Option for constraints in alignment procedure

Option for “align.opt”

align constraints [path_to_the_JSON_file]

Available in the CORAL svn repository since rev #14396

Corresponding twiki page

https://twiki.cern.ch/twiki/bin/viewauth/Compass/DataReconstruction/Constraints

Format of the JSON file


```
[
  {
    "param": "angle",
    "rms": 0.0,
    "coeffs": {
      "GM01X1__": 1.0,
      "GM01Y1__": -1.0
    }
  },
  {
    "param": "angle",
    "rms": 0.0,
    "coeffs": {
      "GM01U1__": 1.0,
      "GM01V1__": -1.0
    }
  },

  {
    "param": "angle",
    "rms": 0.0,
    "coeffs": {
      "GM02X1__": 1.0,
      "GM02Y1__": -1.0
    }
  },
  {
    "param": "angle",
    "rms": 0.0,
    "coeffs": {
      "GM02U1__": 1.0,
      "GM02V1__": -1.0
    }
  }
]
```


It describes the following constraints between GM planes:

$$\text{Angle\_GM01X} = \text{Angle\_GM01Y}$$
$$\text{Angle\_GM02U} = \text{Angle\_GM02V}$$

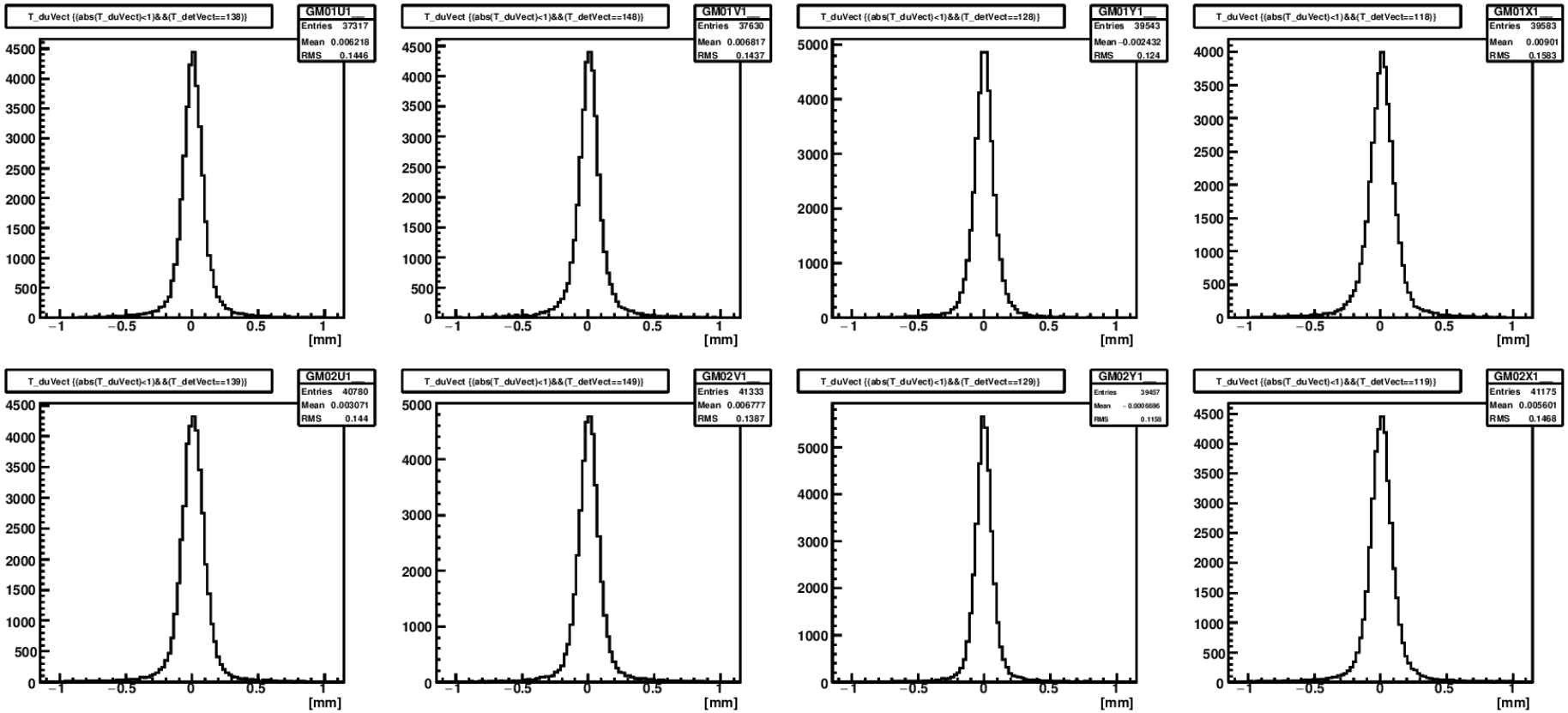
NB: these constraints are how it looks in alignment, but in detectors.dat they are equivalent to:

