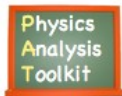


[TWiki](#) > [CMSPublic Web](#) > [SWGide](#) > [WorkBook](#) > [WorkBookAnalysisStarterKit \(2010-04-27, RogerWolf\)](#)



The StarterKit is in the process of being replaced. The functionality in the StarterKit will be ported to FWLite in the very near future. This page contains old information. Please see Chapters 3 and 4 of the [Offline Workbook](#) for the most up to date tutorials.

4.3 CMSSW Analysis Starter Kit

Complete: 5

[Detailed Review status](#)



See the starter kit in the news! [Symmetry Magazine article on Starter Kit.](#)

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Link to latest prescriptions for various releases.

This page is intended for pedagogical introduction to the [StarterKit](#) and PAT. If you want the latest, greatest prescription, please see:

<https://twiki.cern.ch/twiki/bin/view/CMS/SWGuideStarterKit>

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Acknowledgements:

- Freya Blekman (freya.blekman@cernSPAMNOTNOSPAMPLEASE.ch) for contributing the `VerySimplePatAnalyzer`, which has been ported to this package under the name `PatAnalyzerSkeleton`.
- Frederic Ronga (Frederic.Ronga@cernSPAMNOTNOSPAMPLEASE.ch) for giving us configurations for cosmic running.

What is the StarterKit?

- **Focus:** to create and implement the StarterKit, designed to facilitate "fast" analysis, to move from conception to a "reasonable" histogram within a day.
- **Who is the target audience?:** Anyone who wants to get a reasonable start on analysis, including professors, new grad students, theorists, postdocs, those unfamiliar with C++/ROOT/CMSSW, and many more!
- **What other tools are available?:** There are many other tools available for analysis in CMSSW, and the Physics Analysis Toolkit (PAT) is an attempt to consolidate them. We utilize the PAT as an analysis model. While there are other options available, this is the recommended versions for newcomers. We strongly encourage people to use the PAT for all of their analysis efforts, to avoid duplication of effort and to use well-understood objects and algorithms that are "blessed" by the Detector Performance Groups (DPG), Physics Object Groups (POG) and Physics Analysis Groups (PAG).
- **See us in the news!:** Symmetry magazine has run a piece on the CMS Starter Kit here: <http://www.symetrymagazine.org/cms/?pid=1000590>

Structure of the StarterKit

The StarterKit is a group of C++ objects along with corresponding plugins and configuration files to plot specific examples. It is based on the Physics Analysis Toolkit (PAT) described in detail here:

- <https://twiki.cern.ch/twiki/bin/view/CMS/SWGuidePAT>
- <https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookPATTupleCreationExercise>

The prescriptions are based on the PAT prescriptions as shown here:

- <https://twiki.cern.ch/twiki/bin/view/CMS/SWGuidePATRecipes>

The [StarterKit](#) has the following functionality:

- Will perform "common" plots for variables in the analysis such as 4-vector quantities and matching variables for detector objects.
- A tiered structure of output, whereas the user can specify to simply make plots, perform simple skims, or write out a subset of the PAT and/or AOD.
- Can automatically make plots for [CompositeCandidate](#) objects and "drill down" to the constituents recursively.
- Provides user control for histogram binning, etc. This will eventually be generalized using the [ExpressionParser](#) functionality.

Our programming to do list includes:

- Implementation of more complex examples.
- Generic kinematic fitting of arbitrary constituents.
- A validation suite to perform CRON jobs for day-to-day monitoring.
- Extensive FWLite examples for performing analysis.
- Automatic ntuplization of composite candidates.

CMSSW in 90 seconds or less

If you've been following the workbook all along, this should be "old news" to you, but here is the "quick and dirty" introduction for the impatient user. CMSSW stands for "CMS Software", and is a coding framework for the high level trigger, the reconstruction, and the analysis all at the same time. This is a novel approach for a collaboration of this size. It creates "projects" in subdirectories based on static code "tags" (from CVS). It allows us to modularize the performance so that specific tags can be studied and compared.

The [StarterKit](#) makes a new "package" in a directory in your home area. It will check out some code and compile it, and you can run a program on a predefined set of output and check against the "correct" answer to make sure you're starting from a good place.

Full details on the CMSSW framework can be found here: <https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookCMSSWFramework>

A 30 second introduction to scram and some commands can be found here: <https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookScramV1Intro>

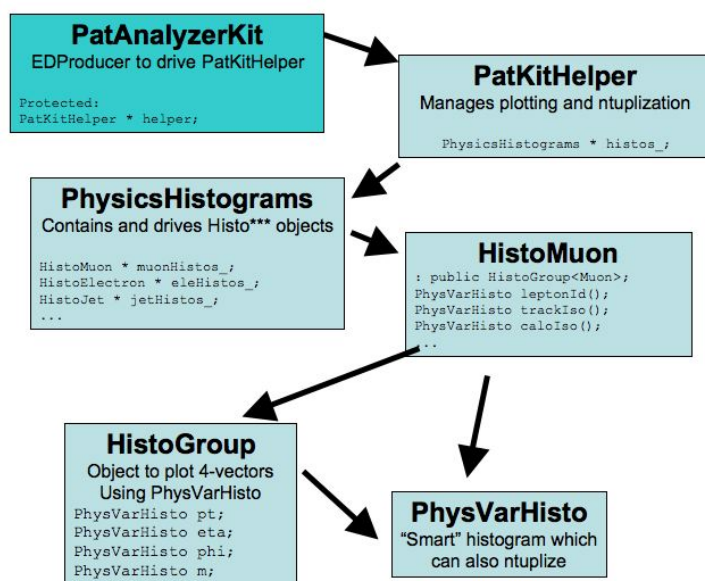
Updated infrastructure

The StarterKit has undergone an infrastructure change in 2.1.4. We have now separated the StarterKit into three different plugins:

- **PatAnalyzerSkeleton** : This provides a skeleton analyzer that will loop over PAT objects and make a simple histogram.
- **PatAnalyzerKit** : This provides the functionality of the 1.6.x version of the **StarterKit** plugin.
- **CompositeKit** : This will histogram an arbitrary collection of **CompositeCandidates**.

