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Tutorial for cmsShow

—Look at ttbar bkg. in tW channel

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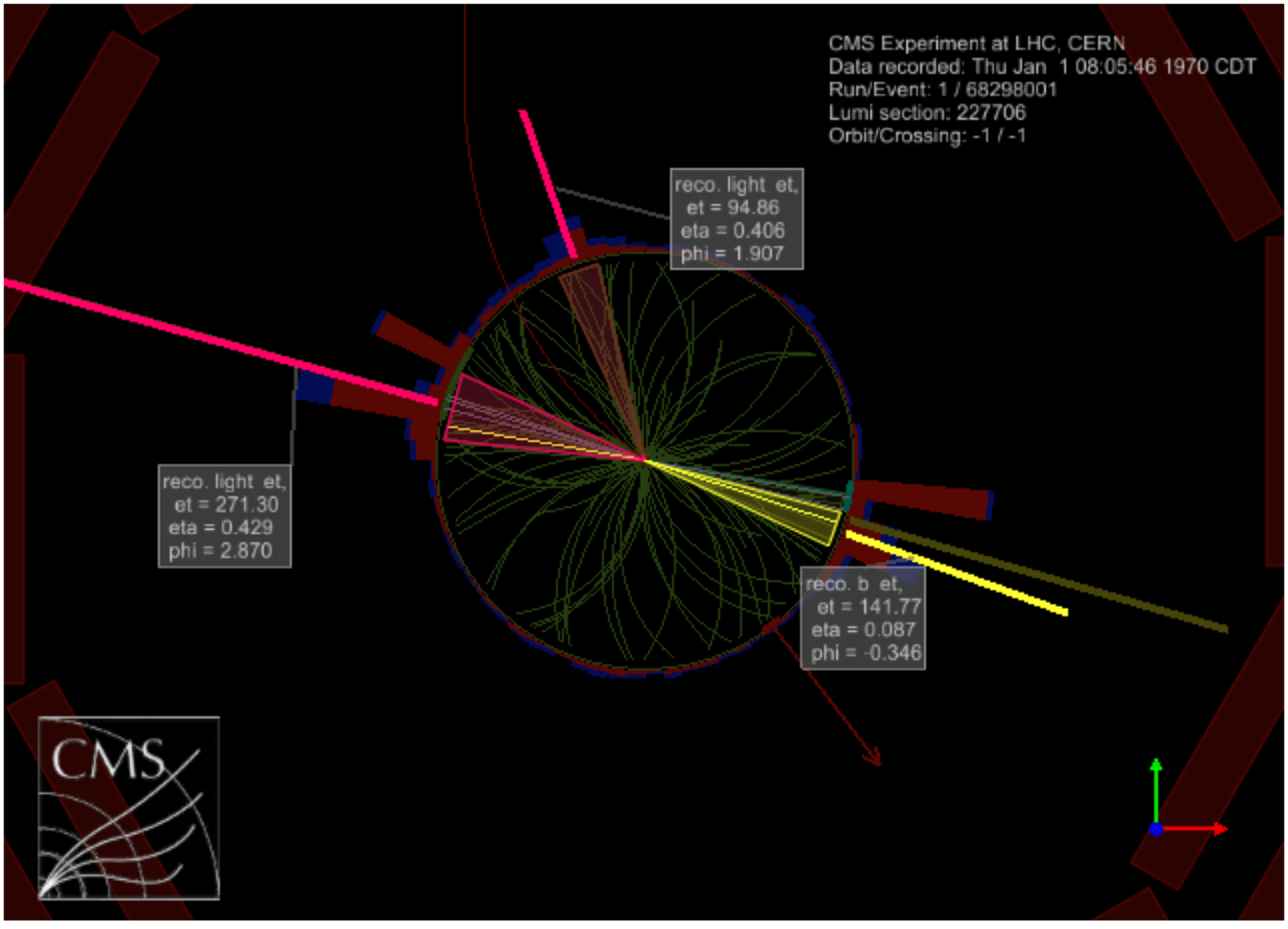
Typical Event Display



Outline

- Step 1: Run cmsShow
- Step 2: Add collections & filter collection elements
- Step 3: Get familiar with views
- Step 4: Display information of a single track (jet)
- Step 5: Save configuration

Run cmsShow

- `ssh -Y cms02@202.122.38.63`
- Make your own directory
  - `mkdir your_name`
  - `cd your_name`
- Copy to your own directory
  - `cp /home/cms01/tutorial/cmseventdisplay/software/cmsShow-5.2-3.linux.tar.gz .`
- Unzip the package
  - `tar xzf cmsShow-5.2-3.linux.tar.gz`
  - `ls`

