Karlsruher Institut für Technologie

Developing a pipeline for grid production with NNLOJET

Weekly QCD-Meeting

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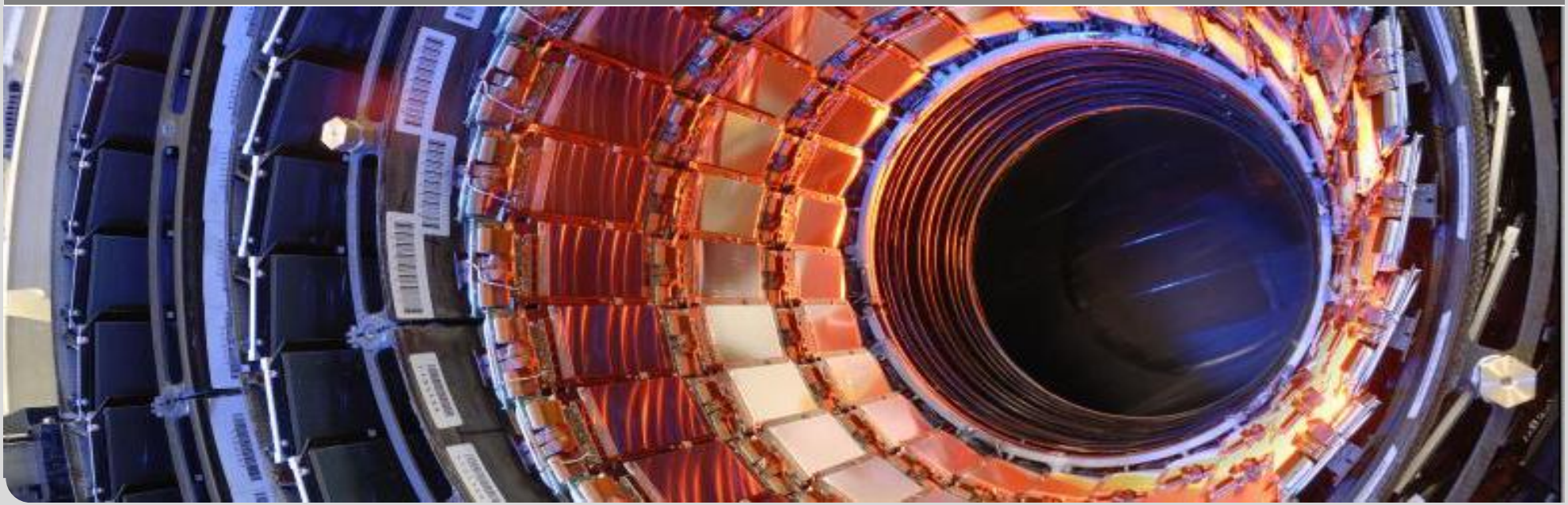
INSTITUTE FOR EXPERIMENTAL PARTICLE PHYSICS (ETP) · KIT-FACULTY FOR PHYSICS



Goal

- automate workflow of NNLOJET grid production
- reusable for different processes in the future
- lightweight, small overhead
- flexible to different environments and demands

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Luigi is a Python package that helps you build complex pipelines of batch jobs

Features:

- dependency resolution
- workflow management
- visualization
- handling failures
- command line integration
- and much more

law
luigi analysis workflow

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law ist built on top of Luigi and adds abstractions for run locations, storage locations and software environments

Features:

- **Remote targets with automatic retries and local caching**
  WebDAV, HTTP, Dropbox, SFTP, all WLCG protocols (srm, xrootd, rfio, dcap, gsiftp, ...)
- **Automatic submission to batch systems from within tasks**
  HTCondor, LSF, gLite, ARC
- **Environment sandboxing, configurable on task level**
  Docker, Singularity, Sub-Shells

Tasks

```
import luigi

class MyTask(luigi.Task):
  param = luigi.Parameter(default = 42)

  def requires(self):
    return SomeOtherTask(self.param)

  def output(self):
    return luigi.LocalTarget(
      '/tmp/foo/bar-{}.txt'.format(self.param)
    )

  def run(self):
    f = self.output().open('w')
    print >>f, 'hello, world'
    f.close()
```

