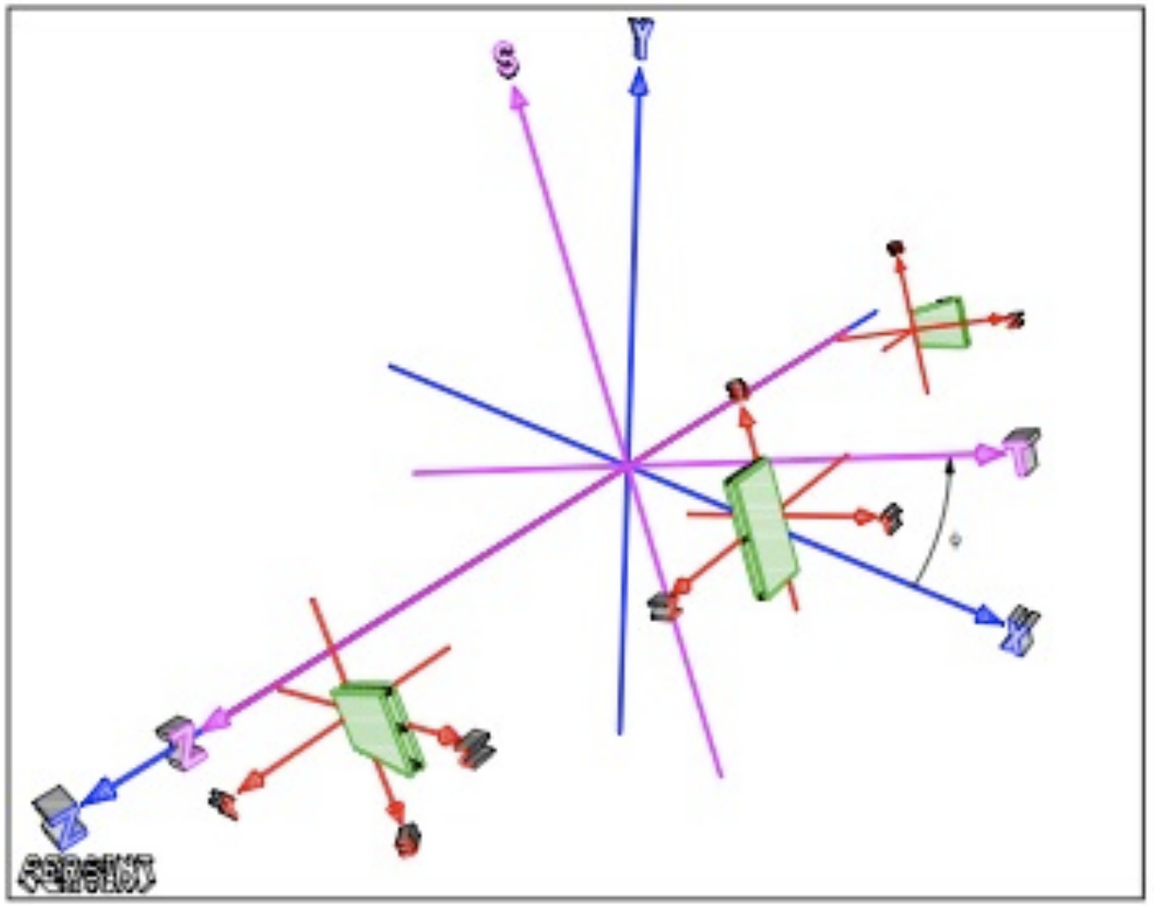
B-Lines implementation in MGM

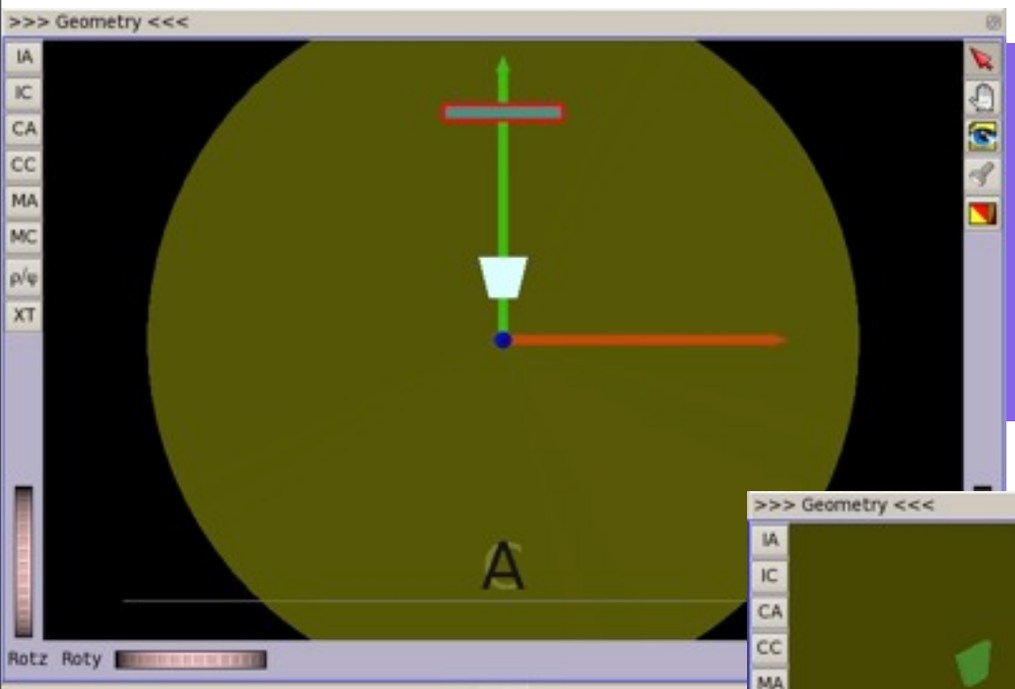
S. Spagnolo

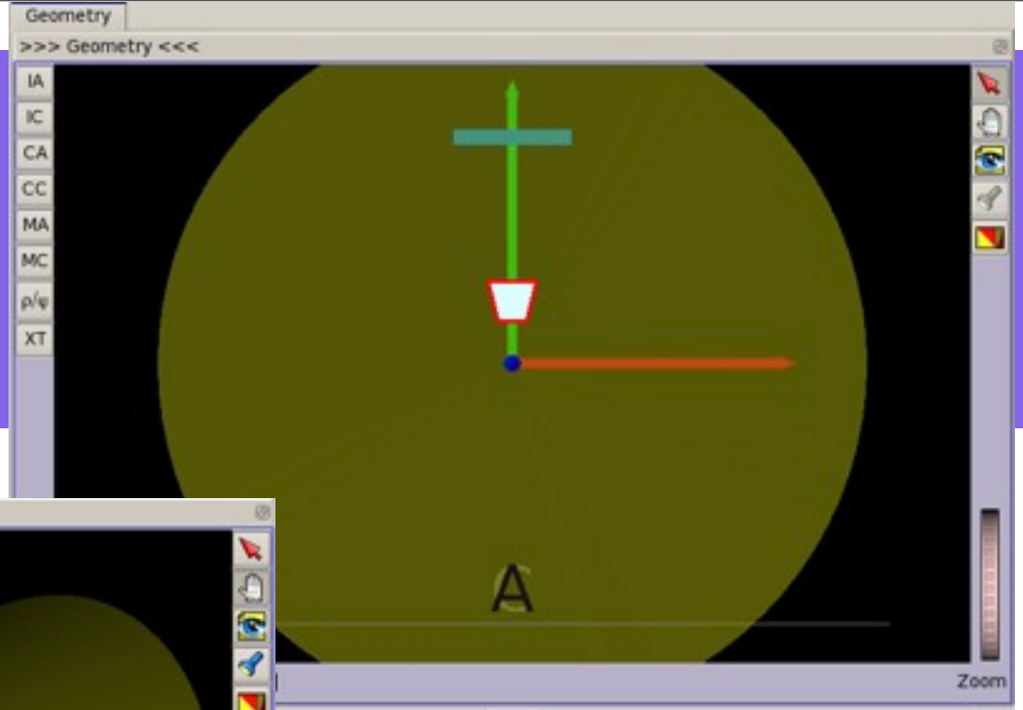
- reminder

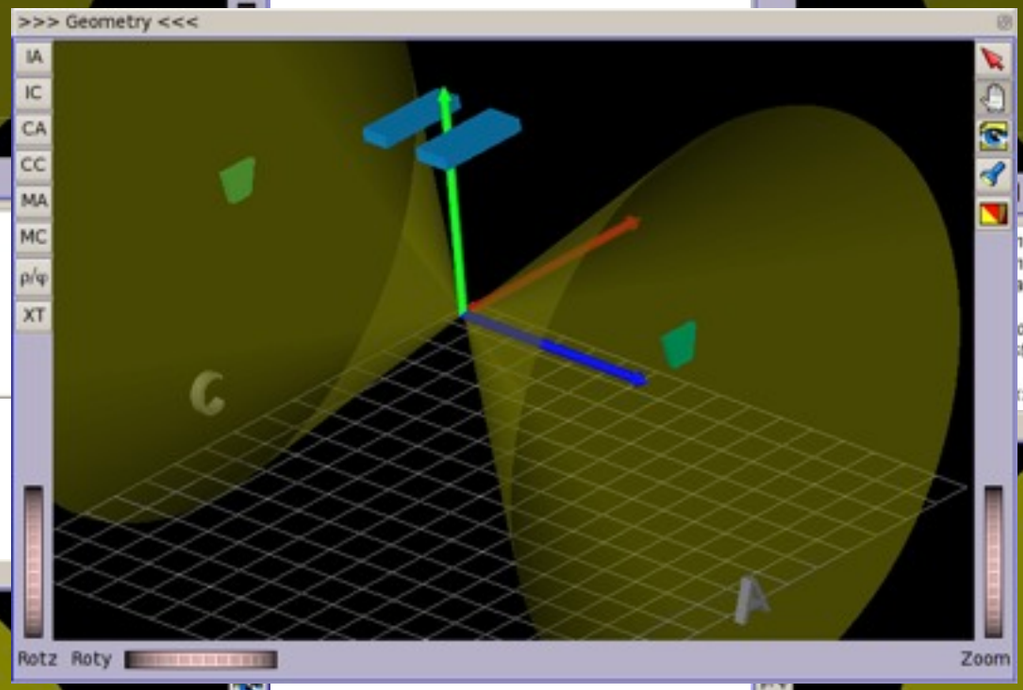


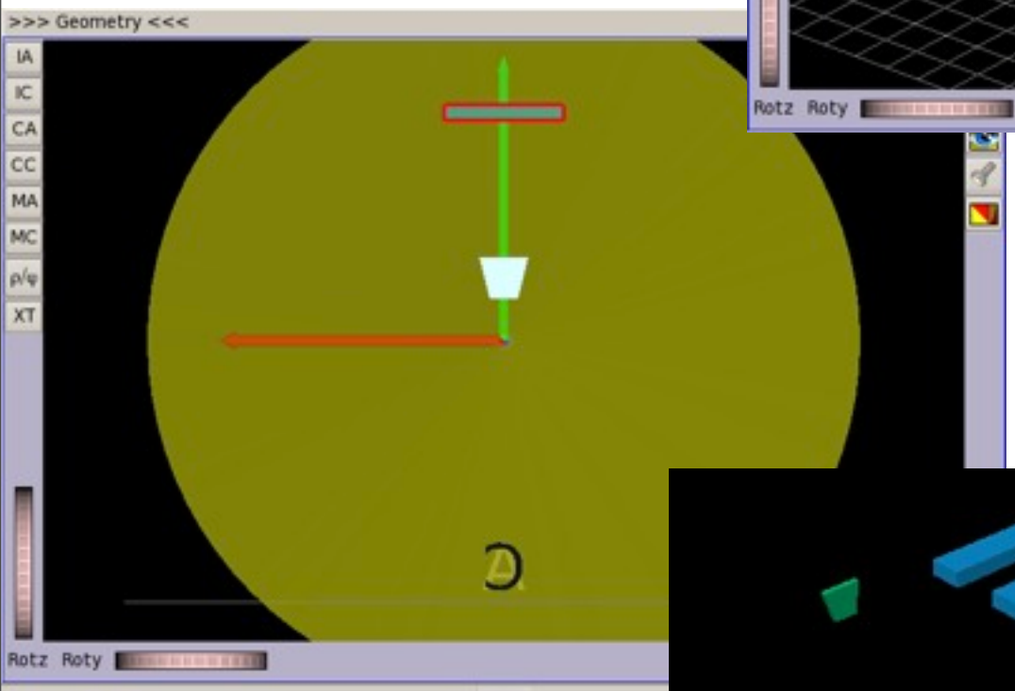
Check implementation

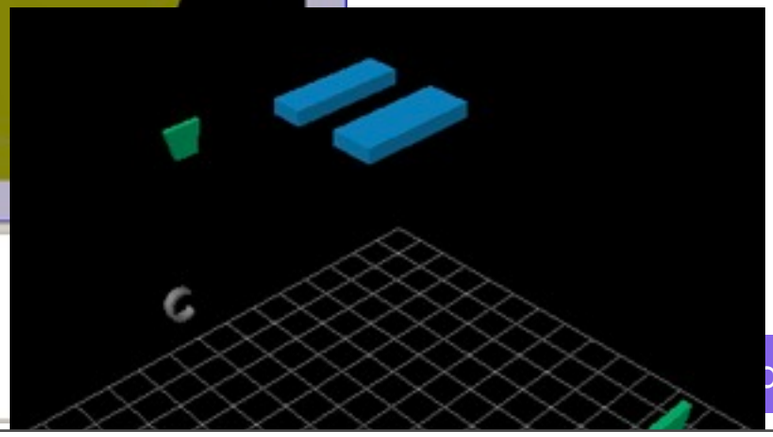
- Concentrate on BOL and EML in sector 5 (stationPhi=3) and StationEta=+-1 (to check both C and A side)
  - Barrel, sector 5, side A ➛ amdb local **szt** frame is equal (but translated) to **-x,z,y** (global ATLAS frame)
  - Barrel, sector 5, side C ➛ amdb local **szt** frame is equal (but translated) to **-x,z,y** (global ATLAS frame) [equal to side A]
  - End-cap, sector 5, side A ➛ amdb local **szt** frame is equal (but translated) to **x,y,z** (global ATLAS frame)
  - End-cap, sector 5, side C ➛ amdb local **szt** frame is equal (but translated) to **-x,y,-z** (global ATLAS frame)
- baseline layout: ATLAS-GEO-10-00-01, conditions

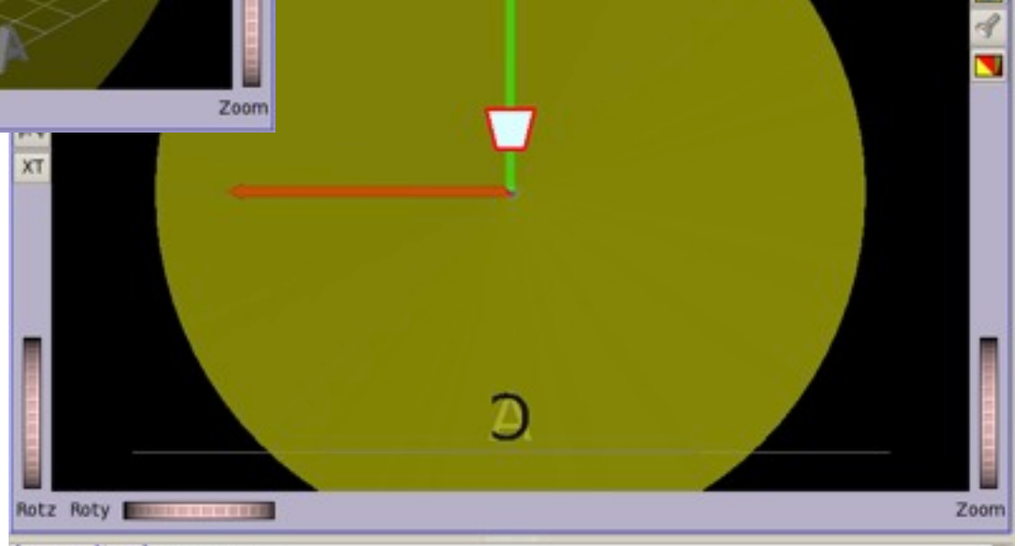













```
[Geometry/Geo] Y2 = 2493 mm
[Geometry/Geo] Z = 968.629 mm
[Geometry/Geo] ===> Material:
[Geometry/Geo] Air
[Geometry/Geo] ===> CopyNo : 103
[Geometry/Geo] ===> Muon station <===
[Geometry/Geo] Name: BOL
[Geometry/Geo] (Eta,Phi) index: (1, 3)
```

```
o : Error reconstructing copynumber
station <===
: (1, 3)
```

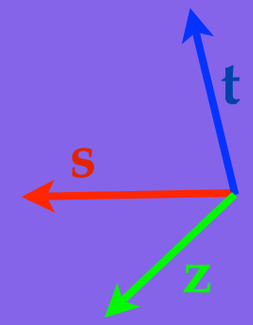
```
[Geometry/Geo] Y2 = 2493 mm
[Geometry/Geo] Z = 728.349 mm
[Geometry/Geo] ===> Material:
[Geometry/Geo] Air
[Geometry/Geo] ===> CopyNo : Error reconstructing copynumber
[Geometry/Geo] ===> Muon station <===
[Geometry/Geo] Name: BOL
[Geometry/Geo] (Eta,Phi) index: (-1, 3)
```

```
[Geometry/Geo] Y2 = 1017 mm
[Geometry/Geo] Z = 848.489 mm
[Geometry/Geo] ===> Material:
[Geometry/Geo] Air
[Geometry/Geo] ===> CopyNo : Error reconstructing copynumber
[Geometry/Geo] ===> Muon station <===
[Geometry/Geo] Name: EML
