Alessandro Dallocchio 18-02-2008

LHC Collimation PHASE II
2nd Design Meeting – 14/02/2008

Present: Gonzalo Arnau Izquierdo, Samuli Heikkinen, Ahmed Cherif, Wihelmus Vollenberg, Ramon Folch, Arnaud Pierre Bouzoud, Oliver Aberle, Alessandro Bertarelli (chairman), Alessandro Dallocchio (scientific secretary).

1. Follow up of 2nd Specification Meeting (A. Bertarelli)

Bertarelli made a summary of the last specification meeting; three main subjects have been discussed:

- *Collimation efficiency*. Last studies on efficiency of Phase I Collimation system indicate that beam intensity must be limited to ~50% of LHC nominal performance to avoid critical beam losses. The main issue emerging from this discussion was that phase II collimation must possibly foresee an upgrade of both primary and secondary collimators (more details can be found on specification meetings web page). Requirement of factor 10 increase in cleaning efficiency is at the moment confirmed.

- *Collimation Impedance*. Last studies confirm that high impedance introduced by LHC collimation system will limit beam intensity to ~50% with respect to LHC nominal performance. A relevant aspect pointed out is that the problem cannot be completely solved by using high electrical conductivity materials for collimator jaws (since they worsen real part of transverse impedance); dielectric materials could improve the situation on one side (Re part), but would strongly increase Im part. Two alternative methods acting on beam dynamics may be used to recover possible instabilities provoked by the impedance: landau damping octupoles and transverse feedback (more details can be found on specification meetings web page): the choice has to be discusses yet. Therefore, during this first part of R&D activity, we cannot focus only on the use of high electrical conductivity materials but we must consider two parallel solutions with conductive and dielectric materials for collimator jaws.

- *Ion beams*. LHC collimation system should acquire the capability of working also with ion beams (for future LHC experiment called ALICE). Main issue coming from this discussion is that an upgrade of primary collimators is probably necessary to attain the target.

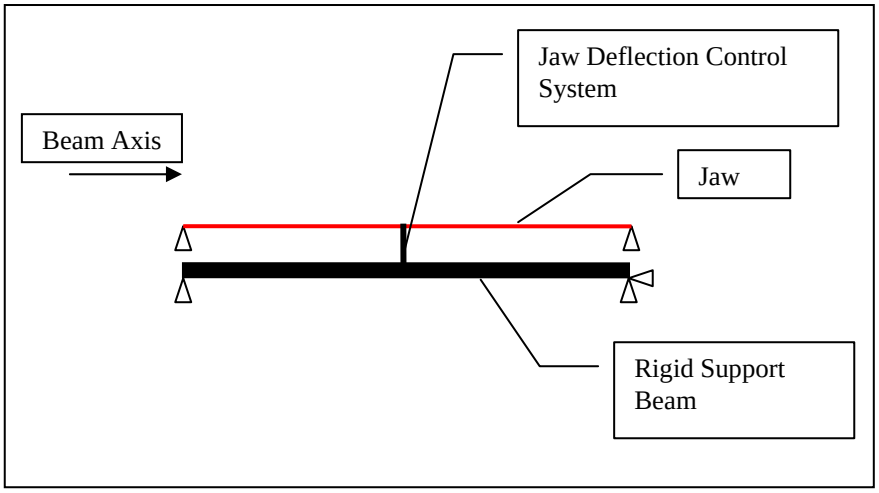
2. Outcomes from material R&D brainstorming discussion – 7/02/2008 (A. Bertarelli; G. Izquierdo)

Presents: A. Dallocchio, A. Bertarelli, I. Wevers; W. Vollenberg, G. A. Izquierdo, S. Heikkinen, F. Cerutti, L. Weber (EPFL).

Main issues discussed in this meeting dealt with energy deposition studies (F. Cerutti) and proposal of new materials (G. Izquierdo).
Cerutti illustrated theoretical guidelines for the evaluation of energy deposition provoked by protons impinging on several materials. Three main parameters can be used to describe these phenomena: radiation length, interaction length and Molier radius (more details will be soon available on specification meetings web page).
After Cerutti's presentation it was proposed to evaluate the possibility of a "multi-component" jaw built as a series of longitudinal slices made up of different materials. This solution could lead to an optimization of the energy deposition with a longitudinally "flat" heat load or at least with small peaks of heat deposition. More studies will be performed on this subject.
G. Izquierdo presented some aspects about liquid metals that can be interesting for our application. Three elements were mainly considered (Gallium *Ga*; Indium *In*; Tin *Sn*). These metals can be maintained in a liquid status at a relatively low temperature; moreover these liquid metals accept a temperature increase of the order of 200°C-450°C respecting ultra-high vacuum requirements. It is clearly difficult to create a perfectly flat film of liquid metal to be used as a "liquid collimation jaw" but it is important during this R&D phase to assess all possible materials.

3. Preliminary study on design solution for jaw assembly (A. Bouzoud)

A preliminary design solution for jaw assembly has been prepared by *Bouzoud* developing an idea of *Bertarelli* and *Dallocchio*: as shown in the sketch the structure is made up of a rigid simply supported beam, ideally not affected by heat deposition, that should ensure high geometrical stability to the system. Collimation jaw is free to expand and connected at the extremities to the support beam. A control system placed in the middle of the jaw should allow to regulate/compensate the deflection of the jaw (due to gravity, mechanical tolerances, etc…) in order to obtain a very good flatness of the jaw assembly. The cooling system should be brazed on the jaw to evacuate the heat load; furthermore, given that rigid support beam will be unavoidably affected by a certain energy deposition, then cooling pipes should be placed also on rigid support in order to obtain a good geometrical stability. To this end an important issue was raised: it is necessary to evaluate the possibility of having welded components inside vacuum tank so that design of cooling system could be more efficient. Experts in vacuum technology will consider this opportunity.



Schema of preliminary design solution for jaw assembly.

4. Action list

- Follow up of design solution.
  (A. Bouzoud)

- Discussion with vacuum experts on the possibility of having welded components inside vacuum tank.

Next brainstorming discussion on materials will be on February 21st, 2008.
Room 376-1-016

Next Phase II Design meeting will be on February 28th, 2008.
Room 376-1-016