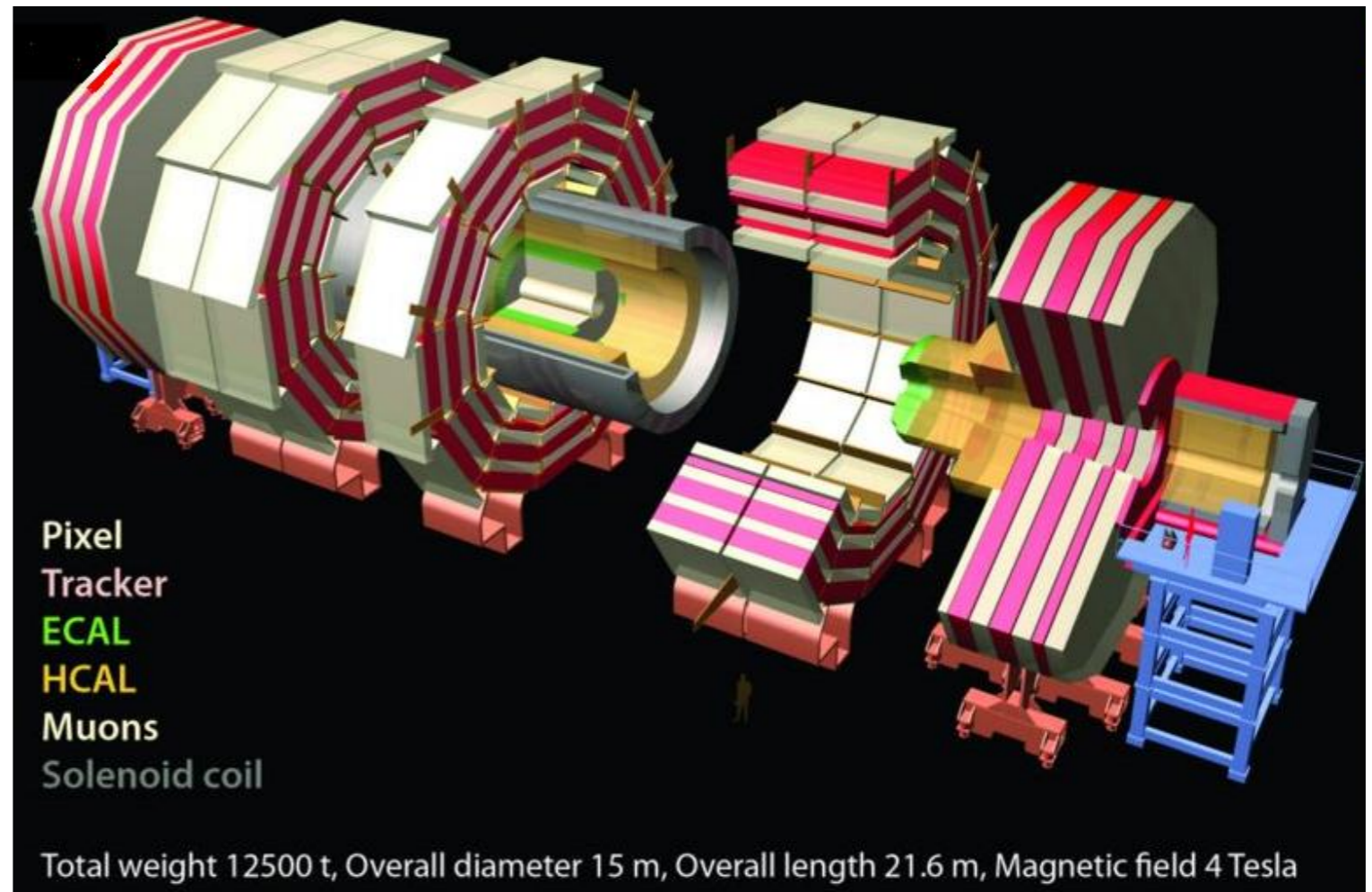
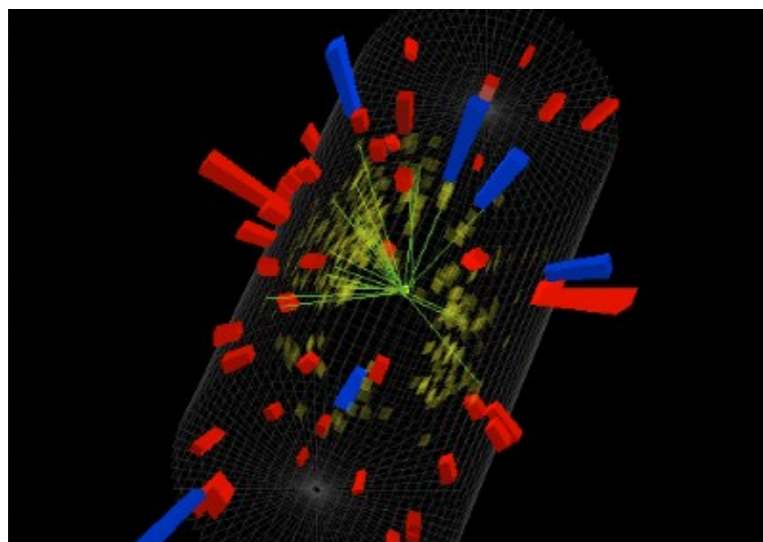




CMS Masterclass 2013



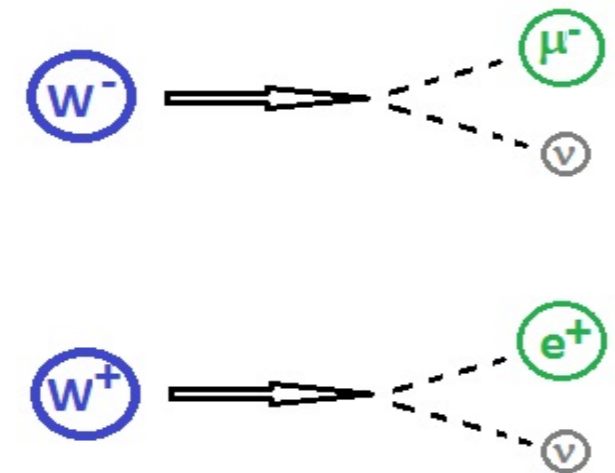


W and Z Decays

Because W and Z only travel a tiny distance before decaying, CMS does not “see” W or Z bosons directly.

