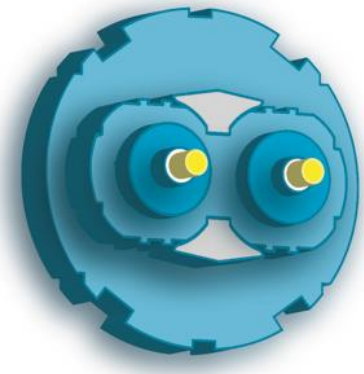


High Luminosity LHC

Technical Meeting on Vacuum for HI-LUMI LHC, WP12

Vacuum related issues for WP14, Beam Transfer and Kickers

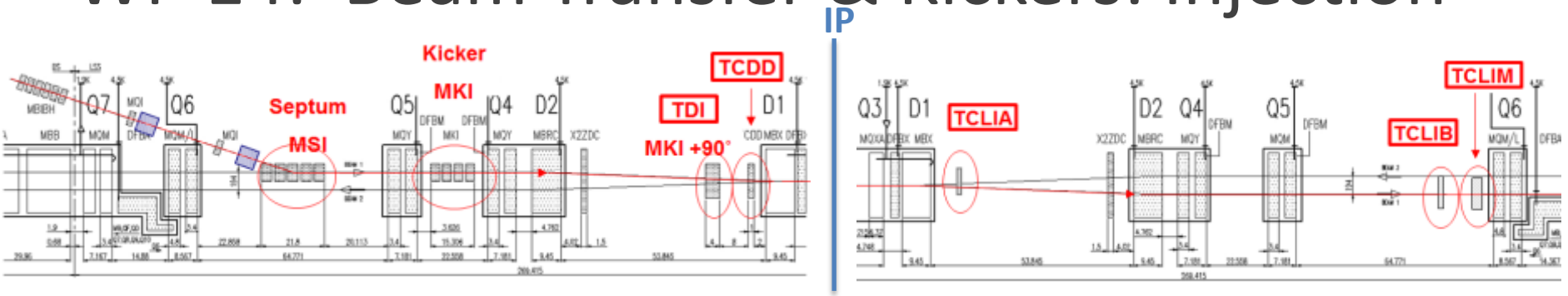
Jan Uythoven for the WP 14 team members

The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.

Outline

- Description of Injection System and changes for HL – LHC
  - Items which affect vacuum
- Description of Beam Dumping system and changes for HL-LHC
  - Items which affect vacuum

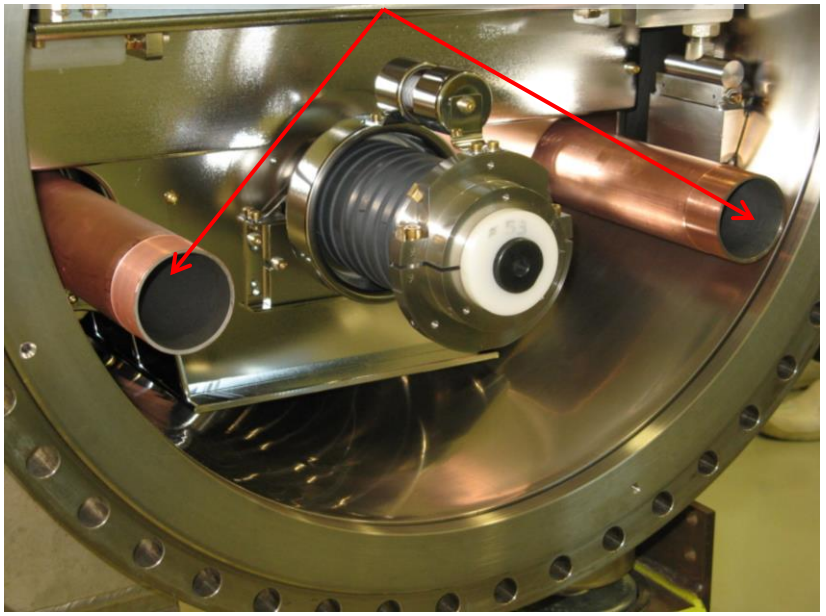
WP 14: Beam Transfer & Kickers: Injection



