SBS GEM detector Gas needs

July , 2019

Nilanga Liyanage and Kondo Gnanvo

Overview

The SBS GEM trackers for GEp-V experiment, expected to run in 2021, will consist of 18 INFN GEM modules arranged into 6 front tracker layers and 40 UVa GEM modules arranged into 10 back tracker layers. All modules will use a 70% Argon + 30% CO_2 gas mixture, with each module requiring a flow rate of 10 STP liters per hour. The total flow of 580 liters per hour plus approximately 20% overhead to account for losses sets the needed rate around 700 liters per hour.

The recoil polarization GEn measurement during GMn experiment, expected to be ready by 2020, requires up to 11 layers (44 modules) of UVa GEMs and 3 layers (9 modules) of INFN GEMs leading to a requirement of approximately 600 liters per hour.

These high gas flow needs for both experimental setups require the establishment of the proposed hall A gas mixing system to be operational before the GMn experiment.

SBS Gas system

The SBS Gas system will consist of the following:

Gas Shed: The SBS gas system will require 7 T-size Argon cylinders and 3 K-size CO_2 cylinders to be connected to the system at a time. The existing hall A gas shed outer enclosure is not big enough to house these cylinders. Therefore, the planed hall A gas shed outer enclosure addition will have to constructed for the operation of the SBS gas system. Jack Segal estimates that the space available inside the existing gas shed is sufficient to house the new gas mixing system.

Gas Mixing system: Jack has completed the design for the Gas mixing system already and has drawn up a detailed budget. The total estimated budget for the mixing system is $ 30,000; the main items include controllers, values and plumbing. The design and the budget are attached to this memo. Jack will be responsible for setting up the Gas mixing system and the main 1/2-inch gas line carrying the gas down to the pivot location in Hall A. These ½-inch lines already exist in place and will be re-purposed for this system.

Gas distribution system: The SBS GEM collaboration will be responsible for setting up the gas distribution system from the pivot to the GEM modules. The plan for this system has been prepared. A smaller version of this system, capable of providing gas up to 20 SBS GEM modules, is currently in place for using with the SBS GEM tracker assembly in the EEL building.

Consumable gas: The gas needs for a one month of running are estimated to be around 350,000 STP liters of Argon and 150,000 STP liters of CO_2. As a result, we will need approximately 42 T-size cylinders of Argon and 10 Liquid CO_2 K-size cylinders per month.

GMn only scenario for 2020:

If only the GMn experiment is running in 2020, the total gas need will be approximately 200 liters per hour. At this lower rate, we can use Ar/CO_2 pre-mixed gas cylinders housed in the existing gas shed outer enclosure and use an existing 1-inch line from the gas shed to the pivot. We will need 15 pre-mixed gas cylinders per month in this case and the cost will be approximately $ 2,500 a month.

Summary:

Setting up of the GEM gas system for SBS will requires Hall A capital infrastructure improvements of adding a gas shed outer enclosure (cost to be estimated by Jefferson lab engineering) and setting up of a new gas mixing system ($ 30 k cost estimate), and a SBS specific gas distribution system ($ 7 - $ 10 k cost estimate).

Running the recoil polarization GEn with GMn will require these to ready by early 2020.

Appendix: Gas system schematics, budget and notes

The pressure drop along the ½”-diameter, approximately 100 m long gas line from the gas shed to the pivot is estimated to be negligible. The GEM modules operate at a very slight over-pressure above atmosphere. The output gas will be vented into the hall through a 1 m long ¼-inch tube connected the output of each module. A micron filter will be installed on each output line to avoid any contamination of the modules due to back diffusion through output lines.

A regulator, set to no more than 10 psig should be added to the distribution system at the pivot. As a further precaution to prevent any damage due to over-pressure, we need to consider adding an input bubbler at this location as well.