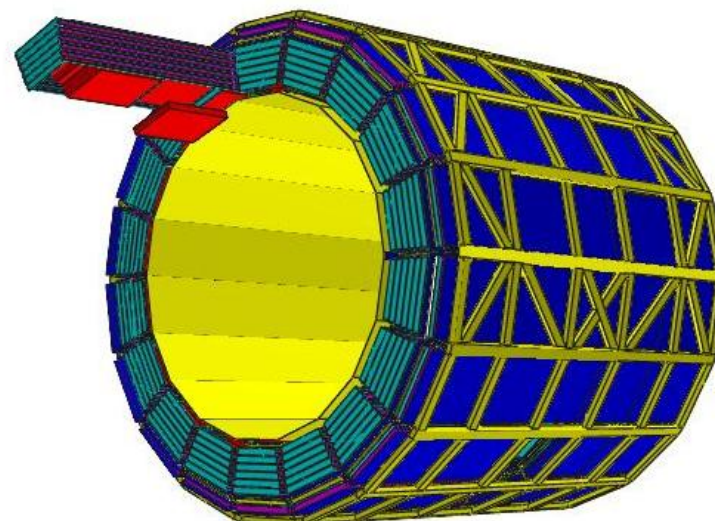
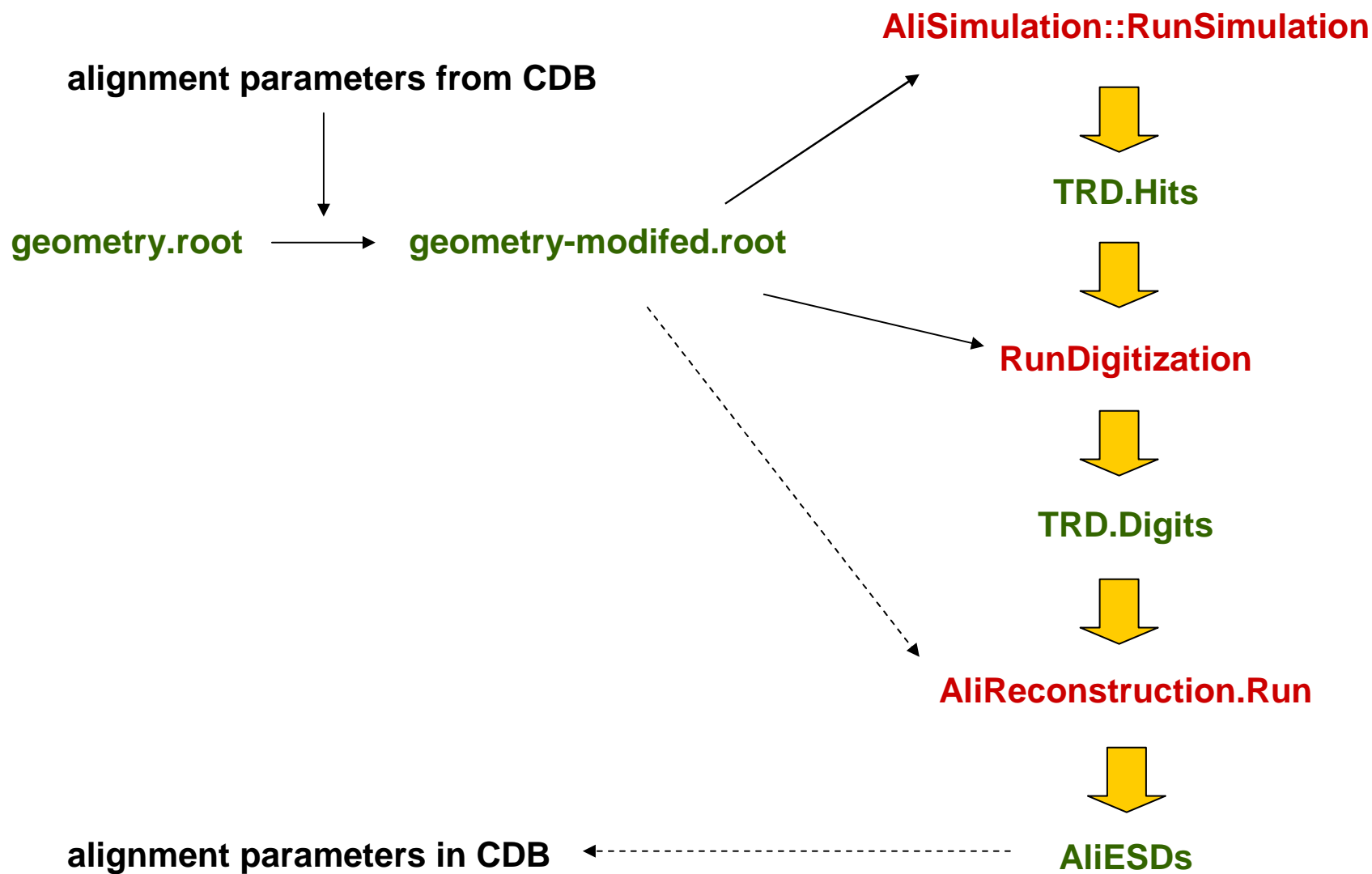


TRD alignment

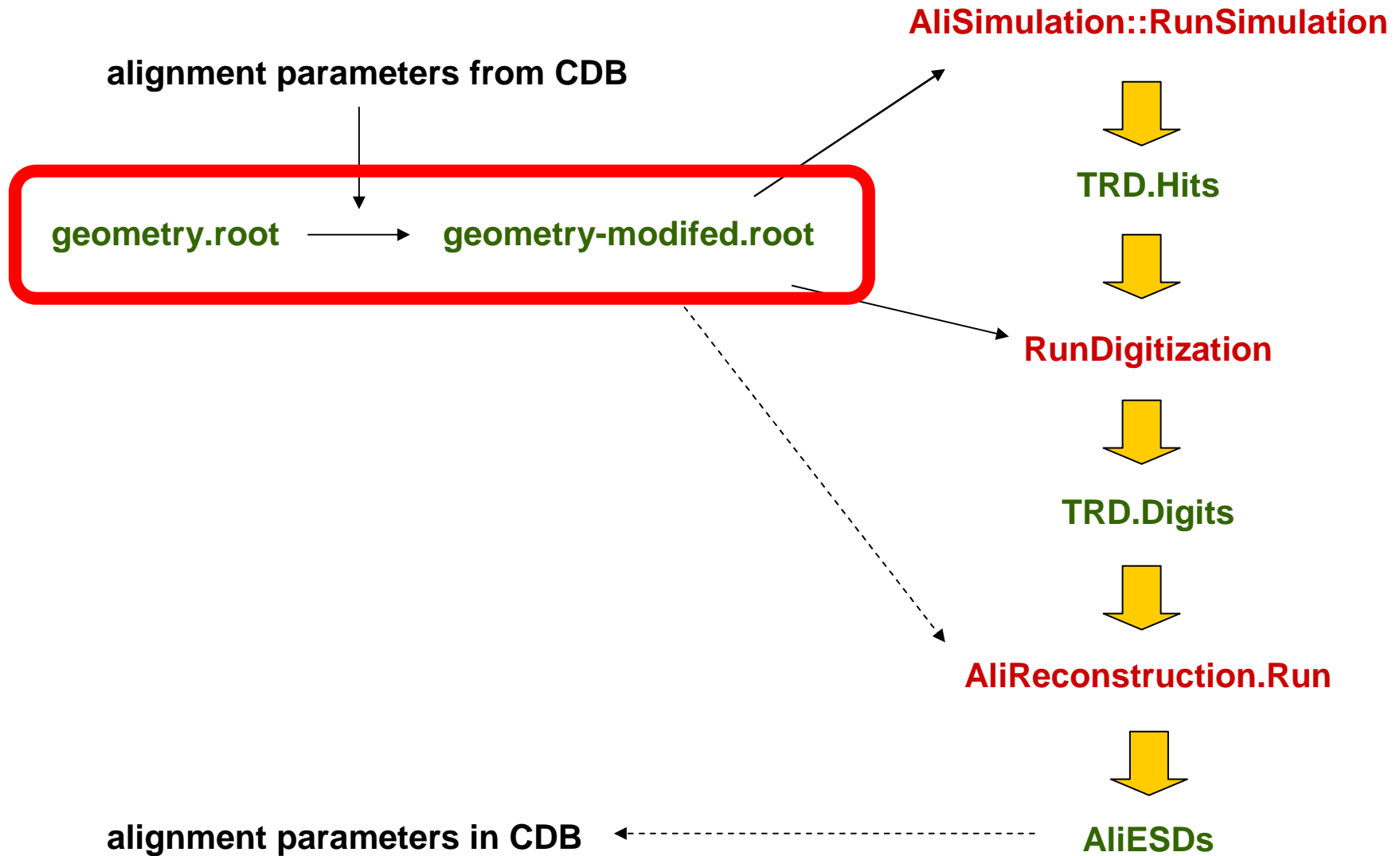


offline meeting, 08-Mar-2006
Dariusz Miskowiec, GSI Darmstadt

misalignment – alignment scheme



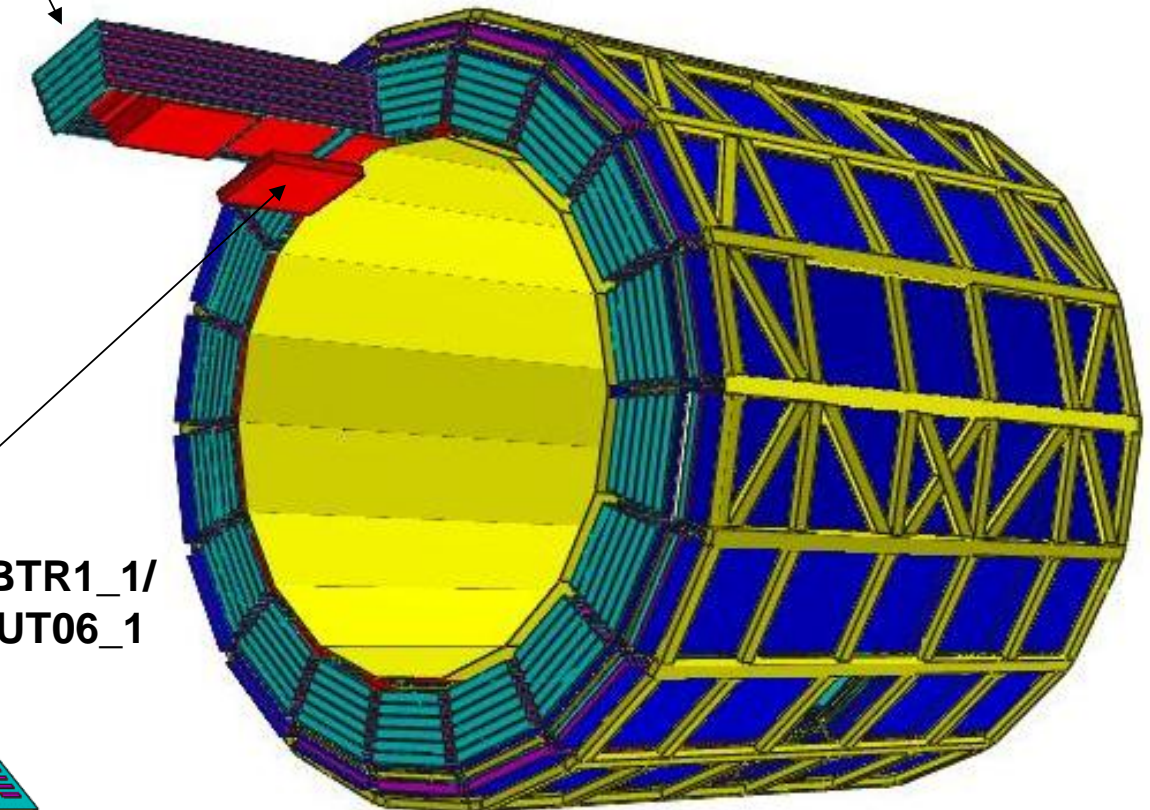
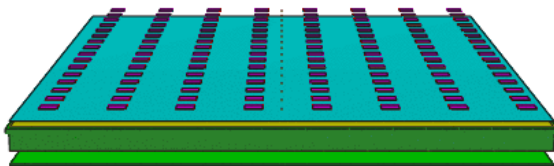
misalignment – alignment scheme



