SHOE
Reconstruction Software: Status & Plans

Matteo Franchini
University of Bologna
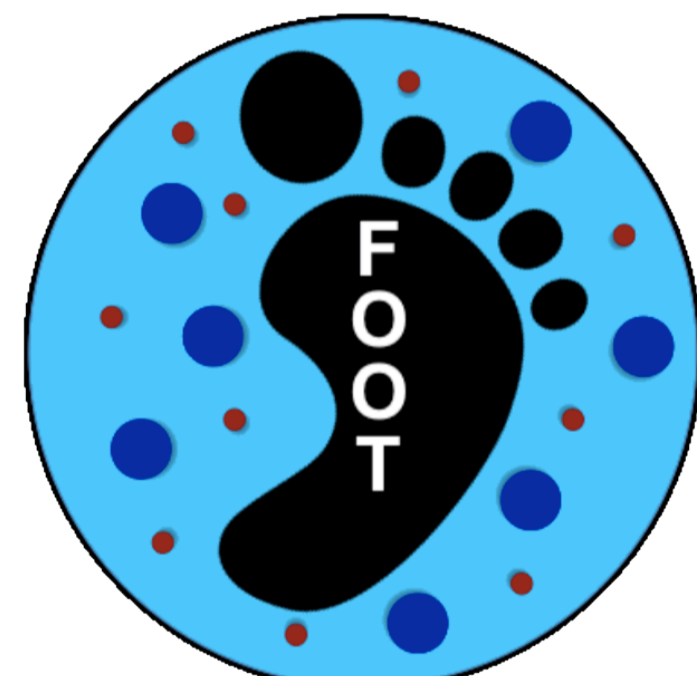
Structure

Level-0

Data Stream → **DatRaw**

Calibration

channel mapping, storing, ...

MC ntuple

Digitiser

(Collection of) Hits

BM, VT, IT, CALO → Clusters → Local Tracks → Vertexing (VT only)

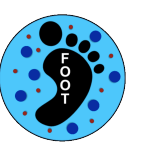MSD → Strip 1D–"cluster" → Crossing points → Local Tracks