$$\text{Angle\_GM01X} - \text{Angle\_GM01Y} = 90.0$$
$$\text{Angle\_GM02U} - \text{Angle\_GM02V} = 90.0$$

↑ /afs/cern.ch/work/a/achumako/public/alignment/opt/constraints/GEM_angles.json

Comparison with constraints and without them

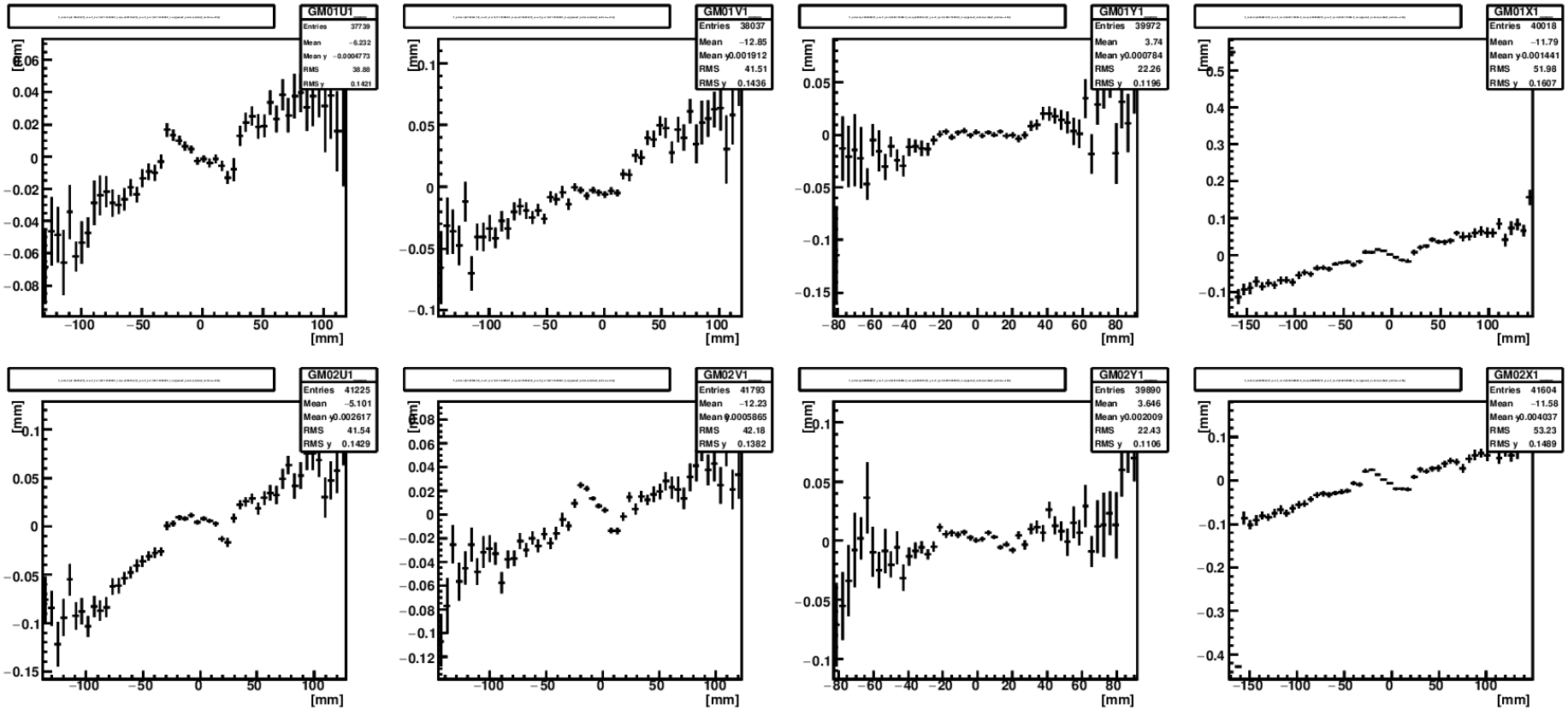
alignment run 278903 (magnets off, mu+)



