Giving *pandas* ROOT to chew on

experiences with the XENON1T Dark Matter experiment

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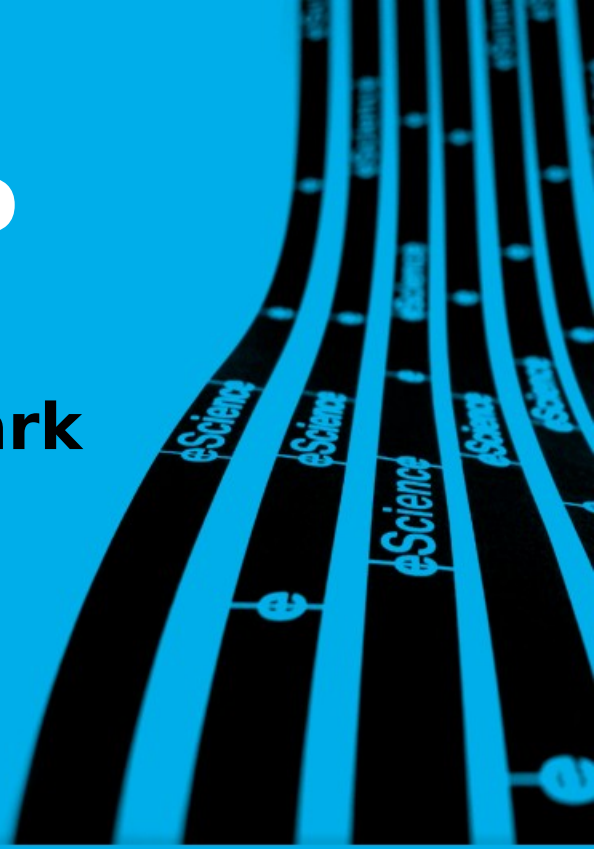

netherlands eScience center
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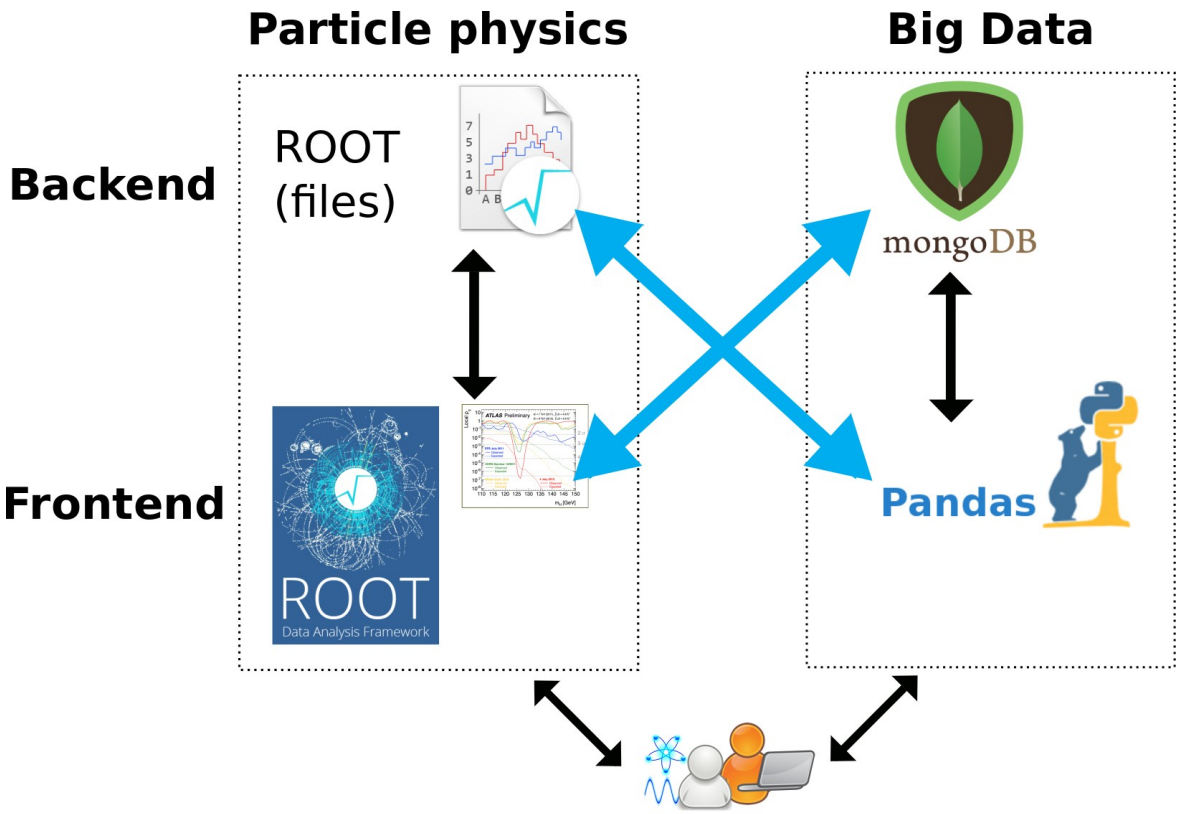
XENON Dark Matter Project

