

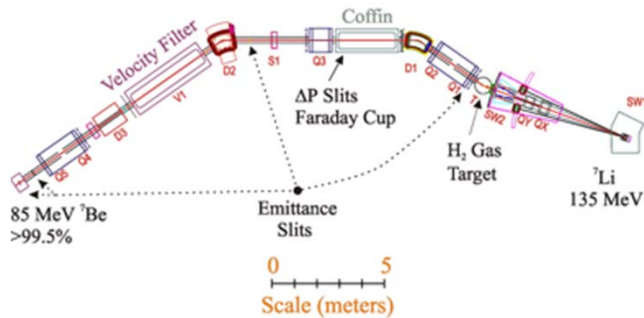


# UPGRADING THE CRYOGENIC HYDROGEN GAS TARGET MONITORING SYSTEM



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Momentum Achromat Recoil Separator layout



**MARS:** Used to create secondary radioactive beams from the K500 Super-Conducting Cyclotrons primary stable beam.

**Cryogenic H<sub>2</sub> Target:** The primary beam transmutes with the H<sub>2</sub> target creating a radioactive beam. This beam is then used in experiments.

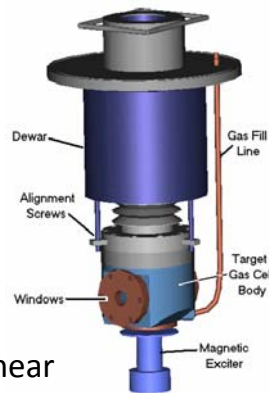
- Kept at 2 Atm of pressure and 77K to ensure a high target density.

**Monitoring:** The target chamber pressure, and whether or not the liquid nitrogen dewar is filling, must be monitored.

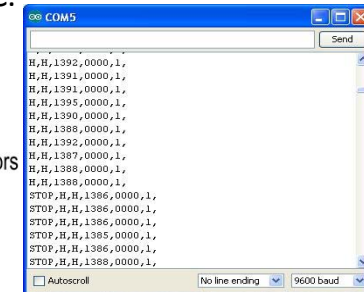
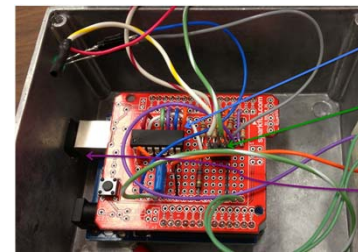
**Pressure:** The pressure sensor outputs an analog, linear 0 to 2 volt signal, with a maximum detectable pressure of 4 atmospheres.

**Filling System:** The filling system has an open circuit when not filling, and forces a digital 0V when LN2 is filling.

**Previous Monitoring:** The signals went into a B&B electronics Analog and Digital IO with a RS232 interface. RS232 is a no longer natively supported communication protocol on modern PC's. The software for monitoring pressure was written in Visual Basic 6, which is no longer supported and is platform (Windows) dependent.



**Arduino Uno [Atmel Inc.]:** The B&B unit has been replaced with an Arduino Uno and a Microchip 3204 12-bit ADC.



The pressure signal, after a low pass filter, goes to the external ADC which converts the signal to a 12-bit number. This is transferred to the Arduino via serial peripheral interface (SPI). A digital High or Low is received from the JC Controls automated LN2 fill control. The Arduino then outputs serial data to the CPU in the above format.

**Monitoring Program:** The VB6 program has been replaced with a program written in python. It primarily utilizes the Tkinter, pySerial and Matplotlib packages to interact with the Arduino and 'continuously' plot pressure values. The whole setup is ready to accept temperature data as well. It sends email alerts if pressure gets too high, and can cause an audible alarm to trigger through the Arduino, which can be shut off in the program, or via a button connected to the Arduino.

