

# Modelling and simulation of the pellet shattering process related to the SPI technology for the ITER DMS

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The ITER disruption mitigation system (DMS) is based on shattered pellet injection (SPI) technology. The principle of operation is to form and accelerate cylindrical cryogenic pellets to high speeds towards a shattering unit, where the pellets disintegrate into a shower of fragments of different sizes, which enter the plasma for the mitigation process. The effectiveness of this mitigation process is strongly dependent on the optimal fragment size distribution and velocities produced by the shattering process. In order to achieve these, it is important to know how the impact conditions, namely pellet material, velocity, impact angle, orientation etc., influence the fragmentation characteristics. The ITER DMS task force has launched a program to characterize and study the fragmentation experimentally.

As part of this program, Fraunhofer EMI is developing numerical models and computer codes to simulate and analyze the complex fragmentation process within the framework of an ongoing research project. The above-mentioned experiments serve, among other things, to calibrate and validate the developed models and procedures. The validated models will then be used to significantly extend the experimentally determined database. The goal is to optimize the shatter unit design as well as to derive guidelines for optimized impact conditions in order to get the desired fragment characteristics.

Our presentation gives an insight into the modelling approach, which combines elements from the peridynamic theory with the discrete element method into a software to simulate cracks and fracture of brittle materials such as cryogenic pellets. For exemplary cases we show the current status of results from simulated pellet shattering processes, and compare them to experimental data. Furthermore, we present how synthetic diagnostics, fragment detection and optimization methods are used to systematically perform the model calibration and validation process.

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