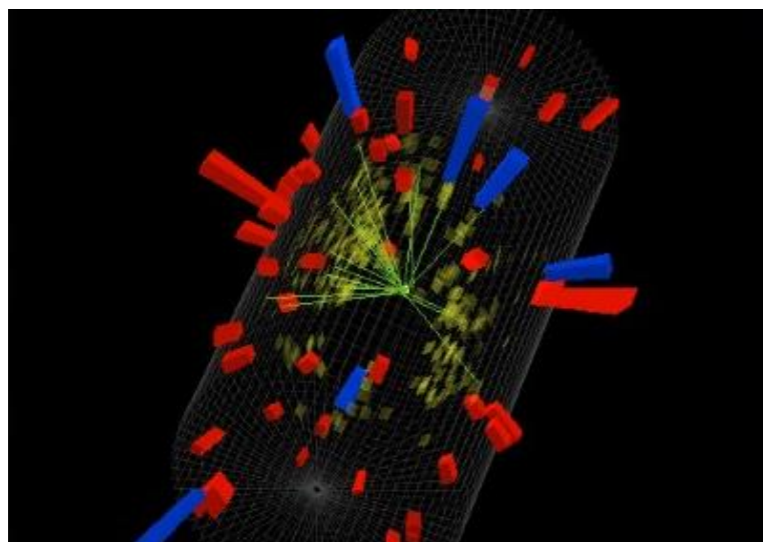
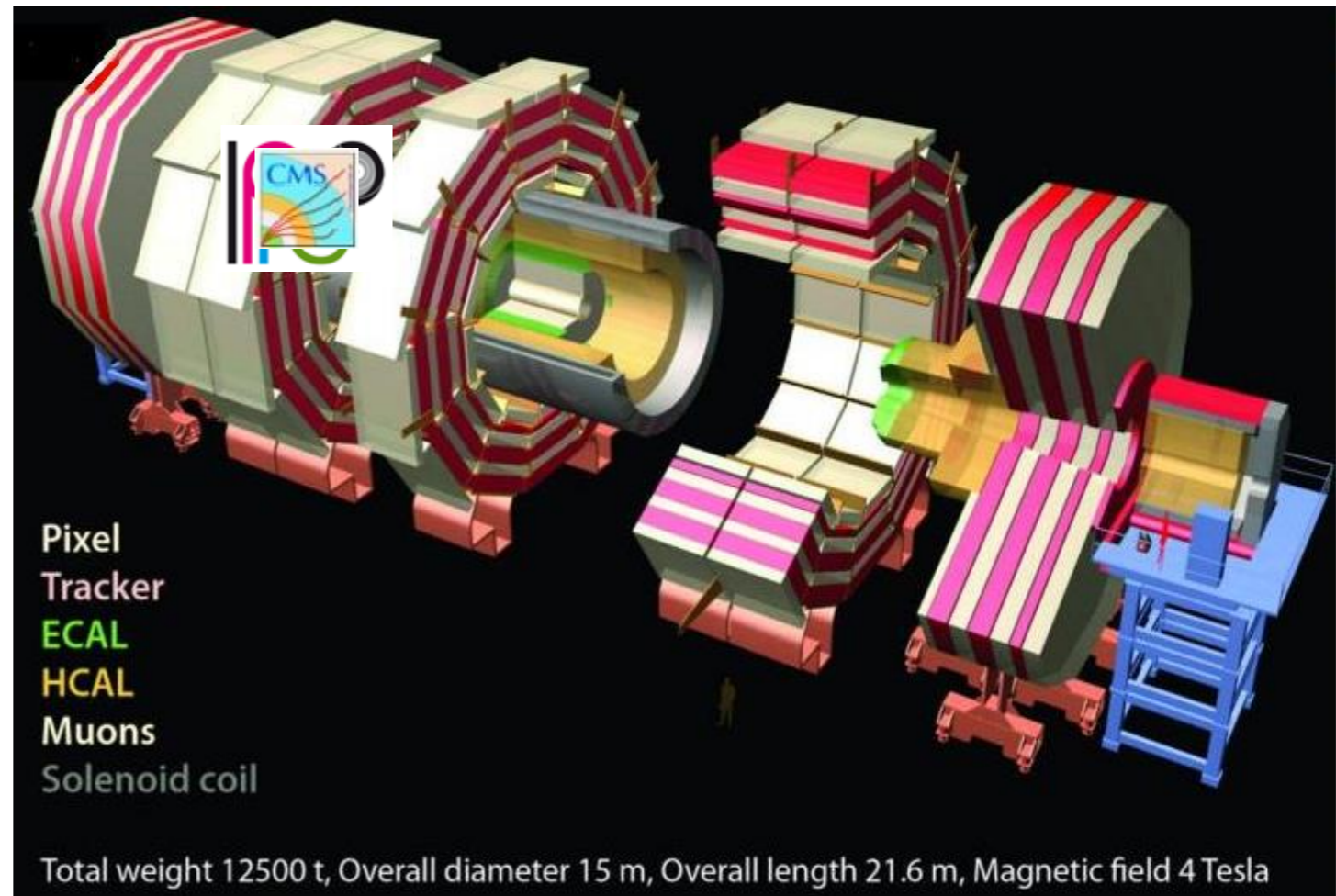


