

### Idmx-sw Tutorial Course: Basics

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Idmx-sw Basics

- University of Minnesota







## Outline



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Idmx-sw Basics







## Pre-Requisites



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## Pre-Requisites

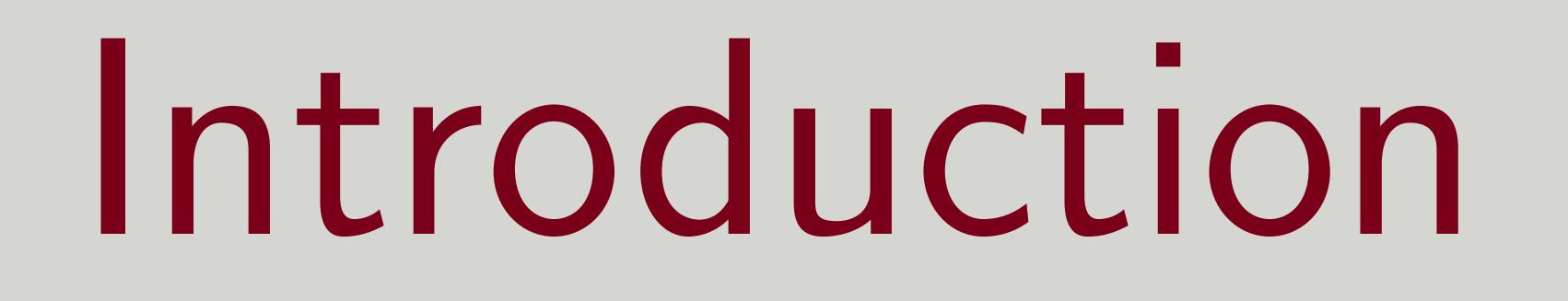
## A container runner <sup>1</sup> installed git version control installed Patience.

### <sup>1</sup>docker is common for personal computers and singularity is common for shared computing clusters. Tom Eichlersmith (UMN) May 30, 2021 Idmx-sw Basics









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## Big ldea

## Simulate/Reconstruct/Analyze event-by-event

- - passengers to put onto the bus

### Event Independence

### Each event is **indepedent** of all other events in the software. This isn't necessarily true in real-life ( **pileup** ), but we have other methods for handling this.

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## Particles/Hits/Objects are put onto event bus (so they are passengers) **Processors** look at one event bus at a time in a certain sequence Generally, processors take passengers off the bus to **analyze** and/or **produce**

### Process knows the sequence and feeds the event buses to the processors









## Compiling Idmx-sw





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## Compiling Idmx-sw

### Demonstration

### I'm going to run these commands while sharing my screen. They are here for your future reterence.

1	git clonerecurs
T	grt cronerecurs
2	cd ldmx -sw
3	<pre>source scripts/ldm:</pre>
4	mkdir build
5	cd build
6	ldmx cmake
7	ldmx make install

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### sive https://github.com/LDMX-Software/ldmx-sw.git

x-env. sh









## **Configuration Scripts**



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## Purpose

## We have to tell the software **a** lot of things... How many events?

- Where is the data to input (if any)?
- Where should we put the output data (histograms or events)? Which processors to run?
- L. and much more!

### Configuration Script

### **Today** : A basic configuration script that runs a simulation of electrons entering the LDMX detector design and then puts those events through some of our reconstruction pipeline.

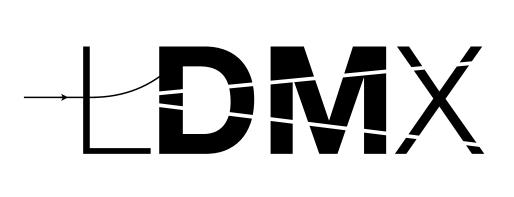
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### A python3 script which is run by the software before grabbing the necessary parameters.

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## **H NOCESS**

## The pass name Input and output files Histogram file Maximum number of events Logging frequency

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1 from LDMX.Framework import ldmxcfg 2 # create my process object 3 p = ldmxcfg.Process('sim') 4 # how many events to process? 5 p.maxEvents = 106 # we want to see every event 7 p.termLogLevel = 08 p.logFrequency = 1 9 # we also only have an output file 10 p.outputFiles = [ "myFirstSim\_" + str(p.maxEvents) + "\_events.root"







## Minimum Simulation

1	from LDMX.SimCore
2	<pre>import LDMX.Ecal.E</pre>
3	mySim = simulator.
4	# get the path to
5	mySim.setDetector(
6	# Get a pre-writter
7	from LDMX.SimCore
8	<pre>mySim.generators =</pre>
9	# add your configu:
10	p.sequence.append(
11	# can still edit p
12	mySim.verbosity =

