HIGH pT MUON ANALYSIS

~ TEAM III ~

H. BEHNAMIAN, D. CIERI, M. DALL'OSSO, J. LEE
K. MONDAL, E. TIRAS

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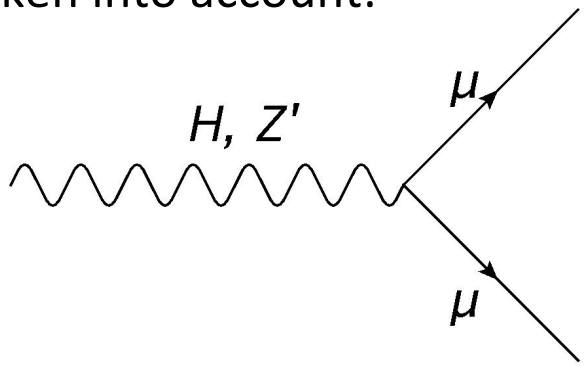
OUTLINE

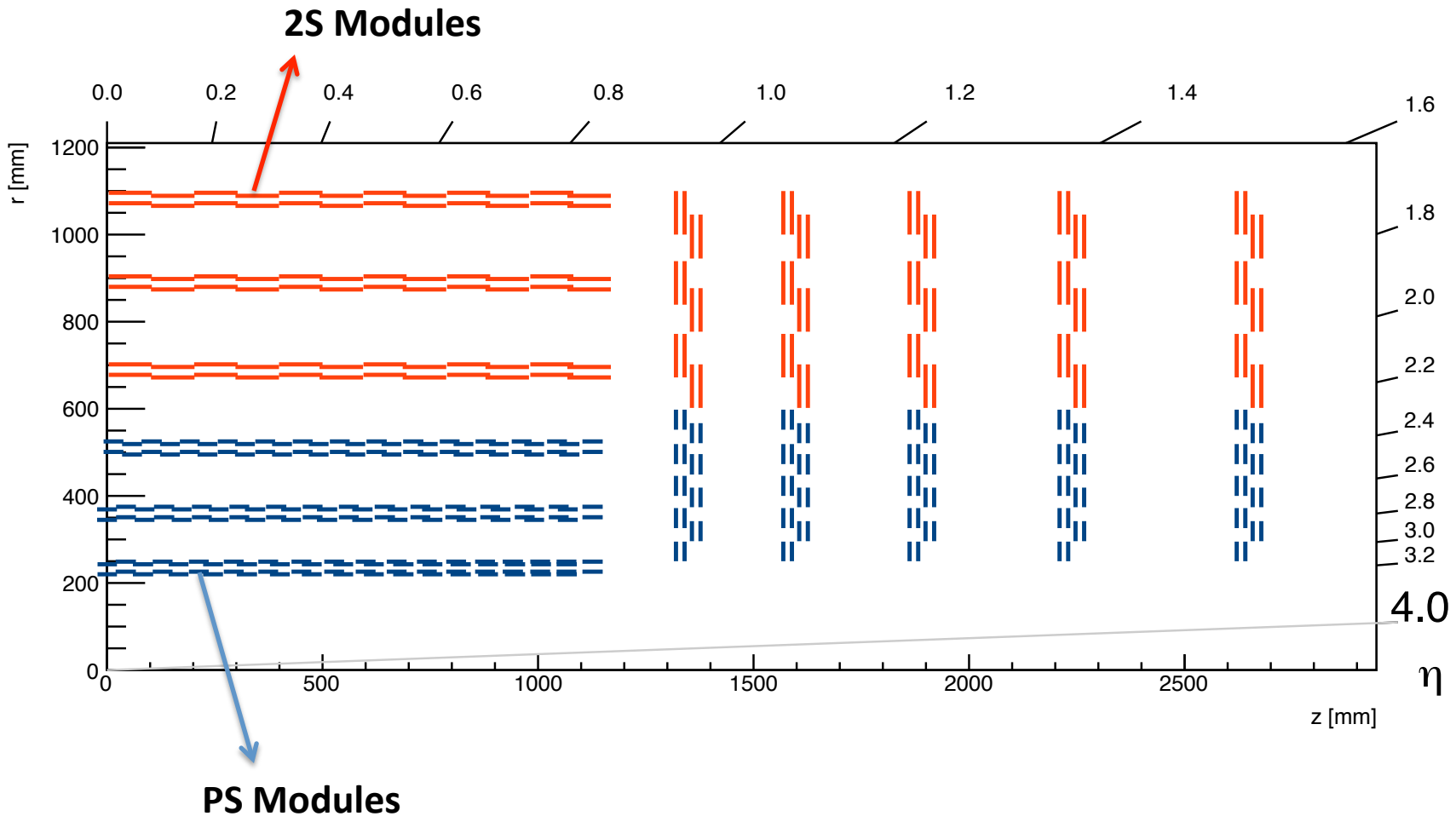
- Introduction
- Tracker Design
- Event Simulation with new design
- Physics Analysis
- Conclusion

