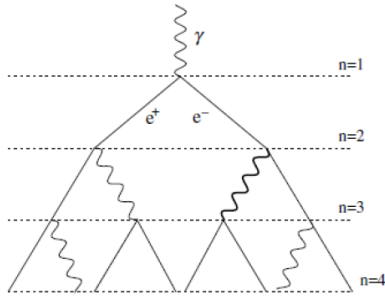


# ***LATTES software distribution***

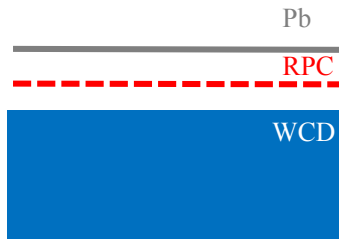
**Ruben Conceição, Bernardo Tomé**



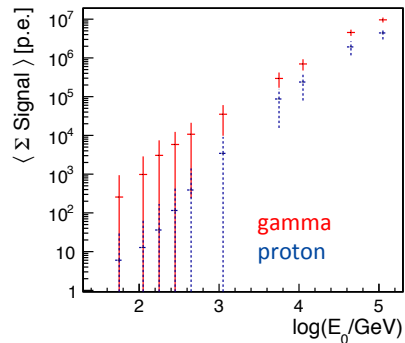
# Towards LATTES sensitivity...



Shower simulation

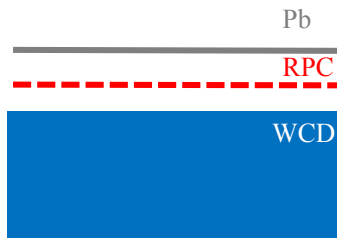
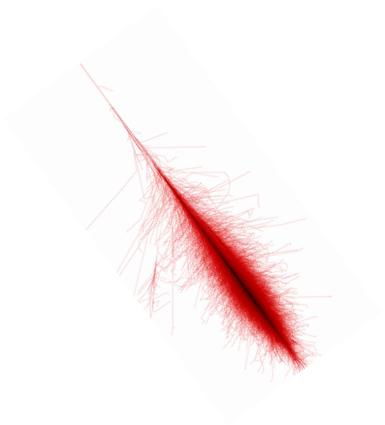


Detector simulation



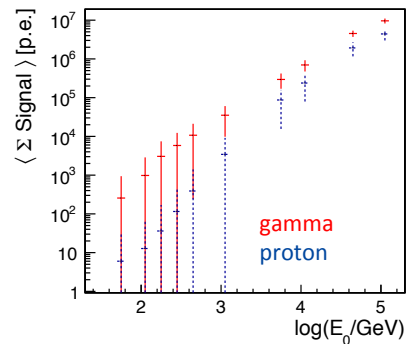
Shower reconstruction

# Towards LATTES sensitivity...



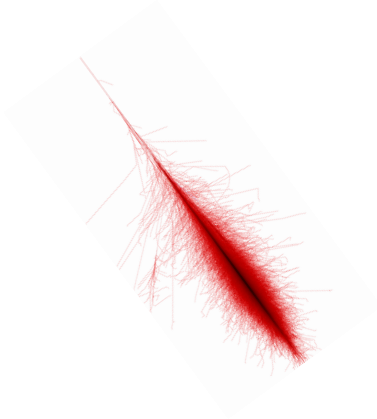
CORSIKA showers

Detector simulation

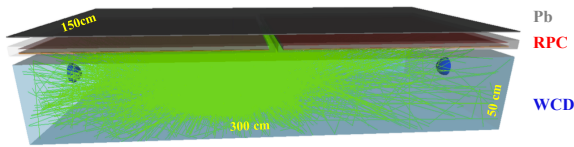


Shower reconstruction

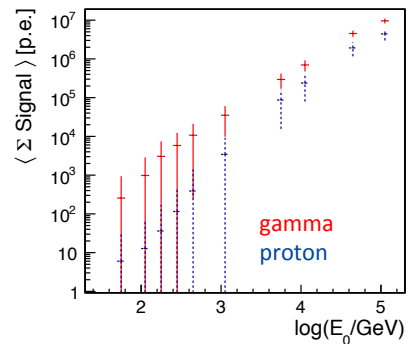
# Towards LATTES sensitivity...