[Geometry/Geo] (Eta,Phi) index: (-1, 3)
```

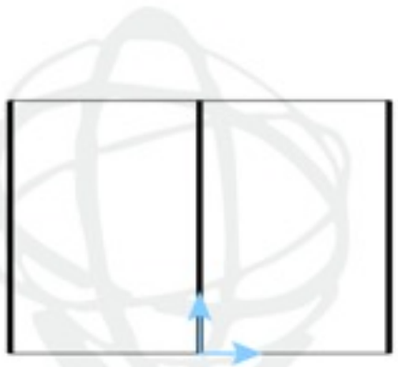
del Salento

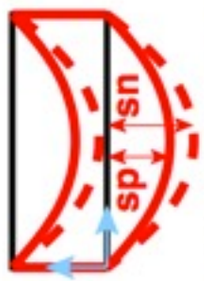
CERN, Muon SW,Feb 1st, 2011

sp=10mm BOL



Cross Plate Sag out of Plane: sp,sn (2 Parameters)





- **sp,sn:**

  sag of cross plates out of chamber plane, tubes remain straight

  maximum elongation along cross plate (at center) equals sp at P-side cross-plate, and sn at N-side cross-plate, positive for sag towards negative *t*

  unit: mm

  typical: $\mathcal{O}(10\,\mu m)$

  formula:

$$\phi = \tfrac{1}{2}(sp + sn)\cdot(z_{rel}^2 - 1) + \tfrac{1}{2}(sp - sn)\cdot(z_{rel}^2 - 1)\cdot s_{rel}$$

  transformation:

$$s \to s$$
$$t \to t + \phi$$
$$z \to z$$

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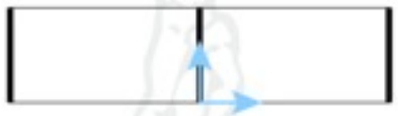
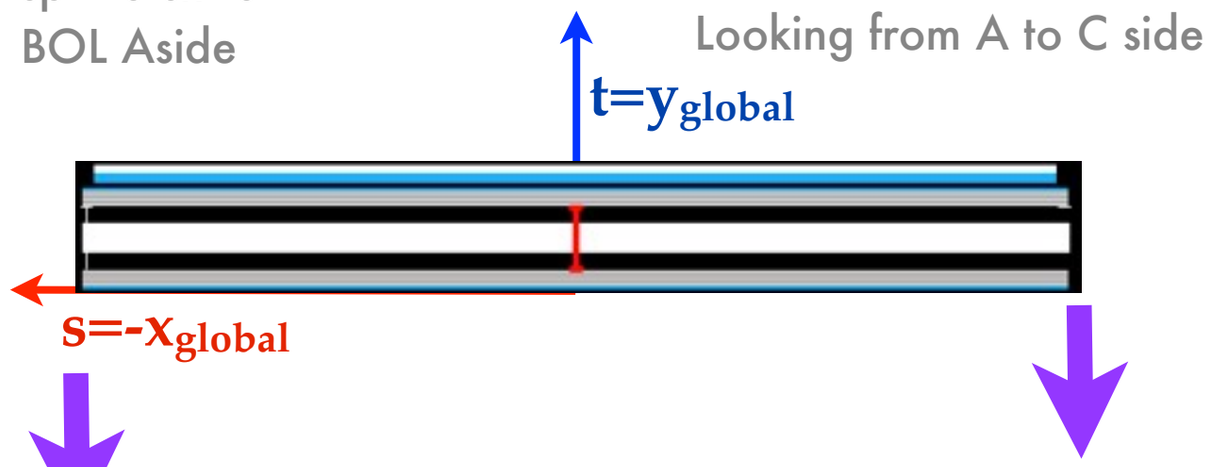
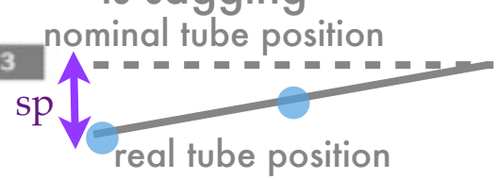


sp ≠ 0 sn=0
BOL Aside

Looking from A to C side

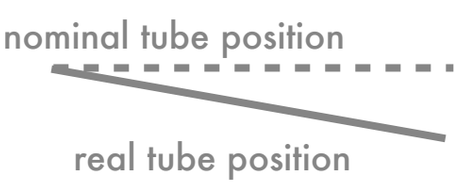


sp > 0 sn=0
this cross plate
is sagging



if tube #=Ntube/2

sp =0 sn > 0
this cross plate is
sagging



sp = 10. mm

[7.4.1.3.0.1.1.1] wire global pos (0.0000,9274.3029,405.0170) Tube length is 4961.4999
RO side tube end-point (-2453.7500,**9274.1507**,405.0170)
HV side tube end-point (2453.7500,9274.4550,405.0170)
[7.4.1.3.0.1.1.**33**] wire global pos (0.0000,9269.4570,1366.1370) Tube length is 4961.4999
RO side tube end-point (-2453.7450,**9264.5117,**1366.1370)
HV side tube end-point (2453.7450,9274.4023,1366.1370)

x,y,z global frame

sp = 0. mm

[7.4.1.3.0.1.1.1] wire global pos (0.0000,9274.4567,405.0170)

sp parameter implementation in barrel A and C OK

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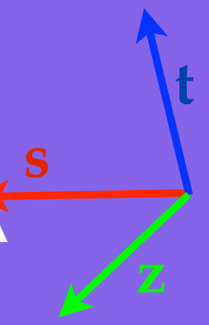
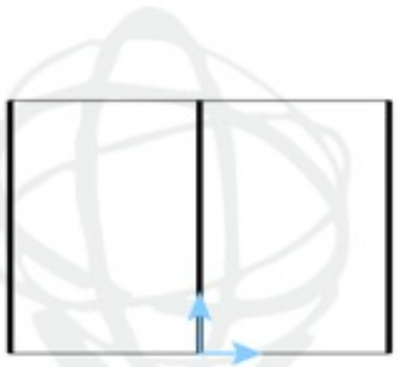
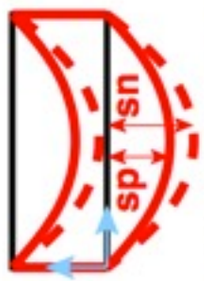
sp=10mm EML-A



Cross Plate Sag out of Plane: sp,sn (2 Parameters)





