LedDisplay for Dummies

Welcome to this tutorial. If you follow carefully the next steps, you will be able to run and enjoy the IceCube LED model as an expert!

1 How to start this thing

- Open a new Terminal and go to ∼/Desktop. There you can find executables for each i3 file. Run them just by writing:
  `$ ./file.sh`
  Easy, isn't it?

- In case this does not work, go to ∼/Deskop/Cubemodel/icecube-display-events. The i3 files are collected there. You must initialize Icetray typing `$ icetray`
  in the Terminal. Then, to run the i3 file just type
  `$ steamshovel file.i3`
  In case you are using a **simulation** file, you also need to load the Geometry frame. This is done automatically for you if you use the .sh files in the desktop. In case you open the simulation file without using the shortcut, just type
  `$ Steamshovel Geometry_only.i3 file.i3`

once you are in the directory.

2 How this thing looks like

If you have already completed the previous step, congratulations! Steamshovel is started and you should see something like Fig. 2.1. In the left upper part you see the IceCube render. The right upper part shows the options which are selected in the display. In the bottom part one can see the frames that the selected file contains (G=Geometry, Q=DAQ, P=Physics...). It is important that you select to loop over all P-frames, right above the "Play" button, therefore Steamshovel will run over all the P-frames that the file contains. Below the "Play" button you can select the speed at which Steamshovel runs the events, in ns/s. The nice value here would depend on the event, but it most of cases around 2500/3000 ns/s is fine.

It is important to focus in `"Select event times by:"`. Below this message one can select the pulses for which the time window and therefore Steamshovel will run over. In Fig. 2.1, `HLCPulses` are selected for the time window, as well as for the bubbles and for the LedDisplay. We will talk about the different options later, but it is important that

you select the **same pulses** for the 3 of them, bubbles, LedDisplay and the time window, otherwise you might seen differences between the screen and the LEDs.

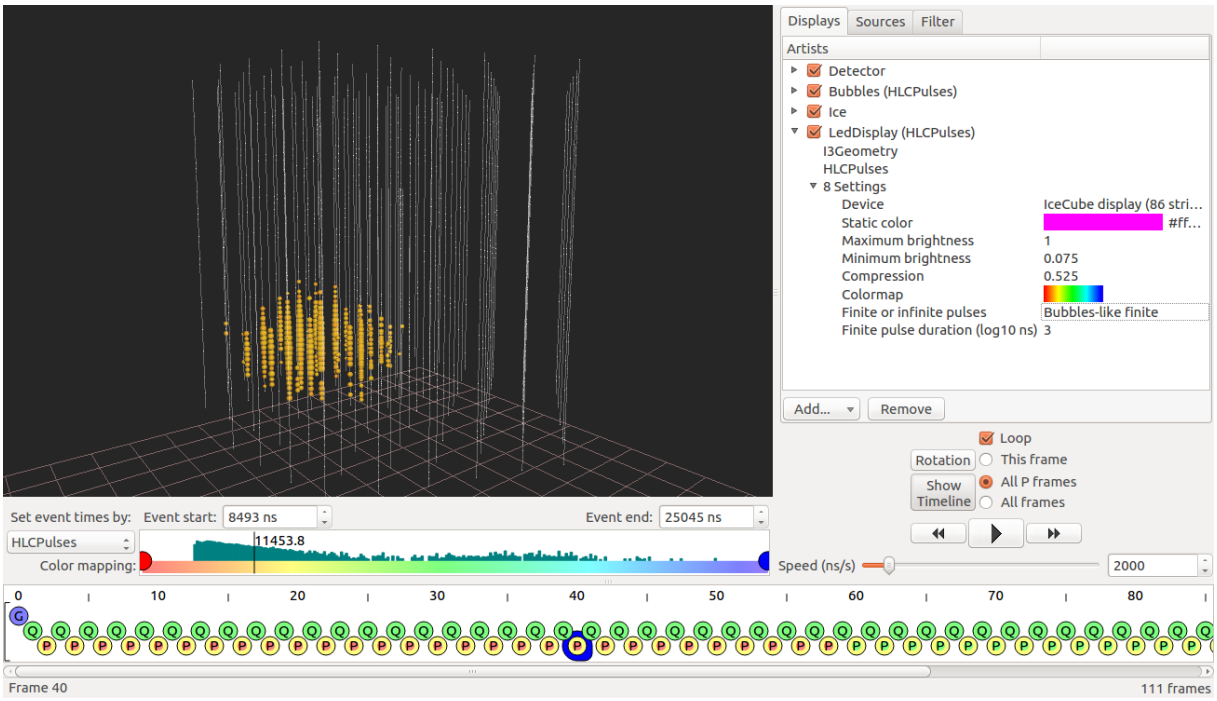

Figure 2.1: A Steamshovel screenshot with a possible configuration.

In steamshovel there are many things that you can add or remove to the display just by selecting them in `Add` or `Remove` buttons. Let us have a brief look to the most important ones for us.

