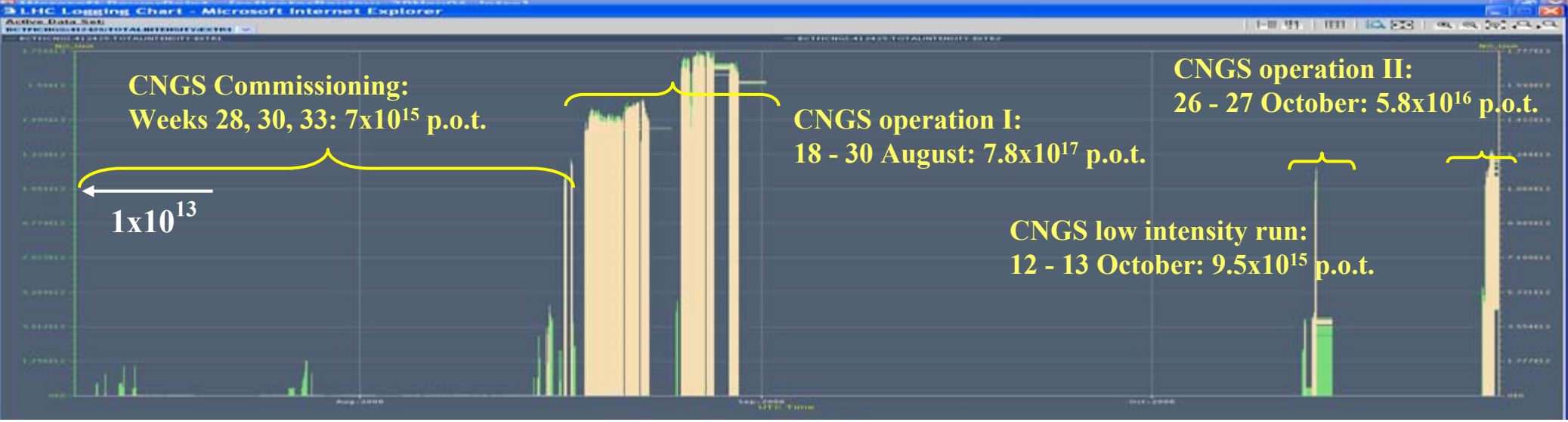
CNGS: Status and Outlook

Edda Gschwendtner, AB/ATB

- Summary of CNGS 2006
- Reflector Repair
- OPERA Brick Production

CNGS Schedule 2006

- **Hardware commissioning**
  - ➔ **Feb. – April 2006**
- **‘Dry runs’ from CCC**
  - ➔ **April – May 2006**
- **Commissioning with beam**
  - ➔ **weeks 28, 30 and 33 in July/August 2006**
- **Physics Runs:**
  - ➔ **18-30 August 2007**
  - ➔ **26-27 October 2007**



	Date	Extractions	Protons
Commissioning W28	10 – 14 Jul. 2006	300	1.3 E14
Commissioning W30	31 Jul. – 4 Aug. 2006	500	2.4 E14
Commissioning W33	14 – 18 Aug. 2006	1300	6.5 E15
Physics Operation I	18 – 30 Aug. 2006	53000	7.8 E17
Low Intensity Tests	12 – 13 Oct. 2006	2500	9.5 E15
Physics Operation II	26 – 27 Oct. 2006	8300	5.8 E16

- Maximum proton intensity reached in 2006: 3.5 $\cdot 10^{13}$/cycle at 400GeV
- While setting up high intensities for all 3 cycles, reflector leak appeared

What Have We Learnt?

- **Commissioning was very successful**
  - ➔ **Detailed hardware commissioning**
  - ➔ **'Dry runs'**
    - **Allowed early debugging of all systems**
- **Smooth start-up**
  - ➔ **Beam interlock system very good**
  - ➔ **Extraction channel well tuned**
  - ➔ **Beam well centered along beam line**
    - **Beam position stability: 50 μm rms**
    - **Beam spot at target: 0.5 mm rms.**
  - ➔ **Centering of beam vs. target and horn important**
  - ➔ **Muon monitors: very sensitive to any beam changes**
    - **Used as on-line feedback for quality control of neutrino beam.**

What Have We Learnt II ?

Radiation Protection constraints to CNGS operation

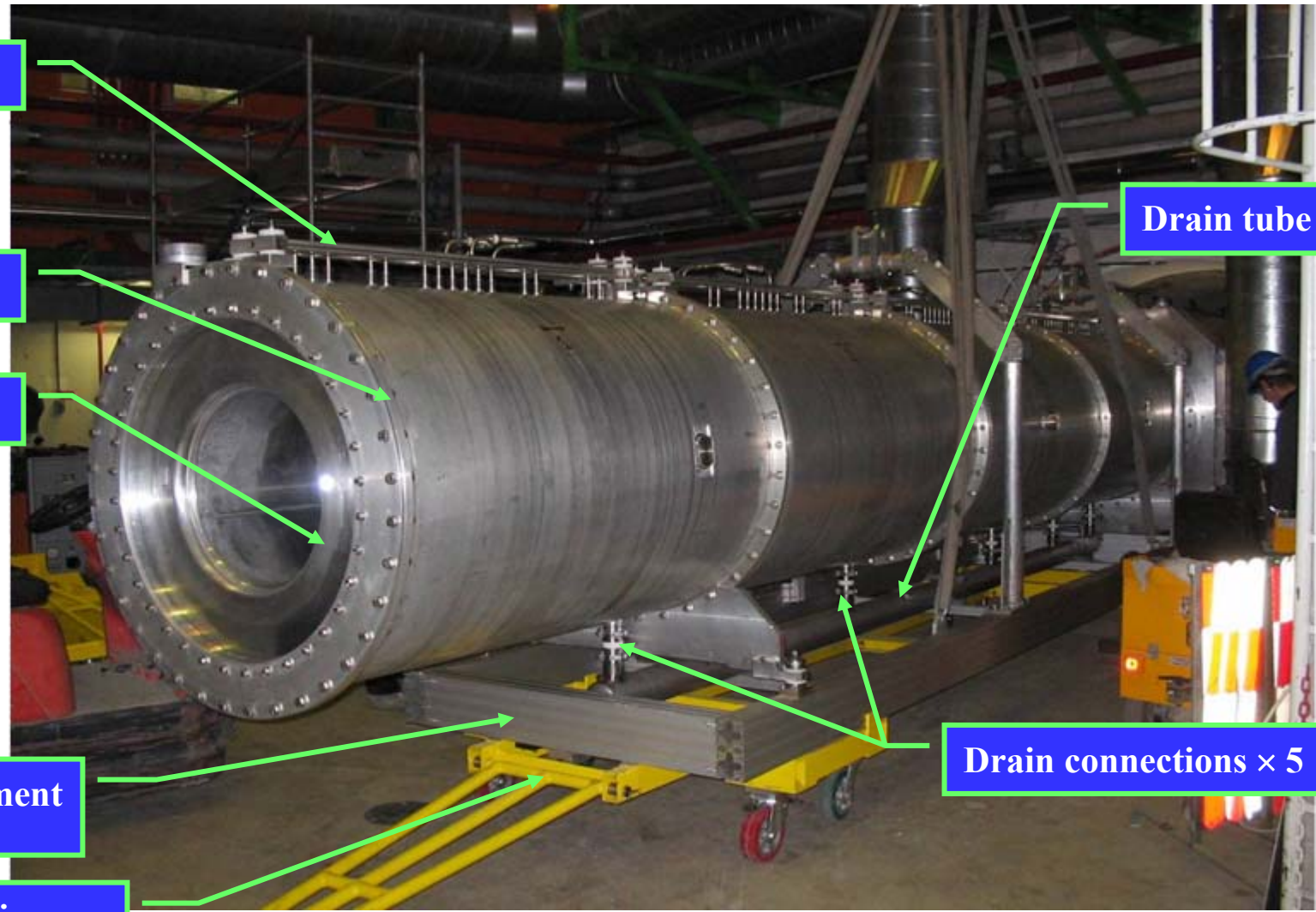
- **Cool down limit for starting access into CNGS**
  - ➔ **2hr + 4hr (i.e. 4 hr ventilation on)**
- **RP inspection mandatory before any access is granted:**
  - ➔ **Takes ~1/2 day (surveys, taking samples, etc.)**
- **Dose planning mandatory for any interventions**
  - ➔ **Emptying sumps before start-up**
    - **amount of condensation water draining into TSG4 sump is completely different in 'beam mode' and in 'access mode'.**