CORSIKA showers

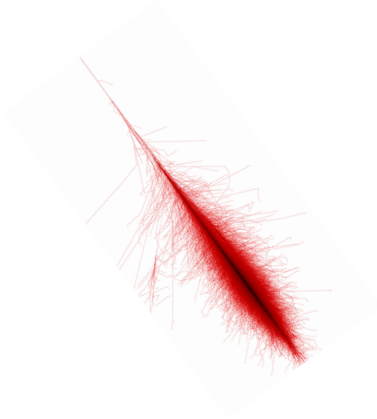


Geant4 simulation  
(LATTESsim)

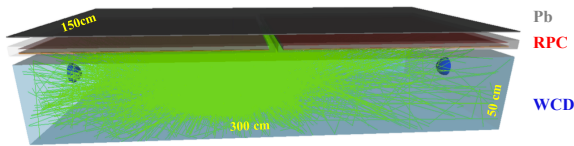


Shower reconstruction

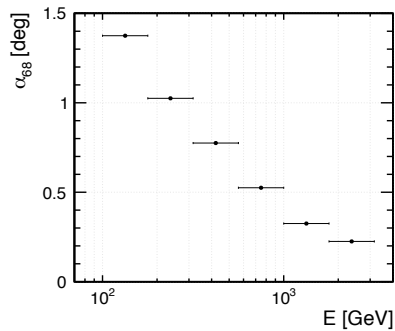
# Towards LATTES sensitivity...



CORSIKA showers



Geant4 simulation  
(LATTESsim)



Reconstruction analyses  
(LATTESrec)


# Shower reconstruction

- ✧ Detector simulation output
  - ✧ Format is a ROOT tree
  - ✧ Methods to access specific simulated shower parameters
    - ✧ WCD signal
    - ✧ RPC hits
    - ✧ Detector configuration and parameters
    - ✧ Shower simulation parameters
- ✧ Reconstruction tool
  - ✧ Several modules to reconstruct the shower
    - ✧ Geometry
    - ✧ Energy
    - ✧ Gamma/hadron discrimination
- ✧ Lightweight and easy to re-process for higher level analysis

# LATTES software

- ✧ LATTES software has been tested and is currently running at:
  - ✧ Our laptops ;- ) [MACOS]
  - ✧ Lisbon cluster [SL6]
  - ✧ Prague cluster []
  - ✧ Rio de Janeiro interactive machines (CBPF) [Ubuntu16]
- ✧ The codes are relatively modular and documentation can be obtained via Doxygen
  - ✧ Just run: *doxygen Doxyfile*

# LATTES documentation



file:///Users/ruben/Desktop/LattesSim/doxygen/html/index.html

## LATTESim v1

Main Page Namespaces ▾ Classes ▾ Files ▾

Search

### LATTESim Documentation

Generated by [doxygen](#) 1.8.13



file:///Users/ruben/Desktop/LATTESrec/doxygen/html/index.html

## LATTESrec v1

Main Page Classes ▾ Files ▾

Search

### LATTESrec Documentation

Generated by [doxygen](#) 1.8.13



# LATTES documentation

## LATTESSim v1

<a href="#">Main Page</a>	<a href="#">Namespaces ▾</a>	<a href="#">Classes ▾</a>	<a href="#">Files ▾</a>	
---------------------------	------------------------------	---------------------------	-------------------------	--

### Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

▾ <b>N</b> corsika	
<b>C</b> Longi	
<b>C</b> Particle	
<b>C</b> SubBlock	
▾ <b>N</b> utl	
<b>C</b> CORSIKAEvent	
<b>C</b> CORSIKAReader	
<b>C</b> Particle	
<b>C</b> CORSIKAEventROOT	
<b>C</b> EventROOT	
<b>C</b> HitROOT	
<b>C</b> PadROOT	
<b>C</b> PMTROOT	
<b>C</b> PrimaryVertex	
<b>C</b> RPCROOT	
<b>C</b> StationROOT	

