EN-STI LIU Activities during LS2

François-Xavier Nuiry, on behalf of the STI group
Outlines

1. Activities other than LIU:
   * HL-LHC, Collimators, n_TOF, AD target

2. LIU
   * SPS
   * PS
   * Booster
   * L4

3. ISOLDE: See Richard Catherall’s talk
STI main activities beyond LIU

**TDI:** Injection dumps for LHC machines (end of TI2 and TI8)
- Operations limited to never surpass 400ºC.
- Graphite R4550 to be used in new TDI, instead of hBN.

**TDIS**
- Two TDIS, each one made up of 3 modules (Graphite-Graphite-Alu/Cu).
- Production of a total of 10 modules (6 installed, 4 spares).

**Collimators**
- Collimation maintenance and spare policy (continuous activity managed by STI, collimation project).
- Recovery of collimator 5th axis for TCT's in pts 1 and 5. YETS 15/16. (STI involved, collimation project).
- Production and installation of 4 TCTW. EYETS 16/17. HL-LHC, collimation project.
- Control system consolidation (STI-ECE).
- Replacement of tertiary collimators (TCT) @ IP1,5,2,8.
- Replacement of 8 primary (TCP) and ~10 secondary (TCS) with BPM design, in pts 3 and 7.
- Passive Absorbers for the LHC warm cleaning insertions (Point 7).

**N-TOF target consolidation:** Target replacement with a new one
- Water cooling corrosion of the aluminum window.
- Risk of shutting down n_TOF physics for >1 year + potential contamination problem.
- Resources required: EN-MME, EN-CV, EN-MEF, EN-HE, DGS-RP

Consolidation project
Planning: YETS 2015

Consolidation project
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Consolidation project
Planning: LS2

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Planning: LS2

Consolidation project
Planning: LS2
STI main activities beyond LIU, for LS2

• AD target
  AD-target area is feeding the AD machine with antiprotons

• Risk analysis
  • If not carried out then an increase of interventions and/or a 50%-100% loss in physics program

• Budget
  → Consolidation budget submitted
  → Reference documents: AD-PM-MG-0001 + BCR:1312689
  → Total budget (all groups involved): ~7.5 MCHF

• Planning: LS2

Resources required:
- TE-MSC, TE-VSC, TE-ABT,
- EN-CV, EN-HE, EN-EL,
- EN-MME, EN-MEF,
- GS-ASE, DGS-RP,
- DGS-SEE, BE-BI.
Main STI objects (LIU related)

- 6 TCDIs (Upgrade)
- TED TT20
- TBSE TT20
- TIDVG
- TIDH LSS1 (Removal)
- SPS High Energy Dump LSS5 (New)
- TED TT40
- TBSE TT41
- TBSE TJ8
- 6 TCDIs (Upgrade)
- TED TI8
- TED TT60
- TBSE TT60
- LSS5
- Under investigation
Main STI objects (LIU related)

- PS Booster
- Absorber / Scraper (upgrade)
- H0H⁻ dump (New)
- Head & tail dump (New)
- LBE Dump H⁻ (New)
- LEIR Dump (New)
- 2 PS Internal dumps (upgrade)
- 3 PS Booster beam stoppers (upgrade?)
TCDI collimators (SPS)

- SPS/LHC Transfer lines collimators (TI2 and TI8)
- 12 collimators and 2 spares
- 2.3m long, > 500kg

PROVISIONAL SCHEDULE:

<table>
<thead>
<tr>
<th>TCDI Removal</th>
<th>TCDI Installation</th>
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<tr>
<td>1/01/2019</td>
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<td>30/06/2020</td>
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Resources required:
EN-MME: Design for manufacturing, prototyping
TE VSC: Vacuum design, new vacuum layout (TI2-TI8), vacuum tests
EN HE: Transport / tooling for integration
EN MEF: CAD Integration / survey (2 steps for each collimator)
DGS RP: RP simulations and support
GS IS: Material procurement
Other actors:
EN EL: new cables for 3 TCDIs + MQIF.87000 and MQID.87100 quads
FP PI: Procurement
Dumps dismantling from LSS1 (SPS)

→ TIDVG
- Target Internal Dump Vertical
- Graphite, 4.3 m long, > ~20 Ton

→ TIDH
- Target Internal Dump Horizontal
- Aluminium, similar size

PROVISIONAL SCHEDULE:
- Late in LS2 (Radiation cooldown)

Resources required:

DGS-RP: ALARA, radioactive waste/storage, calculations
EN-HE: Handling, tooling
TE-VSC: Vacuum chambers, connections
GS IS: Radioactive storage (bunker)
SPS high energy dump @ LSS5

