SHMS Aerogel detector commissioning plan

(December 2017)

During commissioning the SHMS Aerogel detector will be equipped with the SP30 aerogel tray containing aerogel of refractive index of n=1.03. The experts in charge will be Hamlet Mkrtchyan, Arshak Asaturyan, Vladimir Berdnikov and Tanja Horn.

1 **Aerogel Detector Initial Checkout** (Beam energy 2.2 GeV/c)

Expected time: 1 hour

Goal: check signal timing and fADC thresholds

Conditions:

- Beam: 2.2 GeV, 5-20 μA, fast raster off
- Target: 0.5% carbon
- Collimator: SHMS collimator
- Trigger: SCIN ¾
- SHMS angle: 25°,
- SHMS momentum: -1.6 GeV/c

- Establish last KPP HVs in all the channels: Check presence of signals at the racks in fADC.
- Correct timing and fADC thresholds: Take a short run (a few 100k events) with fADCs in mode 9, analyze the accumulated pulse spectra and check timing and fADC thresholds. Fine tune timing and thresholds. Repeat if needed.

Expected 1 hour (eep) Coincidence

Goal: check aerogel response to protons and to scintillation from reflector material

Conditions:

- Beam: 2.2 GeV, 5-60 μA, fast raster 1×1 mm
- Target: 10 cm LH2, 10 cm dummy
- HMS/SHMS collimator: PION/COLLIMATOR
- HMS/SHMS Trigger: SCIN ¾; ¾
- HMS angle: 62.5°,
- SHMS angle: 25.1°,
- HMS momentum: -0.938 GeV/c
- SHMS momentum: +1.997 GeV/c,

- Check aerogel response for protons: Take a run with 10 cm LH2 (~ 1M events), analyze aerogel response

- Estimate scintillation from the reflection materials of tray and diffusion box: Take a run with LH2 or/and dummy (~ 1M events), analyze response

2 **Detailed Detector Checkout** (Beam energy 6.4 GeV)

Expected time: 2-4**?** hours

Goal: gain matching, calibration

Conditions:

- Beam: 6.4 GeV, 5-20 mA, fast raster off
- Target: 0.5% carbon
- Collimator: centered sieve (at 25°) and collimator (at 15°)
- Trigger: SCIN ¾
- SHMS angle and momentum: 25°, -1.6 GeV/c
- SHMS angle and momentum: 15°, -3 GeV/c

- Gain matching: Take a short (~100k events) run. Analyze and plot ADC signal spectra. Locate single photoelectron (SPE) peak in each channel. Change HVs in order to equalize SPE peak positions. Repeat if needed.
- Calibration: Once done with the gain matching, take longer run (~1M events). Analyze and run the calibration code to get new gain constants. Re-analyze the run with the new gain constants in the parameter files to get updated summed signal from the detector and compare with the KPP result.
- Calibration-gain systematics: Repeat the previous point with PMT HVs changed by +50V and –50V. Check independence of detector's signal (in photoelectrons) from PMT gains.

3 **Defocused Run SHMS:**

Expected time: 2-4**?**

Goal: coordinate dependences of detector's responses

Conditions:

- Beam: 6.4 GeV, 5-20 mA, fast raster off
- Target: 0.5% carbon
- Collimator: SHMS collimator
- Trigger: SCIN ¾
- SHMS angle: 15°
- SHMS momentum: -3 GeV/c

Coordinate Response: Take high statistics run(s) (roughly, 1-2 M) in order to get detailed X and Y coordinate dependences of the summed, positive and negative side signals from the detector, also signals in 2-dimensional (X,Y) bins.

4 **(eep) coincidence Runs**

Expected time: 2-4 hrs**?**

Goal: determine delta electron background - get response from sub-threshold and near threshold protons

Conditions:

- Beam: 2.2, 6.4 GeV, 5-60 mA, 1x1 mm fast raster
- Target: 10 cm LH2, 3% Carbon
- Collimator: SHMS collimator
- Trigger: SCIN ¾
- SHMS angle: 25.1°, 27.5°
- SHMS momentum: +1.997 GeV/c, +3.609 GeV/c

Delta electron background: For n = 1.03 aerogel the threshold momentum for protons is 3.8 GeV/c. The (eep) coincidence runs will render an opportunity to study signals from sub-threshold and near threshold protons.