alignable objects in TRD

18 TRD supermodules
like /ALIC_1/B077_1/B071_6/BTR1_1

540 TRD chambers
like /ALIC_1/B077_1/B071_6/BTR1_1/
UTR1_1/UTS1_1/UTI1_1/UT06_1



introducing misalignment in geometry.root

```
root -l
TFile *f=TFile::Open("geometry.root","read");
.L displace.C
displace(Geometry,"/ALIC_1/B077_1/B071_6/BTR1_1",0,-350,0,0,0,0);
Geometry->Export("geometry-modified.root");
.q
```

macro displace.C

```
/*  
// Apply a small displacement to the node characterized by the path nodpat.  
// The x,y,z refer to the local frame of the node.  
// Returns number of created overlaps.  
// D.Miskowiec, February 2006  
*/  
int displace(TGeoManager *geom, char *nodpat, double dx, double dy, double dz,  
            double rx, double ry, double rz) {  
  
    TGeoPhysicalNode *pn;  
    int overlaps_before;  
    int overlaps_after;  
  
    // create new physical node  
  
    geom->RestoreMasterVolume();  
    pn = geom->MakePhysicalNode(nodpat);  
    pn->GetMother()->GetVolume()->CheckOverlaps();  
    overlaps_before = geom->GetListOfOverlaps()->GetEntries();  
  
    // retrieve and decompose the original matrix  
  
    TGeoHMatrix *or = pn->GetOriginalMatrix();  
    TGeoHMatrix ortr;  
    TGeoHMatrix orro;  
    ortr.SetTranslation(or->GetTranslation());  
    orro.SetRotation(or->GetRotationMatrix());  
}
```

macro displace.C

```
// small corrections

TGeoTranslation cotr;
cotr.SetTranslation(dx, dy, dz);
TGeoRotation corx;
TGeoRotation cory;
TGeoRotation corz;
corx.SetAngles(90, 0, 90-rx, 90, rx, 270);
cory.SetAngles(90+ry, 0, 90, 90, ry, 0);
corz.SetAngles(90, rz, 90, 90+rz, 0, 0);

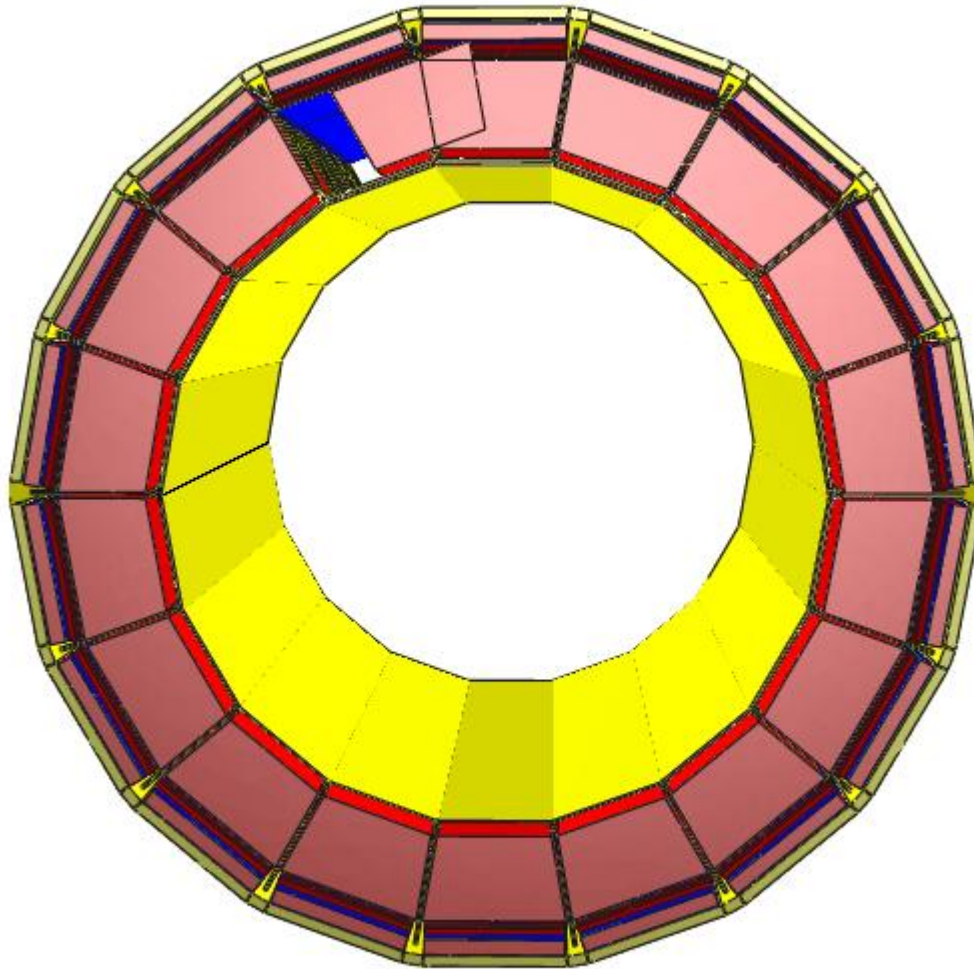
// apply corrections

TGeoHMatrix comb=ortr*orro*cotr*corx*cory*corz;
TGeoHMatrix *mali = new TGeoHMatrix(comb);
pn->Align(mali);
pn->GetMother()->GetVolume()->CheckOverlaps();
overlaps_after = geom->GetListOfOverlaps()->GetEntries();

//pn->GetMother()->GetVolume()->Draw();
int nover = overlaps_after-overlaps_before;
if (nover==1) printf("displace: %d additional overlap\n",nover);
else printf("displace: %d additional overlaps\n",nover);
return nover;
}
/*****/
```