## LATTESrec v1

<a href="#">Main Page</a>	<a href="#">Classes ▾</a>	<a href="#">Files ▾</a>	
---------------------------	---------------------------	-------------------------	--

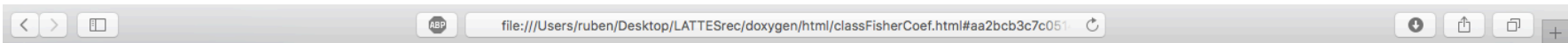
### Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<b>C</b> AxisRec	
<b>C</b> Compactness	
<b>C</b> CoreRec	
<b>C</b> DoubleWithError	
<b>C</b> EbinInput	
<b>C</b> FisherCoef	
<b>C</b> FitParameters	
<b>C</b> GeomRecPar	
<b>C</b> LDFFitParameters	
<b>C</b> Tree	

# LATTES documentation

LATTESrec v1



## ◆ GetFisherVarNames()

std::vector<string> FisherCoef::GetFisherVarNames ( ) const

inline

Definition at line 24 of file **FisherCoef.h**.

```
24 | {return fVarNames;}
```

## ◆ HasFisher()

const bool FisherCoef::HasFisher ( ) const

inline

Definition at line 27 of file **FisherCoef.h**.

```
27 | {return fHasFisher;}
```

## ◆ PrintFisherCoefficients()

void FisherCoef::PrintFisherCoefficients ( ) const

Definition at line 32 of file **FisherCoefs.cc**.

References **fVarNames**, and **fWeights**.

Referenced by **PerformShowerRec()**.

```
33 | {  
34 |     for (unsigned int i = 0; i < fVarNames.size(); ++i)  
35 |         cout << "i: " << i << " --> " << fVarNames[i].c_str() <<  
36 |             " = " << fWeights[i] << endl;  
37 | }
```

## ◆ SetEnergy()

void FisherCoef::SetEnergy ( double energy )

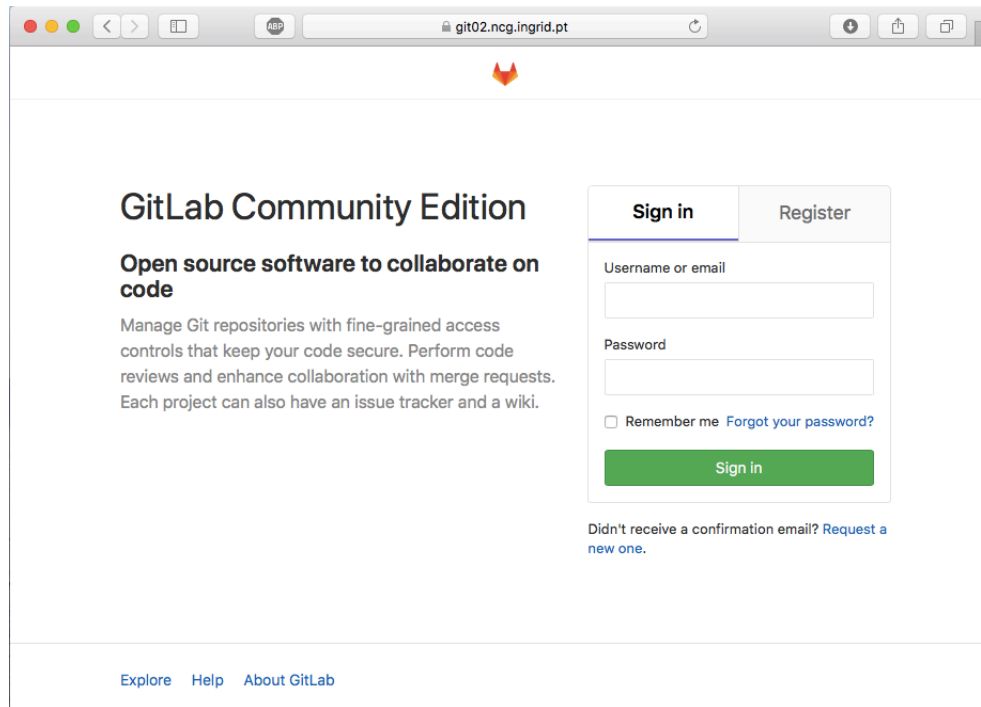
inline

Definition at line 28 of file **FisherCoef.h**.