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import simulator EcalGeometry # geometry required by sim simulator('mySim') the installed detector description 'ldmx-det-v12')

en generator

import generators as gen

[ gen.single\_4gev\_e\_upstream\_tagger() ] ired simulation to the sequence

mySim

barameters after adding to sequence











### Reconstruction

1	#	1]	mJ	Э С	) r	t		С	h	l	р		g	e	0	m
2	im	p	0]	ct		L	D	M	Х		E	С	a			e
3	im	p	0]	ct		L	D	M	Х		H	С	a			H
4	im	p	0]	ct		L	D	M	Х		H	С	a			h
5	#	1]	mJ	Э С	) r	t		р	r	0	С	e	S	S	0	r
6	im	p	0]	ct		L	D	M	Х		E	С	a			d
7	im	p	0]	ct		L	D	M	Х		H	С	a			d
8	#	a	dc	3	t	h	e	m		t	0		t	h	e	
9	p.	S	<b>e</b> (	Jľ	le	n	С	e		e	X	t	e	n	d	
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16	p.	p	al	JS	5 <b>e</b>											

### conditions etrv

- ecal\_hardcoded\_conditions IcalGeometry
- ncal\_hardcoded\_conditions templates
- ligi as ecal\_digi
- ligi as hcal\_digi
- sequence
- LDigiProducer(),
- LRecProducer(),
- LDigiProducer(),
- LRecProducer()

### on before actually running













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## Let's Run It!

# Demonstration I'm going to run these commands while sharing my screen. They are here for your future reference.

### 1 ldmx fire basic.py

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Misspelling parameter names Idmx-sw gives each parameter a sensible default, so the process will run if a parameter is not given Misspelling a parameter means that your parameter value is just silently ignored Attempting to access files outside of directories mounted to container Will see "Not found/doesn't exist" errors even though you can see the file Try mounting the directory using ldmx mount Obviously lots more... Many quirks of Idmx-sw that we all need to learn Please put questions in slack and/or reach out to me If you can imagine a C++ solution, put your ideas in the GitHub issue tracker

## Common Pitfalls in Config Files









## Helpful Tips

- parameters

### Overall

Remember that the configuration script is run as a python script *before* the parameters are taken for processing, so you can automate a lot of stuff.

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os.path.realpath to get full path without symlinks to files argparse to configure your run by changing processors or passing input files or changing

before they have been taken for processing Define python functions (maybe even write your own python module) containing settings/processors/sequences/processes that you use a lot

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# Never type out file paths or file names. Input files can be fed on the command line and output files can be formatted based off of input names and parameters.

- print ldmx classes to see what parameters are given to it after your python nonsense but





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## Python Analyses





## Python Analyses

### Good Starting Point

Easier to write and interact with  $\checkmark$ 

after-the-fact for your reference.) repository.

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# $\square$ Quick start-up and easy to develop $\checkmark$

# **Today** : I will use a helper python module and write an analysis live! (The file will be shared The helper python module **•** EventTree is uploaded and is also available in the ldmx-analysis







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### C++ Processors





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### Tom, you just showed us how cool Python analyses are. Why use C++?

### Reasons

### My General Workflow

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Access to more tools that Python (e.g. Detector ID Decoding) Generally easier to scale to larger samples

① Make sure configuration for generating data sample runs 2 Write short Python analysis to start looking at generated data

