

Set-up

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

- A laptop with internet connection
- Data Analysis Handouts
- One person in the group will need to go to the **CIMA** website at <https://www.i2u2.org/elab/cms/cima-wzh/>
- Find our Masterclass Center **FNAL** and date, **01Mar2024** and **click on it to select it**. Find the **ManhattanKS2024** location at the top of the middle column and **click on it to select**. **Look for the data set assigned to you and your partner and click on it to load that data file.**

Choose your Masterclass	Choose your location	Choose your data file
TestEvents-01Jan2022	CDMX_Ibero2024	100.1
Santander-13May2024	ManhattanKS2024	100.11
CERN-27Nov2023		100.12
Salo-07Dec2023		100.13
Sofia-13Dec2023		100.14
CERN-LAMAP-08Dec2023		100.15
MP-15Jan2024		100.16
Cakovec-24Jan2024		100.17
Bristol-27Mar2024		100.18
CERN-09Feb2024		100.19
Sandbox-31Dec2023		100.2
CERN-20Feb2024		100.21
CERN-26Feb2024		100.22
CERN-29Feb2024		100.23
CERN-22Feb2024		100.24
CERN-01Mar2024		100.25
CERN-04Mar2024		100.3
CERN-06Mar2024		100.4
CERN-08Mar2024		100.5
CERN-11Mar2024		100.6
CERN-13Mar2024		100.7
CERN-19Mar2024		100.8
CERN-22Mar2024		100.9
CERN-27Mar2024		25.1
FNAL-01Mar2024		25.11

Recording Particles Observed in iSpy

Masterclass: FNAL-01Mar2024

Location: ManhattanKS2024

Group: 100.22 — Your data set

Event Analyzed

What you observed in iSpy

Predicted particle that produced final state

Enter mass for neutral particles (Z,H)

Select Event	Final State	Primary State	Enter Mass
Event index: <input type="text" value="1"/> Event number: 100.22-1	<input type="radio"/> e v <input type="radio"/> μ v <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input type="radio"/> 4 μ <input type="radio"/> 2e 2 μ	Charged Particle: <input type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W \pm <input type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	<input type="text" value=""/> GeV/c ² <input type="button" value="Next"/>

e - electron/positron
 v -neutrino/antineutrino
 μ - muon /antimuon

Charged Particles - W Bosons

- **W Bosons** decay into either an **electron / positron**, or a **muon / antimuon** and a **neutrino / antineutrino**
- The **neutrino / antineutrino** will be indicated by a missing energy (**Solid Pink Vector**)
- The **electron / positron** track (**green line**) will not go past the **Ecal barrel** (the first ring) and will **curve counterclockwise** if it is **negative** and **clockwise** if it is **positive**
- The **muon / antimuon** track (**red line**) will continue through the **Hcal barrel** (second ring) and will **curve counterclockwise** if **negative** and **clockwise** if **positive**

What do you record?

Masterclass: FNAL-01Mar2024
 Location: ManhattanKS2024
 Group: 100.22

Indicate the type of final state

electron / positron + neutrino muon / antimuon + neutrino

Click next to move to the next event

Select Event Event index: <input type="text" value="1"/> ▼ Event number: 100.22-1	Final State <input type="radio"/> e ν <input type="radio"/> μ ν <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input type="radio"/> 4μ <input type="radio"/> 2e 2μ	Primary State Charged Particle: <input checked="" type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W± <input type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text"/> GeV/c ² <input type="button" value="Next"/>
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Indicate the charge of the W Boson
 Based on direction final state curved:
 W+ (Clockwise), W- (Counterclockwise),
 W+/- if you couldn't tell

Neutral Particle (Z, & Higgs Bosons)

- **Z Bosons** decay into a pair of leptons: either a **electron + positron** (**two green tracks** curving opposite directions) or **muon + antimuon** (**two red tracks** curving opposite directions)
- **Higgs Bosons** will decay into two Z Bosons, which then decay into two lepton pairs. So the final state will include **4 electron / positron** (**4 green tracks**), or **4 muon / antimuon** (**4 red tracks**), or **2 electron / positron + 2 muon / antimuon** (**2 green tracks + 2 red tracks**)

What do you record?

Masterclass: FNAL-01Mar2024
 Location: ManhattanKS2024
 Group: 100.22

Choose the type of final state Choose Neutral Particle

Record the mass of the final state particles before clicking next

Select Event Event index: <input type="text" value="1"/> ▼ Event number: 100.22-1	Final State <input type="radio"/> e ν <input type="radio"/> μ ν <input type="radio"/> e e <input type="radio"/> μ μ <input type="radio"/> 4e <input type="radio"/> 4μ <input type="radio"/> 2e 2μ	Primary State Charged Particle: <input type="radio"/> W+ <input type="radio"/> W- <input type="radio"/> W± <input checked="" type="radio"/> Neutral Particle (Z, H) <input type="radio"/> Zoo	Enter Mass <input type="text"/> GeV/c ² <input type="button" value="Next"/>
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None of the Above:

- If the event does not match one of the categories above, then look at the **pt of the tracks (click once)**. If the pt is less than 20eV you may consider ignoring it and analyzing the event based on the tracks that remain.
- As a last resort...enter **Zoo** if the event does not fit into any of the categories above.