

Gas Ring Imaging Cherenkov (GRINCH) Detector OSP

Todd Averett, *College of William and Mary*

13 Apr 2017

The Gas Ring Imaging Cherenkov (GRINCH) detector is designed for the BigBite spectrometer in Hall A. It is filled with C_4F_{10} gas at atmospheric pressure and will be used to separate electron events from pion events by detecting Cherenkov light in an array of 510 1" diameter photomultiplier tubes. The detector contains 4 cylindrical mirrors made of coated aluminum sheet metal. Entrance and exit windows are 100 μ m aluminum. The detector is sealed against gas and light leaks using flexible epoxy. The detector dimensions are approximately W x L x H = 1 m x 1m x 2 m. Access to the inside of the detector is made by removing one entire side of the detector, leaving an opening approximately 1 m x 2 m. To re-attach the side panel requires installing approximately 100 nuts and takes approximately 1 hour. The likelihood of someone fitting and being accidentally closed inside the detector is negligible.

The detector will be maintained at an internal pressure of 1 psia by an external gas panel that consists of a differential pressure sensor controlling solenoid valves fed by a gas bottle containing C_4F_{10} . There are two 3/4" NPT pressure relief valves set for 0.5 psig should the vessel reach an overpressure situation. The C_4F_{10} has a very low vapor pressure and at room temperature the maximum pressure in the gas bottle is below 40 psia. The C_4F_{10} gas is non-flammable and non-toxic but is a greenhouse gas. For flushing the detector prior to introducing the C_4F_{10} gas, CO_2 gas will be used with the same gas panel, and exhausted to the surrounding atmosphere. The CO_2 gas is non-flammable and non-toxic but is a greenhouse gas. The hazard with this gas is the potentially large pressure, up to 3,000 psia, in the gas bottle. The gas from the bottle will be held at 40 psia by an external regulator

The PMTs require up to +1200 Volts during normal operation. This will be supplied by a LeCroy model 1450 crate commonly used in Hall A. Connections from the crate to a patch panel box will be made with standard red SHV cables. From each patch panel box, across the hall, to a patch panel box on the BigBite detector system, will be an intermediate custom cable. The patch panel boxes and intermediate cables were manufactured by Jefferson Lab for use with the BigBite spectrometer in the 6 GeV era. From the patch panel box on BigBite will be custom cables made from HV wire and connectors approved by Jefferson Lab. Each cable will provide voltage to 8 PMTs in parallel. At no point along the high voltage distribution system will there be open access to unshielded wires.

Attached to the detector are front-end amplifier and discriminator cards that require approximately 5 Volts and 2 Amps per card. All of the 35 cards will be powered in parallel from a single commercial DC power supply. There will be no exposed wires carrying current. All electronics and PMTs are grounded to the metal detector vessel that will itself be grounded to the BigBite detector frame. All cables attached to the PMTs and cards will be secured to the detector to provide safety and strain relief. All cables from the detector to DAQ electronics or HV systems will be routed according to Hall A requirements for safety against tripping or degradation.

Any access to the inside of the detector, changes to the gas panel, or changes to the high and low voltage systems will be performed by Todd Averett or Bogdan Wojtsekhowski (Jefferson Lab) or trained members of their research groups.