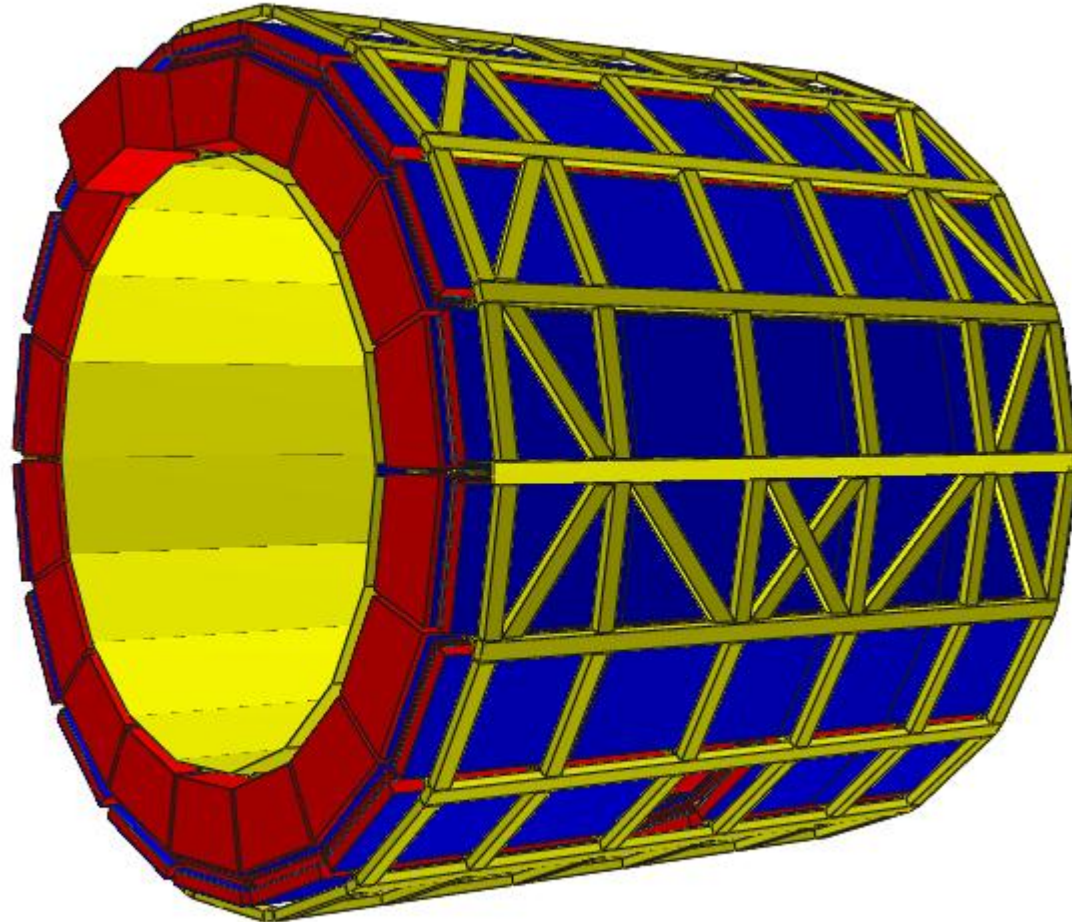
example

`displace(Geometry,"/ALIC_1/B077_1/B071_6/BTR1_1",50,0,0,0,0,0)`



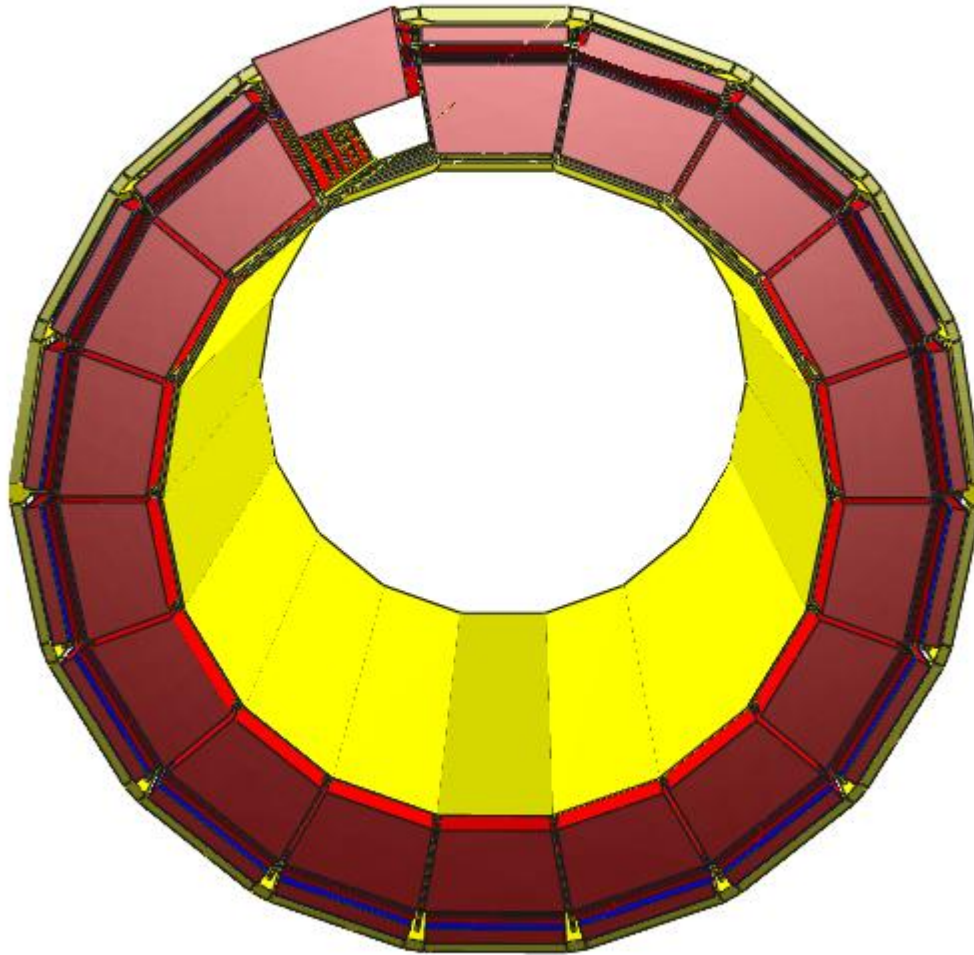
example

`displace(Geometry,"/ALIC_1/B077_1/B071_6/BTR1_1",0,-50,0,0,0,0)`



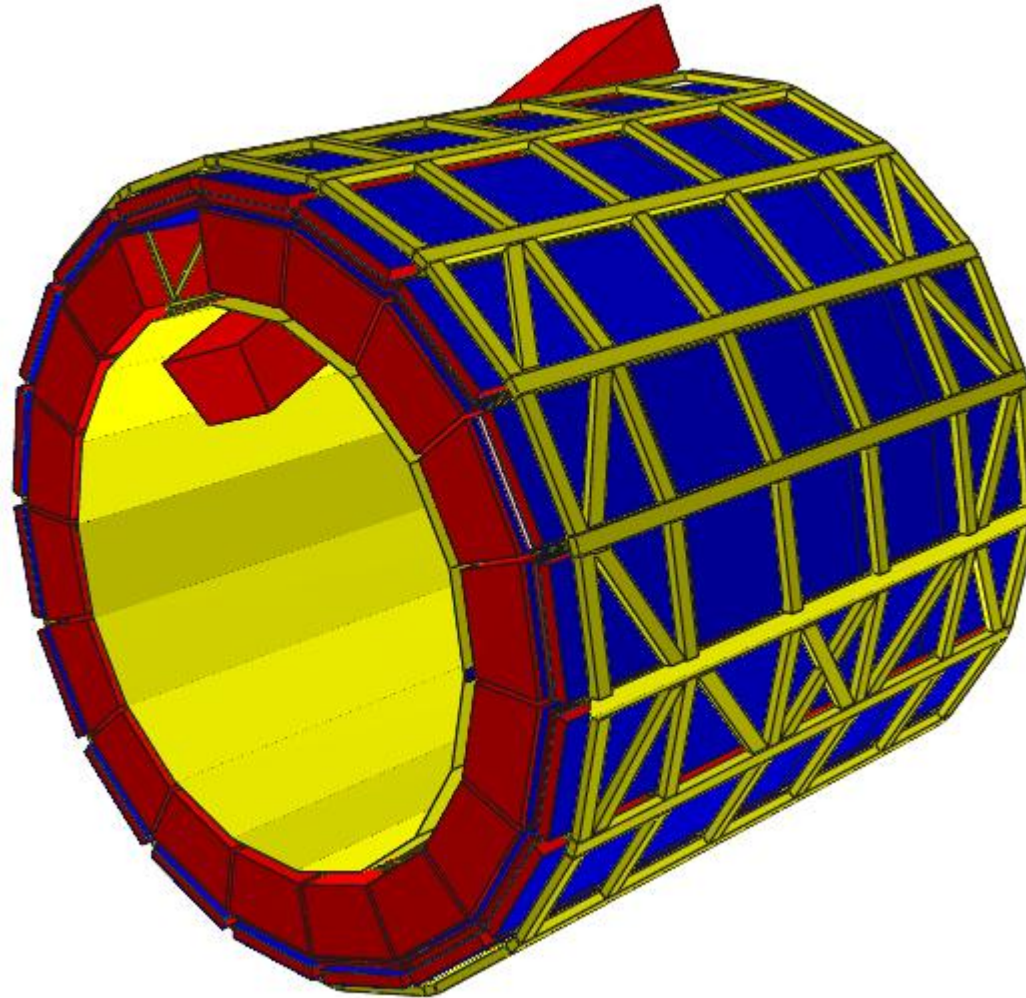
example

`displace(Geometry,"/ALIC_1/B077_1/B071_6/BTR1_1",0,0,50,0,0,0)`

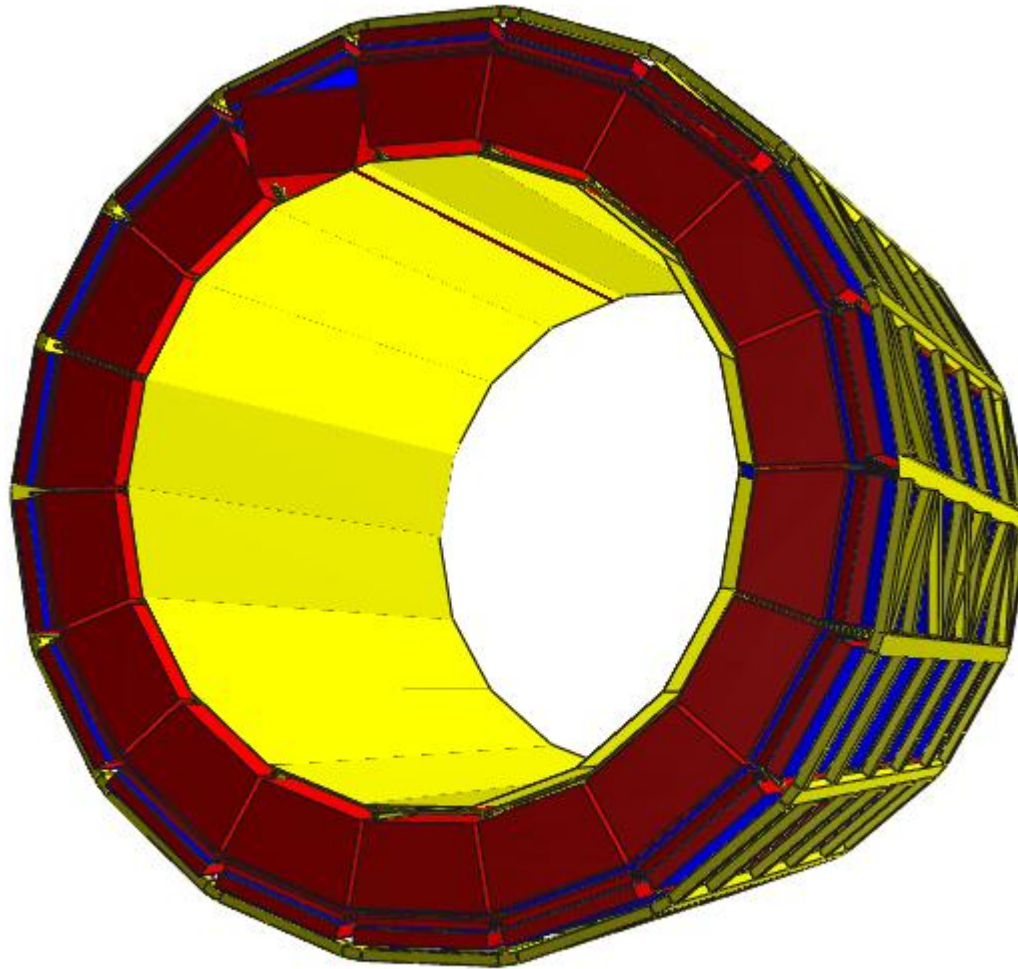