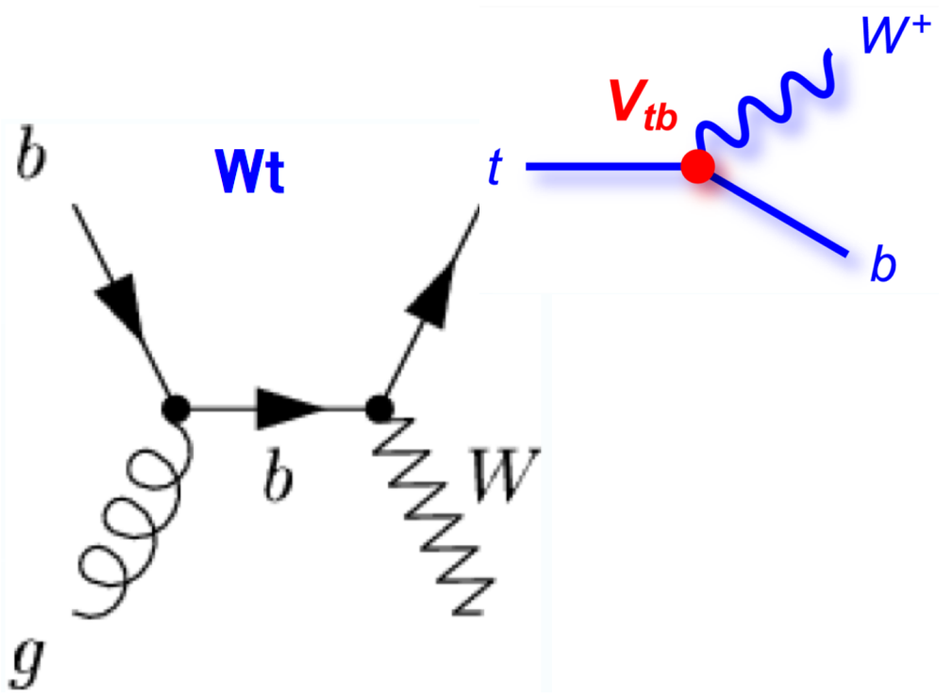
Run cmsShow

- Open file 3pattuple_TChannel.root
  - `cd cmsShow-5.2-3`
  - `ln -s /home/cms01/tutorial/cmseventdisplay/software/cmsShow-5.2-3/3pattuple_TChannel.root`
  - `./cmsShow 3pattuple_TChannel.root`
- File 3pattuple_TChannel.root contains 100 ttbar events that pass tW selection (mistaken as tW events).

tW vs $t\bar{t}$ Events

(Two ways of top quark production)