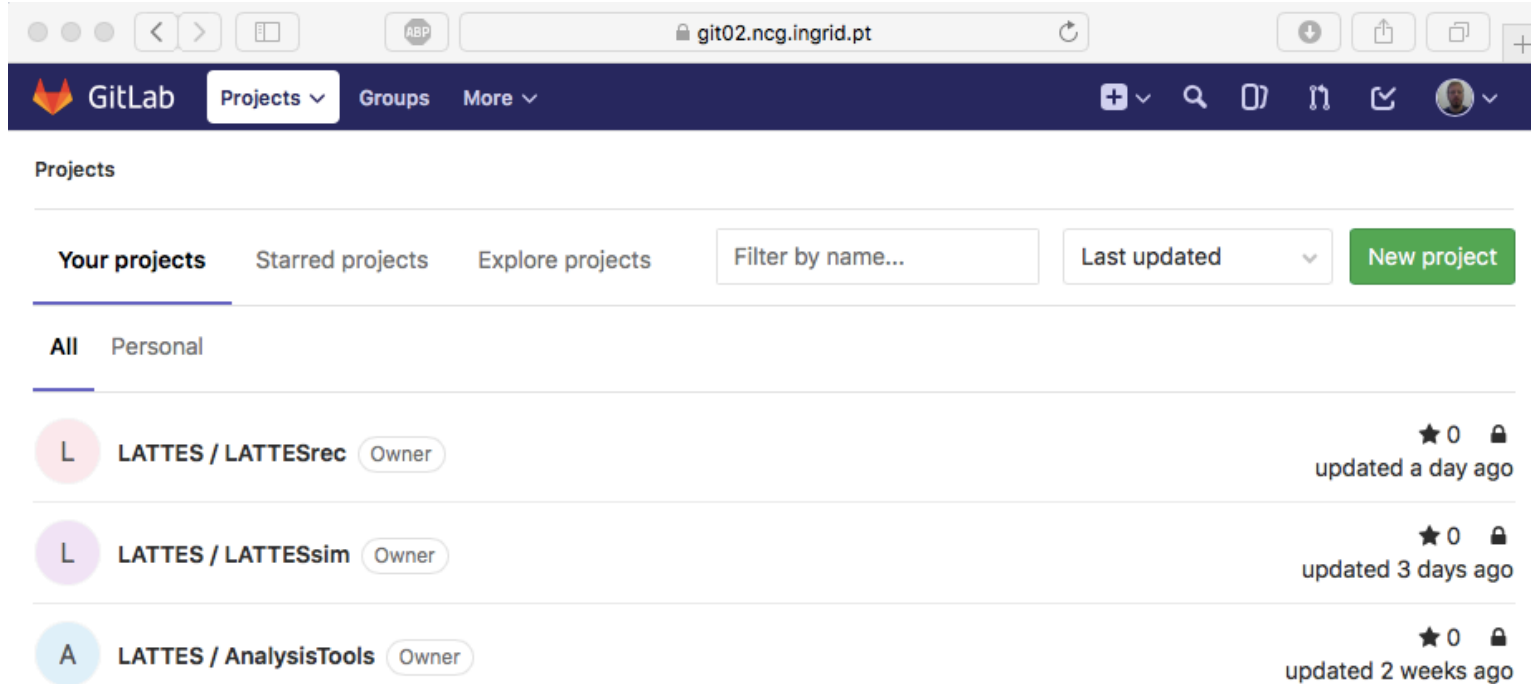
```
28 | {fEnergy = energy;}
```

# LATTES SW distribution

- ✧ If you want to install LATTES SW register at:
  - ✧ [git02.ncg.ingrid.pt](https://git02.ncg.ingrid.pt)
  - ✧ Then send us ([bernardo@lip.pt](mailto:bernardo@lip.pt), [ruben@lip.pt](mailto:ruben@lip.pt)) your username so that we can give you permissions



