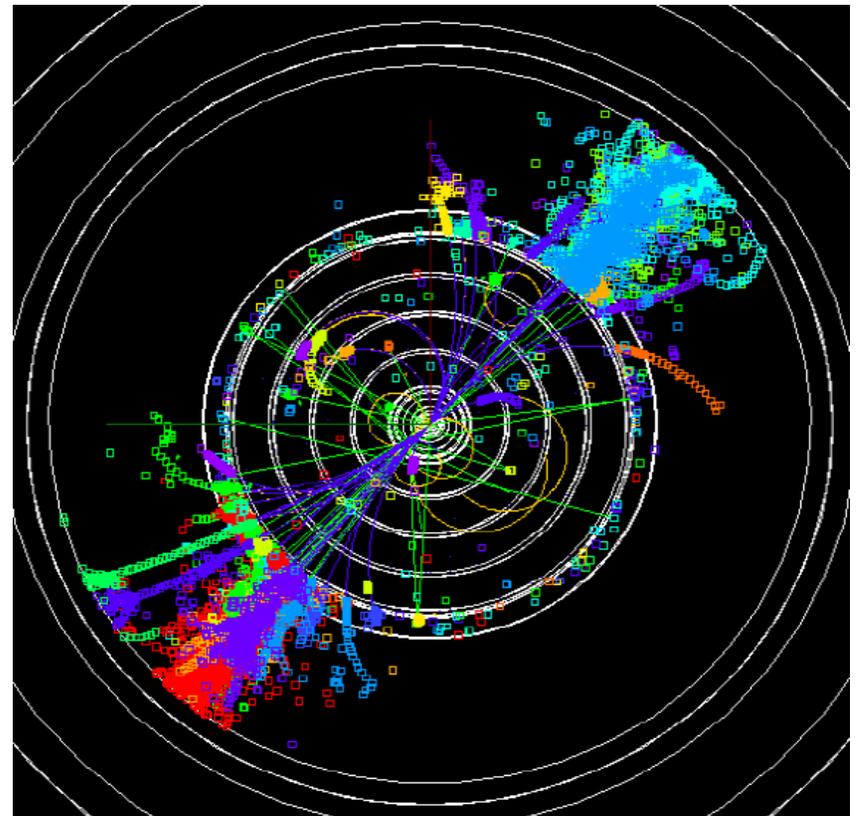
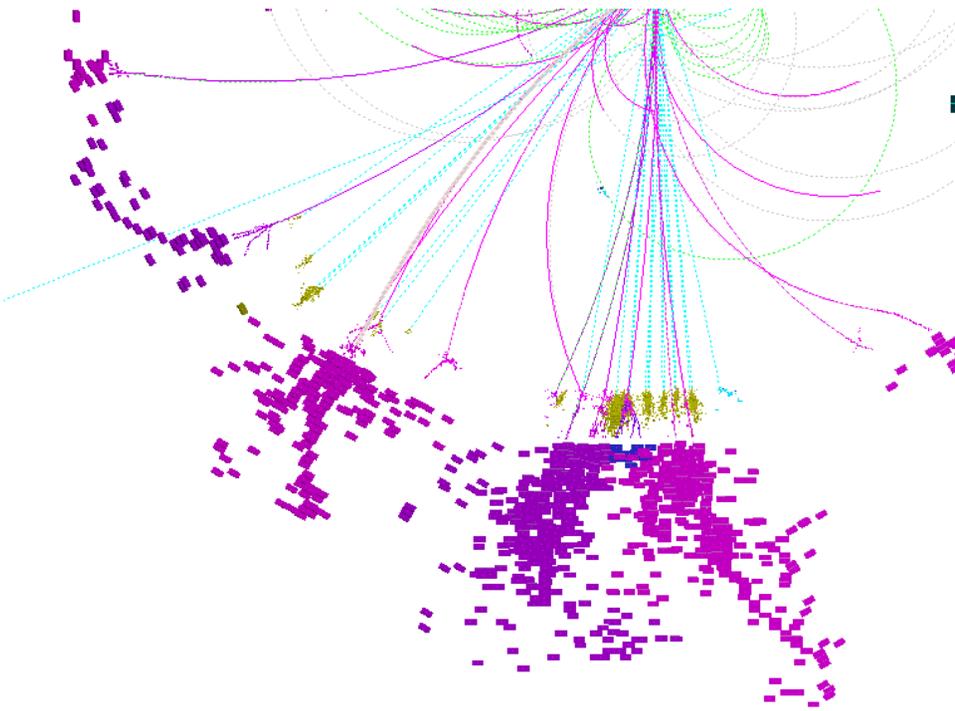