TW → Crossing points → ToF

SC

Goal: reconstruct the objets from single detectors

Structure

BM, VT, IT, CALO

| Clusters | Local Tracks | Vertexing |

VT only

MSD

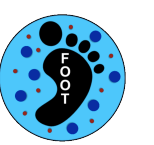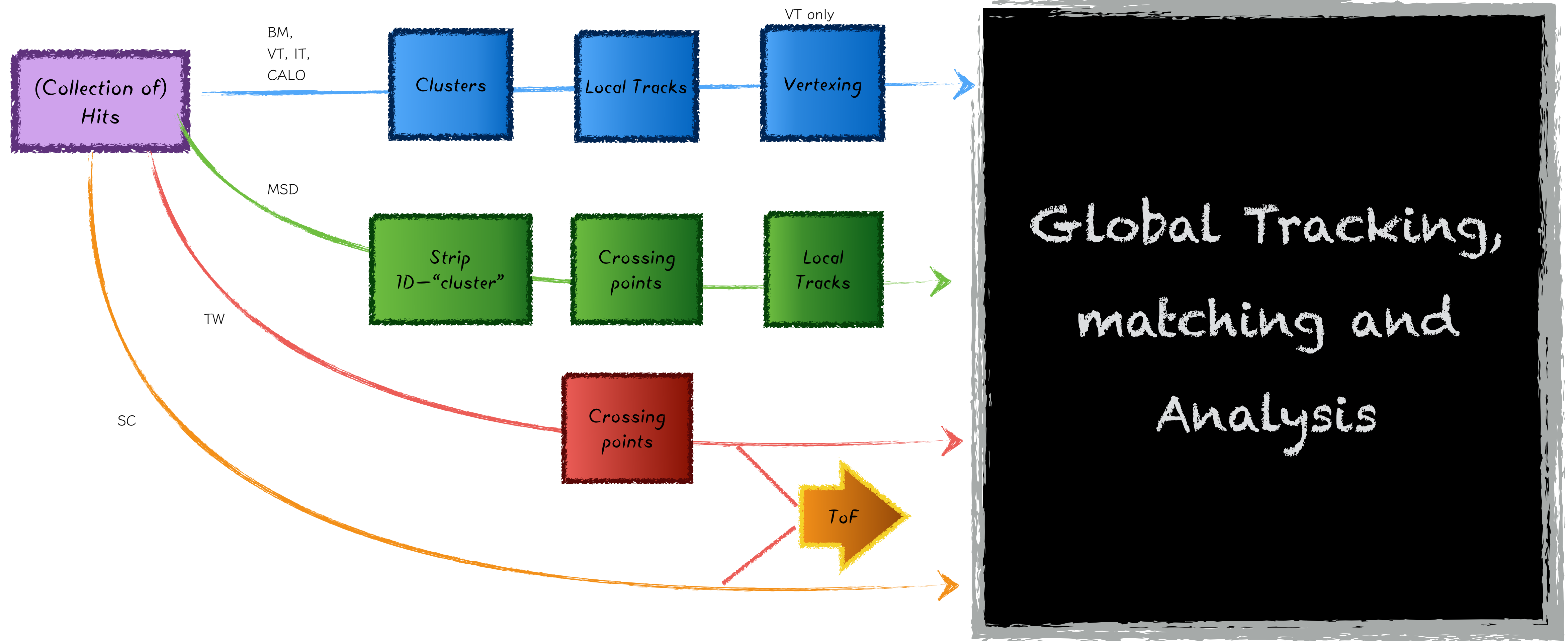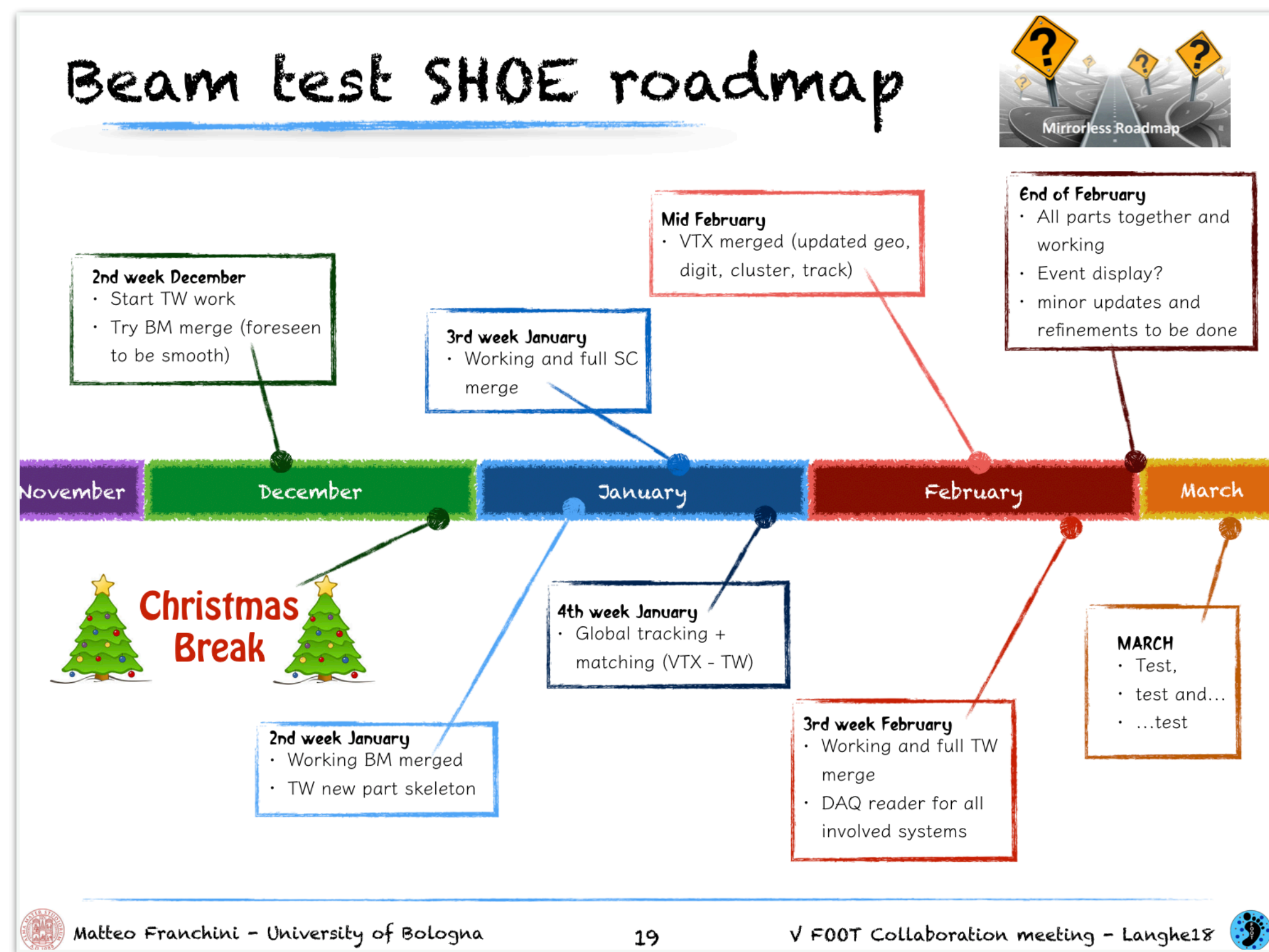| Strip 1D–"cluster" | Crossing points | Local Tracks |

TW

Crossing points

SC

ToF

Global Tracking, matching and Analysis

Coding status

Where we were

Beam test SHOE roadmap

2nd week December
· Start TW work
· Try BM merge (foreseen to be smooth)

3rd week January
· Working and full SC merge

Mid February
· VTX merged (updated geo, digit, cluster, track)

End of February
· All parts together and working
· Event display?
· minor updates and refinements to be done

November | December | January | February | March

Christmas Break

4th week January
· Global tracking + matching (VTX - TW)

3rd week February
· Working and full TW merge
· DAQ reader for all involved systems

MARCH
· Test,
· test and…
· …test

2nd week January
· Working BM merged
· TW new part skeleton

Matteo Franchini – University of Bologna   19   V FOOT Collaboration meeting – Langhe18

Where we are

✱ Goal reached!