Comparison with constraints and without them

alignment run 278903 (magnets off, mu+)

0 iteration (i.e. reco without alignment)

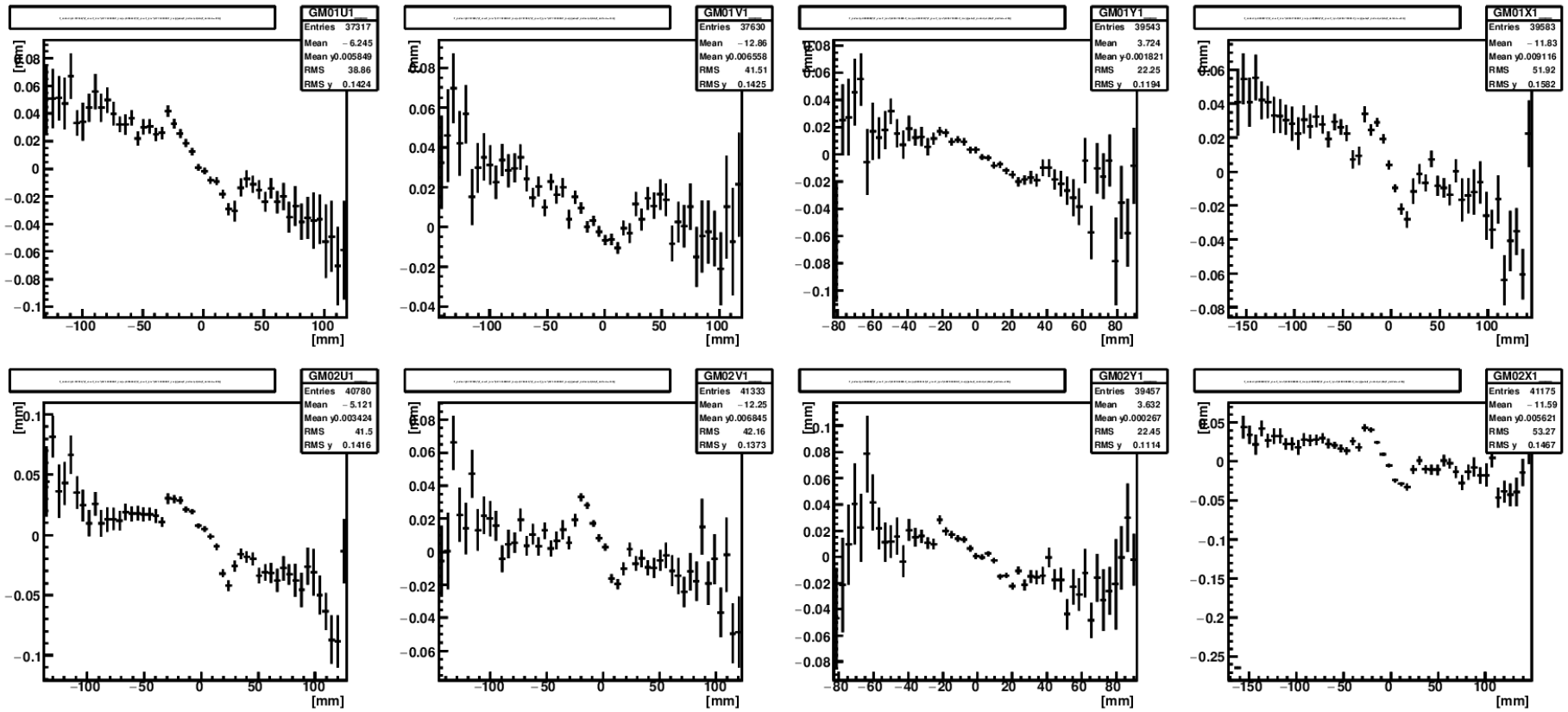


ΔU vs V plots

Comparison with constraints and without them

alignment run 278903 (magnets off, mu+)

