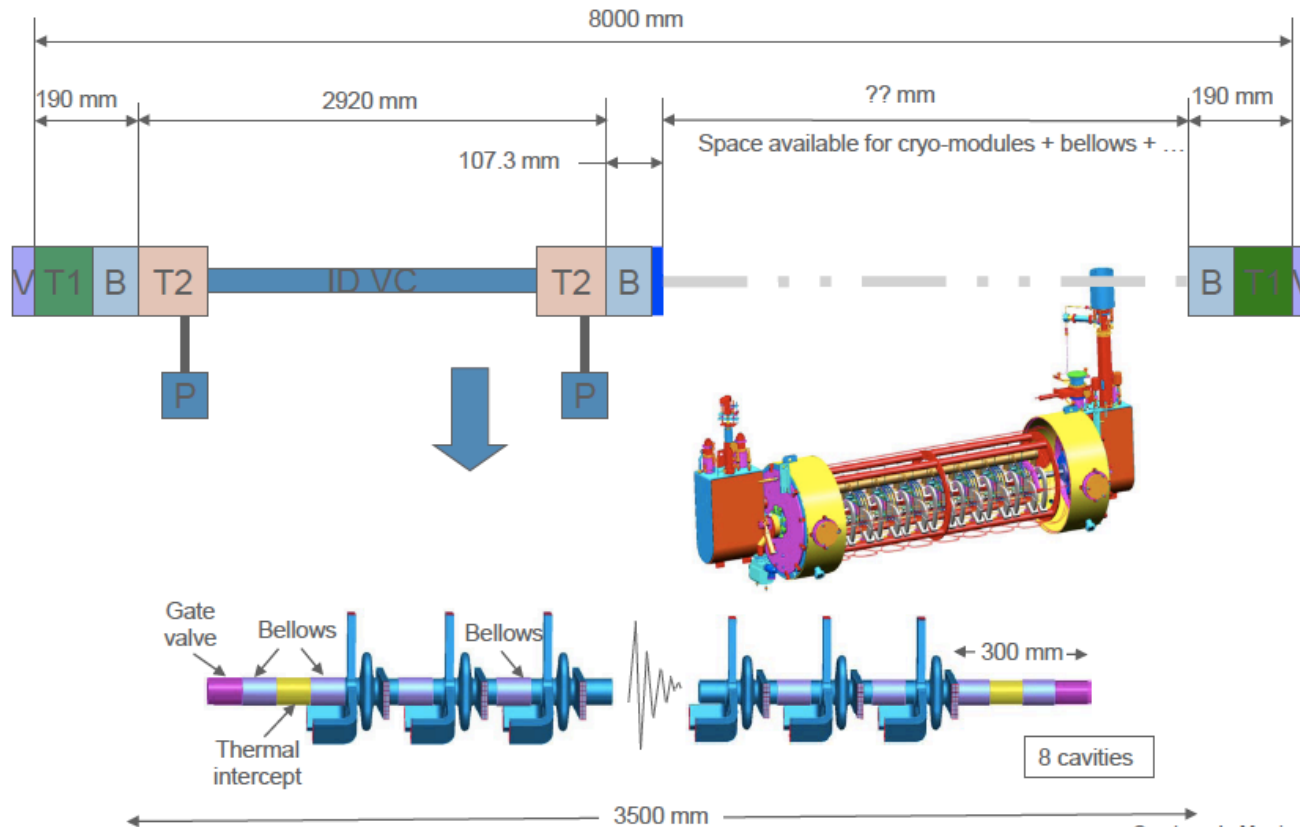
**3. Occasional/rare pressure variations ? -> Switching on/off RF , Quenches (see FLASH example)**

**For the switching of RF we'll need some ,ramping' by means of electrical heaters**

**Trips of CCs ?**



## Deflecting Cavity Cryomodule Insertion



Project X Collaboration Workshop, 08-09SEP10

Courtesy: L. Morrison

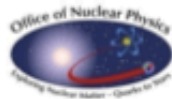
J.D. Fuerst, ANL

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## Key refrigeration technical parameters

- **Each New Cryomodule (CHL) Load**
  - 300W @ 2K (0.0375 atm at return 2K bayonet, +/- 0.1 mbar standard pressure regulation)
  - 300W @ 35K shield cooling
- **Hall D Refrigerator Load**
  - 100W @ 4.5K refrigeration
  - 0.7 liters/hr 4.5K liquefaction (lead cooling, etc.)



# CRYGENIC SEGEMENTATION



## Factors to Consider



- Existing accelerator experience
  - Types of cryomodules
  - Heat Loads and JT Heat Exchanger Location
  - Reliability & Availability
  - Technical Risk
  - Cost
  - Warm space requirements (beam optics)
  - Commissioning and Upgrade scenarios
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- The cryogenic portion of the ICD-2v2 was discussed. It was found to have sufficient content for the Reference Design level document
  - Cryogenic segmentation constraints and concept should be revised for the 3 GeV cw linac

## ISSUES THAT NEED RESOLUTION



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- Finalize cryogenic testing requirements
  - Define cryogenic portion of the availability requirement (Is time to replace/repair cryomodule or scheduled shutdown included in availability requirements?)
  - Superconducting components requirements specification
    - Operating pressure and temperature tolerances ( +/- 10 Pa?)
    - 325 MHz and 650 MHz shields and intercepts operating temperatures
    - Finalize cavity MAWPs (XFEL 1.3 GHz 4 bara warm to PED 97/23 Code)
    - Thermal cycling limits (if any?)
    - Estimated static heat loads and mid  $Q_0$  slope ( $\gamma(T)$ )
  - Commissioning scenarios and future upgrade scenarios
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- IC- 2v2 is technically feasible
  - IC-2 v2 cryogenic segmentation concept should be revised
  - The next iteration will benefit from better understanding of the functional requirements, reliability, and cost implications
  - Close cooperation between cryogenics and cryomodule working groups is essential for the development of an effective Project X cryogenic system
  - Thanks to all participants and collaborators for their contribution.