✱ Working software for half of the FOOT (sub)detectors and also <u>general structure</u> is almost in place

- Margarita, BM, VTX, Scintillator, DAQ reader, EventDisplay

✱ But much other work yet to be done!

- Other detectors, fullRec, testing, tuning, "fileing", …

Beam Test Feedback

* 😀😀😀 Data processing during test beam successful !!!

* 😀😀😀Very powerful event display!!!
  * Need to be complemented with as efficient histo—monitoring and debugging

* More people started to develop on SHOE (some left...💔💔)
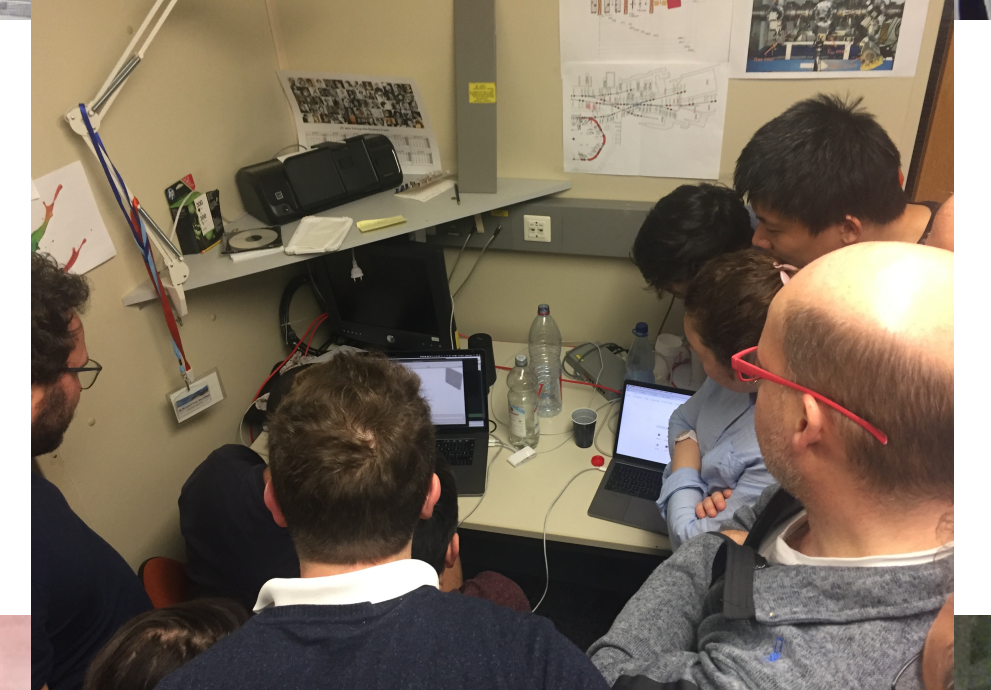
Test beam 2019 data analysis

* VTX and TW always in

* Trigger always Margarita Majority

* <u>Which are VTX high and low threshold? On which sensors?</u>

* Reference run to be used. 2240?

Run	Target	Trigger	Events	VTX threshold	
2210	NO	Margarita Majority	20k	Low	
2211	NO	Margarita Majority	63k	Low	
2212	NO	Margarita Majority	118k	Low	
2239	YES	Margarita Majority	21k	**High**	HV scan BM = 1800V
2240	YES	Margarita Majority	21k	**High**	HV scan BM = 1850V
2241	YES	Margarita Majority	21k	**High**	HV scan BM = 1900V
2242	NO	Margarita Majority	203k (68k for TW)	**High**	TW cross movement
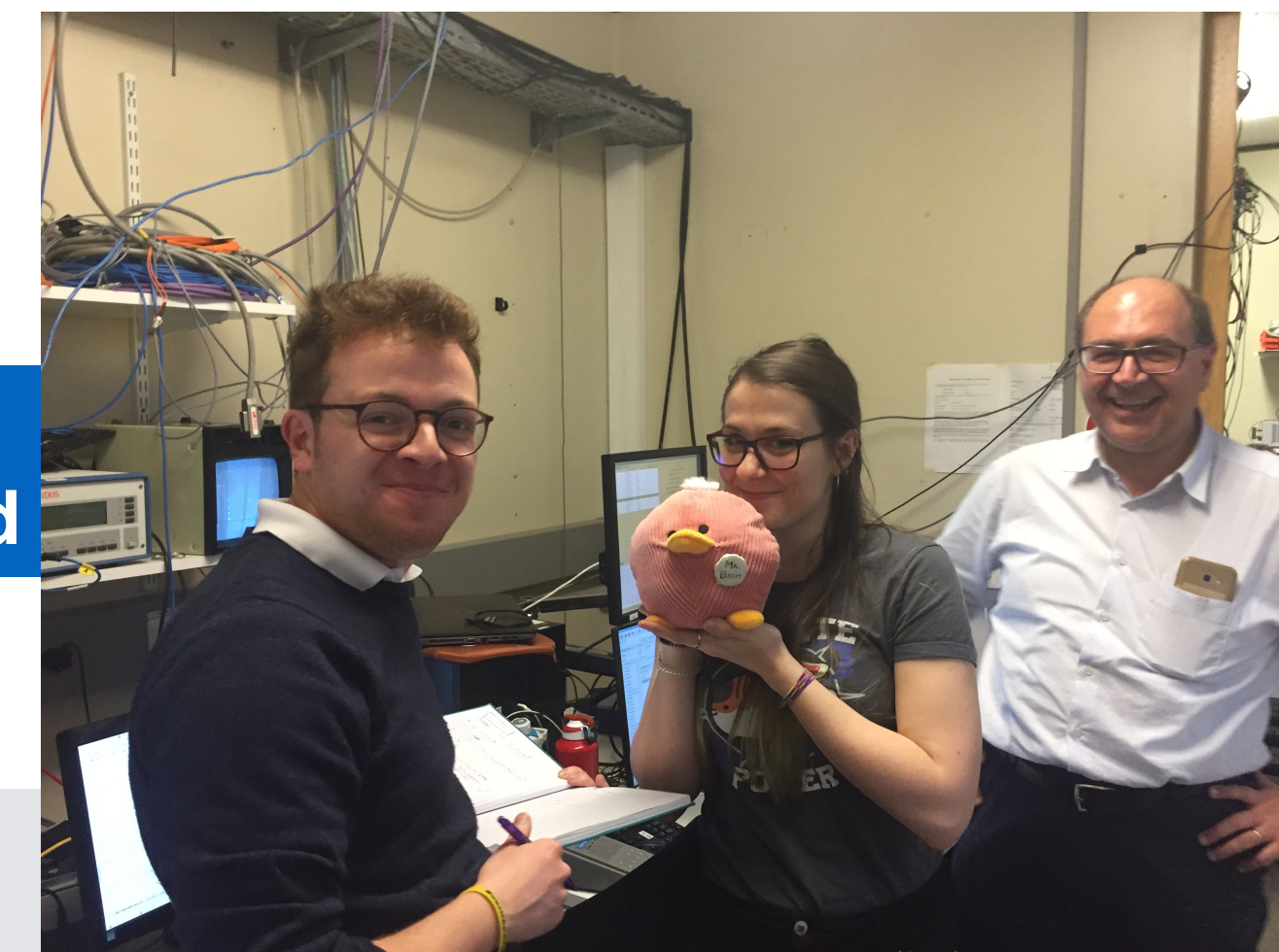
Efficiency tip: please compare results with same file and same software