4 iterations **without** constraints, U was fixed

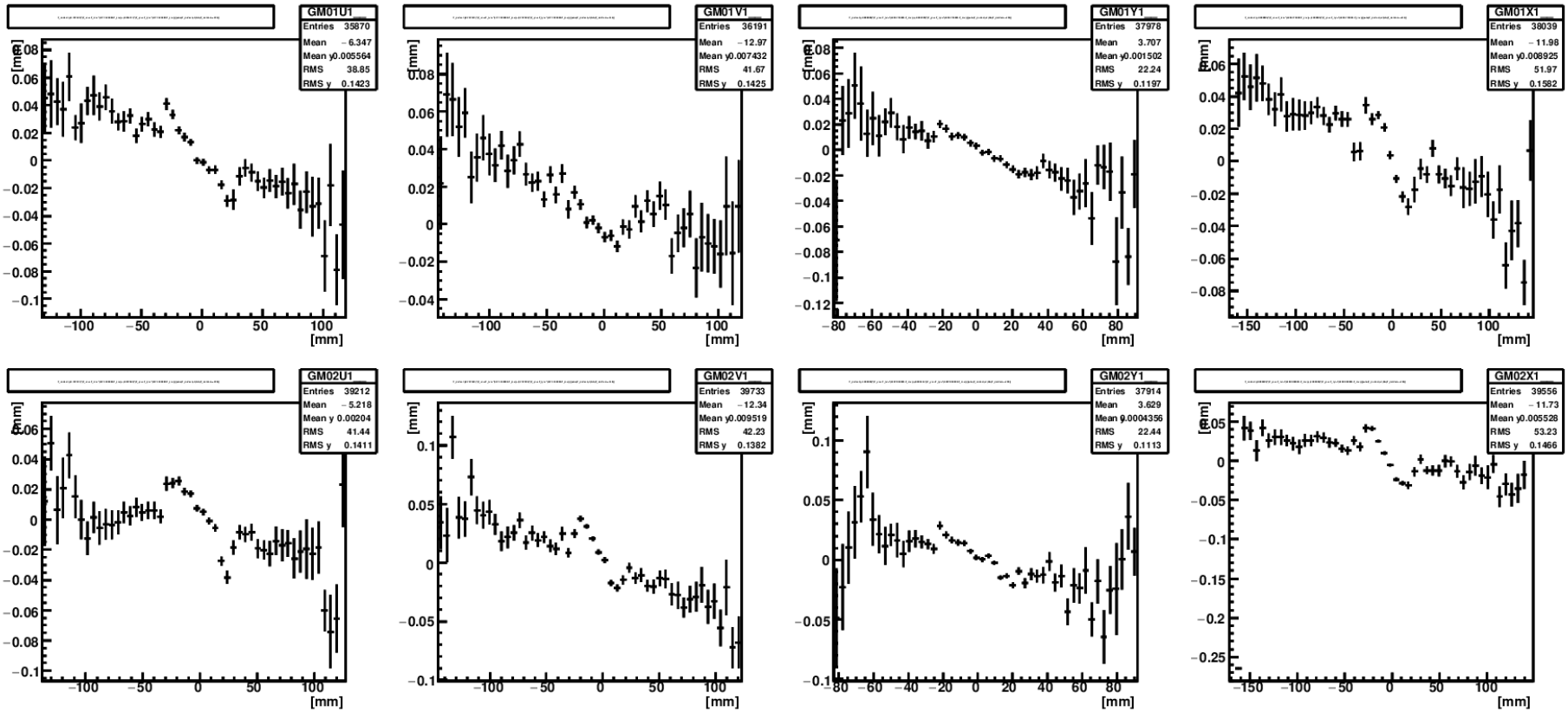


ΔU vs V plots

Comparison with constraints and without them

alignment run 278903 (magnets off, mu+)