CMS *can* detect :

- electrons
- muons



CMS can infer:

- neutrinos from “missing energy”



iSpy-online



Detector Model ?

- Tracker
- ECAL Barrel
- ECAL Endcap
- ECAL Preshower
- HCAL Barrel
- HCAL Endcap
- HCAL Outer
- HCAL Forward
- Drift Tubes (muon)
- Cathode Strip Chambers (muon)
- Resistive Plate Chambers (muon)

Tracking ?

- Tracks (reco.)
- Clusters (Si Pixels)
- Clusters (Si Strips)
- Rec. Hits (Tracking)

ECAL ?

- Barrel Rec. Hits
- Endcap Rec. Hits
- Preshower Rec. Hits

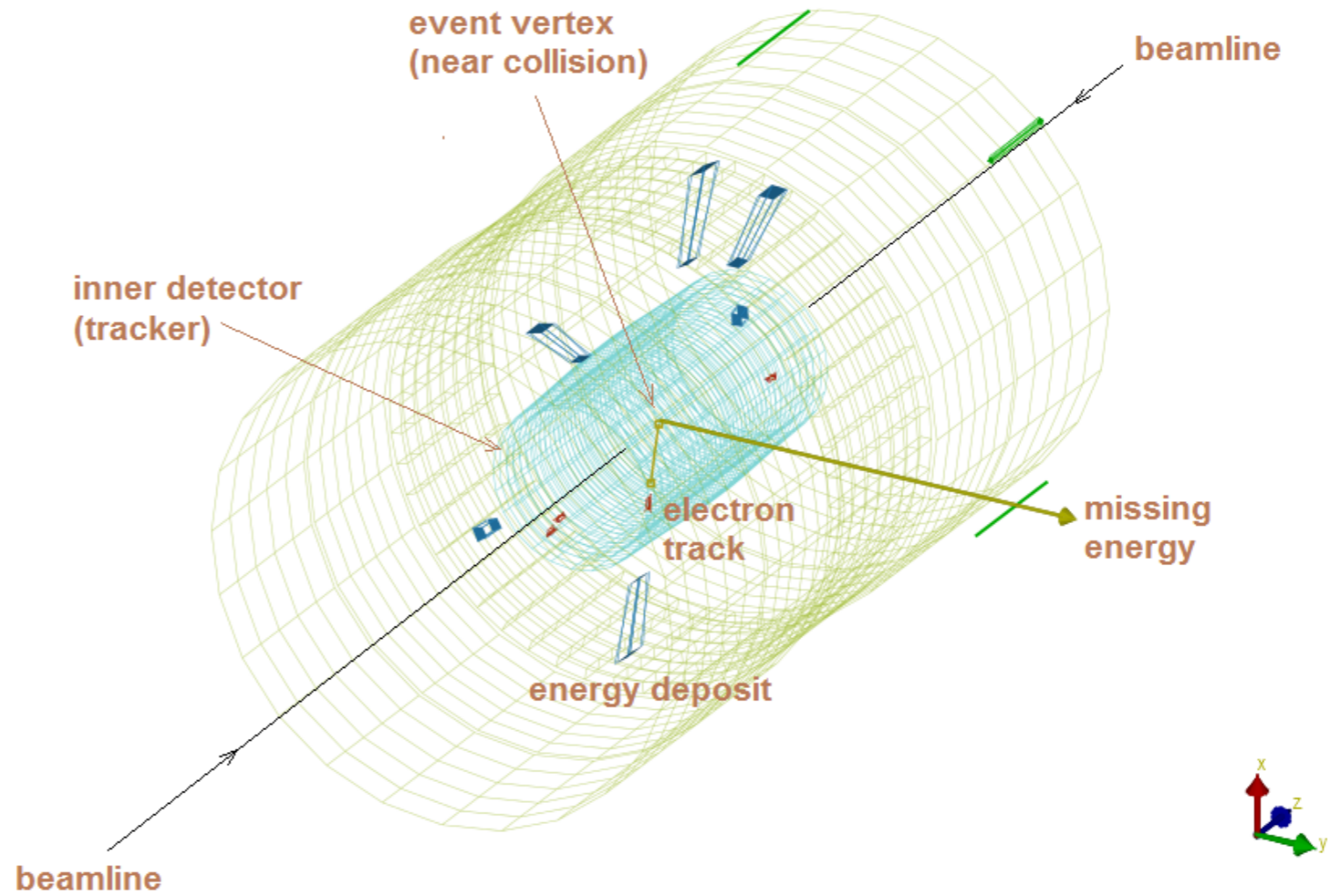
HCAL ?

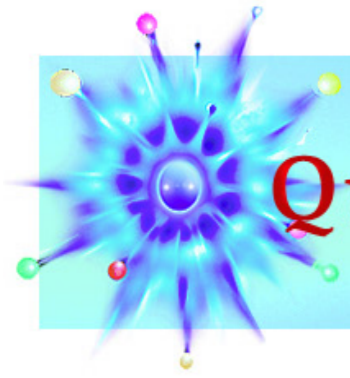
- Barrel Rec. Hits
- Endcap Rec. Hits
- Forward Rec. Hits
- Outer Rec. Hits

Controls:

- rotate
- Ctrl** + → pan x / y
- Shift** + → pan z

event display controls



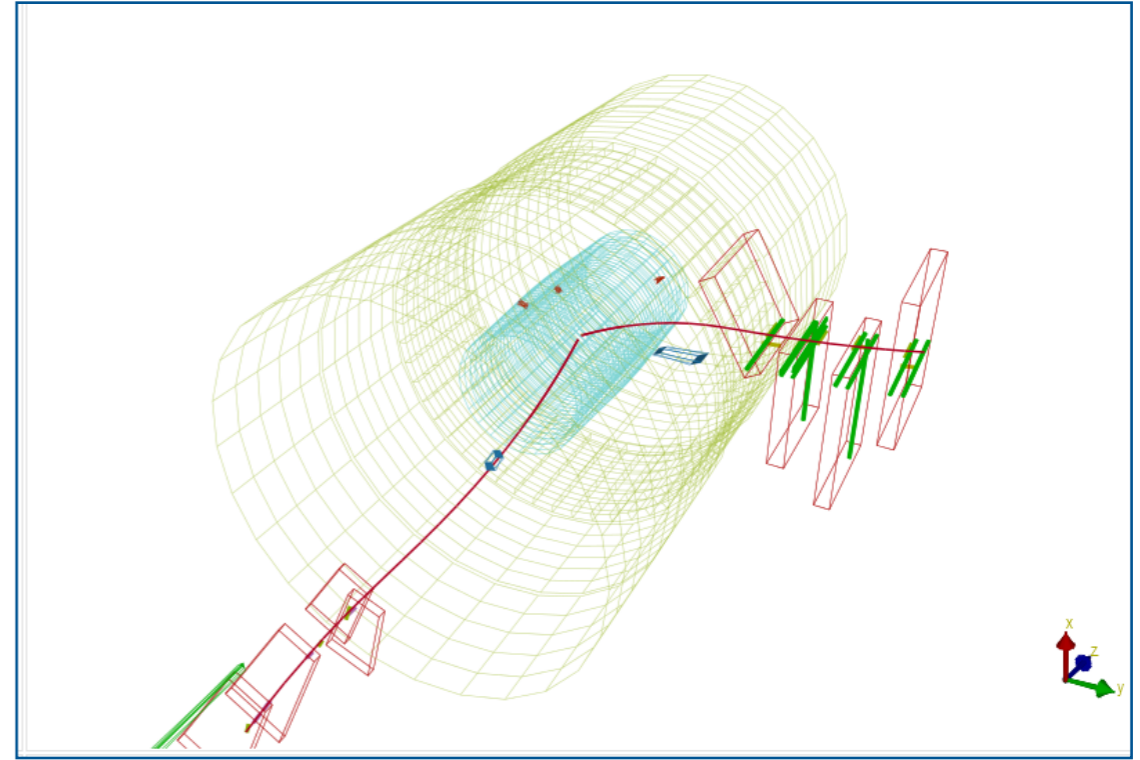
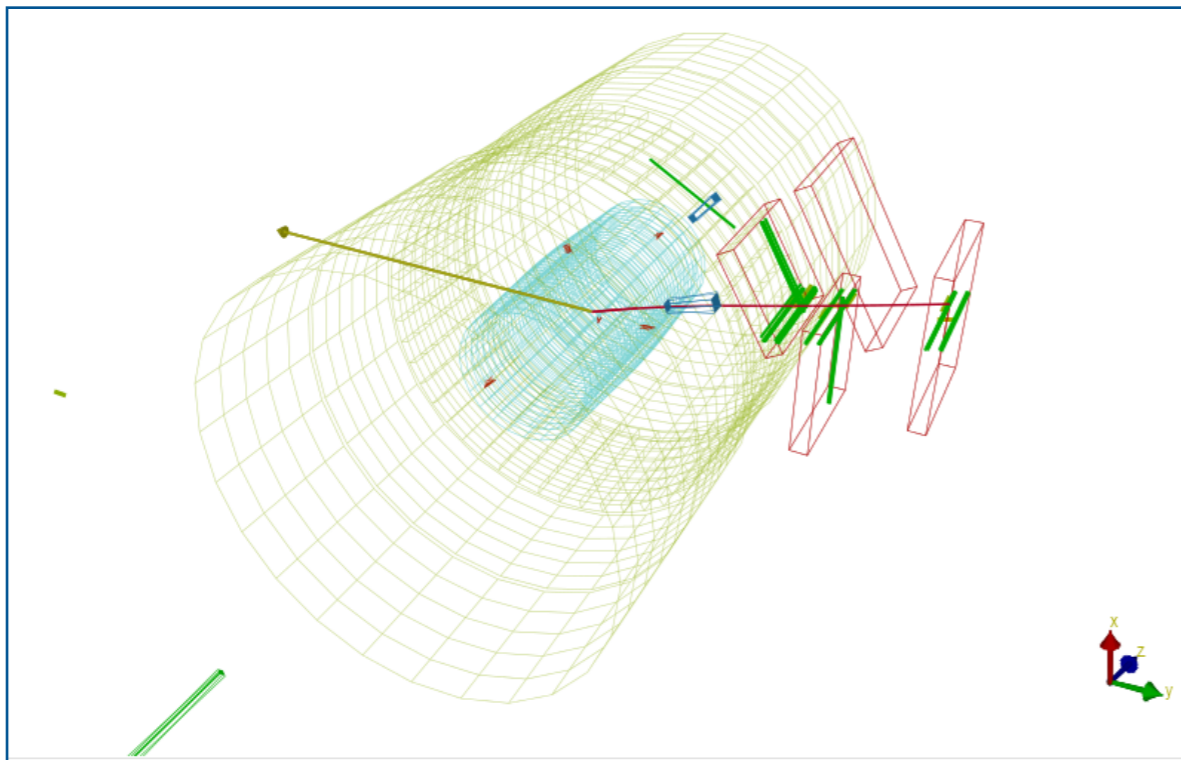


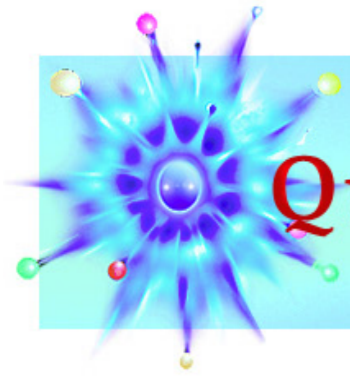
QuarkNet

Measurement

Use new data from the LHC in iSpy to test performance of CMS:

- Can we distinguish W from Z candidates?