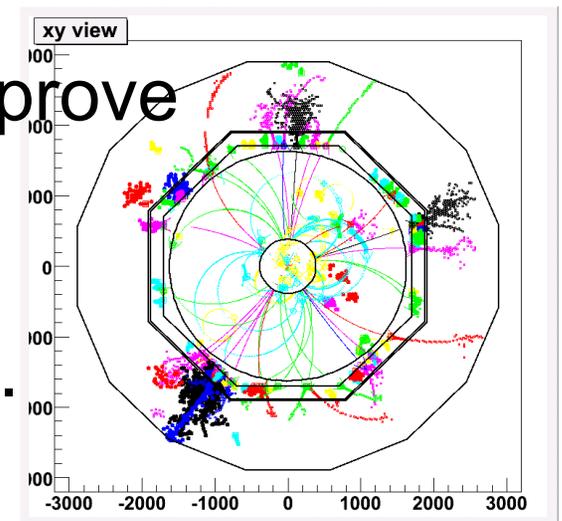
# SlicPandora Software

Jeremy McCormick, SLAC



# Pandora PFA

- PFA originally created for ILD detector.
- Rewritten from scratch to be more modular and fully extensible; now it is much easier to apply to different detector models and software frameworks.
- No external dependencies.
- Available in a public SVN along with related projects and config files.
- Ongoing development to fix bugs, improve algorithm performance, etc.
- Regularly tagged software releases.
- Also used in ILD software framework.
  - MarlinPandora



# Pandora PFA Benefits

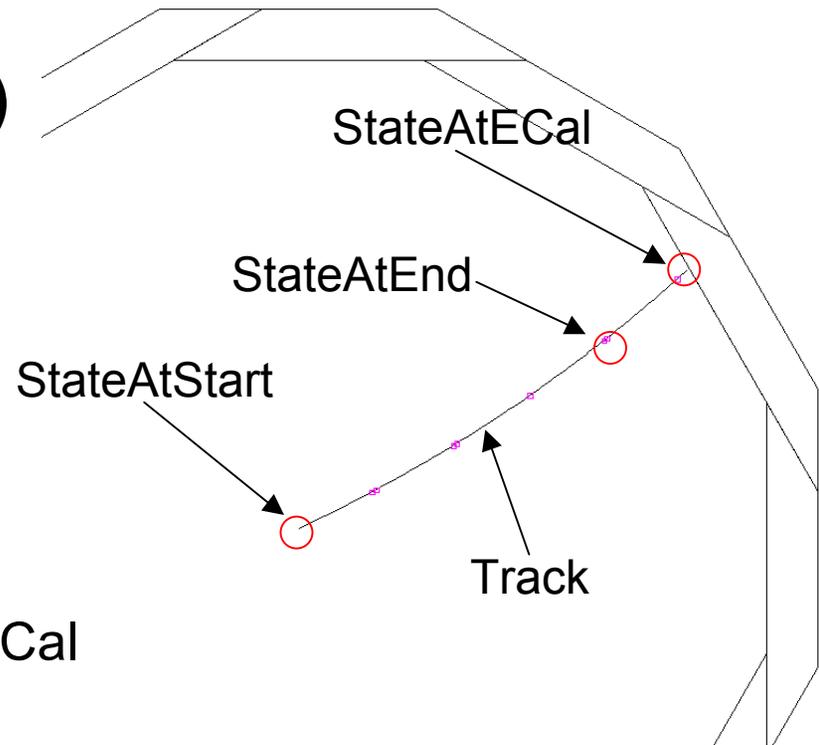
- Best performing PFA algorithm.
- Reasonable performance time, including on events @ 1 TeV and greater.
  - CLIC CDR benchmarks @ 3 TeV
- Allows direct comparison to other detector concepts (e.g. ILD) using the same reconstruction algorithm.
- Take advantage of dedicated developers/author and their expertise.
  - Get bug fixes and improvements “for free.”
- Established set of easy-to-use software tools and utilities.