Introduction

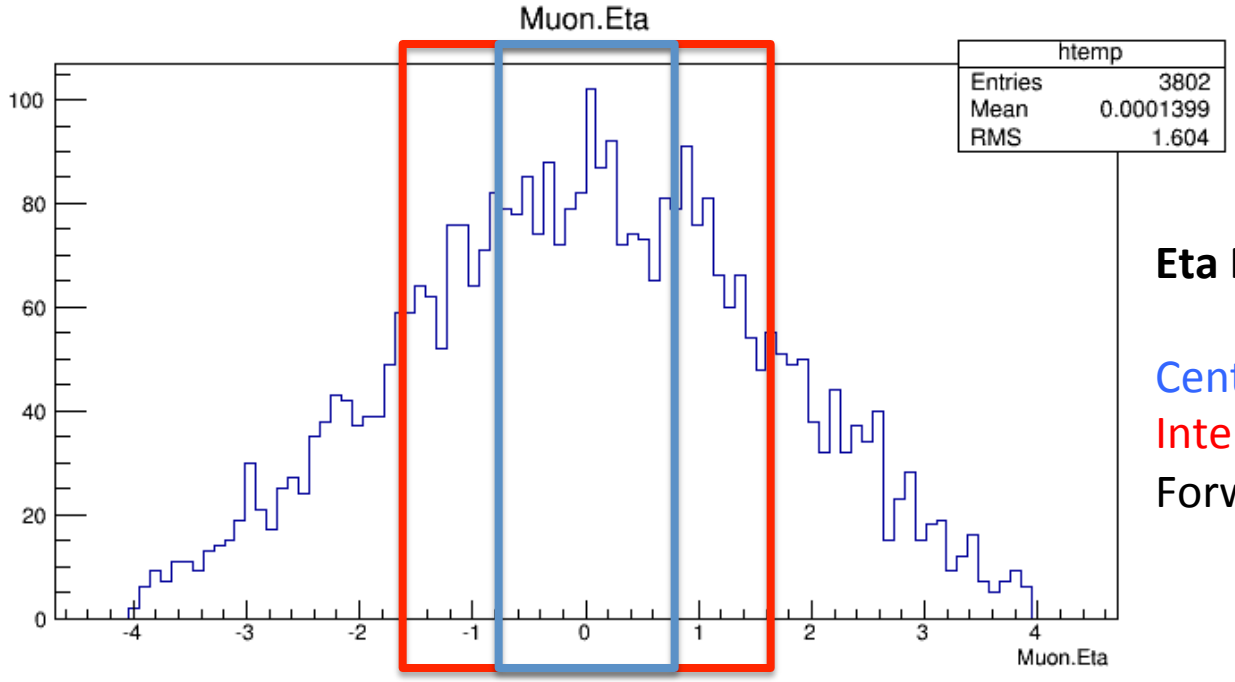
- Design a new CMS Tracker for H and Z' detection.
  - SM H(125 GeV) --> μμ
  - Z' (2.5 TeV) --> μμ
- Good efficiency and momentum resolution for high energy muons required
- Modifications at the layout of the proposed phase II Outer tracker have been performed
- Signal MC without any PU used to verify the performance of the new geometry
- Also background events have been taken into account:
  - Dimuon Drell Yan production
  - ttbar inclusive



Proposed Tracker Layout – Phase II



High pT Muon η Distribution



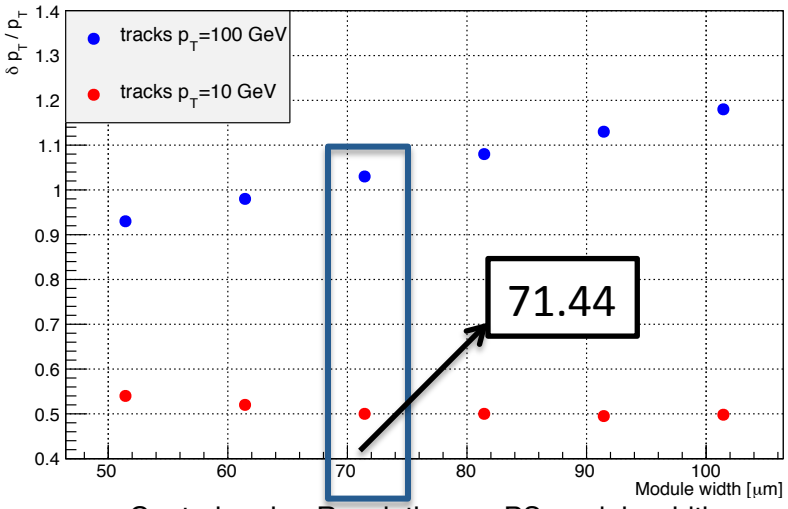
Generator level – muon eta distribution for ggH --> μμ

Eta Regions:

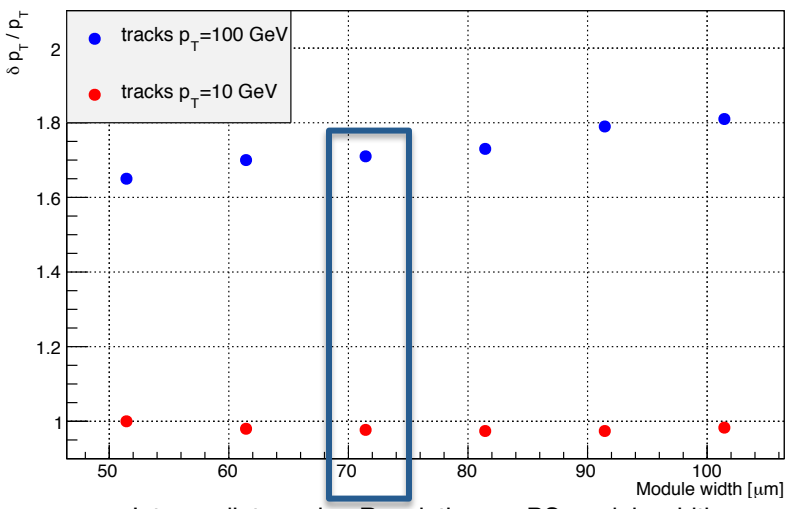
Central (C): 0.0<|eta|<0.8
Intermediate (I): 0.8<|eta|<1.6
Forward (F) : 1.6<|eta|<2.4