4 iterations **with** constraints, U was fixed

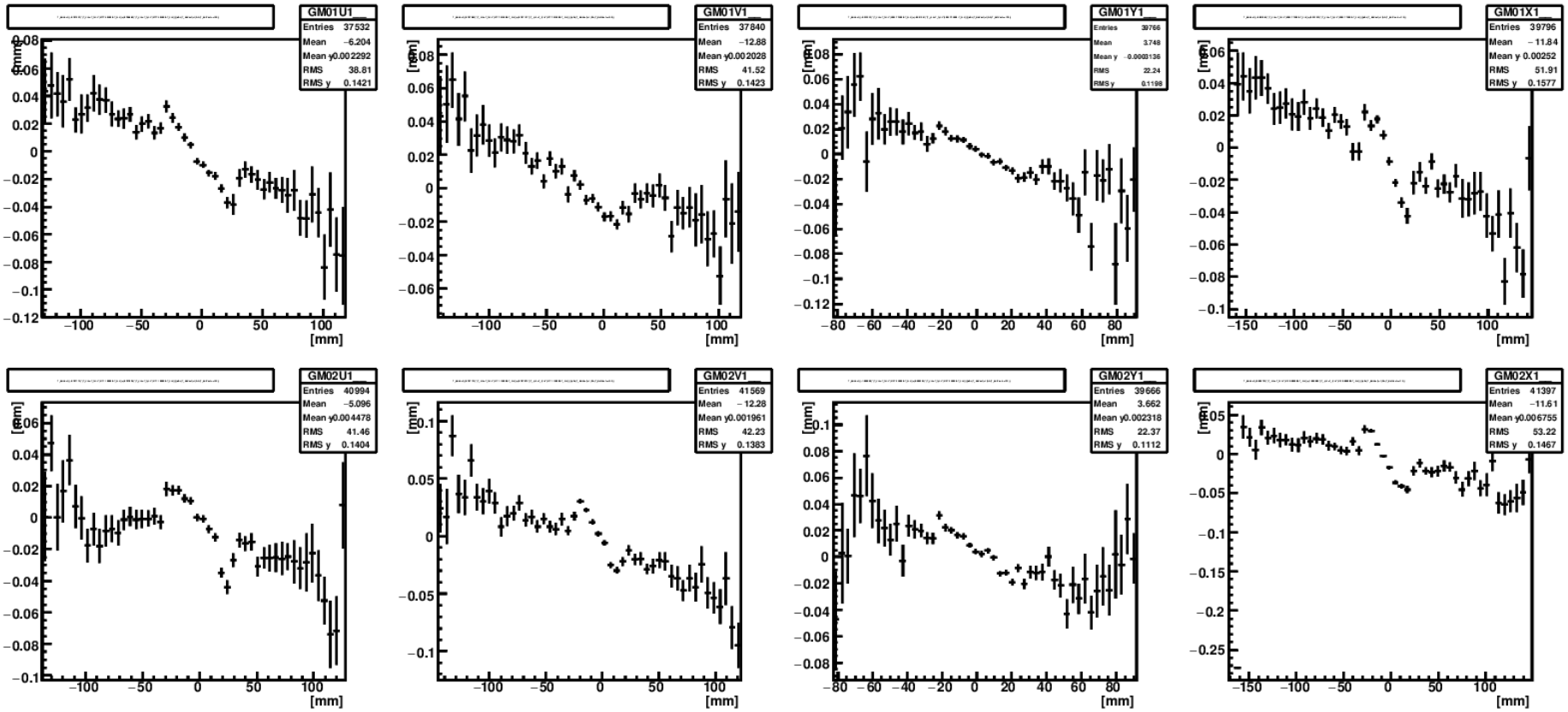


ΔU vs V plots

Comparison with constraints and without them

alignment run 278903 (magnets off, mu+)