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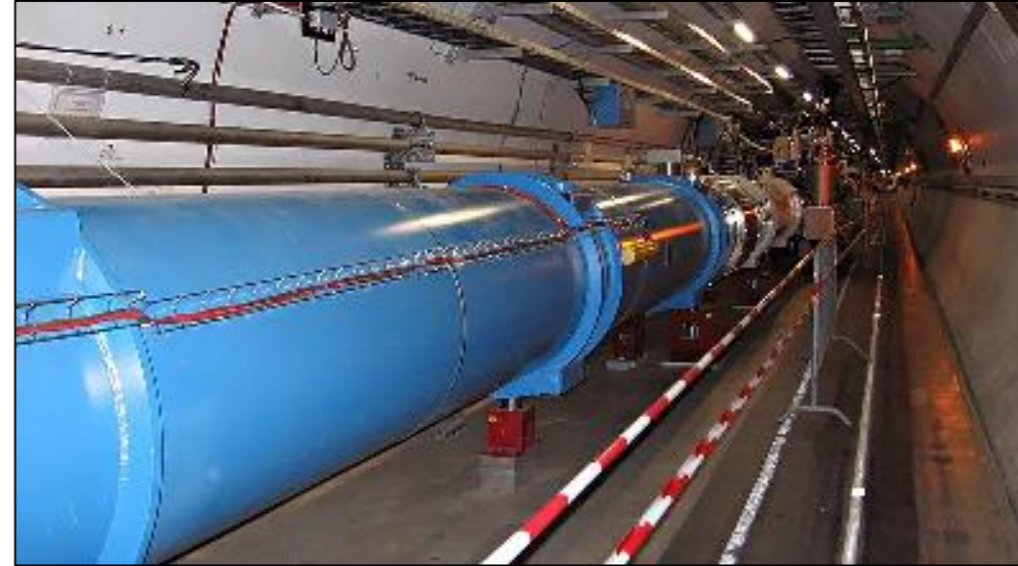
# CMS Masterclass 2016 for Moderators





# CMS masterclass features

- *3000 events:*
  - *W*
  - *Z, J/ψ, Y*
  - *10  $H \rightarrow \gamma\gamma$ , repeated*
  - *3  $H \rightarrow ZZ$ , repeated*
- *New! iSpy-webgl*
- *CIMA – CMS Instrument for Masterclass Analysis*
- *Updated documentation at*  
*<http://tinyurl.com/doc16cms>.*

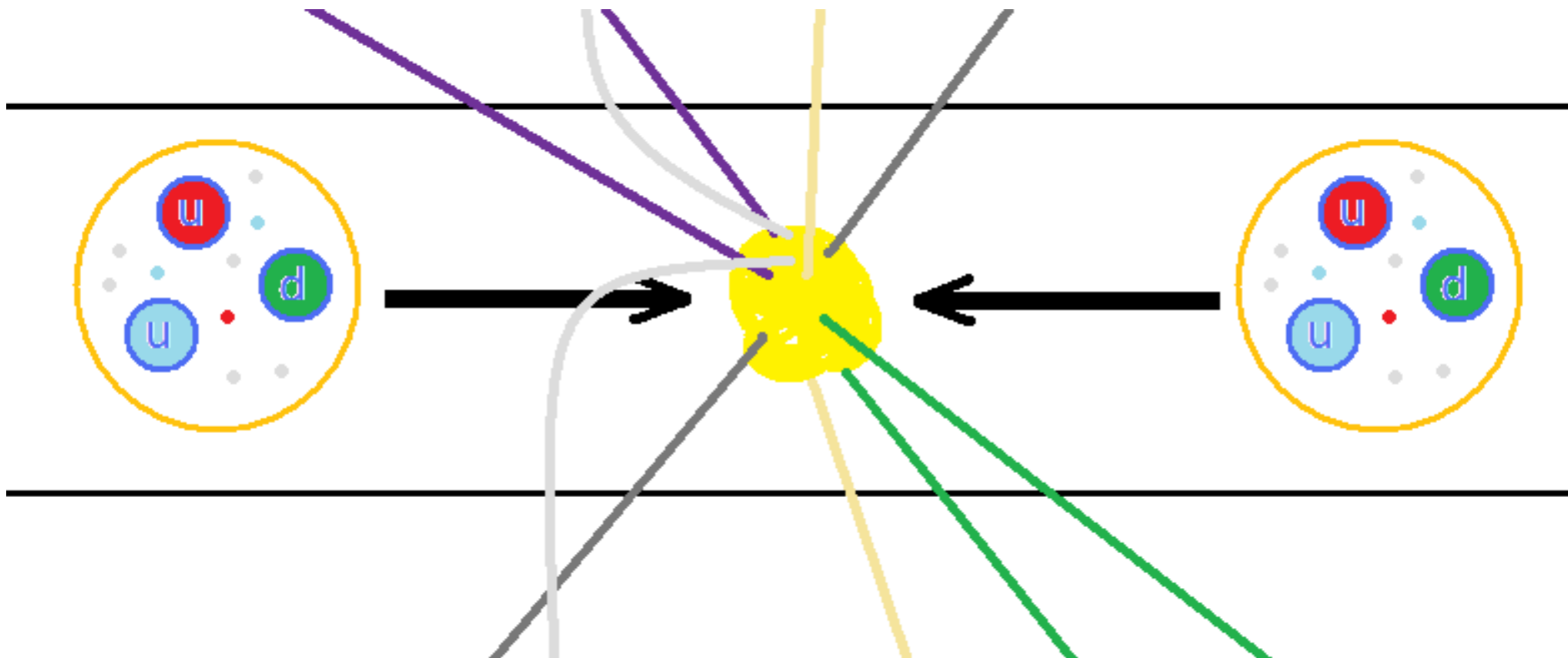


**Students find  $e/\mu$  and  $W^+/W^-$ ; create dilepton and Higgs mass plot.**



## About collisions

- Protons as “bags of partons”
- Parton-parton collisions
- Each parton shares only a portion of proton momentum
- $W^+/W^-$  as probe of proton structure





