BEAM MONITOR PERFORMANCES:

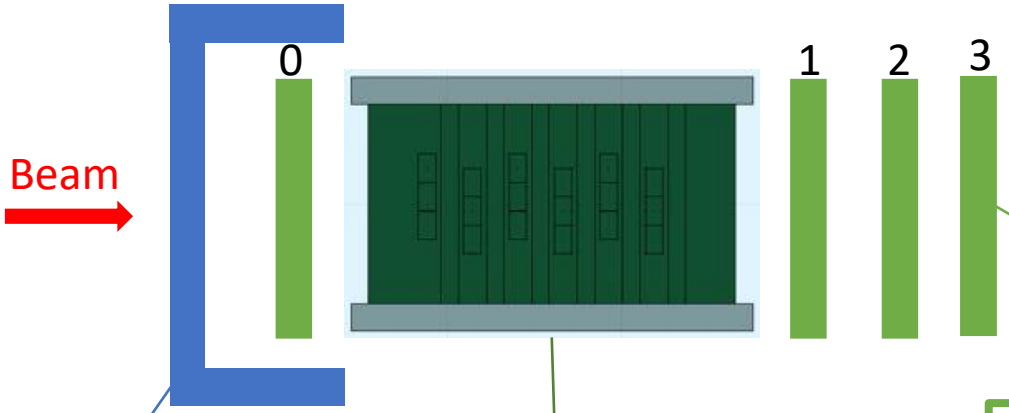
RECENT TEST BEAM OF BEAM MONITOR

Meeting of the FOOT performances group
27/03/2019

Test beam @ Protontherapy center – Trento (4, 5, 6 March 2019)

- Start Counter: Margherita -> first beam test after some time: how to perform the trigger?
- Beam Monitor & MSD (Perugia people) -> Calibration of the BM space-time relations
- Stand alone acquisition to check if everything is still fine