Workflows

```
import law

class MyWorkflow(law.LocalWorkflow):

  def create_branch_map(self):
    return {0: 'foo', 1: 'bar', 2: 'baz'}

  def workflow_requires(self):
    return {'common': SomeCommonDependency.req(self, ...)}

  def requires(self):
    return SomeBranchSpecificRequirement.req(self, ...)

  def output(self):
    return law.LocalFileTarget('some/file_{}.txt'.format(
                                        self.branch))

  def run(self):
    self.output().dump(self.branch_data, formatter='text')
```

Warmup Workflow

```
class Warmup(HTCondorWorkflow):
  channels = luigi.Parameter()

  def create_branch_map(self):
    branchmap = {}
    for i, channel in self.channels:
      branchmap[i] = channel
    return branchmap

  def requires(self):
    return Runcard(
      channel = self.branch_data, warmup = 'true', ...
    )

  def output(self):
    return self.remote_target(
      '{}.{}.{}.warmup.tar.gz'.format(self.process, self.
                                      branch_data, self.name)
    )
```

luigi.cfg

```
[DEFAULT]
name = ZJtriple
process = ZJ
channels = LO R V RRa RRb RV VV
wlcg_path = srm://cmssrm-kit.gridka.de:8443/srm/...
htcondor_accounting_group = cms.jet
htcondor_requirements = (TARGET.ProvidesCPU==true)
htcondor_request_cpus = 1
htcondor_request_memory = 4096
...

[Warmup]
warmup_events = 200000 10000 40000 5000 5000 10000 20000
warmup_iterations = 10 10 10 10 10 10 10
starting_seed = 0
htcondor_request_cpus = 20
htcondor_request_memory = 16384
```

Command Line Interface

```
$ law run FastWarm --print-status -1

print task status with max_depth -1 and target_depth 0

> check status of FastWarm(branch = -1, ...)
|   - check WLCGFileTarget(path=/ZJtriple/FastWarm/
                            htcondor_submission.json,
                            optional)
|     -> absent
|   - check WLCGFileTarget(path=/ZJtriple/FastWarm/
                            htcondor_status.json,
                            optional)
|     -> absent
|   - check TargetCollection(len=14, threshold=0.95)
|     -> existent (14/14)
|
|   > check status of Warmup(...)
|   |   - check ...
```

Command Line Interface

```
$ law run Warmup --local-scheduler --transfer-logs

DEBUG: Checking if Warmup(...) is complete
INFO: Informed scheduler that task
Warmup_warmup_bootstrap__1_False_74e4e0b45d has status
PENDING
INFO: [pid 646590] Worker Worker(salt=845360652, workers=1
                                , host=ekpbms2.ekp.kit.edu,
                                username=mcorrea, pid=646590)
                                 running   Warmup(...)
going to submit 7 htcondor job(s)
submitted 1/7 job(s)
submitted 7 job(s)
16:32:46: all:    7, pending:    7 (  +0),
running:    0 (  +0), finished:    0 (  +0),
retry:    0 (  +0), failed:    0 (  +0)
16:33:46: all: ...
```

Getting Started

- clone repository

```
$ git clone --recurse-submodules
  https://github.com/miguel-sc/nnlo-law-analysis.git
```