There has also been a restructuring of the code status. Previously it was designed such that the user would inherit directly from the **EDM** plugin **StarterKit**, and enhance plots using that hierarchy. This was not very performant and required users to carry around large libraries that contained the **EDProducer** libraries. Instead, a better solution has been worked out, so now the **StarterKit** has a "helper" class, **PatKitHelper**, which will do the majority of the plotting legwork for the plugins. To obtain the plots from this package, it is recommended to simply include this class as described below.

Class structure:



- **PatAnalyzerSkeleton**: EDAnalyzer to show how to only pull out the PAT objects and loop over them.
- **PatAnalyzerKit**: EDProducer to drive **PatKitHelper**.
- **PatKitHelper**: Workhorse to do the plotting for plugins.
- **PhysicsHistograms**: Contains and drives standard **Histo** objects for the various object types.
- **HistoMuon**, **HistoElectron**, **HistoMET**, **HistoJet**, **HistoPhoton**, **HistoTau**: Classes derived from **HistoGroup** to implement specific objects including **PhysVarHisto** matching variables.
- **HistoGroup**: Object to plot 4-vectors using **PhysVarHisto**.
- **PhysVarHisto**: "Smart" histogram which can also ntuplize.

Code overview

The **StarterKit** code overview can be found here:

<https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookAnalysisStarterKitCodeDescription>

Prescription

We assume here that a user has gone through the following workbook that talks about setup:

<https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookSetComputerNode>

<https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookRemoteSiteSpecifics>

To set up a new area and run

#If you are working at Fermilab's cmslpc cluster you need to execute the following command before you start

```
source /uscms/home/malik/cshrc prod
```

```
# set up CVS environment
cmsscvsroot CMSSW
# login to CVS server. Password is "98passwd"
cvs login
# make a directory for the Starter Kit
mkdir StarterKit
cd StarterKit

# create a new project area
scramv1 p CMSSW CMSSW_2_2_8
cd CMSSW_2_2_8/src/
cmsenv

# Get the Starter Kit and the PAT setup by adding following package

addpkg PhysicsTools/PatAlgos V04-14-29
addpkg PhysicsTools/PatUtils V03-05-02
addpkg DataFormats/PatCandidates V03-18-10
addpkg CondFormats/JetMETObjects V01-08-04
addpkg PhysicsTools/StarterKit V02-03-08

# build
scramv1 b

# run
cd PhysicsTools/StarterKit/test
cmsRun PatAnalyzerSkeleton_cfg.py >& skoutput.txt &
tail -f skoutput.txt &
```

Please note the following three comments.

Comment 1: One needs to drop particle flow on input. To achieve this the config files like **PatAnalyzerSkeleton_cfg.py** have additional code lines like below

```
## Necessary fixes to run 2.2.X on 2.1.X data
from CMS.PhysicsTools.PatAlgos.tools.cmsswVersionTools import run22XonSummer08AODSIM
run22XonSummer08AODSIM (process)
```

This comes from PAT recipes given at the twiki:

[https://twiki.cern.ch/twiki/bin/view/CMS/SWGuidePATRecipes#PAT for 2 2 X](https://twiki.cern.ch/twiki/bin/view/CMS/SWGuidePATRecipes#PAT_for_2_2_X)

Because of this you will see messages like this in the output like below:

```
WARNING: to run on Summer08AODSIM from 2.2.X requires to drop CMS.ParticleFlow,
        so PAT will switch from PFTau to CaloTau
Replaced tauTrigMatchHLT1Tau.src: cms.InputTag("allLayer0Taus") => cms.InputTag("allLayer0CaloTaus")
Replaced tauTrigMatchHLTLooseIsoTauMET30L1MET.src: cms.InputTag("allLayer0Taus") => cms.InputTag("allLayer0CaloTaus")
Replaced tauTrigMatchHLTDoubeIsoTauTrk3.src: cms.InputTag("allLayer0Taus") => cms.InputTag("allLayer0CaloTaus")
11-May-2009 16:50:37 CDT  Initiating request to open file dcap://cmsdca1.fnal.gov:24140/pnfs/fnal.gov/usr/cms/WAX/11/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SI$
11-May-2009 16:50:54 CDT  Successfully opened file dcap://cmsdca1.fnal.gov:24140/pnfs/fnal.gov/usr/cms/WAX/11/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/$
%MSG-w CMS.RootFile:  PoolSource:source{*ctor*} 11-May-2009 16:50:58 CDT pre-events
Branch 'recoJetedmRefToBaseProdrecoTracksrecoTrackrecoTracksToorecoTrackedmrefhelperFindUsingAdvancedmRefVectorsAssociationVector_ic5PFJetTracksAssociatorAtVe$
of file 'dcap://cmsdca1.fnal.gov:24140/pnfs/fnal.gov/usr/cms/WAX/11/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/6820DE4B-BE2C-DE11-975D$
that was explicitly dropped.

%MSG
%MSG-w CMS.RootFile:  PoolSource:source{*ctor*} 11-May-2009 16:50:58 CDT pre-events
Branch 'recoPFJets_iterativeCone5PFJets__VALIDATION.' is being dropped from the input
of file 'dcap://cmsdca1.fnal.gov:24140/pnfs/fnal.gov/usr/cms/WAX/11/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/6820DE4B-BE2C-DE11-975D$
that was explicitly dropped.

%MSG
%MSG-w CMS.RootFile:  PoolSource:source{*ctor*} 11-May-2009 16:50:58 CDT pre-events
Branch 'recoPFJets_kt4PFJets__VALIDATION.' is being dropped from the input
of file 'dcap://cmsdca1.fnal.gov:24140/pnfs/fnal.gov/usr/cms/WAX/11/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/6820DE4B-BE2C-DE11-975D$
that was explicitly dropped.
```

Comment 2: The process to open, read and run over a data file is not instantaneous. It takes few seconds to open and begin reading the file. So keep looking at the output of the file skoutput.txt as it grows. If your job is complete, then skoutput.txt file should read the following at the end (By the way, you can look straight at the end of this file by doing tail skoutput.txt otherwise you have to open the file and scroll down).