- **sp,sn:**

  sag of cross plates out of chamber plane, tubes remain straight

  maximum elongation along cross plate (at center) equals sp at P-side cross-plate, and sn at N-side cross-plate, positive for sag towards negative *t*

  unit: mm

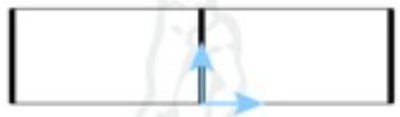
  typical: $\mathcal{O}(10\,\mu\text{m})$

  formula:

$$\phi = \tfrac{1}{2}(\text{sp}+\text{sn})\cdot(z_{\text{rel}}^2-1) + \tfrac{1}{2}(\text{sp}-\text{sn})\cdot(z_{\text{rel}}^2-1)\cdot s_{\text{rel}}$$

  transformation:

$$s \to s$$
$$t \to t+\phi$$
$$z \to z$$



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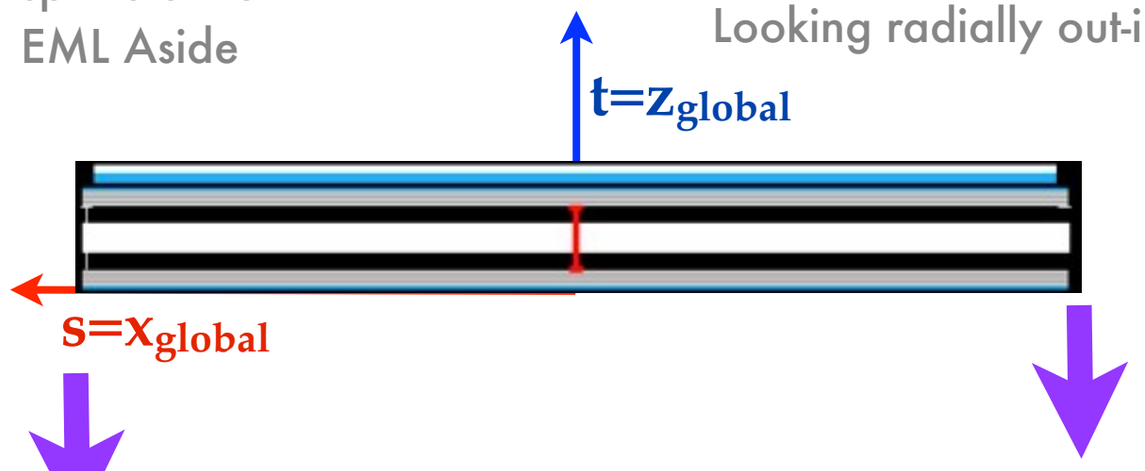
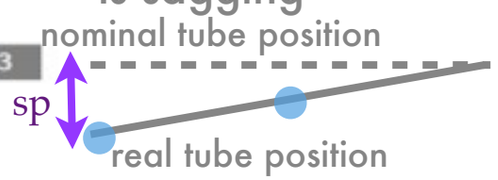
sp ≠ 0 sn=0
EML Aside

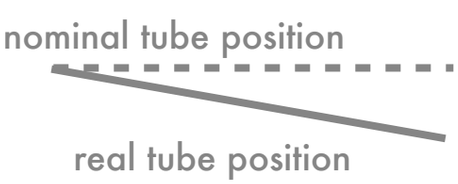
Looking radially out-in



sp > 0 sn=0
this cross plate
is sagging



sp =0 sn > 0
this cross plate is
sagging



if tube #=Ntube/2

sp = 10. mm

[7.17.1.3.0.1.1.1] wire global pos (0.0000,1785.0170,14142.3220) Tube length is 1186.5000
RO side tube end-point (-566.2500,1785.0170,14142.4884)
HV side tube end-point (566.2500,1785.0170,**14142.1557**)
[7.17.1.3.0.1.1.29] wire global pos (0.0000,2625.9970,14137.4979) Tube length is 1546.4999
RO side tube end-point (-746.2356,2625.9970,14142.1210)
HV side tube end-point (746.2356,2625.9970,**14132.8747**)

x,y,z global frame

sp = 0. mm

[7.17.1.3.0.1.1.1] wire global pos (0.0000,1785.0170,14142.3220)

sp parameter implementation in EC A OK

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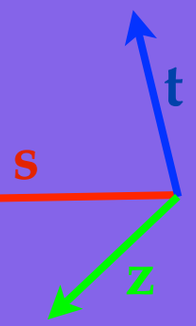
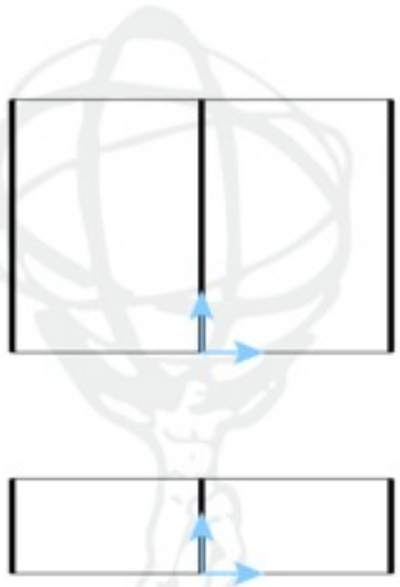
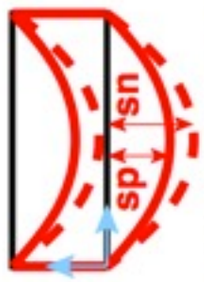
sp=10mm EML-C



Cross Plate Sag out of Plane: sp,sn (2 Parameters)





- **sp,sn:**

  sag of cross plates out of chamber plane, tubes remain straight

  maximum elongation along cross plate (at center) equals sp at P-side cross-plate, and sn at N-side cross-plate, positive for sag towards negative t

  unit: mm

  typical: $\mathcal{O}(10\,\mu\text{m})$

  formula:

$$\phi = \tfrac{1}{2}(\text{sp}+\text{sn})\cdot(z_{\text{rel}}^2-1) + \tfrac{1}{2}(\text{sp}-\text{sn})\cdot(z_{\text{rel}}^2-1)\cdot s_{\text{rel}}$$

  transformation:

$$s \to s$$
$$t \to t + \phi$$
$$z \to z$$

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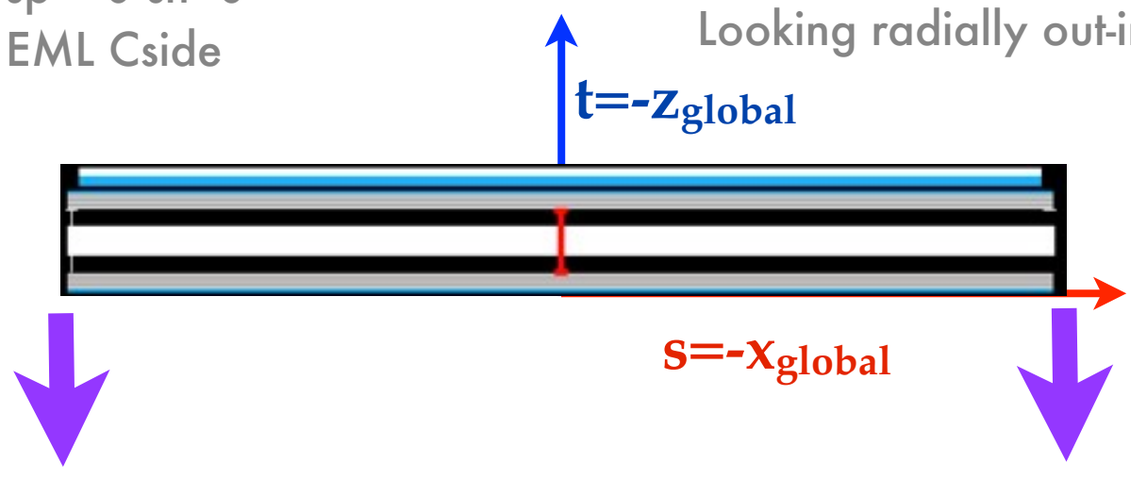
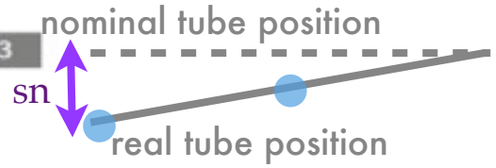
sp ≠ 0 sn=0
EML Cside

Looking radially out-in

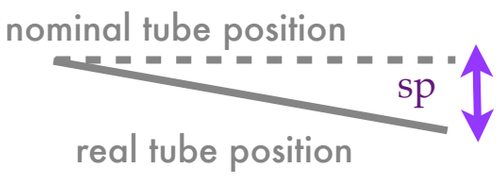


sn > 0 sp=0
this cross plate
is sagging



if tube #=Ntube/2

sp > 0 sn = 0
this cross plate is
sagging



sp = 10. mm

[7.17.-1.3.0.1.1.1] wire global pos (0.0000,1785.0170,-14142.3220) Tube length is 1546.4999
RO side tube end-point (-566.2500,1785.0170,**-14142.1557**)
HV side tube end-point (566.2500,1785.0170,-14142.4884)
[7.17.-1.3.0.1.1.29] wire global pos (0.0000,2625.9970,-14137.4979) Tube length is 1546.4999
RO side tube end-point (-746.2356,2625.9970,**-14132.8747**)
HV side tube end-point (746.2356,2625.9970,-14142.1210)

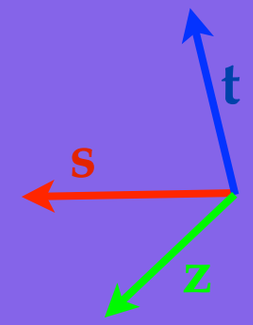
x,y,z global frame

sp = 0. mm

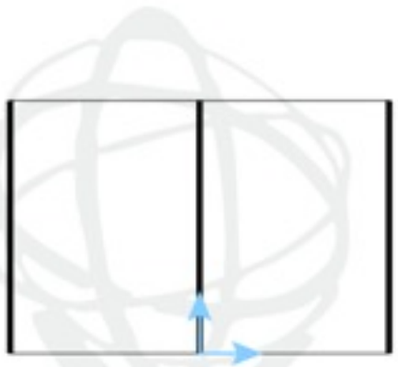
[7.17.-1.3.0.1.1.1] wire global pos (0.0000,1785.0170,-14142.3220)

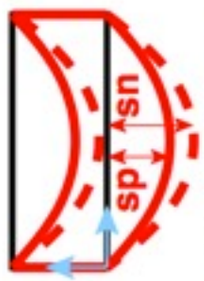
sp parameter implementation in EC C OK

sn=20mm BOL



Cross Plate Sag out of Plane: sp,sn (2 Parameters)





- **sp,sn:**

  sag of cross plates out of chamber plane, tubes remain straight

  maximum elongation along cross plate (at center) equals sp at P-side cross-plate, and sn at N-side cross-plate, positive for sag towards negative *t*

  unit: mm

  typical: $\mathcal{O}(10\,\mu\text{m})$

  formula:

$$\phi = \tfrac{1}{2}(\text{sp}+\text{sn})\cdot(z_{\text{rel}}^2-1) + \tfrac{1}{2}(\text{sp}-\text{sn})\cdot(z_{\text{rel}}^2-1)\cdot s_{\text{rel}}$$

  transformation:

$$s \to s$$
$$t \to t+\phi$$
$$z \to z$$

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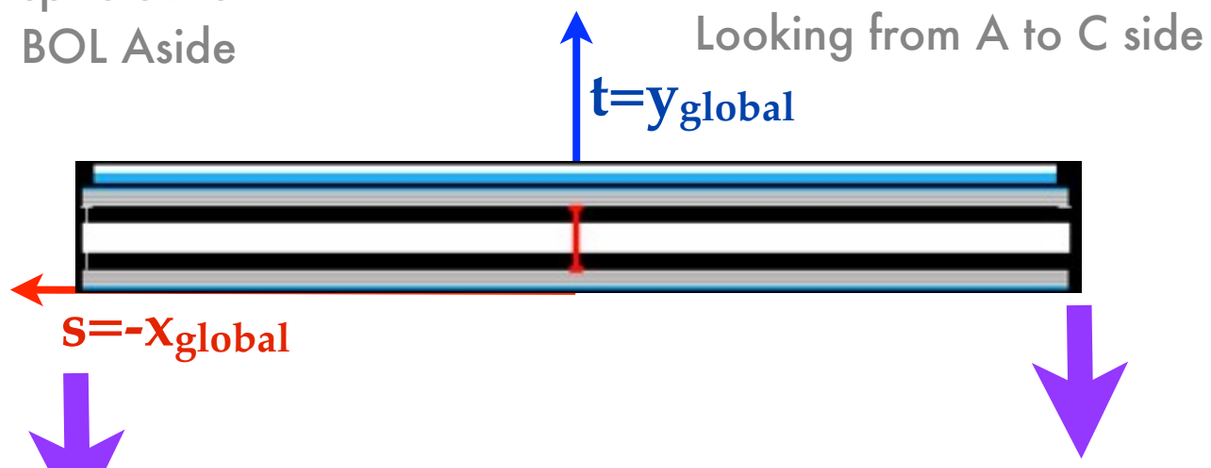
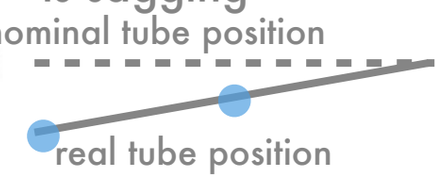
sp=0 sn>0
BOL Aside