3 iterations **with** constraints, U was free

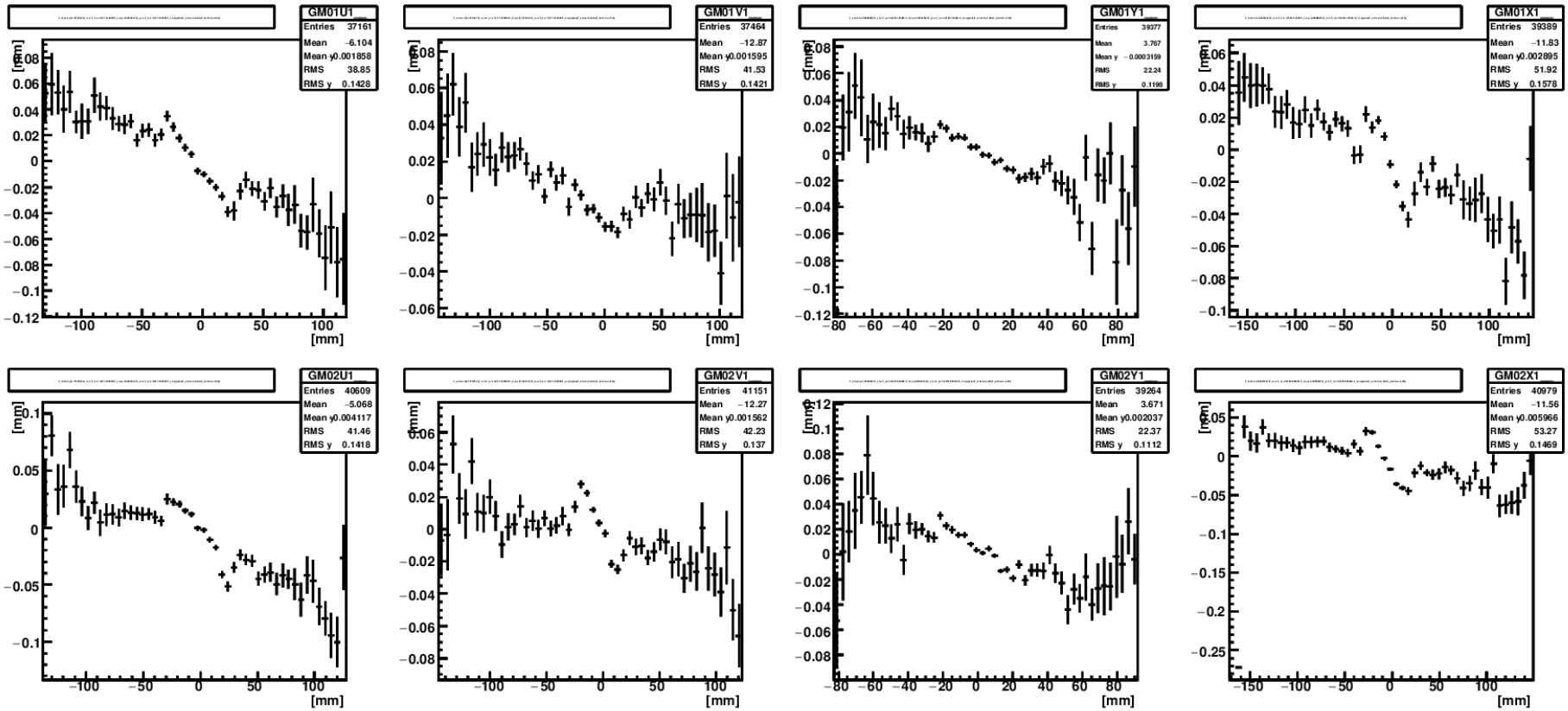


ΔU vs V plots

Comparison with constraints and without them

alignment run 278903 (magnets off, mu+)

5 iterations **without** constraints and U was free



ΔU vs V plots

Comparison with constraints and without them

On the level of the output files

It's obviously, the plots look similar (from 5 to 8 slides).
Nevertheless, the output results are different:

TBName	U(mm)	dU(mm)	T(deg)	dT(deg)
GM01Y1	-0.00018761	+0.0011886	-0.00065340	+0.0019870
GM01X1	-2.5629e-05	+0.0012120	-9.6534e-05	+0.0013505
GM02U1	-2.0354e-06	+0.0011606	-0.00028470	+0.0014354
GM02V1	+3.5768e-05	+0.0011756	-0.00024209	+0.0014215

↑ After 5 iterations without constraints (corresponding plot on the previous slide (#8)).

TBName	U(mm)	dU(mm)	T(deg)	dT(deg)
GM01Y1	-0.00013830	+0.0011886	-6.5366e-05	+0.0013039
GM01X1	-0.00024258	+0.0012131	-6.5366e-05	+0.0013039
GM02U1	+0.00018773	+0.0011617	+0.00067982	+0.0012415
GM02V1	-9.4471e-06	+0.0011718	+0.00067982	+0.0012415

↑ After 3 iterations with constraints (corresponding plot on the slide #7).

Comparison with constraints and without them

Main current problem

The plots obtained after «0 iteration» look even a bit better than others (independently on constraints or without ones, since all of plots are pretty similar).

Applying alignment procedure to the angles leads to bigger misalignment.
My options are like:

```
align T
align U // sometimes contrariwise fix U *
fix T GM04X1 GM04Y1 GM09X1 GM09Y1 // beacause they are pivot points
useDets GM
excludeDets FI07 FI08 GM11 GM10 FI01 FI15 FI02 // beacause of fieldOFF and noBT
```

In «traf.opt»:

```
Traf DetNameOff BM H V ST03***a ST03***c GP**P MP**M FI07 FI08 GM10 GM11
SI FI01 FI15 FI02 GM05 GM06 GM07 GM08
```