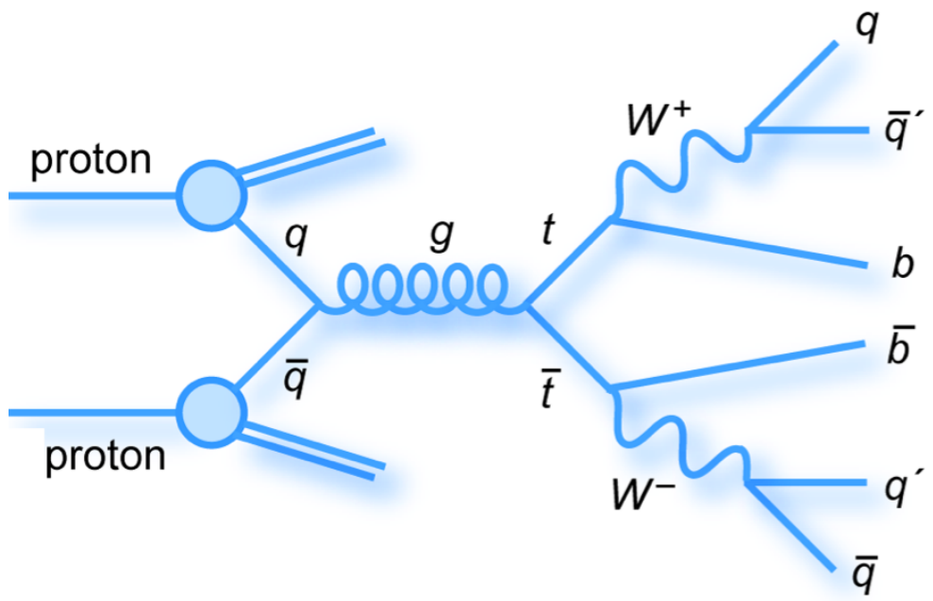
Signal: tW event



Via weak interaction

1 b jet

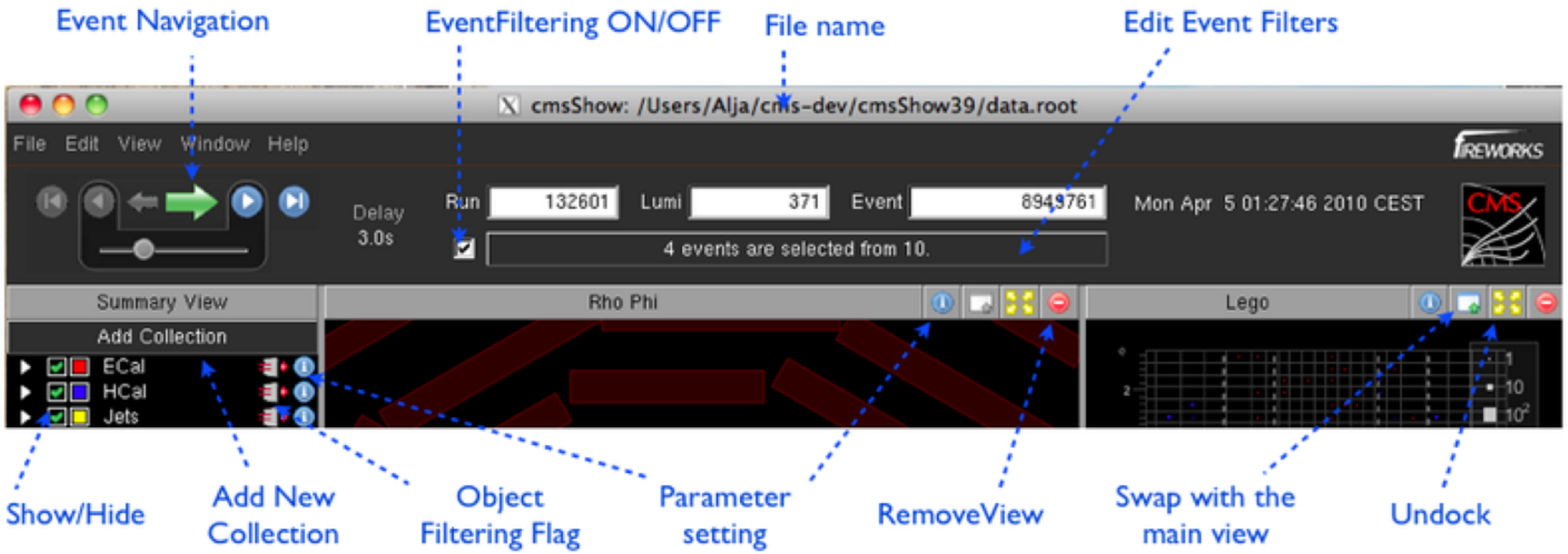
Bkg: $t\bar{t}$ event



Via strong interaction

2 b jets

- When application starts, the main window with the most important controls shows up. Below is a screen shot of top frame with names of individual GUI controls.



Collection: a set of tracks

- Play with the left bar: show/hide collections
- Click on the coloured button (■) at the left of each collection name in the summary view to set default colour for that collection.
- Choose dim colours for all collections because we want to analyse **two other collections** in next slides.

Add 2 Collections for Ana.

- Only 1 of 2 b jets in ttbar is reconstructed => bkg
- How many b jets?
  - `MCtopsBQuark (B jets truth information)`
- How many reconstructed b jets?
  - `topJetsPF (reconstructed jets)`
  - `Choose b jet (in page 11)`

Add Collections

1. Click on **Add Collection** button to activate **Add Collection Dialog**. (Fig 1)
2. Type **MCtopsBQuark** in seach box (Fig 2)
3. Choose collections with purpose named **Jets** or **Candidates**.
4. Repeat 1&2 with **topJetsPF**

✦After that, the summary view should look like Fig 3.