MessageLogger Summary

type	category	sev	module	subroutine	count	total

1	CMS.RootFile	-w	PoolSource:sourc		32	32
2	fileAction	-s	PoolSource:sourc		2	2
3	fileAction	-s	PostModule		1	1

type	category	Examples: run/evt	run/evt	run/evt		

1	CMS.RootFile	pre-events	pre-events	pre-events		
2	fileAction	pre-events	pre-events			
3	fileAction	1/700				

Severity	# Occurrences	Total Occurrences				

Warning	32	32				
System	3	3				

Comment 3: If you want to turn off the per event messages, like below, during processing a run,

```
Begin processing the 1st record. Run 1, Event 1, LumiSection 666666 at 11-May-2009 16:52:31 CDT
Begin processing the 2nd record. Run 1, Event 2, LumiSection 666666 at 11-May-2009 16:53:05 CDT
Begin processing the 3rd record. Run 1, Event 3, LumiSection 666666 at 11-May-2009 16:53:05 CDT
Begin processing the 4th record. Run 1, Event 4, LumiSection 666666 at 11-May-2009 16:53:05 CDT
Begin processing the 5th record. Run 1, Event 5, LumiSection 666666 at 11-May-2009 16:53:05 CDT
Begin processing the 6th record. Run 1, Event 6, LumiSection 666666 at 11-May-2009 16:53:05 CDT
```

you can change the option INFO to ERROR, as shown below, in PatAnalyzerKitSkeleton_cfg.py

```
#process.MessageLogger.cerr.threshold = 'INFO'
process.MessageLogger.cerr.threshold = 'ERROR'
```

To write every 10th event, for example, add/comment out the line as below

```
#process.MessageLogger.cerr.threshold = 'INFO'
process.MessageLogger.cerr.FwkReport.reportEvery = 10
#process.MessageLogger.cerr.threshold = 'ERROR'
```

Comment 3: You can run similarly the python scripts `PatAnalyzerKitDemo_cfg.py` and `CompositeKitDemo_cfg.py`.

To re-setup an old area and run

If you've already made a package and want to start again in the same package:

```
cd StarterKit/CMSSW_2_2_8/src
cmsenv
cd PhysicsTools/StarterKit/test
cmsRun PatAnalyzerSkeleton_cfg.py >& skoutput.txt &
```

To update to a new Starter Kit CVS tag

If you've already built an older version of the Starter Kit, and would like to update to the most recent version, you can do

```
cmscvsroot CMSSW
# login to CVS server. Password is "98passwd"
cvs login
cd StarterKit/CMSSW_2_2_8/src

cvs update -r PhysicsTools/PatAlgos V04-14-29
cvs update -r PhysicsTools/PatUtils V03-05-02
cvs update -r DataFormats/PatCandidates V03-18-10
cvs update -r CondFormats/JetMETObjects V01-08-04

scramv1 b
```

Detailed description of output and running

PatAnalyzerSkeleton

The configuration file is here:

http://cmssw.cvs.cern.ch/cgi-bin/cmssw.cgi/CMSSW/PhysicsTools/StarterKit/test/PatAnalyzerSkeleton_cfg.py?view=markup

Expected output will be:

- **PatAnalyzerSkeletonHistos.root** : Root file containing output histograms.
- **skoutput.txt**: Text file containing program output
- **PatAnalyzerSkeletonSkim.root**: Root file containing skimmed events.

* If you run over hundreds of events you want to change the location of the output directory to a scratch area. For this you must edit the file `PatAnalyzerSkeleton_cfg.py`. To change number of events the relevant portion to change is the following. That is, change 200 events, to whatever number you want. Use -1 if you want to run over all the events.

```
# set the number of events
process.maxEvents = cms.untracked.PSet(
    input = cms.untracked.int32(200)
)
```

But where is the input data file hidden. Look at

```
# this defines the input files
from CMS.PhysicsTools.StarterKit.RecoInput_cfi import *
```

The file `RecoInput_cfi.py` is in `./python` directory. Replace the data files there in by the following

```
/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/6820DE4B-BE2C-DE11-975D-000423D99658.root
/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/7CB3E361-BA2C-DE11-8D51-001617C3B710.root
/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/80069F07-B72C-DE11-BECB-000423D98E54.root
/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/E81D418B-E42C-DE11-8125-001D09F24259.root
```

so that it looks like this instead

```
import FWCore.ParameterSet.Config as cms

# from

def RecoInput() :
    return cms.Source("PoolSource",
                      debugVerbosity = cms.untracked.uint32(200),
                      debugFlag = cms.untracked.bool(True),

                      fileName = cms.untracked.vstring(
                        '/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/6820DE4B-BE2C-DE11-975D-000423D99658.root',
                        '/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/7CB3E361-BA2C-DE11-8D51-001617C3B710.root',
                        '/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/80069F07-B72C-DE11-BECB-000423D98E54.root',
                        '/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/E81D418B-E42C-DE11-8125-001D09F24259.root'
                      )
    )
```

The path of the file in `RecoInput_cfi.py` is called Logical File Name (LFN). This is a site-independent name for a file. At cmslpc cluster this file is located at

```
[malik@cmslpc02 test]$ ll
/pnfs/cms/WAX/11/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/6820DE4B-BE2C-DE11-975D-000423D99658.root
```

To look at this file directly in ROOT use the following command (you cannot browse and look at it just by browsing to it in ROOT)

```
TDCacheFile *_file0 = TDCacheFile::Open("/pnfs/cms/WAX/11/store/relval/CMSSW_2_2_8/RelValZMM/GEN-SIM-RECO/STARTUP_V9_v1/0000/6820DE4B-BE2C-DE11-975D-000423D99658.root");
```

NOTE: The input data files may get deprecated/deleted. It is not necessary to use the data files listed in `RecoInput_cfi.py`. Whatever RECO file you use must exist and readable.