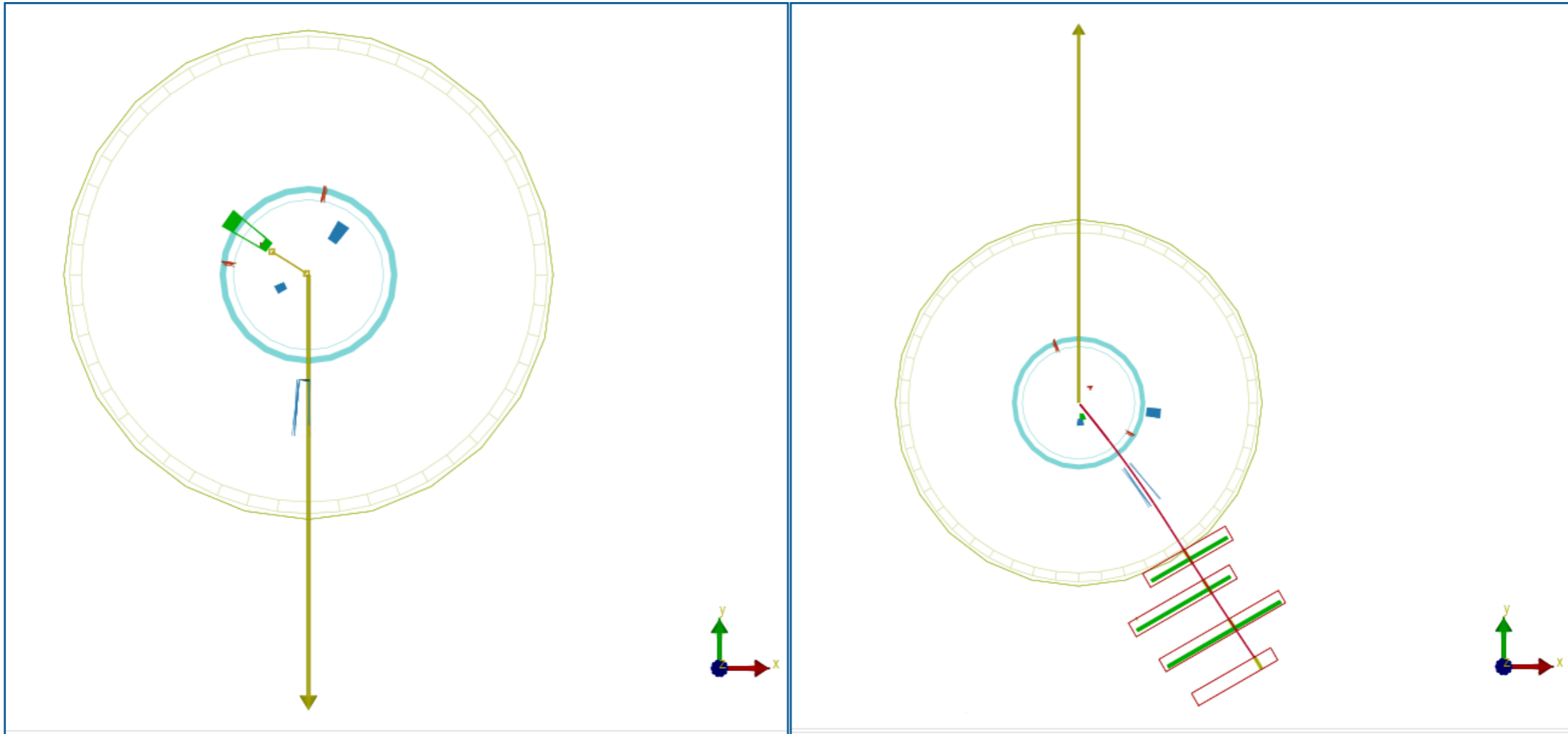


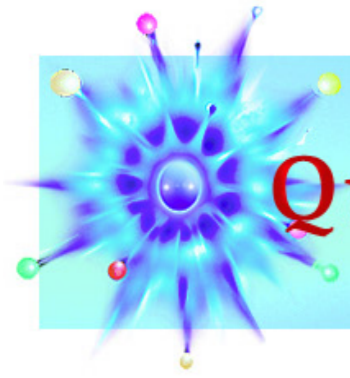


QuarkNet

Measurement

- Can we calculate the e/μ ratio?