# iSpy-online

The screenshot displays the iSpy-online interface. On the left is a 'Detector' panel with a list of components and checkboxes:

- Tracker Barrels
- Tracker Endcaps
- ECAL Barrel
- ECAL Endcap (+)
- ECAL Endcap (-)
- HCAL Barrel
- HCAL Endcaps
- HCAL Outer
- HCAL Forward (+)
- HCAL Forward (-)
- Drift Tubes
- Cathode Strip Chambers

The main 3D visualization shows a detector structure with several key features labeled in red:

- event display controls**: A toolbar at the top of the interface.
- event vertex (near collision)**: A red dot at the center of the detector.
- missing energy**: A pinkish-purple region near the vertex.
- energy deposit**: A green region near the vertex.
- electron track**: A blue track originating from the vertex.
- beamline**: A red and green coordinate system at the bottom left.

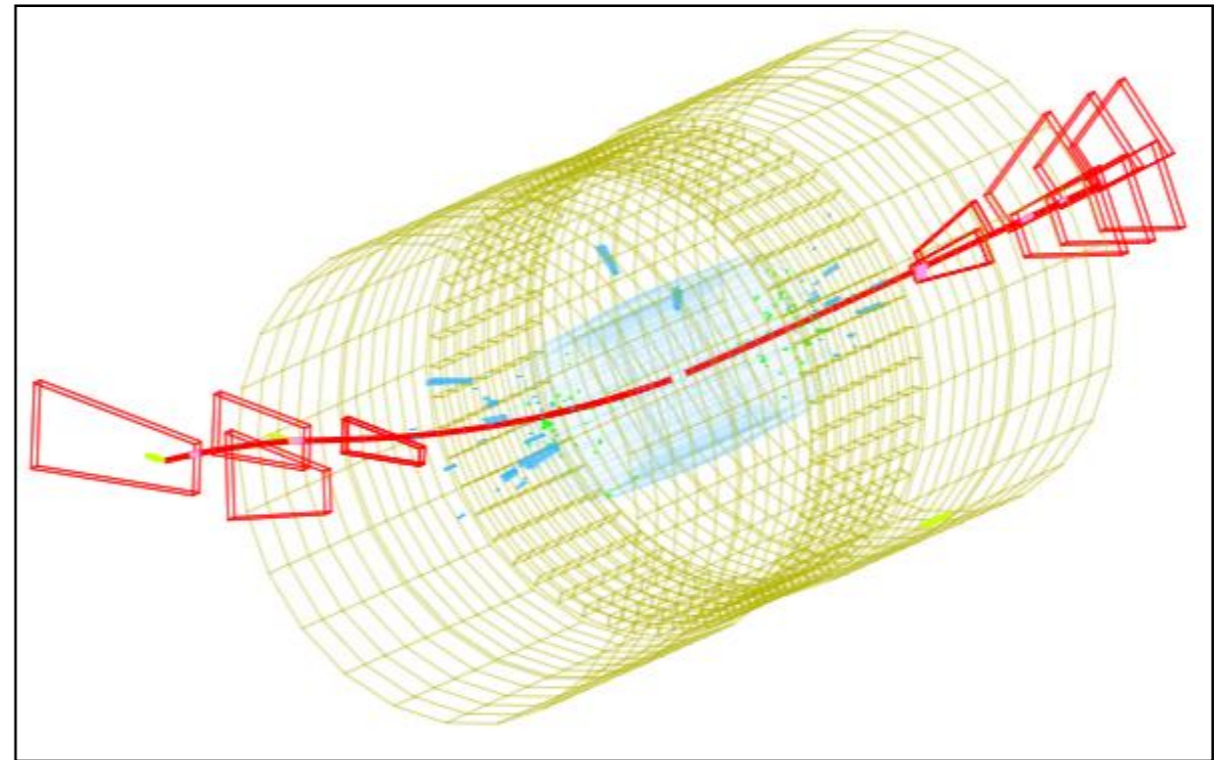
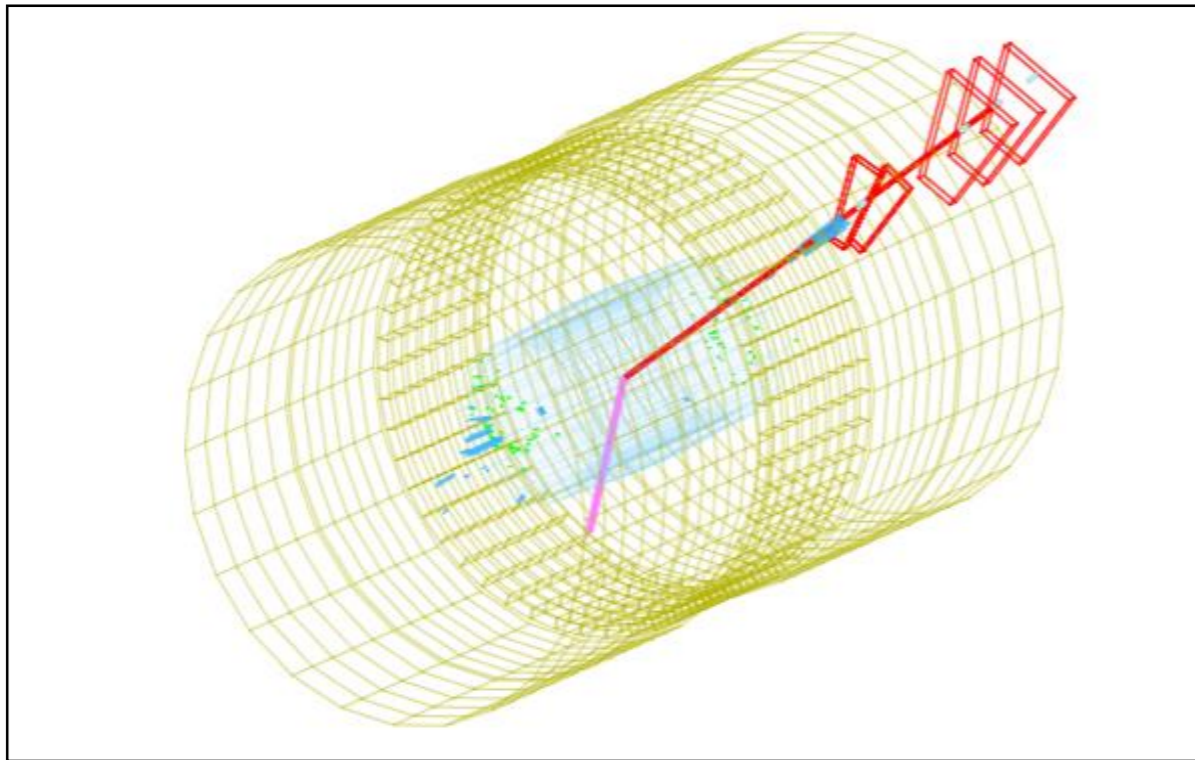
At the bottom of the interface, a legend reads: **ECAL=blue wireframe HCAL=yellow wireframe tracker inside ECAL**



