EN-MME Activities

Francesco Bertinelli / EN-MME

(25’ + 5’ discussion)
MME for LS2 (with earlier YETS and EYETS)

- Preparation (… very different nature of LS1 and LS2)
  - Engineering and Design
  - Fabrication: internal and sub-contracting
  - Non-destructive testing (NDT)
  - Mechanical measurement laboratory

- Installation
  - RP workshop Bldg. 109

- Commissioning

Does MME have enough resources for LS2?
MME for LS2 (with earlier YETS and EYETS)

<table>
<thead>
<tr>
<th>Activities of:</th>
<th>Réels 2010</th>
<th>Réels 2011</th>
<th>Réels 2012</th>
<th>Réels 2013</th>
<th>Réels 2014</th>
<th>Facturé CrFact 2015</th>
<th>WIP 06/07/15</th>
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<tbody>
<tr>
<td>Bureau d'Etudes</td>
<td>(MCHF)</td>
<td>2.4</td>
<td>2.7</td>
<td>2.8</td>
<td>2.8</td>
<td>3.4</td>
<td>1.5</td>
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<td>Fabrication Internne</td>
<td>(MCHF)</td>
<td>2.6</td>
<td>3.5</td>
<td>4.3</td>
<td>5.7</td>
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<td>2.6</td>
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<td>Fabrication Sous-Traitance</td>
<td>(MCHF)</td>
<td>3.8</td>
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<td>(MCHF)</td>
<td><strong>8.8</strong></td>
<td><strong>12.1</strong></td>
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<td><strong>16.4</strong></td>
<td><strong>18.2</strong></td>
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</table>

- ~3000 jobs / year to follow
- Design and Fabrication have ~6 months workload ahead
- MME subcontracting does not have unlimited capacity
### MME Design Office current workload

<table>
<thead>
<tr>
<th>Number of jobs</th>
<th>Date fin</th>
<th>Estimated workload (h)</th>
<th>Work in Progress (h)</th>
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<td>44</td>
<td>≤ 2014</td>
<td>15 500</td>
<td>4 200</td>
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<tr>
<td>31</td>
<td>S1 2015</td>
<td>9 900</td>
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<td>74</td>
<td>S2 2015</td>
<td>27 500</td>
<td>15 700</td>
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<tr>
<td>17</td>
<td>S1 2016</td>
<td>8 500</td>
<td>6 900</td>
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<td>2</td>
<td>S2 2016</td>
<td>700</td>
<td>500</td>
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<tr>
<td>1</td>
<td>≥ 2017</td>
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<td>0</td>
</tr>
<tr>
<td>∑ 169</td>
<td></td>
<td>∑ 88 200</td>
<td>∑ 30 400</td>
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</table>

Source: JMT, situation 22/09/2015
MME Design Office issues

• Workload capacity
  • In recent months increased from 41 to 44 MME Designers (14 staff, 30 Industrial Support, 1 IS for workshop)
  • This is maximum capacity (IS contractual limit and staff/non-staff ratio) unless additional staff designers are recruited
  • ~60 000 job hours / year, ~5 000 job hours / month
  • Hence an existing Work in Progress (WIP) workload of ~6 months

• Options for new requests:
  • Join the queue
  • Justify higher priority over other ongoing work
  • A small job is nevertheless done early (not all WIP – and Users – are ready for the work to be done)
  • … outside MME (e.g. FSUs)
Are enough designers working for LIU / LS2?
Design Office Work-In-Progress (h)

<table>
<thead>
<tr>
<th>Date fin</th>
<th>HL-LHC</th>
<th>LHC</th>
<th>SM18</th>
<th>R&amp;D Magnets</th>
<th>HiRadMat</th>
<th>LIU</th>
<th>Non-LHC Accelerators</th>
<th>LINAC4</th>
<th>HIE-ISOLDE</th>
<th>ELENA</th>
<th>AWAKE</th>
<th>CLIC/CTF3</th>
<th>SPL</th>
<th>LHC Experiments</th>
<th>Non-LHC experiments</th>
<th>Other</th>
<th>Total</th>
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<tr>
<td>≤ 2014</td>
<td>1 700</td>
<td>350</td>
<td>100</td>
<td>250</td>
<td>550</td>
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<td></td>
<td>4 150</td>
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<tr>
<td>S1 2015</td>
<td>900</td>
<td>450</td>
<td>400</td>
<td>100</td>
<td>300</td>
<td>400</td>
<td>50</td>
<td>250</td>
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<tr>
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<td>1 450</td>
<td>200</td>
<td>500</td>
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<td>650</td>
<td>150</td>
<td>2 300</td>
<td>30 400</td>
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</table>