Beam Test Feedback
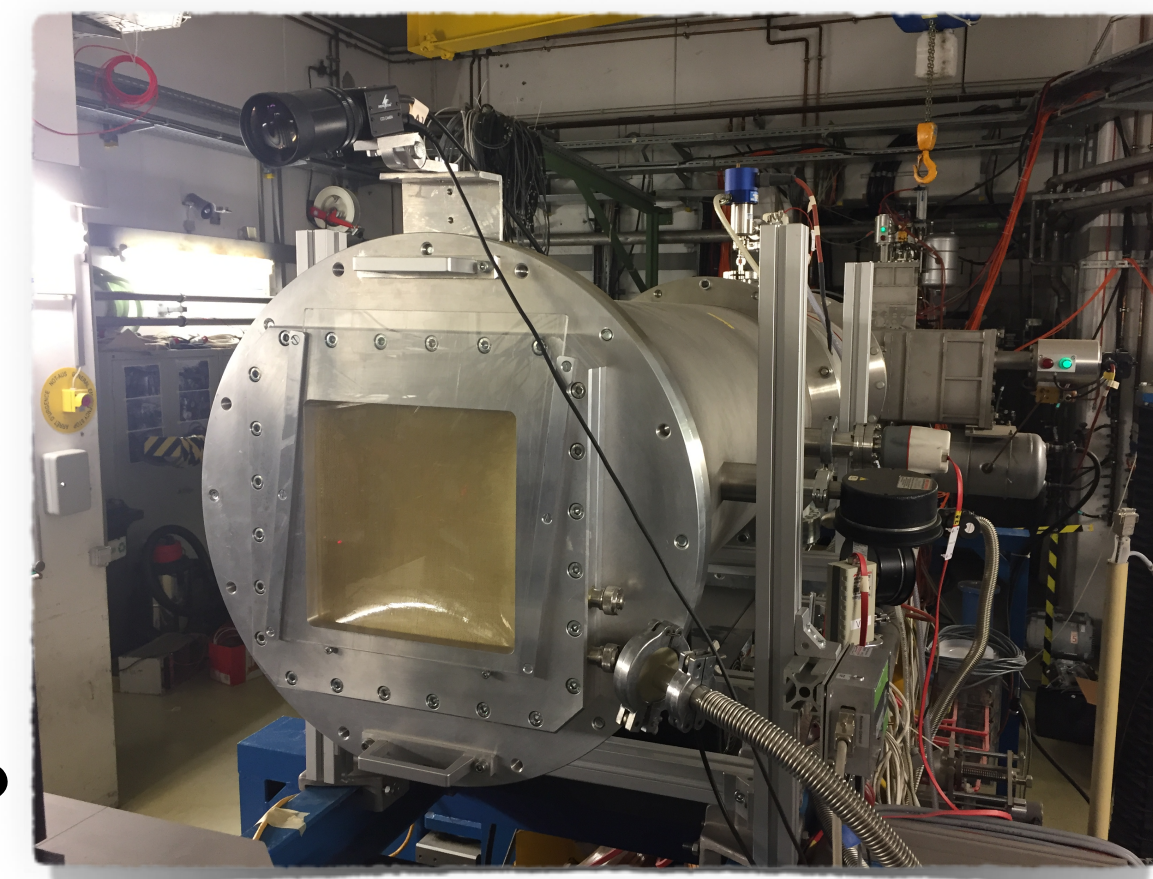
* 🥶 Execution time ~ 2s per events
  * Mainly due to ST and TW waveform —> should be reduced in future

* 😑 Standardise some conventions (cm, ns, GeV, ...)

