MERcury Intense Target (MERIT) Experiment Installation Issues

I. Efthymiopoulos (for the CERN team)

Thanks to:
A.Fabich, H.Hasseroth, F.Haug, J.Lettry, and the colleagues from the service groups at CERN

Outline

- The experimental layout
  - See talk by A.Fabich
- The cryogenics system
  - DVB box tendering
  - N2 exhaust line to TT10
- Solenoid power supply
- Safety issues
  - Access and interlocks
  - Solenoid and cryogenics review
- Transport and installation
- Budget
  - See talk by A.Fabich
- Control room
  - See talk by A.Fabich
- Schedule
  - See talk by A.Fabich

… and a short update on

- Beam parameters – pulse list
- Instrumentation

Cryogenics

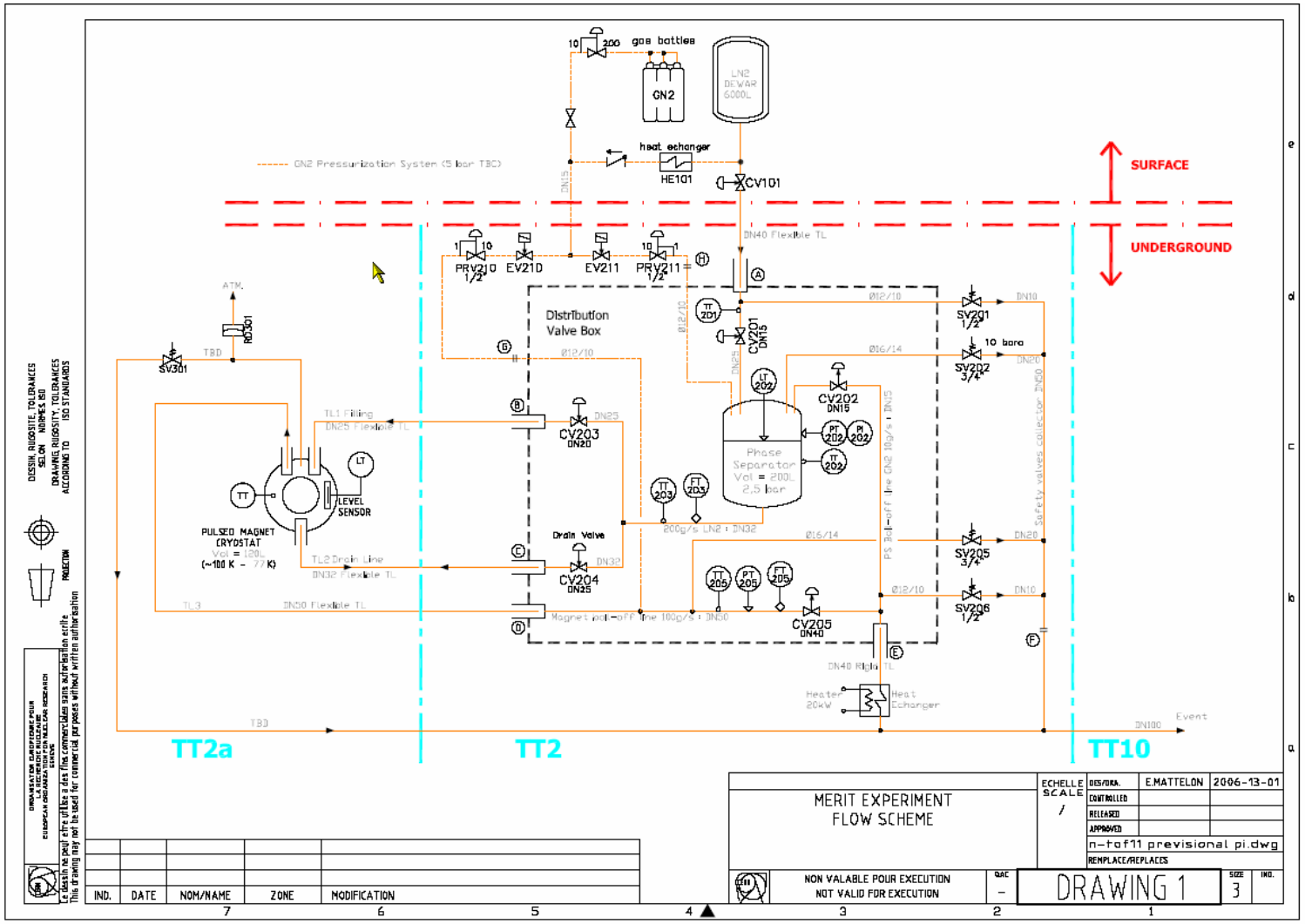
Aim:

- Provide LN2 to cool the solenoid at 80K
- Readout and control according to CERN standards
  - Guarantee safety of operations
- Collaboration between RAL & CERN
  - Project engineer: F.Haug/CERN

Status:

- System design completed including instrumentation and safety valves
- Gas N2 exhaust line to TT10 installed

Cryogenics



F.Haug - CERN

Cryogenics

- Specification document for DVB available
  - Tendering ongoing at RAL
  - Item on the critical path!!
- Procurement of other components in parallel
  - Valves, control equipment

Schedule:

- Test at CERN (surface) in Autumn 2006
- Installation in the tunnel to follow

ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
Laboratoire Européen pour la Physique des Particules
European Laboratory for Particle Physics

MERIT Project *EDMS document No.: 695878*

Technical Specification for the fabrication of a Cryogenic Valve Box for liquid nitrogen distribution

Abstract

This Technical Specification concerns the design and the fabrication of a cryogenic Distribution Valve Box as part of the liquid nitrogen cooling system for the MERIT project. MERIT is a proof-of-principle experiment to test a mercury jet target as a source of pions for a Neutrino Factory or Muon Collider. A pulsed solenoid capable of producing 15 Tesla surrounds the jet in order to collect the pions produced in the interaction of the proton beam with the mercury. The solenoid is manufactured from copper and cooled by liquid nitrogen.

The liquid nitrogen that flows to and from the magnet is controlled by means of a Distribution Valve Box which is part of the overall cryogenic system.

This Distribution Valve Box (DVB) is being purchased by Rutherford Appleton Laboratory (RAL) to be used at CERN.

January 2006

Solenoid Power Supply

Aim:

- Provide power for the solenoid: “pulsed” mode, 7kA / 30 min, 5MW
- Recuperate the power supply used for the SPS extraction to the West Area
  - Work done by CERN/AB-PO group

Status:

- Power supply installed in bat.193
- Refurbishment started – will be completed by October 2006
- AC transformer installed
  - Associated AC circuitry refurbishment to be done for the 18kV cell
- Cabling:
  - DC cabling {power supply – solenoid} installed
    - 6× 400 mm^2 Al cables - air cooled
  - AC cabling partially done

Solenoid power supply

Power Supply in 193 building

Power Supply in 193 building

AC Transformer

G.LeGedoc – AB/PO

Safety issues

- New round of safety discussions in the last months…
- MERIT Presentations in:
  - AB Installation Committee – interface with PS/SPS
  - AB Safety Committee
- ISIEC form for the experiment
  - Identify safety structure and define safety issues
- Initiated reviews of all system components
  - Started with Solenoid and Cryogenics system
  - Others have to follow