Source: JMT, situation 22/09/2015
## Design Office Work done Jan. - Aug. 2015

**Source PPT, analysis 23/09/2015**

<table>
<thead>
<tr>
<th>Project</th>
<th>Total</th>
<th>HL-LHC</th>
<th>LHC</th>
<th>SM18</th>
<th>R&amp;D Magnets</th>
<th>HiRadMat</th>
<th>LU</th>
<th>Non-LHC Accelerators</th>
<th>LINAC4</th>
<th>HIE-ISOLDE</th>
<th>ELENA</th>
<th>AWAKE</th>
<th>CLIC/CTF3</th>
<th>SPL</th>
<th>LHC Experiments</th>
<th>Non-LHC experiments</th>
<th>Other</th>
<th>Total</th>
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<tbody>
<tr>
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<td>657</td>
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<td>0.1</td>
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<td>30 400</td>
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</table>
Recommended tips (for LS2)

• Design & fabrication requests
  • Think ahead in time:
    • consider one Semester (or more) for new MME design requests (starting S1 2016)
    • Consider a 2\textsuperscript{nd} Semester (or more) for MME fabrication requests
  • Include in PLAN
  • In launching a design job do not assume that MME fabrication automatically follows
  • In following-up an MME design\&fabrication job, balance the necessary time for both activities
    • When design is 80\% ready start fabrication contacts (too early = ignored, too late = wasted time …)
    • Special supplies can take several months (3 to 6), e.g. special raw materials, forgings, bellows, ceramics
# Design Office MME for User Groups

<table>
<thead>
<tr>
<th>LIU</th>
<th>BE-ABP</th>
<th>BE-BI</th>
<th>BE-OP</th>
<th>BE-RF</th>
<th>EN-MME</th>
<th>EN-STI</th>
<th>TE-ABT</th>
<th>TE-MSC</th>
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<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>37</td>
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<td>463</td>
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<td>1 512</td>
<td>499</td>
<td>524</td>
<td>5 895</td>
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"LIU" in this table includes jobs: AD, PS, ISOLDE, SPS, LINAC2, LINAC3, LIU but not ELENA, AWAKE, HIE, ISOLDE and LINAC4.

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<tr>
<th>HL-LHC</th>
<th>BE-ABP</th>
<th>BE-BI</th>
<th>BE-OP</th>
<th>BE-RF</th>
<th>EN-MME</th>
<th>EN-STI</th>
<th>TE-ABT</th>
<th>TE-MSC</th>
<th>TE-VSC</th>
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<td>6 000</td>
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<td>1 500</td>
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<td>26 120</td>
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<td>791</td>
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<td>196</td>
<td>1 231</td>
<td>5 487</td>
<td></td>
<td></td>
<td></td>
<td>12 706</td>
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</table>
Design WIP LIU examples