# LATTES @ gitlab

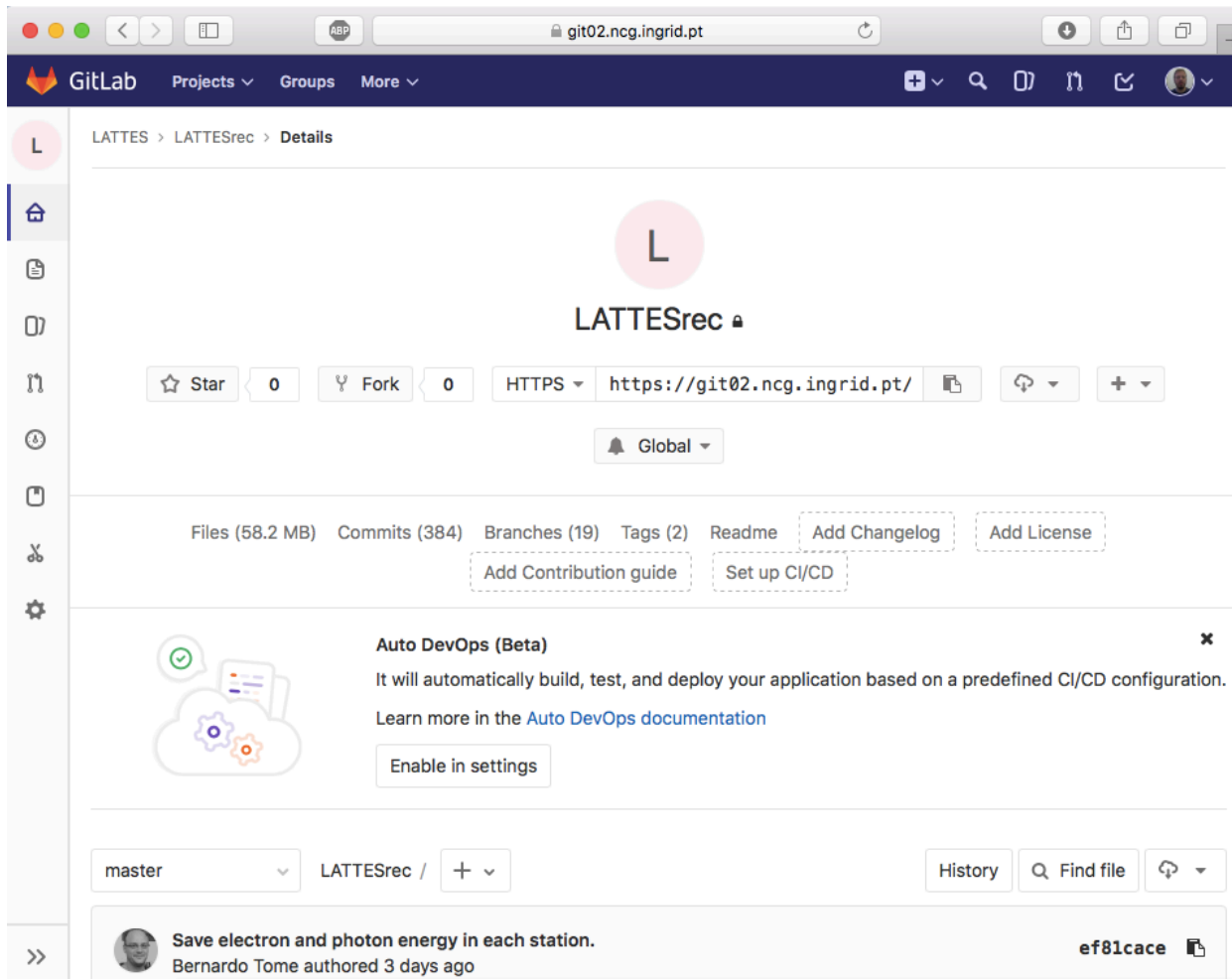


The screenshot shows the GitLab web interface in a browser window. The address bar displays 'git02.ncg.ingrid.pt'. The navigation bar includes the GitLab logo, 'Projects' (selected), 'Groups', and 'More'. The main content area is titled 'Projects' and features tabs for 'Your projects', 'Starred projects', and 'Explore projects'. A search bar 'Filter by name...' and a 'Last updated' dropdown menu are present, along with a green 'New project' button. Below the tabs, the 'All' filter is selected, showing a list of three projects:

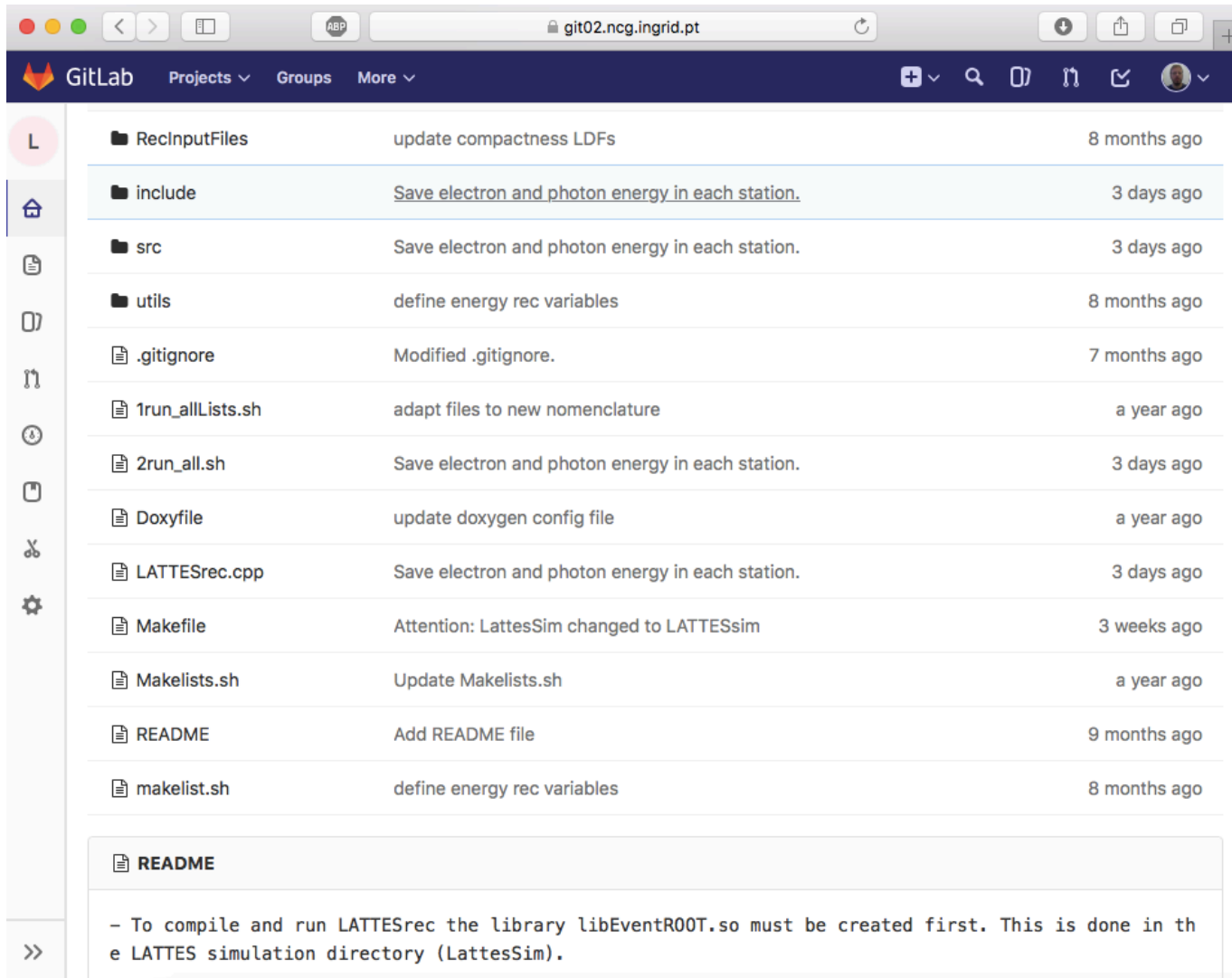
Project Name	Owner	Stars	Lock	Last Updated
LATTES / LATTESrec	Owner	0	Yes	updated a day ago
LATTES / LATTESsim	Owner	0	Yes	updated 3 days ago
LATTES / AnalysisTools	Owner	0	Yes	updated 2 weeks ago