Issues Requiring more Studies

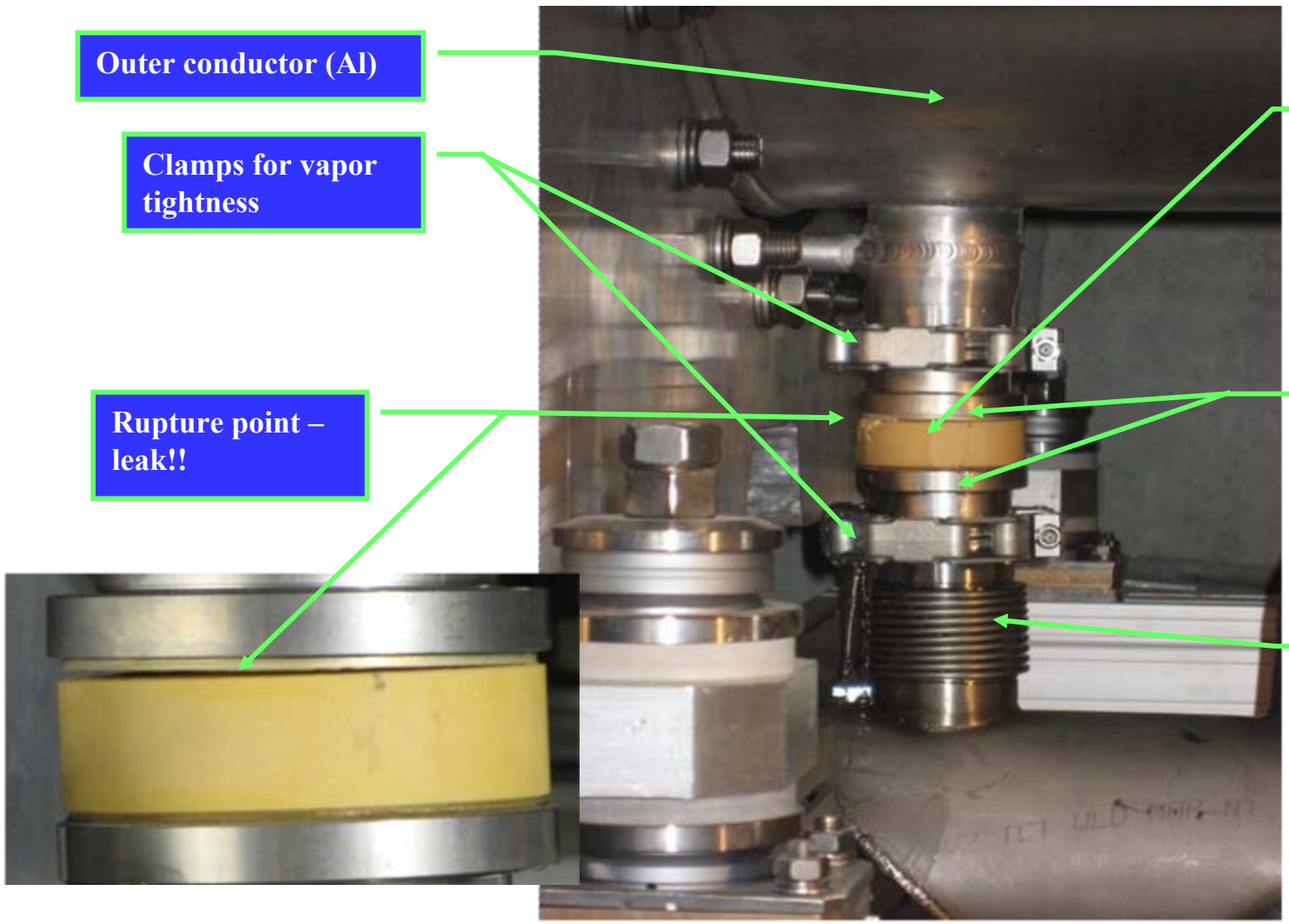
- **TBID calibration:**
  - ➔ **Move target out**
- **Polarity change:**
  - ➔ **Understand different muon signals**
- **Muon detectors:**
  - ➔ **linearity effects with high intensity**

- **Alignment of beam with respect to target and horn**
  - ➔ **Might need to be done regularly (every month)**

The CNGS Reflector



Leaking Drain Connection

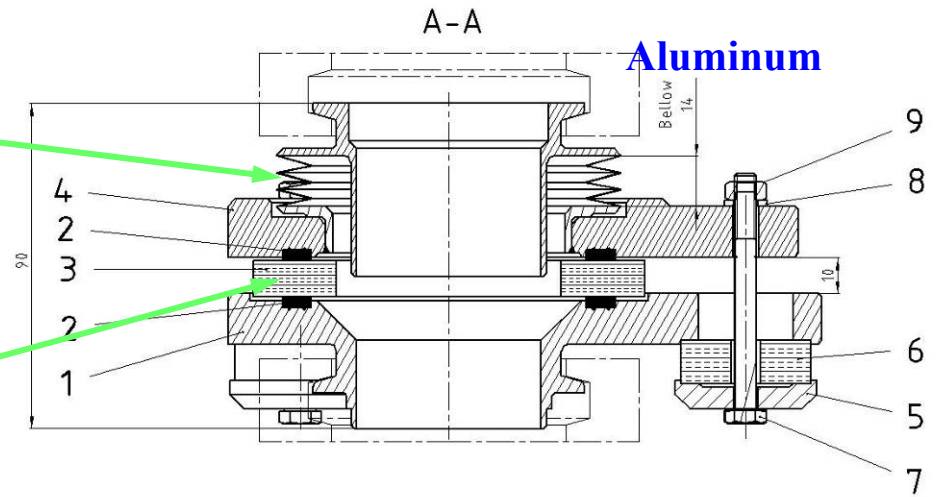


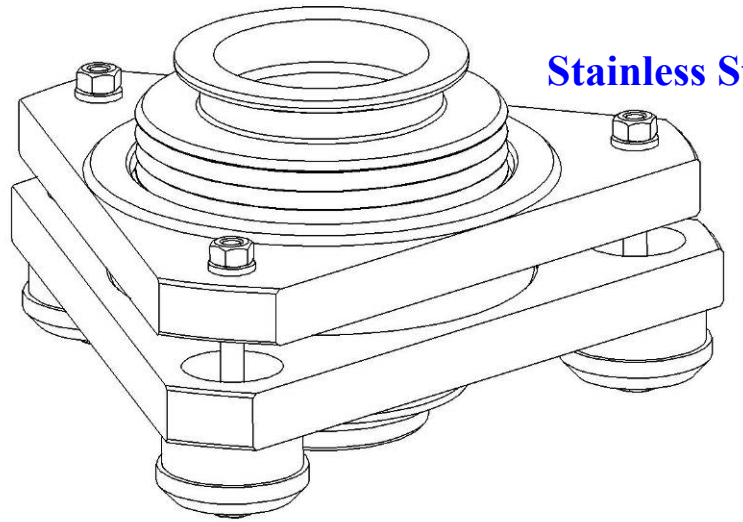
New Design for Drain Connection

CNGS Reflector Leak Review Meeting with AB, TS and RP experts, held on 29 Nov 06

Improvements of new design:

- **Second welded bellows**
  - ➔ **Absorb better any misalignment errors**
- **Water and vapour tightness maintained**
  - ➔ **tightening the ceramic between flanges with bolts**
- **Brazing is avoided**
- **Rigorous QA during assembly**
  - ➔ **Tracing of equipment and record history**





Next Steps

Tests

- First Prototype of drain connection delivered end this week
- Mounting prototype on spare horn
- Transport to BA7
- Perform tests with spare horn, starting Week 6:
  - ➔ Electrical tests: double pulse, 150kA
  - ➔ Vibration measurements on old drain connection
    - Understand stress/displacement
    - Free/fix connector
  - ➔ Vibration measurements on new drain connection
    - Validation of new design

Repair

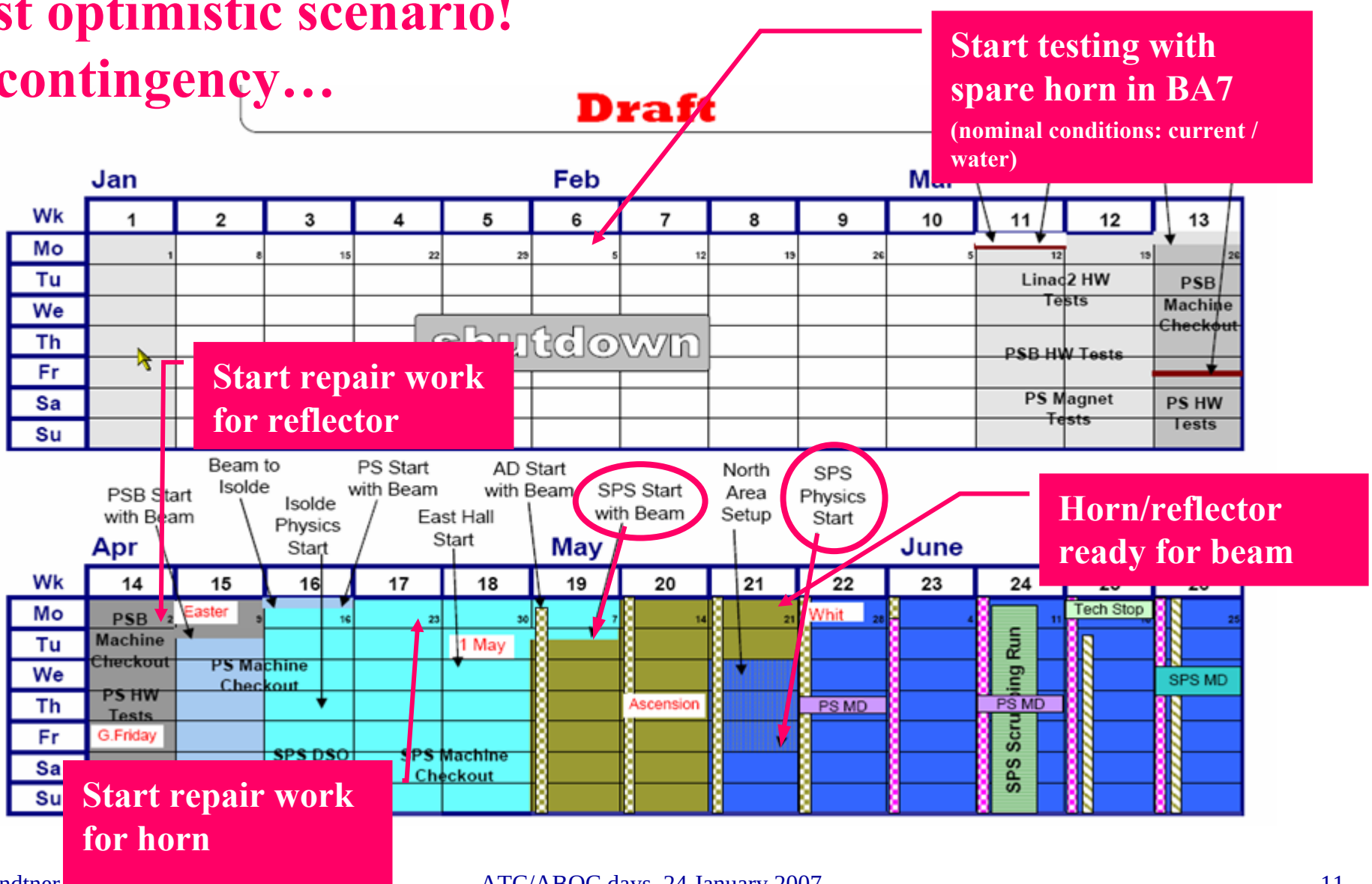
- Radiation Issues
  - ➔ Careful dose planning needed
- Repair is not trivial

All drain connections: (3 x 5 + spares)

- ➔ Ceramic: ordered (6 weeks delivery)
- ➔ Flanges + bellows: delivery end March