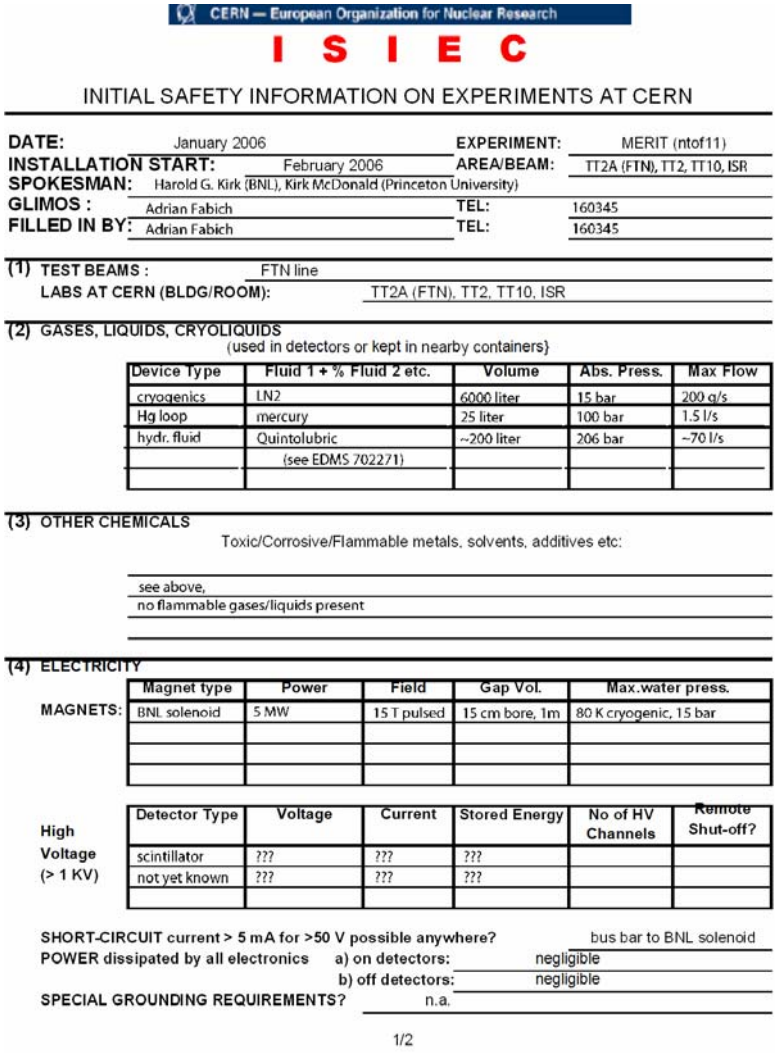
Safety

ISIEC

- Initial Safety Information for Experiments at CERN
  - CERN is informed about all safety particularities of MERIT

MERIT Safety structure:

- H.Kirk & K.McDonald overall responsible as spokespersons
- A.Fabich as GLIMOS
  - General Liaison in Matters of Safety
- Information on safety issues for the experiment under CERN/EDMS structure
- Also available from the experiment web pages: http://cern.ch/merit



CERN — European Organization for Nuclear Research

I S I E C

INITIAL SAFETY INFORMATION ON EXPERIMENTS AT CERN

DATE: January 2006 EXPERIMENT: MERIT (ntof11)
INSTALLATION START: February 2006 AREA/BEAM: TT2A (FTN), TT2, TT10, ISR
SPOKESMAN: Harold G. Kirk (BNL), Kirk McDonald (Princeton University)
GLIMOS : Adrian Fabich TEL: 160345
FILLED IN BY: Adrian Fabich TEL: 160345

(1) TEST BEAMS : FTN line
LABS AT CERN (BLDG/ROOM): TT2A (FTN), TT2, TT10, ISR

(2) GASES, LIQUIDS, CRYOLIQUIDS
(used in detectors or kept in nearby containers)

Device Type	Fluid 1 + % Fluid 2 etc.	Volume	Abs. Press.	Max Flow
cryogenics	LN2	6000 liter	15 bar	200 g/s
Hg loop	mercury	25 liter	100 bar	1.5 l/s
hydr. fluid	Quintolubric	~200 liter	206 bar	~70 l/s
	(see EDMS 702271)			

(3) OTHER CHEMICALS
Toxic/Corrosive/Flammable metals, solvents, additives etc:

see above,
no flammable gases/liquids present

(4) ELECTRICITY

	Magnet type	Power	Field	Gap Vol.	Max.water press.
MAGNETS:	BNL solenoid	5 MW	15 T pulsed	15 cm bore, 1m	80 K cryogenic, 15 bar

	Detector Type	Voltage	Current	Stored Energy	No of HV Channels	Remote Shut-off?
High Voltage (> 1 KV)	scintillator	???	???	???		
	not yet known	???	???	???		

SHORT-CIRCUIT current > 5 mA for >50 V possible anywhere? bus bar to BNL solenoid
POWER dissipated by all electronics a) on detectors: negligible
b) off detectors: negligible
SPECIAL GROUNDING REQUIREMENTS? n.a.