Fig 1. "Add collection" button

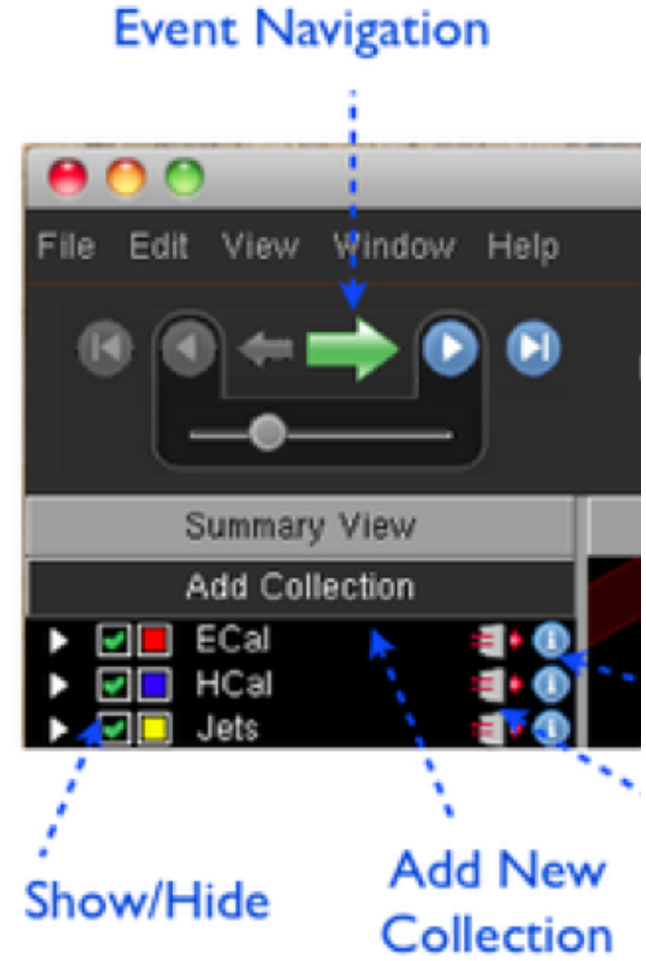


Fig 2. Add collection dialog

Fig 3. Updated summary view

Pick b from all reco. jets

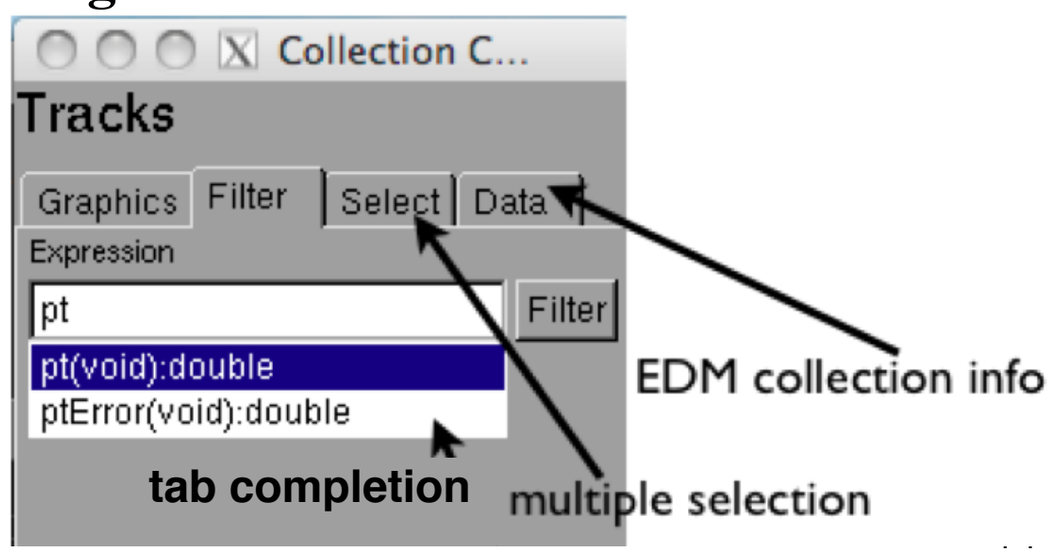
- Click on **the info button** (Fig 1) of collection **topJetsPF** to activate **collection controller** (Fig 2).
- Choose Filter tab.
- Enter cut condition into Filter tab:

Fig 1. the Info button


```
$.pt()>40 && $.eta()>-2.4 && $.eta()<2.4 &&
   $.bDiscriminator("combinedSecondaryVertexBJetTags")>0.898
```

- What does bDiscriminator mean?
  - $.**bDis.**>0.898: b jets
  - $.**bDis.**<=0.898: light jets