Reflector Repair Schedule

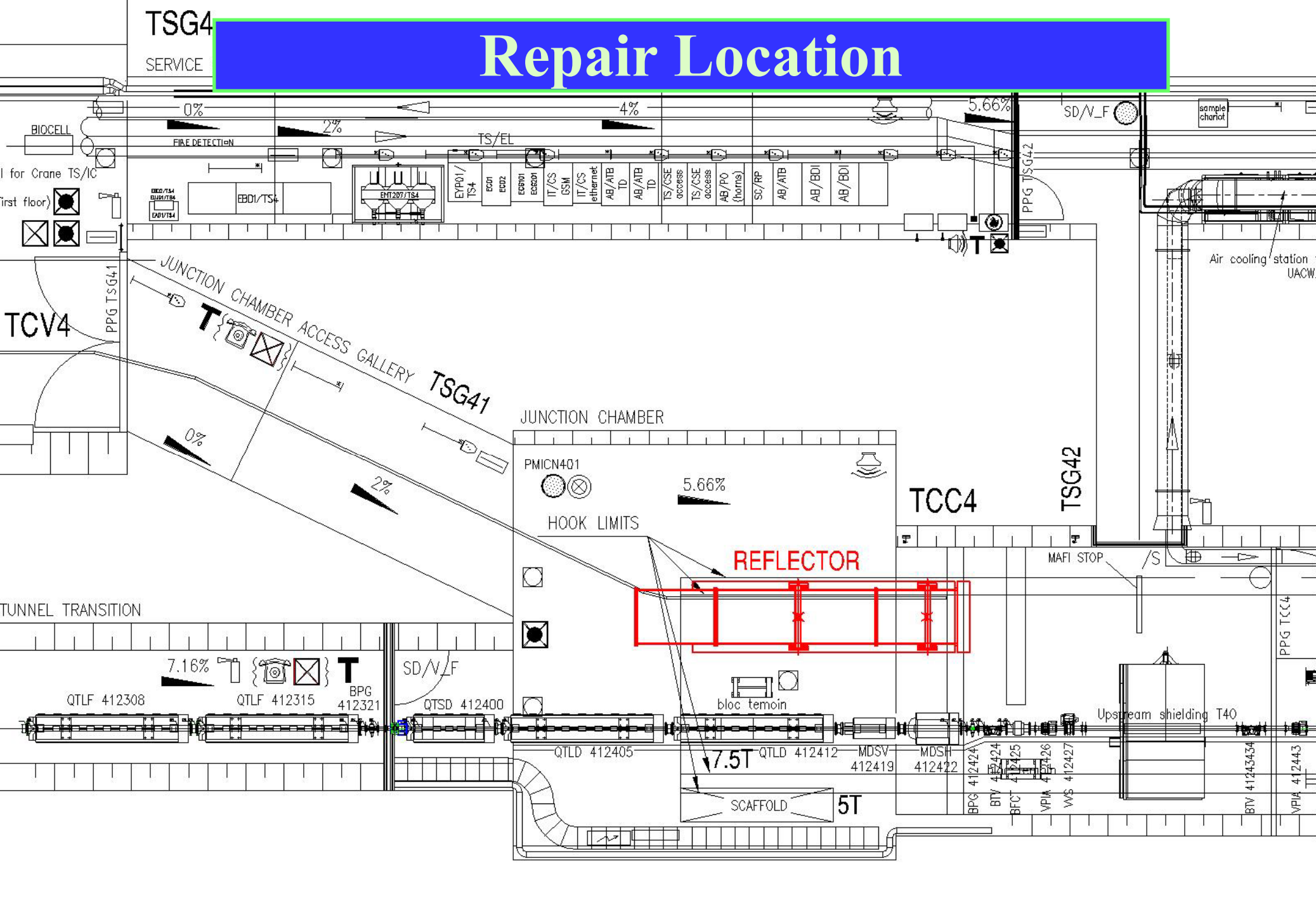
Most optimistic scenario!
No contingency…



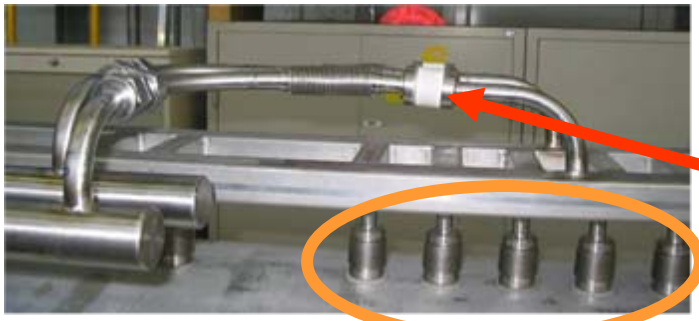
Repair Procedure

- The top and side shielding blocks are removed with crane
  - ➔ for the horn everything can be done remotely
  - ➔ for the reflector the side shielding requires manual intervention
- Repair cannot be done in the beam position of the reflector (horn)
  - ➔ access is limited
  - ➔ radiation levels higher inside the shielding
- The reflector and horn moved to upstream area of the target chamber
  - ➔ sufficient space available
- Chariot foreseen for the horn transport can be used as pedestal during the works
- Outer conductor part of reflector/horn has to be disconnected from the bottom chassis
  - ➔ bellows flexibility not sufficient to remove ceramic pieces.

Repair Location

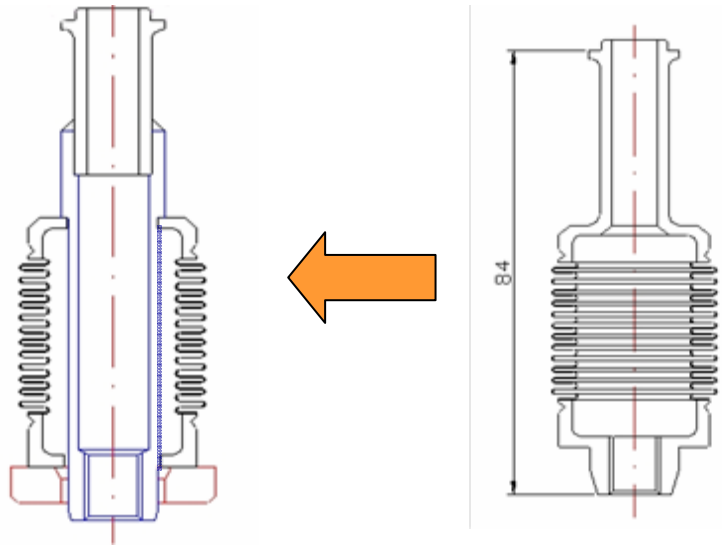


CNGS Horns: Other Possible Weak Points



- **Water inlet bellows**
  - ➔ Thin stainless steel foil brazed on ceramic sleeve
  - ➔ Thin foil brazed to water tube

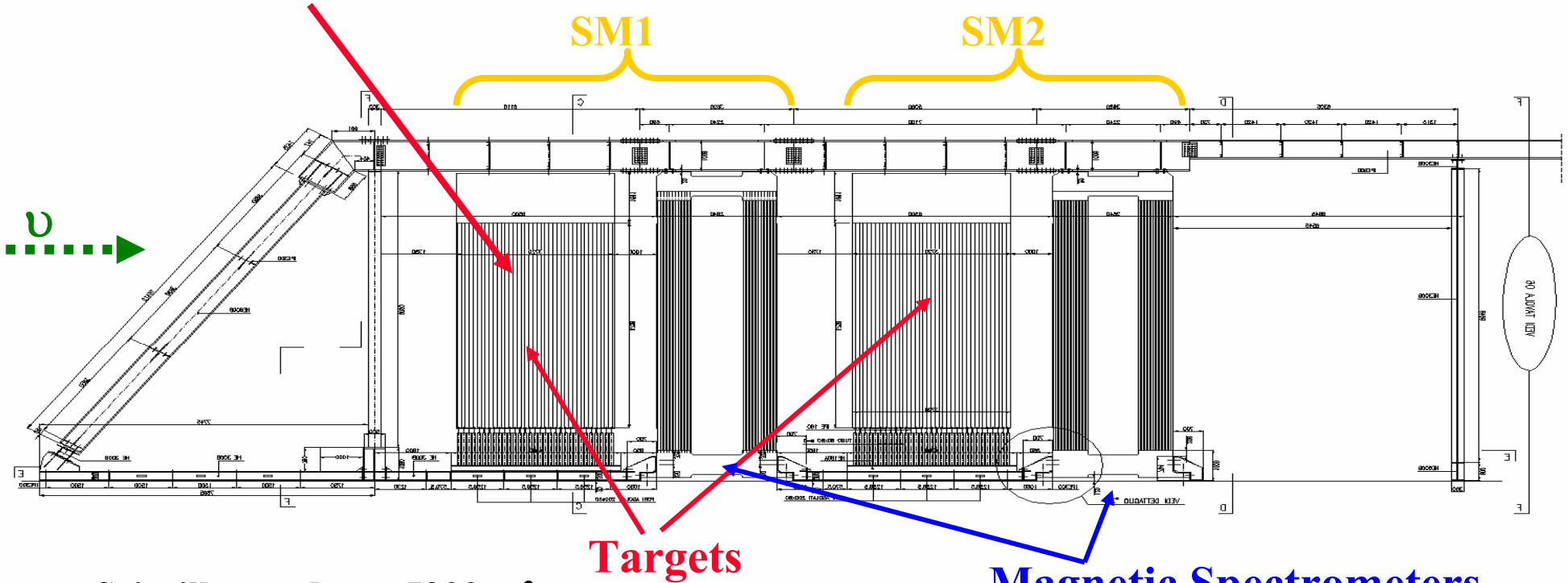
- **Water sprayers**
  - ➔ Double-walled → no leak when bellows failure
  - ➔ 50% already replaced