# SlicPandora Workflow

1. Generate LCIO events using slic and detector/stdhep of your choice.
2. Run SLIC output through LCSim tracking to generate Track and Track State collections.
3. Take LCSim LCIO output and run in slicPandora to generate PFOs.
4. Use LCIO analysis tool of your choice to work with PFOs (JAS3, ROOT, etc.).

# LCSim Tracking

- SLIC output is run through LCSim's SiSim digitization and SeedTracker tracking algorithm to generate Tracks and TrackStates for Pandora.
- Track States (momentum, position, time)
  - StateAtStart
    - initial momentum
  - StateAtEnd
    - momentum at last hit
    - Pandora doesn't seem to use.
  - StateAtECal
    - momentum of Track swum to ECal
    - Very important to get right.



# SlicPandora

- Frontend to the PandoraPFANew project.
  - LCIO binding
  - Geometry format
- Uses geometry XML file generated by GeomConverter from compact detector.
- Reads input LCIO file with simulated events, tracks, and track states.
- Outputs LCIO file with Reconstructed Particles.
- Uses standard XML config file for Pandora algorithm settings.

# Software Dependencies

- slicPandora
    - top level project that provides the binary
  - PandoraPFANew
    - standalone Pandora algorithm
  - LCIO
    - common IO framework
  - PandoraMonitoring (optional)
    - ROOT-based event visualization
  - ROOT (optional)
    - need if monitoring is enabled
    - running with version 5.26
- NOTE: At this moment, it is best to use the CVS head of all packages unless otherwise indicated.

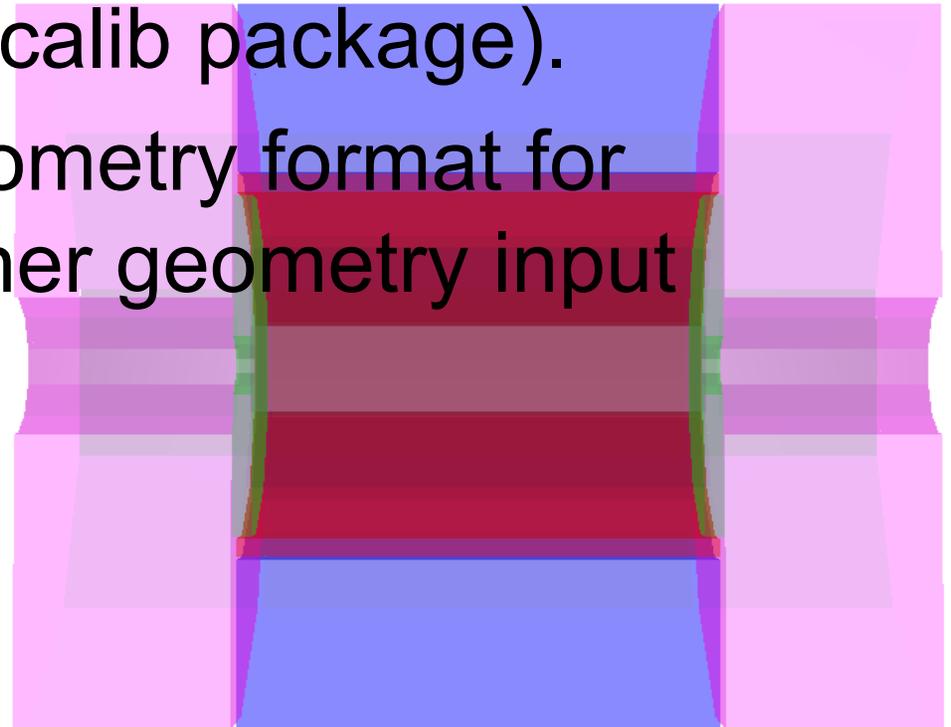
# Command Line Interface

```
./bin/PandoraFrontend geometry.xml pandoraSettings.xml  
inputEvents.slcio reconOutput.slcio nevents nskip
```