CHEP2016
San Francisco, CA, 10/10/2016

Beyond HEP-specific tools

- The XENON(1T) experiment
  - Relatively small (150 researchers), no dedicated software manpower
  - Signal processing & physics analysis software written in Python3
    - C++ is an overkill for the kind of data analytics they do daily
    - Low-level C/C++ libraries only for performance-critical tasks
  - Tension between HEP-specific software and generic “big data” solutions. Some XENON researchers prefer C++/ROOT.
- **Can't we just have both, please?**

Interfacing HEP and the Big Data Ecosystems



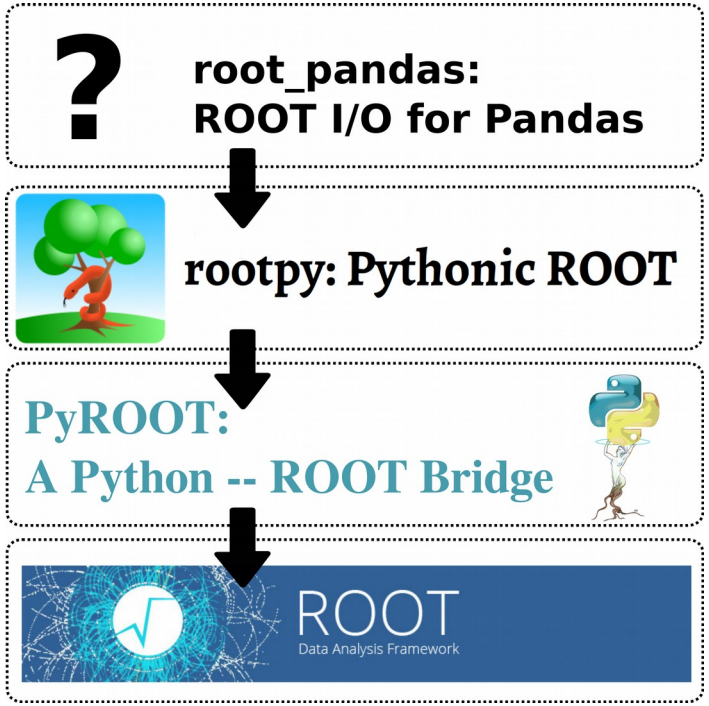
Goals

- Understand the current capabilities and limitations of the Python(3)/ROOT ecosystem
- Install everything in user space, without compiling and all the dependency hell.

```
ln -s `python3.4-config --exec-prefix`/lib/libpython3.4m.dylib `python3.4-config –exec-prefix`/lib/libpython3.4.dylib
./configure --enable-python --with-python-incdir=`python3.4-config --exec-prefix`/include/python3.4m --with-python-libdir=`python3.4-config –exec-prefix`/lib
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:`python3.4-config –exec-prefix`/lib
export PYTHONPATH=$LD_LIBRARY_PATH
```

```
conda install python=3.4 root=6 numpy matplotlib pandas rootpy jupyter
```