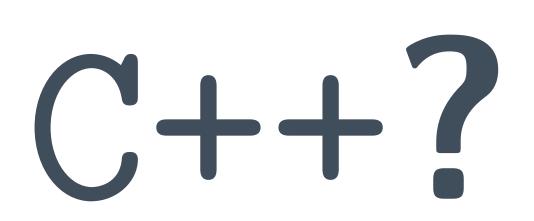
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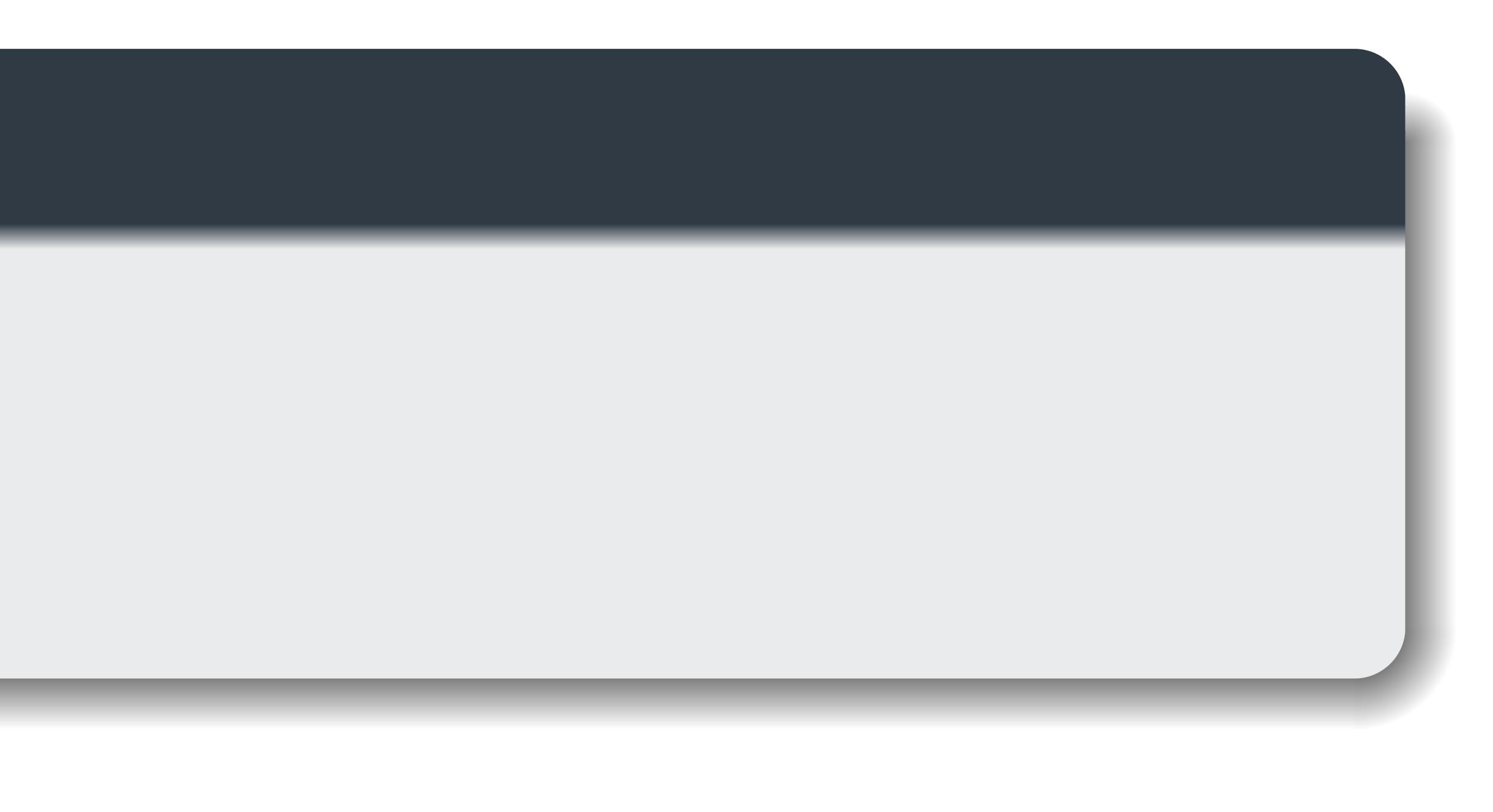
# 3 Switch to C++ when Python analysis is "getting out of hand" or I need a C++-only tool













## Starting a C++ Analysis

### General Outline

### To Build (in README of ldmx-analysis)

1	mkdir	buil	d.,	cd	bu
2	ldmx	cmake			
3	ldmx	make	ins	stal	

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## Clone the ldmx-analysis repo and make your own branch (e.g. myusername-dev) Copy an existing analyzer's header (in include/Analysis) and source (in src/Analysis) to your own files in the same directories. Clean out the other analyzer code and start writing your own! Start make histograms/ntuplizing/skimming!

ild; #make a build directory









## Analysis

# Features to Look At:

- Vourself

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Lots of examples in DQM module and ldmx-analysis repo.

Helpful for creating *lots* of histograms EcalPN analyzer in DQM module

NtupleManager: Create tree of once per event values in histogram file Helpful for higher-level physics variables when you don't know which you want to compare yet

ECalVetoAnalyzer in ldmx-analysis

setStorageHint: Skim events based on criteria in your processor Helpful for picking out specific (maybe frustrating?) events to look at in more detail

TriggerProcessor in Recon module

Process::keep: drop or keep event objects to save space in your output files

Can be done only in python configuration

### HistogramPool: Manage histograms by name instead of managing histogram pointers







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