- **geometry.xml** is a Pandora format from GeomConverter.
- **pandoraSettings.xml** is the Pandora config (default of slicPandora/examples/PandoraSettings.xml is fine)
- **nevents** is optional and defaults to all events.
- **nskip** is optional and defaults to zero.
- Grid ready using Dirac on the LCG grid.
- Setup script provided by slicPandora for runtime libraries.

# SlicPandora Geometry Format

- GeomConverter output binding that operates similar to LCDD, etc.
- Generated from compact description plus calorimeter sampling fractions conditions file (using lcsim-cal-calib package).
- Fully descriptive geometry format for slicPandora. No other geometry input data required.



# Geometry XML Format

```
<pandoraSetup>  
  <detector>  
    <calorimeters>  
      <calorimeter>  
        <id>  
        <layers>  
      <coil>  
    <tracking>
```

# Pandora Detector Parameters

- calorimeter
  - type
  - innerR, innerZ, innerPhi, innerSymmetryOrder, outerR, outerZ, outerPhi, outerSymmetryOrder
  - hits collection name
  - cellSizeU, cellSizeV
  - mipEnergy, mipSigma, mipCut, timeCut
  - digital flag
  - id
  - layers
- coil
  - bfield, innerR, z, outerR
- tracking
  - innerR, outerR, z

# Calorimeter Layer Parameters

- Parameters provided for *each layer*.
  - radiation lengths, interaction lengths
  - distance from IP
  - cell thickness (includes absorber + dead material)
  - sampling fraction
  - EM sampling fraction
  - HAD sampling fraction

# Calorimeter Calibration

- The lcsim-cal-calib package is used to generate sampling fractions from single particle data.
  - Range of single particle types and energies simulated in SLIC.
  - Events are analyzed in LCSim to derive sampling fractions.
  - Output sampling fractions put by hand into CalorimeterCalibration.properties file in detector directory.
- Same events are run in Pandora and fit again using a different Driver.
  - Isolated hits are removed by Pandora, so data must be refitted to match its final cluster energies.
  - Final sampling fractions put into CalorimeterCalibration.properties file.

# Pandora Monitoring

- Event visualization using ROOT's Eve library.
- Visualization of detector, hits/cells, tracks, MCParticles, PFOs, etc.
- Various color coding schemes.
- Runs within Pandora, event by event.
- NOTE: JAS3/Wired4 can still be used as an event display with the output LCIO file from Pandora.