Looking from A to C side

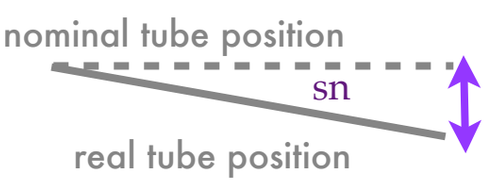


sp > 0 sn=0
this cross plate
is sagging



if tube #=Ntube/2

sp =0 sn > 0
this cross plate is
sagging



sn = 20. mm

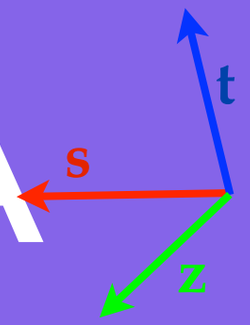
[7.4.1.3.0.1.1.1] wire global pos (0.0000,9274.1490,405.0170) Tube length is 4961.4999
RO side tube end-point (-2453.7500,**9274.4533**,405.0170) x,y,z global frame
HV side tube end-point (2453.7500,9273.8447,405.0170)
[7.4.1.3.0.1.1.33] wire global pos (0.0000,9264.4573,1366.1370) Tube length is 4961.4999
RO side tube end-point (-2453.7300,9274.3478,1366.1370)
HV side tube end-point (2453.7300,**9254.5668**,1366.1370)
7.4.-1.3.0.1.1.33] wire global pos (0.0000,9265.7586,-2566.1368) Tube length is 4961.4999
RO side tube end-point (-2453.7349,9274.3620,-2566.1368)
HV side tube end-point (2453.7349,**9257.1553**,-2566.1368)

sn = 0. mm

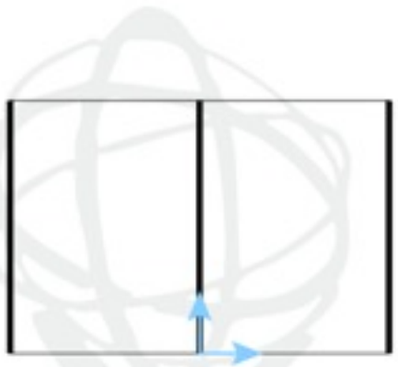
[7.4.1.3.0.1.1.1] wire global pos (0.0000,**9274.4567**,405.0170)

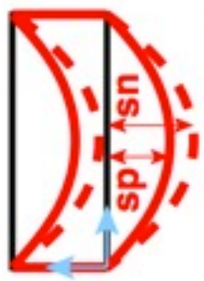
sn parameter implementation in barrel A and C OK

sn=10mm EML-A



Cross Plate Sag out of Plane: sp,sn (2 Parameters)





- **sp,sn:**

  sag of cross plates out of chamber plane, tubes remain straight

  maximum elongation along cross plate (at center) equals sp at P-side cross-plate, and sn at N-side cross-plate, positive for sag towards negative *t*

  unit: mm

  typical: $\mathcal{O}(10\,\mu\text{m})$

  formula:

$$\phi = \tfrac{1}{2}(\text{sp}+\text{sn})\cdot(z_{\text{rel}}^2-1) + \tfrac{1}{2}(\text{sp}-\text{sn})\cdot(z_{\text{rel}}^2-1)\cdot s_{\text{rel}}$$

  transformation:

$$s \to s$$
$$t \to t+\phi$$
$$z \to z$$

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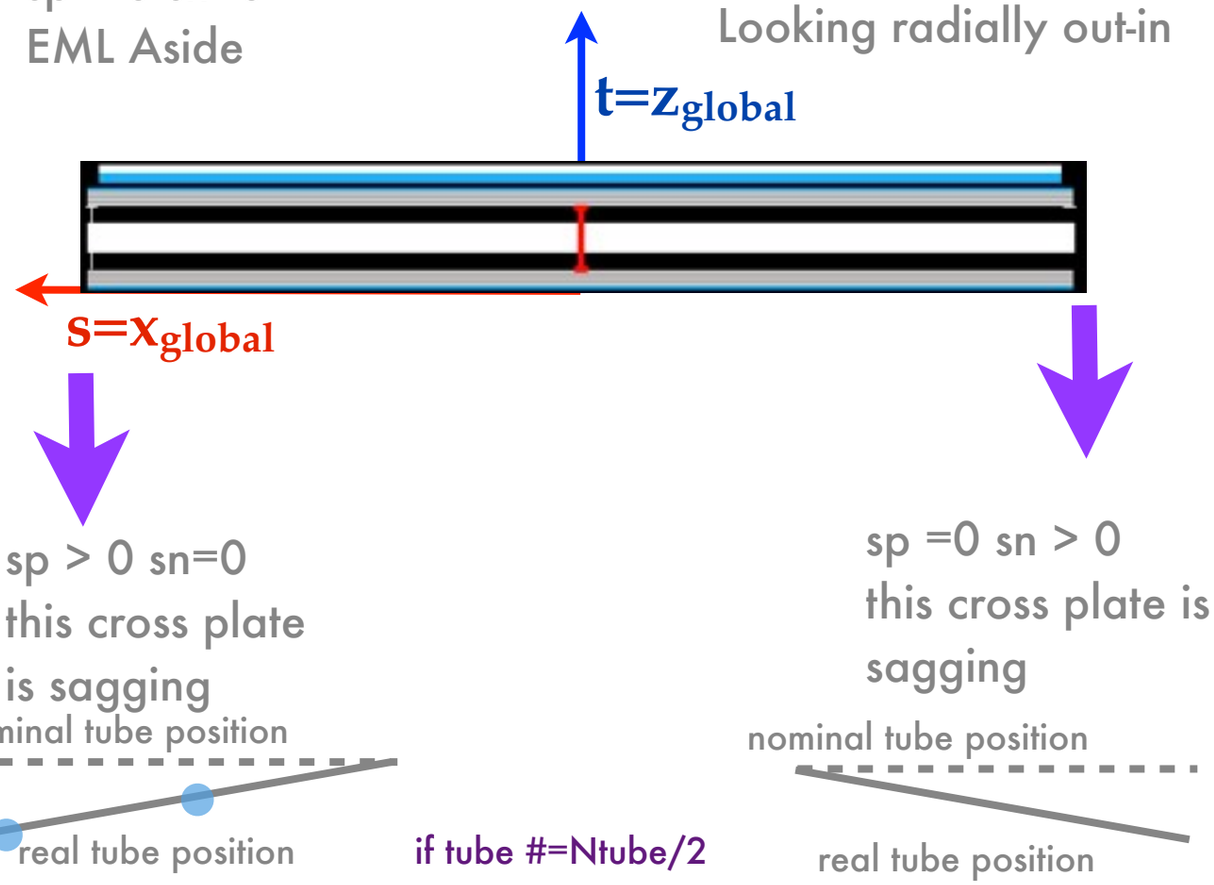
sp ≠ 0 sn=0
EML Aside

Looking radially out-in



sp = 10. mm

[7.17.1.3.0.1.1.1] wire global pos (0.0000,1785.0170,14142.3220) Tube length is 1186.5000
RO side tube end-point (-566.2500,1785.0170,14142.4884)
HV side tube end-point (566.2500,1785.0170,**14142.1557**)
[7.17.1.3.0.1.1.29] wire global pos (0.0000,2625.9970,14137.4979) Tube length is 1546.4999
RO side tube end-point (-746.2356,2625.9970,14142.1210)
HV side tube end-point (746.2356,2625.9970,**14132.8747**)

x,y,z global frame

sp = 0. mm

[7.17.1.3.0.1.1.1] wire global pos (0.0000,1785.0170,14142.3220)

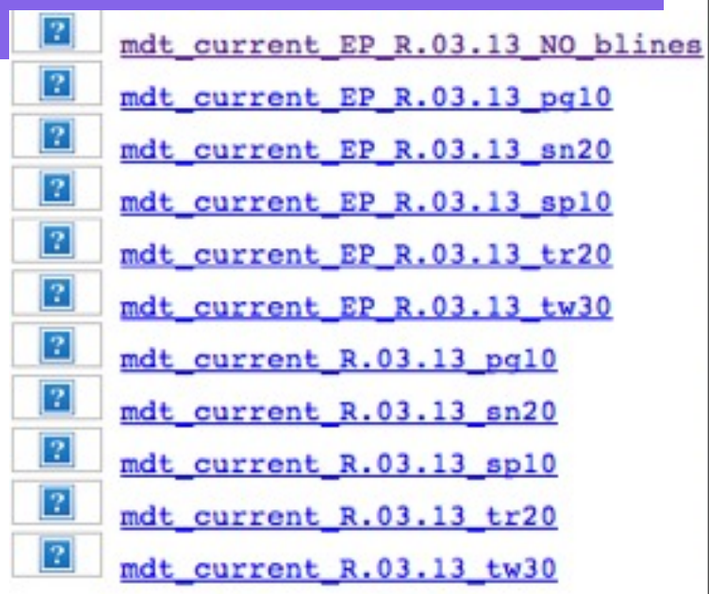
sp parameter implementation in EC A OK

All numbers from MGM

******

http://www.fisica.unisalento.it/~spagnolo/allow_listing/MDTDeformations/

******



Files named mdt_current_EP_*
contain
[atlas id of the tube] xRO, yRO, zRO, xCenter, yCenter,zCenter, xHV, yHV, zHV
for all tubes of
BOL in sector 5 at eta + and -1, i.e. [7.4.eta.3.0.1.1.tube#]
EML in sector 5 at eta + and -1, i.e. [7.17.eta.3.0.1.1.tube#]
coordinates are in the global ATLAS reference frame

Each file corresponds to a single B-line parameter being different than 0, value in the file name

Files named mdt_current_R.03_13_*
contains similar info with a few more details including A and B lines used

