

# SAND Data Analysis status and prospective

[dune-nd-sand-physics@fnal.gov](mailto:dune-nd-sand-physics@fnal.gov)  
[dune-nd-sand-software@fnal.gov](mailto:dune-nd-sand-software@fnal.gov)

# Status

- **Full simulations** w/ official beam: (FLUKA & GENIE + GEANT4)
- Fast Reconstruction
  - Beam Monitoring
  - External Background
- Studies w/ partial info from **MC truth**, in particular:
  - STT digit == smearing of hit (time, position)
  - Particle ID
- Performances:
  - Preliminary Pattern Reco
  - Momentum resolution w/ circular fit
  - neutrino energy resolution
- Physics Analyses: [docdb-13262](#)

# Next tasks

- Define Calibration Data:
  - How do we produce it?
  - Which format?
  - How do we input in the reconstruction?
  
- Digitization:
  - Trigger: which time reference ( $t_0$ )
  - Digit format (input from DAQ?)
  
- Integrate «Fast Reconstruction»

# Next tasks

- Improve Reconstruction:
  - Tracking & Vertexing:
    - STT Kalman Filter
  - EM Shower:
    - ECAL Clustering
  - Particle ID:
    - e- ID in ECAL
    - $\mu/\pi$  separation:  
need for downstream  $\mu$  catcher?
- EventSummaryBuilder → CAF

# Final Goals

- Full event reconstruction
- Event classification
- Background rejection
- Physics analyses

# SAND as muon spectrometer for LAr-ND

- Muon acceptance
- What about upstream muon ranger?

# GRAIN review

- Re-do beam monitoring analysis
- Which information could GRAIN provide?
  - Conservative assumption:  
Selection (w/ reasonable purity) of interaction in Ar
  - Or additionally: calorimetry information
- How well can  $\nu$ -LAr interactions be reconstructed w/ SAND?
  - Re-evaluate:
    - $\nu, \mu, e, \pi, p$  momentum resolution
    - Acceptance
- What SAND w/ GRAIN can do?
  - Disentangle neutrino interaction models?

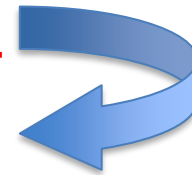
# Requirements

- run on CENTOS7
- complaint with interfaces
- complaint with coding convention
- C++/ROOT (cannot fix a release too early...)
  
- Questions:
  - High-level requirements from ND-Software?
  - Performance?
  - Functionalities, if any?
    - How to deal with competitive algorithms ?
    - How to manage calibrations ?




# Repositories

- Baltig group: **dune**
- Geometry:
  - <https://github.com/DUNE-ND-SAND/dunendggd>
  - <https://github.com/DUNE/dunendggd>
- Digitization/Reconstruction
  - <https://baltig.infn.it/dune/sand-reco>
  - Public read access
  - Exploit continuous integration resources by INFN
  - License?




# Repositories























dune

 **dune**  Group ID: 631 [Leave group](#)  

**Subgroups and projects** [Shared projects](#) [Archived projects](#)

Search by name

Last updated 

>		 sand-optical 		 0	 10	 2
	 sand-reco 	This project aims at developping tools to reconstruct neutrino interaction in the SAND ...	★ 0			5 days ago
	 STTTrackReco 		★ 0			3 weeks ago
	 cluster-analysis 	The project aims to test and validate the SAND ECAL clustering algorithm.	★ 0			2 months ago
	 sand-FLUKA 	Codes for FLUKA simulations analysis	★ 0			1 year ago
	 nuev-generator 	development of code, script and macros in order to generate neutrino event in a format...	★ 0			1 year ago