# PandoraMonitoring Example

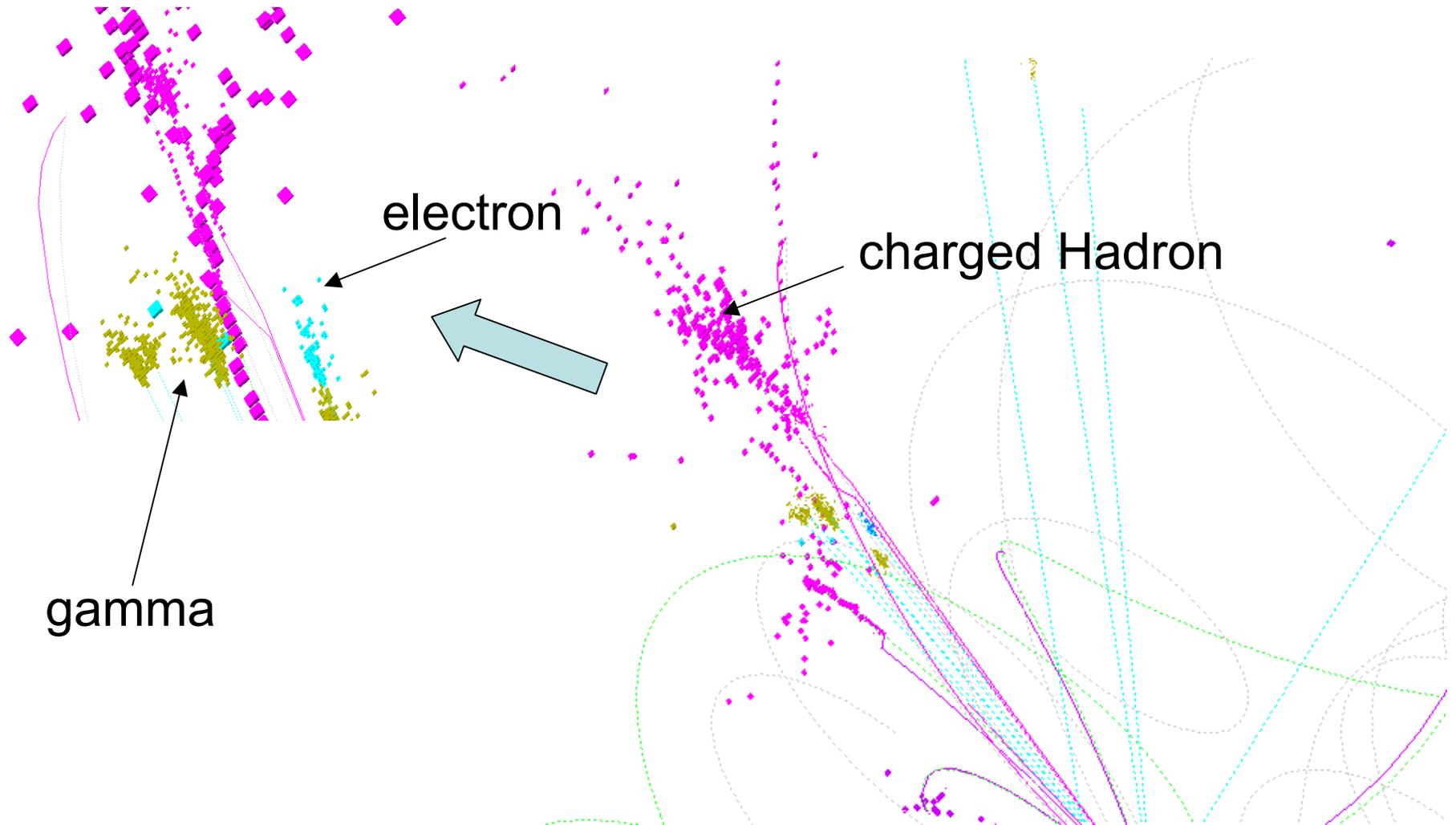
The image shows a screenshot of the PandoraMonitoring software interface. The main window is titled "Eve Main Window" and contains a 3D visualization of a detector simulation. The detector is represented by a central red cylindrical volume, surrounded by purple and blue structures. A cluster of particles is visible in the center, with a yellow selection info window overlaid on it. The selection info window displays the following data:

```
currentClusters
--- cluster
Eem(corr)=3.52723
Ehad(corr)=3.43827
NHits=69
--- calo-hits
Eem=3.18993
Ehad=3.13373
first pseudo-layer=1
last pseudo-layer=45
min intLenFromIP=0
max intLenFromIP=1.17549e-38
from MC with PDG -2212 = 0.0149065 GeV
from MC with PDG -211 = 3.15115 GeV
from MC with PDG 211 = 0.0238719 GeV
```

Labels with arrows point to various parts of the interface:

- Event Window**: Points to the top right corner of the main viewer area.
- Scene Browser**: Points to the left sidebar containing a tree view of the scene hierarchy.
- Commands & Settings**: Points to the bottom left panel containing various controls and settings.
- Selection Info**: Points to the yellow information window overlaid on the particle cluster.