example

```
displace(Geometry,"/ALIC_1/B077_1/B071_6/BTR1_1",0,0,0,20,0,0)
```



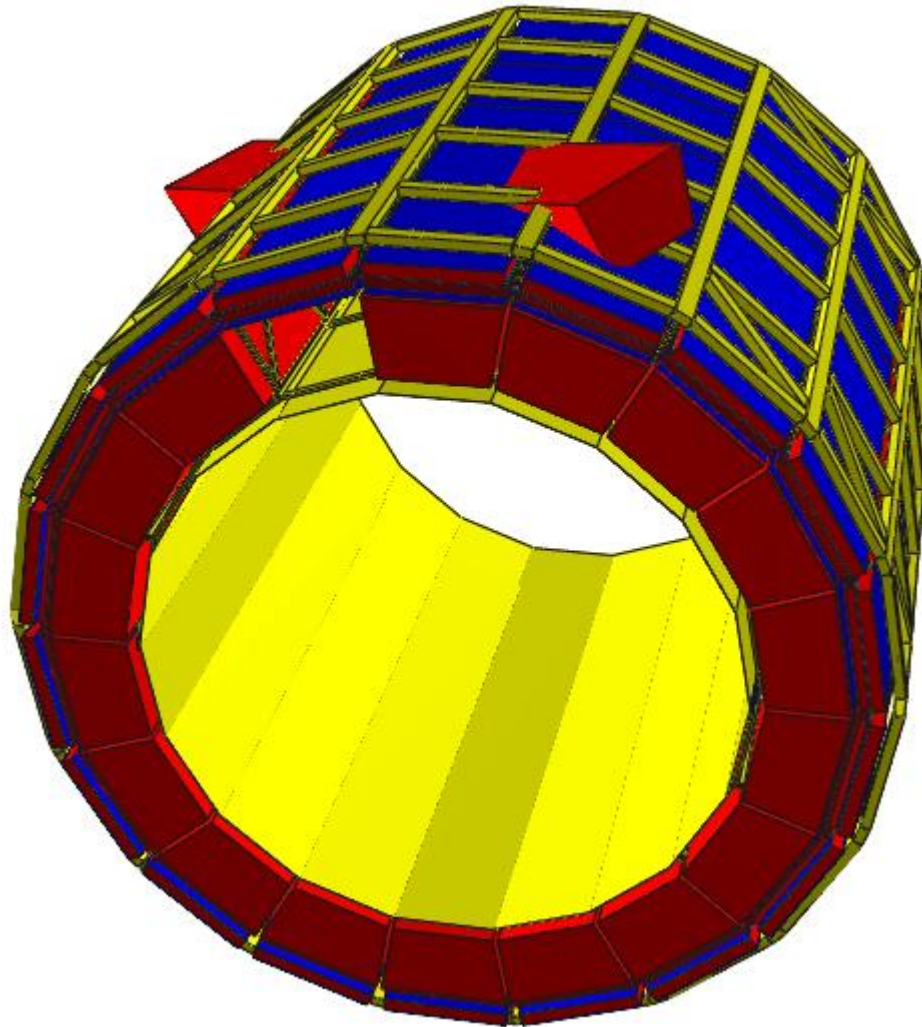
example



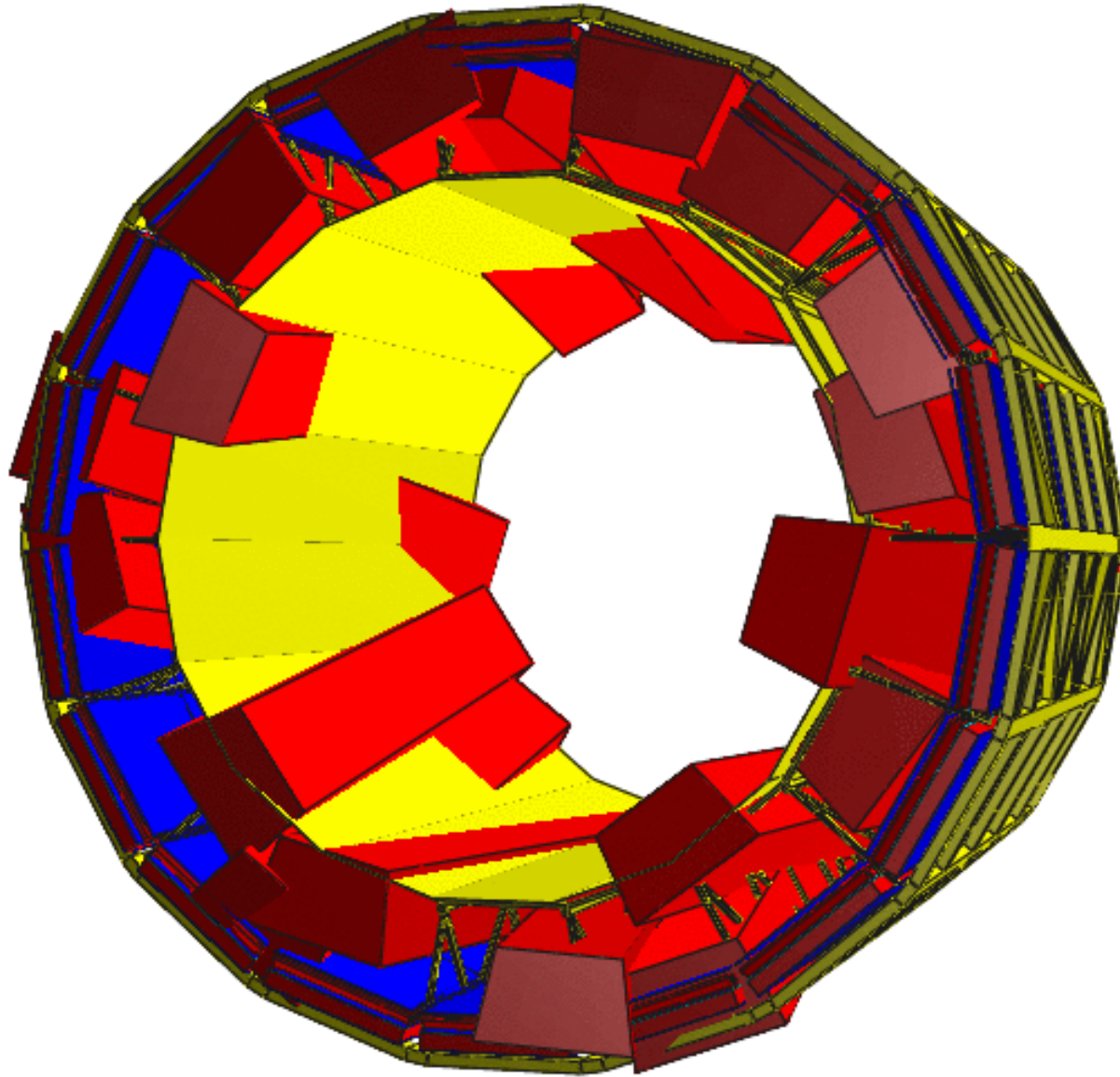
`displace(Geometry,"/ALIC_1/B077_1/B071_6/BTR1_1",0,0,0,0,20,0)`

example

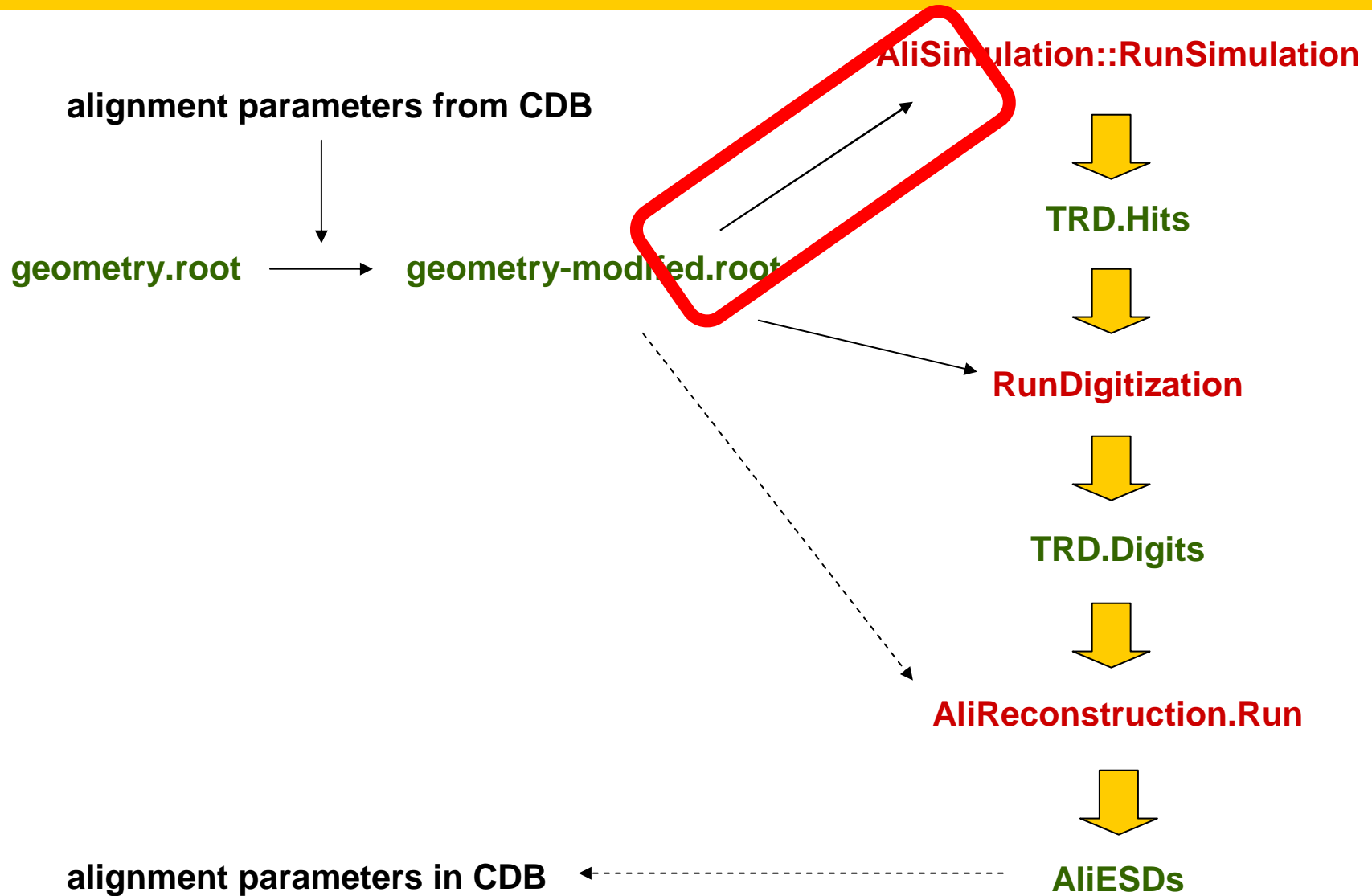
`displace(Geometry,"/ALIC_1/B077_1/B071_6/BTR1_1",0,0,0,0,0,50)`