To change the location of the output directory, the relevant portion is the following:

```
# talk to output module
process.out = cms.OutputModule("PoolOutputModule",
    process.patEventSelection,
    process.patEventContent,
    verbose = cms.untracked.bool(False),
    fileName = cms.untracked.string('PatAnalyzerSkeletonSkim.root')
)
```

Change this to read

```
# talk to output module
process.out = cms.OutputModule("PoolOutputModule",
    process.patEventSelection,
    process.patEventContent,
    verbose = cms.untracked.bool(False),
    fileName = cms.untracked.string('/my_scratch/username/PatAnalyzerSkeletonSkim.root')
)
```

where `"my_scratch/username/"` is the name of your scratch directory. For instance, if you are using lxplus, you can use `"tmp/[username]"`, and at Fermilab, you can use `"uscms_data/d1/[username]"` after you create those directories.

Histogram Output

The first thing you should check is the Histogram file `PatAnalyzerSkeletonHistos.root`. If you copy the [rootlogon.C](#) file into your current directory, you can open root like this:

```
your_pc:%> root PatAnalyzerSkeletonHistos.root
```

The output will look something like this:

You are now in the command line for the ROOT program. If you wish, you can turn on the statistics box by doing the following:

```
root [1] gStyle->SetOptStat(111111);
```

You can specify between one and six "1"s, which correspond to the name, number of entries, mean, standard deviation, underflow, and overflow bins.

You can now execute the following command:

```
root [2] TBrowser b;
```

This will bring up a browser so that you can examine your `PatAnalyzerSkeletonHistos.root` file. It should look like this:

Click on the "ROOT Files" directory to descend into the next level, which should look like this:

Next click on PatAnalyzerSkeletonHistos.root.

Next click on "patAnalyzerSkeleton"

Finally click on "nmuons". This plots the number of muons in the sample.

PatAnalyzerKit

If you execute the PatAnalyzerKit configuration file PatAnalyzerKitDemo_cfg.py, you'll obtain a different histogram and skim files, namely, PatAnalyzerKitHistos.root and PatAnalyzerKitSkim.root. We won't spend a lot of time on the clicking details since it is now assumed that you are familiar with them. Drill down PatAnalyzerKitHistos.root until you find a window that looks like this:

If you click on "muons", you see:

You'll notice that there are a great number of histograms here. This is what you get for free when using the PatKitHelper! These histograms are made to match the DQMOffline package here:

<http://cmslrx.fnal.gov/lxr/source/DQMOffline/>

This allows the user to trivially examine the data quality of objects in their analysis.

Skim File Output

We now turn to the file in the scratch directory that you have been ignoring until now, /my_scratch/username/PatAnalyzerSkeletonSkim.root. This file (as all CMSSW files) can be opened directly in ROOT to examine its contents. First, we make sure that we have copied the [rootlogon.C](#) file to your home directory, and then type the following commands:

```
your_pc:%> root /my_scratch/username/PatAnalyzerSkeletonSkim.root
```

Be sure to substitute your scratch area that you wrote to before instead of "/my_scratch/username/PatAnalyzerSkeletonSkim.root".

Within ROOT, we type

```
root [1] TBrowser b;
```

You will see TBrowser window that looks like this:

If you click on "ROOT files" again and click on "/my_scratch/username/PatAnalyzerSkeletonSkim.root", you will see a window that looks like this:

Click on "Events" and you will see this:

The names follow this pattern `type_label_instance_process`

This is an image of the PAT Layer 1 output that we defined in our config files earlier. If you select a leaf (say, "selectedLayer1Muons"), you see something like this:

The actual object itself is stored on the leaf ending in ".obj". If you click that, you see

Finally, if you click on "calolso", for instance, you see a plot of the calorimeter isolation of the muons in the sample:

Command Line Analysis

At this point, we can go back to the ROOT command line and do some more interesting things. If you type


```

root [3] Events->SetAlias("muons", "patMuons_selectedLayer1Muons__StarterKit.obj");
root [4] Events->Scan("muons.pt()");
*****
*   Row   * Instance * muons.pt( *
*****
*     0 *         0 * 6.1444063 *
*     1 *         0 * 85.423522 *
*     1 *         1 * 15.493708 *
*     2 *         0 * 53.2528 *
*     2 *         1 * 41.444122 *
*     3 *         0 *          *
*     4 *         0 * 23.130413 *
*     5 *         0 * 78.275489 *
*     5 *         1 * 8.9454069 *
*     6 *         0 *          *
*     7 *         0 * 53.046157 *
*     7 *         1 * 42.688365 *
*     8 *         0 * 45.450954 *
*     8 *         1 * 43.736446 *
*     9 *         0 * 30.245582 *
*     9 *         1 * 26.314161 *
*    10 *         0 *          *
*    11 *         0 *          *
*    12 *         0 * 42.888347 *
*    13 *         0 *          *
*    14 *         0 * 13.324078 *
*    15 *         0 * 44.617420 *
*    15 *         1 * 42.307502 *
*    16 *         0 * 15.144822 *
*    17 *         0 * 38.056137 *
Type <CR> to continue or q to quit ==>

```

This starts to scan through the objects in the "muon pt" branch. You can also start making more advanced plots in principle, but we'll just plot the muon pt of the first muon. Hit "q" to "quit" the scan over the muon pt, and type

```
root [5] Events->Draw("muons[0].pt()", "muons[0].pt() < 1000");
```

You should obtain a plot that looks like this:

Now, you can also make cuts on your ntuple as follows:

```
root [6] Events->Draw("muons[0].pt()", "muons[0].pt() > 30 && muons[0].pt() < 1000");
```

This cuts on the muon pt to be greater than 30 [GeV/c](#). You should obtain something that looks like this:

This should give you the flavor of the types of things that can be done with the command line interface. This behaves exactly like a standard ROOT TTree after you have made these alias commands, and you should be able to do whatever you like with the TTree functionality on the command line.