Fig 2. collection troller



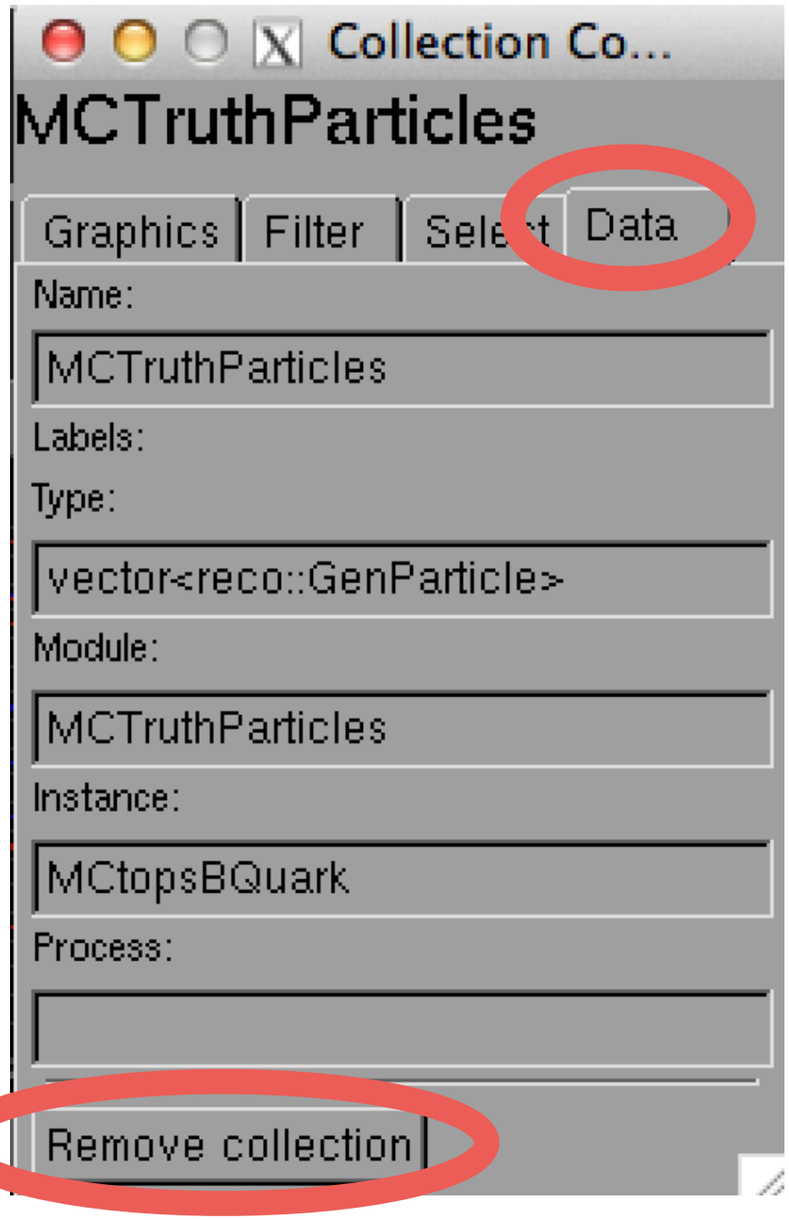
More on Collection Controller

- You can remove the unnecessary collections in **the Data tab** (see Fig 1).

- You can also set the default colour and visibility properties via **the Graphics tab**. (Or directly set them in **the Summary View**.)

- Play with it!

Fig 1. Remove button in controller



View Types

- **Pho Phi/Rho Z** views show Pho Phi/Rho Z projections, and they are called Projected Views.

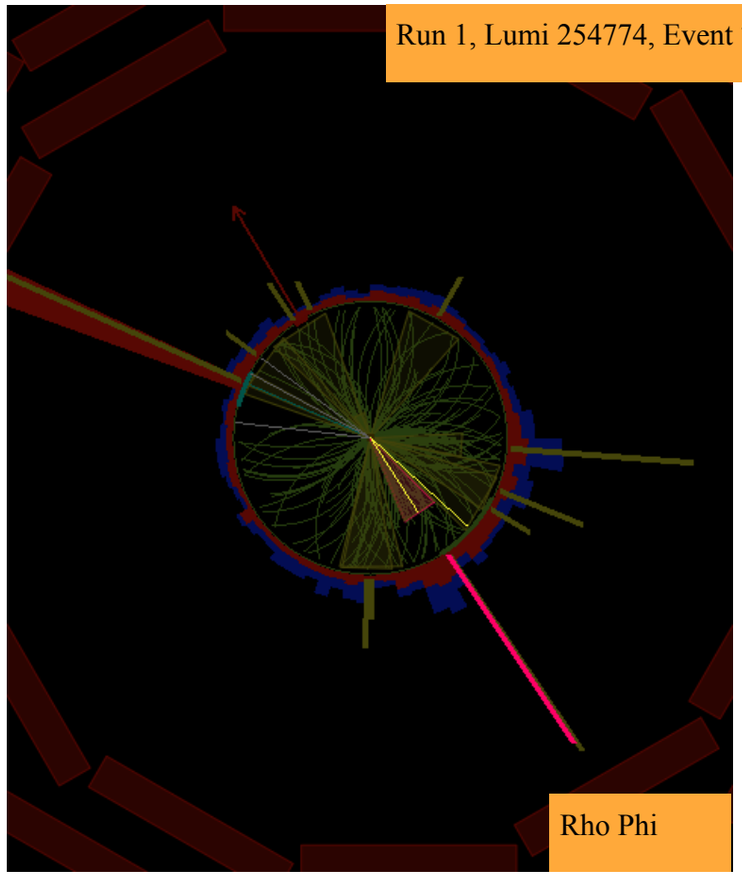
- **3D** view shows CMS.CaloTowers, split into ECAL and HCAL contribution.

- **Lego** view presents calo towers are show as stacked lego plots (HCal on top of Ecal). It shows collections as a eta-phi histogram.

