Aerogel Tape

Beam-vacuum bake-out requires beam-pipe temperatures of 100°C or higher,

The MAPS subsystem is not (necessarily) robust to high temperature or temperature gradients,

It is thought that bake-out will need to be done with the MAPS system installed, and can be done by flowing hot gas inside the beam pipe during the bake-out,

Host-Lab engineers estimated that the apparent incompatibility with the MAPS system could be overcome with a ~5 m/s airflow through ~5 mm space between the outer beam pipe and the innermost MAPS vertex layer from an ANSYS evaluation using T_{BP} = 100°C,

Emma's presentation just now nicely illustrates that internal heating and external cooling of the beam pipe is (or can be) different from T_{BP} = 100°C. Qualitatively, a similar conclusion was reached from a physical mock-up at Jefferson Lab,

In a recent meeting with project colleagues, it was suggested that "1 mm of aerogel tape" would be needed to overcome the situation,

Here, it is not my goal to debate necessity, sufficiency, or adequacy of 1 mm of aerogel tape; instead, I simply want to assess where we are in the parameter space in terms of tracking resolutions,

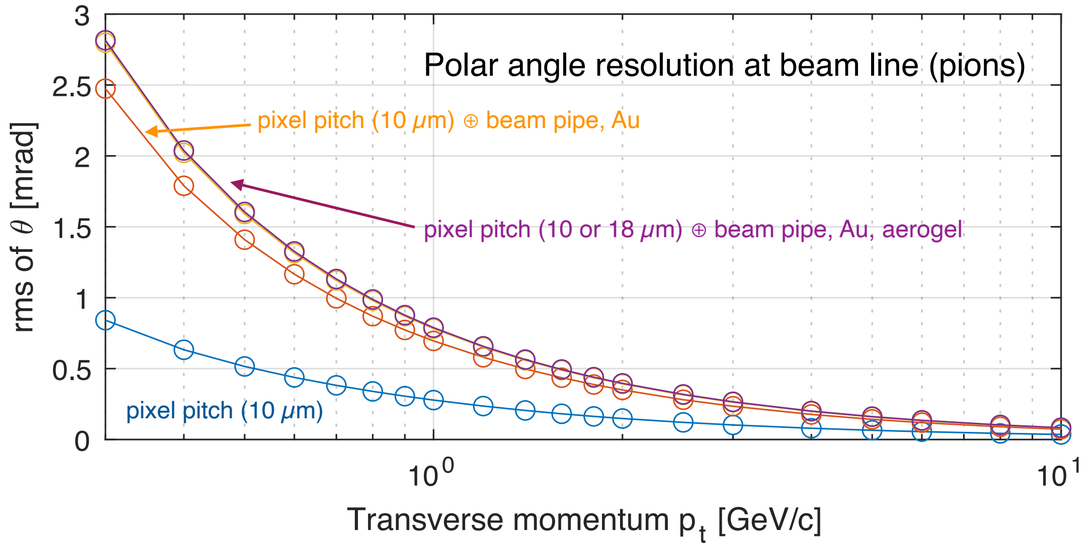
RovaShield is an industrial producer of "aerogel tape"; their Rova Flex Plus tape has a density of ~0.28 g/cm^3 and a thermal conductivity of ~0.038 W/m.K; the tape is advertised as a mix of silica aerogel and an acrylic binder in an unspecified proportion,

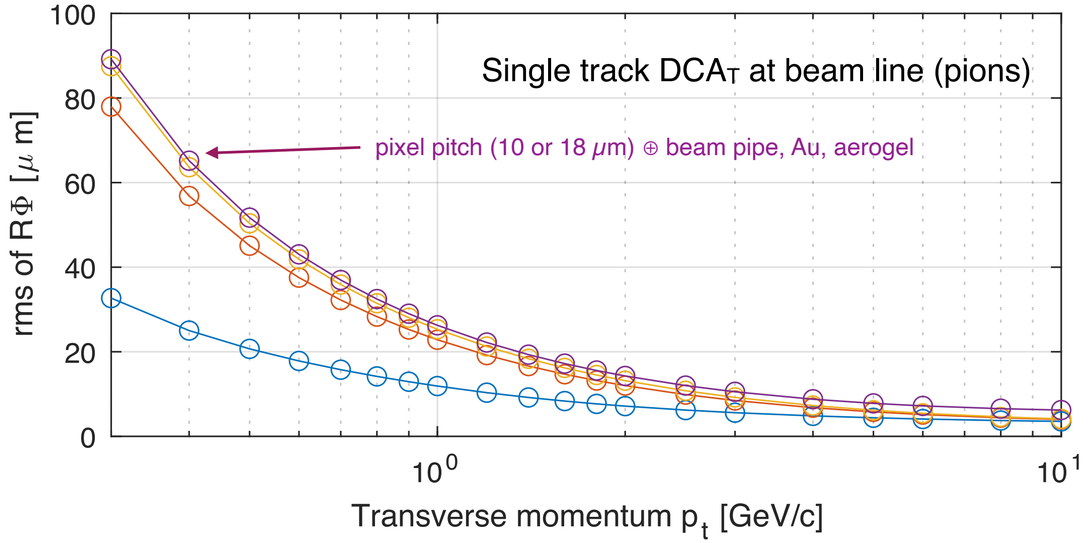
I approximate "aerogel tape" by silicon dioxide. Silicon dioxide has a density of 2.2 g/cm^3 and a radiation length of X_0 = 12.3 cm or 27 g/cm^2

1 mm of this "aerogel tape" at a density of 0.28 g/cm^3 then corresponds to X_0 ~ 96cm and X/X_0 ~ 0.10%,

The beryllium beampipe is thought to have X/X_0 ~ 0.22 — 0.30% (I have seen varying numbers and will use the upper value, corresponding to 1 mm wall thickness, here) and 2 μm of gold coating adds X/X_0 ~ 0.06% (I do not know how uniform the 2 μm will be).

Then, for the ePIC reference layout, at mid-rapidity:





For reference, YR table 11.2 (p437) presents a requirement: DCA_T ~ 20 μm/p_T ⊕ 5 μm. This will be missed by ~20% for p_T 0.5 GeV/c.