Experimental Setup

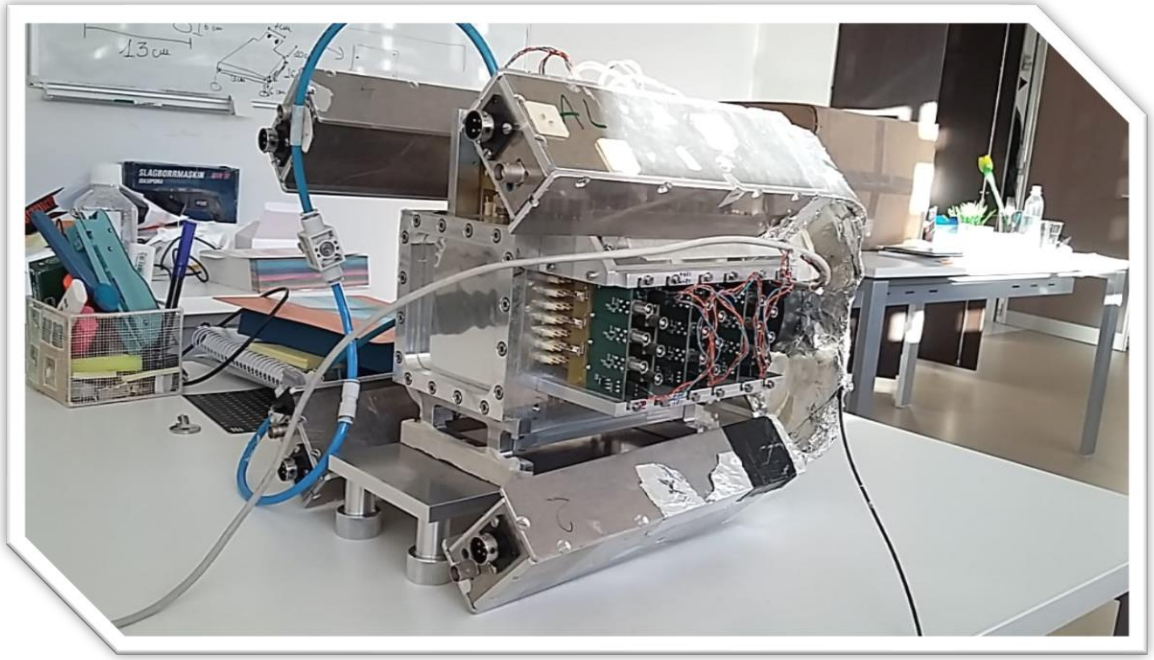


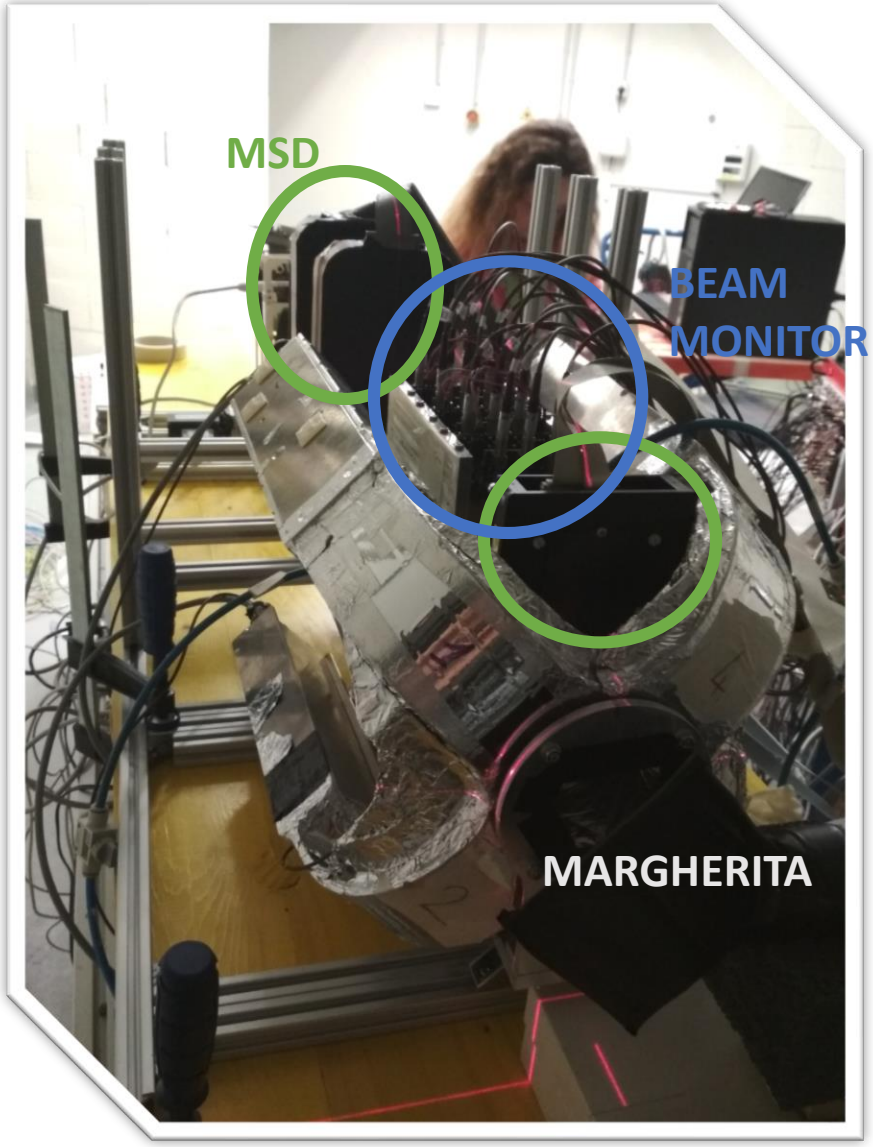
MARGHERITA
- Plastic scintillator -> 250 µm thick disc, 52 mm diameter
- Light collected by plastic optical fibers radially grouped and connected to four photomultipliers
- Isocenter at the SC center
- Trigger signal : at least 2 signals from the SC