- Internal dump in LSS5 (SPS)
- Replace TIDVG, TIDH
- 1 dump and 1 spare

Resources required:

- **GS-SE**: Civil engineering works in LSS5
- **EN-CV**: Possibly dedicated water cooling ~300 kW
- **EN-HE**: Handling, tooling, crane
- **DGS-RP**: Calculations, validation, installation
- **EN-MME**: Design, subcontracting
- **EN-MEF**: Survey, procurement external shielding blocks
- **TE-VSC**: Design, procurement, installation, connections
- **EN-EL**: Cabling, installation
- **GS IS**: Material procurement
- **FP-PI**: Procurement

PROVISIONAL SCHEDULE:

Installation and commissioning → End of LS2
TEDs and TBSEs (Simulations)

- TED: SPS Dump-Stopper, 5 objects (+ spares).
  ~4.5m long, ~22 Tons
- TBSE: Beam stopper, 4 objects (+ spares).
  ~4m long, ~1.5 Tons

**Resources required in case of replacement:**

- **EN-MME:** Design, manufacturing
- **EN-HE:** Handling, tooling
- **DGS-RP:** Calculations, validation, survey
- **TE-VSC:** Modification of vacuum chambers
- **FP-PI:** Procurement
PS internal dump

- Two new PS internal dumps
- New positions: SS47, SS75?
- 2 dumps and 2 spares
- ~15kg, enters in the beam in <0.3s
- ~400,000 cycles per year
- Steel and concrete shielding blocs

**Resources required:**

- **EN-MME:** Design for fabrication
- **EN MEF:** CAD Integration / shielding / survey
- **EN HE:** Transport / tooling for integration
- **TE VSC:** Vacuum design checks, chambers, tests
- **EN CV:** Cooling
- **EN EL:** New cables
- **DGS RP:** RP simulations / Radioactive waste

**Other actors:**

- **BE ABP:** ECR
- **FP PI:** Procurement

**PROVISIONAL SCHEDULE:**

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<tr>
<th>Removal</th>
<th>LBE Beam tests</th>
<th>Dumps installation</th>
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<td>1/01/2019</td>
<td>5/08/2019</td>
<td>1/11/2019</td>
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**Removal:**
- LBE Beam tests
- Dumps installation

**New shielding for the dumps:** part of the Consolidation Project
LIU-ION LEIR dump

- Location: Next to ETL.BHN.10 Magnet (between LEIR and PS)
- 1 dump and 1 spare
- Al cylinder ~ φ70mm x 20mm
- Shielding may be required (TBD)
- PROVISIONAL SCHEDULE YETS 2017-2018

Resources required:
EN-MME: Design for fabrication
EN MEF: CAD Integration / shielding / survey
EN HE: Transport. Dismantling of shielding
TE VSC: Vacuum chamber modification
TE-MSC: Magnet dismantling and reassembly
DGS-RP: Shielding calculation

Other actors:
BE ABP: ECR
FP PI: Procurement
PS booster absorber / scraper

- Replacement of the Windows Beam Scope BRr.WBS8L2
- **RP / Fluka simulation to be launched**
- Maintenance scenario to be studied (ALARA)
- 4 independent axis (1 per ring)
- 1 absorber and 1 spare / modular design
- 520mm long, ~ 300kg (estimates)
- Shielding: should be studied.

**PROVISIONAL SCHEDULE:**

<table>
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<tr>
<th>Removal</th>
<th>Installation</th>
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<td>5/01/2020</td>
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<td>16/04/2020</td>
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**Resources required:**

- **EN-MME**: Design for fabrication
- **EN MEF**: CAD Integration / survey
- **EN HE**: Transport / tooling for integration
- **TE VSC**: Vacuum design, and vacuum tests
- **EN EL**: New cables
- **DGS RP**: RP simulations / Radioactive waste

**Other actors:**

- **BE OP / ABP**: Specifications
- **FP PI**: Procurement
PS booster beam stoppers and injection dumps

- **Injection dumps:**
  - H0H: under production.
  - Head & Tails: under production.