- MKI injection kickers, LS1: full complement 24 shielding wires, reducing beam impedance. Extrapolate run II data. For HL-LHC additional measures such as active cooling and different ferrites might be needed and are being studied.
- TDI injection absorber
  - LS1 / run2: Interferometry for redundant gap measurement & interlocking
    Vacuum feed-through
  - **LS2: Replace TDI with multi module beam absorber system, compatible with extremely bright LIU beams**
    - Tensile stresses, new collimator materials – in the worst case could limit the number of bunches which can be injected at a time
- Other absorbers to be verified, some of them might need replacement:
  - TCLIA, TCLIAB, TCDD, TCLIM
  - TCLIA maximum opening affects maximum crossing angle for ALICE ZDC for ion operation

Injection kickers MKI

M.Barnes



- Main upgrade taking place in LS1
  - Reduction of beam impedance
  - Includes many mitigations concer-ning vacuum, especially NEG-coating. Removal of solenoids.
  - Concerns:
    - Beam induced heating > run II
    - Vacuum behaviour during scrubbing and operation with 25 ns
- **HL-LHC: Up to 2017** a ***prototype*** magnet including water cooling and new yoke ferrites with higher T-Curie is foreseen
- **Vacuum involvement for HL-LHC:**
  - **New ferrites & doping or coating of ceramic tube to reduce SEY**
- Operational experience will show if changes need to be applied