1/2

Safety issues

Solenoid and Cryogenics Review

- Review held in February 2006
  - Review panel from CERN safety and cryogenic system experts
  - Report available

    http://edms.cern.ch/document/710659

CERN
CH-1211 Geneva 23
Switzerland

EDMS Document No
7106259
Created:9 March 2006
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GENERAL SAFETY & HYGIENE GROUP
MECHANICAL SAFETY SECTION

MEMORANDUM

MERIT CRYOGENICS PROJECT REVIEW

To: I. Efthymiopoulos AB/ATB
A. Fabich AB/ATB

From: A. Astone SC/GS
V. Benda AT/ACR
B. Delille SC/GS
G. Lindell SC/GS
G. Perinic AT/ECR

Distribution List :
P. Cennini AB/ATB
A. Desirelli SC/GS
B.Pichler SC/GS
R. Trant SC/GS

Document(s) Received

Building(s)

1. INTRODUCTION

This memorandum concerns the MERIT magnet cryostat project review. It contains recommendations to be put in practice by the MERIT collaboration either in matter of mechanical and cryogenics aspects of the magnet and its feeding system design. The recommendations shall be fulfilled prior to the use of the MERIT cryostat magnet at CERN.

2. CRYOSTAT MECHANICAL DESIGN

In the framework of the MERIT cryostat magnet project review, SC/GS Mechanical Safety (MS) section here lists its remarks concerning design and commissioning of the magnet.
According to CERN D2 safety code an engineering file shall be provided to SC/GS/MS containing all documents and design parameters necessary for acceptance of the cryostat magnet at CERN. We expect the MERIT collaboration to provide CERN the engineering report before shippping of the cryostat magnet to CERN.
The document shall in particular contain:

1. Base material and filler material certificates
2. User's notice
3. Complete set of drawings
4. A list and all results of planned safety inspections, safety checks and quality controls

Safety issues

…Solenoid and Cryogenics Review

Major remarks – to my judgment:

- Provide documentation for solenoid fabrication
  - Including x-ray validation of the welds
  - Proof that ASME standards are respected
    - And corresponding vessel validation is made
- Important to keep good record of the tests made and findings during the MIT tests
- Safety valves and operating pressure for solenoid to be defined
- Process flow diagram for the cryogenics operation should be defined

Safety issues

…Solenoid and Cryogenics Review

- Next steps:
  - Provide answers to all the points raised in the report by end of May 2006
    - A.Fabich as GLIMOS of the experiment to collect all the information
- Next reviews to schedule:
  - Hg-loop system
  - Transport and installation
- … and inspections in-situ upon final installation

Safety issues

Access and interlock

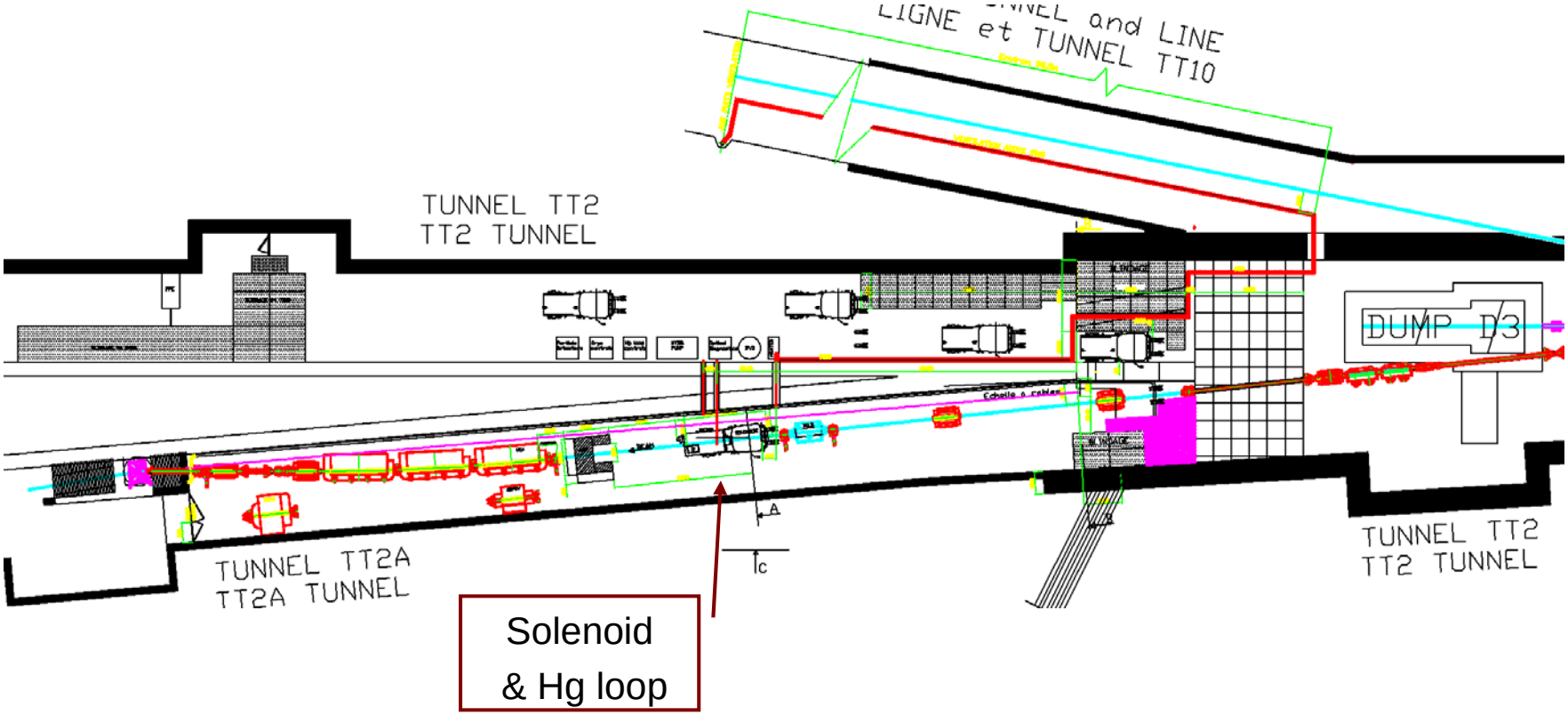
- Access in TT2/TT2A tunnels possible when PS/SPS in operation
  - Important to allow installation throughout summer
  - Limited access as in other exp. areas
    - Card reader for personnel access