We now turn to using derivatives of TSelectors, the FWLite::Event model.

Using FWLite::Event

To do any sort of "meaningfully complicated" analysis, it will be necessary to use a macro instead of a command line argument. To do so, Chris Jones and others have developed utilities to do this, which you can read about here:

<https://twiki.cern.ch/twiki/bin/view/CMS/SWGuideEDMWithRoot>

The [StarterKit](#) is (in principle) fully compatible with FWLite but at the moment we have not yet implemented a test suite for those tools. However there are easily available tools for running on the "ntuple" output of the [StarterKit](#) which can be derived simply from the above link.

For the following example, be sure that you use the attached [rootlogon.C](#) file. This will set up the environment. Then, you can open the file sk_fwlite.C, and edit it to point to the proper skim file (/my_scratch/username/PatAnalyzerSkeletonSkim.root).

The file is here:

http://cmssw.cvs.cern.ch/cgi-bin/cmssw.cgi/CMSSW/PhysicsTools/StarterKit/test/sk_fwlite.C?view=markup

To get this file to your directory in your cmslpc account (either cut paste in a new file) or use

```
wget -nc http://cmssw.cvs.cern.ch/cgi-bin/cmssw.cgi/CMSSW/PhysicsTools/StarterKit/test/sk_fwlite.C
```

In its entirety, it is here:

Then, you can type

```
root -l PatAnalyzerSkeletonSkim.root

root[1] .L sk_fwlite.C++
root[2] sk_fwlite();
```

To run our example. You should obtain a plot that looks like this:

You can extend this file to do whatever analysis you'd like.

SOME USEFUL TIPS (though random)

Another fwlite macro showing how to plot Pt of Jet, Electrons, Taus, Photon, Track and MET is here: [sk_fwlite_JetMuonPhotonMETTrack.C](#)

The output of root plot looks like this (enable gStyle->SetOptStat(111111) on root prompt) [OutputOf sk_fwlite_JetMuonPhotonMETTrack 223.png](#)

Another script to plot Muon Pt,Eta and Phi is here: [sk_fwlite_MuonPtPxPyPzEtaPhi.C](#) The plots of Muon Pt, Eta and Phi are here [Muon_Pt_Phi_Eta 223.png](#) Plots of Muon Pt computed from Px, Py and Pz (see the macro for the formula) and also Px,Py,Pz are here [Muon_PtFromPxPyPz_and-Px_Py_Pz 223.png](#). Compare this Pt to Pt above. They should be identical and this is the case.

If one wants to put cuts on, for example on pT, Eta, No. of muons in an event, one can put the following kind of snippet in the python script([PatAnalyzerSkeleton_cfg.py](#) or [PatAnalyzerKitDemo_cfg.py](#))and have only such muons written to your skim file

```
# input pat sequences

process.selectedLayer1Muons.cut = cms.string('pt > 30. & abs(eta) < 2.1')
process.minLayer1Muons.minNumber =cms.uint32(5)
process.maxLayer1Muons.maxNumber =cms.uint32(5)
```

The default file having muon pT,eta selction cuts is at here: http://cmslrx.fnal.gov/lxr/source/CMS.PhysicsTools/PatAlgos/python/selectionLayer1/muonSelector_cfi.py The default files for other objects like Jets, taus, Photons are here: <http://cmslrx.fnal.gov/lxr/source/CMS.PhysicsTools/PatAlgos/python/selectionLayer1/>

The plot with muon with no pT cut (i.e. pT>0 [GeV](#)) and with pT>30 [GeV](#) are below [MuonWith pT greater than0GeV 223.png](#) [MuonWith pT greater than30GeV 223.png](#)

Cosmics example with FWLite

It is possible to run cosmics data with PAT and FWLite as well. We provide an example configuration which is [cosmics_cfg_223.py](#). This config is different from the default file which is [here](#) and which you get by default when you check out the [StarterKit](#) in CMSSW_2_2_3. The differences are that I had removed some of the processes in patLayer0 as follows. It works and makes the root file [patcosmics.root](#) . Once it creates the [patcosmics.root](#) file, you can run the macro called [sk_fwlite_cosmics](#) to make the eta_phi plots for muons for CRUZET and CRAFT data as mentioned below.

```
process.patLayer0.remove(process.caloRecoTauProducer)
process.patLayer0.remove(process.caloRecoTauDiscriminationByIsolation)
process.patLayer0.remove(process.pfRecoTauDiscriminationByIsolation)
process.patLayer0.remove(process.gamIsoDepositTk)
process.patLayer0.remove(process.gamIsoDepositEcalFromClusters)
process.patLayer0.remove(process.allLayer0Photons)
```

NOTE from PAT experts:The default PAT config is not expected to run on the Cosmic events, which have a completely different event content.

Either you run the LHC reconstruction sequence on them, or you'll have to take care to remove most of the functionalities and replace all input tags correctly (and in any case I think in the end you'll get very little from it: PAT is not designed with that usecase)

As mentioned above, we also provide a modified FWLite macro to make a simple muon eta-vs-phi plot [here](#).