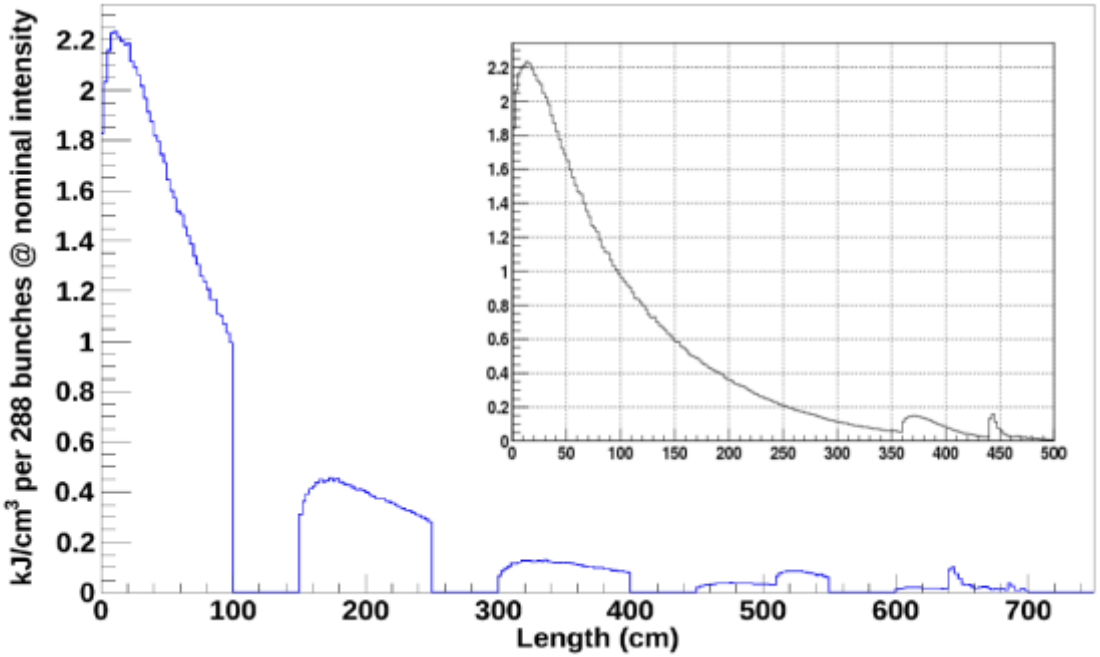
Absorbers for injection

- Injection absorber **TDI**
  - LS1: qualification of position measurement by interferometry, feed through. Spare magnet to be exchanged during run II.
  - LS2: Likely 2 x 5 tanks instead of one large tank
  - Other injection absorbers under study
    - TCLIA/B, TCDD, TCLIM
  - **Vacuum involvement:**
    - **New absorber materials, material choice to be finalised in the coming 12 months**
    - **Additional equipment, pumping and monitoring**

Possible future TDI layout

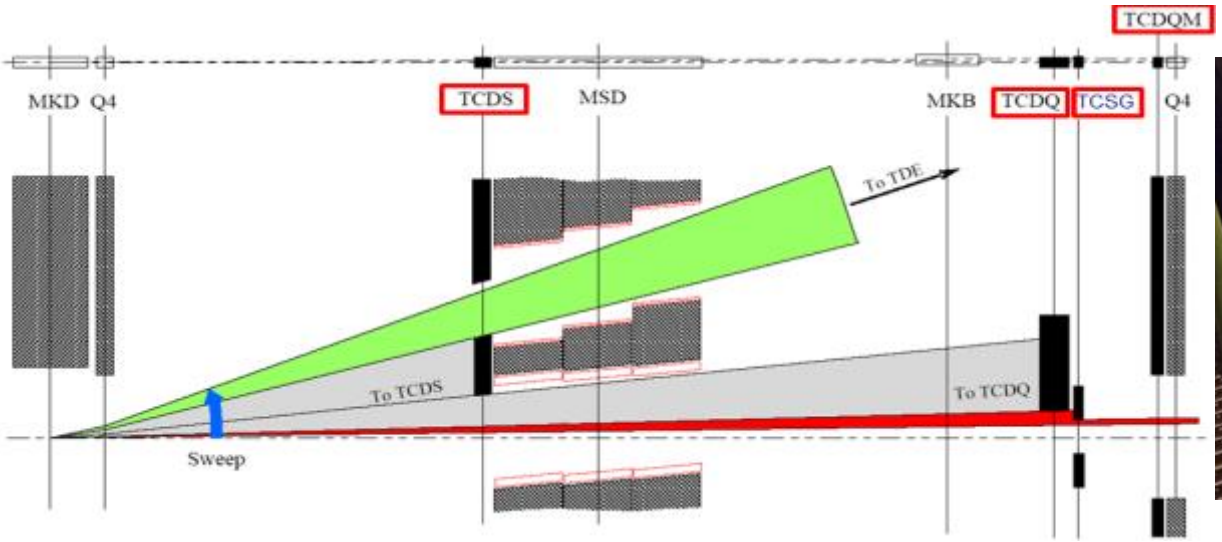
Modules separated by vacuum

- For C165+SiN+Mo of length 5 m
- 5 modules, each of 1 m in length separated by 0.5 m of vacuum