MSD
- MSD 0 & 3: 7 cm x 4 cm
- MSD 1 & 2: 7 cm x 8 cm

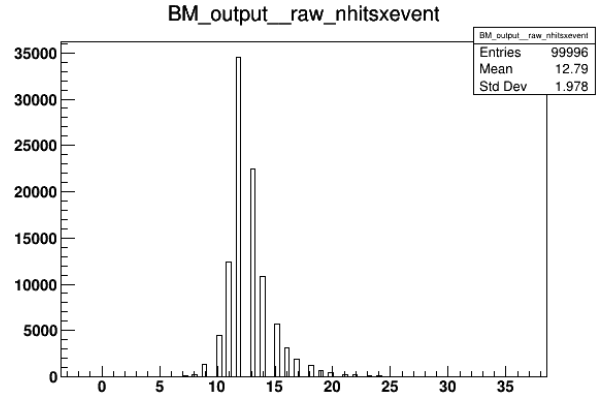
BEAM MONITOR
- Mixture Ar/CO2 -> 80/20 %
- Flux system inside the irradiation room
- Pressure inside the chamber: ≈ 0.9 Bar

Experimental Setup



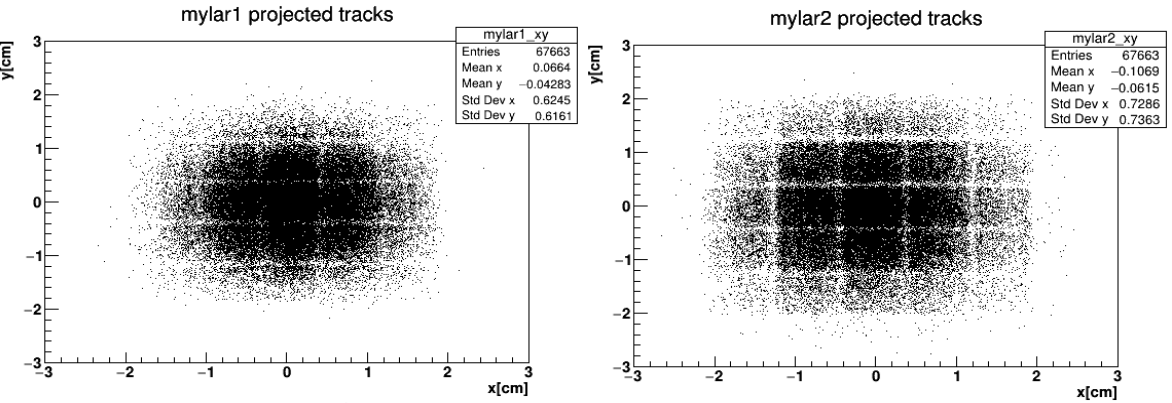


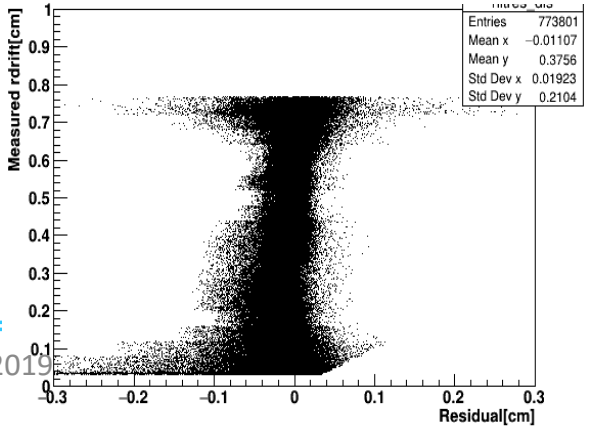
Stand alone acquisition: E = 80 MeV & HV = 2200 V