# 250 GeV W Jet



# Grid Tools

- CLIC SiD group has provided a comprehensive set of tools for using slicPandora and related apps on the LCG grid.
  - slic, lcsim, slicPandora
- Built on Dirac gridware (from LHCb).
- Possible to run a job that chains applications
  - Run slic, lcsim, & slicPandora in the same job script.
- Need to get a grid certificate and then register with the European ILC VO to use it.
- Jobs are submitted using python scripts.
- Remote job submission possible and relatively straightforward (tested at SLAC).
- Output data files can be stored in the grid catalog and used by subsequent jobs.
- WWW monitoring tool to check status of jobs.

# Online Job Monitoring

Action Buttons

Job Summary

The screenshot displays the Job Monitoring application interface. On the left, there is a 'Search/Filter' panel with dropdown menus for Site, Status, Minor status, Application status, Owner, and JobGroup, and a text input for JobID. The main area contains a table of jobs with columns: Jobid, Status, MinorStatus, ApplicationStatus, Site, JobName, LastUpdate [UTC], LastSignOfLife [UT], SubmissionTime [L], and Owner. A context menu is open over the first row (Jobid 249281), listing actions like JDL, Attributes, Parameters, Logging info, Peek StandardOutput, Get LogFile, Get PendingRequest, Get StagerReport, Get Sandbox, Actions, Pilot, and Show value. At the top right, there are 'Action Buttons' for Reschedule, Kill, and Delete. The top right corner shows 'Selected setup: ILC-Production'.

Jobid	Status	MinorStatus	ApplicationStatus	Site	JobName	LastUpdate [UTC]	LastSignOfLife [UT]	SubmissionTime [L]	Owner
249281	Done	Execution Complet	SLIC v2r8p4 Succ	LCG.CERN.ch	test_job	2010-11-05 10:37	2010-11-05 10:37	2010-11-05 10:34	jeremy
249278	Done	Execution Complet	Job Finished Succ			2010-11-05 09:57	2010-11-05 09:57	2010-11-05 09:48	jeremy
249229	Failed	Maximum of resche	Failed to setup pro			2010-11-05 07:42	2010-11-05 07:42	2010-11-04 17:59	jeremy
249218	Failed	Maximum of resche	Failed to setup pro			2010-11-04 17:57	2010-11-04 17:57	2010-11-04 16:36	jeremy
249217	Failed	Maximum of resche	Failed to setup pro			2010-11-04 16:31	2010-11-04 16:31	2010-11-04 16:02	jeremy
249182	Failed	Maximum of resche	Failed to setup pro			2010-11-04 15:46	2010-11-04 15:46	2010-11-04 15:04	jeremy
249181	Killed	Marked for termina	On Hold: after resc			2010-11-04 15:02	2010-11-04 15:02	2010-11-04 14:53	jeremy
249178	Killed	Marked for termina	On Hold: after resc			2010-11-04 15:02	2010-11-04 15:02	2010-11-04 14:38	jeremy
249175	Killed	Marked for termina	Unknown			2010-11-04 15:02	2010-11-04 15:02	2010-11-04 14:29	jeremy
249169	Killed	Marked for termina	Unknown			2010-11-04 15:02	2010-11-04 15:02	2010-11-04 14:00	jeremy

Search/Filter

Action Menu

# ILCDirac API

## Example SLIC Job

```
dirac = DiracILC ( ... )  
job = ILCJob()  
job.setSLIC( slicVer,  
             macroFile,  
             inputStdhepFile,  
             outputFile,  
             detectorModel,  
             nevents)  
[...more setup here...]  
job.setName( "my_grid_job" )  
dirac.submit( job )
```

# Documentation

- [SlicPandora Instructions](#)
- [LCD Wiki](#)
- [ILCDirac API](#)