It can be run as follows:

```
cmsRun cosmics_cfg.py

root -l
root[1] .L sk_fwlite_cosmics.C++
root[2] sk_fwlite_cosmics();
```

This will produce a plot that looks like this:

Here is also an eta_vs_phi plot produced using CRAFT data

For the CRAFT data you have to select the right data file and replace it in

```
cosmics_cfg.py
```

This means replace the FOLLOWING

```
# source
process.source = cms.Source("PoolSource",
    fileNames = cms.untracked.vstring(
        '/store/data/Commissioning08/Cosmics/RECO/CRUZET4_V4P_multiCosmicMuon_v1/0000/02AC0387-1181-DD11-9E5E-0018F3D096EC.root',
        '/store/data/Commissioning08/Cosmics/RECO/CRUZET4_V4P_multiCosmicMuon_v1/0000/0465ED82-1181-DD11-A198-001731A28585.root',
        '/store/data/Commissioning08/Cosmics/RECO/CRUZET4_V4P_multiCosmicMuon_v1/0000/04E10B9A-4A82-DD11-A57E-0018F3D096B4.root',
        '/store/data/Commissioning08/Cosmics/RECO/CRUZET4_V4P_multiCosmicMuon_v1/0000/08F1A76D-7281-DD11-A542-001A92971BC8.root',
        '/store/data/Commissioning08/Cosmics/RECO/CRUZET4_V4P_multiCosmicMuon_v1/0000/0E739F9A-1181-DD11-A433-001A928116C6.root',

        .....
        .....
        .....

    )
)
```

WITH

```
# source
process.source = cms.Source("PoolSource",
    fileNames = cms.untracked.vstring(

        '/store/data/Commissioning08/Cosmics/RECO/CRAFT_ALL_V4_ReReco-v1/0000/60FD96C9-64C1-DD11-9539-001D0967D1DE.root'

    )
)
```

To add more data files, first look at the directories below. Pick ONLY the ones with size in G like 2.0G and NOT empty files

```
/pnfs/cms/WAX/11/store/data/Commissioning08/Cosmics/RECO/CRAFT_ALL_V4_ReReco-v1/0000/
/pnfs/cms/WAX/11/store/data/Commissioning08/Cosmics/RECO/CRAFT_ALL_V4_ReReco-v1/0001/
/pnfs/cms/WAX/11/store/data/Commissioning08/Cosmics/RECO/CRAFT_ALL_V4_ReReco-v1/0002/
/pnfs/cms/WAX/11/store/data/Commissioning08/Cosmics/RECO/CRAFT_ALL_V4_ReReco-v1/0003/
.....
.....
.....
```

CompositeKitDemo

Now we examine the output of the CompositeKitDemo. To run it, do

```
cmsRun CompositeKitDemo_cfg.py
```

If you open the root file CompositeKitHistos.root, open a TBrowser and drill down, you'll see a screen that looks like this:

You'll notice that in addition to the physics object directories, there is a directory called "hToZZ". Clicking on this yields

If you click on "hToZZMass_1" you get

This is the invariant mass of all the candidates in question.

You can also look at the invariant masses of the constituents, for instance you can click on the folder called "Z1" to see:

Clicking on the mass, you see

Now you can click on the constituents of the Z's, for instance "muon1" to see:

You have access to all the histograms for all the constituents. This is helpful in making sideband subtraction plots, for instance, since you can plot the histogram for the objects under the Z peak, and those outside.

For instance, clicking on "muon1Pt_1", you obtain

Common Errors

Here we discuss some common errors from users.

scram project errors

If you see something like

Thanks to Patrick Gartung and Catalin Dumitrescu, we have a solution for this.

Ensure that the following lines are **not** in your .cshrc file:

```
if ( -f "/afs/fnal.gov/ups/etc/setups.csh" ) then
  source "/afs/fnal.gov/ups/etc/setups.csh"
endif

if ( { ups exist shrc } ) then
  setup shrc
endif
```

Feedback

We have developed a questionnaire for you to fill out to help us help you! Please copy and paste the following into an email to the authors above when you are finished with the Requests, and give us your feedback. This is text-only, so be patient with us!

These are exclusive categories, so please select the one that most describes you:

1) How familiar are you with C++

- ☐ a) I could code a `std::map<std::string, std::vector<int> >` and have no problem.
- ☐ b) I know what public inheritance means but I can't figure out what you're talking about in (a).
- ☐ c) I'm still mad we went away from F77.

2) How familiar are you with ROOT?

- ☐ a) I've successfully added my own classes to ROOT.
- ☐ b) I can book my own histograms and plot them without trouble.
- ☐ c) I still use PAW.

3) Have you performed CMSSW analyses before?

- ☐ a) Yes, and I probably could actually have written this better than you.
- ☐ b) Yes, but not at the expert level.
- ☐ c) Are you kidding? You're supposed to be doing this for me!

4) Have you used FWLite?

- ☐ a) Yes, I've used it and I love it!
- ☐ b) Yes, I've used it but it needs some work.
- ☐ c) No.

5) How long did it take you to get from cvs checkout procedure to a plot?

- ☐ a) Less than an hour.
- ☐ b) Between an hour and a day.
- ☐ c) More than a day.

6) What analysis are you planning on doing in CMS?

Comment:

7) Did you like this type of framework?

- ☐ a) This will be great when you get it working. Suggestions below.
- ☐ b) This is too complicated, make it simpler. Suggestions below.
- ☐ c) I thought it was awful and didn't accomplish any of the goals I needed it to do. Suggestions below.

Suggestions:

8) Any further comments or questions:

Comment:

#CMS.ToDoList

Starter Kit To-Do List

As you can see, we have a fairly functional Starter Kit to start you off with. The last pieces are coming together in the coming weeks. They include

- Generic histogramming utilities. These will include the following capabilities:
 - Config file booking of simple and more complex variables (`pt(jet1)` / `pt(jet2)`, for instance).
 - More user control over histogram binning and axis limits.
 - "Before and after" plots given some cuts.
- Automated nightly validation scripts for monitoring purposes.

Review status

Reviewer/Editor and Date	Comments
Main.Aresh - 21 Feb 2008	changes in verbatim elements because of some lines too long for printable version
SalvatoreRappoccio - 03 Dec 2007	page author

Responsible: Salvatore Rappoccio and Sudhir Malik
Last reviewed by: Sudhir Malik- 5 November 2008.