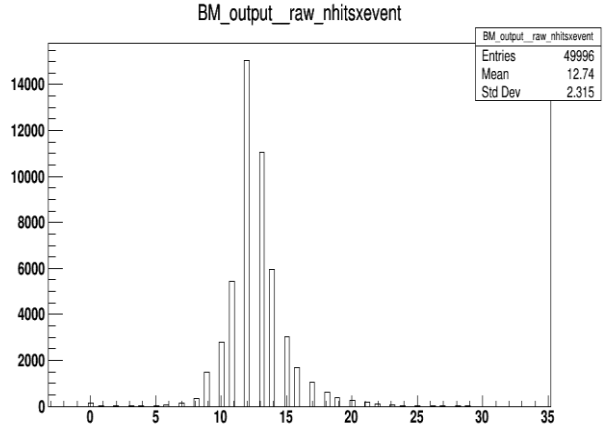


DECEMBER

- 100K events
- Efficiency ≈ 0.9
- Number of hits per event ≈ 12.79

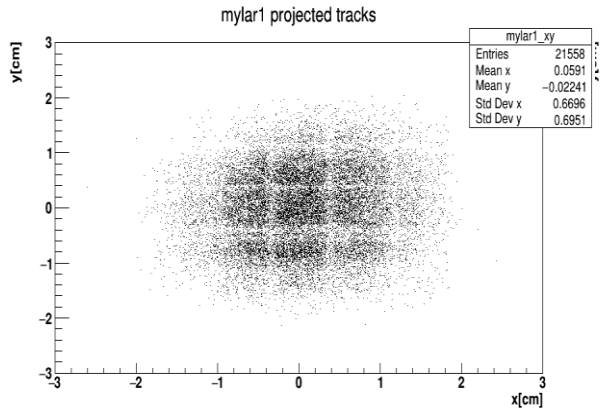


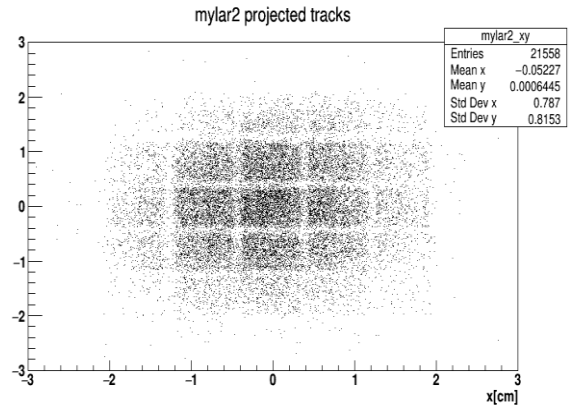


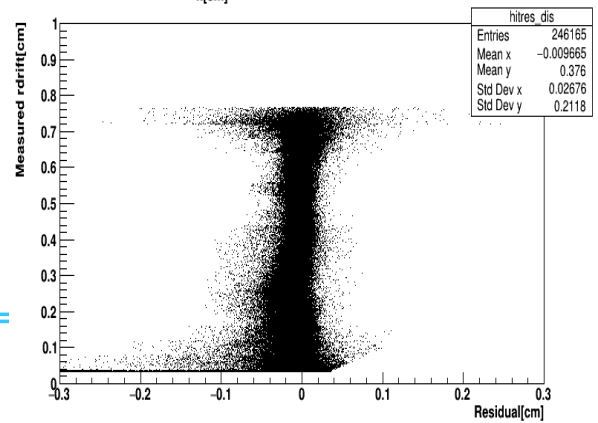


MARCH

- 50K events
- Efficiency ≈ 0.9
- Number of hits per event ≈ 12.74







Acquisition all together

1) - Beam energy = 80 MeV
   - BM @ 0°, 5°
   - HV = 2200 V
   - events = 100K

2) - Beam energy = 228 MeV
   - BM @ 0°, 5°, 10°
   - HV = 2200 V
   - events = 100K

What we expect:

- MSD0: horizontal coordinate (30 µm resolution)
- MSD1 e 2: horizontal coordinate (30 µm resolution), vertical coordinate (60 µm resolution)
- MSD3: horizontal coordinate & vertical coordinate (30 µm resolution)

→ First results in a month

GSI program

WITH EMULSIONS:

For each of the 2 energy values (30 min to change the beam energy) :

