Z path
instructions

To start:
- software and data should be already downloaded to ATLAS directory
- start the program: **HYPATIA_7.4_Masterclass.jar** (in Linux: script **HYPATIA_7.4_Masterclass.sh**)

Reading the data:
- your data is in the dowloaded file group<x>.zip, where <x> is your letter
- in the window **Invariant Mass** select   File ➔ Read Event Locally
- go to **ATLAS/HYPATIA_7.4_Masterclass1/events/** and select the file **group<x>.zip**

Data analysis:
Your task is to look at the event display, examine tracks and other objects to find candidates for products of decays of Z boson or Higgs particle. The table below is a summary of steps necessary for proper identification of event types:

- $Z \rightarrow e^+ e^-$
- $Z \rightarrow \mu^+ \mu^-$
- $H \rightarrow l^+l^-l^+l^-$ where *l* denotes **μ** or **e** (decays: $H \rightarrow \mu^+\mu^-\mu^+\mu^-$, $H \rightarrow \mu^+\mu^-e^+e^-$ or $H \rightarrow e^+e^-e^+e^-$)
- $H \rightarrow \gamma\gamma$
- Background (all other events)

transverse energy needs to be small, to reject events with energetic neutrinos if ***ETMis*** is larger than **30 GeV** count the event as **background** and contiunue with the next event	
consider only tracks with relatively large transverse momentum (for example ***Pt*** > 5 GeV) to find individual leptons and then **lepton pairs** (**e⁺e⁻** or **μ⁺μ⁻**)	

e^+e^-	$\mu^+\mu^-$
electron track **is visible** in the Inner Detector	muon track **is visible** in the Inner Detector (if this track is selected "*Muon track*" appears in the *Output display* tab)
track **does not** continue beyond Inner Detector	track **continues** to the Muon Detector
after extrapolating the track to electromagnetic calorimeter some yellow energy deposit should be found, sometimes in *Physics Objects* tab an object with similar *Pt*, φ and θ can be found	**no energy deposit** in the electromagnetic calorimeter, and if it is there, the parameters *Pt*, φ and θ of the object in the *Physics Objects* tab are different than those of the track
after extrapolating the track to the hadronic calorimeter no significant energy deposit should be found	after extrapolating the track to the hadronic calorimeter no significant energy deposit should be found

all selected tracks (lepton candidates) have to originate from **the same vertex**
tracks have to be added always in pairs - two particles of the same type (**ee** or **μμ**), but with **opposite sign of electric charge**; more than one pair can be added
according to the found lepton types the events are assigned to: **Z → e⁺e⁻**, **Z → μ⁺μ⁻** or **H →**$l^+l^-l^+l^-$ categories (***l*** denotes **e** or **μ**, like: **H →**$e^+e^-\mu^+\mu^-$)
in the events **without leptons**, search also for the **photon pairs:** two objects in the *Physics Objects* tab, not associated with any track; such events are assigned to **H →**$\gamma\gamma$ category
an event without any lepton pair or photon pair belongs to **background**

Storing results and uploading them to the server:
- results of anaysis can be stored in the window   **Invariant Mass:** *File → Export Invariant Mass*
  This opens a window to save *Invariant_Masses.txt*   file (save it to Desktop or any other place)
- In the Web browser open: *http://cernmasterclass.uio.no/*
- from the menu select "*OPloT*", and in the opened page select   "*Student*"
- log yourself as: *Username:* **ippog**   *Password:* **imc**
- in the third page choose today's date, Krakow as the *Institution*, your dataset number (*Group number* - for example 11) and *Group letter*
- in the next page, on the right, use the file selection button and then *submit* button. After uploading the file histograms representing your results are displayed

In the case of any problems or doubts - ask the tutor