Interfacing ROOT to Python *pandas*



pandas should read ROOT files

Truly “Pythonic” ROOT interface

Python bindings for ROOT

C++

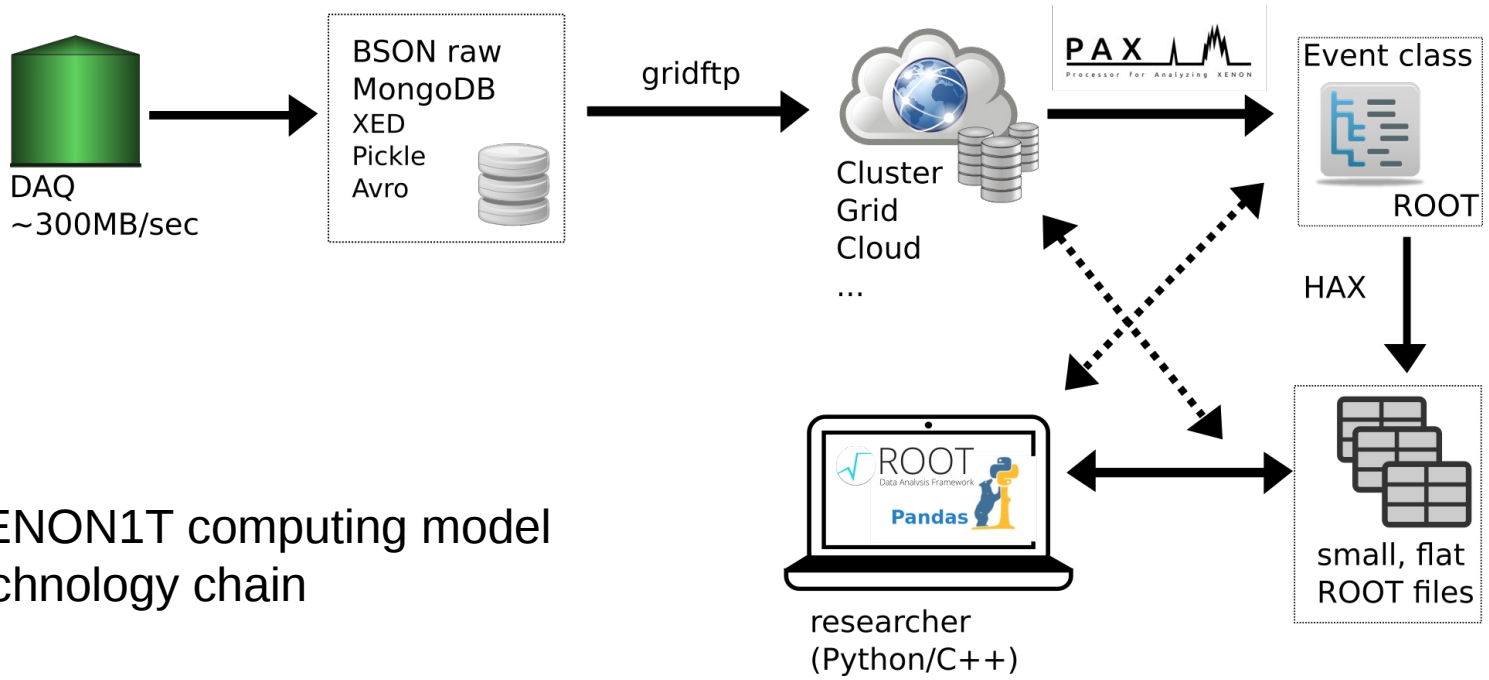
```python
from rootpy.tree import Tree, TreeModel
from rootpy.tree import FloatCol, IntCol
from rootpy.tree import FloatArrayCol, CharCol
from rootpy.io import root_open
from random import gauss, choice

f = root_open("test.root", "recreate")
# define the model
class Event(TreeModel):
    s = CharCol()
    x = FloatCol(default = 'nan')
    y = IntCol(default = 0)
    f = FloatArrayCol(5)
tree = Tree("test", model=Event)
# fill the tree
for i in range(5):
    tree.s = ord(choice(ascii_letters))
    tree.x = gauss(.5, 1.)
    tree.y = i
    for j in range(5):
        tree.f[j] = gauss(-2, 5)
    tree.fill()
tree.write()
f.close()
```