# Interfaces (Data Model)

## INPUT

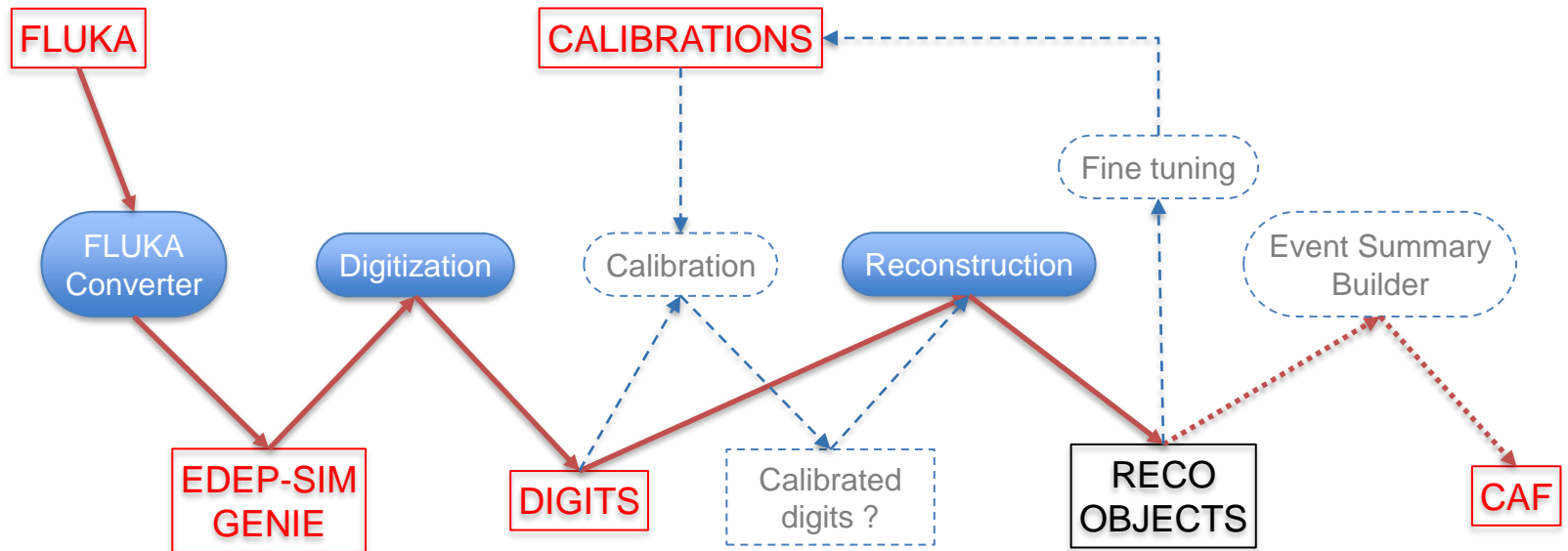
- **[edep-sim]**
  - <https://github.com/DUNE/edep-sim#output-tree-format>
  - [Edep-sim output \(cern.ch\)](#)
- **[genie] (embedded in the edep-sim data format)**
  - [GENIE Physics and User Manual \(rl.ac.uk\)](#)
- **[FLUKA]**
  - [/eos/user/s/salap/DUNE-IT/ntuple.spiega](#)
- **[Digits]**
  - from DAQ
- **[Calibrations]**
  - External interface

## OUTPUT

- **[CAF]**
  - [https://cdcvs.fnal.gov/redmine/projects/dune-neardet-design/wiki/CAF\\_ntuple\\_format](https://cdcvs.fnal.gov/redmine/projects/dune-neardet-design/wiki/CAF_ntuple_format)

*The set of external specifications conditioning this SW project.*

# SW Design (and Data Models)

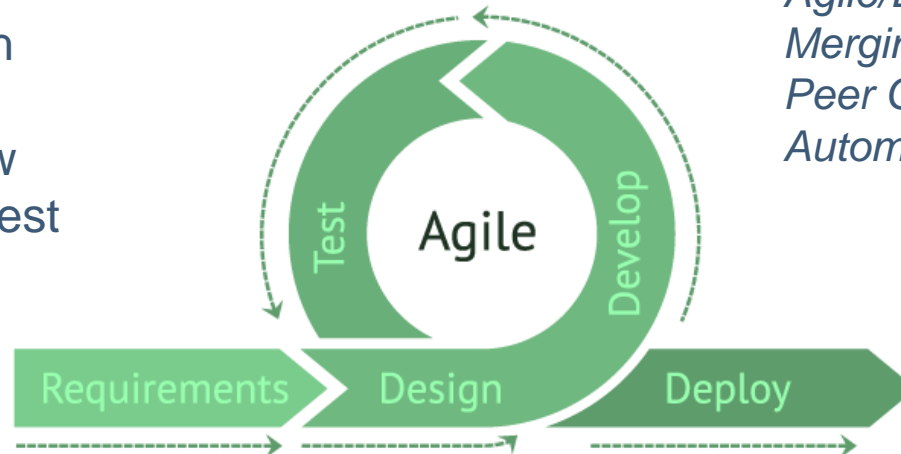


Digits & Reco Data Model: [Data Model · Wiki · dune / kloe-simu · GitLab \(inf.n.it\)](#)