* 😑 More clear documentation (tWiky, updated presentation, WebSite, ... ?)

* 😑 More cross talk among each detector package, helps in setup debugging

* 😑 More user—friendly configuration and interface (created some confusion)
Suggestions from the users??

More user-friendly

Goal: increase the base of users (and developers maybe? 🙏🙏)

Problem

* Now a forest of "private" scripts to execute SHOE + 1 fullData exe + 1 fullMC exe

* Many numbers and options still hardcoded or from command line

Solution

* Move to a single "main" and control the setup from one "single" configuration file
  - easy reproducible results by anyone,
  - easy to share configuration tuning exchanging only config file
 - avoid long and teasing misunderstanding on result comparison

Versioning

* Big step forward with versioning (thank Chris)

* All config files has a tag in the name (i.e. "_GSI_") and are placed inside a dir named as the tag

* Code only reads config files in that dir. Add "—exp tagName" from command line

* Same applies to MC production versions

DecodeRaw -in /gpfs_data/local/foot/DataGSI_match/data_built.2211.physics_foot.daq.VTX.1.dat -out run_2211_match_20k.root -his -ntu -trk (-nev 20000) **-exp GSI**

Post Reconstruction = FullRec

* Meaning = collect and match together all information from single detectors reconstruction

* Global Reconstruction <u>works and tested</u> on the "beam test SHOE version" on MC
  * planning to fit the VTX points
  * Not straight forward passing from linear to elliptical fit in Genfit
  * Man power borrowed by <u>Event Building</u>

* Matching Event: different detector objects (tracks with scintillators, clusters, BM, …)
  * Very important to understand the FOOT apparatus, debugging and evaluate performances.

* Data Analysis from private code by Roberto. You saw al lot of work done there!!!!
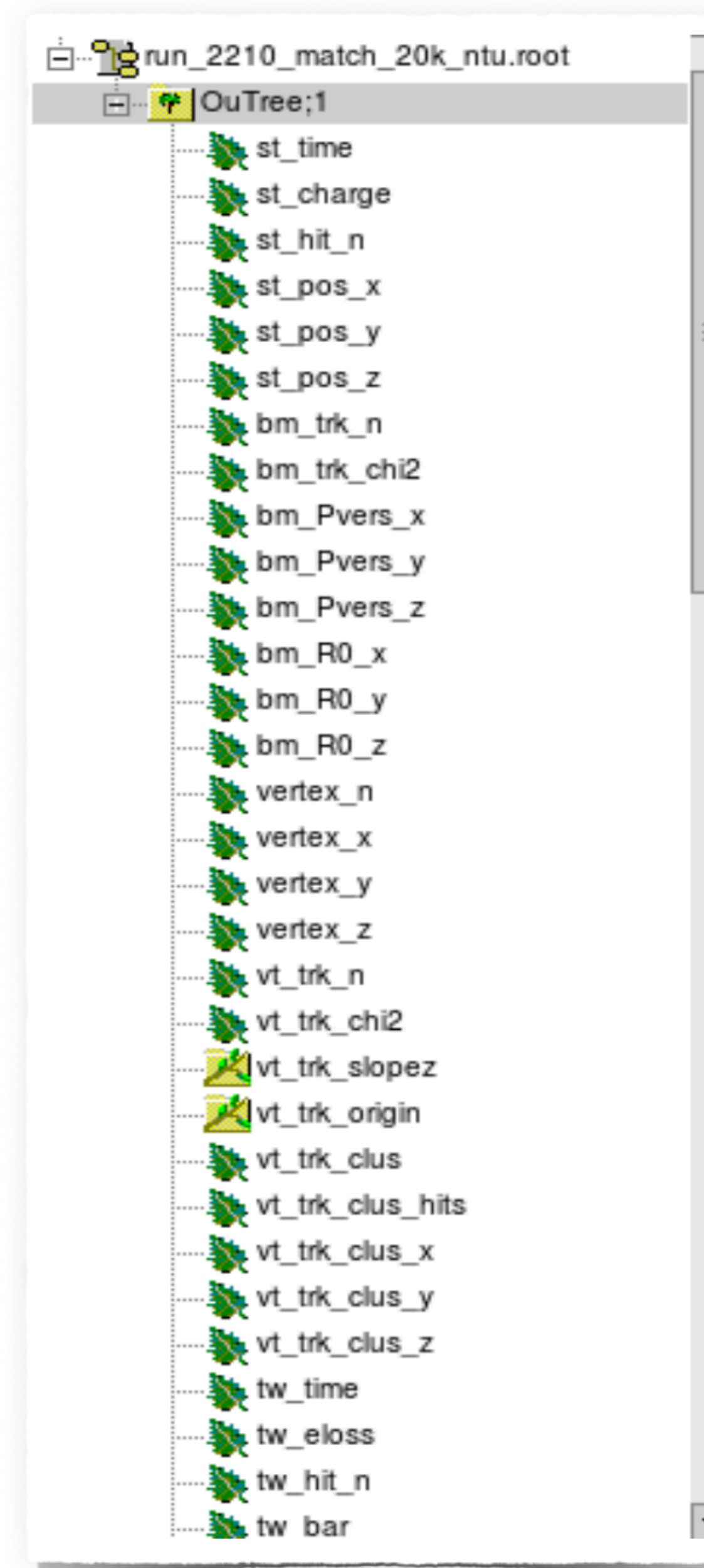 * In the future it will be included in SHOE
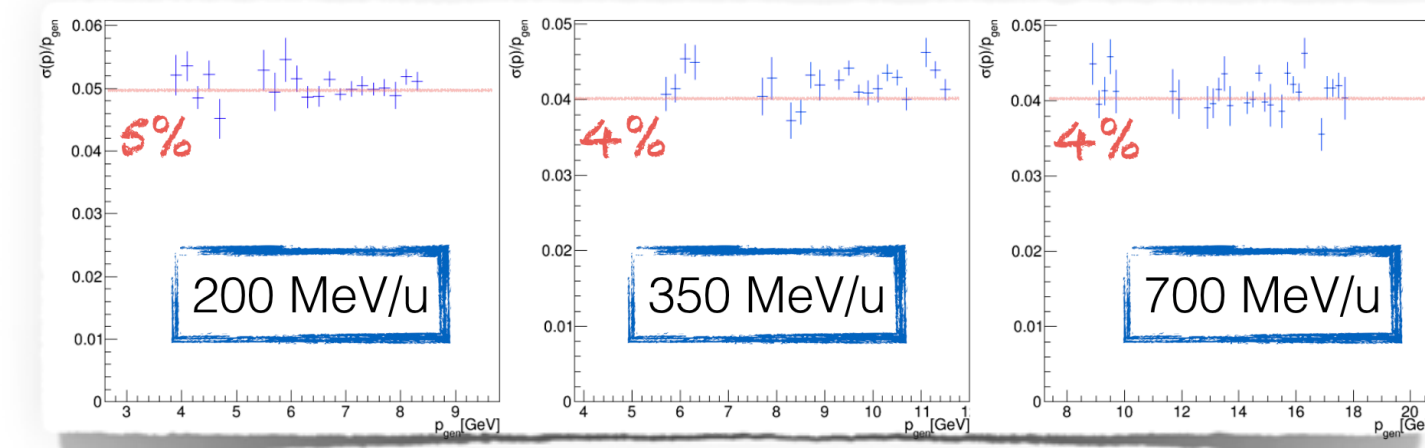
Software for Beam Test data