# Example: get LATTESrec

✧ git clone <https://....>



# All info there!



The screenshot shows a GitLab web interface for a repository. The browser address bar displays 'git02.ncg.ingrid.pt'. The GitLab header includes navigation links for 'Projects', 'Groups', and 'More'. A sidebar on the left contains icons for home, search, and settings. The main content area lists repository files and folders with their commit messages and timestamps. The 'include' folder is highlighted. Below the list, a 'README' file is shown with a snippet of text.

File/Folder	Commit Message	Timestamp
RecInputFiles	update compactness LDFs	8 months ago
include	<a href="#">Save electron and photon energy in each station.</a>	3 days ago
src	Save electron and photon energy in each station.	3 days ago
utils	define energy rec variables	8 months ago
.gitignore	Modified .gitignore.	7 months ago
1run_allLists.sh	adapt files to new nomenclature	a year ago
2run_all.sh	Save electron and photon energy in each station.	3 days ago
Doxyfile	update doxygen config file	a year ago
LATTESrec.cpp	Save electron and photon energy in each station.	3 days ago
Makefile	Attention: LattesSim changed to LATTESsim	3 weeks ago
Makelists.sh	Update Makelists.sh	a year ago
README	Add README file	9 months ago
makelist.sh	define energy rec variables	8 months ago

**README**

```
- To compile and run LATTESrec the library libEventROOT.so must be created first. This is done in the LATTES simulation directory (LattesSim).
```

# Manage permissions

Expiration date

Add to project Import

### Existing members and groups

Members of **LATTESrec** 6  Name, ascending ▾

	<b>Bernardo Tome</b> @bernardo · LATTES Joined 2 months ago			Owner
	<b>Filipe de Oliveira Salles</b> @filipe.o.salles Joined a month ago	Reporter ▾	Expiration date	
	<b>Jakub Vicha</b> @vicha Joined a day ago	Developer ▾	Expiration date	
	<b>Liliana Apolinario</b> @liliana Joined a month ago	Reporter ▾	Expiration date	
	<b>Ruben Conceição</b> @ruben <span>It's you</span> · LATTES Joined 2 months ago			Owner
	<b>Ugo Giaccari</b> @ugo Joined a month ago	Reporter ▾	Expiration date	

# Summary

- ❖ Modular end-to-end simulation framework
  - ❖ From showers to high-level analysis
- ❖ Realistic and detailed description of the LATTES concept using Geant4 - LATTESsim
  - ❖ Optimization studies
  - ❖ Test different designs
- ❖ Reconstruction algorithms integrated in a single module - LATTESrec
  - ❖ Allows high-level analysis
- ❖ LATTESsim and LATTESrec available in gitlab repositories + doxygen documentation



