Interaction of the CERN LHC Beam with Collimators and Absorbers*

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Carbon collimators and beam absorbers are installed in many locations around the LHC to absorb beam losses, since carbon is the material that is most suitable to absorb the beam energy without being damaged. Because collimators and absorbers are close to the beam, it is very likely that they are hit first when the beam is accidentally deflected. In this contribution we present the results of two-dimensional hydrodynamic simulations of heating of a solid carbon cylinder with a radius = 2.5 cm and a length = 10 m which is facially irradiated by one LHC beam with nominal parameters.

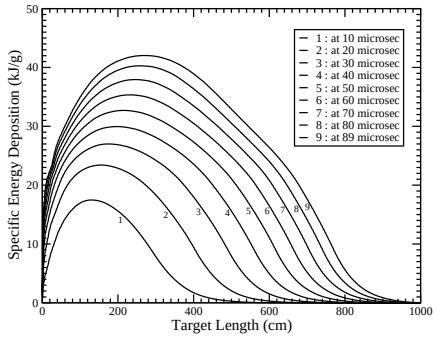

Figure 1: Specific energy deposition vs target axis at different times during irradiation.

Fig. 1 shows specific energy deposition along target axis at different times. It is seen that at 10 μs a specific energy of about 15 kJ/g is deposited. The magnitude of the peak increases with time while its position shifts rightwards. It is seen that at the end of the pulse, at 89 μs, a maximum specific energy deposition of about 40 kJ/g is achieved.

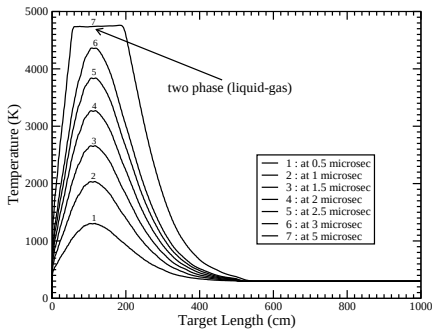

Figure 2: Temperature vs target axis at different times.

Fig. 2 shows the temperature evolution along the target axis during early stages of heating. It is seen that the temperature increases as more and more energy is deposited by the beam and at 5 μs it becomes constant. This is because the target enters into a two-phase liquid–gas state.

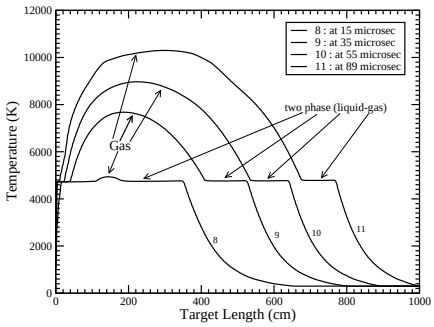

Figure 3: Temperature vs target axis at different times up to 5 μs.

Fig. 3 shows temperature evolution at later times. It is seen that at 15 μs, a small region of the target becomes gaseous. Following curves show that the two–phase region moves rightwards while the temperature in the gaseous part increases to about 10000 K.

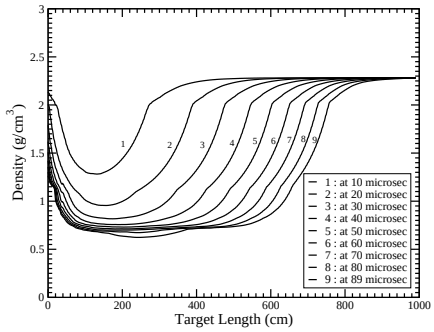

Figure 4: Density along target axis at different times after 5 μs.

Figure 4 shows the density change along the target axis at different times. It is seen that at the end of the pulse, at 89 μs, the beam has penetrated about 9 m into solid carbon and the density in the beam heated region has been reduced to about one third of the solid density (2.28 g/cm^3).

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