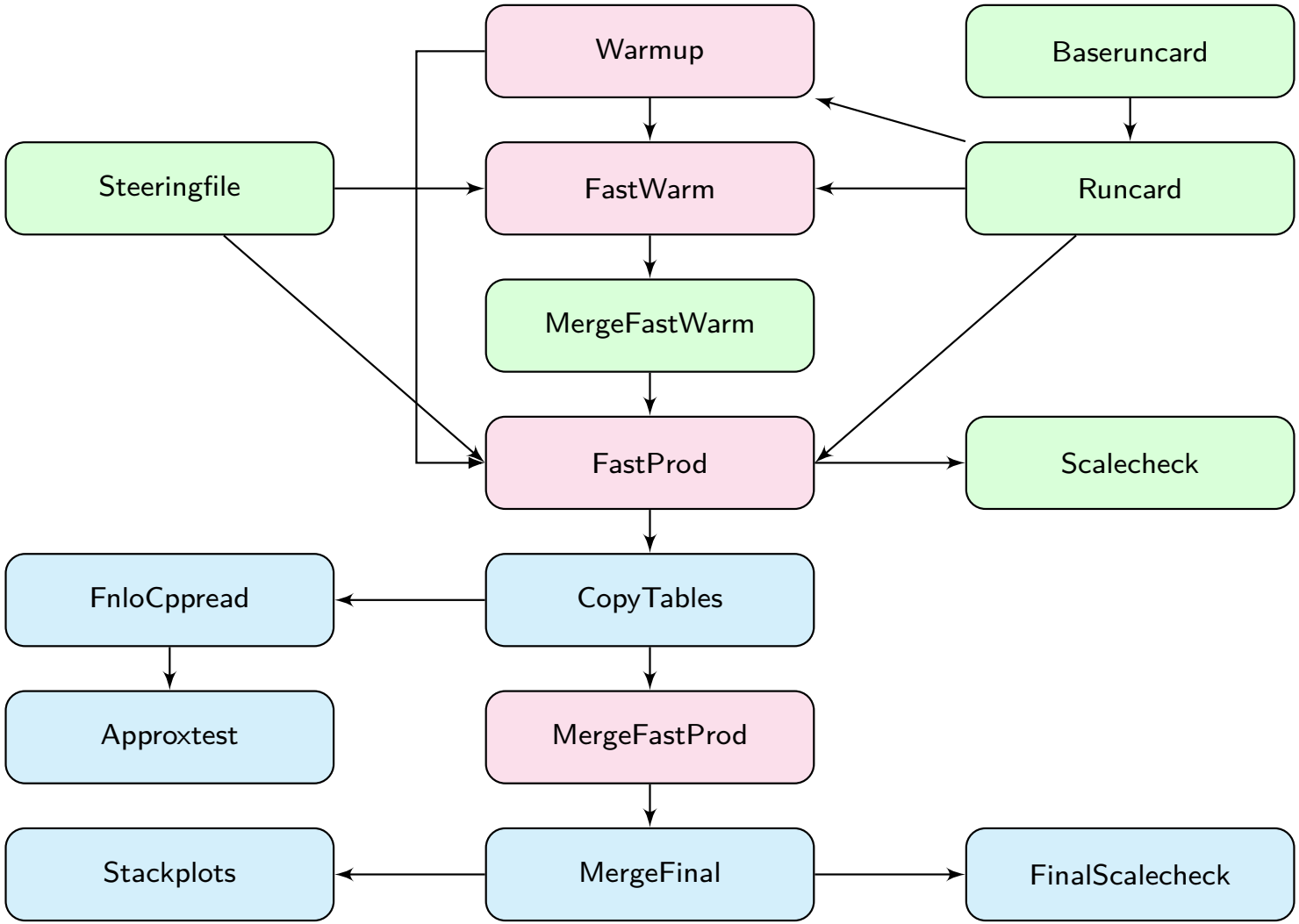
- copy NNLOJET runcard and steeringfile into repository
- insert substitution strings ('@SEED@', ...) into runcard
- edit luigi.cfg
- set environment variables

```
$ source setup.sh
```