# Coding and Development Workflow

- Language: C++11
- Code Format:
  - Based on [Google C++ Style Guide](#)
  - Proposal: `clang-format -style="{BasedOnStyle: Google, BreakBeforeBraces: Linux, DerivePointerAlignment: false}"`
- Project layout: [pitchfork](#)
- Development Workflow:

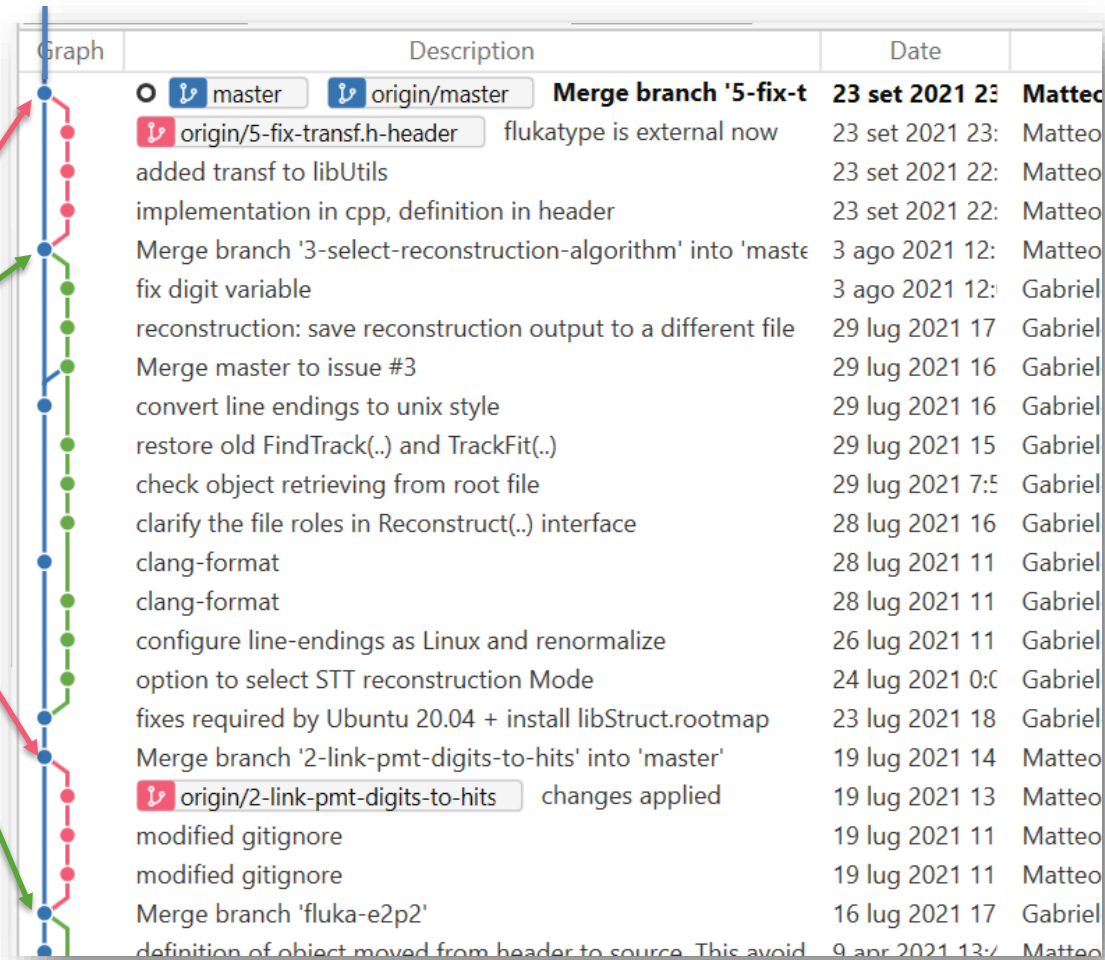
1. Create Issue
2. Open Branch
3. Develop
4. Test / Review
5. Merge Request
6. Release



*Exploits:  
Agile/DevOps,  
Merging by Pull Request  
Peer Code Review,  
Automated Tests,*