- Estimation of the Margherita and Beam Monitor discrimination threshold ~ 20 minuti
- Beam Monitor HV scan -> 1800 V to 2000 V (50 V steps), 100k events each step (~2 min/step with a rate of 1 kHz) ~ 20 minuti

→ 2 hours of acquisition & data analysis to find the **beam monitor working point**

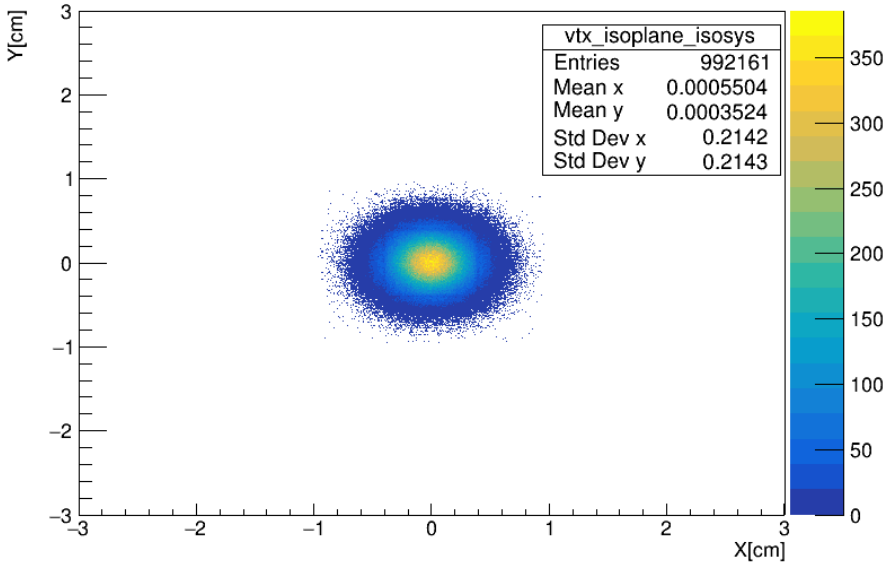
WITH ELECTRONIC SETUP:

- Calibration of Beam Monitor & Vertex: 250k events for each energies and angles

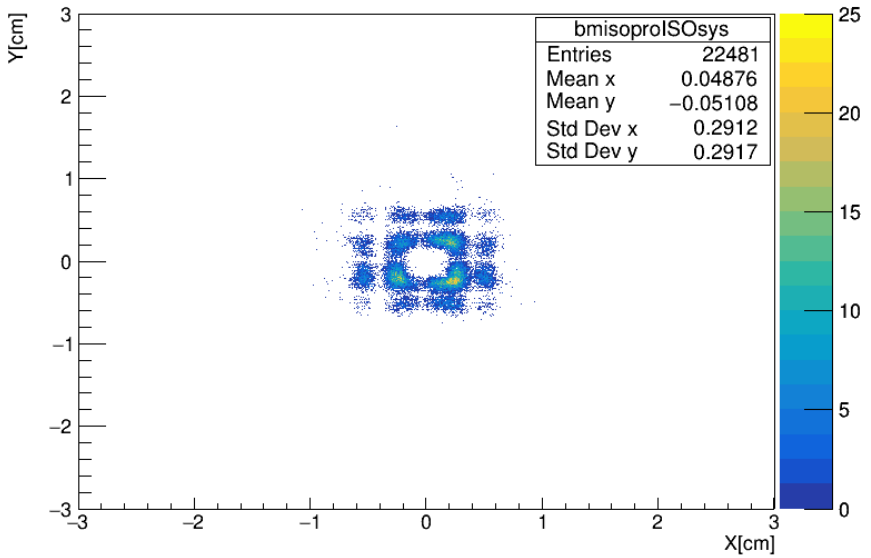
MC study

- We perform a MC study to check the possibility to combine the BM tracks with the vertex tracks to calibrate the BM space-time relations:

- MC output: Drift distance; “Real” time (inverting the FIRST st-rel)
- Use Garfield st-rel to calulate the “fake” drift distance used as input for the hits
- Create BM tracks with Genfit algorithm



