Design and special features of the cluster-jet target for $\overline{\text{P}}$ANDA*

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The first target to be operated at the $\overline{\text{P}}$ANDA experiment will be a cluster-jet target. A prototype of this cluster-jet target has already been built up in full $\overline{\text{P}}$ANDA geometry at the University of Münster [1] and operates successfully for years. With this device it is routinely possible to achieve hydrogen target thicknesses of more than $2 \times 10^{15}\ \frac{\text{atoms}}{\text{cm}^2}$. The target thickness is stable in time and can easily be adjusted by varying the pressure or temperature of the used gas before entering the nozzle. Based on the experience with performance of the prototype, the final $\overline{\text{P}}$ANDA cluster source was designed and is currently under construction at the University of Münster (Fig. 1). The cluster

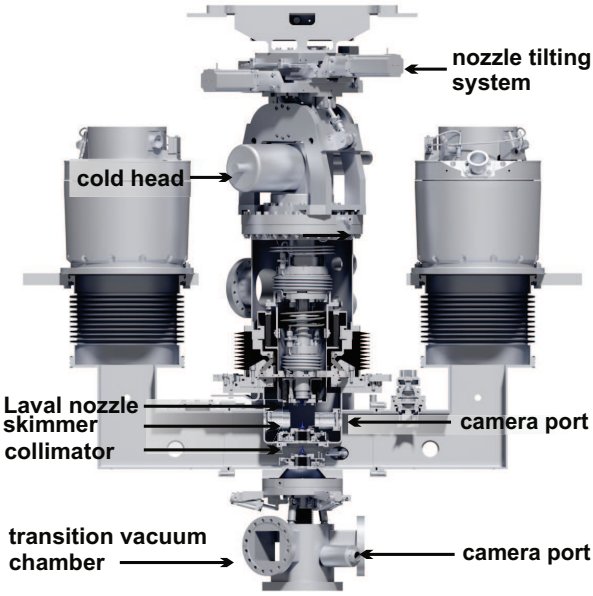

Figure 1: Main components of the cluster source for $\overline{\text{P}}$ANDA.

beam itself is produced by the expansion of pre-cooled gases in a Laval nozzle (for further information concerning the Laval nozzle see [2]). For gas cooling a cold head is used which allows lowest temperatures of about 9 K without gas flow, which is more than sufficient for the target operation. A conical skimmer arranged behind the nozzle extracts the cluster beam from the residual gas and followed by a second orifice, the collimator, which defines the final size and shape of the cluster beam. Moreover, the cluster source includes a nozzle tilting system, allowing for an adjustment of the nozzle system relative to the experimental setup. With this system it is possible to select highly intensive core beams located within the cluster beam leading to highest target thicknesses [3]. To observe these core beams the skimmer chamber includes two camera ports on opposite sites of the chamber. For an optimal extraction and adjustment of the cluster beam towards the interaction point, skimmer and collimator are installed on xy-tables. To provide the required vacuum conditions the skimmer and collimator chambers are pumped via differential pumping systems. Due to the high gas load in the skimmer chamber, a pumping station consisting of two roots pumps combined with two fore pumps with an overall nominal pumping speed (for air) of up to $7800\ \frac{\text{m}^3}{\text{h}}$ is used. This pumping system simultaneously provides the pre-vacuum for the collimator chamber, where two turbo molecular pumps with a pumping speed (for air) of $2000\ \frac{\ell}{\text{s}}$ each are installed. Subsequently to the collimator chamber the transition vacuum chamber provides the connection to the vacuum of the HESR. For this chamber, additional camera ports are included, allowing for an online cluster beam and thickness monitoring without influencing the cluster beam itself. This non disturbing measurement principle is described in [4]. For the test operation of the $\overline{\text{P}}$ANDA target a slow control system is developed. This slow control for instance contains the control of the stepper motor devices for the nozzle tilting system and the adjustment of skimmer and collimator, the operation of the pneumatic valves and the vacuum pumps as well as the hydrogen pressure control. Above that, a monitoring of relevant parameters, e.g. pressures, gas temperature and gas flow at the nozzle, is included. After full implementing and all necessary tests in Münster, the target might be installed at the COSY accelerator for a first test operation in an experimental environment.

References

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* Work supported by HGShire, EU(FP7), BMBF and GSI.
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DOI:10.15120/GR-2015-1-MU-HADRONS-21