example -- many random displacements

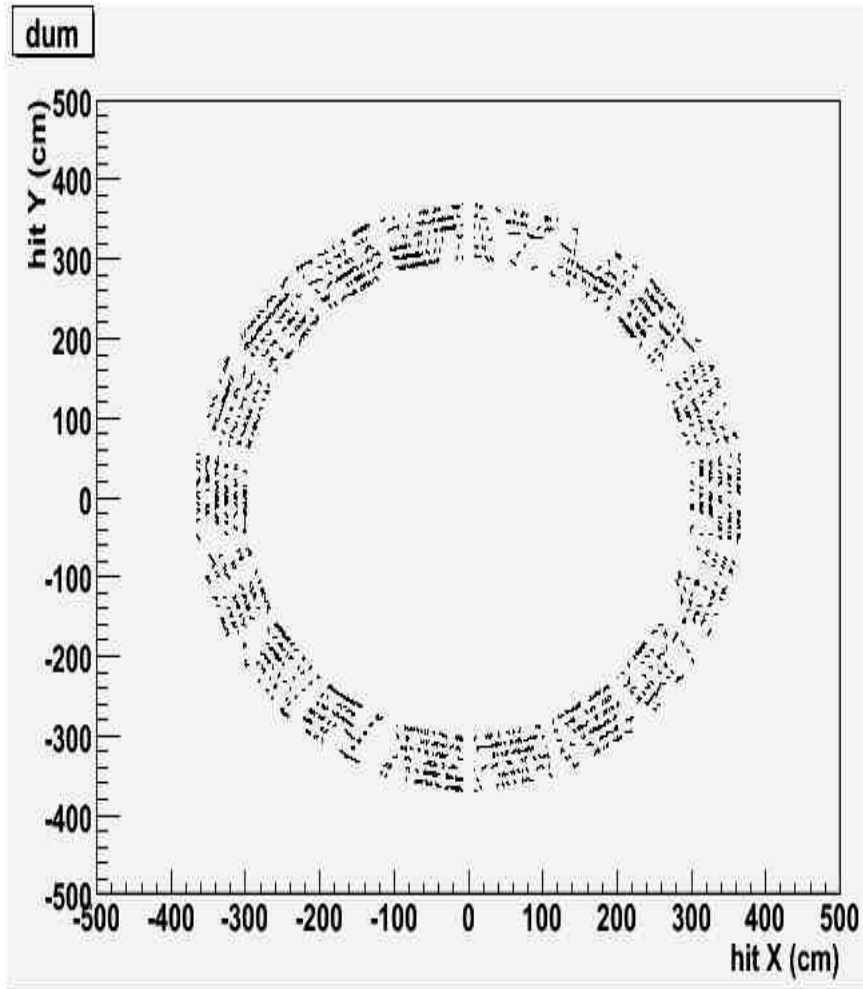


misalignment – alignment scheme

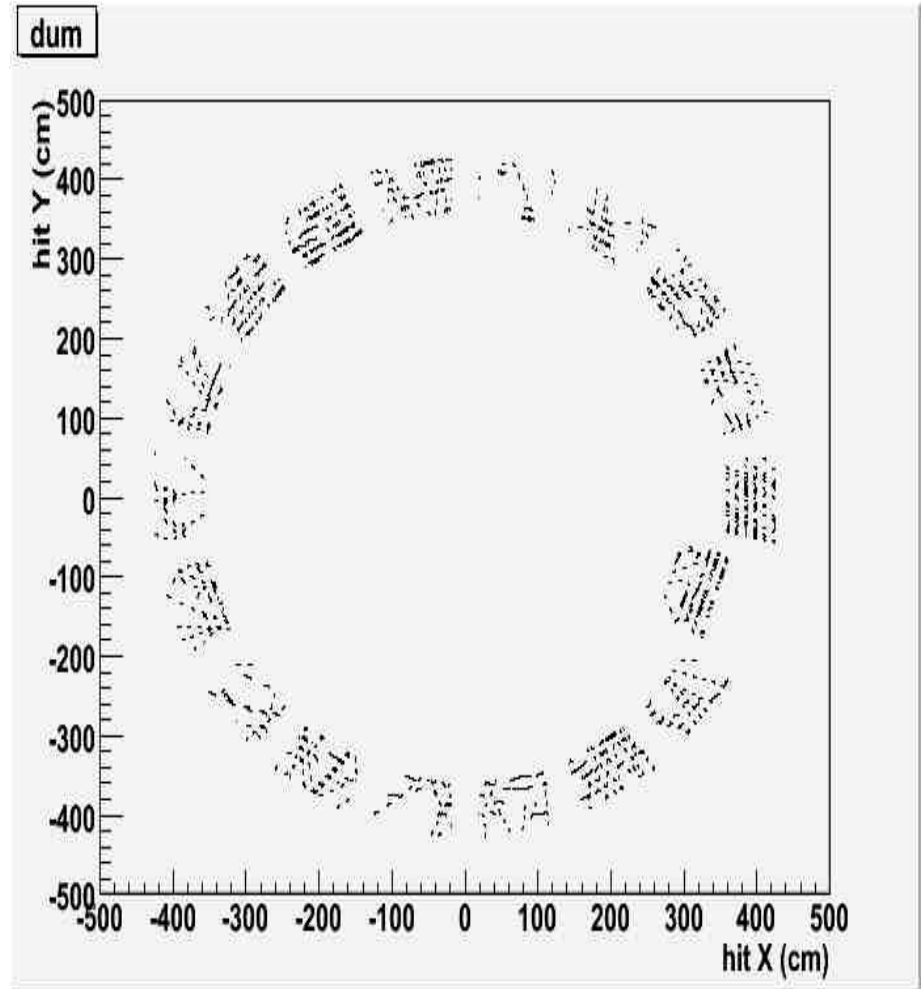


hits are generated depending on the geometry

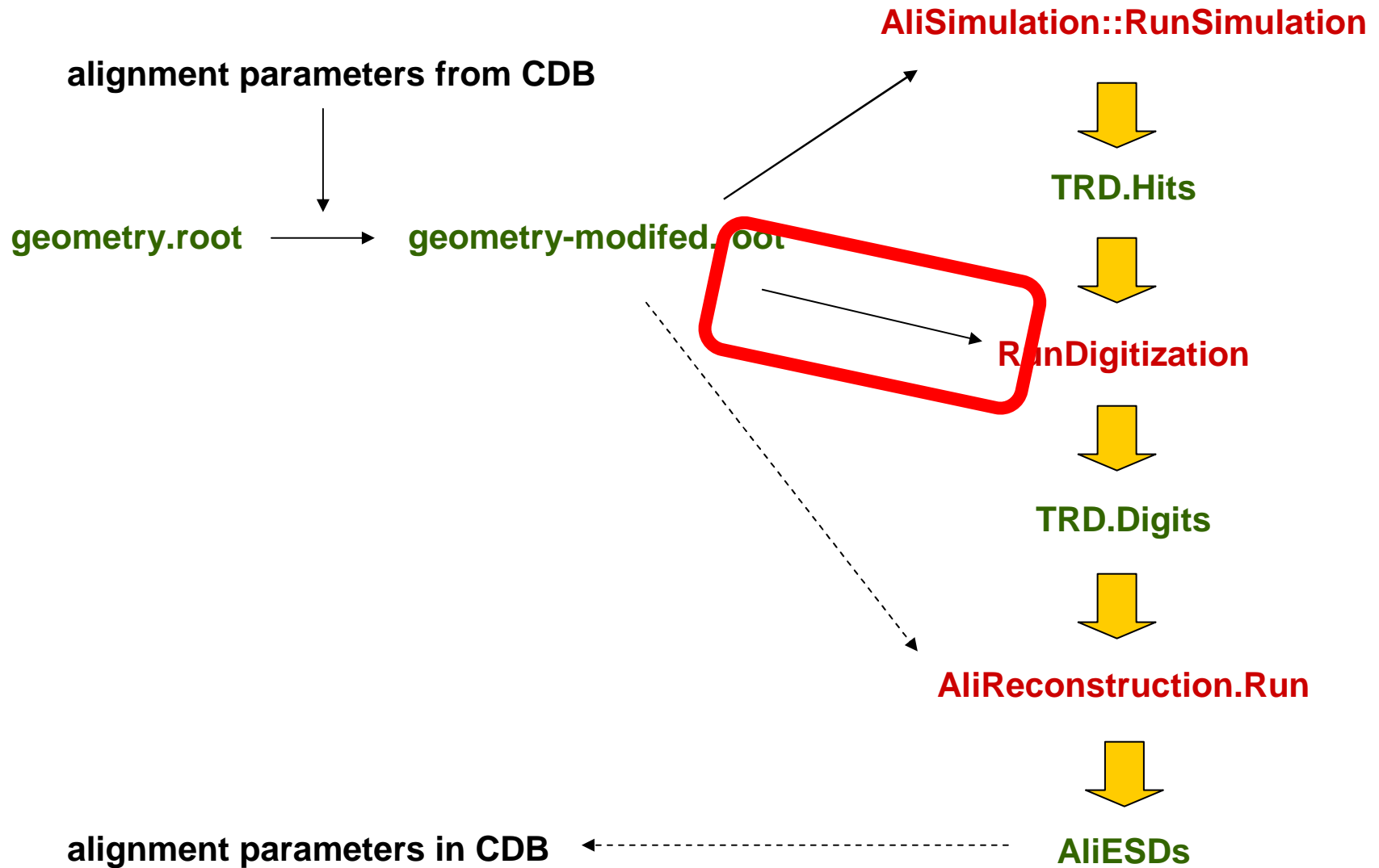
ideal geometry



supermodules shifted outwards



misalignment – alignment scheme

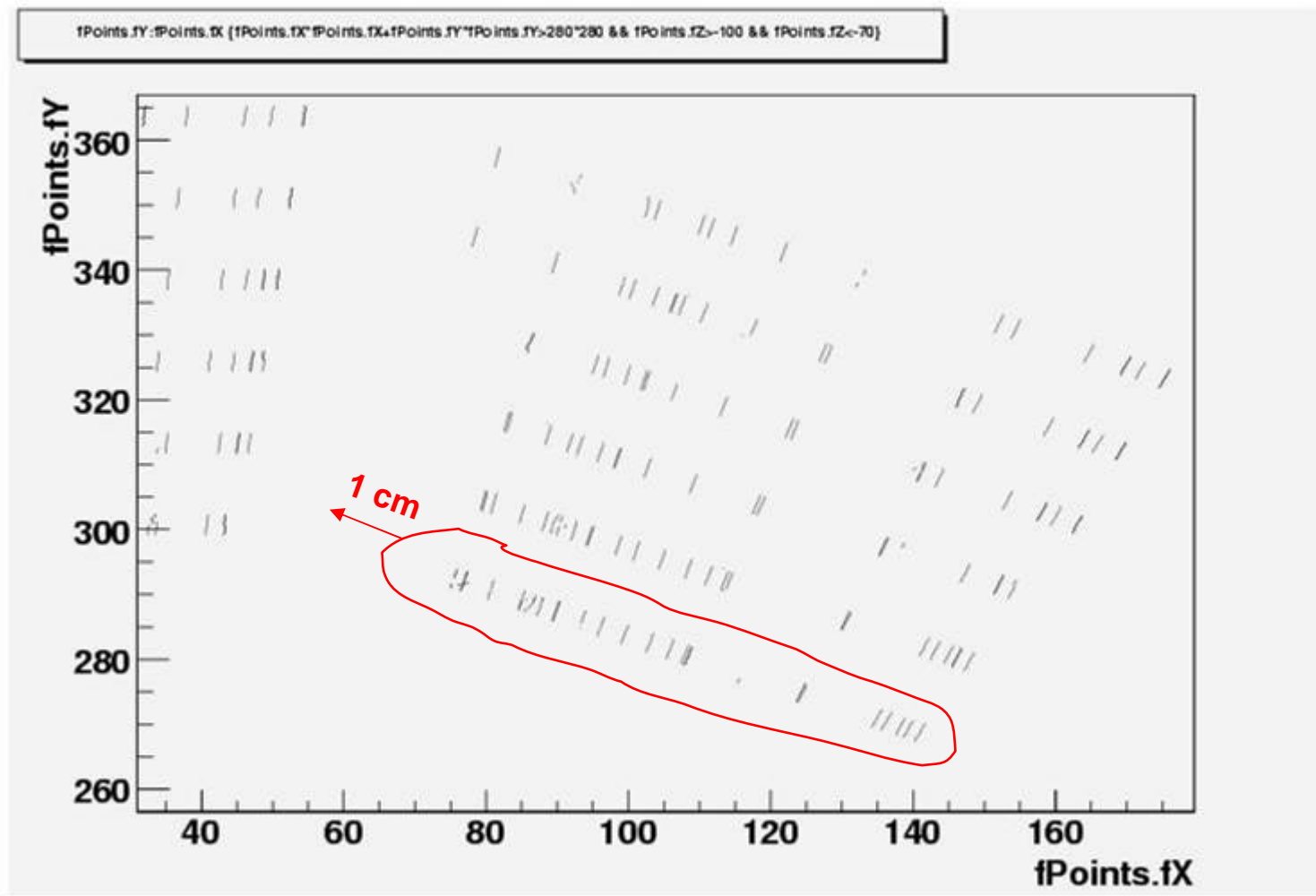


introducing actual geometry in the digitizer

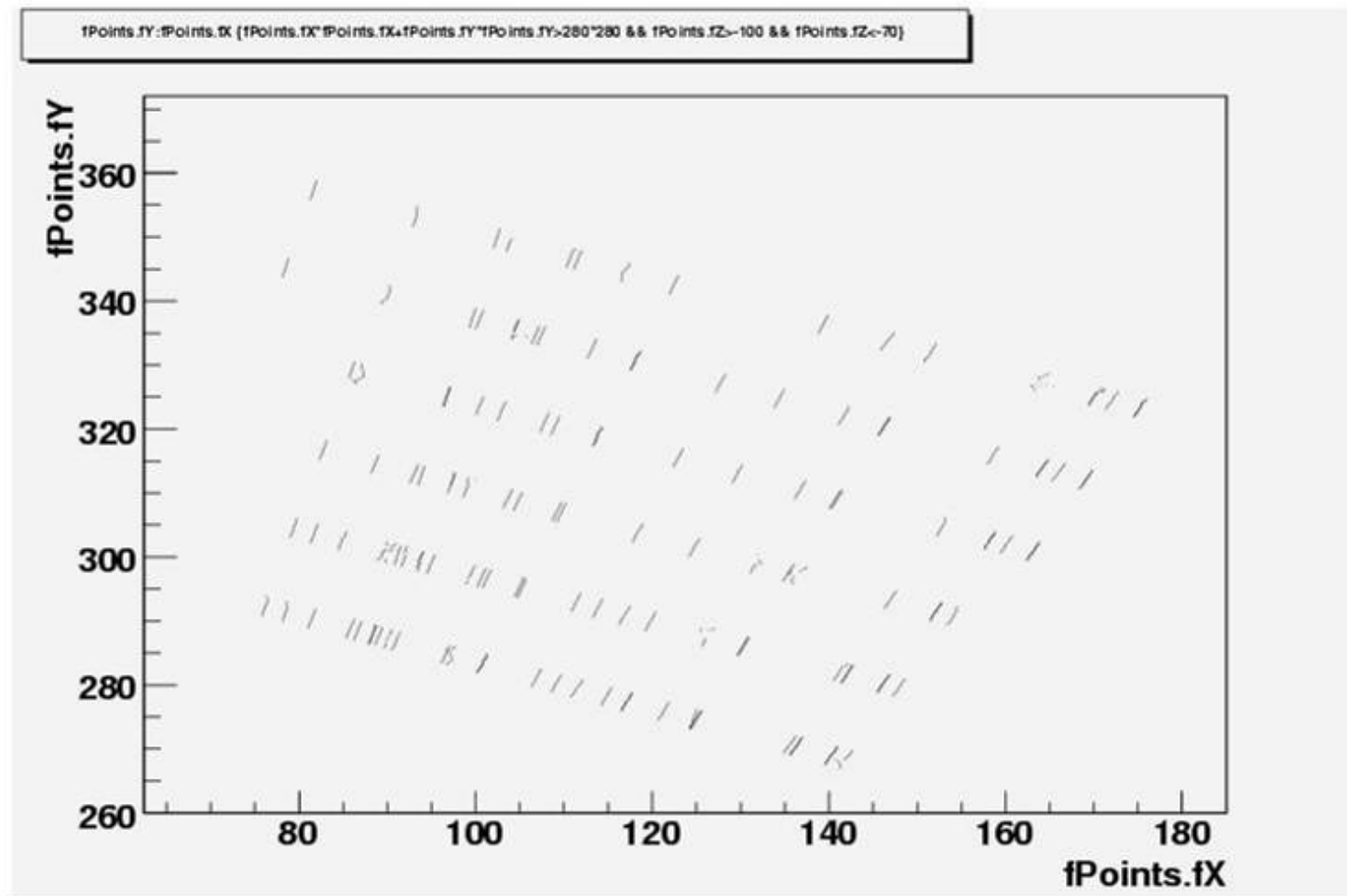
```
xmas [0]=hit->X();
xmas [1]=hit->Y();
xmas [2]=hit->Z();