A.Lechner

WP 14: Beam Transfer & Kickers: Beam Dump

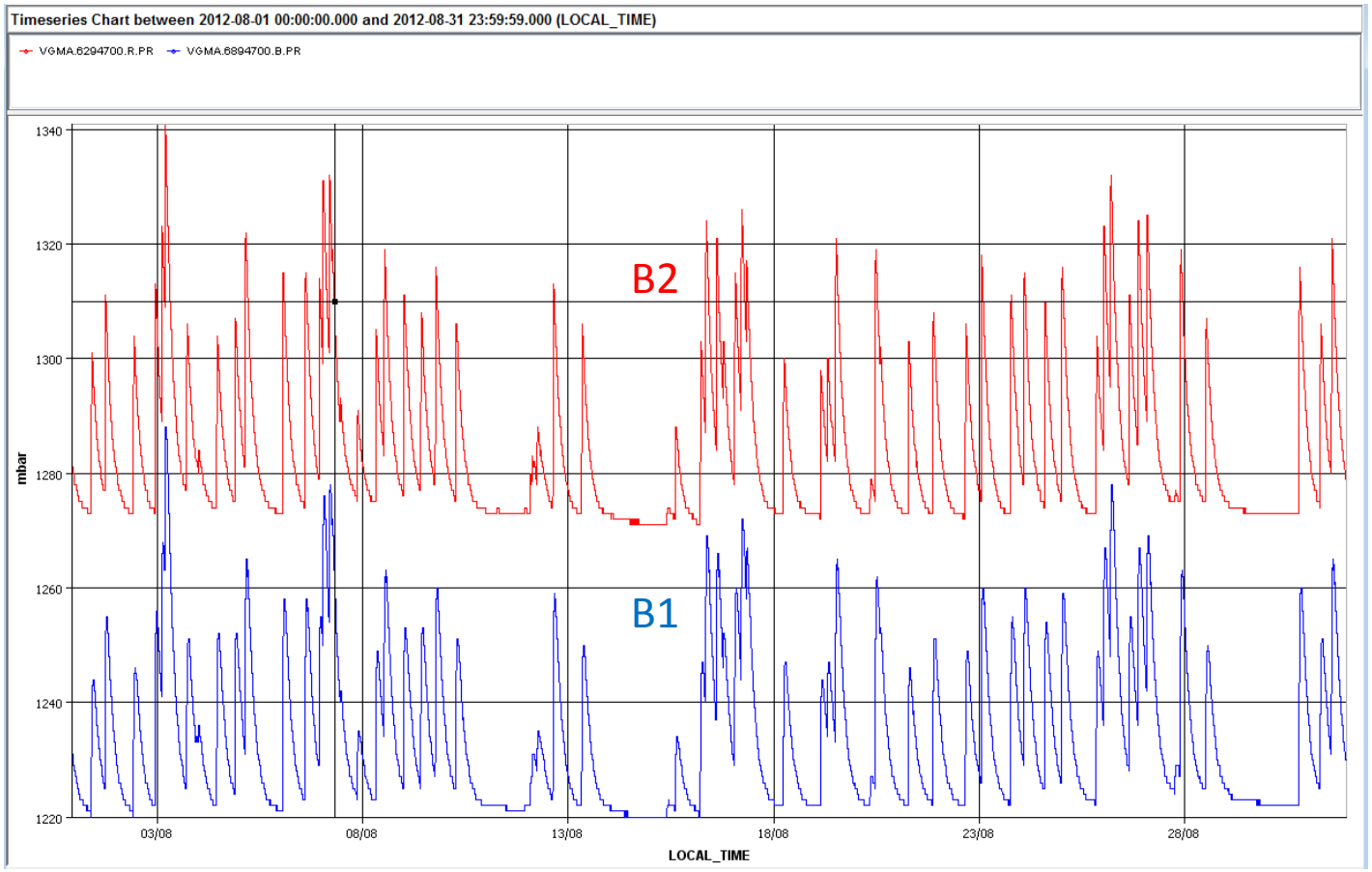


- LS1: TCDQ upgraded, from 2 to 3 modules; CFC instead of graphite absorbers. Compatible with HL-LHC parameters from 2010 – presently work on bellows VMTAC
- **LS3:** Possible upgrade of other absorbers to be confirmed
  - TCDS, TCSG (coll. WP), TCDQM
  - Dump block TDE– study gas handling and pressure increase
  - TDE window
  - Possibly change dilution pattern: dilution magnets MKB
- Detailed studies after injection system studies which have priority

Vacuum for Beam Dumping System

- N_2 pressure on TDE
  - Pressure on dump → see graph run I
  - Pressure in bottle → see graph run I
- TDE window
- Additional MKBs ?
- TCDS upgrade