Tracker Design: module width

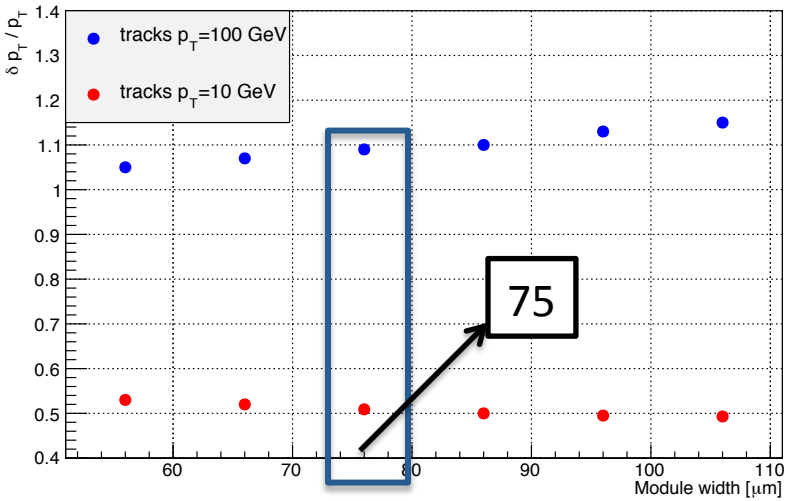
Central region Resolution vs. 2S module width



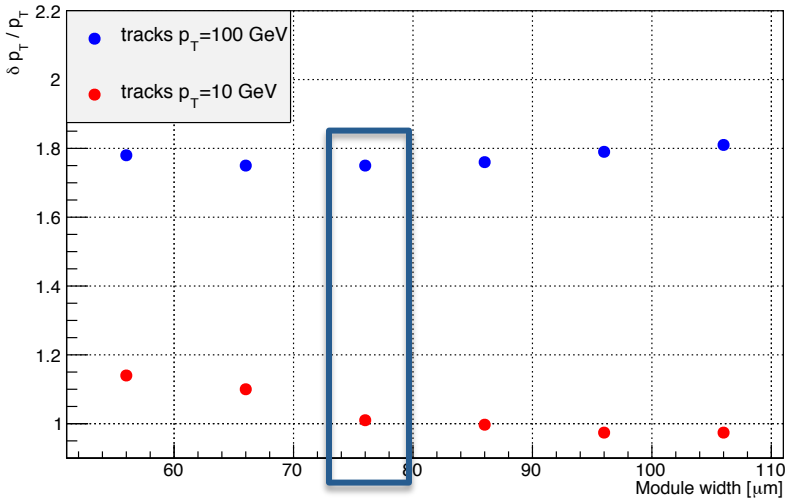
Intermediate region Resolution vs. 2S module width



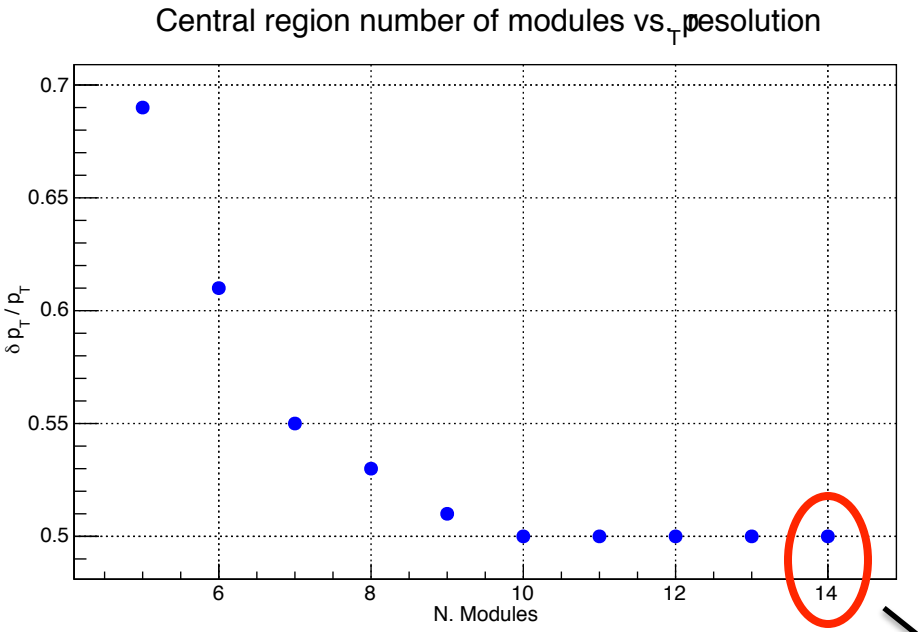
Central region Resolution vs. PS module width