gGeoManager->SetCurrentPoint(xmas);
gGeoManager->FindNode();
gGeoManager->MasterToLocal(xmas,xloc);
char *node_name = gGeoManager->GetPath();
// deduce pad and timebin from xloc:
if (strstr(node_name, "/UJ")) {...} // drift volume
if (strstr(node_name, "/UK")) {...} // ampl. volume
```

space points with modified geometry

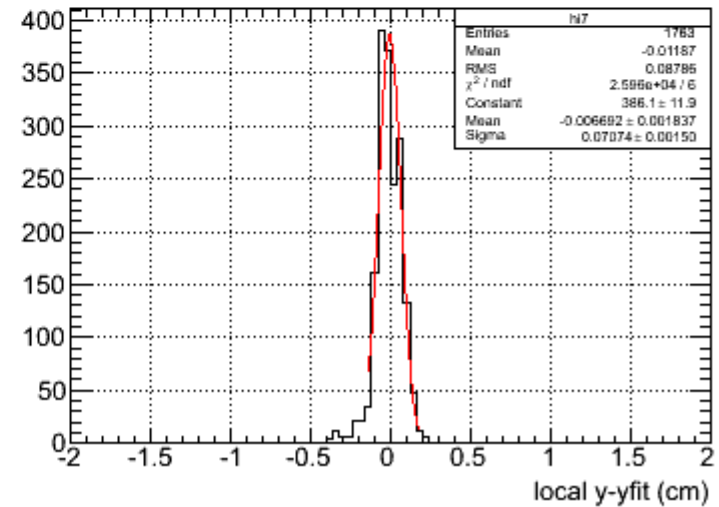
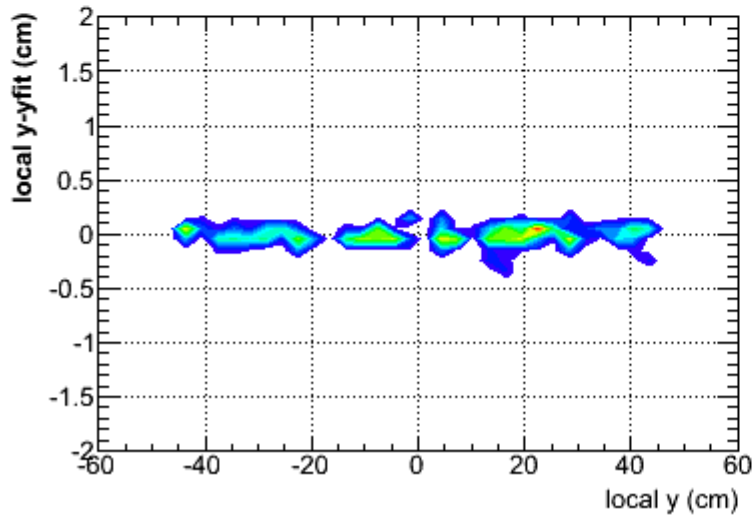
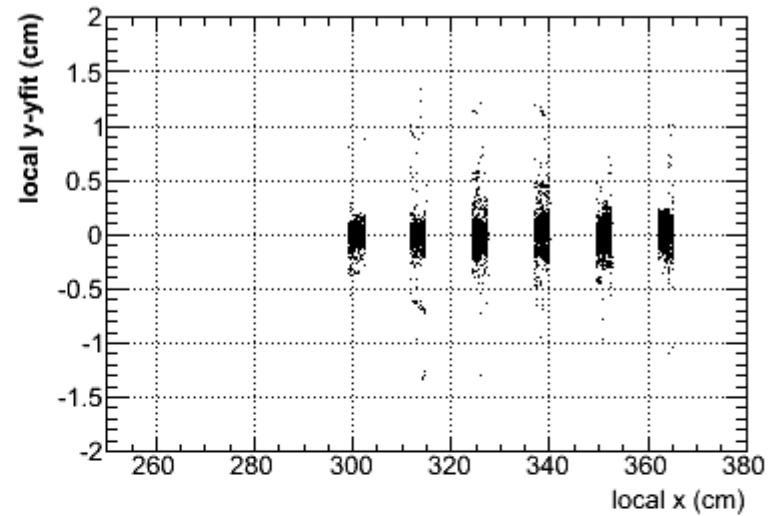
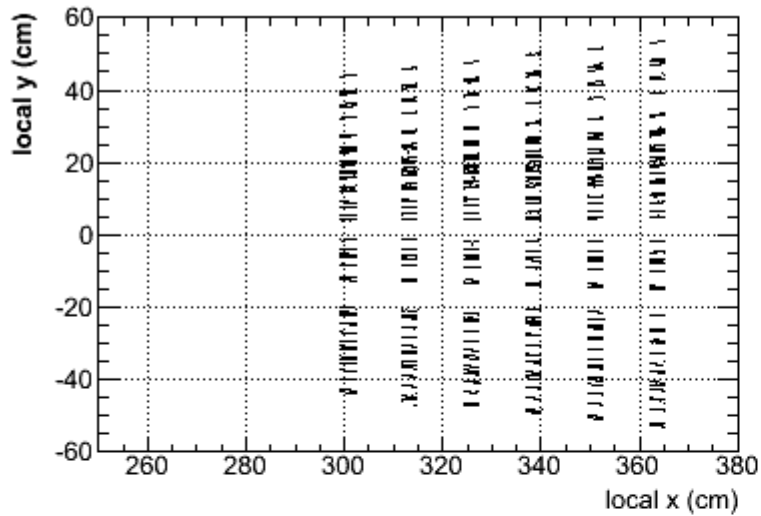
one chamber shifted by 1 cm in the azimuthal direction