**J3016223**
TE/ABT
KICKERS BT-KFA10 + BT-KFA-14L1
LIU-PSB
Installation LS2

**J3019356**
BE/BI
BGI (Beam Gas Ionization monitor)
LIU-PS
Installation YETS 2017-2018

**J3025838**
BE/RF
FINEMET CAVITIES
LIU-PSB
Installation LS2

**J3025439**
BE/ABP
NEW LEBT OPTICS LINAC3-GTS
LIU-ions
Installation EYETS 2016-2017
... more known coming for LIU

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>WP Holder</th>
<th>MME Pilot</th>
<th>Designer</th>
<th>Design Kick-off (est)</th>
<th>Deadline Installation</th>
<th>Design Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIU-PSB</td>
<td>BHZ11 &amp; BHZ162 ASSEMBLY DRAWINGS</td>
<td>W.Weterings</td>
<td>B.Riffaud</td>
<td>L.Zuccalli</td>
<td>01/10/2015</td>
<td>EYETS 2016-2017</td>
<td>Scheduled</td>
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<tr>
<td>LIU-PS</td>
<td>BEAM PIPE MODIFICATION (WIDE BAND PICK-UP INSERTION)</td>
<td>TBD</td>
<td>B.Riffaud</td>
<td>R.Ricol</td>
<td>01/11/2015</td>
<td>EYETS 2016-2017</td>
<td>Scheduled</td>
</tr>
<tr>
<td>LIU-PSB</td>
<td>PICK-UP TUNE (RE-DESIGN)</td>
<td>TBD</td>
<td>D.Steyaert</td>
<td>Y.Coutron</td>
<td>TBD</td>
<td>EYETS 2016-2017</td>
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<tr>
<td>LIU-PSB</td>
<td>SUPPORT FOR WIRE SCANNER (PROTO)</td>
<td>B.Dehning</td>
<td>N.Chritin</td>
<td>A.Demougeot</td>
<td>TBD</td>
<td>EYETS 2016-2017</td>
<td>Identified</td>
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<td>LIU-PSB</td>
<td>SEM GRID + SUPPORT</td>
<td>F.Roncarolo</td>
<td>D.Steyaert</td>
<td>TBD</td>
<td>TBD</td>
<td>YETS 2017-2018</td>
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<tr>
<td>LIU-PSB</td>
<td>BEAM PIPE MODIFICATION (SEM GRID INSERTION)</td>
<td>TBD</td>
<td>D.Steyaert</td>
<td>TBD</td>
<td>TBD</td>
<td>YETS 2017-2018</td>
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<tr>
<td>LIU-PS</td>
<td>SUPPORT FOR WIRE SCANNER (SERIES)</td>
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<td>D.Steyaert</td>
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<td>YETS 2017-2018</td>
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<td>LIU-PS</td>
<td>BMP42 (BUMPER) &amp; SMH42 (SEPTUM)</td>
<td>M.Hourican</td>
<td>B.Riffaud</td>
<td>L.Zuccalli</td>
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<td>LIU-PS</td>
<td>BMP42 &amp; SMH42 POWER SUPPLY (TRANSFO.)</td>
<td>J-M. Cravero</td>
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<td>LIU-PS</td>
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<td>D.Steyaert</td>
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<td>B.Riffaud</td>
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<td>LIU-PS</td>
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<td>F-X.Nuiry</td>
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<tr>
<td>LIU-SPS</td>
<td>TPSG4 &amp; TPSG6</td>
<td>B.Balhan</td>
<td>B.Riffaud</td>
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<td>TBD</td>
<td>LS2</td>
<td>Identified</td>
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<tr>
<td>LIU-IONS</td>
<td>LEIR EXTERNAL BEAM DUMP &amp; Y CHAMBER</td>
<td>A.Perillo / J.Hansen</td>
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<td>LS2</td>
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<td>LIU-SPS</td>
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<td>F-X.Nuiry</td>
<td>D.Steyaert</td>
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<td>TBD</td>
<td>TBD</td>
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• Forum for priority discussions is LIU-PLI follow-up meetings with EN/MEF
Design WIP collimators

**TDIS absorber**
New generation of TDI absorber. 3 independent modules with jaws active length 1.5 m.

**TCDIL Collimator**
New TCDI collimator with jaws active length 2.1 m.

**TCSPM Collimator**
New generation of collimator for HL-LHC. Completely new jaw design.

**TCLD Collimator**
New TCLD collimator to be installed between two 11T dipoles. Active length 600 mm.
# Fabrication strategy collimators

<table>
<thead>
<tr>
<th>Project</th>
<th>Quantity</th>
<th>Fabrication date</th>
<th>Install.</th>
<th>Design Drawings Engineering</th>
<th>MME Fabrication</th>
<th>STI Fabrication</th>
<th>Special fabrication technologies</th>
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<tbody>
<tr>
<td>TGDIL</td>
<td>- 1 prototype, 13 to be installed in LHC, 2 spares</td>
<td>1 prototype: 10-2016, 14 collimators: 10-2018</td>
<td>LS2 7-2019</td>
<td>Design and drawings expected by October 2015</td>
<td>1 prototype: MME internal fabrication: 5%, MME Subcontracting: 95%, MME assembly: 50%</td>
<td>14 collimators: External fabrication: 100%, External assembly: 100%, STI Installation: 100%</td>
<td>EB welding, High precision machining</td>
</tr>
<tr>
<td>TCSPM</td>
<td>- 1 prototype, 1 for installation in SPS (testing for HL LHC)</td>
<td>1 prototype: 6-2016, 1 collimator: 6-2017</td>
<td>EYETS 2017-2018</td>
<td>New design, engineering and drawings expected by September 2015</td>
<td>1 prototype and 1 collimator: MME internal fabrication: 10%, MME Subcontracting: 90%, MME assembly: 50%</td>
<td>STI Installation: 100% If more than 1 collimator have to be installed and manufactured, STI will take care of the whole subcontracting manufacturing and assembling and MME just about the prototype</td>
<td>EB welding, High precision machining, Brazing</td>
</tr>
<tr>
<td>TCLDA</td>
<td>- 1 prototype, 2 for installation</td>
<td>1 prototype: 3-2017, 2 collimators: 6-2018</td>
<td>LS2</td>
<td>Design and drawings expected by September 2015</td>
<td>1 prototype: MME internal fabrication: 10%, MME Subcontracting: 90%, MME assembly: 50%</td>
<td>2 collimators: External fabrication: 100%, External assembly: 100%, STI Installation: 100% To be checked if the production of two collimators is enough to make an external contract</td>
<td>EB welding, High precision machining, Brazing</td>
</tr>
</tbody>
</table>
Design WIP HL-LHC SC magnets