## Student tasks

Students must distinguish W from Z candidates.

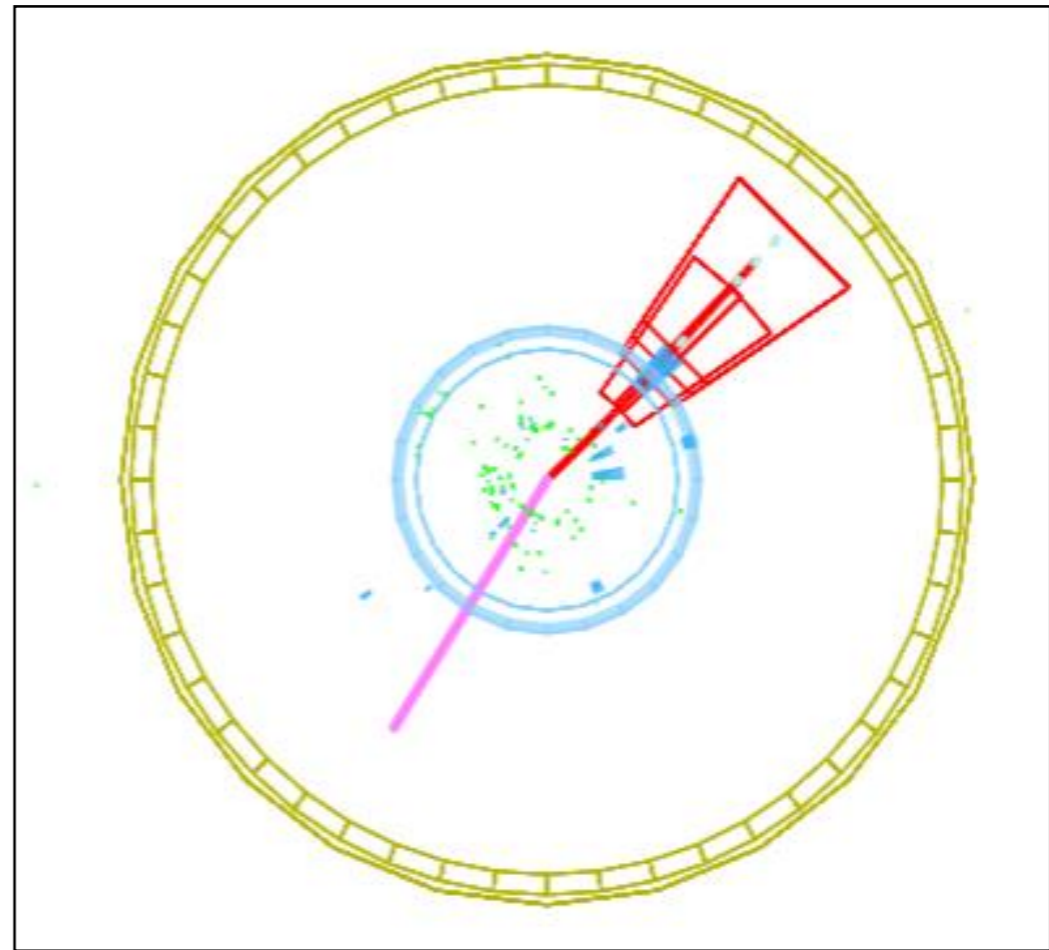
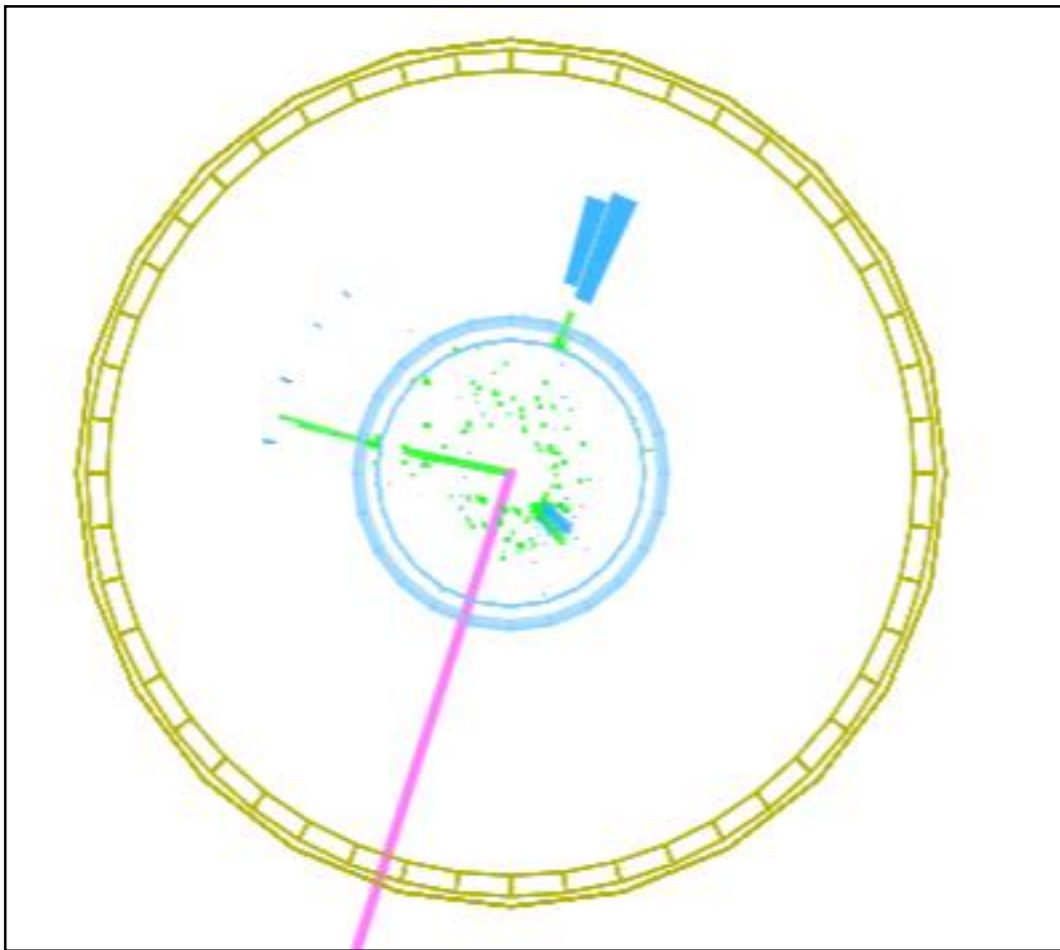
*Typical questions are about third lepton track or high missing  $E_t$  in dilepton event.*