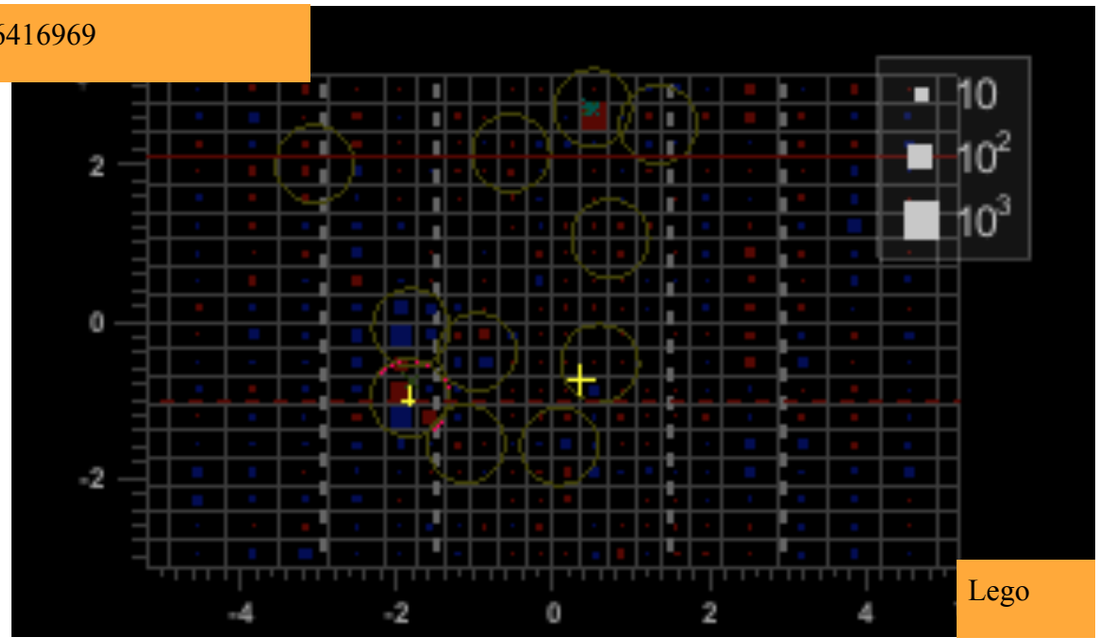
- **Table** view contains detailed information about any EDM object (physics objects, triggers, ...).

- More views can be added from the View ->New Viewer menu.

- **Caution! Pay attention to various views when analysing. Don't be mislead by the appearance of one view.**



(It seems like)
2 b jets reco. as light jet



(In fact)
Only 1 b jet reco.!

Control Windows

- In the main window
  Left slice: a single view
  Right slice: packs all other views

- Window control icons in the title bar:
  - Swap view on the right side with main view on the left side with a click on  icon.
  - Any views can be un-docked from the main Fireworks window by clicking on  icon.

Make Image for Media

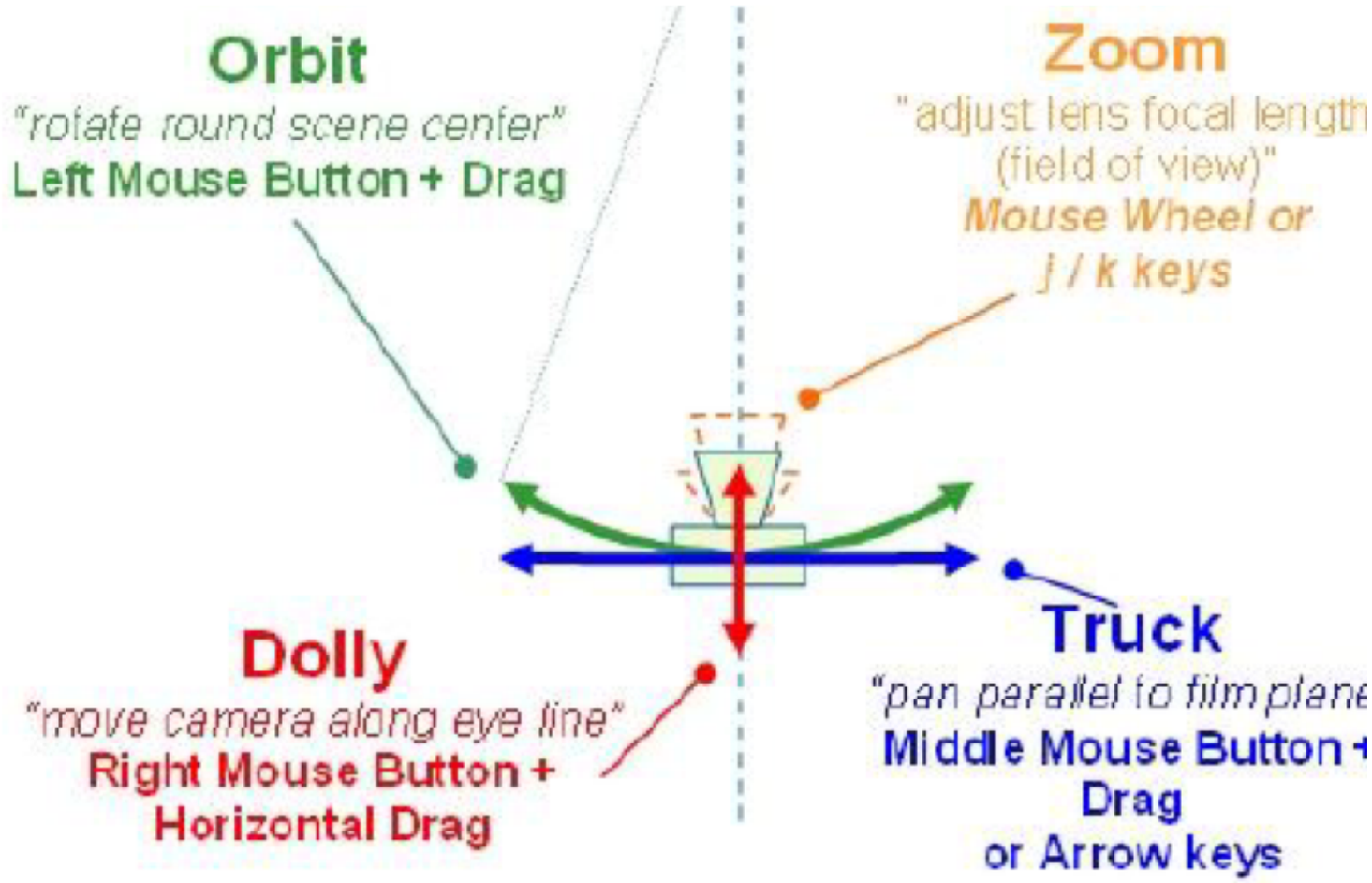
- The **view controller** is activated by clicking on the info icon in the title bar.