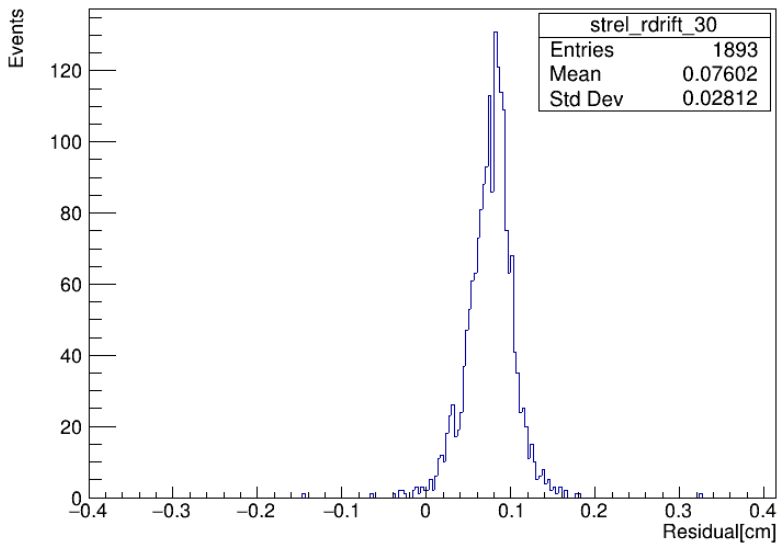
Real beam profile

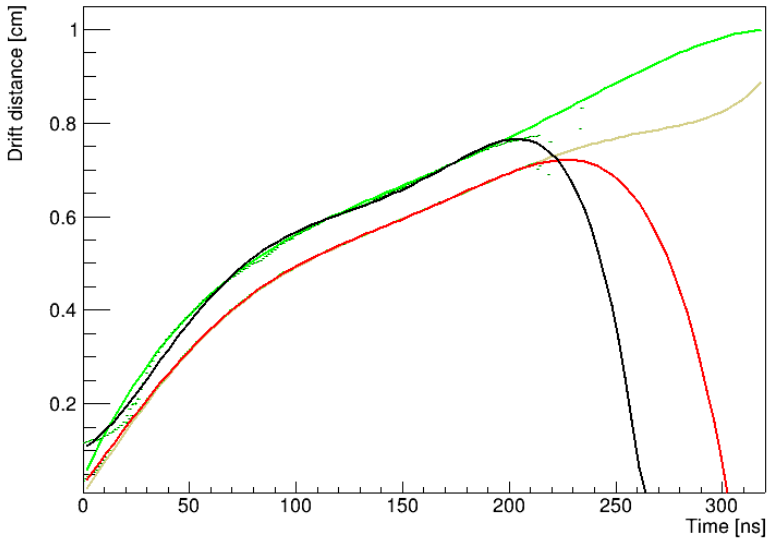


Beam Monitor beam profile using Garfield “fake” drift distance

MC study

- Calculate the residuals: difference between BM “fake” drift distance and the vertex extrapolated drift distance for each hit
- Evaluate the new st rel using the residuals





Example of residulas for hits with 0.3<rdrift<0.31

Green: Real rdrift (FIRST)