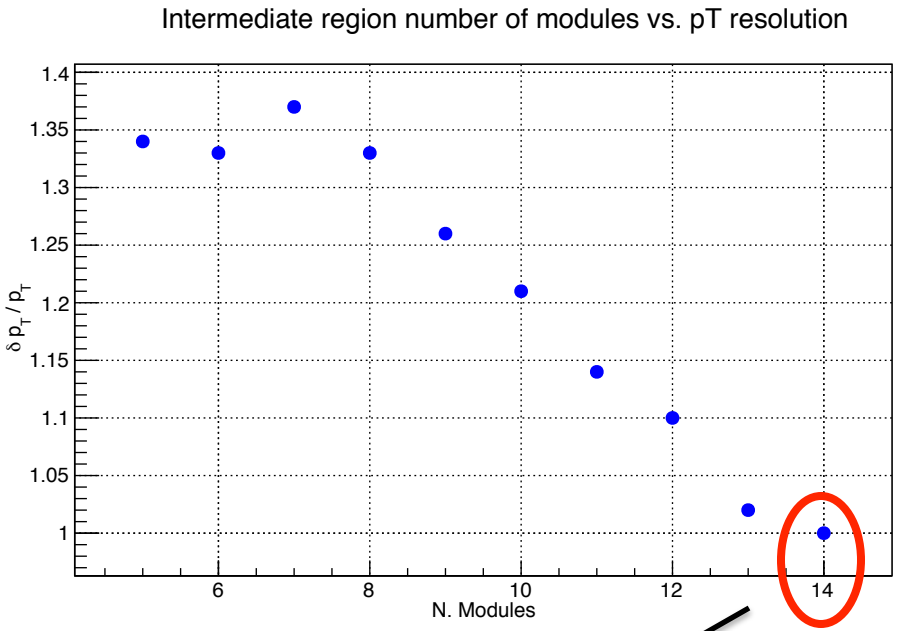


Intermediate region Resolution vs. PS module width



Tracker Design: # of modules





# of modules in Barrel

Tracker Geometry Optimization

	pT RESOLUTION						BARREL				ENDCAP				BARREL & ENDCAP	
	10 GeV			100 GeV			Layers #		Modules #		Disk #		Ring #		Module width	
	C	I	F	C	I	F	PS	2S	PS	2S	PS	2S	PS	2S	PS	2S
TRADITIONAL	0.49993	1.07997	1.75722	1.12594	1.97182	3.60283	3	3	1150	12	5	5	1 to 9	10 to 15	96	91.44
	0.54443	1.1578	1.7948	1.10537	1.92529	3.61313	4	4	1350	14	5	5	1to 9	10 to 15	75	71.44
	0.54345	1.07146	1.75722	1.09245	1.90923	3.60283	3	5	1350	14	5	5	1 to 9	10 to 15	75	71.44
	0.52135	0.98664	1.69732	1.09557	1.98437	3.60744	2	6	1350	14	5	5	1 to 9	10 to 15	75	71.44
	0.54488	1.07169	1.7933	1.07966	1.84603	3.55667	3	5	1350	14	6	6	1 to 9	10 to 15	75	71.44
	0.50699	0.99761	1.74031	1.07333	1.88668	3.55092	2	5	1350	14	6	6	1 to 9	10 to 15	75	71.44
GEOMETRY 1	0.51915	0.98819	2.32054	0.94405	1.57915	4.05386	2	5	1350	14	6	6	1 to 4	5 to 12	75	71.44
	0.55255	1.00328	2.32054	0.9367	1.5634	4.05386	2	6	1350	14	6	6	1 to 4	5 to 12	75	71.44
GEOMETRY 2	0.50137	0.9138	2.29613	0.90913	1.51347	4.0466	1	6	1350	14	6	6	1 to 2	3 to 11	75	71.44
	0.46802	0.88764	2.29767	0.92342	1.54602	4.0435	1	5	1350	14	6	6	1 to 2	3 to 11	75	71.44
	0.53118	0.9436	2.2967	0.90104	1.50628	4.04747	1	7	1350	14	6	6	1 to 2	3 to 11	75	71.44

100 GeV

Traditional:

Central Eff.: 1.12594
Int. Eff.: 1.97182

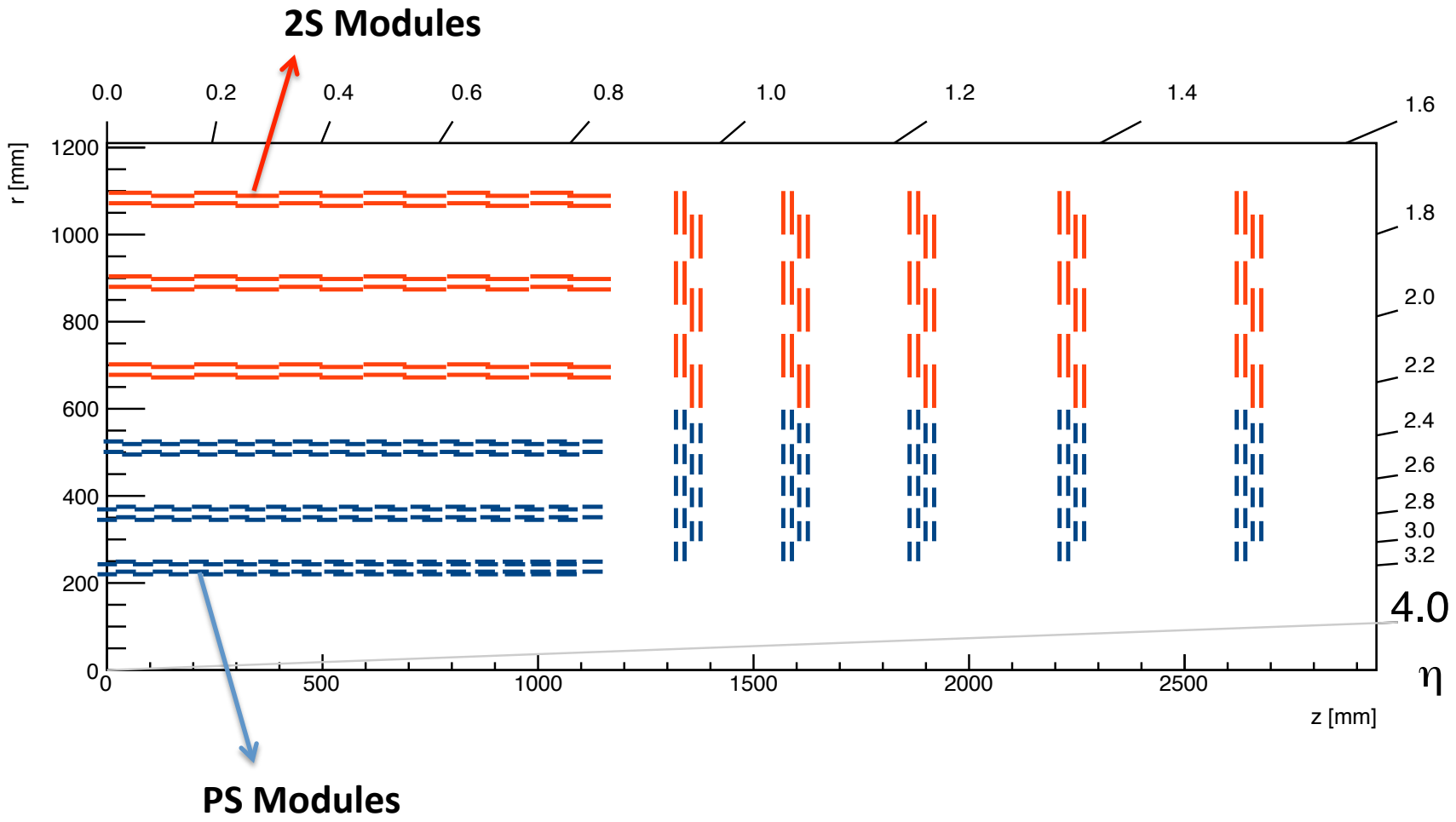
Geometry 1:

Central Eff.: 0.94405
Int. Eff.: 1.57915

Geometry 2:

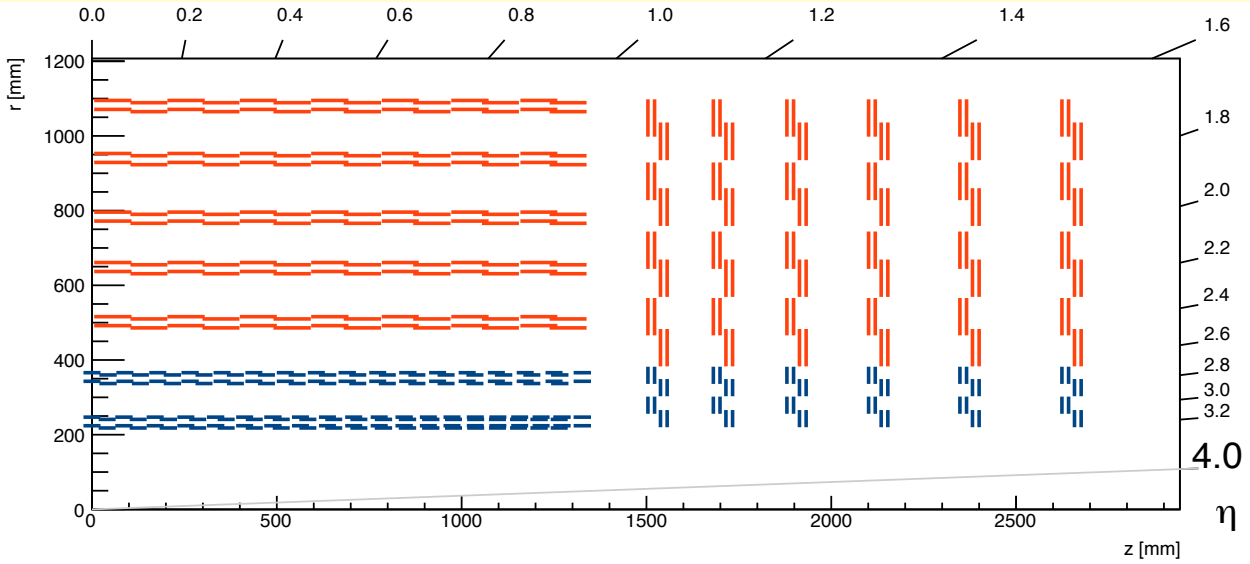
Central Eff.: 0.90913
Int. Eff.: 1.51347