Numbers from MGM example

mdt_current_EP_R.03.13_NO_blines reference

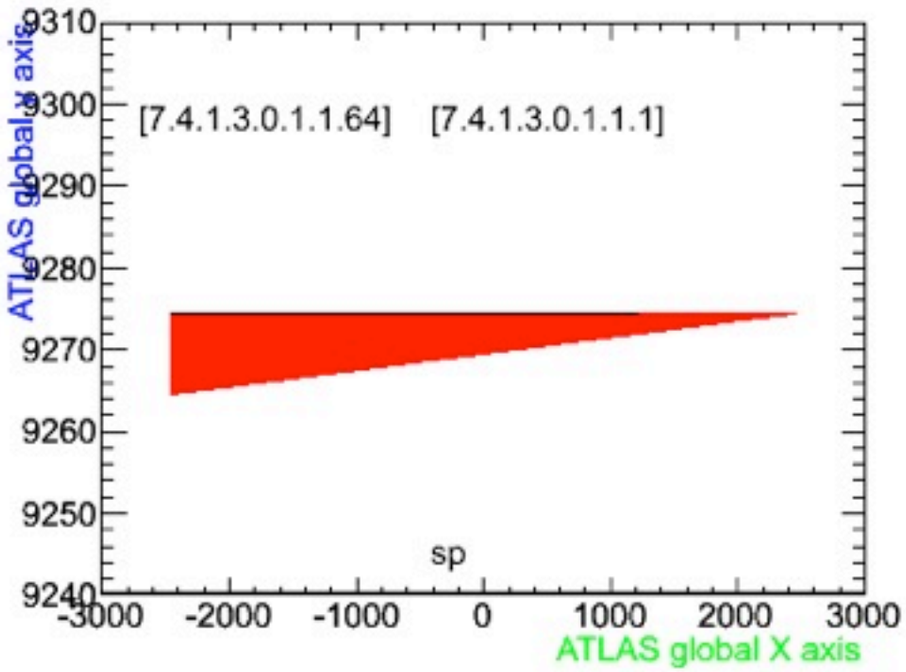
```
[7.4.-1.3.0.1.1.1]    -2453.7500 9274.4567 -1605.0168   0.0000 9274.4567 -1605.0168   2453.7500 9274.4567 -1605.0168
[7.4.-1.3.0.1.1.2]    -2453.7500 9274.4567 -1635.0518   0.0000 9274.4567 -1635.0518   2453.7500 9274.4567 -1635.0518
[7.4.-1.3.0.1.1.3]    -2453.7500 9274.4567 -1665.0868   0.0000 9274.4567 -1665.0868   2453.7500 9274.4567 -1665.0868
[7.4.-1.3.0.1.1.4]    -2453.7500 9274.4567 -1695.1218   0.0000 9274.4567 -1695.1218   2453.7500 9274.4567 -1695.1218
[7.4.-1.3.0.1.1.5]    -2453.7500 9274.4567 -1725.1568   0.0000 9274.4567 -1725.1568   2453.7500 9274.4567 -1725.1568
[7.4.-1.3.0.1.1.6]    -2453.7500 9274.4567 -1755.1918   0.0000 9274.4567 -1755.1918   2453.7500 9274.4567 -1755.1918
[7.4.-1.3.0.1.1.7]    -2453.7500 9274.4567 -1785.2268   0.0000 9274.4567 -1785.2268   2453.7500 9274.4567 -1785.2268
[7.4.-1.3.0.1.1.8]    -2453.7500 9274.4567 -1815.2618   0.0000 9274.4567 -1815.2618   2453.7500 9274.4567 -1815.2618
[7.4.-1.3.0.1.1.9]    -2453.7500 9274.4567 -1845.2968   0.0000 9274.4567 -1845.2968   2453.7500 9274.4567 -1845.2968
```

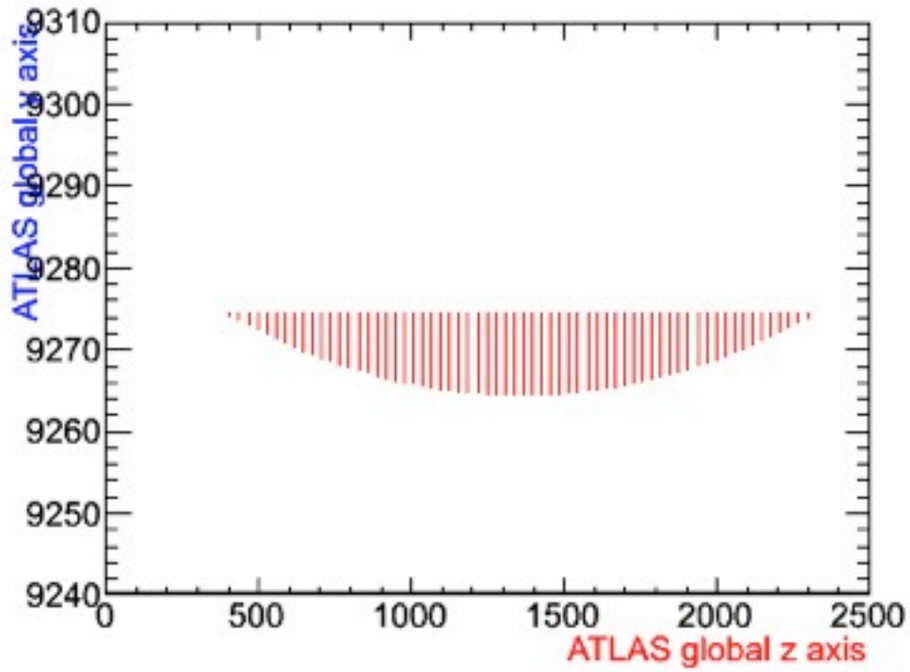
distance of RO or HV side from tute center in ideal geometry

mdt_current_EP_R.03.13_tw30

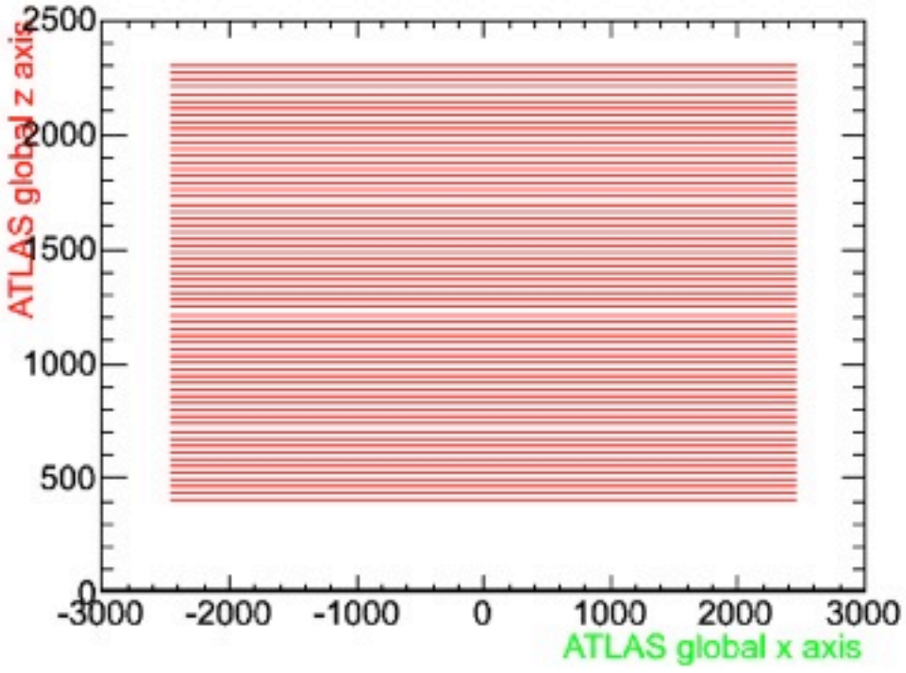
```
[7.4.-1.3.0.1.1.1]    -2453.5849 9246.0088 -1605.7710   0.0000 9274.4567 -1605.0168   2453.5849 9302.9046 -1604.2627
[7.4.-1.3.0.1.1.2]    -2453.5988 9247.2322 -1635.8060   0.0000 9274.4567 -1635.0518   2453.5988 9301.6812 -1634.2977
[7.4.-1.3.0.1.1.3]    -2453.6121 9248.4556 -1665.8410   0.0000 9274.4567 -1665.0868   2453.6121 9300.4578 -1664.3327
[7.4.-1.3.0.1.1.4]    -2453.6247 9249.6790 -1695.8760   0.0000 9274.4567 -1695.1218   2453.6247 9299.2343 -1694.3677
[7.4.-1.3.0.1.1.5]    -2453.6368 9250.9025 -1725.9110   0.0000 9274.4567 -1725.1568   2453.6368 9298.0109 -1724.4027
[7.4.-1.3.0.1.1.6]    -2453.6482 9252.1260 -1755.9460   0.0000 9274.4567 -1755.1918   2453.6482 9296.7874 -1754.4377
```

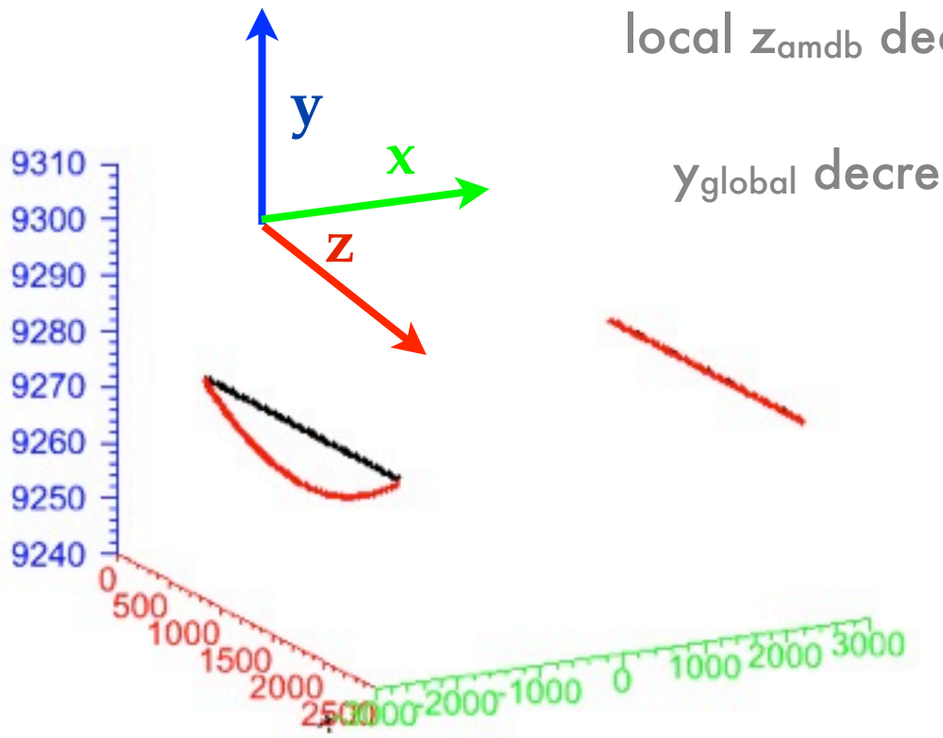
sp=10mm BOLA





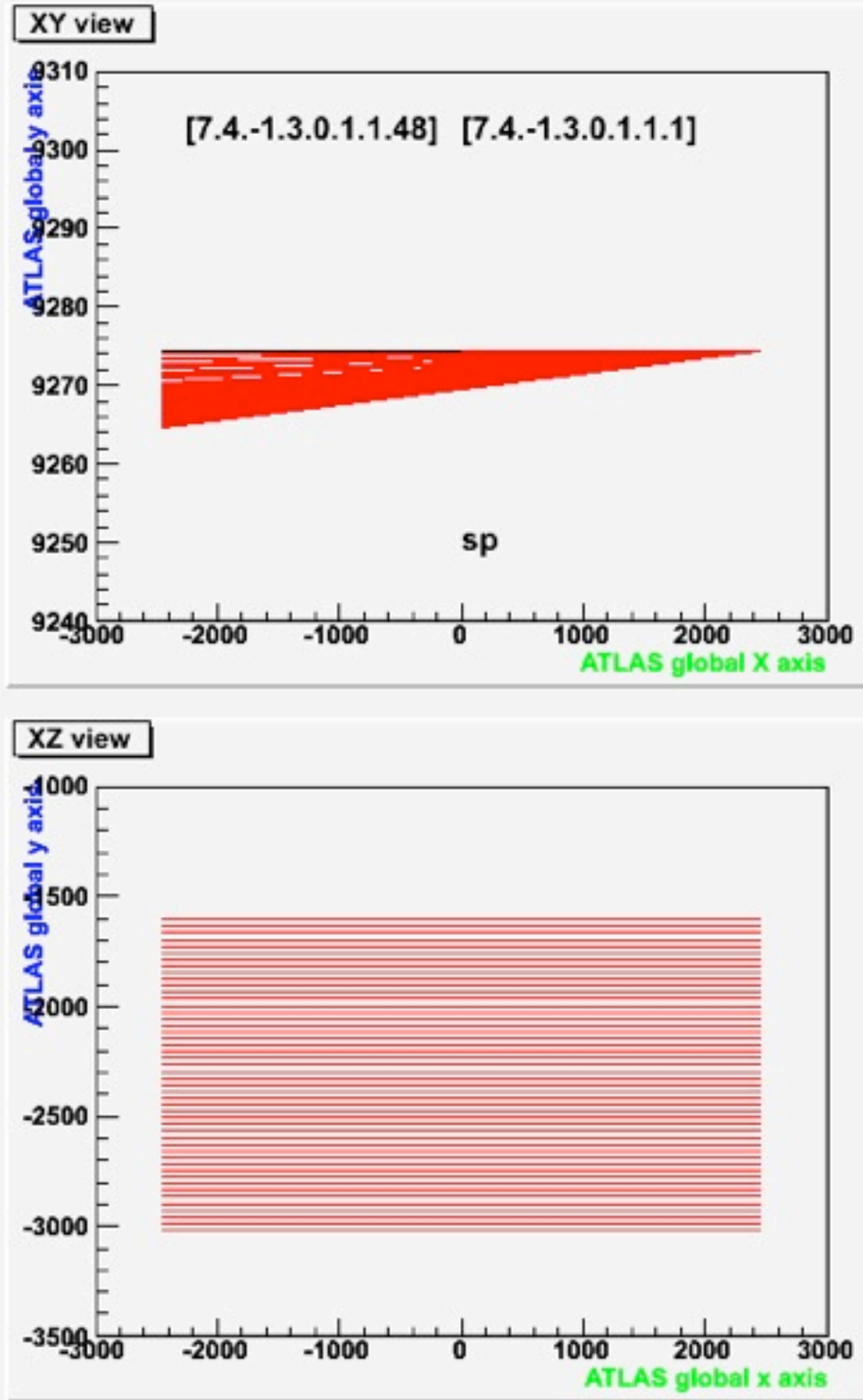
szt ➽-x,z,y





local z_{amdb} decreasing at $s_{amdb}>0$
i.e.
y_{global} decreasing at $x_{global}<0$

