Nitrogen Gas Purge System for RICH

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The RICH detector uses silica aerogel as radiator to produce Cerenkov photons. Aerogel efficiency is reduced if it absorbs water. A nitrogen purge system is used to minimize water concentration in the aerogel volume.

A 1500-gallon, liquid nitrogen (purity ≈ 99.998%, O_2 <5 ppm, H_2O <3 ppm) dewar located in the Hall B Gas Shed is used to purge the RICH detector's nitrogen volume.

Figure 1 shows the piping and instrumentation diagram. Gas flows through a series of filters. Stage 1 filtration (F1) is done by a HEPA filter, which removes particles larger than 0.01 µm. Stage 2 filtration (F2) uses activated charcoal, which removes volatile organic compounds. The coalescing filter used in stage 3 (F3) removes particles down to 0.003 µm and eliminates traces of oil vapor and its associated odor.

Gas pressure is reduced to 15 psig by pressure regulator PR1 before it goes to the 66-slm capacity manual valve flow meter, Fig. 1, which controls flow to the detector's nitrogen volume. Manual valve flow meters do not depend on power or network availability, ensuring uninterrupted gas flow during a power or network outage, or both.

An 80-slm capacity mass flow transducer is used to read back gas flow and supply flow signals to EPICS and the alarm handler. Signals available to monitor are nitrogen flow, supply pressure, exhaust water concentration, and differential pressure between nitrogen volume and atmosphere.

Nitrogen volume pressure is controlled by the oil level of an oil-filled gas bubbler. A transducer with a range of ±10 InWC is used to monitor the differential pressure between the detector volume and the atmosphere.

Current nominal nitrogen gas flow is 42 slm, resulting in 150 ppm water concentration in the detector volume. Full gas flow of 132 slm, 66 slm per channel, is achievable with a pressure regulator set to 5 psi.

In summary, this designed, fabricated, assembled, and tested system has been performing well since its installation at the beginning of 2018.

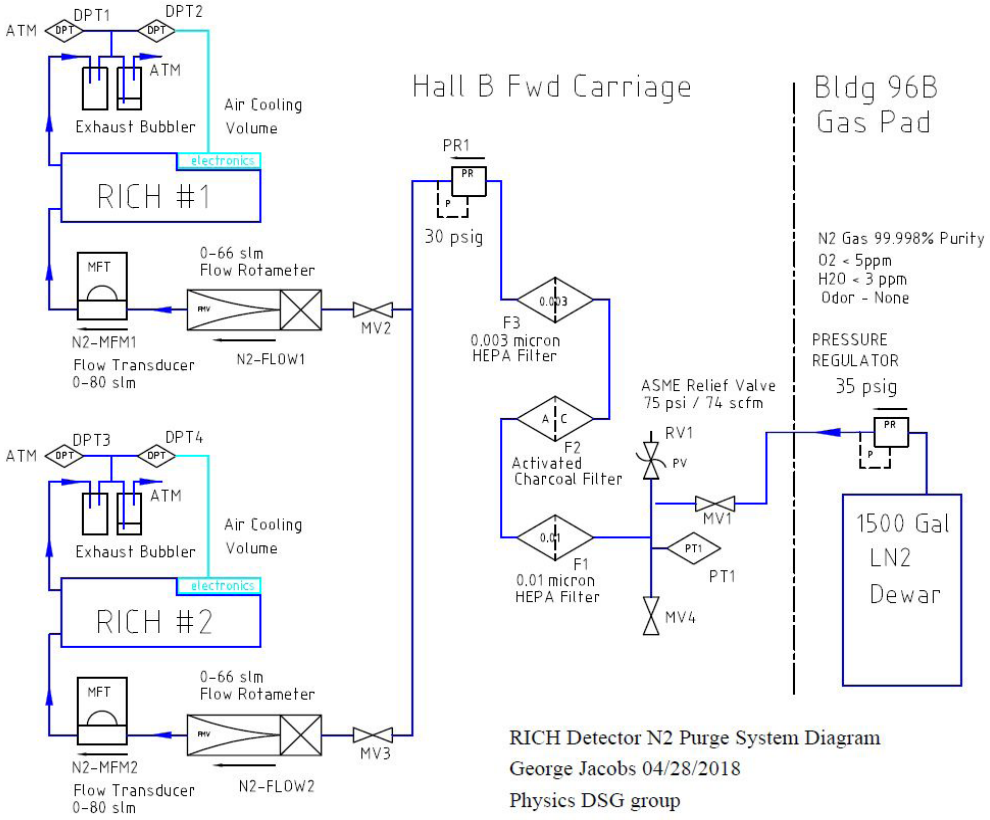

FIG. 1. Piping and instrumentation diagram of RICH nitrogen purge system.