

Set-up

For this activity, you will work with a partner. Each person will need:

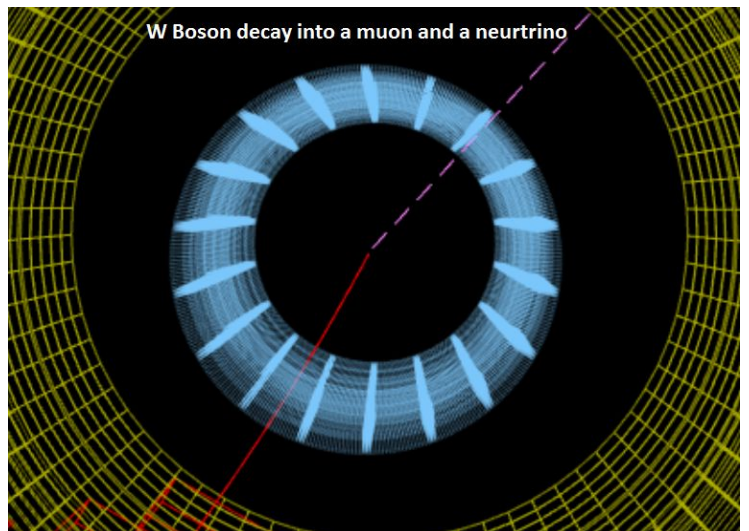
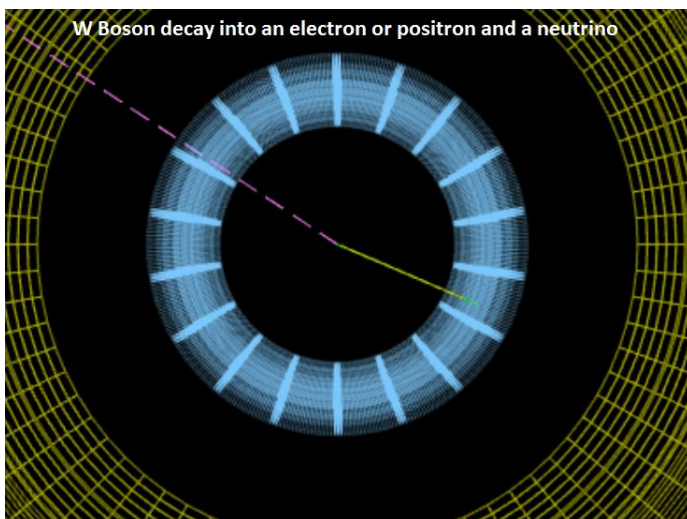
- A laptop with internet connection
- Data Analysis Handout
- One person in the group will need to go to the **iSpy** event analysis website at <http://www.i2u2.org/elab/cms/ispy-webgl/>
- Use the “open” tab to load the events assigned by your instructor.
- Check the following options: **ECAL Barrel**, **HCAL Outer**, **Event**, **Electron Tracks**, and **Missing Et**.
- The other person in the group will need to go to the **CIMA** website at <https://www.i2u2.org/elab/cms/cima/index.php>
- Choose your masterclass assigned by your instructor

Analysis

Use the information below to identify the particles produced during you assigned events.

W Bosons

- **W Bosons** decay into a lepton (an electron, positron, or a muon) and a neutrino.
- The **neutrino** will be indicated by a **missing energy** (pink dashed line) usually **greater than 20 GeV**.
- The **electron** track (green line) will not go past the **Ecal barrel** (the first ring) and will **curve counter clockwise** because it is negatively charged.
- The **positron** track (green line) will not go past the **Ecal barrel** (the first ring) and will **curve clockwise** because it is positively charged.
- The **muon** track (red line) will continue through the **Hcal barrel** (second ring) and will curve either **clockwise if positive** or **counterclockwise if negative**.