sp=10mm BOLC



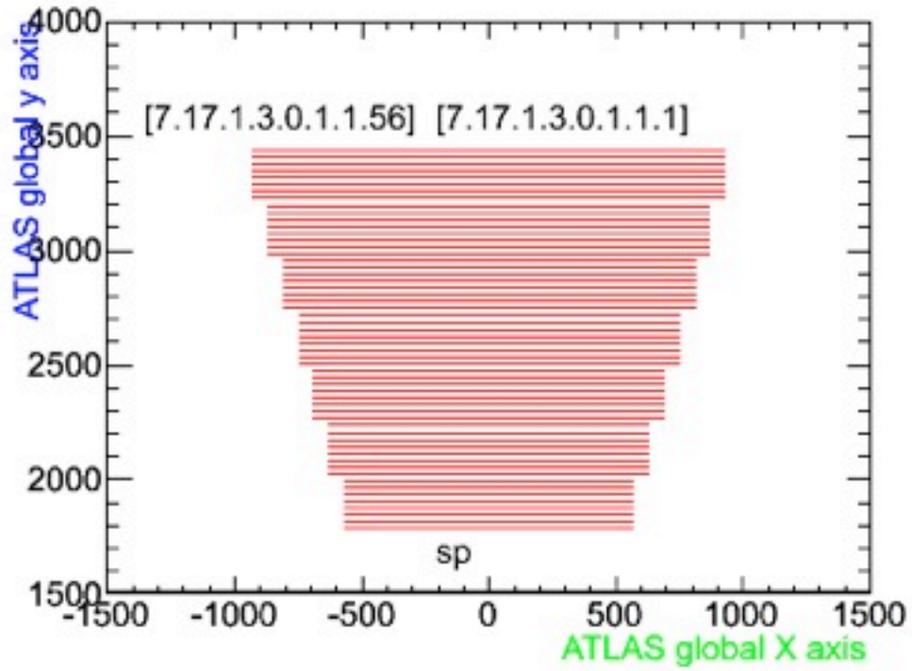
szt ➽ -x,z,y

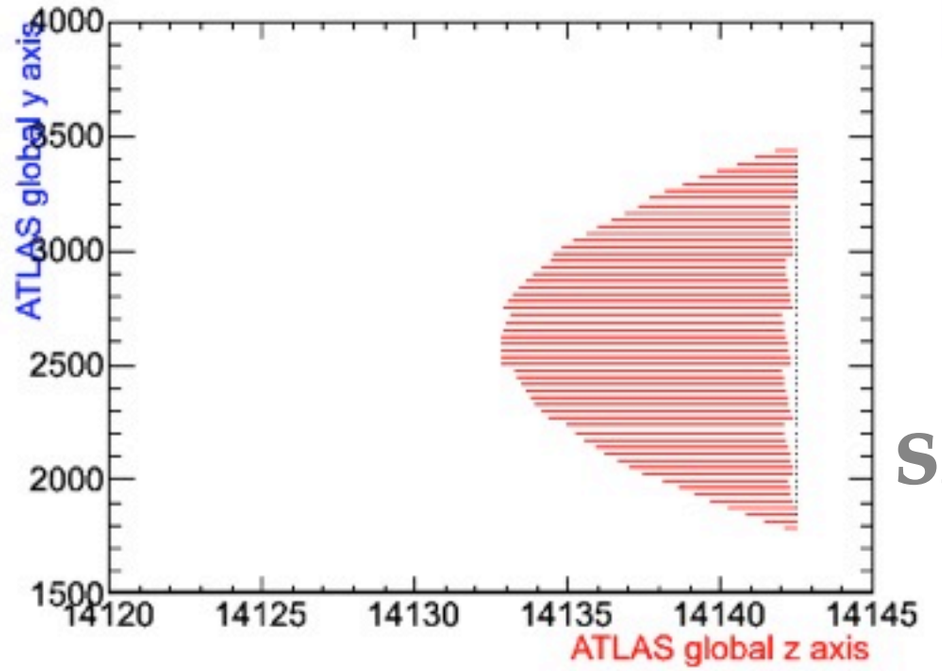
local z_{amdb} decreasing at $s_{amdb}>0$

i.e.

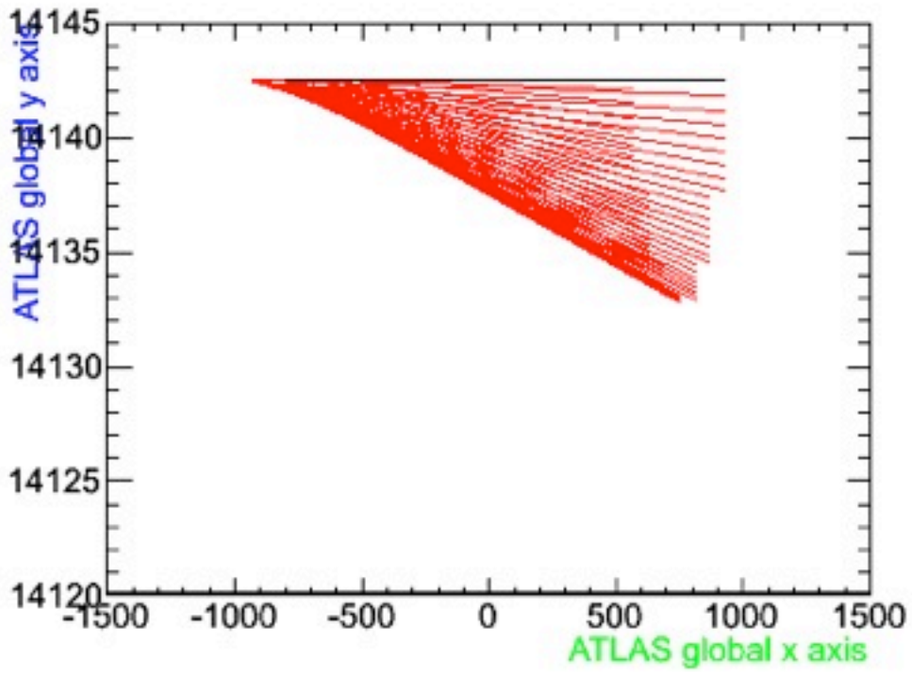
y_{global} decreasing at $x_{global}<0$

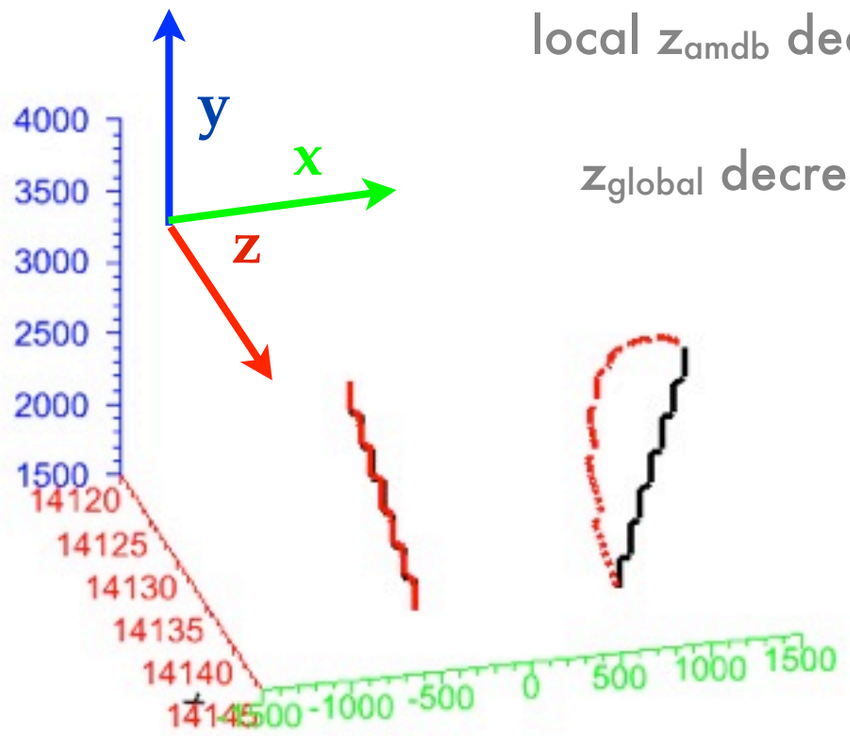
sp=10mm EMLA





szt ➽ x,z,y



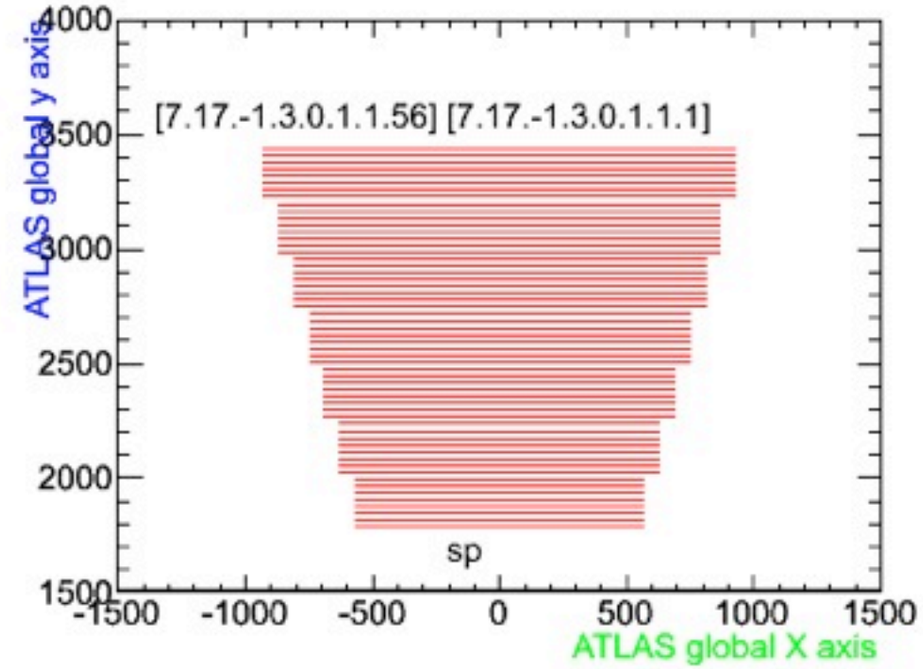


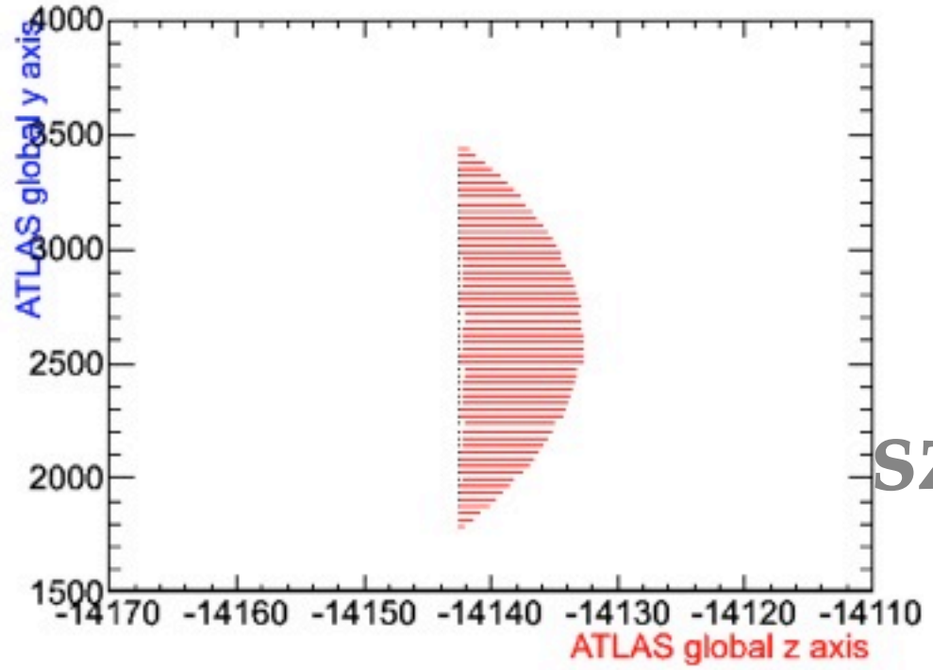
local z_{amdb} decreasing at $s_{amdb}>0$

i.e.