# Development workflow

Master branch

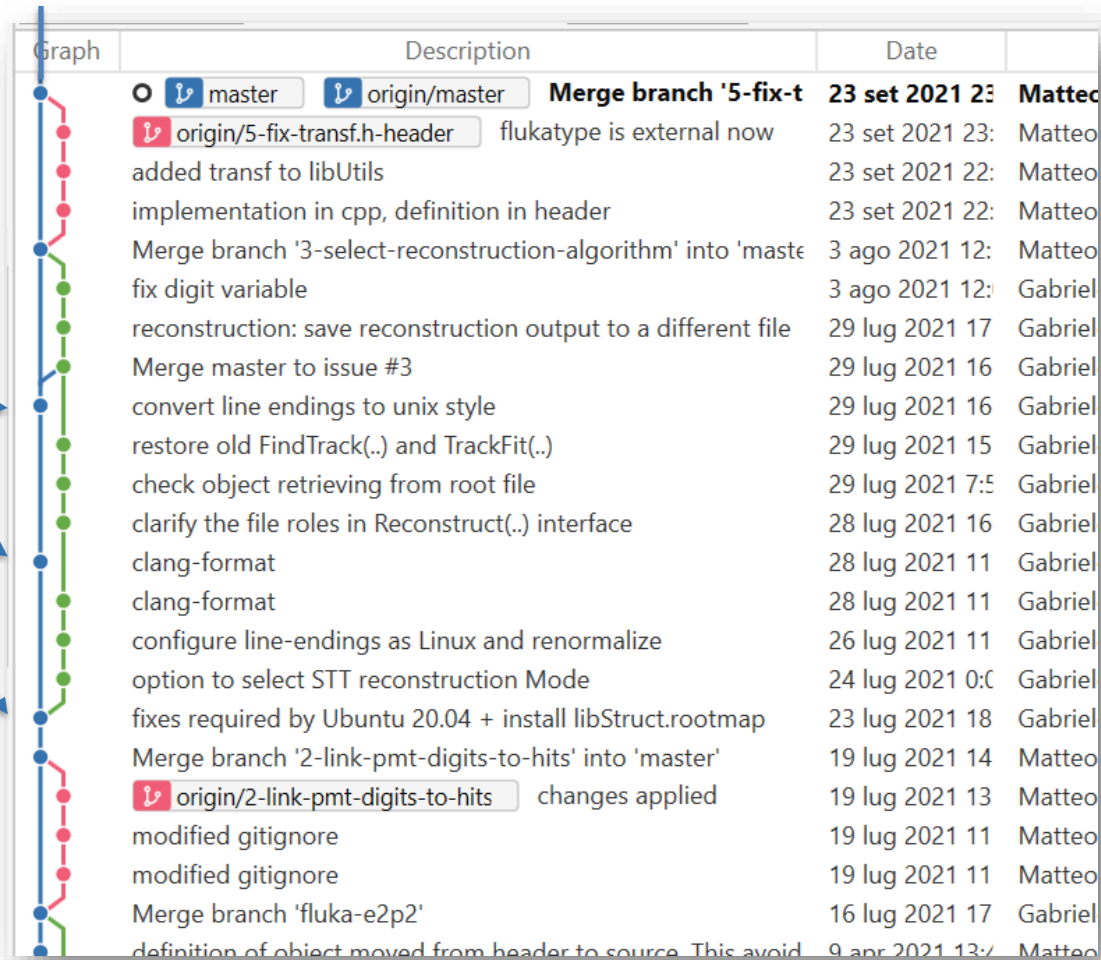














On master commit  
only when merge