## Student tasks

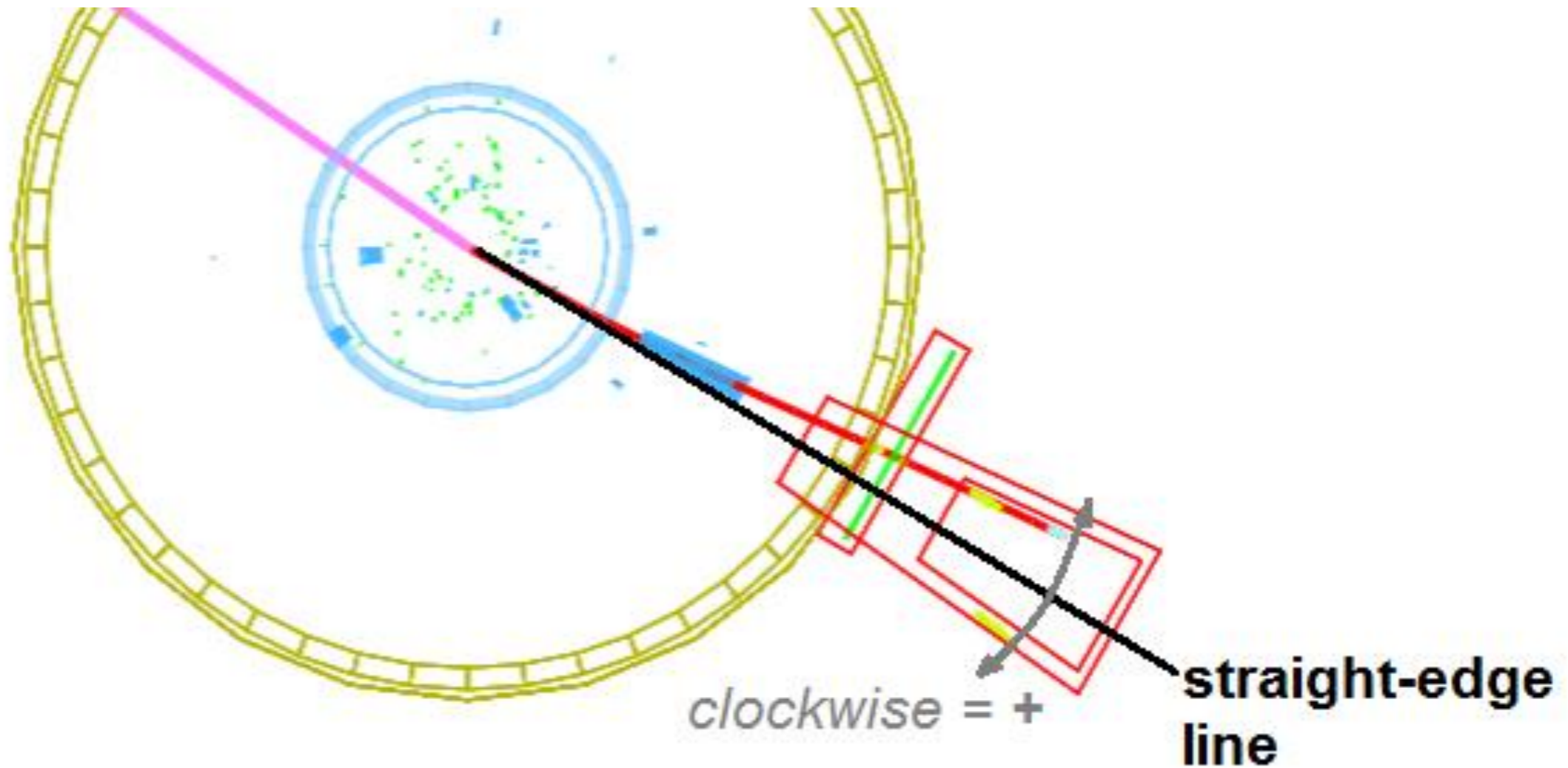
Students distinguish electron *events* from muon *events*.





## Student Tasks

Students distinguish  $W+$  from  $W-$  using track curvature.