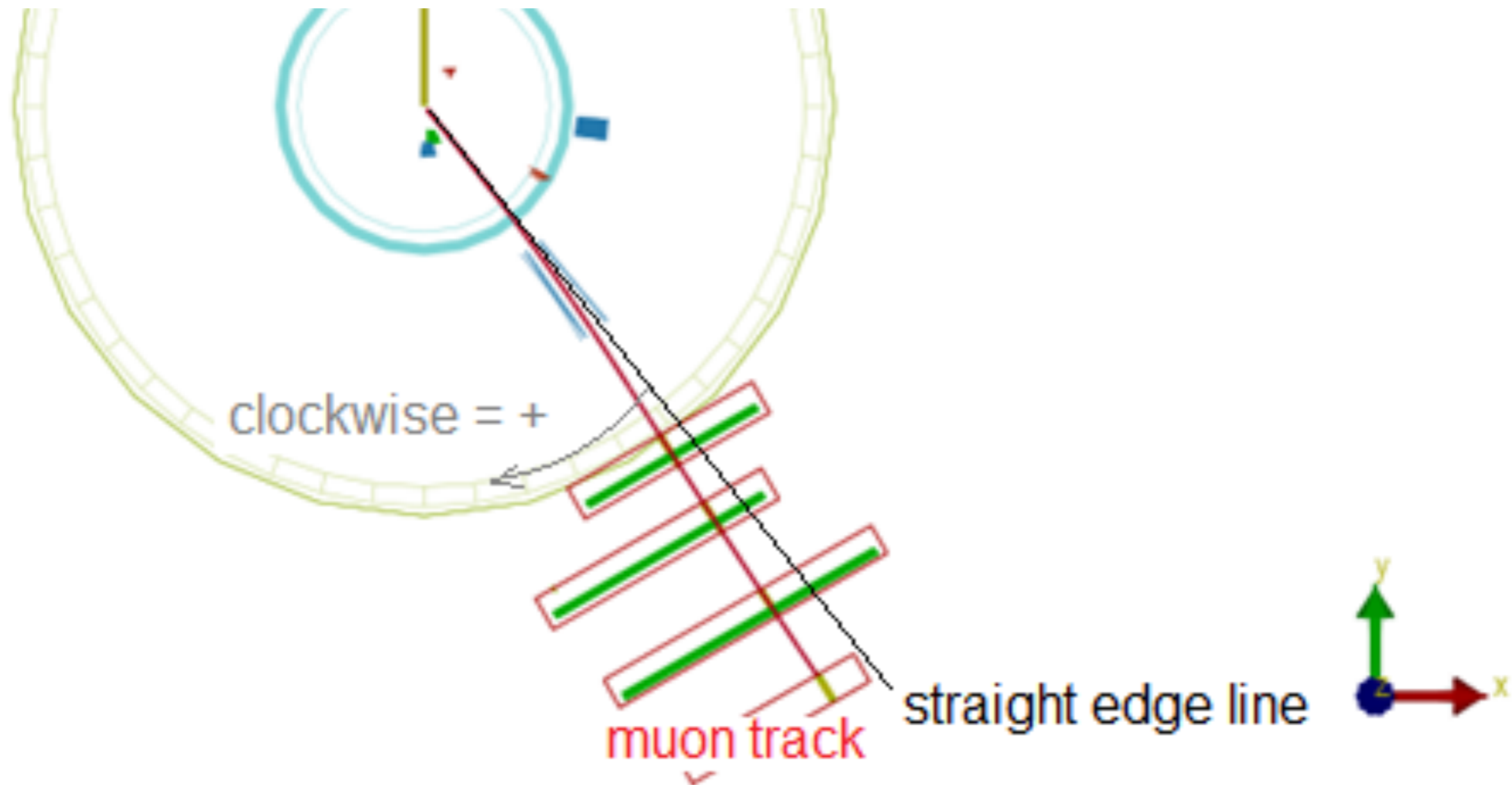




QuarkNet

Measurement

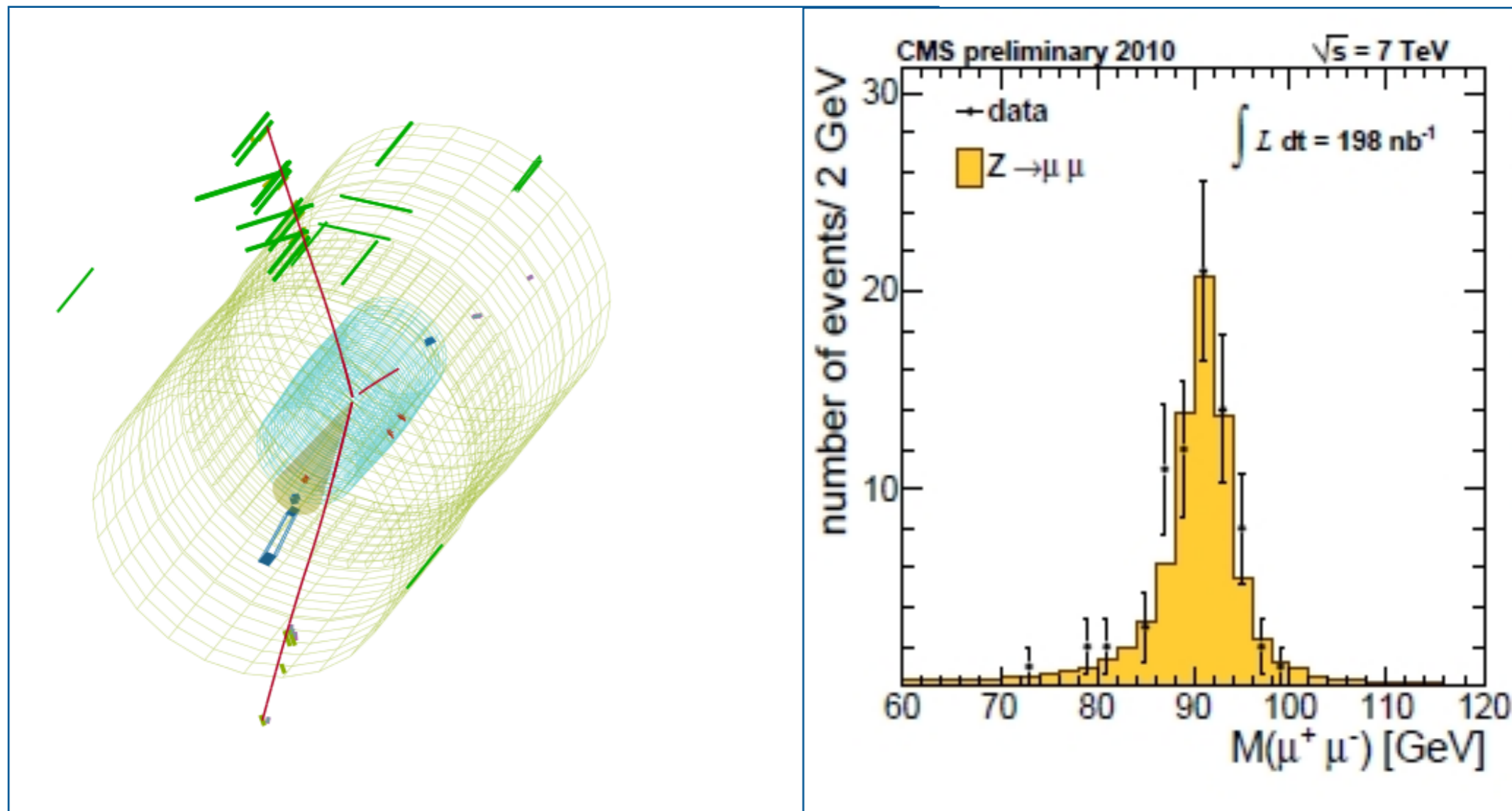
- Can we calculate a W^+/W^- ratio for CMS?





Measurement

- Can we make mass plot of Z candidates?