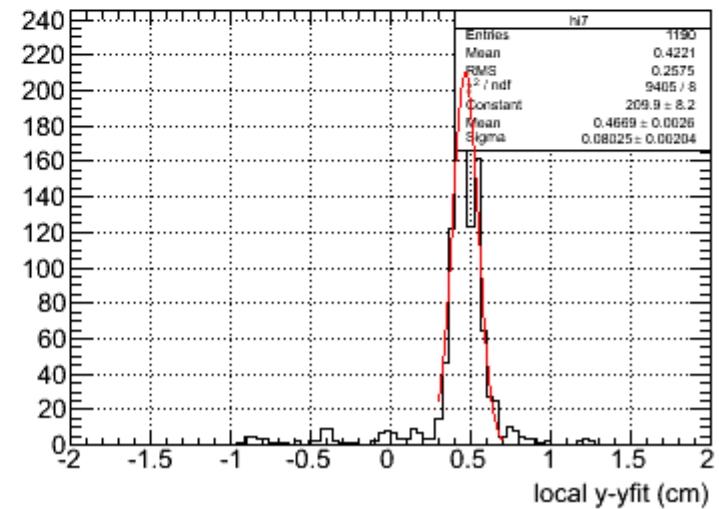
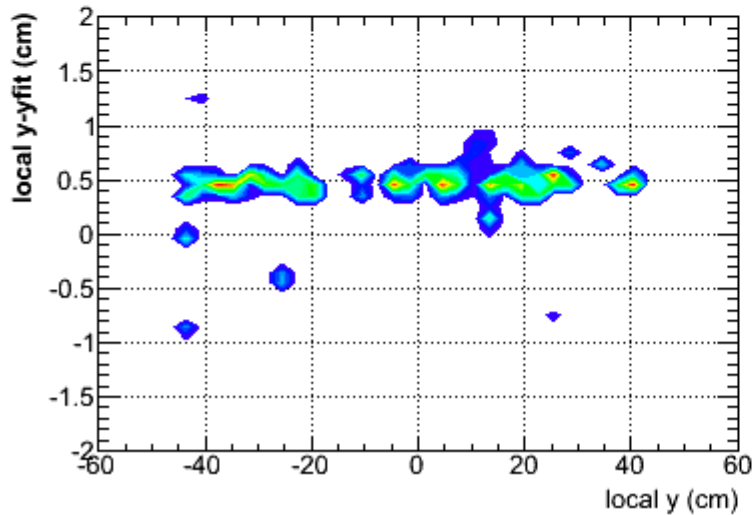
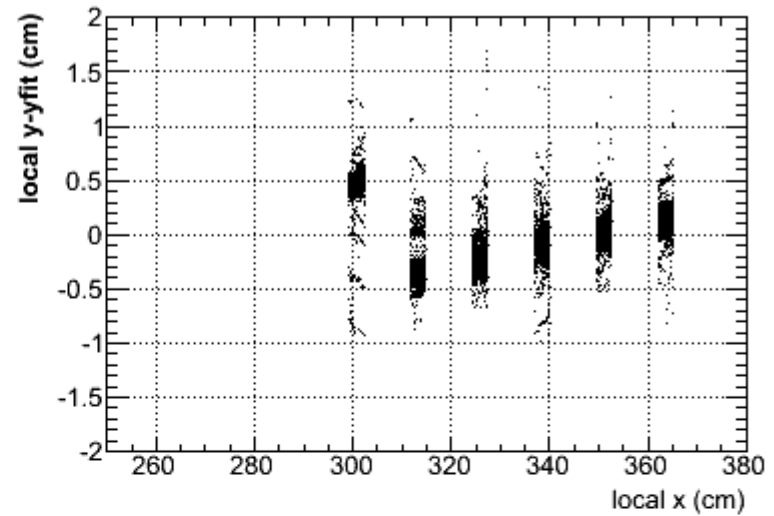
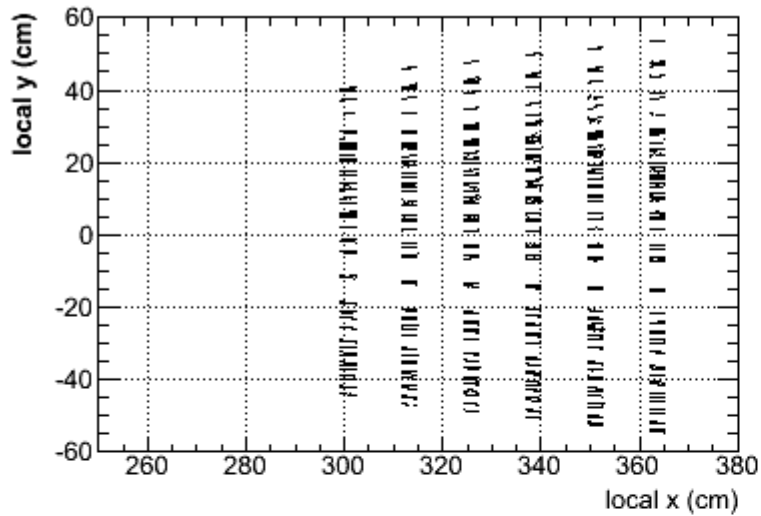
space points with ideal geometry



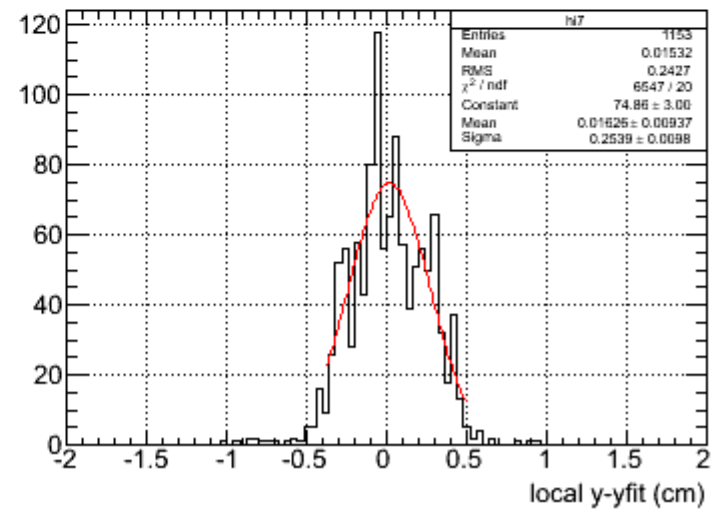
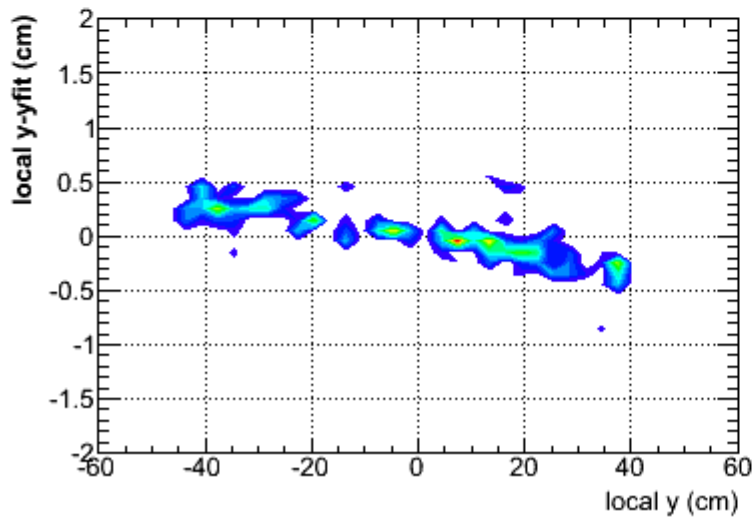
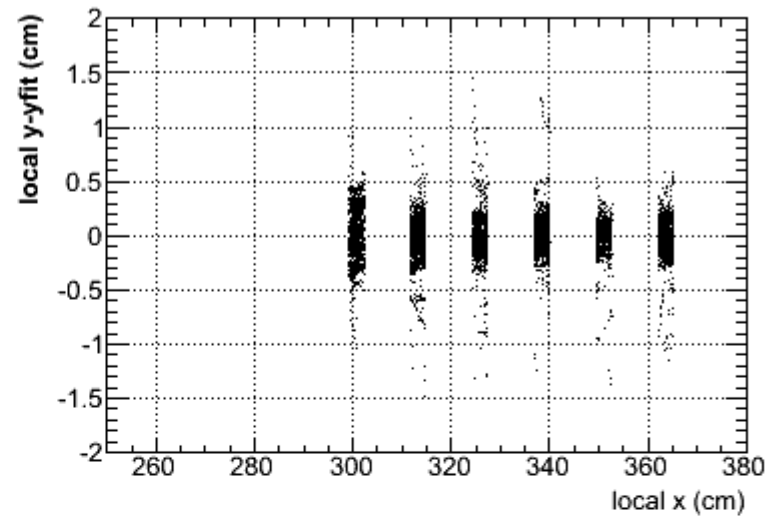
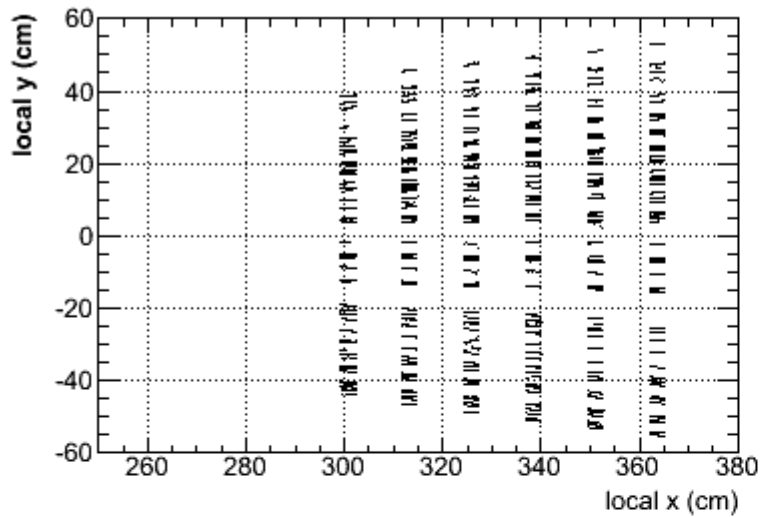
space points with ideal geometry



