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Numerical investigations of the WASA pellet target operation and proposal of a new technique for the PANDA pellet target

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The conventional nozzle vibration technique of the hydrogen micro-droplet generation that is supposed to be used for internal pellet target production for the future PANDA experiment at the international FAIR facility in Darmstadtfor is described. The operation of this technique has been investigated by means of detailed computer simulations. Results of calculations for the geometry and operation conditions of the WASA pellet generator are presented and discussed. We have found that for every given pellet size, there is a set of operation parameters where the efficiency of the WASA hydrogen pellet target operation is considerably increased. Moreover, the results of presented computer simulations clearly show that the future PANDA pellet target setup can be realized with the use of much smaller (and cheaper) vacuum pumps than those used at present in the WASA hydrogen pellet target.
To qualitatively improve the PANDA hydrogen pellet target performance we have proposed the use of a novel flow focusing method of Gan˜a´n-Calvo and Barreto combined with the use of conventional vacuum injection capillary. Possibilities of this approach for the PANDA pellet target production have been also explored by means of computer simulations. The results of these simulations show that the use of this new approach looks very promising and in particular, there is no need here to use of expensive ultra-pure hydrogen to prevent nozzle clogging or freezing up due to impurities and it will allow simple, fast, smooth and a wide range of change of pellet sizes in accordance with requirements of different experiments at the PANDA detector.
We also propose and describe the idea of a new technique to break up a liquid microjet into microdroplets using a process of liquid jet evaporation under pulsed laser beam irradiation. This technique should be experimentally checked before it may be used in the design of the future PANDA pellet target setup.

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