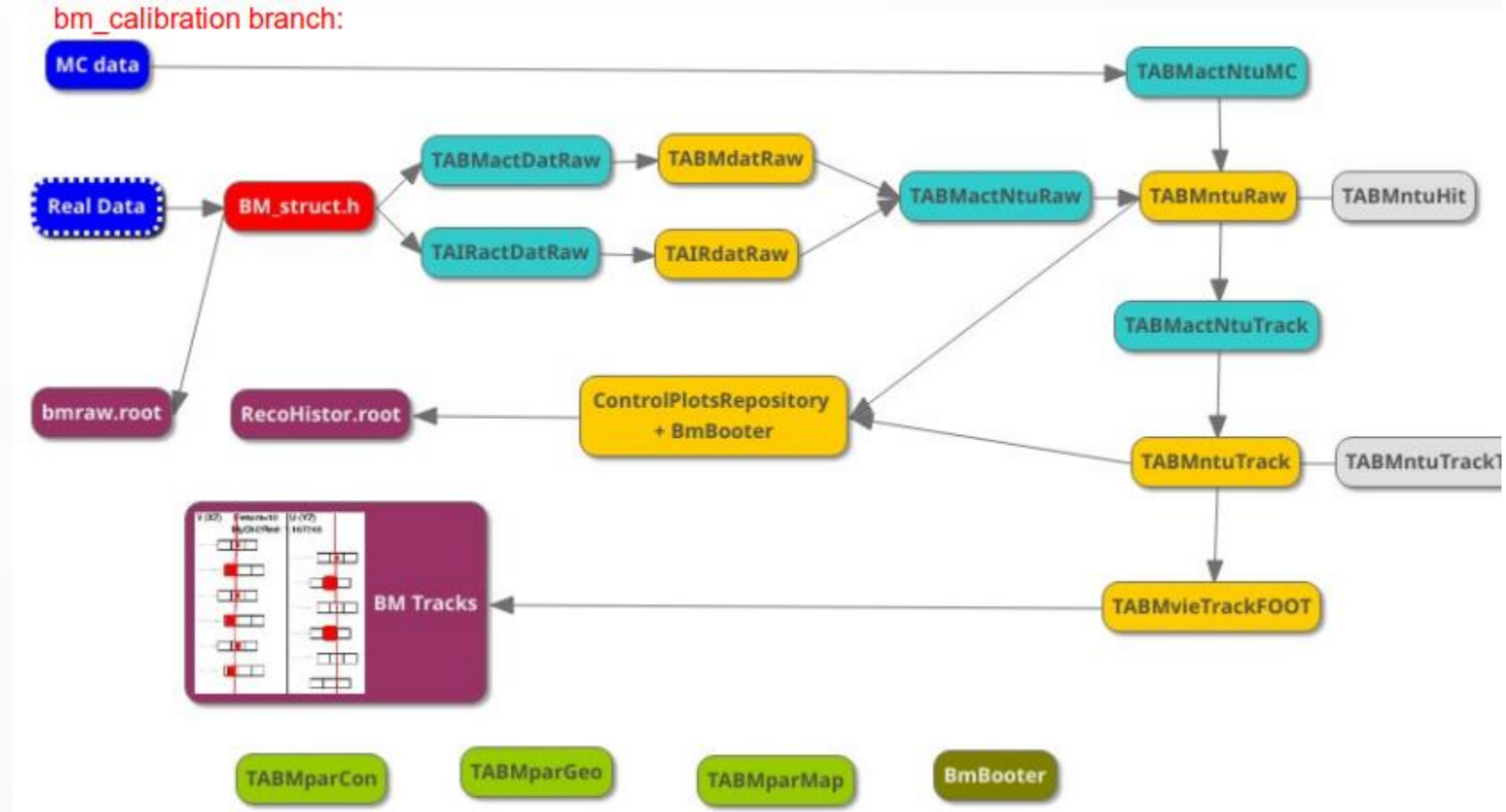
Brown: Garfield rdrift

Red: rdrift used as input for the BM tracking

Black: new fitted rdrift

- The macro that evaluate the new st rel is working on MC data (tested also with small detector tilt and misallignment)
- It needs only the tracks from an external detector (and of the BM of course)
- Not tested on real data (not yet)
- Ready for the MSD data of March and for a calibration with the vertex detector @ GSI