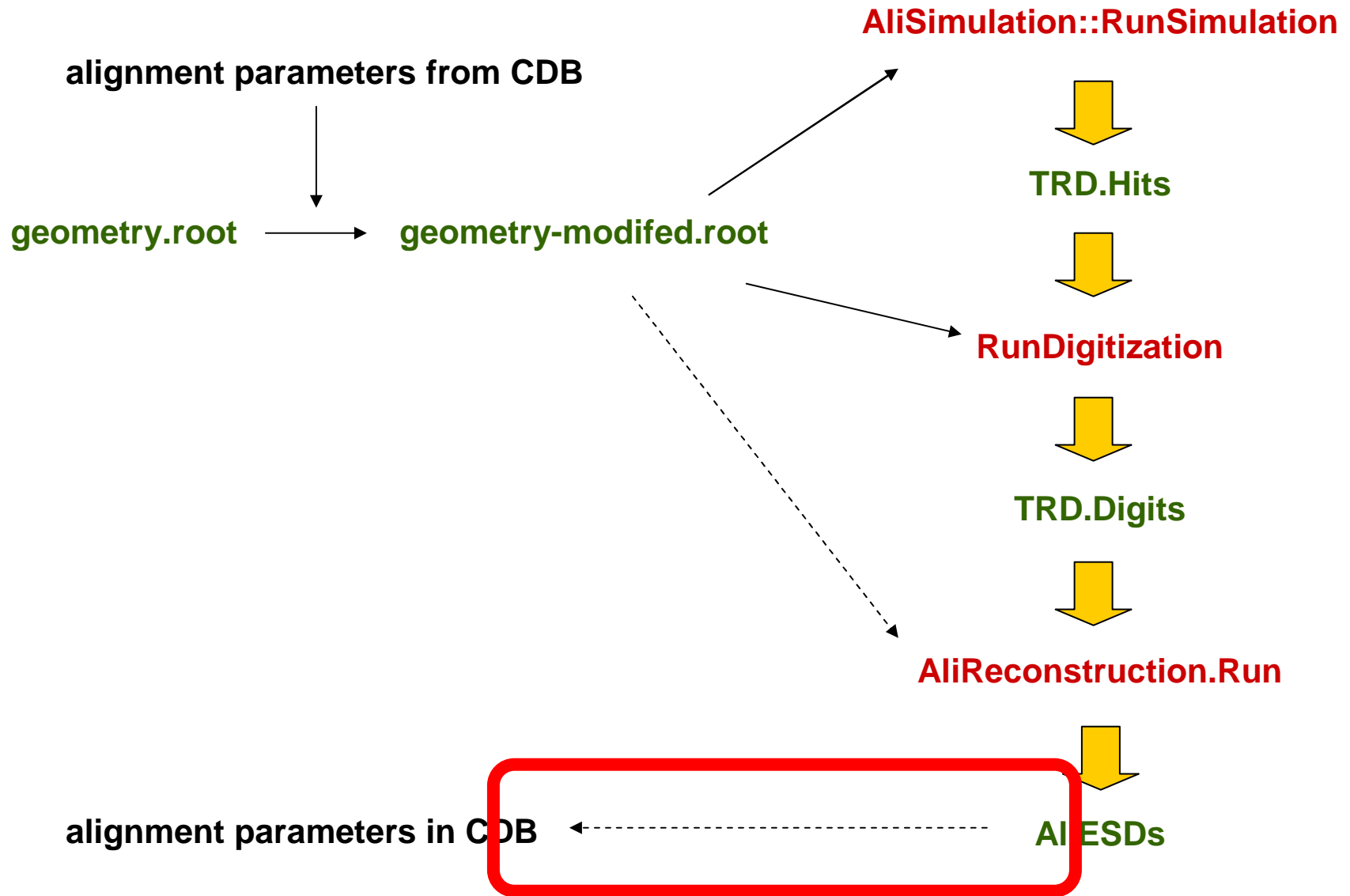
space points with modified geometry: 1 cm phi shift



space points with modified geometry: 5 cm r shift

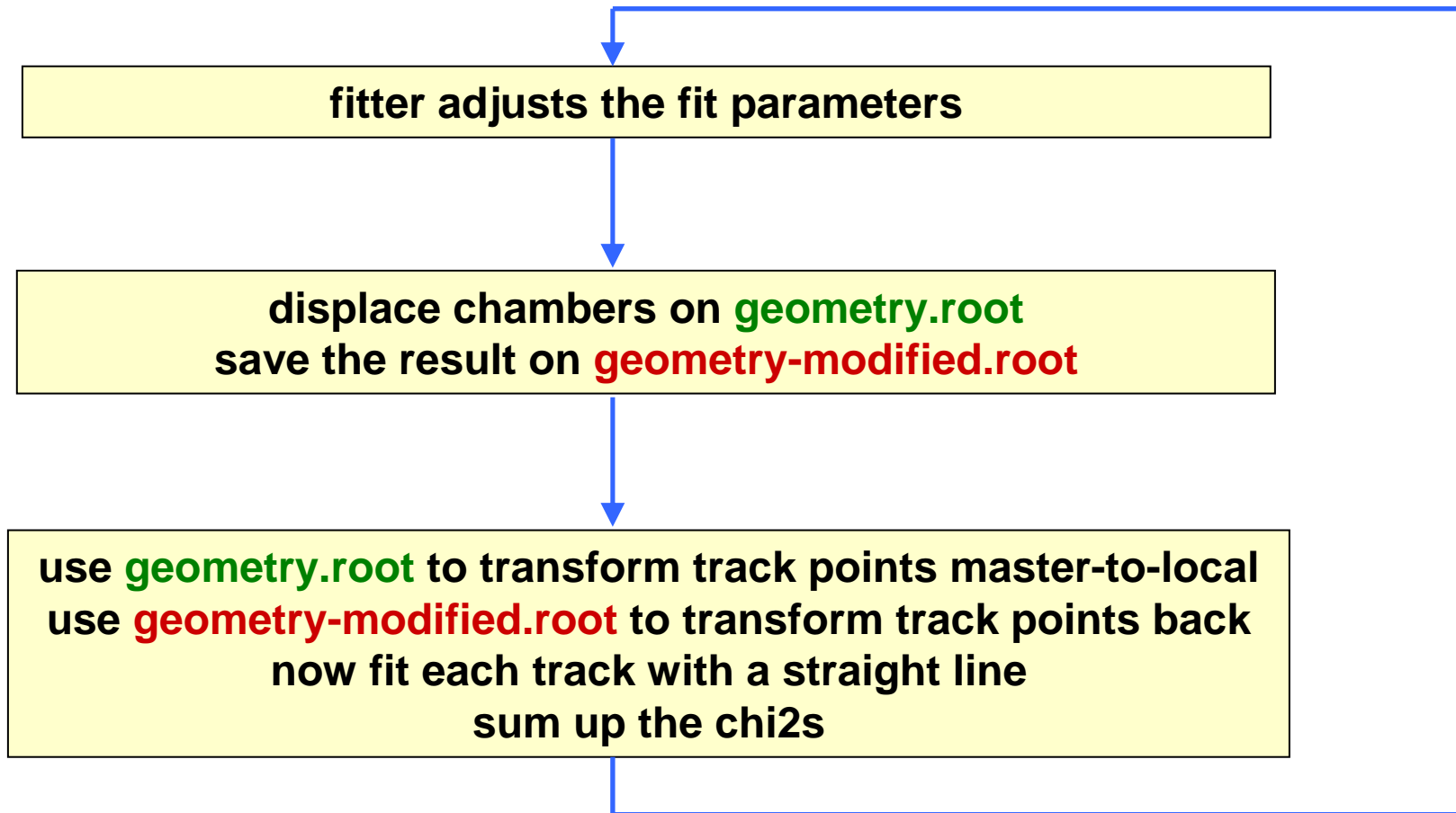


misalignment – alignment scheme



deducing the misalignment from the data

data: 100 pions with 2-5 GeV into one TRD stack, $B=0$
geometry: one chamber displaced
software quality: working prototype



deducing the misalignment from the data

```

/*****/
void find_misalignment() {
    TFitter fitter(100);
    fitter.SetFCN(fcn);

    fitter.SetParameter(0, "dx", 0, 0.5, 0, 0);
    fitter.SetParameter(1, "dy", 0, 0.5, 0, 0);
    fitter.SetParameter(2, "dz", 0, 0.5, 0, 0);
    fitter.SetParameter(3, "rx", 0, 0.5, 0, 0);
    fitter.SetParameter(4, "ry", 0, 0.5, 0, 0);
    fitter.SetParameter(5, "rz", 0, 0.5, 0, 0);

    fitter.FixParameter(1);
    fitter.FixParameter(3);
    fitter.FixParameter(4);
    fitter.FixParameter(5);

    double arglist[100];
    arglist[0] = 2;
    fitter.ExecuteCommand("SET PRINT", arglist, 1);
    printf("    dx    dy    dz    rx    ry    rz\n");

    arglist[0]=50;
    fitter.ExecuteCommand("SIMPLEX", arglist, 1);
    //fitter.ExecuteCommand("MINIMIZE", arglist, 1);
    fitter.ExecuteCommand("CALL 3", arglist, 0);
}
/*****/

```

deducing the misalignment from the data

```
/******  
void fcn(int &, double *, double &f, double *x, int iflag) {  
    if (iflag) ;  
  
    AliTRDCalChamberPos *cpos = new AliTRDCalChamberPos();  
    cpos->SetPos(0, x[0], x[1], x[2]);  
    cpos->SetRot(0, x[3], x[4], x[5]);  
    displace("geometry.root", cpos, "geometry-modified.root");  
  
    read_tracks(fina, volar, trackar, 10000000);  
    trafo("geometry.root", trackar, "mas2loc");  
    trafo("geometry-modified.root", trackar, "loc2mas");  
  
    double chi2=fit_tracks(trackar, alpha, nt);  
  
    for (int i=0; i<6; i++) printf("%10.3f", x[i]);  
    printf("%15.3f\n", chi2);  
  
    f=chi2;  
    if (iflag==3) show_residuals(nt);  
}  
/******
```

deducing the misalignment from the data

results of the minimization (simplex)

input misalignment	$rd\varphi$ (cm)	dz (cm)	dr (cm)	rot φ (deg)	rot z (deg)	rot r (deg)
1 cm shift in φ	0.92 (50)	fixed 0	0.48 (50)	fixed 0	fixed 0	fixed 0
-5 cm shift in r	-0.02 (50)	fixed 0	-4.25 (50)	fixed 0	fixed 0	fixed 0