Proposed Tracker Layout – Phase II

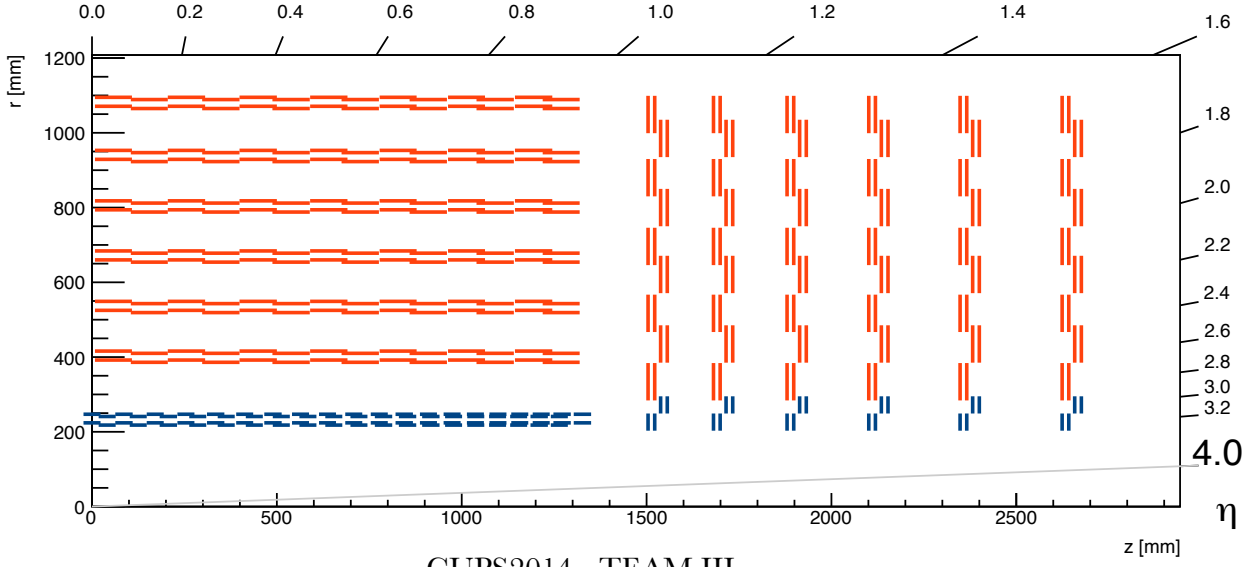


Chosen Tracker Geometries

Geometry 1

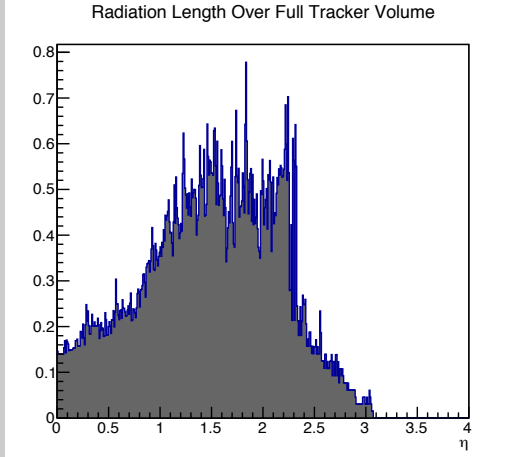


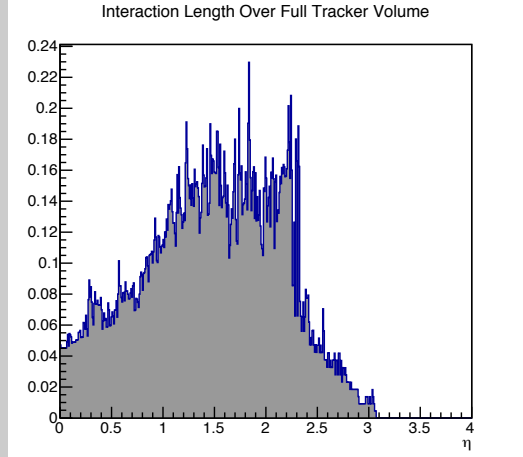
Geometry 2

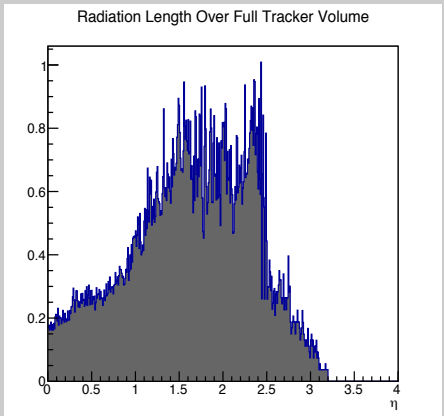


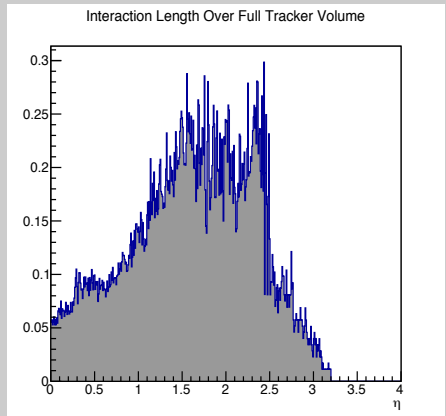
Material Budget for Different T. Geometries

Std. Geometry

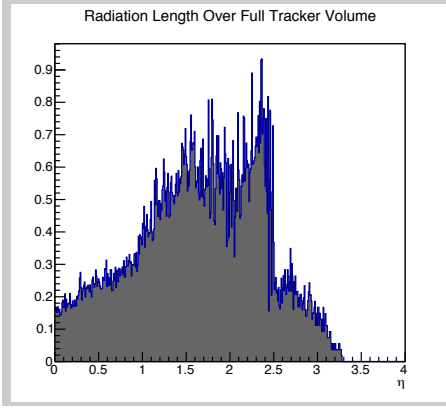


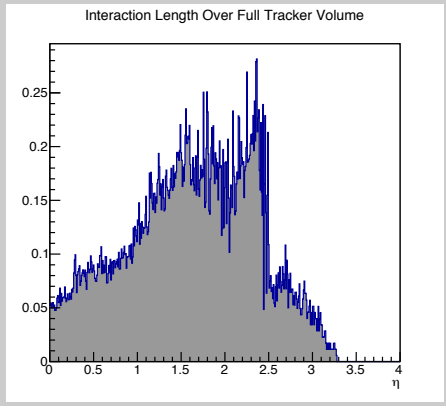






Geometry 1





Geometry 2

Event Simulation

Events simulation with the new tracker geometries performed for both

- **Signal:**
  - gg → H → μμ
  - VBF → H → μμ
  - Z'(2500) → μμ
- **Background:**
  - ttbar → μμ (final state)
  - DY → μμ

Physics Analysis: selection cuts

Trigger:

Muon pT > 10
Muon |Eta| < 3.5

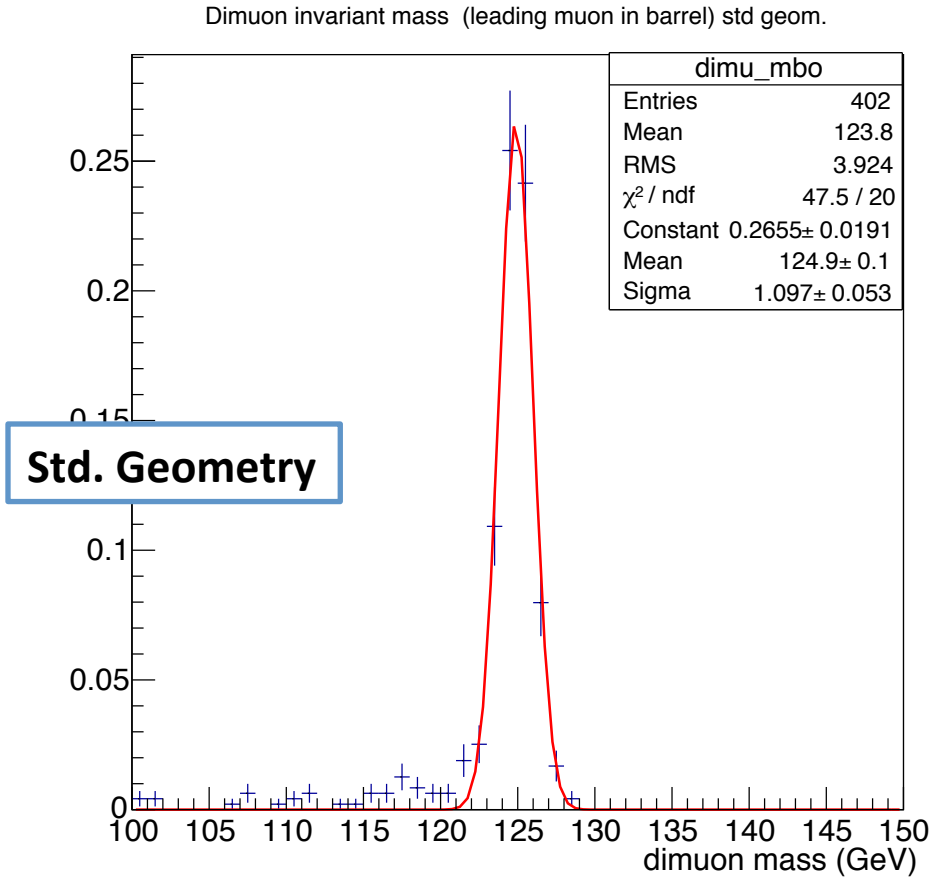
Muon selection:

Leading muon pT > 25
Next Leading muon pT > 15
Charge Consistency (opposite charge)

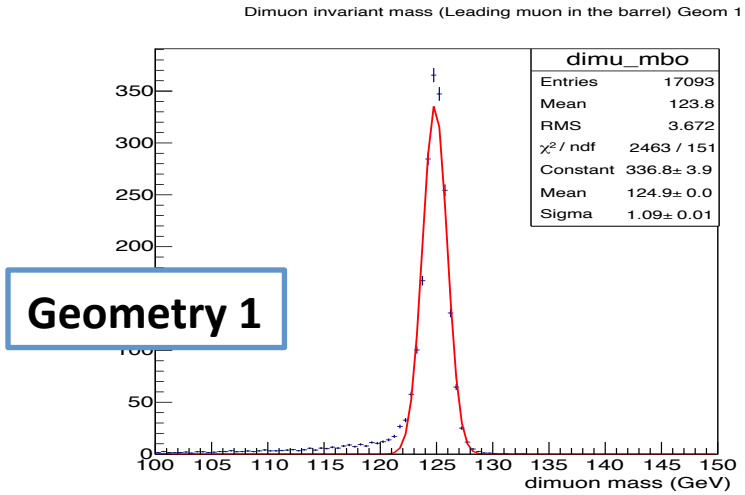
Dimuon invariant mass cuts:

Dimuon pT > 10
Dimuon mass > 50

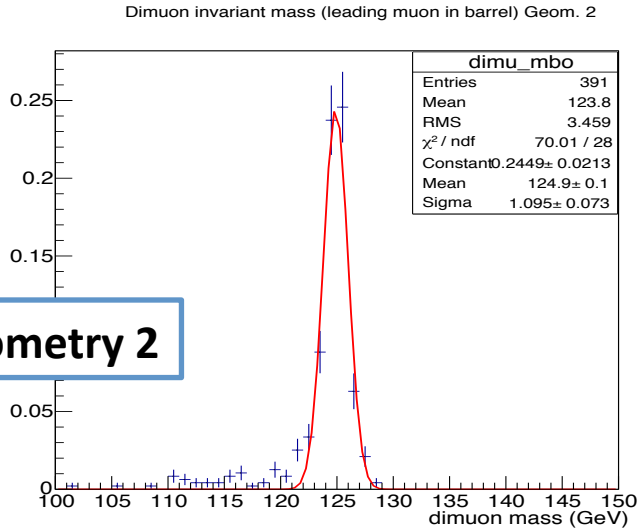
Physics Analysis: Signal Mass Distributions