OPERA Experiment

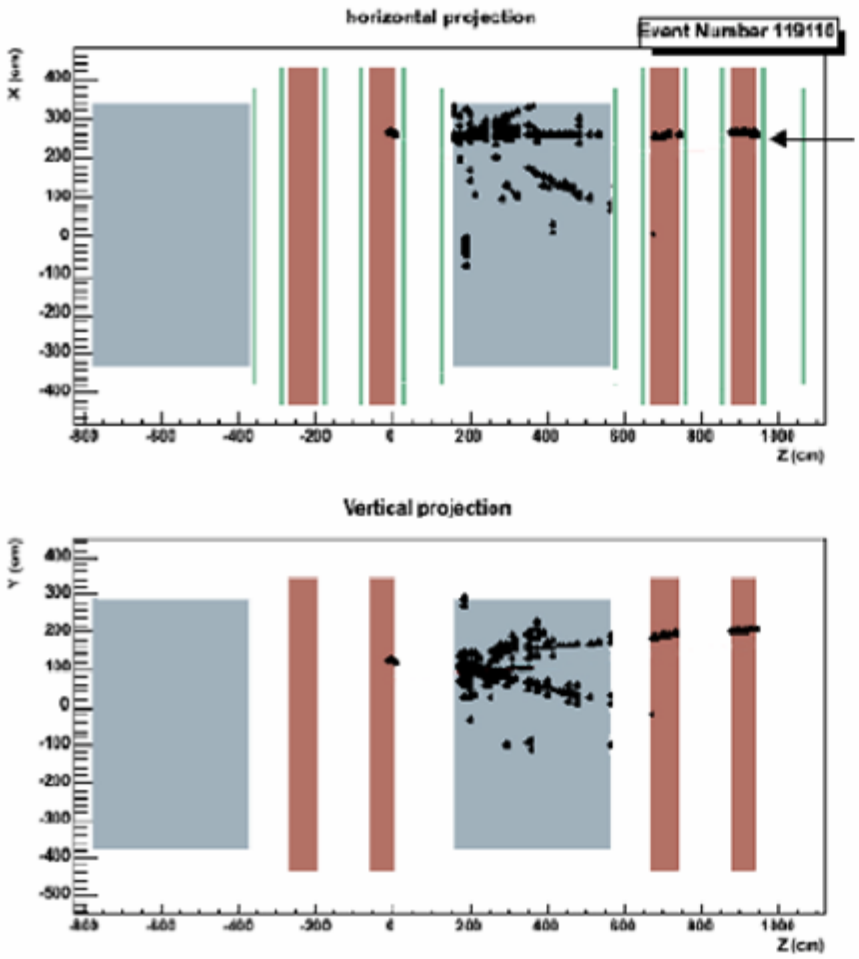
In total: 206336 bricks, 1766 tons

31 target planes / supermodule

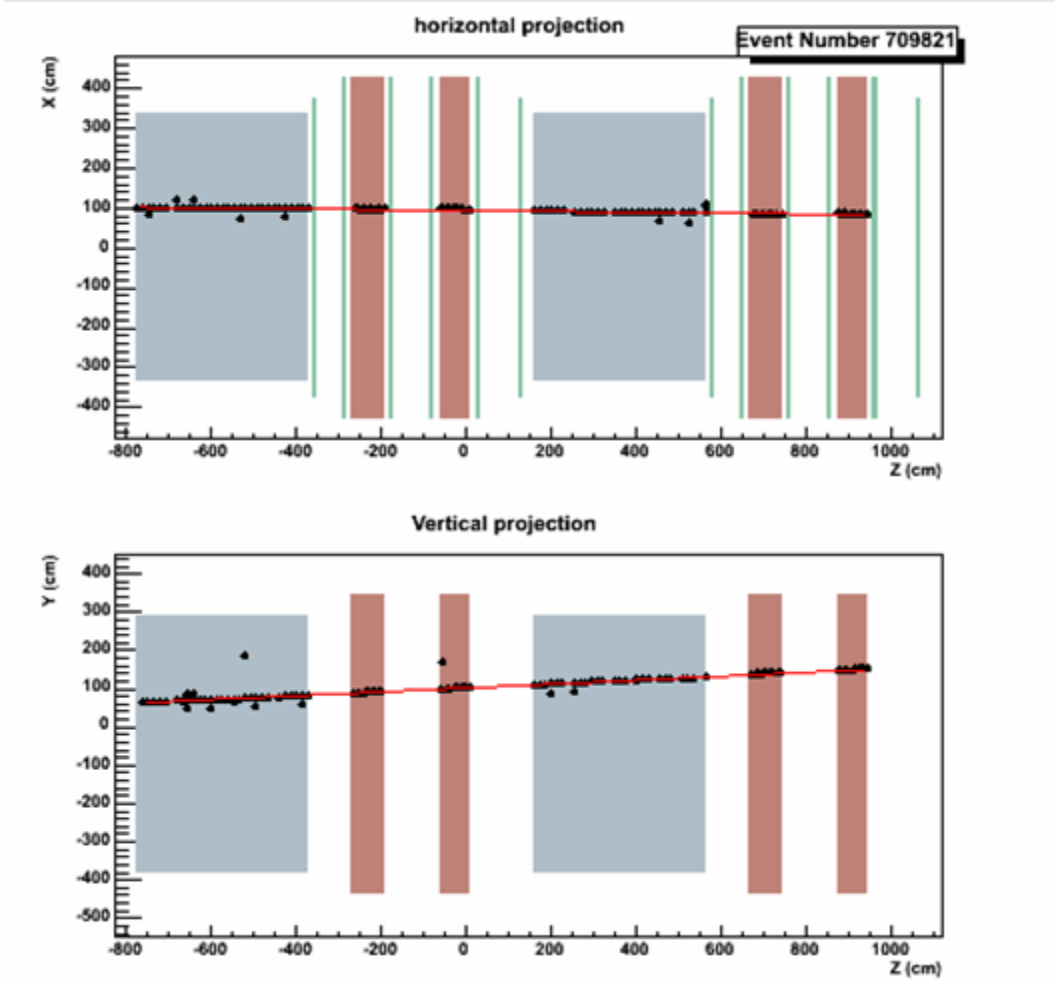


Scintillator planes 5900 m²
8064 7m long drift tubes
3050 m² Resistive Plate Counters
2000 tons of iron for the two magnets

