

# LHC Collimation PHASE II

## 12<sup>th</sup> Design Meeting - 20/05/2009

*Present:* Arnaud Pierre Bouzoud, Roger Perret, Bruno Feral, Marc Timmins, Romain Blanchon, Gonzalo Arnau Izquierdo, Stephan Roesler, Luisella Lari, Fritz Caspers, Gilles Favre, Ralph Assmann, Alessandro Bertarelli (chairman), Alessandro Dallochio (scientific secretary).

### 1. Design Status

*Dallochio* made a resume of the design status (more details on [Dallochio's talk](#)) focusing on the following issues:

- Modular design concept. Promising candidate materials for collimator jaws and abandoned solutions.
- Brazed cooler. A procedure to qualify the design was developed and successful experimental results have been obtained from the two prototypes. This procedure, opportunely revised, will be sent for approval in order to be ideally applied to the whole production. Furthermore, non-destructive and destructive tests will be performed on the prototypes.
- Updated design. Last version of Phase II mechanical design was presented and compared to the previous one. The new concept is based on non-continuous jaws made up of separate blocs independently supported. FEM analyses show clear advantages in terms of thermo-mechanical stability.

*Perret* described some details of the new mechanical design, particular attention is devoted to the new RF system (Ferrite blocs “coupled” with plates) and to the contact elements placed between each bloc. The new fine adjustment system, allowing the control of the jaw flatness, is described. The design team proposed the production of a test-bench to experimentally verify the effectiveness of the adjustment system made up of push-pull differential screws: some preliminary drawings of the test-bench and of the collimator jaw assembly were shown (see [provisional drawings](#)).

#### 1.1. Comments and remarks

- *Caspers* commented about ultrasounds cartography performed for cooler prototypes to verify the quality of the brazing; he proposed, as a cross-check, to perform also a 3D X-ray control of the brazing joint of one prototype with a device will be soon available at CERN.
- *Assmann* remarked that the ultrasound cartography shows a strange imperfection close to the inlet/outlet pipes. Possible defect must be verified.
- *Ralph* proposed to perform erosion/corrosion tests for the cooler prototypes in order to verify, also for these aspects, the reliability of the proposed design.
- *Bertarelli* commented *Ralph's* proposal saying that brazed surface of the cooler is much thicker with respect to phase I pipes. This should ensure a good safety margin, anyway the possibility of erosion/corrosion tests will be carefully evaluated and supported by CFD detailed analysis of the cooler's pipes. Furthermore, *Bertarelli* remarked the importance of testing cooler prototypes with water in order to verify the flow rate and the pressure losses over the cooling circuit. *Bertarelli* proposed to add these tests to the qualification procedure.

- *Caspers* recalled the possibility of a detailed measurements of the water flow profile with a 3D Doppler device. This would provide detailed information about laminar and turbulent profiles or possible cavitation risk.
- *Caspers* gave positive feedback about new RF system used for the last version of the jaw assembly. RF contacts between jaw blocs are designed correctly as well as ferrite tiles. Minor modification concerns RF contacts that must have finer fingers with smaller gaps.
- *Caspers* remarked that, due to the new shape of the back-stiffener, potential problems due to resonances must be carefully verified.
- *Assmann* approved the proposal of building a test-bench to verify the effectiveness of the new design of the jaw assembly, especially concerning the fine adjustment system.
- *Assmann* reported that CERN management is interested not only in the BPM embedded system but also in a BLM system embedded in the collimator jaws in order to measure the number of intercepted particles. *Bertarelli* remarked that BLM integration was discussed during the 11<sup>th</sup> CDM2. Many problems were found concerning the integration of a BLM (with its connecting cables) into the vacuum tank. *Assmann* proposed to evaluate a new BLM design that will be presented at CERN.

## 2. Material testing (SiC)

*Blanchon* presented preliminary results obtained from measurements of electrical resistivity of SiC samples (more details in his [talk](#)). Several samples of SiC, from different suppliers, will be measured in order to identify suitable material(s) in terms of RF performances (required range for electrical resistivity is 1-100  $\Omega\text{m}$ ).

*Blanchon* showed also preliminary results obtained from brazing tests between Cu and SiC. Additional tests are foreseen, including grooves and/or intermediate layer of Molybdenum, in order to overcome problems due to differential CTE.

### 2.1. Comments and remarks

- *Caspers* remarked that experimental procedure used to measure SiC electrical resistivity is potentially affected by errors. Further investigations are necessary. Moreover, electrical resistivity of SiC could be function of temperature and frequency, and DC measurements must be confirmed by RF tests.
- *Caspers* commented that the solution of Cu support with grooves with brazed SiC tiles, must be verified from the point of view of RF performances.

### 3. Action list.

ACTION	MANAGED BY	OPENED	CLOSED
Tests on Mo plate and tube: machining, welding, bending dimensional stability after baking out.	G. Favre G. Arnau	19/06/2008	In progress
Identify one or more ceramics with the following properties: Resistivity :1-100 $\Omega$ m Diel. Const: as low as possible (up to 5) Loss factor: < 1E-2 Brazeability to metal support. High density	G. Arnau	19/06/2008	In progress
Once ceramics identified do brazing and machining tests	G. Arnau G. Favre	19/06/2008	In Progress
Thermo-mechanical calculations using Cu-diamond and Al-diamond to confirm its interest	A. Bertarelli A. Dallochio	3/07/2008	Closed
Contact BNL for radiation tests	G. Arnau	3/07/2008	To be done
Verify with R. Assmann the collimation efficiency in case of ceramic jaws.	A. Dallochio	17/07/2008	Standby
Prepare a document for PLANSEE including design specifications of the back-stiffener	A. Bertarelli	05/09/2008	Done
Follow the preparation of a mockup of the cooler (EPFL): Inox pipes back-casted in Al-CD	G. Arnau Izquierdo	05/09/2008	In Progress
Prepare a prototype of cooler: machined pipes + brazed / welded cover.	Bouzoud Perret	19/09/2008	Closed
Contact PSI and B. Dehning for integration of BLM	Dallochio	19/09/2008	Standby
Energy deposition studies (FLUKA analyses) for different materials and design (accident scenarios: direct impact on TCSM + impact on TCP and shower on TCSM):	L. Lari F. Cerutti	19/09/2008	In Progress
Prepare plans of BPM and cables.	G. Arnau	03/10/2008	Closed
Prepare list of specifications for BPM system to submit to the supplier for the feasibility study.	Jones, Gasior, Bertarelli, Dallochio	03/10/2008	Closed
Modify flanges for BPM electrical connections	Bouzoud Jones	03/10/2008	Closed
Verify minimum bending radius of BPM cables	Jones	03/10/2008	Closed
Ralph to give his principle agreement on installation constraints of long and thick coaxial cable in the tunnel	R. Assmann	03/10/2008	Closed
Verify how to perform evaluation tests	A. Bertarelli /	3/10/2008	Closed

of the BPM system (ring or specific test bench)	R.Assmann		
Evaluate the cost / benefit ratio of the in-vacuum BLM solution to possibly include it in jaw design	R. Assmann / B. Dehning	3/10/2008	Standby