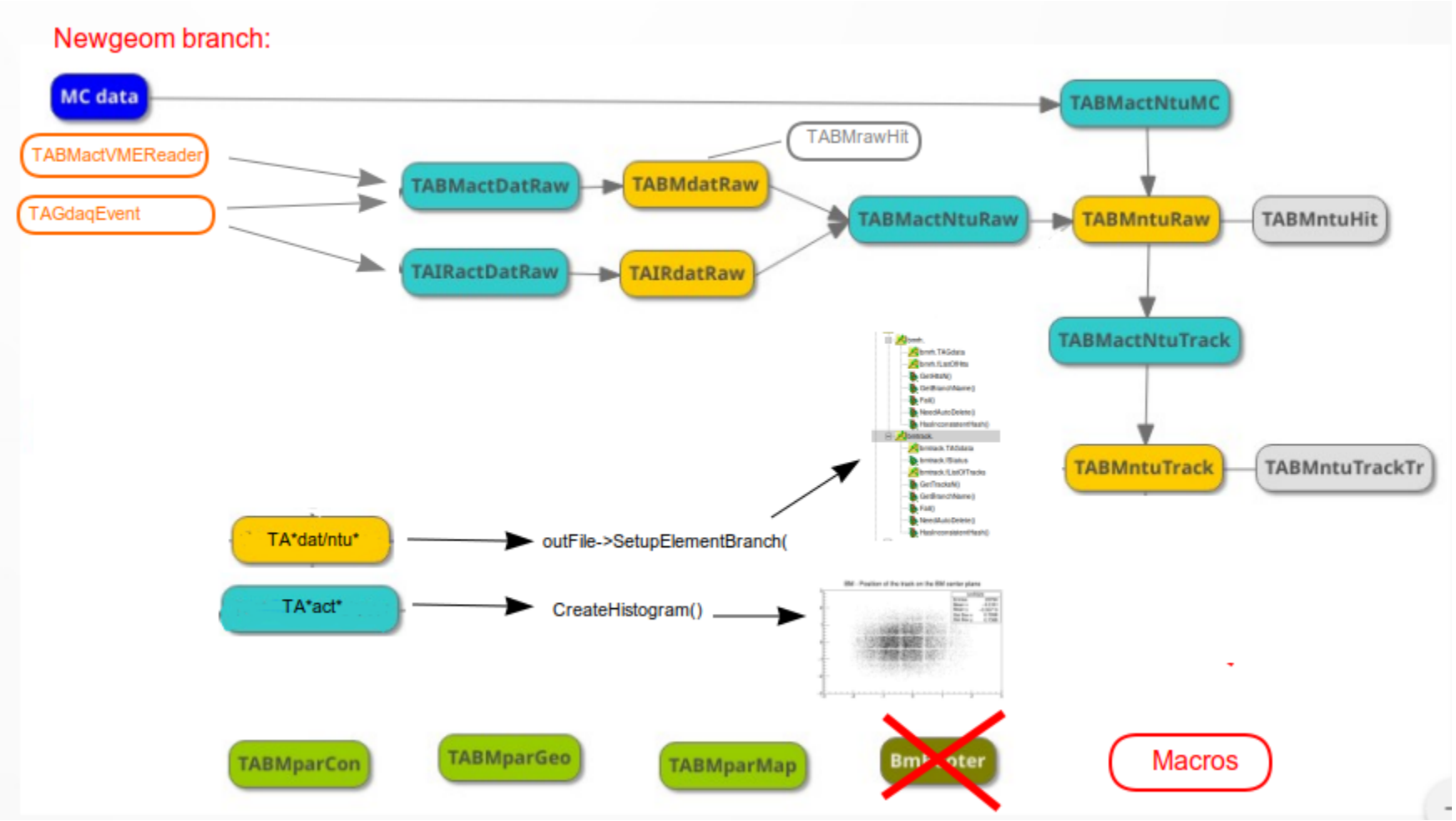
BM Software: bm_calibration



bm_calibration branch:

- Used for the BM stand alone tests
- Managed by BmBooter
- Will be used for the GSI emulsion data taking
- Merged in the master branch (thanks to Matteo)
- After the GSI april shift will be used only to develop/test a new tracking algorithm based on Legendre polynomials

BM Software: newgeom



BM in newgeom branch:

- BmBooter dependence eliminated
- Possibility to use macros!
- Will be used for the GSI electronic setup
- Tested on MC and BM stand alone data (read by TABMactVMEReader)
- Almost ready:
  -CreateHistogram()
  -Macro to calculate the T0 time


THANK
YOU