- **Detector:** You should always have this one on, otherwise you won't see the detector, and that will make you very sad. Remember that for simulation files you have to load the Geometry_only.i3 file, otherwise you will miss this (the shortcut in the desktop already loads it for you).
- **Bubbles:** The bubbles that you see in the screen for the DOMs which have detected some light. You must select which pulses you want to see (again, we will talk about this later) and the duration of them (it is in logarithmic scale, therefore a value of about 5 looks already like infinitive pulses for our display). Remember that this is only what the screen shows, in the LED there could be something different!
- **Particle:** A very interesting thing to add, specially for simulation files. It shows the path of the simulated/reconstructed particle as the bubbles which appear in the screen. There are many features to include like Cherenkov cone, interaction vertex... In case of simulation files, you should always select **I3MCTree**. For the case of real events, you should select (if available) one of the results of the reconstruction.
- **LedDisplay:** The most important thing for us, it manages to send the information to the LEDs from the computer, therefore you must always have it. The possible options will be explained in the next section.

3 LedDisplay controller

Here it is the next section. As said before, LedDisplay should always be on. If you are not able to find it when pressing `Add` button, it is probably due to a bad connection between the USB to the LEDs. Let us discuss the options that LedDisplay has:

- **Geometry:** You will have no other options than I3Geometry, so always select this one.
- **Pulses:** As in the case of the bubbles, the selection of the pulses is very important and determines what the LEDs show. I (Cris) have cut out most of the possibilities you would have here in order to leave only the most important ones, which are:
  - **HLCPulses**: pulses where the noise have been filtered out.
  - **InIcePulses**: pulses with noise.
  - Something else: unless you want to show something very particular, you should not use something else than the 2 pulses above. There are 2 special files (`testing.i3` and `iceproperties.i3`) which contain artificial pulses with different names. I will talk you about this later.
- **Settings:**
  - **Device:** If you do not have `IceCube display (6 strings)` here, check the USB connection.
  - **Static color:** This does not work anymore, just do not touch it.
  - **Maximum brightness:** Obviously, it controls the brightness level in order to do not blind anyone. Configure it according to the environment light. A value around 0.8 might be sufficient low.
  - **Minimum brightness:** in cases where the charge at a certain module is too low, the value for the brightness that Steamshovel sends to the LEDs is too low that you see nothing. With this controller, you can give a little bit of light to these poor OMs in order to make them shine (a bit)!
  - **Compression:** It controls the brightness between different modules. From 0 to 1, bigger values increases the difference between OMs with more charge respect to OMs with lower charge. With 0, there is no difference in the brightness between modules. I would suggest to set this one always to 1 or a value close to it.
  - **Colormap:** It chooses the colormap. Do not change it from the default one, otherwise the poster will show pictures with a different colormap than the Display, and everyone would freak out.
  - **Finite or infinite pulses:** This wonderful controller allows you to choose between:
    - **Infinite pulses:** Once a OM detects light, it is never turned off.
    - **Default finite:** Once a OM detects light, the corresponding LED will be on for a while. The color at that OM corresponds to the first charge it has detected.

* **Bubbles-like finite:** Once a OM detects light, the corresponding LED will be on for a while. In this case the color at that OM changes with the new charges that it is collecting. This is exactly the way that `Bubbles:` changes the color of the Bubbles in the screen, so I would always suggest, in case of finite pulses, to use this one.
* **Finite pulse duration:** Duration of the finite pulses, in log 10 of ns. A nice value for this one depends on the event. A value about 3 or 3.5 should be nice for most of the files, but you might want to adapt this one to your own preference.

4 The i3 files

I have selected some nice i3 files, which I believe are more than enough for the purpose of the model. Please notice that the simulation files might not be perfectly filtered into cascades or tracks. Specially in the case when a track is close to the edge of the detector, it can seem like a cascade. You can check it just by seeing which particle goes away the simulation using the `Particle` setting. In table 4.1 you can read a brief description about the different files in `~/Deskop/Cubemodel/icecube-display-events` and its corresponding shortcut at the desktop.

Table 4.1: i3 files description

i3 file	**.sh shortcut in desktop**	**Description**
allhese_renamed_....gz	allhese.sh	Very nice HESE events (real events starting inside the detector). You will find cascades, tracks and a coincident event here.
DoubleBang_Ev...bz2	doublebang.sh	Double bang events, obviously from simulation
simulation_cascades.i3	sim_cascades.sh	Cascade events from simulation.
simulation_tracks.i3	sim_tracks.sh	Track events from simulation
simulation_highE_alls.i3	sim_highE.sh	Simulation events with very high energy and, therefore, so much light on the LED model.
muonBundlesFor...hz2	downgoingmuon.sh	So... donwgoing muons.
superevents.i3	FamousEvents.sh	BigBird, Ernie, Bell, Kloppo and Hydrangea. Such a bunch of nice events!
FRF_oneG.i3.gz2	noise.sh	Noise
iceproperties.i3	iceproperties.sh	Special file to show people the dust layer at the South Pole. This can be use to clarify why there are some modules which detect almost no light. In this file you will find "pulses" according to the absorption and scattering length of the light at that depth. You can select between one which shows the properties by differences in the brightness (the brightest, the better ice properties) or by timing (in blue the best ones). In case of selecting the colored one, do not forget to select the pulses also in the time window otherwise you will see nothing.
testing.i3	–	Special file to test if the LEDs are working one by one or all at the same time. You should not need this one

Please, in case you see a mistake in any of the files, let me know as soon as possible.
Do not forget to have fun using the super IceCube model!