- starter kit twiki presentation.zip: starter_kit_twiki_presentation.zip

I	Attachment	History	Action	Size	Date	Who	Comment
	MuonWith_pT_greater_than0GeV.png	r1	manage	19.0 K	2008-11-26 - 22:18	SudhirMalik	
	MuonWith_pT_greater_than0GeV_223.png	r1	manage	19.0 K	2009-01-26 - 06:54	SudhirMalik	
	MuonWith_pT_greater_than30GeV.png	r1	manage	18.7 K	2008-11-26 - 22:26	SudhirMalik	
	MuonWith_pT_greater_than30GeV_223.png	r1	manage	18.1 K	2009-01-26 - 07:32	SudhirMalik	
	Muon_PtFromPxPyPz_and-Px_Py_Pz.png	r1	manage	39.2 K	2008-11-22 - 08:13	SudhirMalik	
	Muon_PtFromPxPyPz_and-Px_Py_Pz_223.png	r1	manage	31.7 K	2009-01-26 - 06:54	SudhirMalik	
	Muon_Pt_Phi_Eta.png	r1	manage	34.8 K	2008-11-22 - 08:12	SudhirMalik	
	Muon_Pt_Phi_Eta_223.png	r1	manage	27.3 K	2009-01-26 - 06:53	SudhirMalik	
	OutputOf_sk_fwltite_JetMuonPhotonMETTrack.png	r1	manage	44.7 K	2008-11-22 - 03:09	SudhirMalik	
	OutputOf_sk_fwltite_JetMuonPhotonMETTrack_223.png	r1	manage	40.5 K	2009-01-26 - 06:52	SudhirMalik	
	RootBrowser.BMP	r1	manage	1169.6 K	2009-01-12 - 07:24	SudhirMalik	
	RootBrowser.JPG	r1	manage	32.5 K	2009-01-12 - 07:26	SudhirMalik	
	RootBrowser.PNG	r1	manage	15.0 K	2009-01-12 - 07:18	SudhirMalik	
	Slide1.jpg	r1	manage	6.6 K	2008-06-25 - 22:37	SalvatoreRRappoccio	
	Slide10.jpg	r1	manage	85.4 K	2008-06-25 - 22:41	SalvatoreRRappoccio	
	Slide11.jpg	r1	manage	59.3 K	2008-06-25 - 22:41	SalvatoreRRappoccio	
	Slide12.jpg	r1	manage	57.8 K	2008-06-25 - 22:42	SalvatoreRRappoccio	
	Slide13.jpg	r1	manage	29.9 K	2008-06-25 - 22:42	SalvatoreRRappoccio	
	Slide14.jpg	r1	manage	63.9 K	2008-06-25 - 22:42	SalvatoreRRappoccio	
	Slide15.jpg	r1	manage	74.5 K	2008-06-25 - 22:43	SalvatoreRRappoccio	
	Slide16.jpg	r1	manage	71.7 K	2008-06-25 - 22:43	SalvatoreRRappoccio	
	Slide17.jpg	r1	manage	78.8 K	2008-06-25 - 22:44	SalvatoreRRappoccio	
	Slide18.jpg	r1	manage	82.2 K	2008-06-25 - 22:44	SalvatoreRRappoccio	
	Slide19.jpg	r1	manage	59.5 K	2008-06-25 - 22:44	SalvatoreRRappoccio	
	Slide2.jpg	r1	manage	62.9 K	2008-06-25 - 22:37	SalvatoreRRappoccio	
	Slide3.jpg	r1	manage	59.3 K	2008-06-25 - 22:38	SalvatoreRRappoccio	
	Slide4.jpg	r1	manage	68.1 K	2008-06-25 - 22:38	SalvatoreRRappoccio	
	Slide5.jpg	r1	manage	65.3 K	2008-06-25 - 22:39	SalvatoreRRappoccio	
	Slide6.jpg	r1	manage	64.1 K	2008-06-25 - 22:39	SalvatoreRRappoccio	
	Slide7.jpg	r1	manage	80.9 K	2008-06-25 - 22:40	SalvatoreRRappoccio	
	Slide8.jpg	r1	manage	70.6 K	2008-06-25 - 22:40	SalvatoreRRappoccio	
	Slide9.jpg	r1	manage	48.1 K	2008-06-25 - 22:41	SalvatoreRRappoccio	
	cosmics_cfg_223.py.txt	r2 r1	manage	24.4 K	2009-02-18 - 21:20	SudhirMalik	
	eta_vs_phi_plot_223_CRAFT.png	r1	manage	21.9 K	2009-02-18 - 21:06	SudhirMalik	
	eta_vs_phi_plot_CRAFT.png	r1	manage	21.6 K	2009-01-11 - 22:34	SudhirMalik	
	pat_logo.jpg	r1	manage	3.4 K	2008-06-25 - 22:48	SalvatoreRRappoccio	
	root_output.png	r1	manage	24.6 K	2008-11-04 - 20:08	SudhirMalik	
	root_output_1.jpg	r1	manage	59.2 K	2008-08-04 - 22:28	SalvatoreRRappoccio	
	root_output_10.jpg	r1	manage	100.8 K	2008-08-04 - 22:30	SalvatoreRRappoccio	
	root_output_11.jpg	r1	manage	111.4 K	2008-08-04 - 22:31	SalvatoreRRappoccio	
	root_output_11_223.png	r1	manage	36.2 K	2009-01-26 - 06:16	SudhirMalik	
	root_output_12.jpg	r1	manage	72.7 K	2008-08-04 - 22:31	SalvatoreRRappoccio	
	root_output_12_malik.png	r2 r1	manage	30.7 K	2008-11-04 - 20:56	SudhirMalik	
	root_output_12_malik_223.png	r1	manage	24.5 K	2009-01-26 - 06:17	SudhirMalik	
	root_output_13.jpg	r1	manage	70.8 K	2008-08-04 - 22:31	SalvatoreRRappoccio	
	root_output_13_malik.png	r1	manage	24.2 K	2008-11-04 - 23:15	SudhirMalik	
	root_output_13_malik_223.png	r1	manage	19.8 K	2009-01-26 - 06:19	SudhirMalik	
	root_output_14.jpg	r1	manage	64.6 K	2008-08-04 - 22:32	SalvatoreRRappoccio	
	root_output_14_malik.png	r1	manage	24.8 K	2008-11-04 - 23:16	SudhirMalik	
	root_output_14_malik_223.png	r1	manage	20.2 K	2009-01-26 - 06:18	SudhirMalik	
	root_output_15.jpg	r1	manage	57.3 K	2008-08-04 - 22:32	SalvatoreRRappoccio	