# Development workflow

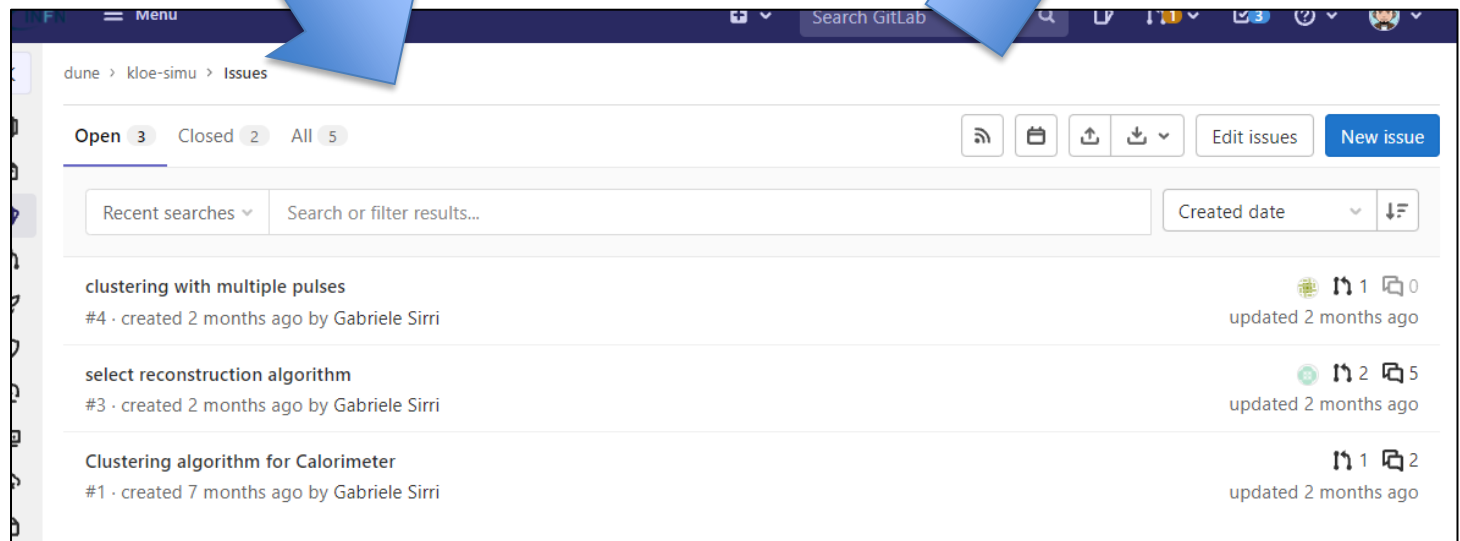
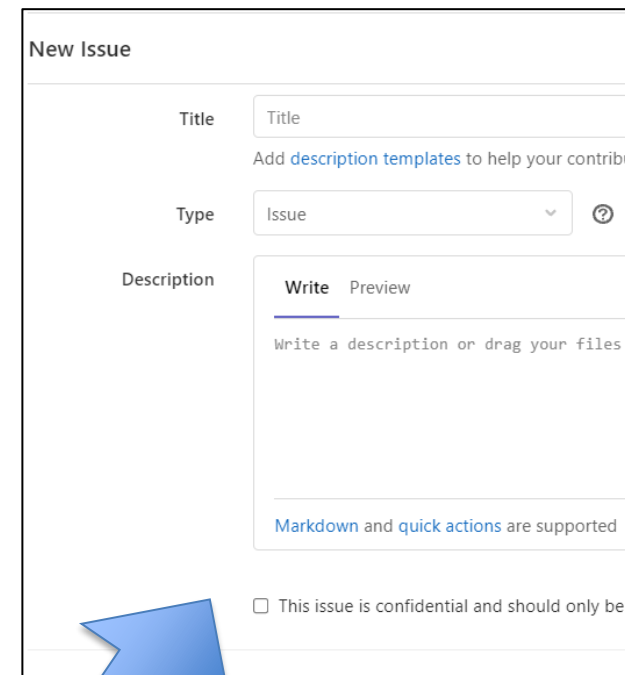
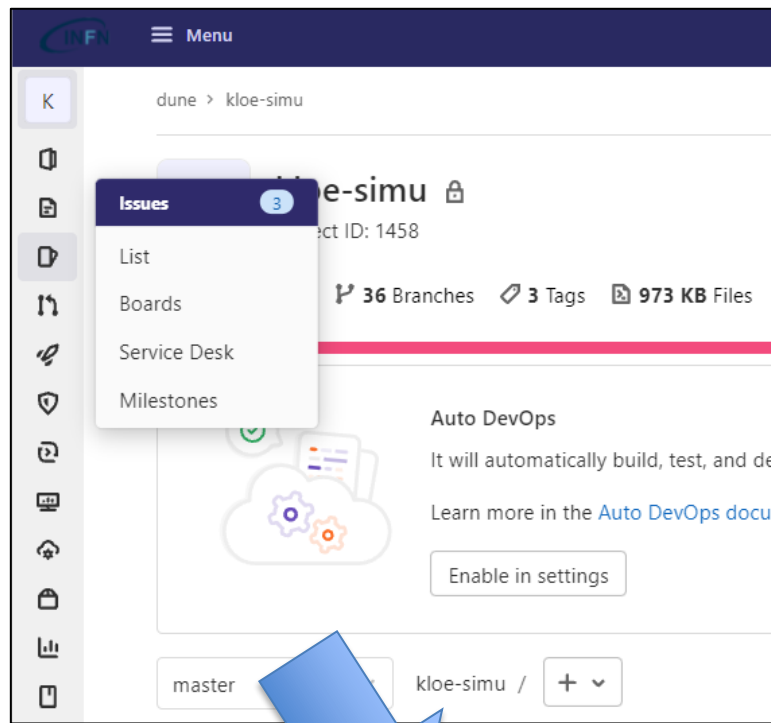
## Master branch