Listing 1: Creating tree models with rootpy

```python
class ReconstructedPosition(object):
    x = float('nan')
    y = float('nan')
    ....

class Peak(object):
    area = 0.0
    detector = 'ptc'
    ...
    rec_positions = list(ReconstructedPosition)

class Hit(object):
    channel = 0
    center = 0.0
    ...
class Event(object):
    event_number = 0
    dataset_name = 'Unknown'
    ...
    peaks = list(Peak)
    hits = np.array([], dtype=Hit.get_dtype())
```

Listing 2: The pax Event model

Computing model technology chain



XENON1T computing model technology chain

ROOT with Anaconda

- **Anaconda**: Python scientific libraries bundled together in one installation
- **Conda**: binary packaging and dependency management system
  - Isolated environments ++
  - Python-agnostic

conda-recipes / python / gensim / meta.yaml

```yaml
package:
  name: gensim
  version: 0.8.8

source:
  fn: gensim-0.8.8.tar.gz [py2k]
  url: https://pypi.python.org/packages/source/g/gensim/gensim-0.8.8.tar.gz
  md5: 39b47095185f05a01b83ebf1a6748953 [py2k]

#  patches:
   # List any patch files here
   # - fix.patch

build:
  number: 1

requirements:
  build:
    - python
    - setuptools
    - scipy

  run:
    - python
    - scipy

test:
  # Python imports
  imports:
    - gensim.similarities
    - gensim.test
    - gensim.corpora
    - gensim.models
about:
  home: http://radimrehurek.com/gensim
  license: GNU Library or Lesser General Public License (LGPL)
```

