A Comparison of MC and Measured Mass for the Tracker

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Beamtest EVO Meeting

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Updating the Gleam Material Audit

- The current Gleam geometry/material model comes from Tom Borden's original spreadsheet (circa 2003)
- Sandro Brez has shown some calculations and measurements for the tracker, as built.
- I present a detailed comparison, and draw some conclusions.

Tower Mass, From Sandro

Everything in grams!

Mass verification

Mass verification	
mass crossed by radiation	20160
sidewalls	2480
closeouts	5364
closeouts bottom	1609
MCM	1260
cables	656
screws	224
brackets	190
other	137
tower mass (gr, estimated)	**32080**
tower mass (gr, measured)	**32520**

See Beamtest vrvs meetings, 7 March 2007:
https://confluence.slac.stanford.edu/display/BeamTest/Beam+Test+VRVS+meetings

More from Sandro

Masses of the trays							
tray type	closeout	honeycom	Top side payload	Bottom side payload	MCM	Total theor	Total measured
MID	298	55	244	492	70	1159	1174
Heavy	298	165	266	1853	70	2652	2630
Light	298	55	244	244	70	911	931
Top							1215
Bottom							2200

detCheck: Material Summary

Material Name	# Log. Vol.	# Phys. Vol.	Volume (cubic cm)	Mass (grams)
Al_1lb	2	14	48793	780
Al_3lb	2	5	18218	876
C_closeout	6	76	3877	4536
TKR_Si	1	36	1872	4493
Tkr_MCM_board	1	36	328	591
Tkr_wall	2	4	1402	3563
Tray_bot_bias	1	18	819	890
Tray_bot_face	4	20	981	1476
Tray_top_face	2	18	1521	1923
W	1	192	142	2755
W_alloy	1	64	354	6242
Totals	**23**	**483**	**78307**	**28125**

detCheck: Summary by Logical Volume

Name	Volume (cu cm)	Convex vol	# Phys.	Total volume	Material	Mass (grams)
SiLayerBox	52	52	36	1872	TKR_Si	4493
TKRBiasBox	45	45	18	819	Tray_bot_bias	890
TKRBotFaceReg	48	48	12	585	Tray_bot_face	880
TKRBotFaceSup	60	60	4	241	Tray_bot_face	363
TKRCloseoutBotLong	65	65	2	131	C_closeout	154
TKRCloseoutBotShort	64	64	2	128	C_closeout	149
TKRCloseoutRegLong	50	50	34	1711	C_closeout	2002
TKRCloseoutRegShort	48	48	34	1664	C_closeout	1946
TKRCloseoutTopLong	61	61	2	122	C_closeout	143
TKRCloseoutTopShort	59	59	2	119	C_closeout	139
TKRCoreBotBox	4490	4490	1	4490	Al_3lb	216
TKRCoreRegBox	3431	3431	13	44615	Al_1lb	713
TKRCoreSupBox	3431	3431	4	13727	Al_3lb	660
TKRCoreTopBox	4178	4178	1	4178	Al_1lb	66
TKRFaceMin	35	35	3	107	Tray_bot_face	161
TKRFaceMinBot	47	47	1	47	Tray_bot_face	71
TKRMCM	9	9	36	328	Tkr_MCM_board	591
TKRTopFaceReg	81	81	13	1056	Tray_top_face	1335
TKRTopFaceSup	92	92	5	464	Tray_top_face	587
TKRWallLong	352	352	2	704	Tkr_wall	1788
TKRWallShort	349	349	2	698	Tkr_wall	1774
convRegSquare	0	0	192	142	W	2755
convSuperSquare	5	5	64	354	W_alloy	6242

Tracker General Comparison

	Sandro	Gleam	Meas-MC
Active mass	20160	19432	728
Passive mass	10937	8719	2218
Not Modeled	983	—	983
Total Mass	32080	28150	3930

Active Rad. Len	1.376	1.356*

** "measured" from TkrRadLength for vertical muons*

Active Mass, per tray

	Sandro	Gleam
Tungsten	229.6	229.6 ★
Tungsten Alloy	1567	1560.5 ★
Silicon (2)	250.8	249.6 ★
Regular Core	55	55.8 ★
Heavy Core	165	165 ★
Stuff (Regular)†	266	225.4
Stuff (Heavy) †	301	257.6

† Face plate, bias board, glue

★ *means agreement*

Passive Mass, per tray

	Sandro	Gleam
Bottom Closeout		258
Regular Closeout	298	196
Top Closeout		240
MCM (2)	70	65.6
Walls (per tracker)	2704	3562

Tray masses

	Sandro (meas/calc)	Gleam
Bottom	2200/—	865
No-converter	931/911	775
Heavy	2630/2652	2498
Regular	1174/1159	1025
Top	1215/—	912

Circled masses include extra elements: titanium brackets, cable supports, stronger closeout, etc., not modeled.

Conclusion

- For the middle three tray types, the measured mass is about 140 g more than the MC shows.
  - About 100 g of this comes from the closeouts.
  - the rest is roughly consistent with Sandro's higher estimates for the thickness of the payload (+270 microns), and with our observation that the x-y planes are are closer together than modeled (+220 microns).
  - Calling this extra active material ~carbon, amount of added X0 should be about 1.4%, roughly consistent with the measurement.
- The top and bottom trays need some special attention.
- The real walls are lighter than the model, which makes up for most of the missing cables.
  - Can the cables be modeled as a uniform layer?

The good news: most of the discrepancies seem to be understood, and should be fairly easy to correct.