	root_output_15_malik.png	r1	manage	22.8 K	2008-11-05 - 06:26	SudhirMalik
	root_output_15_malik_223.png	r1	manage	18.7 K	2009-01-26 - 06:20	SudhirMalik
	root_output_16.jpg	r1	manage	66.1 K	2008-08-04 - 22:44	SalvatoreRRappoccio
	root_output_16_223.png	r1	manage	19.6 K	2009-01-26 - 07:54	SudhirMalik
	root_output_17.jpg	r1	manage	72.3 K	2008-08-04 - 22:45	SalvatoreRRappoccio
	root_output_17_223.png	r1	manage	22.3 K	2009-01-26 - 07:55	SudhirMalik
	root_output_18.jpg	r1	manage	63.4 K	2008-08-04 - 22:45	SalvatoreRRappoccio
	root_output_18_malik.png	r1	manage	26.0 K	2008-11-05 - 18:36	SudhirMalik
	root_output_18_malik_223.png	r1	manage	21.1 K	2009-01-26 - 07:56	SudhirMalik
	root_output_19.jpg	r2 r1	manage	72.8 K	2008-08-05 - 20:42	SalvatoreRRappoccio
	root_output_19_223.png	r1	manage	19.8 K	2009-01-26 - 07:57	SudhirMalik
	root_output_1_malik.png	r1	manage	24.6 K	2008-11-04 - 20:18	SudhirMalik
	root_output_2.jpg	r1	manage	53.0 K	2008-08-04 - 22:28	SalvatoreRRappoccio
	root_output_20.jpg	r1	manage	56.1 K	2008-08-04 - 22:45	SalvatoreRRappoccio
	root_output_20_malik.png	r1	manage	22.4 K	2008-11-05 - 18:36	SudhirMalik
	root_output_20_malik_223.png	r1	manage	19.7 K	2009-01-26 - 07:58	SudhirMalik
	root_output_21.jpg	r1	manage	152.0 K	2008-08-05 - 20:42	SalvatoreRRappoccio
	root_output_21_223.png	r1	manage	32.7 K	2009-01-26 - 07:59	SudhirMalik
	root_output_22.jpg	r1	manage	60.0 K	2008-08-05 - 20:43	SalvatoreRRappoccio
	root_output_22_malik.png	r1	manage	22.7 K	2008-11-05 - 18:37	SudhirMalik
	root_output_22_malik_223.png	r1	manage	18.2 K	2009-01-26 - 07:59	SudhirMalik
	root_output_23.jpg	r1	manage	21.6 K	2008-09-25 - 14:35	SalvatoreRRappoccio
	root_output_23_223CRUZET.png	r1	manage	20.1 K	2009-02-18 - 21:07	SudhirMalik
	root_output_3.jpg	r1	manage	59.1 K	2008-08-04 - 22:29	SalvatoreRRappoccio
	root_output_4.jpg	r1	manage	65.1 K	2008-08-04 - 22:29	SalvatoreRRappoccio
	root_output_5.jpg	r1	manage	60.7 K	2008-08-04 - 22:29	SalvatoreRRappoccio
	root_output_5_malik.png	r1	manage	21.1 K	2008-11-04 - 20:27	SudhirMalik
	root_output_5_malik_223.png	r1	manage	17.0 K	2009-01-26 - 05:07	SudhirMalik
	root_output_6.jpg	r1	manage	64.1 K	2008-08-04 - 22:29	SalvatoreRRappoccio
	root_output_6_223.png	r1	manage	21.0 K	2009-01-26 - 05:20	SudhirMalik
	root_output_7.jpg	r1	manage	170.4 K	2008-08-04 - 22:30	SalvatoreRRappoccio
	root_output_7_malik.png	r1	manage	43.7 K	2008-11-04 - 20:41	SudhirMalik
	root_output_8.jpg	r1	manage	73.9 K	2008-08-04 - 22:30	SalvatoreRRappoccio
	root_output_9.jpg	r1	manage	102.3 K	2008-08-04 - 22:30	SalvatoreRRappoccio
	root_output_9_malik.png	r1	manage	36.1 K	2008-11-04 - 20:48	SudhirMalik
	root_output_9_malik_223.png	r1	manage	37.0 K	2009-01-26 - 05:28	SudhirMalik
	rootlogon.C	r2 r1	manage	4.8 K	2008-08-28 - 15:07	SalvatoreRRappoccio
	shortcuts_image1.jpg	r1	manage	106.7 K	2008-06-25 - 22:46	SalvatoreRRappoccio
	sk_fwite_JetMuonPhotonMETTrack.C	r1	manage	3.4 K	2008-11-22 - 02:30	SudhirMalik
	sk_fwite_MuonPtPxPyPzEtaPhi.C	r1	manage	2.1 K	2008-11-22 - 08:11	SudhirMalik
	sk_new_structure.jpg	r1	manage	59.1 K	2008-08-04 - 18:12	SalvatoreRRappoccio
	skstruct.jpg	r1	manage	226.7 K	2008-06-25 - 22:50	SalvatoreRRappoccio
	starter_kit_twiki_presentation.zip	r1	manage	1092.1 K	2008-06-25 - 22:27	SalvatoreRRappoccio
	tutorial.css	r1	manage	0.3 K	2009-01-09 - 22:03	SudhirMalik

Topic revision: r51 - 2010-04-27 - [RogerWolf](#)

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