

1 HMS Surveys

Summary of HMS surveys done mostly during the summer of 2017. Define the pointing in the spectrometer coordinate system with +X downwards and +Y towards smaller angles. Table 1 lists measured mispointing in horizontal and vertical for each survey number and HMS angle. The horizontal mispointing is plotted versus HMS angle in Fig 1 and shows a definite trend with angle. This was seen before in the 6 GeV era. The vertical mispointing is plotted versus HMS angle in Fig 2 and indicates a slight dependence on angle. For HCANA, the HMS vertical mispointing in mm is set to $2.37 - 0.086 * \text{Angle} + 0.0012 * \text{Angle}^2$ where the Angle is in degrees for Angle ≤ 50 deg. For all angles that are greater or equal to 50 degrees, the vertical mispointing is set constant value of $2.37 - 0.086 * 50 + 0.0012 * 50^2 = 1.07\text{mm}$. The HMS horizontal mispointing in mm is set to $0.52 - 0.012 * \text{Angle} + 0.002 * \text{Angle}^2$ where the Angle is in degrees for Angle ≤ 40 deg. For all angles that are greater or equal to 40 degrees, the vertical mispointing is set constant value of $0.52 - 0.012 * 40 + 0.002 * 40^2 = 3.24\text{mm}$.

Survey	HMS Angle	Horizontal point (Y_{spec})	Vertical point (X_{spec})
C1876	65.00	+3.32	+1.22
C1809R	50.00	+2.92	+1.07
C1792R	40.534	+3.45	+0.91
C1807R	40.013	+3.29	+0.94
C1842	35.944	+2.67	+0.82
C1953	30.002	+2.44	+1.05
C1842	25.013	+1.47	+0.92
C1842	15.004	+0.76	1.29
C1842	15.005	+0.82	1.45
C1980	12.490	+1.20	+1.82

Table 1: Table of HMS surveys

2 SHMS Surveys

Define the pointing in the spectrometer coordinate system with +X downwards and +Y towards larger angles. Table 2 lists measured mispointing in horizontal and vertical for each survey number and SHMS angle. The horizontal mispointing is plotted versus SHMS angle in Fig 3. The vertical mispointing is plotted versus SHMS angle in Fig 4. For HCANA, the horizontal mispointing is -0.6mm for all angles and the vertical mispointing is -1.26mm for all angles

Survey	Angle	Horizontal point (Y_{spec})	Vertical point (X_{spec})
C1793	7.4787	+0.06	-1.29
C1876	10.00	-1.48	-0.13
C1982	12.499	+0.97	-0.02
C1812	15.01	-0.74	-1.34
C1806R	15.02	-0.38	-1.16
C1876	20.00	-0.60	+0.13
C1796R	20.32	-0.57	-0.27
C1808R	24.99	-0.43	-1.28
C1790	24.61	-0.87	-0.21
C1981	29.991	-0.23	-2.37
C1810R	39.94	-0.43	-1.25

Table 2: Table of SHMS surveys

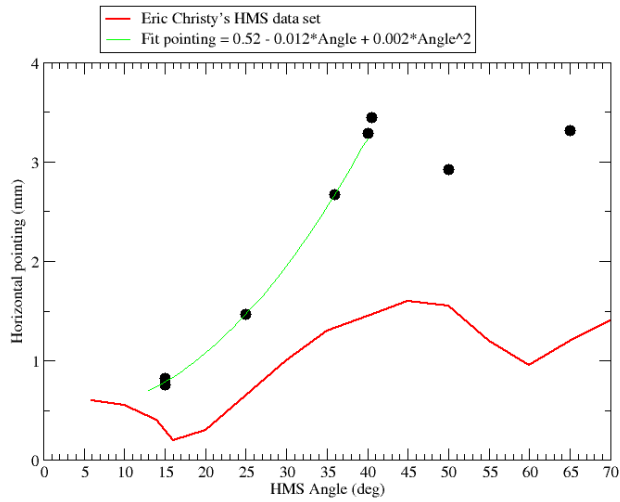


Figure 1: HMS horizontal pointing versus HMS angle. The fit is to the data points at 40 degrees and below. Eric Christy's HMS data set is from the 6 GeV measurements.

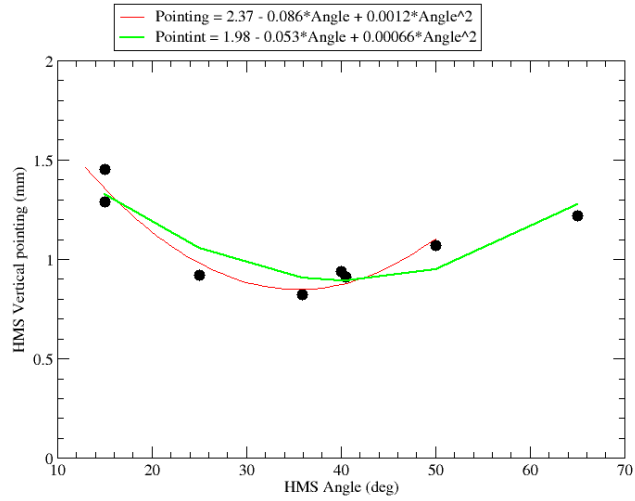


Figure 2: HMS vertical pointing versus HMS angle. The red line is fit to data up to 50 degrees and is used in HCANA. The green line is fit to all the data points.

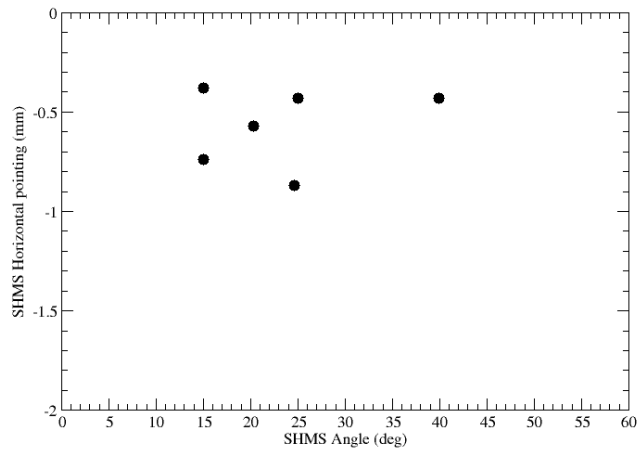


Figure 3: SHMS horizontal pointing versus SHMS angle.

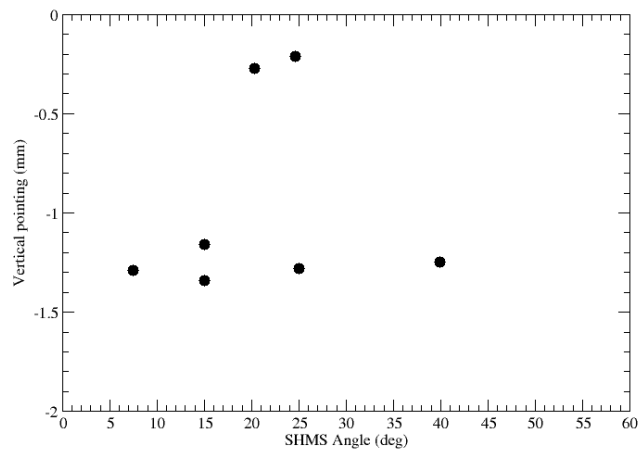


Figure 4: SHMS vertical pointing versus SHMS angle.