DarkLight Requirements

DarkLight Collaboration

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1 Introduction

The DarkLight experiment requires several operational periods with the ARIEL electron beam. The primary goal for DarkLight is to search for a potential "dark matter" candidate. Before this can be undertaken the experimental components: spectrometer magnets, GEM detectors, trigger scintillators, and data acquisition system must be thoroughly calibrated and studied. This will be done in a commissioning period that will include a number of physics measurements. Once these commissioning runs are successfully completed the primary experimental running can proceed. The following sections outline the various requirements for the commissioning period and for the final, experimental operation.

2 Commissioning

Commissioning will require the ARIEL electron beam. We will want five (5) beam kinetic energies: 10, 15, 20, 25, and 30 MeV. We will used the 1 μm carbon target. At all of these energies the requested current will be around 1–5 μA. We many request a higher or lower current depending on the performance and count rate of the detectors and the data acquisition system. The actual value for the current is not too important for these measurements. Ideally we would like a high duty factor for the beam.

2.1 First Commissioning Phase

In the initial commissioning phase both magnet power supplies will be cabled with the same polarity: to bend electrons into the detectors. We may need to open the e-Hall to adjust the position of the detectors based on the results of the measurements.

2.1.1 Magnet calibration and Linearity

For each energy we will vary the magnet current, for both spectrometers, over the range: -20, -10, 0, 10, and 20 % of the nominal magnet current for the given energy. This will sweep the electrons elastically scattered from the carbon target across the face of the detectors to verify the calibration of the magnet current and linearity of the spectrometer response.

If the GEM detectors are found to NOT be on the focal plane of the spectrometer in may be necessary to access the e-Hall and adjust the GEM positions.

2.1.2 Carbon Elastic and Inelastic Scattering

For each energy we will set the magnet current, of both magnets, to position the elastic peak from carbon scattering towards the high momenta region of the GEM detectors. We will then collect data to look for the inelastic peaks. For these measurements it would be useful to know the incident electron beam current.

2.1.3 Møller Scattering

For each energy we will adjust the magnet current, of both magnets, to detect the Møller electrons.

2.2 Second Commissioning Phase

In the second commissioning phase the polarity of the positron arm magnet power supply will be reversed. This can be done either on the connections to the spectrometers in the e-Hall or on the power supplies on the roof.

For each energy we will then adjust the magnets to look for coincident events in the 20° and 36° spectrometers arising from Bethe-Heitler scattering from carbon.

3 DarkLight Experiment Data Runs

For the actual DarkLight experiment, searching for a possible “dark matter” candidate we will want 150 μA of 30 MeV electrons on the 1 μm Ta target. The electron arm magnet will be set for around 10 MeV/c and the positron arm magent will be set for around 18 MeV/c. We will then collect data.