# Acknowledgements



**REPÚBLICA  
PORTUGUESA**

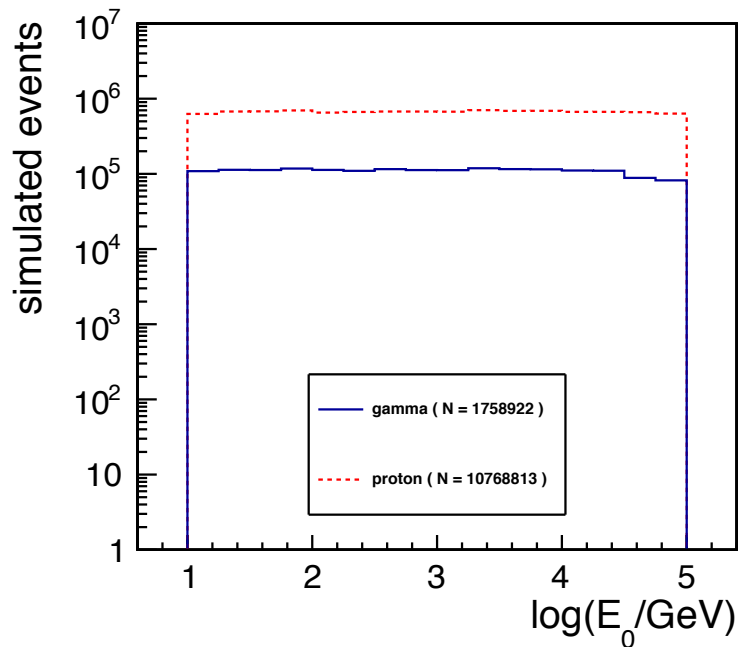


**TÉCNICO  
LISBOA**

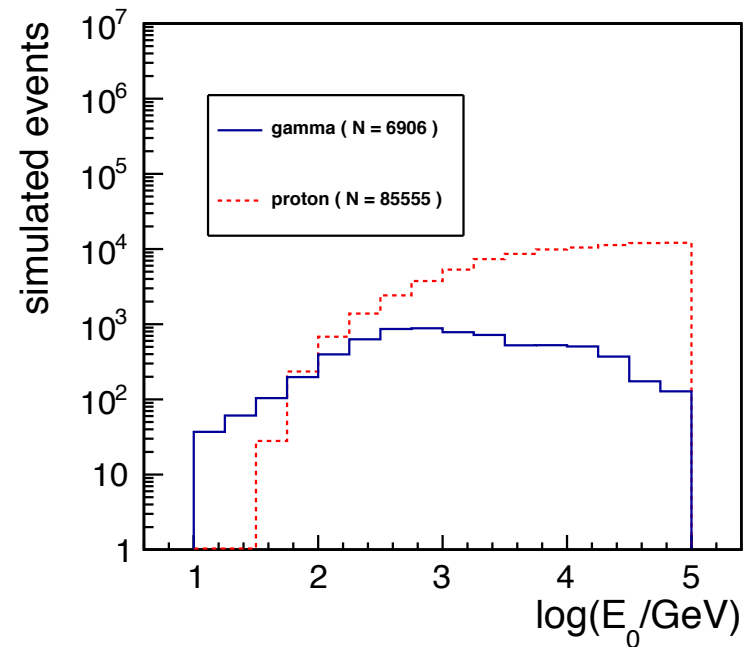
# Backup slides

# Reconstruction efficiency

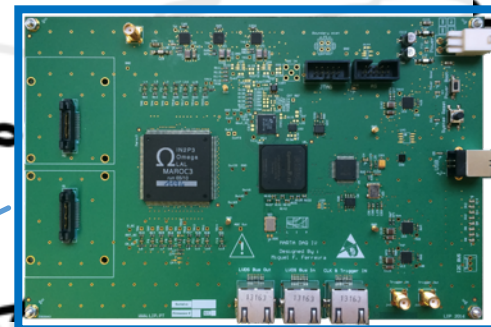
Before quality cuts



After quality cuts



# Ongoing developments and tests on RPCs, electronics and read-out systems



ents

DAQ Engineering prototype

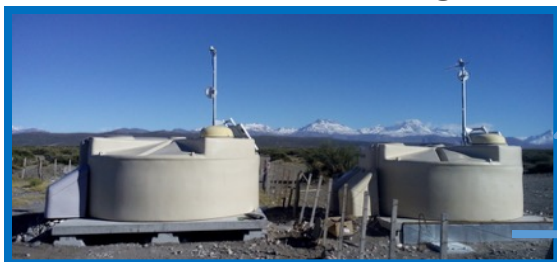
RPC based muon hodoscope for precise studies of the Auger WCD

Construction and Assembling



RPC hodoscope

RPCs in the field @ Auger



R. Conceição