or  
very minor commits  
- code formatting  
- bug fix



Graph	Description	Date	Author
  master	<b>Merge branch '5-fix-t</b>	<b>23 set 2021 23</b>	<b>Matteo</b>
 origin/5-fix-transf.h-header	flukatype is external now	23 set 2021 23:	Matteo
	added transf to libUtils	23 set 2021 22:	Matteo
	implementation in cpp, definition in header	23 set 2021 22:	Matteo
  origin/3-select-reconstruction-algorithm	Merge branch '3-select-reconstruction-algorithm' into 'maste	3 ago 2021 12:	Matteo
	fix digit variable	3 ago 2021 12:	Gabriel
	reconstruction: save reconstruction output to a different file	29 lug 2021 17	Gabriel
  master	Merge master to issue #3	29 lug 2021 16	Gabriel
	convert line endings to unix style	29 lug 2021 16	Gabriel
	restore old FindTrack(..) and TrackFit(..)	29 lug 2021 15	Gabriel
	check object retrieving from root file	29 lug 2021 7:5	Gabriel
	clarify the file roles in Reconstruct(..) interface	28 lug 2021 16	Gabriel
	clang-format	28 lug 2021 11	Gabriel
	clang-format	28 lug 2021 11	Gabriel
	configure line-endings as Linux and renormalize	26 lug 2021 11	Gabriel
	option to select STT reconstruction Mode	24 lug 2021 0:0	Gabriel
	fixes required by Ubuntu 20.04 + install libStruct.rootmap	23 lug 2021 18	Gabriel
  origin/2-link-pmt-digits-to-hits	Merge branch '2-link-pmt-digits-to-hits' into 'master'	19 lug 2021 14	Matteo
 origin/2-link-pmt-digits-to-hits	changes applied	19 lug 2021 13	Matteo
	modified gitignore	19 lug 2021 11	Matteo
	modified gitignore	19 lug 2021 11	Matteo
  origin/fluka-e2p2	Merge branch 'fluka-e2p2'	16 lug 2021 17	Gabriel
	definition of object moved from header to source. This avoid	9 apr 2021 13:4	Matteo

1. Create Issue
2. Open Branch
3. Develop
4. Test / Review
5. Merge Request
6. Release





1. Create Issue
2. Open Branch
3. Develop
4. Test / Review
5. Merge Request
6. Release

Testing and code review  
may be performed at each  
PUSH by other developers or  
continuous integration

```
tentineutrino@neutrino-01:analysis (redesign-STTcluster)$ git checkout -b new_branch
Switched to a new branch 'new_branch'
tentineutrino@neutrino-01:analysis (new_branch)$ echo new_file > new_file
tentineutrino@neutrino-01:analysis (new_branch)*$ git add new_file
tentineutrino@neutrino-01:analysis (new_branch)*$ git commit -m "created new_file"
[new_branch 8950a83] created new_file
 1 file changed, 1 insertion(+)
 create mode 100644 new_file
tentineutrino@neutrino-01:analysis (new_branch)$ git push --set-upstream origin new_branch
Enumerating objects: 4, done.
Counting objects: 100% (4/4), done.
Delta compression using up to 8 threads
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 281 bytes | 281.00 KiB/s, done.
Total 3 (delta 1), reused 0 (delta 0), pack-reused 0
remote:
remote: To create a merge request for new_branch, visit:
remote:   https://baltig.infn.it/tenti/STTTrackReco/-/merge\_requests/new?merge\_request%5Bsource\_branch%5D=new\_branch
remote:
To baltig.infn.it:tenti/STTTrackReco.git
 * [new_branch]      new_branch -> new_branch
Branch 'new_branch' set up to track remote branch 'new_branch' from 'origin'.
tentineutrino@neutrino-01:analysis (new_branch)$
```

1. Create Issue
2. Open Branch
3. Develop
4. Test / Review
5. Merge Request
6. Release