* *Inserted flat tree production by Alberto. Contains basic informations from the SHOE classes (tracks, clusters, scintillator hits, ...).*

* *Allows combination of single detectors info*

* *Very useful at this stage.*

Not the strategy for the future!!!!!

* *Data analysis performed into SHOE once the structure ready.*

* *More control under results, less error prone!*

run_2210_match_20k_ntu.root
  OuTree;1
    st_time
    st_charge
    st_hit_n
    st_pos_x
    st_pos_y
    st_pos_z
    bm_trk_n
    bm_trk_chi2
    bm_Pvers_x
    bm_Pvers_y
    bm_Pvers_z
    bm_R0_x
    bm_R0_y
    bm_R0_z
    vertex_n
    vertex_x
    vertex_y
    vertex_z
    vt_trk_n
    vt_trk_chi2
    vt_trk_slopez
    vt_trk_origin
    vt_trk_clus
    vt_trk_clus_hits
    vt_trk_clus_x
    vt_trk_clus_y
    vt_trk_clus_z
    tw_time
    tw_eloss
    tw_hit_n
    tw_bar

Beam Monitor

* Quite complete and working part.

Comments

- The beammonitor.cfg file is commented, but long and not user friendly.

- The Event display is working (very thanks to Christian!), but the visualization of only the BM tracks is not so easy/fast

- BM independent debug level defined in beammonitor.cfg with a number from 0 to 15, from the old code merge. It is not harmonized with the general code debug status (sorry Christian)

from Yun

Merge independent branch

- bm_calibration does not work with the FOOT general DAQ data. Maybe after the Legendre polynomy development it will not be used anymore.

from Yun

Scintillator & Margarita - TOF

* Needs manpower and optimisation.

* Meeting scheduled on 12th June with Niccolo for information sharing

* Include latest configuration

* Share precise status information and plans.