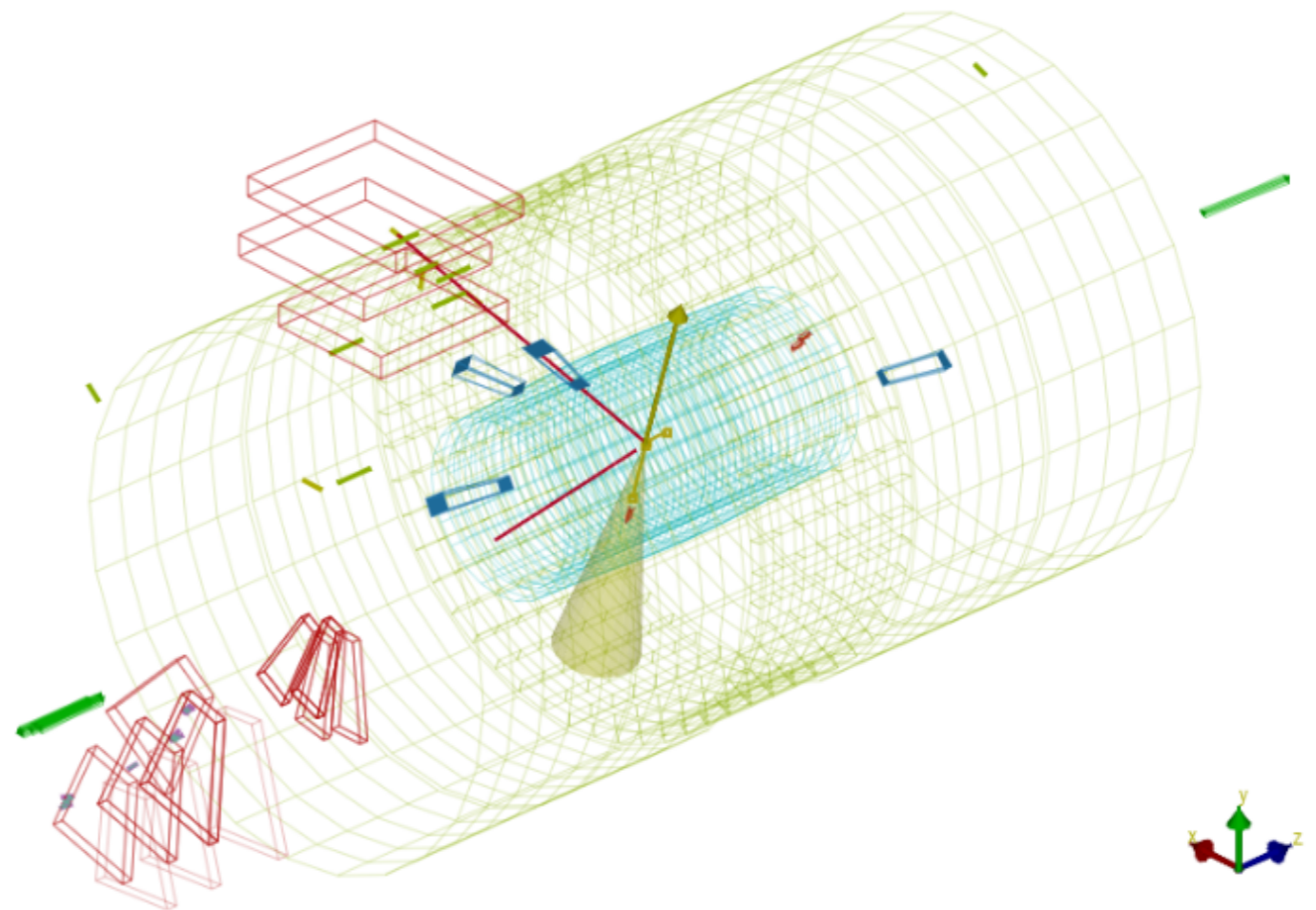
EvNo	E1	px1	py1	pz1	pt1	eta1	phi1	Q1	E2	px2	py2	pz2	pt2	eta2	phi2	Q2	M
128943239	72.89895	13.36098	-26.087	66.74727	29.3095	1.5612	-1.09746	1	37.6277	-10.9181	35.80517	-3.82334	37.3966	-0.10197	1.86677	-1	90.31227



Measurement

- Can we find rarer ZZ events?
 - $Z \rightarrow e^+e^-$
 - $Z \rightarrow \mu^+\mu^-$
 - $ZZ \rightarrow$
 - $e^+e^-e^+e^-$
 - $\mu^+\mu^-\mu^+\mu^-$
 - $e^+e^-\mu^+\mu^-$

Can we pick out electrons and/or muons?



How should an event be filtered so we can recognize the correct tracks?