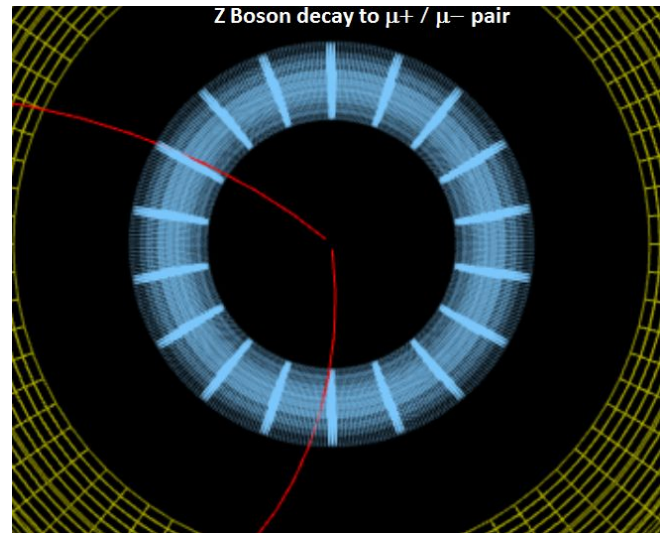
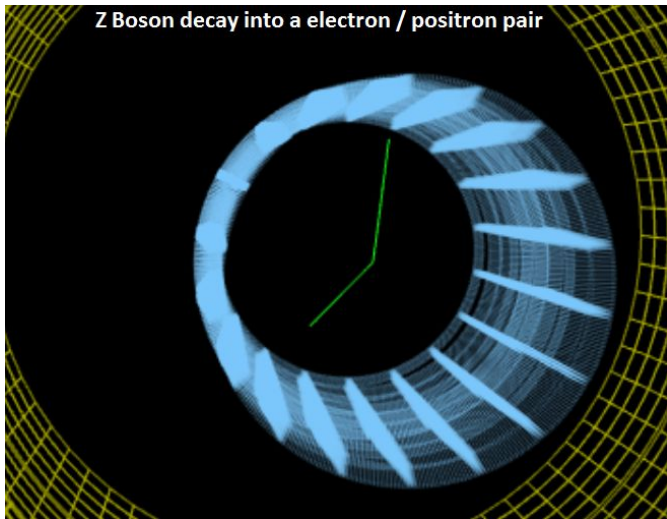


What do you record?

- Indicate the final state by checking either **electron or muon**
- Indicate the primary particle by choosing **W+** if the lepton was positive (curved clockwise), **W-** if the lepton was negative (curved counter clockwise) or **W** if you cannot tell
- **Click Submit**

Neutral Particle (Z Bosons)

- Z Bosons decay into **two leptons** (an electron / positron pair, or a μ^+ / μ^- pair)

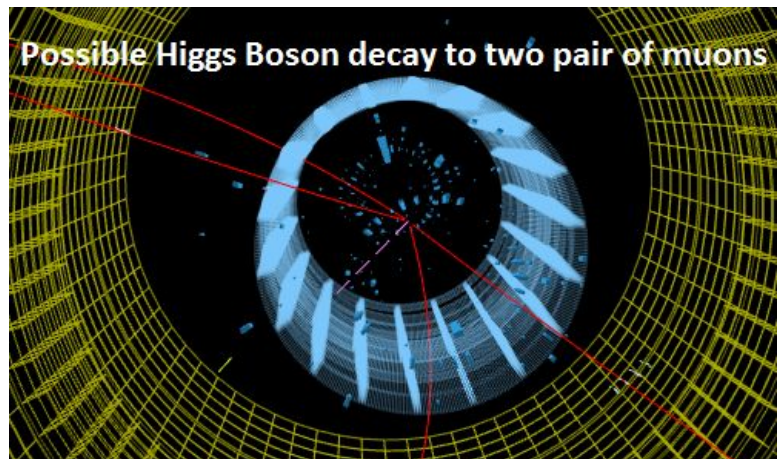
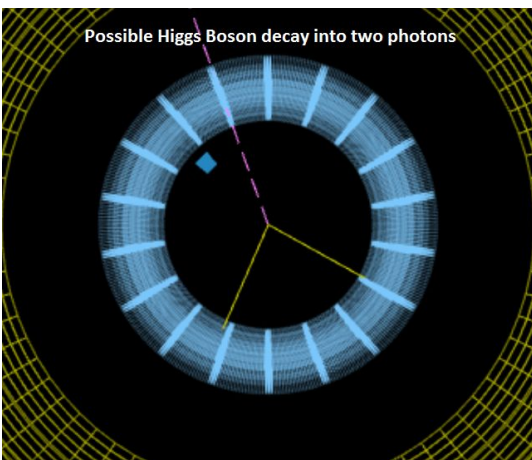


What do you record?

- **Shift-Click on 1st track then 2nd track and copy mass value into CIMA**
- Indicate the final state by checking either electron or muon.
- Indicate the primary particle by choosing NP (neutral particle)
- Click submit **then click the mass of the Z particle in the histogram (mass you copied into CIMA)**

Higgs Bosons Candidates

- **Higgs-like particles** will decay into **two Z particles** (so two pairs of leptons) or **two photons**
- **Photon tracks**(yellow lines) will appear inside the ECAL.



What do you record?

- Choose Higgs in the special column
- Click submit and **click mass of the particle into the histogram**

None of the Above:

- If the event includes **both muon(s) and electron(s)**, then look at the **energy of the tracks (Shift-Click the track)**. If the energy is low you may consider ignoring it and analyzing the event based on the tracks that remain.
- Enter **Zoo** if the event does not fit into any of the categories above.