Geometry and MC

* Now ROOT geometry (used in reconstruction) and FLUKA geometry are not in coming from the same transformation algorithm anymore

* Just a warning. We only need to put extra attention on geometry implementation.
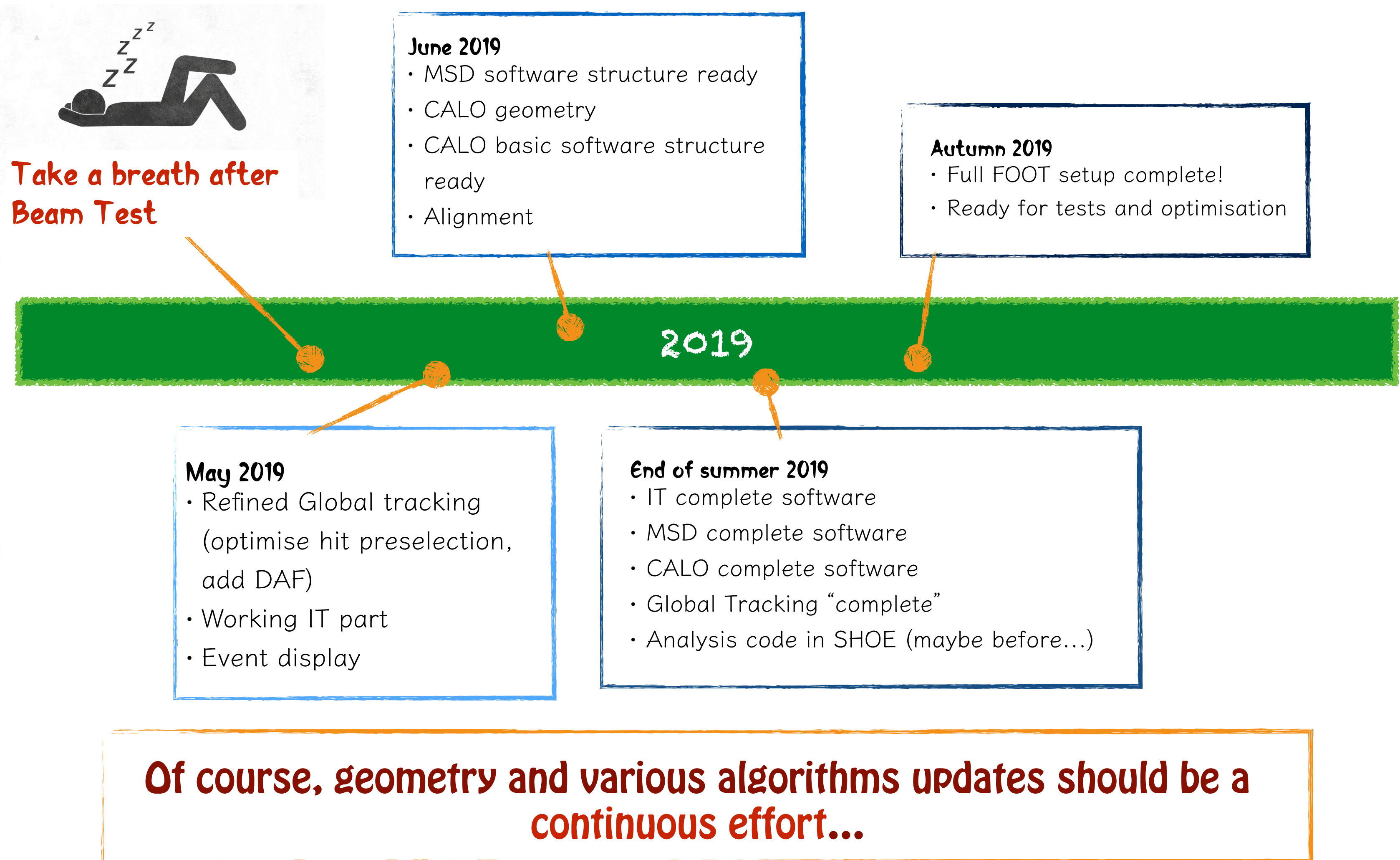
Future is twofold

Test beam data

* Structure in place

* Needs to tune detector configuration and test results more than coding

* Unfortunately involved people are also code developers ...

* Decide a feasible goal and a deadline

Towards FOOT full setup

* Need to add the missing parts (IT, MSD, CALO)

* Improve the fullRec and global tracking and matching

* Work to improve robustness and clearness

* More user friendly and common interface

Pre beam test SHOE roadmap

Take a breath after Beam Test

June 2019
- MSD software structure ready
- CALO geometry
- CALO basic software structure ready
- Alignment

Autumn 2019
- Full FOOT setup complete!
- Ready for tests and optimisation

2019

May 2019
- Refined Global tracking (optimise hit preselection, add DAF)
- Working IT part
- Event display

End of summer 2019
- IT complete software
- MSD complete software
- CALO complete software
- Global Tracking "complete"
- Analysis code in SHOE (maybe before…)

Of course, geometry and various algorithms updates should be a continuous effort...

* Our future plan from Langhe_2018

* Too optimistic

* To be revised...

Post beam test SHOE roadmap

Take a breath after Beam Test

Wake up!

September 2019
- MSD software structure ready
- CALO geometry
- CALO basic software structure ready
- Refined Global tracking (optimise hit preselection, add DAF)

Software meeting

Data Building and understanding

2019

April

December

July (end?) Software meeting

End of 2019
- IT, MSD, CALO complete software
- FullRec ready
- Global Tracking tested
- Analysis code in SHOE
- Full FOOT setup complete!