- You can switch background colour between black and white, add the CMS logo and camera guide, add event information, and scale the picture, etc. via the **view controller**.

- After you have done all the settings, click on Save Image to save the image you just made.

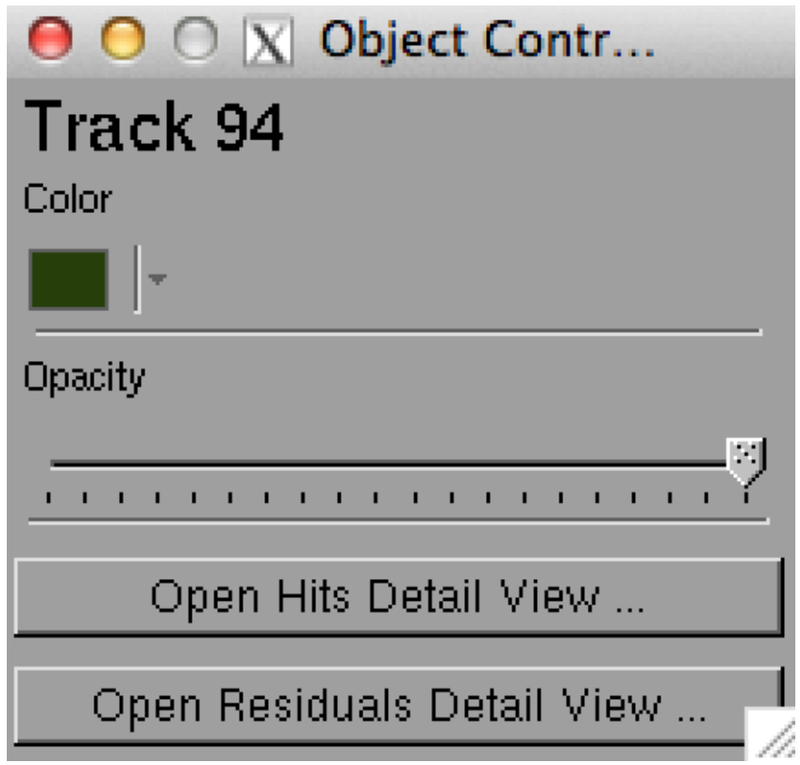
Interact with Camera

- You can interact with the views with your mouse or trackpad.



Change Single Object Property

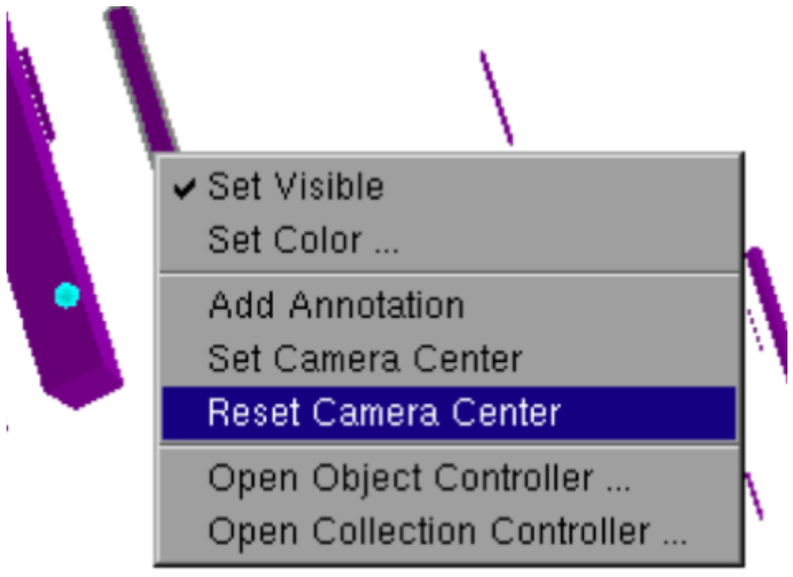
- Via the **Object Display Controller**, the user can select a non-default color for an object, e.g. to identify a "special" electron in all views.