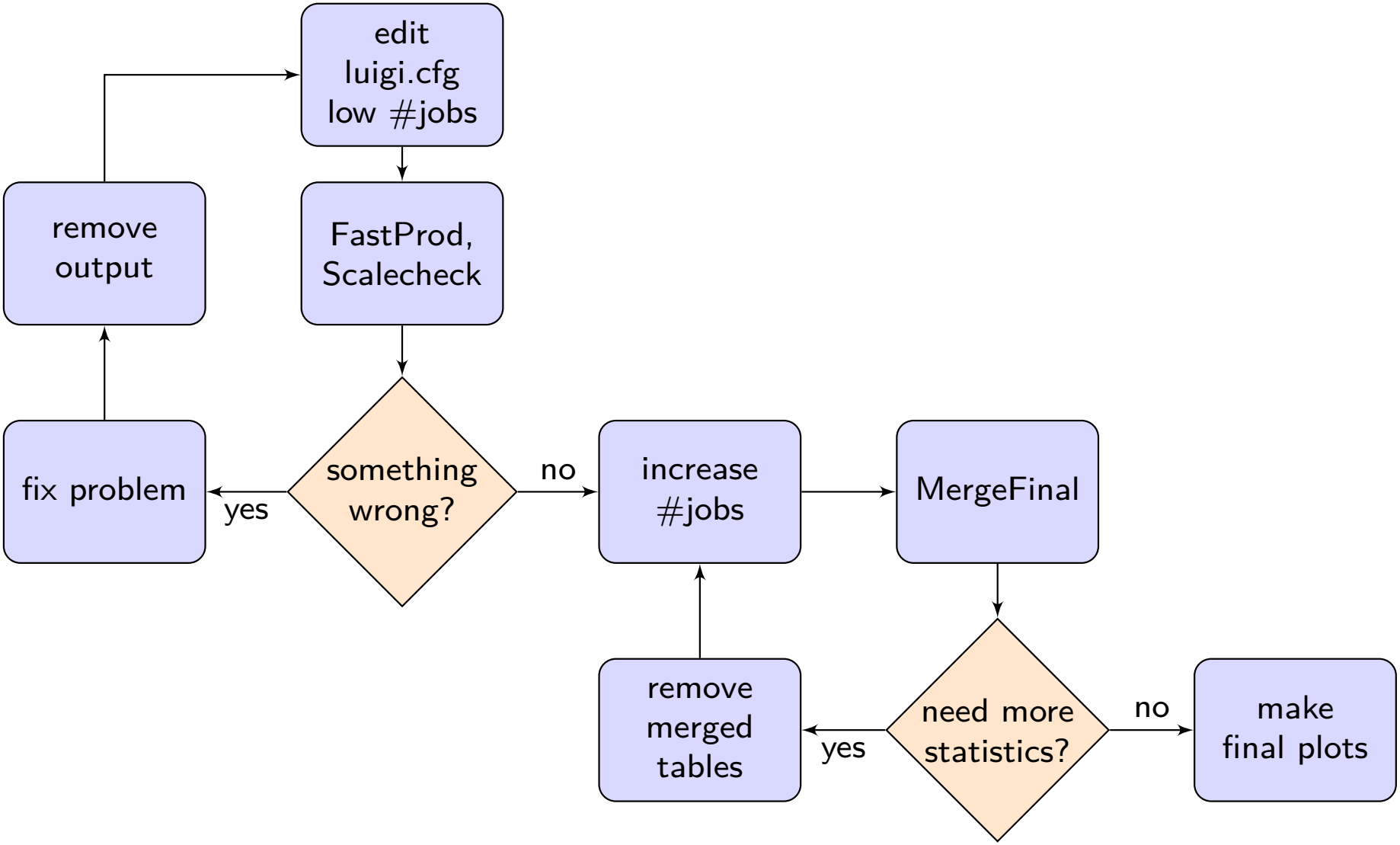
- initialize law

```
$ law db --verbose
```

Dependency Tree (simplified)



Flowchart


edit
luigi.cfg
low #jobs
FastProd,
Scalecheck
something
wrong?
yes
fix problem
remove
output
no
increase
#jobs
MergeFinal
need more
statistics?
yes
remove
merged
tables
no
make
final plots

Features

- pipeline works for any NNLOJET runcard
- run methods don't contain any external dependencies
  → works on any environment
- output of any task can still be supplied manually
- significant boost in speed through parallelization and a non-linear dependency tree
- flexible, compute only what you need
- addition of custom tasks is possible
- results are reproducible