Of course, geometry and code updates should be a continuous effort and communication

Towards FOOT full setup

* Need to add the missing detector:
  - IT (responsible Chris)
  - MSD (responsible Riccardo)
  - CALO (responsible Lorenzo)
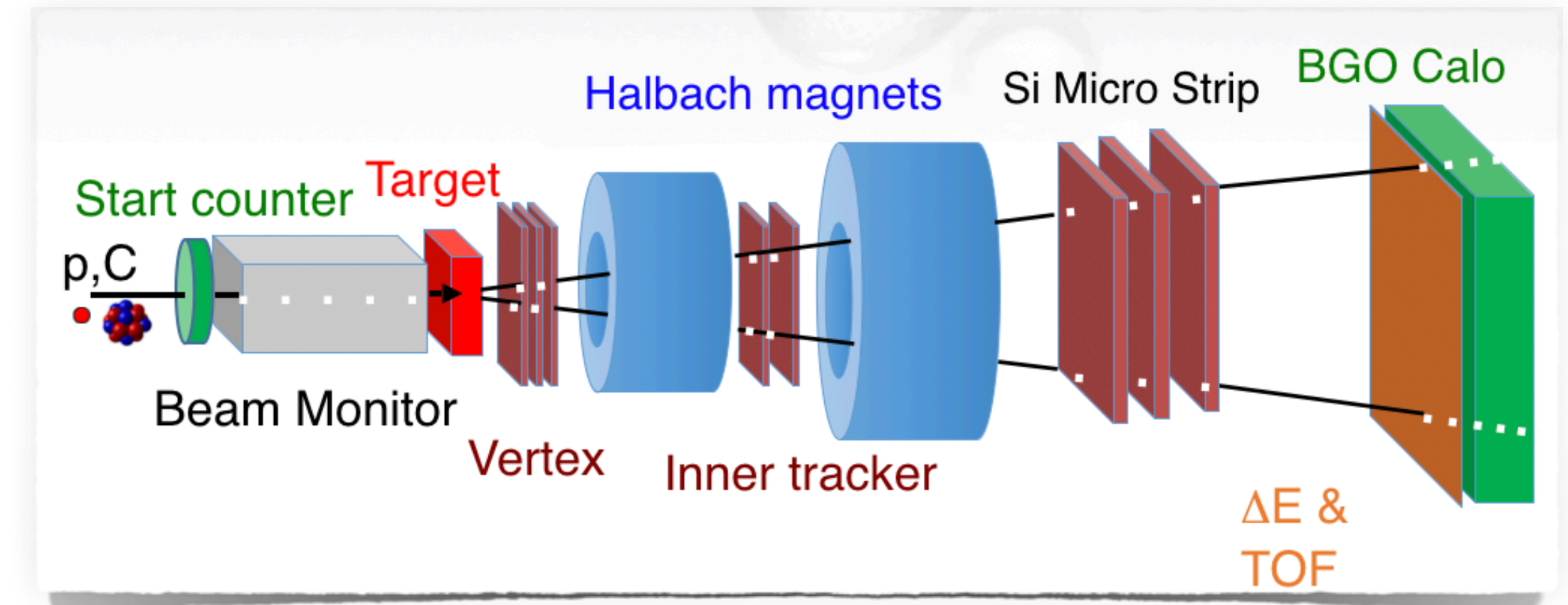
* Structure similar to other detectors. Main work on Geometry (MC) and Mapping (data)

* Help needed:
  - Scintillator currently without en expert supervise. Alessio and Giacomo volunteered for now...
  - Geometry part is very important. Strengthen the bulk!
  - Help in CALO, MSD, fullRec and testing is also needed

Organisation

*ST: Alessio

*BM: Yun

*VT: Chris

*IT: Chris

*MSD: Riccardo

*TW: Alessio and Giacomo. Any volunteers welcome !!!!!!!

*CALO: Lorenzo

*MC: Serena

*GLOB: Matteo and Alberto

Conclusion (1)

* We'll proceed using the beam test code version.

* Anyone can push his changes in the same branch for now.

* Need to split in a "freezed" version for beam test and a "fullSetup" version? When?

* If you prefer to work on private branches, make a frequent merging.

* Exchange information in the mailing list and during software meetings
  * What you are doing
  * What's on the changing you committed on GIT (if needed)
  * What are you planning to do next

Conclusion (2)

* Test reference run 2240? Use same file version and code version and configuration (always specify if not)

  ◦ Helps on comparison

* Decide a reasonable goal and deadline for BT data (decide shortly)

* Software meeting before August. Desiderata:

  ◦ Status of the "beam test" (alignment, calibration, missing part, status, …)

  ◦ Status of the "full setup" (plans with time, with done, needs, ideas …)

  ◦ Description of processes of common interest for better understanding: alignment, global tracking, calibration strategy, …

* Planning tutorial after summer. But it will be appreciable that participants will then effectively run the code.

Conclusion (3) – Towards FOOT full setup

* Big summer effort!

  - Implementation of missing detectors in level—0;

  - Work on FullRec combining info from different detectors;

  - Harmonise and more user friendly;

  - Improve communication and documentation;

  - After that a fast tutorial can be organised.

* Any suggestions from the users are more than welcome (almost mandatory 😁)

* Any help in any part is more than welcome!!! 😇

  - Especially on Scintillator and Geometry. But not esitate to come working on your favourite item!

Conclusion (4)

Apologie in advance, when I'll ping you…

… but you know what's behind…