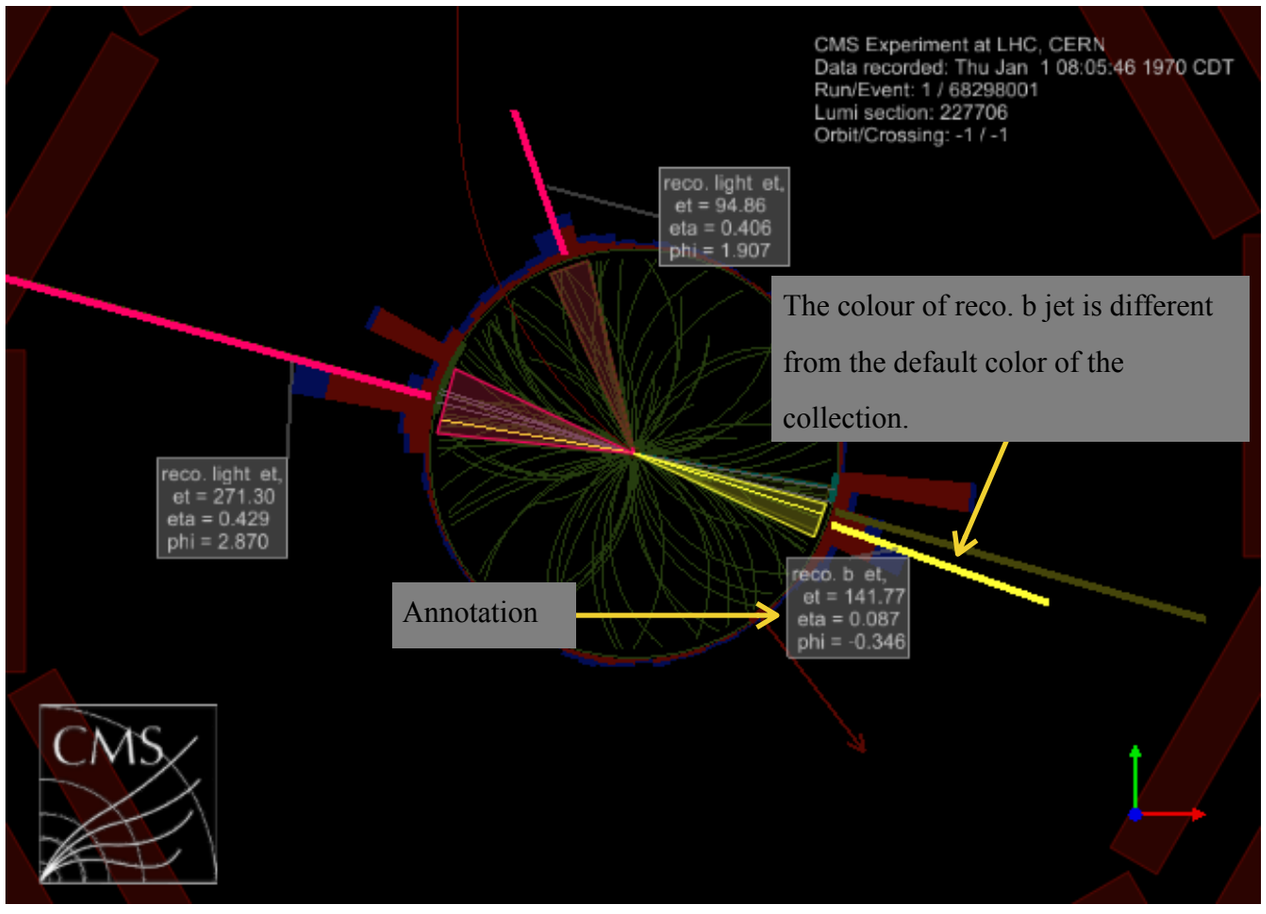
- This controller window opens from the Window -> Show Object Display Controller menu, or via the **context menu**.

- One can also add annotation to a specific object to denote its detailed properties. This is done in the **context menu**.

- Context menu pops up when you right click an object.



Context menu



Save/Load Configuration

- All your settings (on collections/views/objects, etc., especially the cumbersome filters,) can be saved/restored.
- Save your changes in the current config. file
  - File->Save Configuration [Ctrl+s]
- Save in a new file
  - File->Save Configuration As [Ctrl+S]
- Load the config file you just saved.
  - when starting: `./cmsShow -c ./test_configuration.fwc`
  - load at run-time: File->Load Configuration [Ctrl+l]

Homework

- Find an event in which 2 b jets are reconstructed as one. Check that the combined reconstructed jet's "pt" should be around the sum of the pt read from the two real (MC truth) b jets.
- Tips: May it's quite hard to find such an event, there are only 2 events in 100 events in **3pattuple_TChannel.root**, you could just look at

  ★ Run 1 Lumi 260247 EvID 78058476