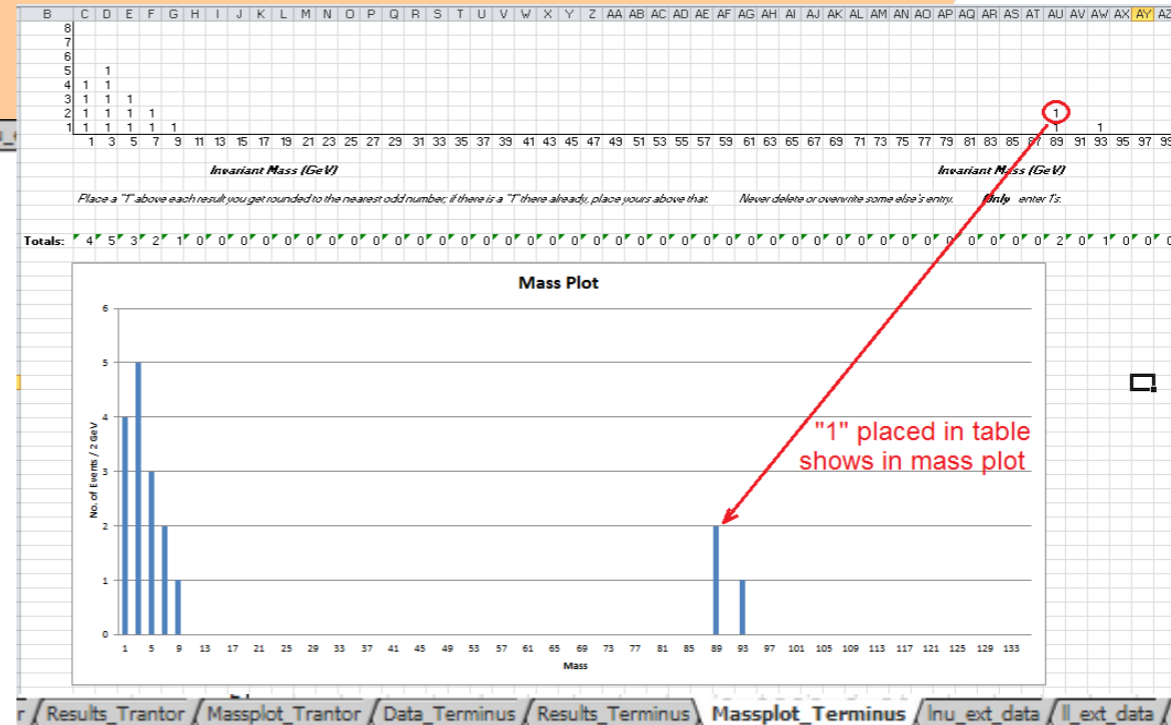


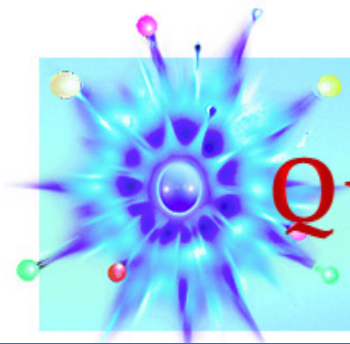
Recording event data

Dataset	Ord No	Ev No	electron	muon	W+ cand	W- cand	W cand	Z cand	"zoo"	ZZ cand	Mass	Mass-->odd
masterclass_1	1	104488192	1			1						
masterclass_1	2	104883322	1		1							
masterclass_1	3	106817913	1			1						
masterclass_1	4	109019570		1		1						
masterclass_1	5	110202776	1		1							
masterclass_1	6	111147144	1			1						
masterclass_1	7	143928422	1			1						
masterclass_1	8	145942990	1					1			89.40	89
masterclass_1	9	149498854	1					1			93.61	93
masterclass_1	10	150447432		1		1						
masterclass_1	11	151909513										
masterclass_1	12	152676268										
masterclass_1	13	155762440										
masterclass_1	14	157942843										
masterclass_1	15	160037345										
masterclass_1	99	95617291										
masterclass_1	100	96831177										
Sums -->			8	2	2	6	0	2	0	0		

Ratios --> e/mu 4 W+/W- 0.33333333

The interface includes a 'Detector Model' list on the left with checkboxes for various components like Tracker Barrels, ECAL Barrel, and HCAL Barrel. A 3D wireframe model of the detector is shown in the center.





QuarkNet

Helping Develop America's Technological Workforce

Moderators' page

EditGrid

Welcome, [qmasterclasses](#)
[Preferences](#) | [Verify Email](#) | [Logout](#)

Home

Spreadsheet / [qmasterclasses](#) / [CMSWZ2013sample](#)

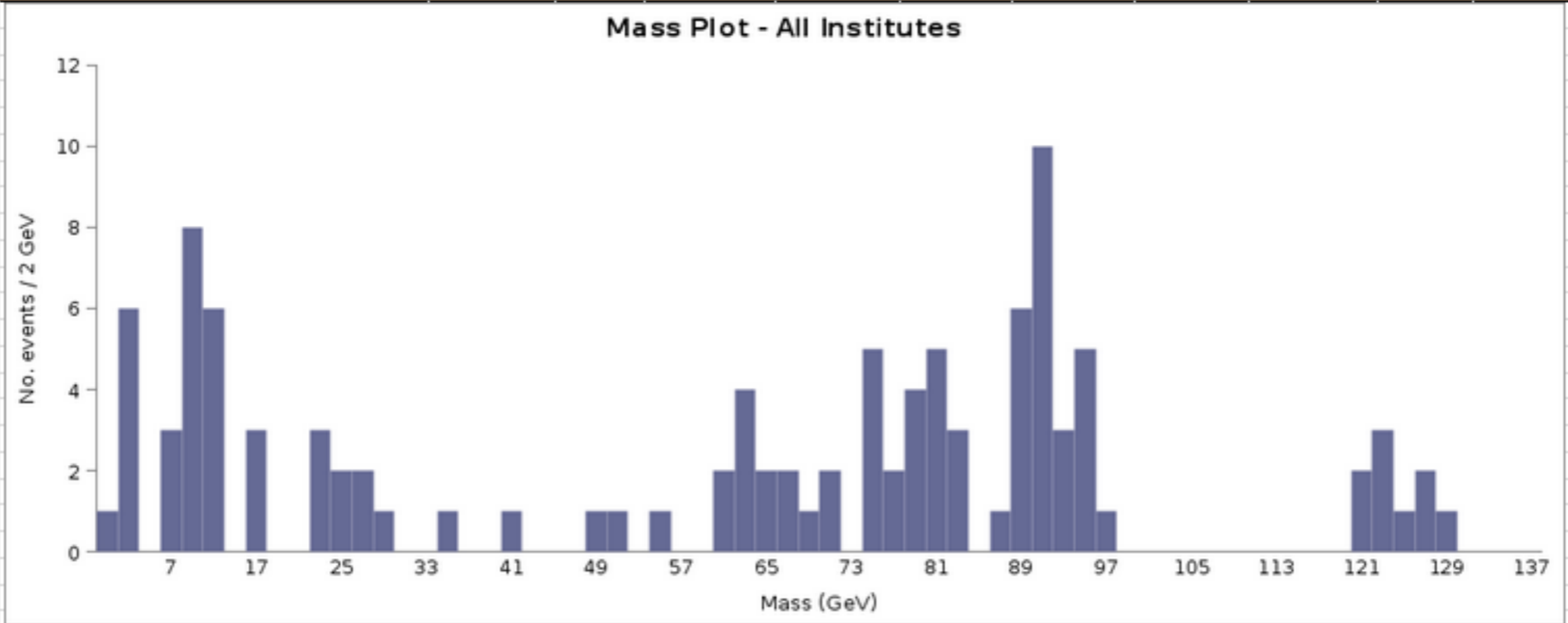
File Edit View Format Insert Data Share Publish Collaborate Macro Help