Beam Events 2006

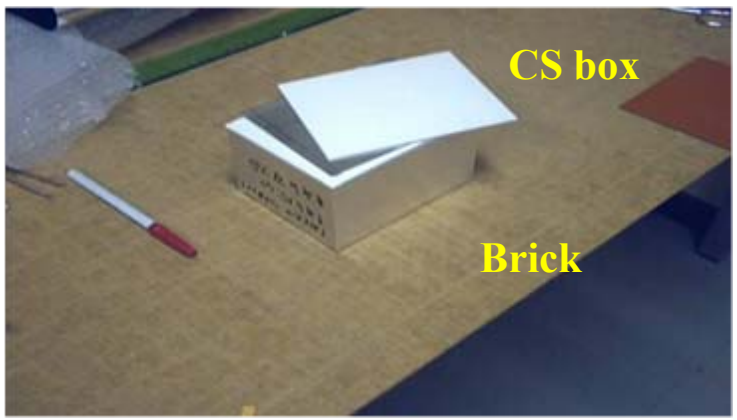


CC event in the first magnet



Muon from CC interaction in the material in front of the detector (BOREXINO, rocks)

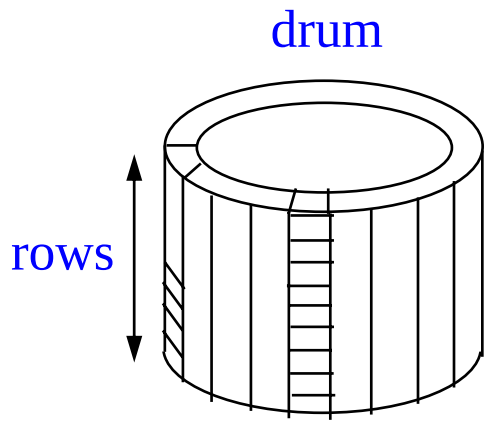
Brick Production



OPERA Outlook for 2007

Courtesy of D. Autiero, Y. Declais

- **Assumptions**
  - Official SPS schedule: 135.15 useful days
  - 1.7 E13 pot/extraction, 70% efficiency of machines complex
  - Pedestal bricks on 15 January 2007: 1300
  - Week 3 and 4: 5 drums of 8 rows/week
  - Week 5 and 6: 10 drums of 8 rows/week
  - BMS MD, devoting 3 working days/month



- **Options**
  - SPS Supercycle with 3 CNGS, 39.6 sec, 1.56 E17 pot/day
  - SPS Supercycle with 1 CNGS, 16.8 sec, 1.22 E17 pot/day
  - Filling speed from 12 February 2007 on:
    - 15 drums of 9 rows/week (= 15 x 9 x 26 =3510 bricks)
  - Filling speed from 12 February 2007 on:
    - 10 drums of 9 rows/week (=2340 bricks)

OPERA Outlook for 2007

Courtesy of D. Autiero, Y. Declais

Option	Integrated pot	Bricks on 26/05/07	Bricks on 11/11/07	Bricks with interactions
3 CNGS cycles 15 drums/week	2.1 E19	52624	124228	1163
1 CNGS cycle 15 drums/week	1.65 E19	52624	124228	914
3 CNGS cycles 10 drums/week	2.1 E19	37180	84916	803
1 CNGS cycle 10 drums/week	1.65 E19	37180	84916	631

➔ **Will be presented in the next SPSC, 6 February 2007**

CNGS Perspectives for 2007

- **Repair of Reflector and Horn ongoing**
  - ➔ **Finished by week 21 for SPS Physics Start-Up**

    …if everything goes well!!

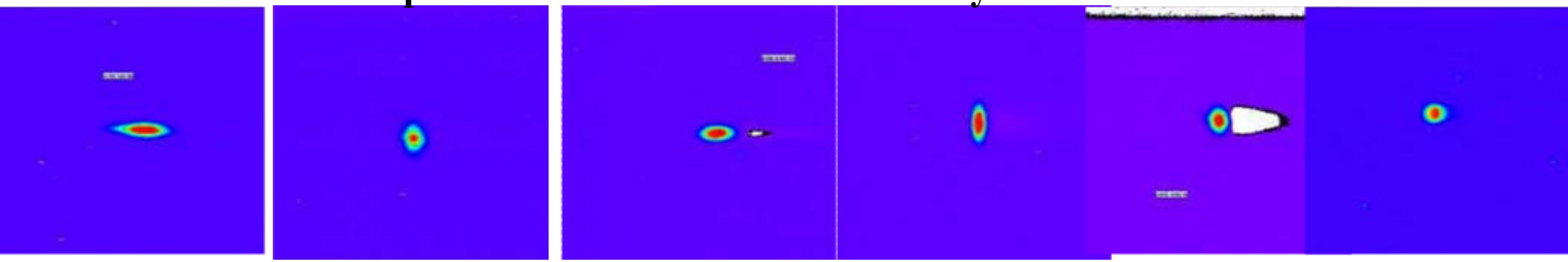
- **2 weeks needed to complete the setting up schedule of October 2006 of the CNGS primary & secondary beam.**
  - ➔ **Understand polarity change, muon detector linearity, etc…**

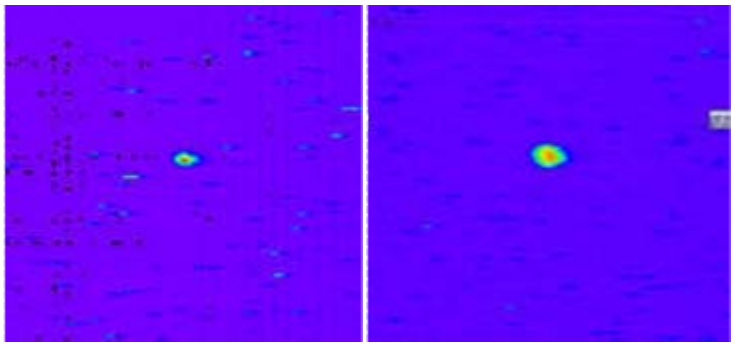
- **MD slots during the run needed for the Secondary Beam Line**

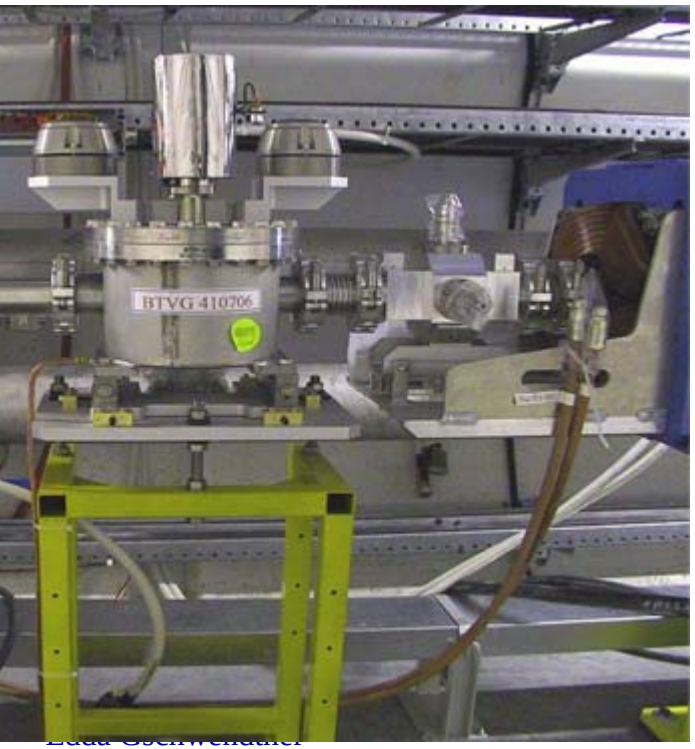
Spare Slides

FIRST SHOT 11 July 2006

1st shot down proton beam line: beam is already well centered on screens







8 profile monitors (BTVG):
Optical Transition Radiation screens:
- **75 μm carbon**
- **12 μm titanium screens**

