Task 1: Worst case shock beam impact / worst case continuous beam impact

The worst case shock beam impact has been specified and published in LHC Project Note 293 and LHC Project Report 599. The data has been provided for input to energy deposition calculations. Further refinements can be expected in the details of incoming beam distribution (zero divergence to realistic divergence).

Timeline: In parallel to task 2, as needed.
Missing input: -

Task 2: Energy deposition in jaws of different material

The beam impact distribution is used to calculate the energy deposition in jaws of different materials. Done with FLUKA code. Details:

(i) Redo previous results for Cu (partly done).
(ii) Studies for C, Be, Al, … (materials to be defined)
(iii) Summarize in coherent way and provide numerical input to task 3.

Timeline: ongoing, Nov 2002
Missing input: Task 2b

Task 2b: Material survey to select relevant materials

A survey of materials of interest for the LHC collimation system is done in order to make a pre-selection of materials and their exact properties (e.g. there are many different forms of Carbon materials, choose a few).

Timeline: to be started, Nov 2002
Missing input: -

Task 3: Damage and fatigue analysis

The energy deposition data is used in ANSYS to evaluate damage and fatigue issues for different materials and lengths.

Timeline: to be started, up to Dec 2002
Missing input: Tasks 2, 2b.

Task 3b: Experimental tests of various materials with beam

The materials are exposed to beam to test the model predictions and check issues of damage, fatigue, elastic and inelastic deformations, vacuum, …

Timeline: 2003
Missing input: Task 2b.

Task 4: Decision on jaw material and length

Based on Tasks 1-3b a jaw material and length is selected both for primary and secondary jaws (at least two different types of jaws).

Timeline: Dec 2002 (Summer 2003)
Missing input: Tasks 2, 2b, 3, 3b.

Task 5: Verify material and length choices and establish tolerances

Verify the cleaning efficiency, impedance, layout of cleaning insertions, local electron cloud, and vacuum with design choices from Task 4. Establish tolerances on system parameters (both jaw and beam parameters) and define required degrees of freedom in jaw movement.

Timeline: Mar 2003 (Oct 2003)
Missing input: Task 4.

Task 6: Mechanical design of jaws and construction of prototype

Based on the choices of lengths and materials perform mechanical design of collimator jaws for primary and secondary collimators (at least 2 types of jaws). Specify design surface roughness and flatness. Include cooling channels etc to meet tolerances in regular operation (deformations, temperature, …) where we expect up to 100/500 kW beam impact (continuous/peak). Include eventual jaw instrumentation (temperature sensors, charge collector, …). Include provisions against local electron cloud (bias voltage), if required. Consider consequences of foreseen bake-out. Add required tapering for impedance. Add mechanism for active control for surface flatness, if required (change of mounting stress).

Timeline: Dec 2003
Missing input: Tasks 4, 5.

Task 7: Radiation environment and levels/Handling of collimators and tools required

Establish radiation levels in the cleaning insertions. Specify the handling of the collimators and the tools required.

Timeline: Mar 2003 (Oct 2003)
Missing input: Task 4.

Task 8: Mechanical system layout (tank, mechanical support, motors, …) and construction of prototype

Design the mechanical systems (at least 2) for primary and secondary collimators, which include the vacuum tanks, mechanical support and control (jaw position and angle), motors for remote control, provisions for remote handling, provisions for remote diagnostics of jaws (window to inspect collimator surface or more sophisticated). If required include measures against local electron cloud. Include survey and alignment measures. In case of remote handling include provisions for achieving installation tolerances. Provide fail-safe information on collimator gap (machine safety depends on collimator gap). Design front-end electronics for collimator control. Construct prototypes of mechanical systems and associated controls for primary and secondary collimators.

Timeline: Dec 2003
Missing input: Tasks 4, 5, 6, 7.

Task 9: Tests of prototype components

Test the jaws (bake-out, heating, deformations, integrated diagnostics, bias voltage, …). Test the tanks and mechanical systems (mechanical handling, alignment, installation issues, motors, remote handling, …). Test integrated systems for primary and secondary collimators (requires two jaws each primary and secondary).

Timeline: Apr 2004
Missing input: Tasks 6, 8

Task 10: Production of collimation system

After successful tests of integrated systems produce the overall system.

Timeline: Dec 2005 (tbc)

Task 11: Installation of systems

Timeline: Dec 2006 (tbc)