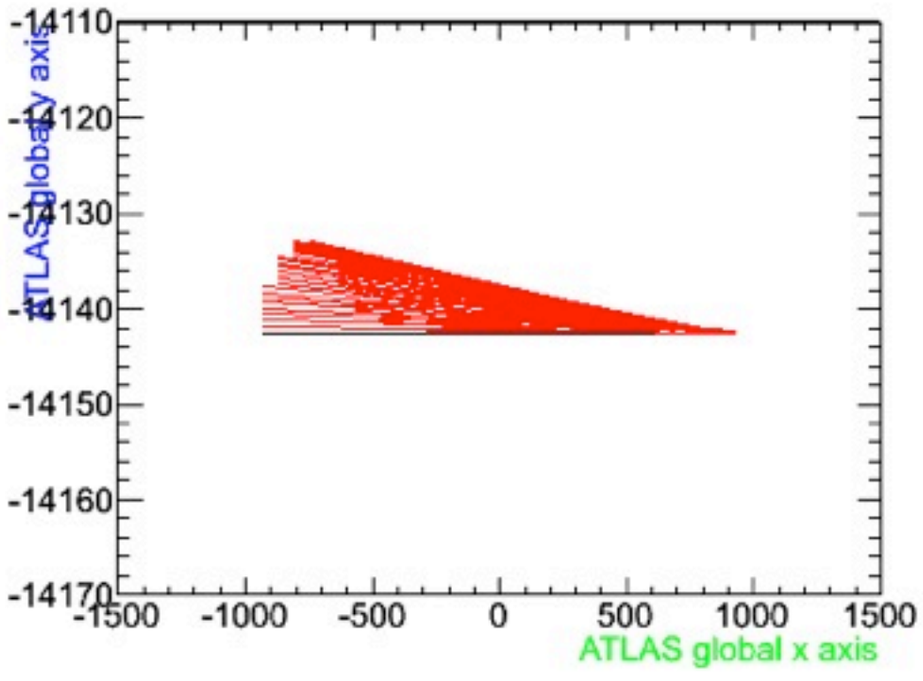
z_{global} decreasing at $x_{global}>0$

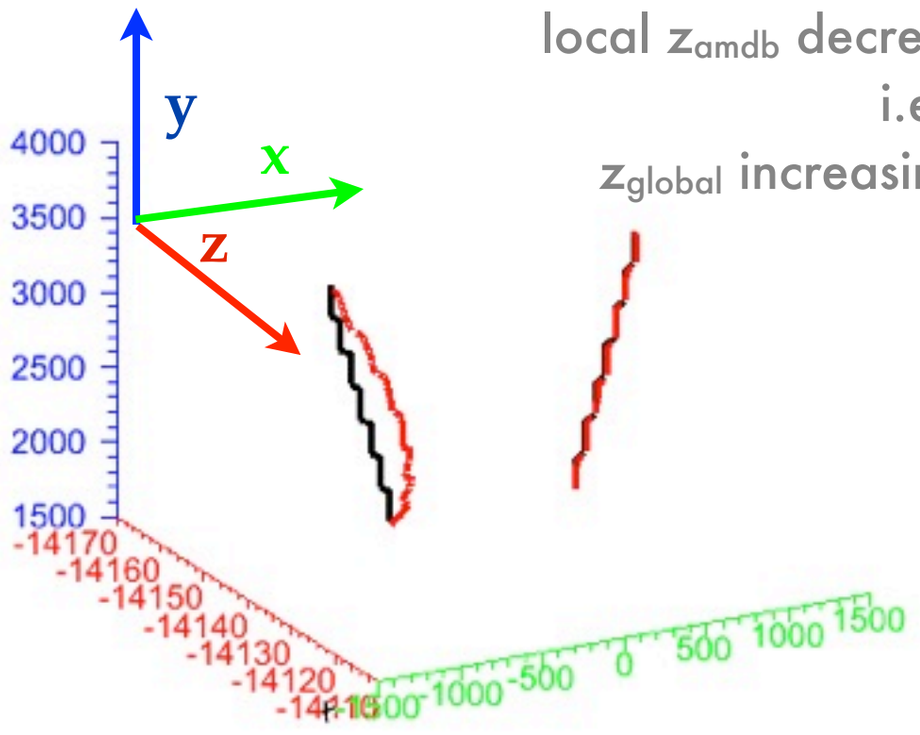
sp=10mm EMLC





szt ➽ -x,z,-y



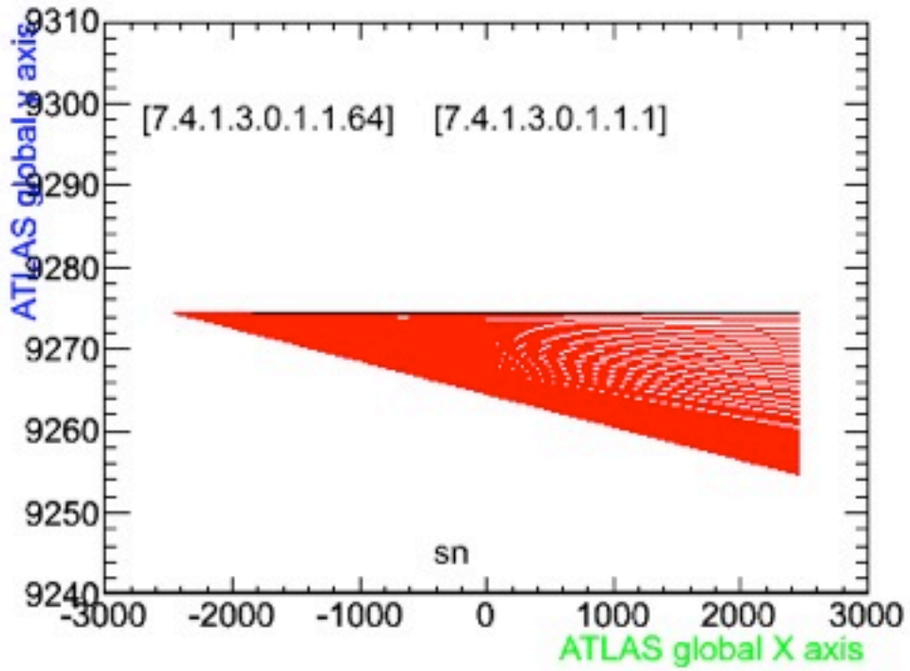


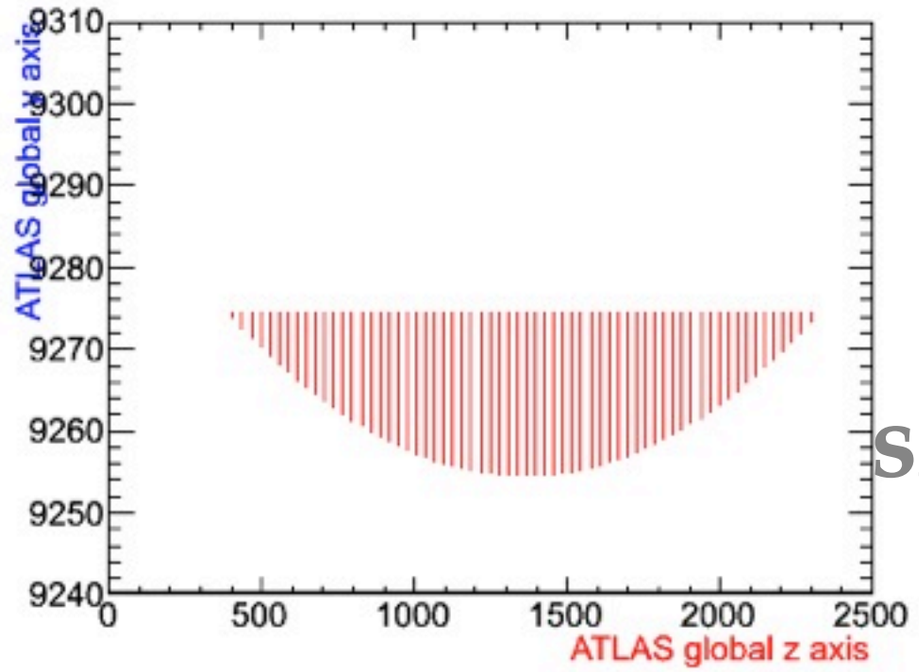
local z_{amdb} decreasing at $s_{amdb}>0$

i.e.