On-line display

CNGS.TNM/Acquisit

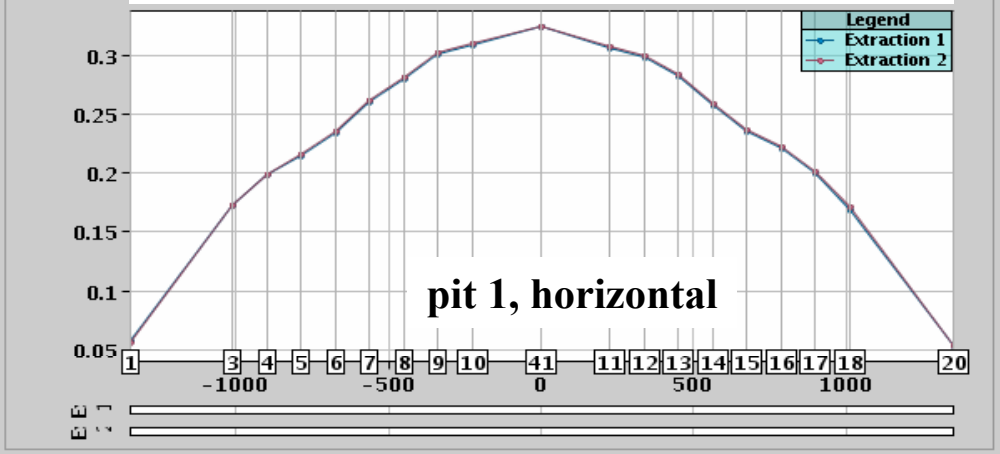
BFCT
Extraction 1: 1.1310E13
Extraction 2: 1.1288E13

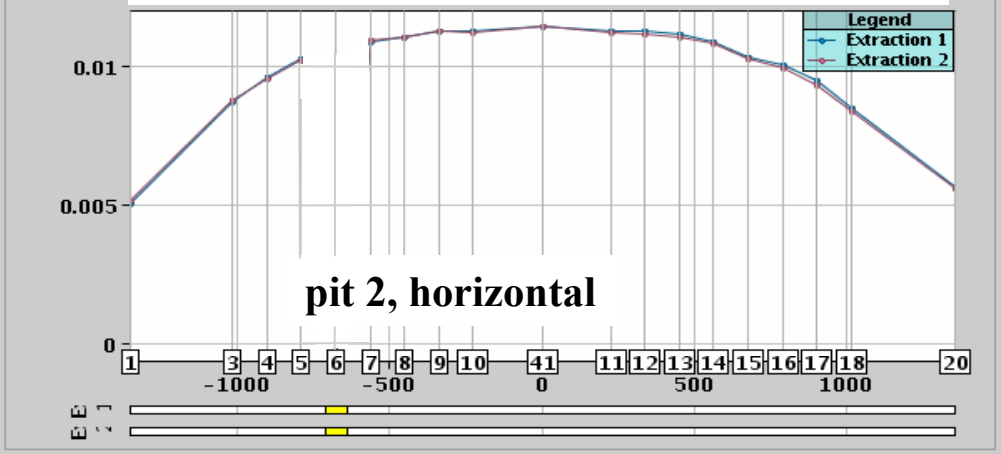
Movable Monitor Pit 1
Extraction 1: 3.2165E-01
Extraction 2: 3.2290E-01

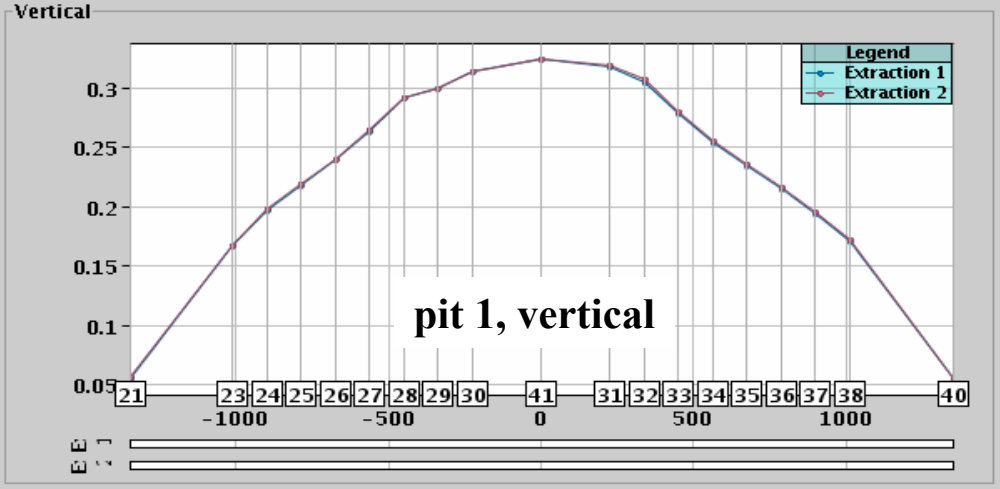
Movable Monitor Pit 2
Extraction 1: 1.1101E-02
Extraction 2: 1.1183E-02