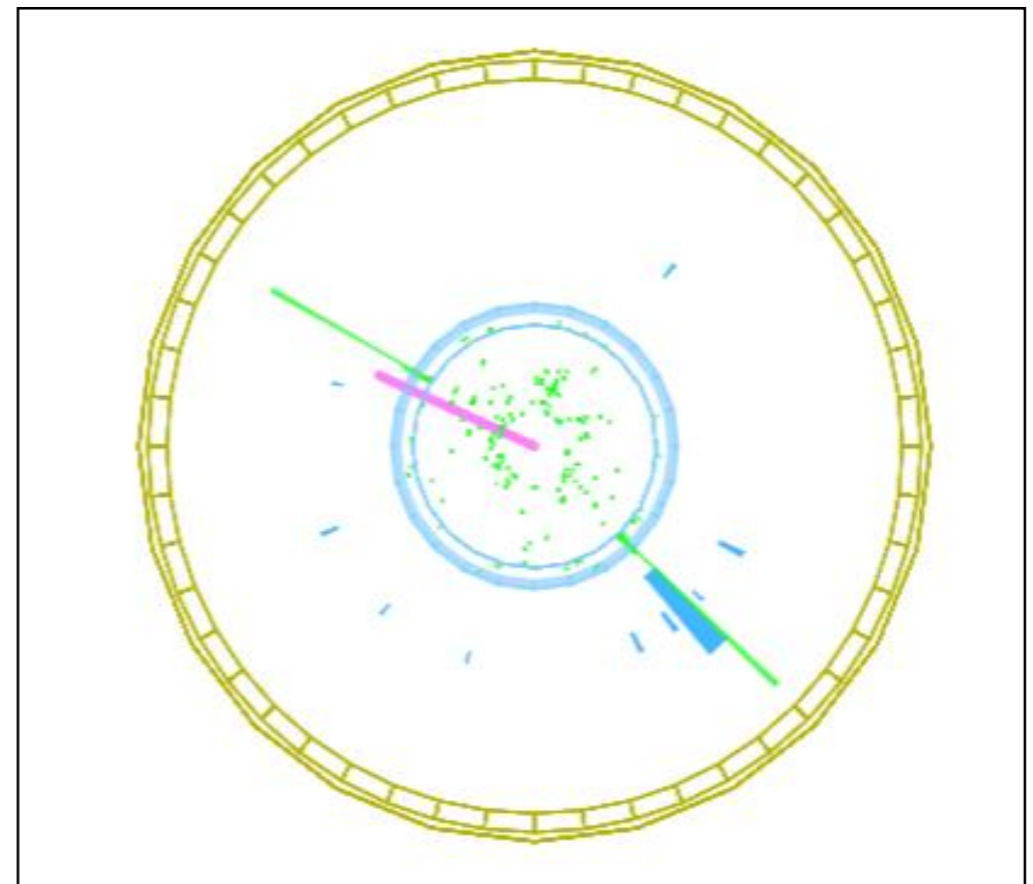
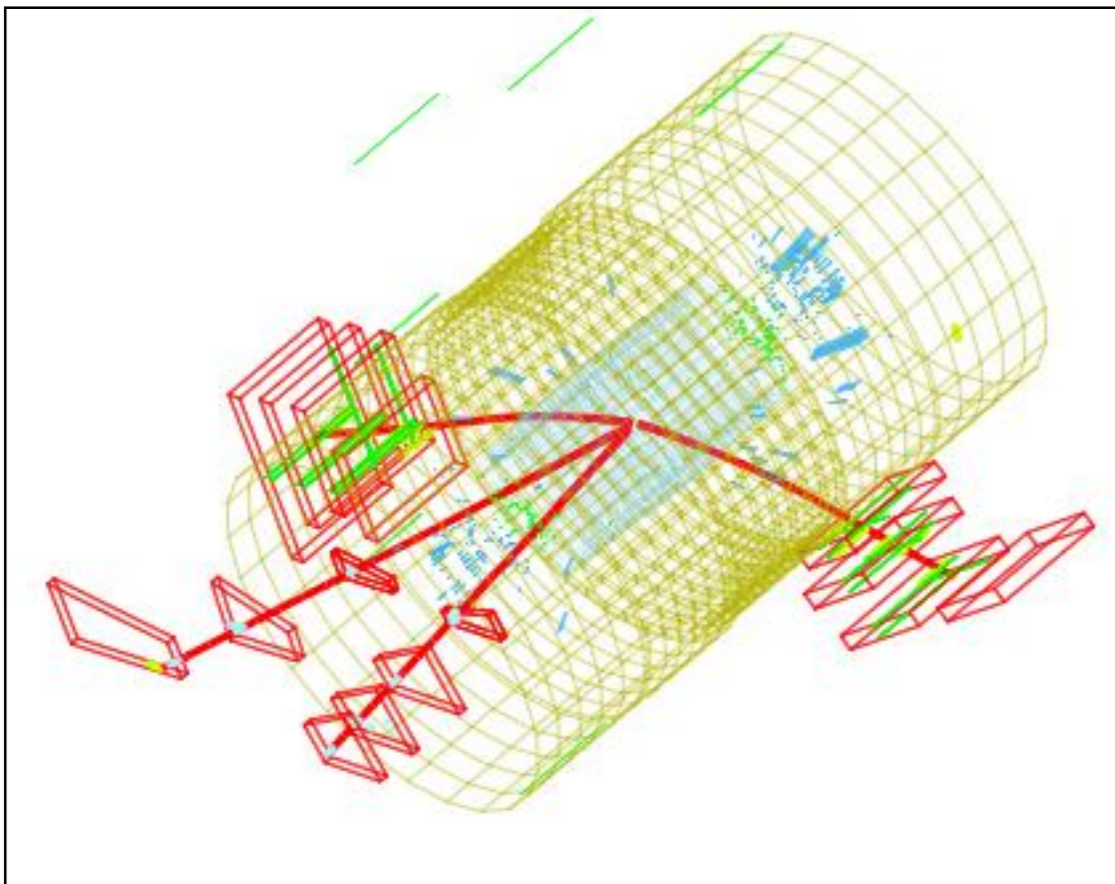




## Student tasks

Students look for  $H \rightarrow ZZ$  and  $H \rightarrow \gamma\gamma$  events.

