

Investigations on Monitor Systems at the Beam Dump of the PANDA Cluster-Jet Target*

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The cluster-jet target will be the day-1 target for the PANDA experiment at FAIR. Therefore, this target has already been set up at Münster and is currently under investigation at COSY/Jülich to study the target performance in combination with a proton beam. In parallel, further important studies are currently ongoing at the PANDA cluster-jet target prototype at the University of Münster which will be of high relevance for the PANDA experiment.

For the best possible performance, the cluster-jet target needs to be adjusted perfectly so that the cluster-jet does not hit any part of the beam pipe which would lead to a smaller target thickness and higher pressures at the interaction point. For this purpose several diagnosis tools need to be installed at different points of the setup. Currently an optical beam monitor system is installed, which allows to visualise the position of the cluster-jet in two vacuum chambers close to the jet nozzle. In addition, a rod system is used to measure the target thickness in another chamber in a distance of 2.9 m behind the nozzle. As this position will not be available in the final PANDA setup, it has to be removed or placed at a different position, so that there would be no monitor system below the interaction point. Therefore, investigations are ongoing to place some monitor systems within the target beam dump. These are mainly the rod system and a MCP detector for different purposes.

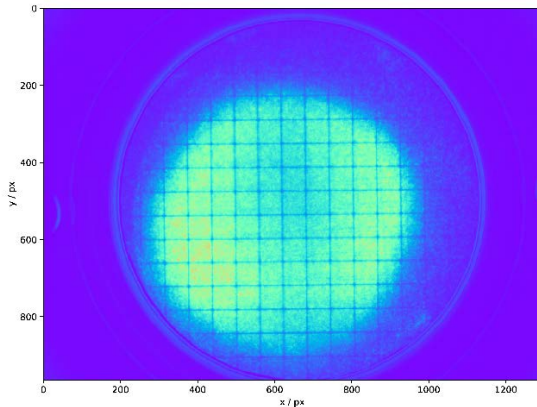


Figure 1: Visualisation of a hydrogen cluster-jet via a MCP setup at the prototype target in Münster.

The rod system allows to measure the thickness profile of the cluster-jet by scanning through the jet which then leads to the destruction of clusters and a pressure increase. From this, the absolute target thickness can be calculated when knowing the pumping speed at the chamber and the cluster velocity. This velocity had been measured and simulated for the nozzle currently used within the final

PANDA cluster-jet target [1, 2]. However, it was also shown that these velocities also depend on the nozzle and its emission angle [3], so that a perfect way would be to do these velocity measurements directly at the PANDA target.

Therefore, a MCP detector is planned to be installed within the last beam dump stage. The MCP in combination with a phosphor screen can visualise a hydrogen cluster-jet that was ionised by an electron gun as it can be seen in figure 1. This can help to perfectly adjust the PANDA cluster-jet target so that the jet passes the complete system up to the beam dump without any contact with the beam pipe. Furthermore, it is also possible to use it for a time-of-flight (TOF) measurement.

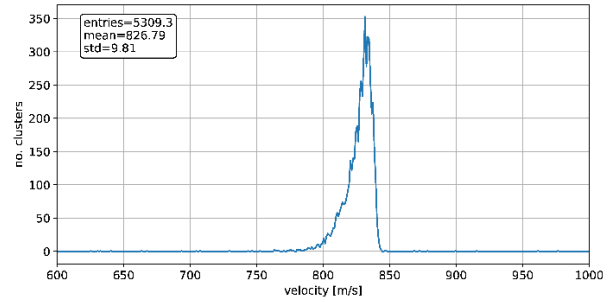


Figure 2: Hydrogen cluster velocity distribution measured with a time-of-flight setup.

To measure the cluster velocity, single clusters are ionised by a pulsed electron gun which defines the start signal for the TOF measurement. At the MCP these clusters generate a huge number of electrons that are then accelerated onto the phosphor screen, leading to a voltage signal that is used as stop signal. From the time-of-flight and the path length between ionisation and detection, the velocity of the cluster can be calculated. The velocity distribution for a hydrogen cluster-jet that was generated at stagnation conditions of 35 K and 10 bar is shown in figure 2.

CONCLUSION

Current investigations at the University of Münster show that the insertion of an MCP system for beam monitoring and velocity measurements in combination with a rod system to measure the absolute target thickness is of high interest for the PANDA cluster-jet target.

REFERENCES

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