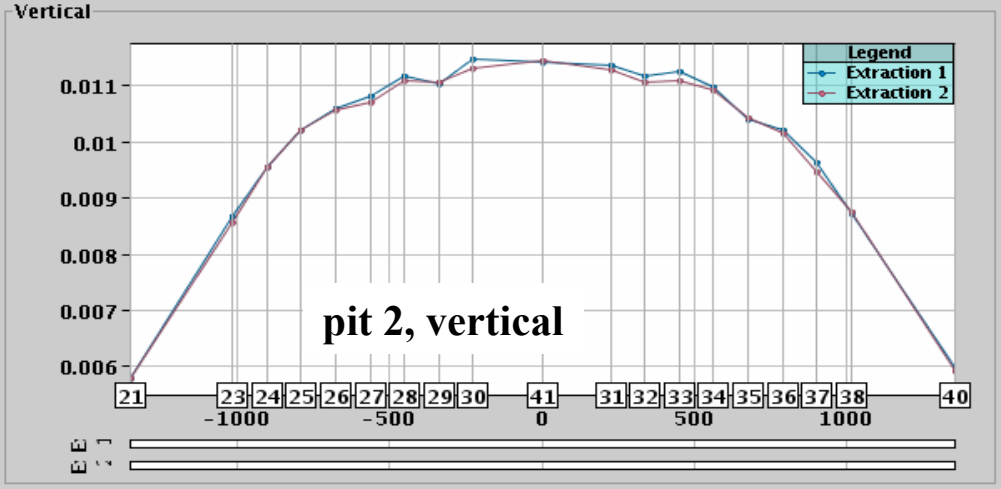
$E_{muon} > 20GeV$

$E_{muon} > 50GeV$









Acquire | Start Monitoring | Save | Continuous Saving | C:\SDDS

Pit 1

Pit 2

Radiation Levels inside Reflector Shielding

31st October 2006

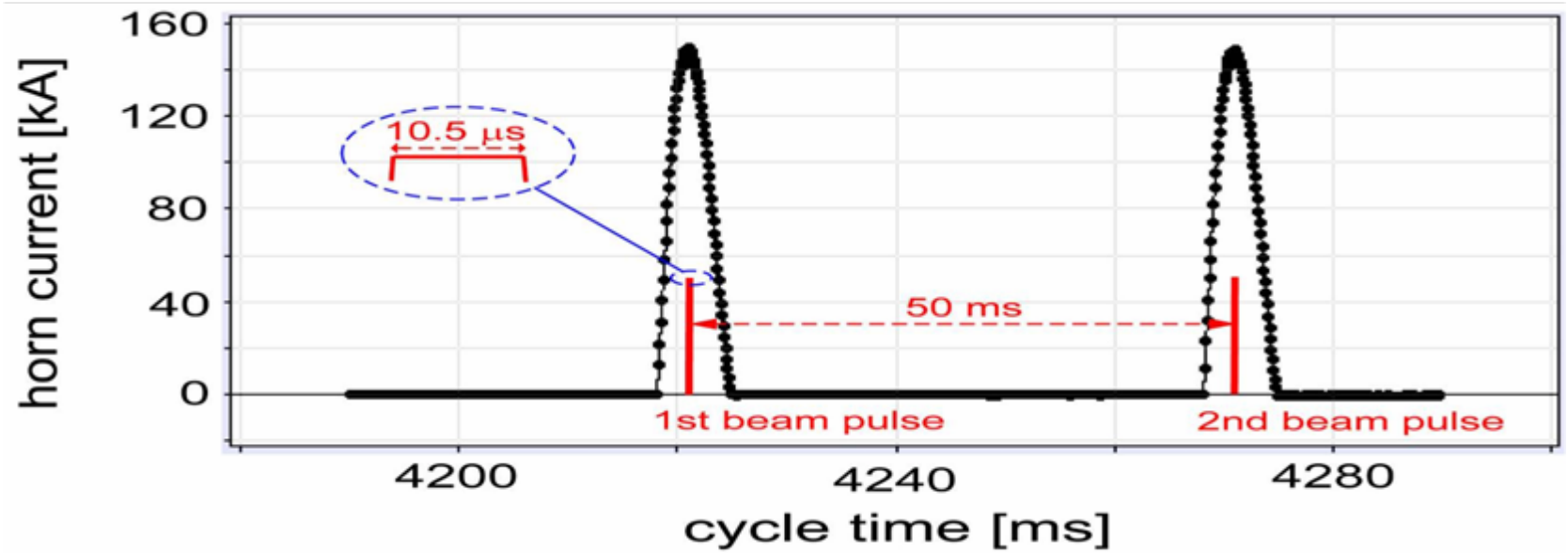
Dossier d'Intervention en Milieu Radioactif N° : CNGS/03-06

Intitulé de l'intervention : Retrait partiel du blindage du réflecteur et recherche de l'origine de la fuite.

Date : 30/10/06

Radiation x 5 for the horn

Horn/Reflector Power System



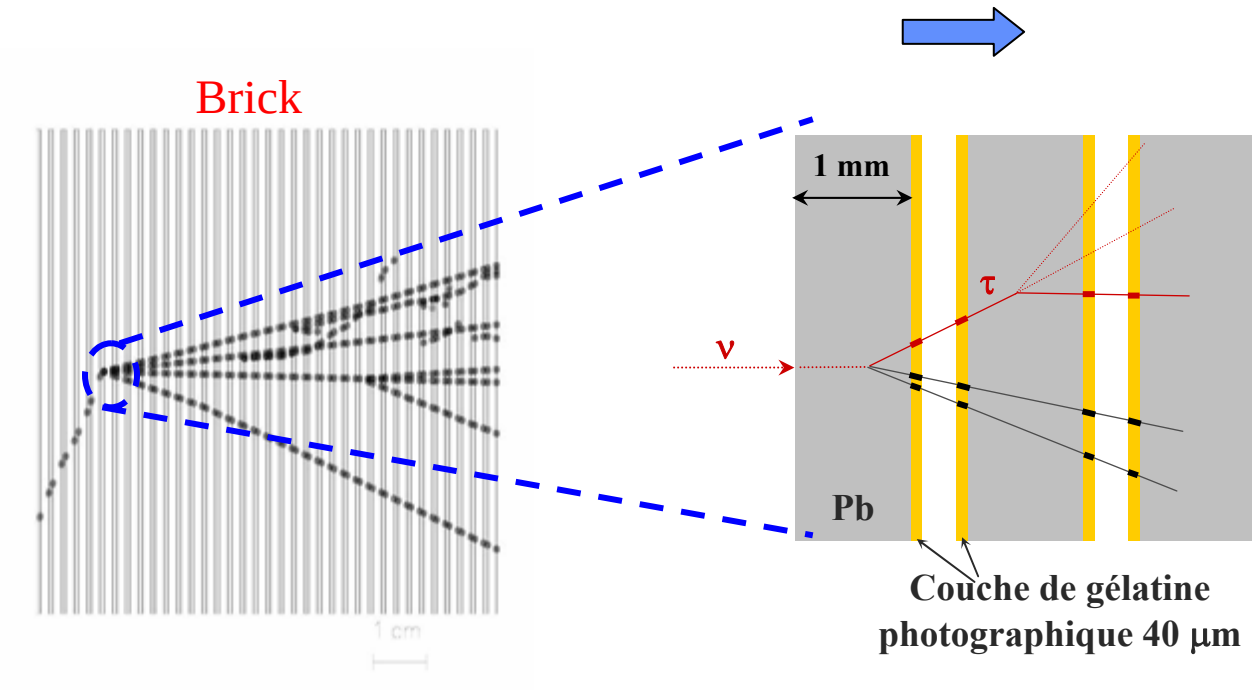
In total:
~ 400000 pulses

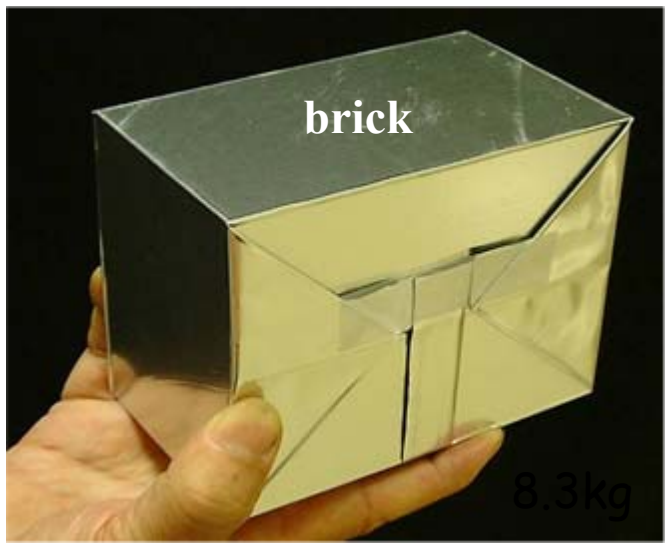
	Unit	HORN System	REFLECTOR System
Load Peak current	kA	150	180
Pulse duration	ms	6.5	9.8
Transformer ratio		16	32
Primary peak current	A	9375	5646
Charging voltage	V	6300	5800
Water flow for delta T=5C	l/min	50	50
Pressure	bar	1.2	1.2

Basic unit: brick:

56 Pb sheets + 56 photographic films (emulsion sheets)

lead plates: massive target
emulsions: micrometric precision





10.2 x 12.7 x 7.5 cm^3