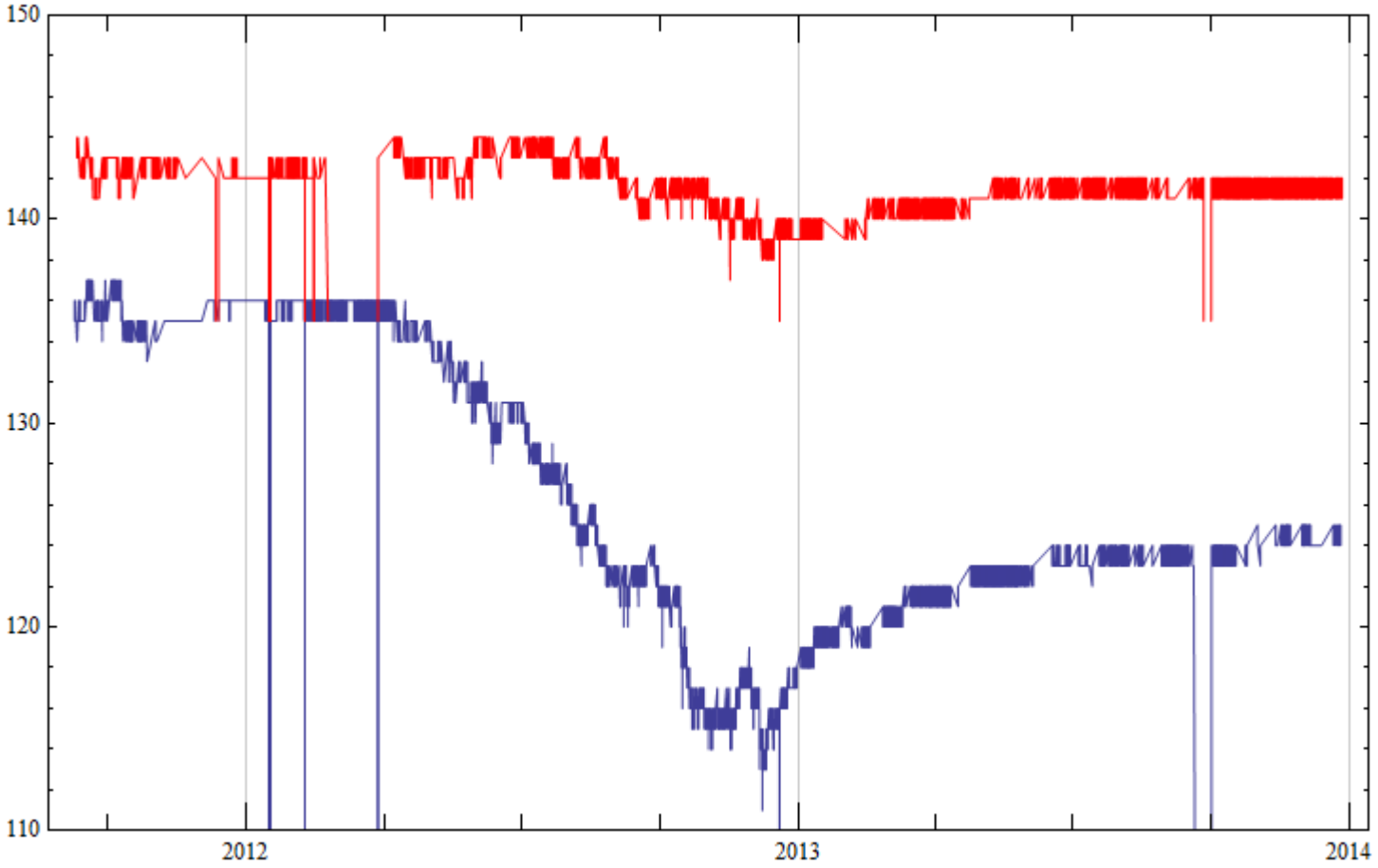
TDE – N_2 pressure



Δ p ≈
0.06 bar

August 2012

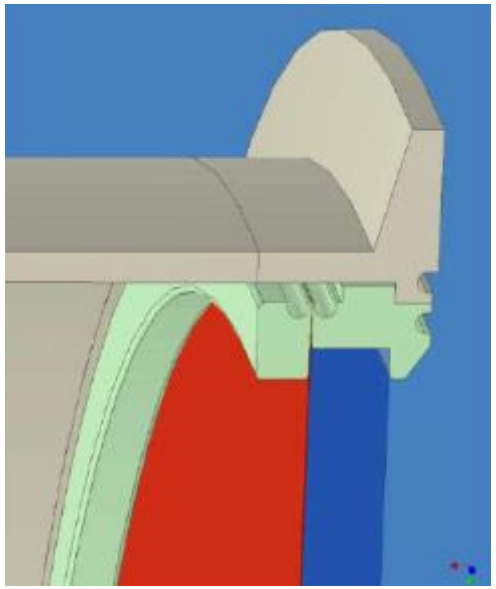
TDE in the bottle



Behaviour not understood

Vacuum work related to dump

- No change of TDE itself, but if simulation show limitations changes might be required on:
  - **N_2 handling**
  - Dilution kickers MKB
    - **Possibly extra MKB kickers to be installed**, new vacuum sector..
  - **TDE window to be checked for HL-LHC beams**
    - **Assuming the different dilution failure scenarios**

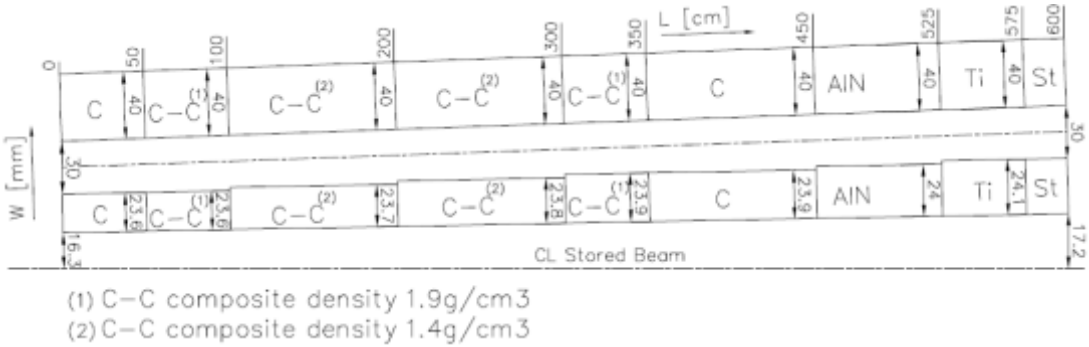


Detail of entrance window, showing 15 mm CC plate, 200 μm metallic foil and vacuum flange.

Absorbers

- TCDS – likely to be replaced in LS3
  - Different absorber material

Present TCDS



- Possibly also replace:
  - TCSG (coll. WP)
  - TCDQM

B.Goddard, W.Weterings

- Vacuum involvement:
  - **Check on absorber materials, installation, …**

Conclusions on HL-WP14

- **LS2 concentrate on injection system**
  - **TDI:** New absorber materials and separation of absorbers in several tanks. Coming soon.
  - Possibly replace other injection absorbers
  - **MKI**, replaced LS1. Ongoing R&D for new ferrites and coated ceramic tube for low SEY. Possibly install prototype.
  - Presently budget foreseen *within WP14* for vacuum TDI, TCLIA/B
- **For LS3 accent will be on the beam dumping system**
  - Simulations are about to start. **TCDS** likely to be exchanged.
  - Could involve ***little*** related vacuum work
  - Could involve ***significant*** vacuum work:
    - **TDE window, additional MKBs, N_2 handling system**
  - Presently budget foreseen *within WP14* for vacuum TCDS