- Interlock conditions defined:
  - Access interlock: no beam ⊕ magnet off ⊕ ODH detection
  - Magnet power supply interlock↔ cryogenics system

- Installation issues and cabling under discussion

Transport & Installation

- Detailed look at the transport of solenoid started
- Passage around TT2/TT2A junction always critical



Beam request – pulse list

- Based on pulse list July 2005
  - http://proj-hiptarget.web.cern.ch/proj-hiptarget/default/Documents/subsystems/ProtonBeam/pulselist.xls
  - Total dose limited to $3*10^{15}$ protons on target.

Beam parameters:

- Nominal momentum 24 GeV/c
- Intensity/bunch – baseline: harmonic 16 (i.e. 16 buckets in PS, Δt=125ns)
  - **$2\text{-}2.5*10^{12}$ protons / bunch**
  - **total maximum > $32*10^{12}$ protons/pulse**
- Pulse length up to 20 ms possible (beyond 2 μs switch to 14 GeV/c)

- To be done:
  - Define priority list
  - MD time in 2006 assigned
  - Set-up time in 2007 may be required to achieve the highest intensities

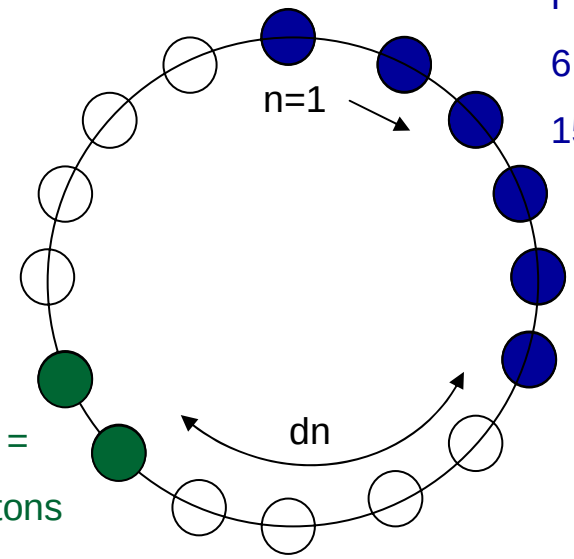
Beam setup for Cavitation Studies

- h16 beam operates in bunch pairs
  - Bunch pairs located in bucket n and n+1

PUMP:

6 bunches =

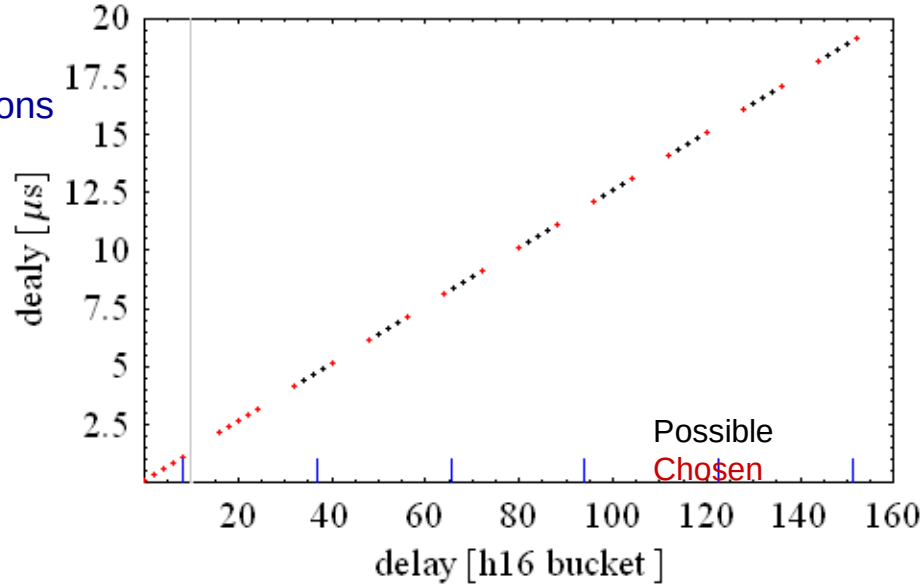
15*10^{12} protons



PROBE:

2 bunches =

5*10^{12} protons



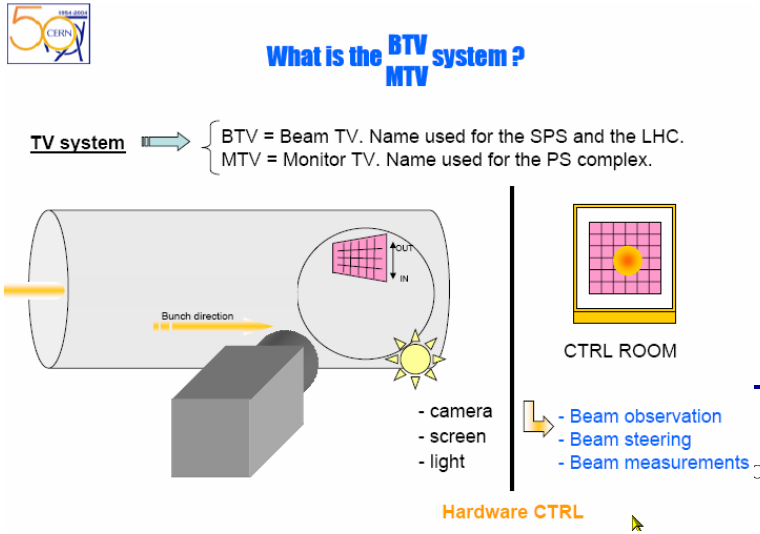
- $dn_{experiment}$ = 0,2,4,6,8, 16,18,20,22,24, 32,40, 48,56, ...
- Inhomogeneous intensity distribution causes intensity limits
  - MD dates scheduled towards the end of 2006 – profit from development of CNGS beams with similar (high) intensities

Beam profile measurement

3 Monitor types considered
Based on beam properties to be measured

- MTV screens
  - "almost" readily available
  - Minor effort
  - Minimum budget
- SEM-grid
  - None available - needs new construction
  - Costly: >50 kChF
  - Manpower these days very little at CERN
- Wire scanner
  - "Slow" measurement

Baseline: MTV screens



Transverse beam parameters

- Position & spot size → MTV screens
- Direction → 2× MTV screens & collimator
- Divergence → not a direct measurement
  - Rely on beam simulations
  - Estimate from spot size monitors

Longitudinal beam parameters

- Measured by pick-ups in the PS & TT2 line upstream of MERIT
- Log values and make available the information for the MERIT collaboration
- Parameters measured:
  - Bunch length
  - Bunch spacing
  - Pulse length
  - Intensity