Deuterium Recuperation for Cluster Targets at COSY

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For experiments at COSY two cluster targets have been built at the IKP of the University of Münster and installed in the internal experiments COSY–11 and ANKE in 1995 and 1999, respectively [1–3]. Due to the special design they allow to provide cluster beams of all gases except helium as targets for scattering experiments. For studies on elementary meson and hyperon production processes in the pp–, pn– and pd–scattering, hydrogen and deuterium gas is of special interest as target material.
Different to hydrogen, deuterium gas is comparatively expensive. Therefore, a recuperation system was build in order to reduce the loss of D_2–gas to a minimum. This system was successfully tested at a cluster target in Münster and installed at the COSY ring in summer 1999.
The deuterium flow in the closed circle is depicted in figure 1: Exhausted gas is collected from the pump stages and cleaned by a special molecular filter to eliminate oil from the forepump. The pre–cleaned gas passes a metal–membrane compressor and enters a hydrogen–purifier with a pressure of $\sim$ 14 bar. At this point the deuterium must be free of oxygen to avoid damages of the catalytic driven purifier. After this procedure ultra high pure deuterium is available and can directly be supplied to the cluster target installation.
To provide high quality cluster beams, stable conditions in the gas supply system are necessary. Therefore, a remote gauge system has been installed in order to monitor both the pressure of the exhausted gas behind the forepump as well as the final pressure of the compressed gas. Together with the information of the measured gas flow through the nozzle one can easily check the status of the deuterium recuperation system.
The first test operation of the recuperation system at COSY was performed within a COSY–11 beam time in summer 1999. During a test interval of ten hours a stable cluster beam was produced in combination with a deuterium loss of less than 5%. This loss is due to the amount of clustered gas which passes the scattering chamber for beam–target interaction and therefore is not pumped away at the cluster source.
Before starting the recuperation mode, the vacuum system of the cluster source including the gas connection of the corresponding forepump exhaust to the recuperation system has to be flushed with deuterium. By this, hydrogen from previous cluster modes as well as oxygen and nitrogen is eliminated, which is essential to provide stable deuterium cluster beams. Therefore, for an effective use of the recuperation system it is evident to have longer periods ($\geq$ two days) of continous operation with deuterium.

References:

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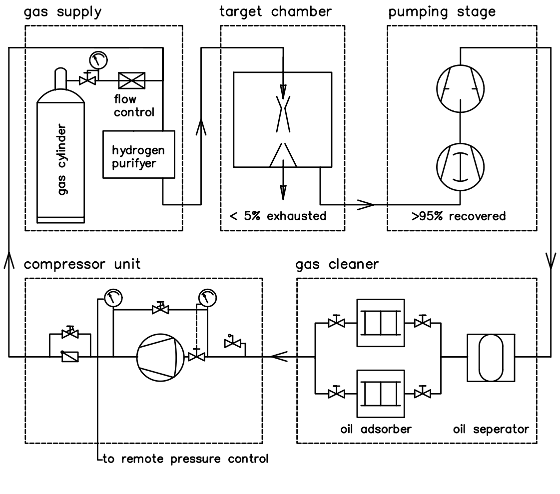

Figure 1: Gas flow in deuterium recuperation system.