conda-recipes / python / gensim / build.sh

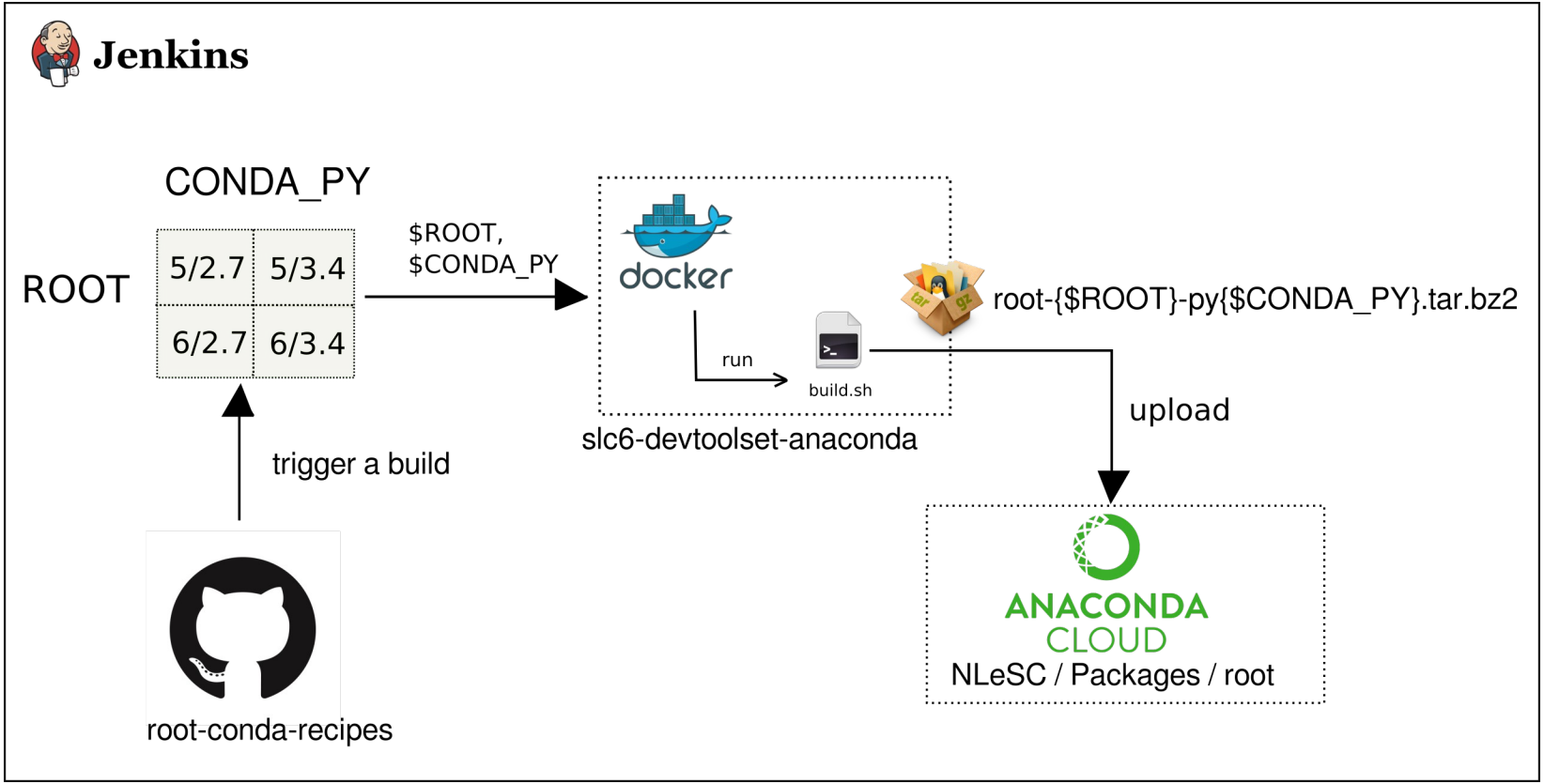
```bash
#!/bin/bash

$PYTHON setup.py install
```

Portable ROOT Anaconda binaries

- dynamic dependencies on GCC/glibc
- ROOT 6 needs GCC 4.8 or newer
- should work on older Linux distributions
  - preferably the same binary (one size fits all)
  - SLC 6 + CERN Developer Toolset (v2) makes it possible to have fresh compiler with old glibc (2.12)
- Please give it a try and report problems

```
conda install -c nlesc root
```

Continuous Integration



Sustainability & Issues

- Install a conda environment and “don't touch it”
  - New versions of ROOT (and dependencies) will need building/testing/publishing
  - “old glibc” is a moving target
- Conda is stable, but still evolving

Tim Head
@betatim

Follow

OH: TIL installing ROOT is already as easy as `conda install -c nlesc root` via @ibabusch

1:30 PM - 18 Sep 2015

kreczko commented on Nov 25, 2015

@remenska : nice work. Following the conversation in the HSF packaging forum (https://groups.google.com/forum/#!topic/hep-sf-packaging-wg/h4HWHnVkBA8)

Will advertise this to our groups.

cdeil commented on Sep 3, 2015

the rootpy project member

@remenska – That's awesome, thank you!

🎉

@ndawe – Should these binaries be used for rootpy testing on travis-ci (either exclusively or in addition to what's there now)?

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nlesc

NLeSC / Packages / **root** 6.04

1

Conda | Files | Labels | Badges | Builds | Settings

LGPL v2.1

12728 total downloads