Std. Geometry



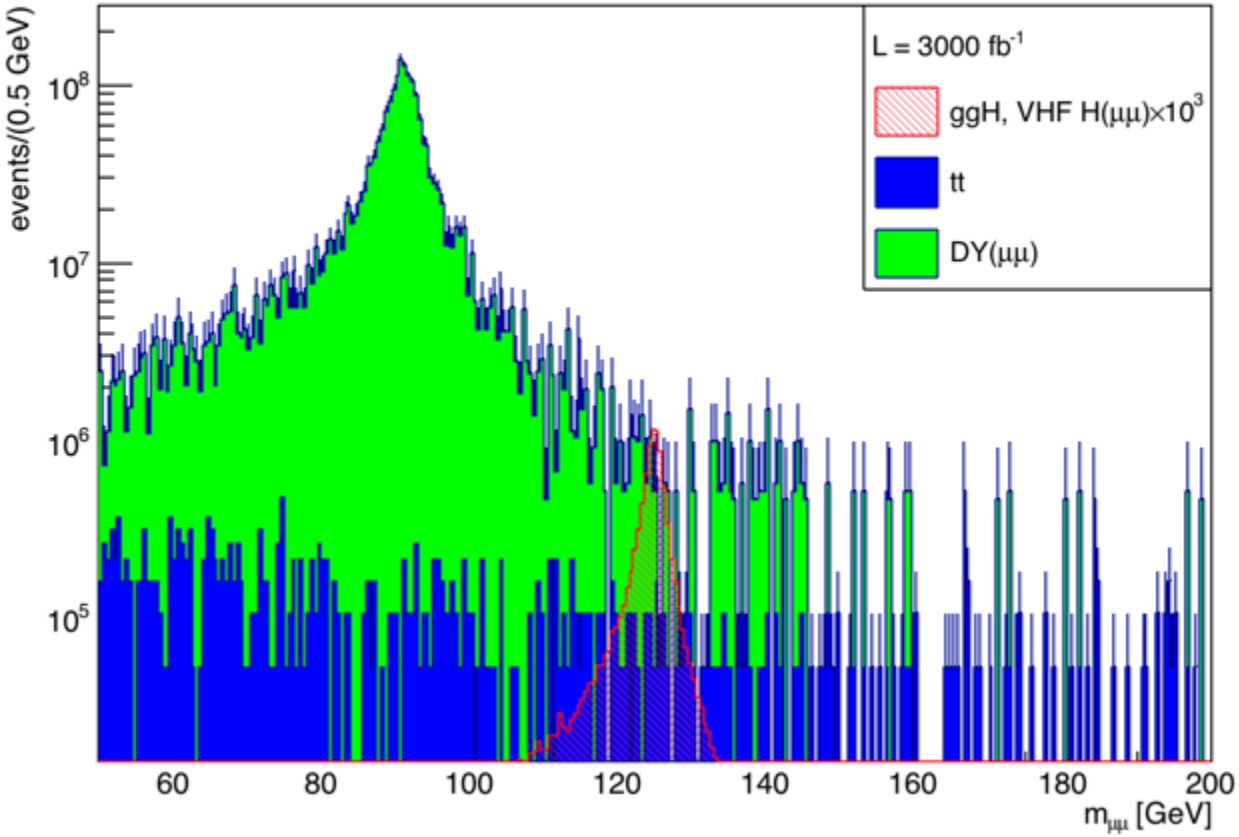
Geometry 1



Geometry 2

Signal vs. Background dimuon mass

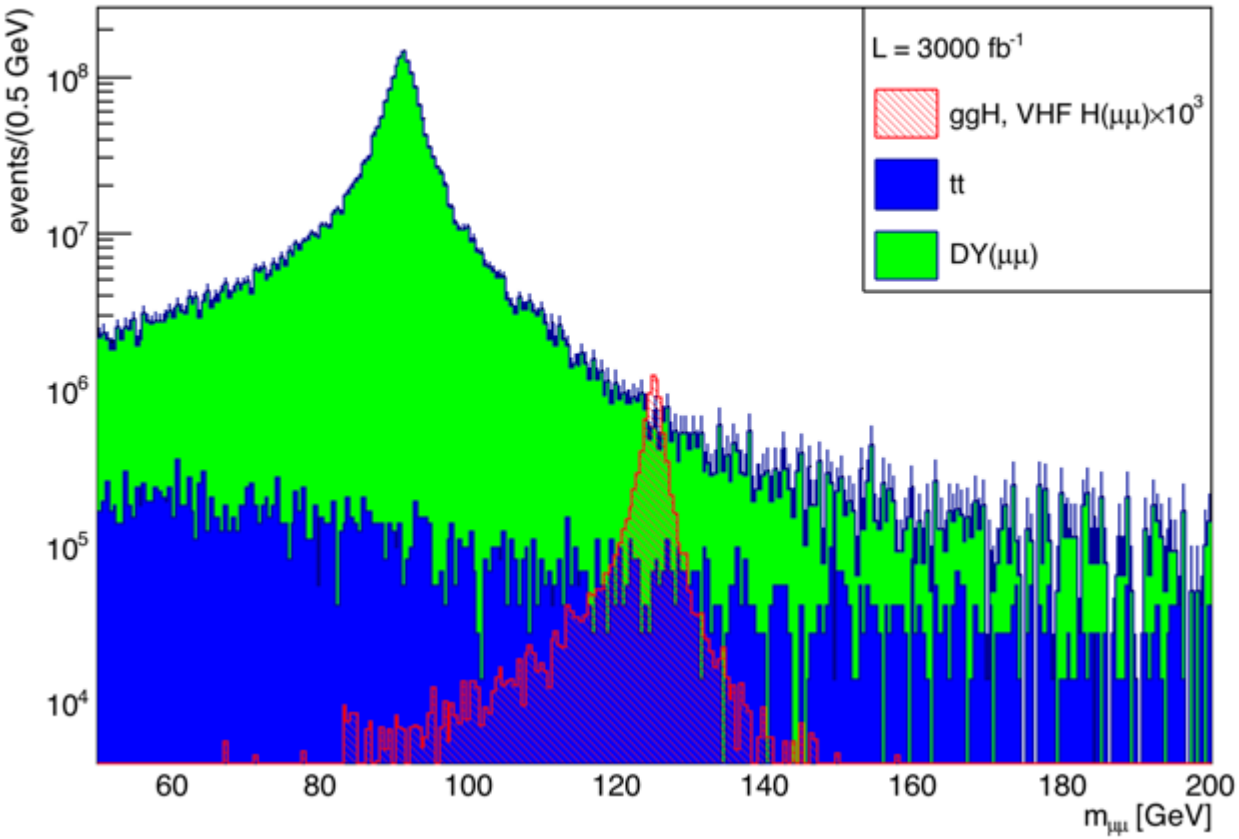
Geometry 1



signal 7986 ± 30
background (1.36 ± 0.02)E+07
S/√B = 2.17

Signal vs. Background dimuon mass

Geometry 2



signal 7990 ± 81
background (1.43 ± 0.08)E+07
S/√B = 2.11

Conclusions

- Two geometries developed using tkLyout tool focusing on high pT resolution
- Both geometries worked very well to reconstruct H and Z' dimuon decays
- New geometries improved dimuon mass resolution
- We could not run over the all background and signal datasets but mass spectrum is comparable with the reference mass spectrum