11T Dipole & Collimator

Dipole 2m Short Model  1in1  2in1  Dipole Assembly  Dipole & Collimator assembly

MQXFS/MQXF Quadsrupole

MQXFS 1,5m Short Model  MQXF Section  MQXFB Magnet

Tooling for dipole and quadrupole (for Nb3Sn cable)

winding, curing, reaction and impregnation tooling  lifting and handling tools  assembly tools
It is important that crab cavities are validated with beam in SPS, before LS2. Only after this validation we will be able to start the production for HL-LHC.

- The 1\textsuperscript{st} cryomodule will have to be assembled in SM18 by end of 2016, the 2\textsuperscript{nd} to be assembled by mid-2017.
- They will be cold tested (one after the other) in SM18 during 2017. The best performing will be installed in SPS end of 2017 and has to be tested with beam during 2018.
PLAN for MME

• MME uses JMT to manage its workload: PLAN and JMT are not synchronised

• Users can help:
  • Consistency between PLAN and JMT in Username and title
  • Link to JMT Job if existing

• Be clear with “request-by date”
  • Specify date for “job finished by MME” (not installation date)

• Deliverables:
  • If fabrication is “internal MME” or “Sub-contracting MME”, then “job finished” = fabrication drawings ready (include time to iterate with Workshop)
  • If fabrication is “responsibility of Users”, then “job finished” = Tender drawings
    ➢ User with Design Office to discuss fabrication strategy early
  • Avoid “responsibility of User” becoming “MME subcontracting”.

• Work priorities:
  • Better to discuss early at the Design stage (working back from Installation date minus semester(s) fabrication time): i.e. Design Office workload for S1 2016 will be based on October 2015 PLAN requests, with priorities discussed if needed.
## Fabrication Work-in-Progress

<table>
<thead>
<tr>
<th></th>
<th>Milling</th>
<th>Turning</th>
<th>Electro-erosion</th>
<th>Sheet Metal work &amp; welding</th>
<th>Electron Beam welding</th>
<th>Metrology</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work done Jan. to June 2015 (h)</td>
<td>12 200</td>
<td>5 450</td>
<td>1 500</td>
<td>11 450</td>
<td>1 300 2 machines</td>
<td>3 450</td>
<td>36 750</td>
</tr>
<tr>
<td>WIP (h)</td>
<td>11 900</td>
<td>4 200</td>
<td>1 400</td>
<td>9 400</td>
<td>2 800 (43% LINAC4 PIMS)</td>
<td>2 700</td>
<td>35 100</td>
</tr>
<tr>
<td>WIP equivalent months</td>
<td>5.9</td>
<td>4.6</td>
<td>5.6</td>
<td>4.9</td>
<td>8.6 3 machines</td>
<td>4.7</td>
<td>5.7</td>
</tr>
</tbody>
</table>

- In PLAN sufficient to detail if the following activities are needed:
  - Machining
  - Sheet metal work & welding
  - Electron beam welding
  - Vacuum brazing & Heat Treatments
  - MME subcontracting

Source: JMT, situation 30/06/2015 except FE and vacuum brazing

Delivery of new, retrofit Leybold&PTR EB machine
ACC/CONS consolidation
Fabrication examples

- First LIU fabrications started S2 2015, e.g.
  - J3025786 TE/ABT 9 bobines SEPTUM SMV10 - SMV20 for LIU-PSB
  - J3025461 BE/OP HALF SECTOR TEST VACUUM CHAMBERS for LIU-PSB
RP workshop in Bldg. 109