*Occasionally, students “find” too many Higgs candidates.*







# Recording event data

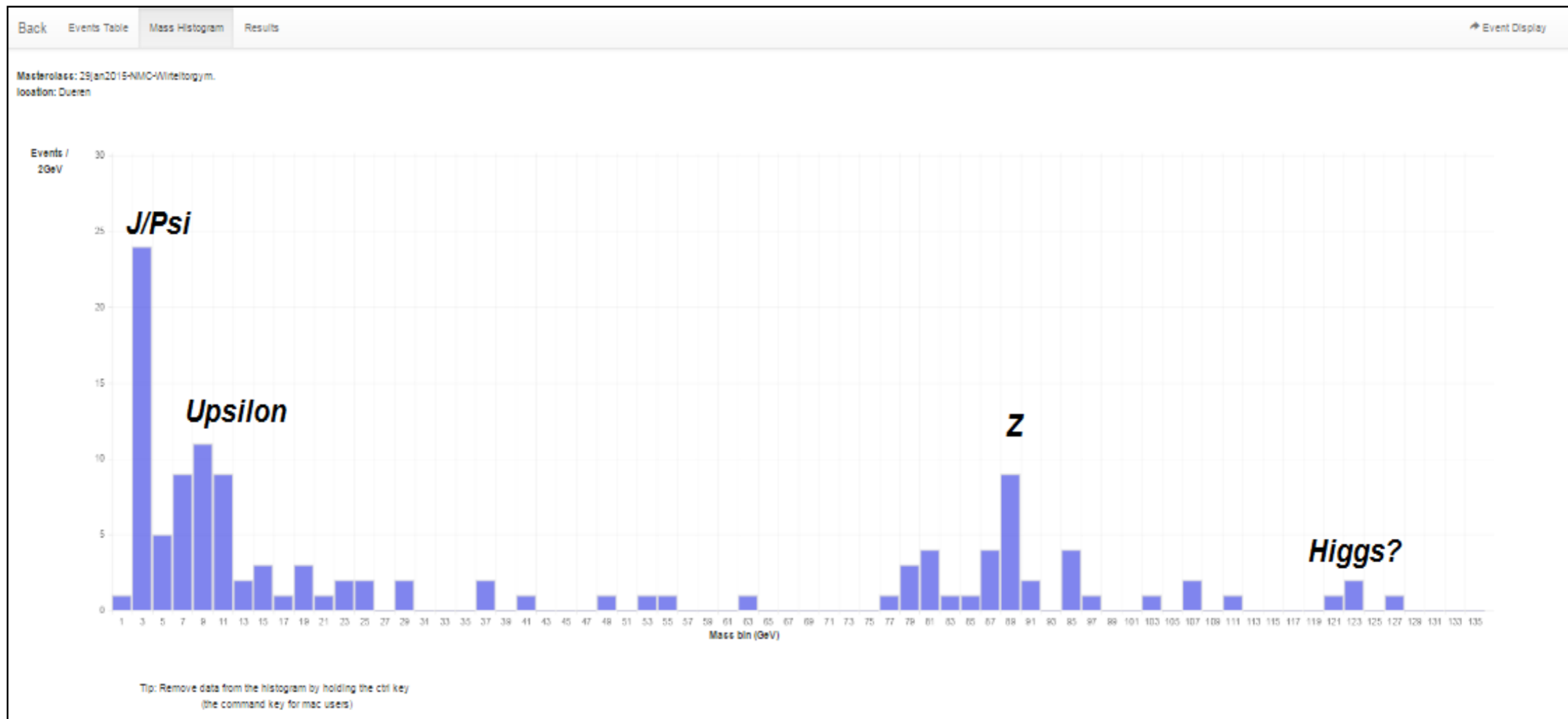
Find your dataset.

Record parent particles and decay modes.

Event index	Event number	final state	primary	Chosen Values	Mass
704	400912970	<input checked="" type="checkbox"/> Electron <input type="checkbox"/> Muon	<input type="checkbox"/> Higgs <input type="checkbox"/> W	e;W+	
703	135353826			mu;W+	
702	500633024			Zoo	
701	329962807			Z;mu	50.642



# What you see





# What you see

Back Events Table Mass Histogram Results

Masterclass: 29Jan2015-NMC-Witelltoqym.  
Location: Dueren

Group	Muon	Electron	W	W-	W+	Z	Higgs	Zoo	Total
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	19	22	6	6	10	19	0	18	59
4	23	15	0	9	16	13	1	13	52
5	18	21	10	9	9	11	0	8	47
6	8	8	1	6	4	5	0	11	27
7	0	0	0	0	0	0	0	0	0
8	16	15	2	7	10	12	1	14	46
9	21	13	2	11	10	11	0	14	48
10	0	0	0	0	0	0	0	0	0
11	26	24	0	14	19	17	0	1	51
12	15	19	0	7	13	14	3	10	47
13	15	22	0	11	16	10	1	6	44
14	24	15	0	7	17	15	0	8	47
15	0	0	0	0	0	0	0	0	0

↓

Total:

Muon	Electron	W	W-	W+	Z	Higgs	Zoo	Sum	e/mu	W+/W-
185	174	21	87	124	127	6	103	468	0.94	1.43



# Additional step with CIMA

<https://www.i2u2.org/elab/cms/cima/auth.php>

username  
Admin

password  
\*\*\*\*\*

Go!

MasterClass



# Additional step with CIMA

The screenshot displays the CIMA web interface with two browser windows. The left window shows the login page at <https://www.i2u2.org/elab/cms/cima/auth.php> with a login form containing 'username' (Admin) and 'password' fields, and a 'Go!' button. A red arrow labeled 'MasterClass' points to the password field. A large blue arrow points from the login window to the main interface window.

The main interface window shows the page <https://www.i2u2.org/elab/cms/cima/Classes.php> with the following sections:

- Create new Masterclass Event:** Includes a text input for 'Event name' and a 'Create Event' button.
- Edit Event:** Includes a dropdown menu for 'Select event' (Test2) and an 'Edit Event' button.
- Manage Tables:** Includes buttons for 'change active status' and 'delete'.
- Masterclasses Table:** Lists various events with their dates and statuses. The entry '04Mar2015' is highlighted with a red circle.
- Tables Table:** Lists 'RiyadhTeam1' through 'RiyadhTeam4' with a '# of Groups' column. The 'Results' button above this table is also circled in red.

Red text annotations on the right side of the main window state: 'Choose: - Date - Results button - Nothing else on this page!'.



# Combined results





## Q&A

*Students might ask:*

- *About individual events → try to keep it general*
- *About double events, like  $W+W^-$  or  $WZ$  (nope)*
- *Life at CERN or Fermilab*
- *Popular doomsdays*

*You might ask or comment on:*

- *How students decided on specific candidate events*
- *No. of events needed for “good” results*
- *How their day went*

Questions for me: [kcecire@nd.edu](mailto:kcecire@nd.edu)