LHC Collimation PHASE II
7th Design Meeting - 24/04/2008

Present: Gonzalo Arnau Izquierdo, Arnaud Pierre Bouzoud, Ramon Folch, Wihelmus Vollenberg, Fritz Caspers, Alessandro Bertarelli (chairman), Alessandro Dallocchio (scientific secretary).

1. Summary of RF issues and implications on design solutions. (A. Dallocchio)

The meeting started with a presentation held by *A. Dallocchio* including a summary of RF issues and their implications on the design of Phase II collimators.
As discussed in the previous CDM2 and confirmed during the 5th specification meeting, the choice between metallic and ceramic jaws strictly depends on the stabilization method will be used for the LHC beams (Landau damping octupoles or Transverse feedback); recent studies seem to support the effectiveness of the transverse feedback but it is necessary to wait for LHC to become operational in order to have a definitive confirmation. Following the requirements of *R. Assmann*, at this stage of the project, both solutions of metallic and ceramic jaws must be developed. *Dallocchio* made a summary of the different solutions based on the specifications given by RF specialists (E. Metral, F. Caspers):

1. Metallic jaw. This option entails that the best electrical conductor should be used in order to obtain good RF performances. The jaw must be monolithic, with a flat surface and without gaps.
2. Ceramic jaw. This solution entails the use of ceramic tiles (5-10 mm thick) bonded on a continuous metallic support. Ceramic material should have an electrical resistivity within the range 1-10 Ωm in order to obtain good RF performances while the metallic support should have a good electrical conductivity. This configuration could accept the use of relatively short ceramic tiles (50-200 mm) with gap between the tiles up to 2-3 mm (to be verified).
3. Comb jaw. From the RF point of view, the use of a metallic "comb" jaw is equivalent, at low frequency, to the solution presented at point 2. This option must be evaluated (a comb jaw sample is under construction and the RF performances will be tested).

Dallocchio remarked the importance of developing a stable support system that could be ideally adapted to the different design solutions used for the jaws (ceramic tiles, metallic monolithic jaw…). Current design status foresees a rigid back stiffener made up of Molybdenum and a jaw support including the cooling system. Two different solutions have been evaluated:

1. Cooling pipes machined from solid block + brazed covers. Potential material that can be used in this case is GLDCOP. UHV requirements and risks coming

from the exposure of brazed joints to high radiation must be carefully taken into account.

2. Cooling pipes embedded in a cast block. This solution should be evaluated in case of metal-diamond composites will be used (the idea was proposed during the material R&D brainstorming discussion held on 19/03/2008, see the minutes of the 4th CDM2).

2. Discussion on current design status

A discussion followed the presentation held by *Dallocchio*.
Some comments were given about design solutions of collimator jaws: *Caspers* remarked that, in case of ceramic tiles, the gap between the tiles must be up to 2-3 mm (all the solution must be tested to verify RF performances); concerning the metallic support on which the ceramic tiles are bonded, the required electrical conductivity is not extremely high (Copper as well as Aluminum is accepted). *Caspers* explained that preliminary results (tests and simulations) seem to confirm that very good RF performances can be obtained with a material with electrical resistivity 1-10 Ωm with a coating (10-20 μm) made up of a material with very high conductivity; more details will be given.
Bouzoud presented some design studies about integration of BPM in the collimator jaw assembly, some problems come from rigid cables. Furthermore, *Bouzoud* and *Perret* are studying a solution for the cooling pipes embedded in a cast block: this option presents some problems concerning the radius of bending of pipes.
Caspers remarked that the RF rail (used for Phase I collimators) can be probably replaced by Ferrite blocks.
Bertarelli and *Dallocchio*, following preliminary calculations, confirmed that the design principle of a back stiffener + flexible jaw could work correctly; more detailed calculations will be done. *Bertarelli* remarked that the fixed point must be removed from the jaw that need two free supports. The fixed point can be used for the back stiffener; this change should give a better geometric stability (to be verified).
The option of including an active regulation system in the middle of the jaw assembly has been preliminary evaluated; the use of a piezoelectric actuator was excluded because it cannot survive to the bake-out temperature.
A list of open actions can be found in the next paragraphs

3. Action list

ACTION	MANAGED BY	OPENED	CLOSED
Verify potential problems relative to machining and brazing of Molybdenum	G. Favre	28/02/2008	In Progress
Verify the feasibility of the Molybdenum back stiffener (PLANSEE, PAM)	G. Izquierdo	24/04/2008	In Progress
Verify the feasibility of Molybdenum pipes (PLANSEE)	G. Izquierdo	24/04/2008	In Progress
Define specifications for metal-diamond samples to be used for RF tests	F. Caspers G. Izquierdo	24/04/2008	
Supply of metal-diamond composite samples for UHV tests.	L. Weber	14/03/2008	In progress
Validation of the metal-diamond materials to UHV requirements.	I. Wevers W. Vollenberg	14/03/2008	
Find ceramics with electrical resistivity within the range: 1-10 Ωm (evaluate the proposal of Caspers of using SiC). Verify the influence of temperature on the electrical conductivity.	G. Izquierdo	10/04/2008	In progress
Energy deposition and thermo-mechanical calculation on Collimator jaw assembly	A. Dallocchio F. Cerutti	24/04/2008	In progress
Verify with R. Assmann the cleaning efficiency of a “comb” jaw.	A. Bertarelli A. Dallocchio	27/03/2008	

Next Phase II Design meeting will be on May 15^{h}, 2008.
Room 376-1-016