- The only general purpose RP workshop
- Equipped with milling machine, lathe, saw, drill, TIG welding, fume extraction
- Is the capacity of the RP workshop enough for LS2?
  - Dec. 2014 “survey” by E. Jensen:
    - LIU-SPS:
      - BE-RF: modify some supporting systems of both 200 MHz and 800 MHz cavities – work to be checked with RP as the supports come from the SPS machine but are not activated
      - BE-BI: some 10 days of work for SPS and other consolidation activities
    - LIU-PSB:
      - TE-ABT: reserve a generic slot of turning/ milling for a couple of weeks for magnet upgrade work
      - TE-VSC: block B109 for 1-2 weeks during LS2 for PSB vacuum work
      - BE-BI: BI.BTV30 - 2 days for vacuum chamber modification and 2.5 days for tank modification. BT.BTV30 - 2 days for vacuum chamber modification.
    - LIU-PS:
      - TE-ABT group: Small tasks to be done in the RP workshop in bldg. 109 during LS2. But the tasks will be limited to small works to adapt old parts to the newly to install septa
      - TE-MSC: radioactive workshop will be needed sporadically, but can’t provide a schedule since it is based on a case by case principle
  - Conclusion: yes it is enough.
- Is the Free Access Workshop enough? If not, need to raise the issue …
- But need GS-consolidation and ACC-CONS support to finish Workshop Bldg. 109 before LS2.
Mechanical Measurements Laboratory

• Request HL-LHC: during LS2 monitor the vibration induced in the tunnel by the civil engineering work (will help decide what could be done during Run 3 in case of delays)
  • Acquire the data from the instrumentation already installed in the triplet area (LMC action);
  • Place a few more instruments in the LHC tunnel areas where crab cavities will be installed as this could be the nearest and latest place to be excavated.
Metallurgy and NDT

• X-ray support to EN/CV work
• No advanced requests
Thank-you for your attention
EN (ATS) priorities

1. Completion of the LS1

2. Operation
   - Infrastructures
   - LHC, its injectors & the associated experiments
     - The fixed target programme

3. Projects
   - LHC Upgrade (Linac4, HL-LHC, LIU, LHC Detectors)
     - Neutrino Facility (Extension of EHN1, Icarus, Nessie)
     - Diversity Activities (HIE-Isole, ELENA, AWAKE)

4. Studies
   - Energy Frontier (ILC, CLIC, FCC)
   - Diversity Activities (TSR, R&D for accelerators and detectors)
MME priorities wrt LS2

1.1 Preparation for LS2 -> LIU, HL-LHC

LIU:
- Mechanical design and fabrication (internal and subcontracting) for:
  - Linac4 source
  - Linac4 to PSB connection line and equipment
  - Electron beam welding of Linac4 PIMS
  - PSB H+ injection
  - BI for LIU (New Wire Scanner, BTV, BGI, BGV...)
  - BDs for LIU (L4 dump, PS dump, SPS TIDVG, ...)
  - Crab cavities and cryo-module design and manufacturing for tests in SPS before LS2.

HL-LHC:
- Engineering and mechanical design for:
  - Crab cavities and cryo-module design
  - HL-LHC Secondary Collimators (TCSPM also for LS3)
  - DS (11T) Collimators (TCLD)
  - HiRadMat experiments related to Collimation project
  - BBLRC demonstrator (TCPW)
  - Advanced materials for collimators upgrade (thermo-mechanical characterization and HiRadMat Tests)
  - Hollow electron lens.

1.2 Completion of Own infrastructure/Equipment Consolidation Projects

- Consolidation of equipment/Productive Technical Assets for the mechanical workshops, laboratories etc.
- ERP studies.
- Need to complete RP workshop consolidation before LS2.

1.3 Preparation for LS3 -> HL-LHC

Engineering, mechanical design and fabrication (internal and subcontracting) for:
- Crab cavities and cryo-module
- New collimators in the experimental insertions (TCLx etc.)
- Hollow Lens Beam Collimation
- R&D for LHC Collimation Advanced Materials.

Mechanical design and follow-up for:
- HL-LHC 11 T Magnets and cryo-assembly
- Nb3Sn triplets (including magnets and BI)
- HL-LHC new magnet development phase
- Design SC links (cables and test stations).