A1 *foo*

	A	B	C	D	E	F	G	H	I	J	K	L	M
3		Institute	electron	muon	W+ cand	W- cand	W cand	Z cand	"zoo"	ZZ cand	e/mu	W+/W-	
4		A	131	140	117	99	13	29	35	3	0.94	1.18	
5		B	147	140	106	75	19	23	2	2	1.05	1.41	
6		C	93	129	92	69	5	32	22	2	0.72	1.33	
7		Combination -->	371	409	315	243	37	84	59	7	0.91	1.30	

Mass Plot - All Institutes





Try some real events



Tracks (reco.)	<input type="checkbox"/>
Clusters (Si Pixels)	<input type="checkbox"/>
Clusters (Si Strips)	<input type="checkbox"/>
Rec. Hits (Tracking)	<input type="checkbox"/>
ECAL	?
Barrel Rec. Hits	<input checked="" type="checkbox"/>
Endcap Rec. Hits	<input checked="" type="checkbox"/>
Preshower Rec. Hits	<input type="checkbox"/>
HCAL	?
Barrel Rec. Hits	<input checked="" type="checkbox"/>
Endcap Rec. Hits	<input checked="" type="checkbox"/>
Forward Rec. Hits	<input type="checkbox"/>
Outer Rec. Hits	<input type="checkbox"/>
Muon	?
DT Rec. Hits	<input checked="" type="checkbox"/>
DT Rec. Segments (4D)	<input checked="" type="checkbox"/>
CSC Segments	<input checked="" type="checkbox"/>
RPC Rec. Hits	<input checked="" type="checkbox"/>
CSC Rec. Hits (2D)	<input checked="" type="checkbox"/>
Physics Objects	?
Electron Tracks (GSF)	<input checked="" type="checkbox"/>
Tracker Muons (Reco)	<input checked="" type="checkbox"/>
Stand-alone Muons (Reco)	<input type="checkbox"/>
Global Muons (Reco)	<input checked="" type="checkbox"/>
Calorimeter Energy Towers	<input type="checkbox"/>
Jets	<input type="checkbox"/>
Missing Et (Deno)	<input checked="" type="checkbox"/>

Open **iSpy-online** with:

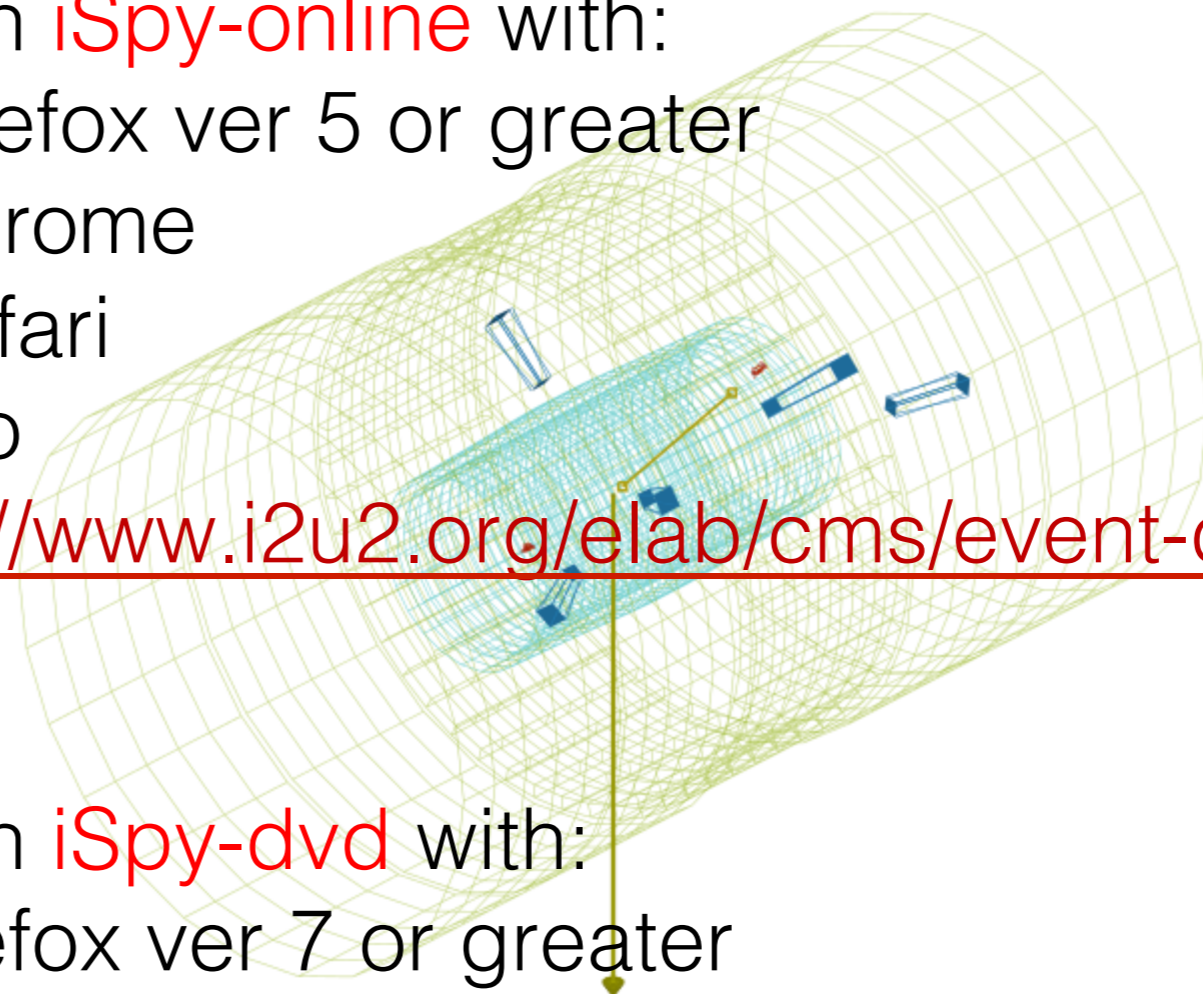
- Firefox ver 5 or greater
- Chrome
- Safari

Go to

<http://www.i2u2.org/elab/cms/event-display>

Open **iSpy-dvd** with:

- Firefox ver 7 or greater



Try EditGrid: <http://tinyurl.com/cmismc13sandbox>