- **Beam stoppers in BI and BTP:**
  - Thermo-mechanical simulation are needed.
  - BI.STP-FA: Graphite cylinder
  - BI.STP-SW: Aluminium cylinder
  - BTP.STP.10: 2 Alum. cylinders

**Resources required in case of replacement:**
- EN-MME: Design
- EN-MEF: Integration
- EN-HE: Dismantling
- TE-VSC: Vacuum
- DGS-RP: EIS Equipment

**SCHEDULE:**
- Installation baseline: LS2.
LBE dump (H- / 160MeV) (L4)

- LINAC 4 measurement line dump
- Dimensions and weight: optimisation to be done

Resources required:
DGS RP: Shielding optimisation
EN MME: Detail drawings, subcontracting
GS SE: Validation, possible civil engineering modifications
EN HE: New crane, dismantling of the line & installation
TE VSC: Modification of the line & connection
EN MEF: Integration, Survey, Re-alignment of the line
EN EL: Cabling
EN CV: Water cooling of the dump

Baseline: connection during the **LS2**

- **installation**
- **LBE Beam tests**


- Emergency connection to PS complex in case of major failure in the Accelerator Complex. To be ready by the **end of 2016**.
TDIS – LS2

- Two TDIS
- Each TDIS made up of 3 modules
- A total of 10 modules (6 installed, 4 spares)
- Prototyping of sub-assemblies may be required

Project Schedule overview:
- Detailed design CERN (2015-2016)
- Prototyping and tests at CERN (2016-2017)
- Procurement and Manufacture (2016-2018)
- Assembly (2018-2019)
- Installation and commissioning (2019)

Contract scenario:
- Parts to be ordered separately
- Assembly and testing done at CERN (no turnkey contracts)

Suppliers to be consulted:
- Raw materials with or without machining (graphite, 3D CfC, Glidcop, 3D forged 316LN)
- Machining, welding, brazing
- Off-the-shelf components (Interferometers, bake-out jackets, vacuum equipment, mechanical components…)
New LHC Collimators – LS2

- 6 different types of collimators for the LHC
- Main design principles identically for all types
- Quantities not yet defined

Subcontractor key qualification criteria:
- Proven experience in scientific instrument production
- Capacity to produce precise mechanical assemblies
- Electron beam welding and Vacuum brazing
- Familiar with ultra high vacuum requirements
- Company able to test all functionalities of the equipment

Project Schedule overview:
- Collimator design at CERN (2015/16)
- Prototyping and tests at CERN (2016/17)
- Production follow up (start in 2017/18)
- Reception at CERN and cabling/controls (2019)
- Installation and commissioning (2019)

Contract scenario:
- **Turn key contract** for the collimator core assembly: Tank, Jaws, Tables, part of the supporting structure. Quality controls (functional tests, vacuum leak tests and metrology) shall be included in the contract.
- Tender open to several companies.

Collimator few characteristics:
- 1.5m long, about 1m high
- Weight close to 500kg
- Equipped with 1.2m long jaws with a flatness of 0.02mm
- Working around 10^{10} mbar
- Electron beam welded tank
- Vacuum brazing of cooling circuit to Glidcop® support structure
Collimation

- Collimation maintenance and spare policy (continuous activity managed by STI, collimation project).
  - 2 spares for TCSP collimators for point 6, with BPM. Presently produced by CINEL. (time scale: 2016).
  - 4 TCTW collimators (for BBLR compensation) for installation, with BPM and wire. Presently produced by CINEL. (time scale: 2016).
  - 1 TCPP for testing, with BPM. Presently produced by CINEL. (time scale: 2016).
  - Spare policy for mechanical components.
  - Consolidated Mechanical Design.
  - Primary collimator spares (TCP).
  - Spares for other collimator types.

- Recovery of collimator 5th axis for TCT’s in point 1 and point 5. YETS 15/16. (managed by STI, collimation project).
  - To be discussed if need of adding few motors also in Points 2 and 8.

- Control system consolidation (STI-ECE). LS2. Consolidation project.

- Replacement of tertiary collimators (TCT) @ the four interaction points: (IP1,5,2,8). LS2. Consolidation project.
  - More robust TCT for lower Beta8 in run II and III (16 collimators), possibly layout modification.

- Replacement of primary (TCP) and secondary (TCS) collimators with BPM design, in points 3 and 7. LS2. Consolidation project.
  - 8 TCP replaced by 8 TCPP.
  - ~10 TCS replaces by 10 TCSP.

- Passive Absorbers for the LHC warm cleaning insertions (Point 7). LS2. Consolidation Project.

- Train for remote collimator survey (STI-ECE?). Consolidation Project. Timeline??

- R and D ongoing activities (STI NOT INVOLVED?):
  - TCTPM (M for Metal) (EN-MME?). For points 2 and 8.
  - TCLA (ABT + MME ?). For point 6.
  - TCLD (TE-CRG, EN-MME) Point 2 and 6?

STI participation to be clarified