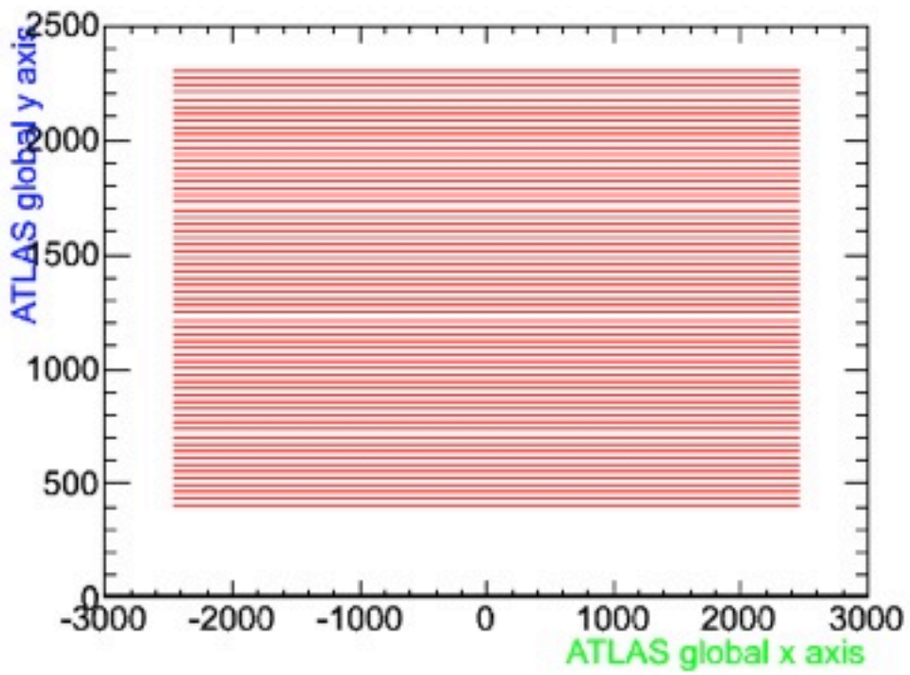
z_{global} increasing at $x_{global}<0$

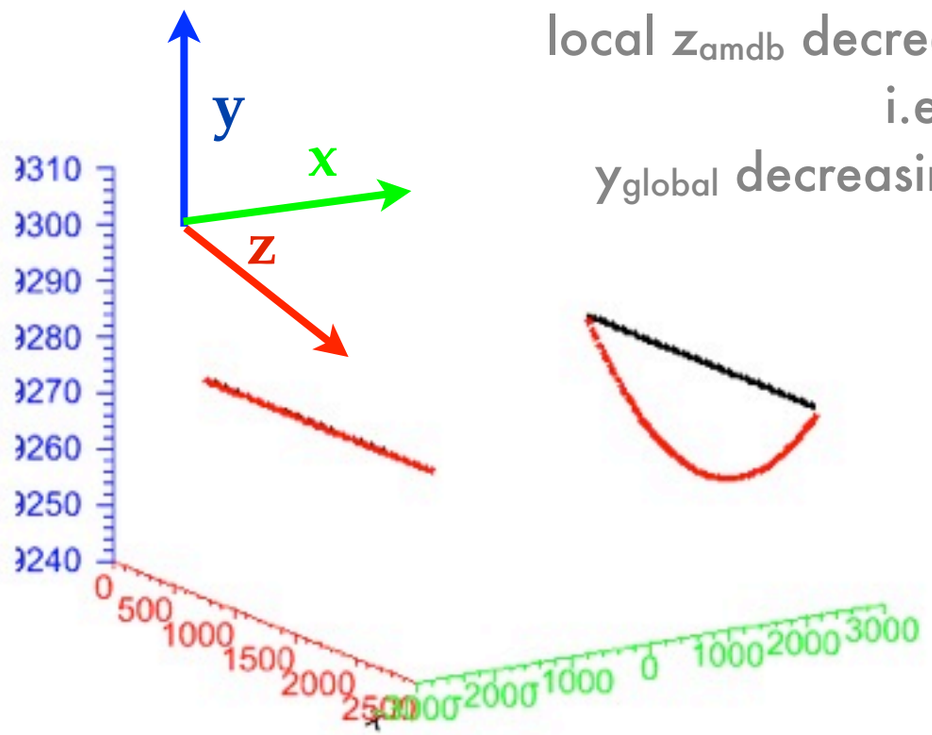
sn=10mm BOLA





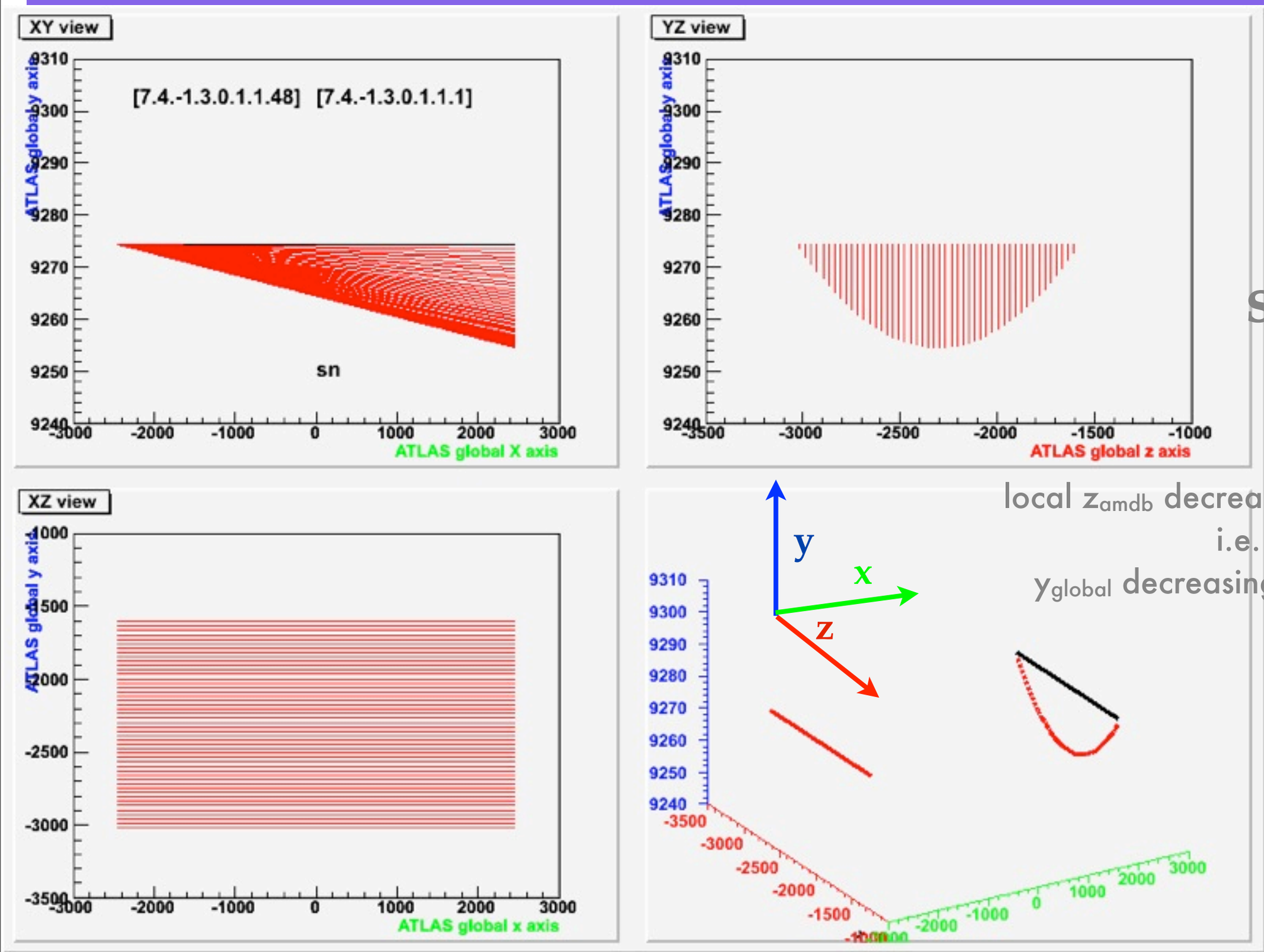
szt ➽-x,z,y





local z_{amdb} decreasing at $s_{amdb}<0$
i.e.
y_{global} decreasing at $x_{global}>0$

sn=10mm BOLC



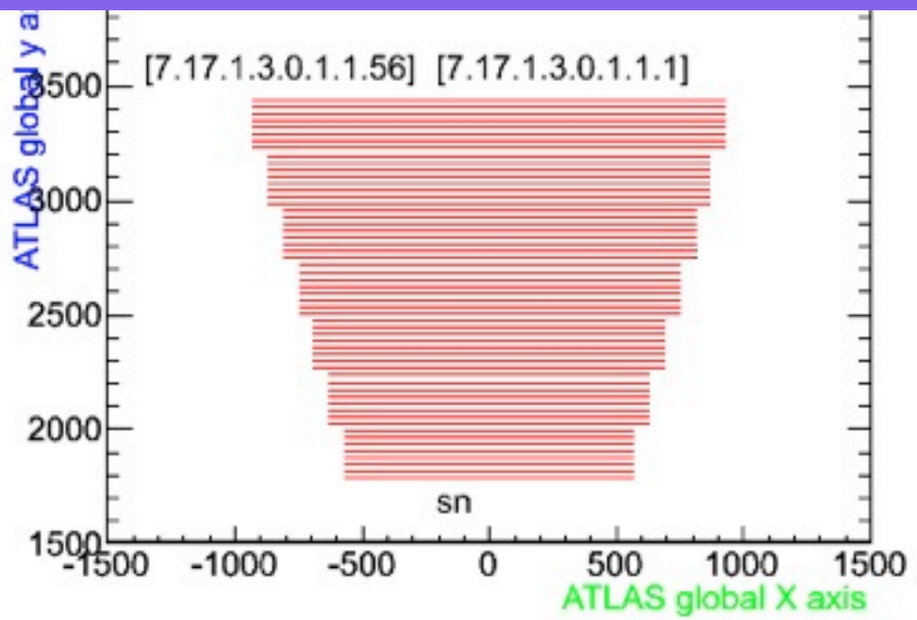
szt ➽-x,z,y

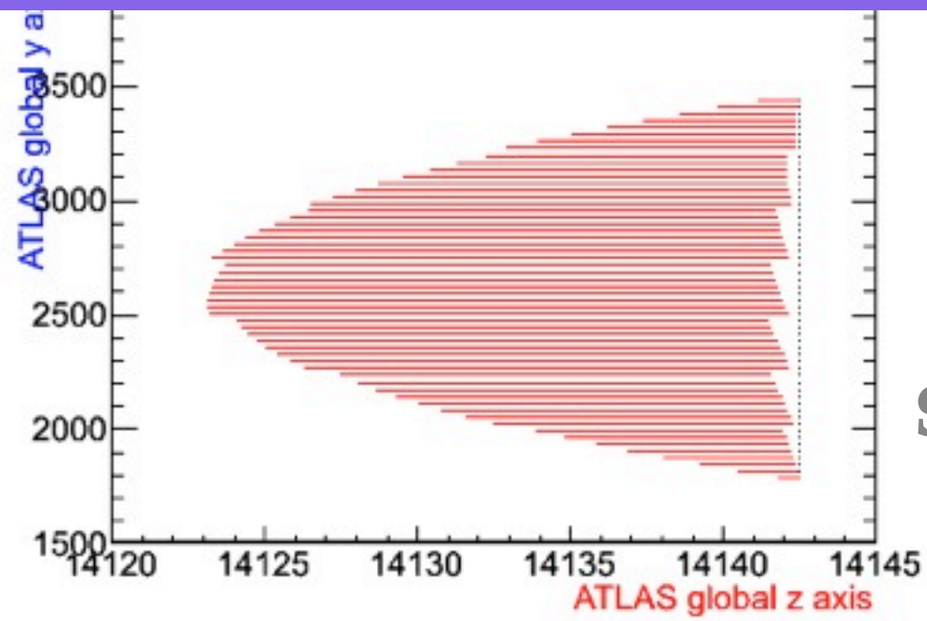
local z_{amdb} decreasing at $s_{amdb}<0$

i.e.

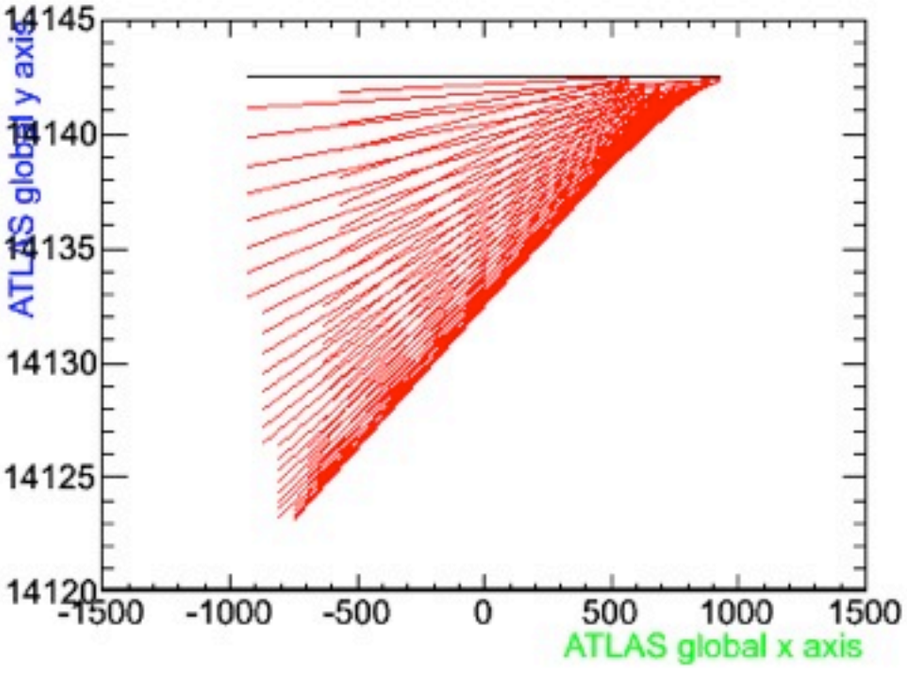
y_{global} decreasing at $x_{global}>0$

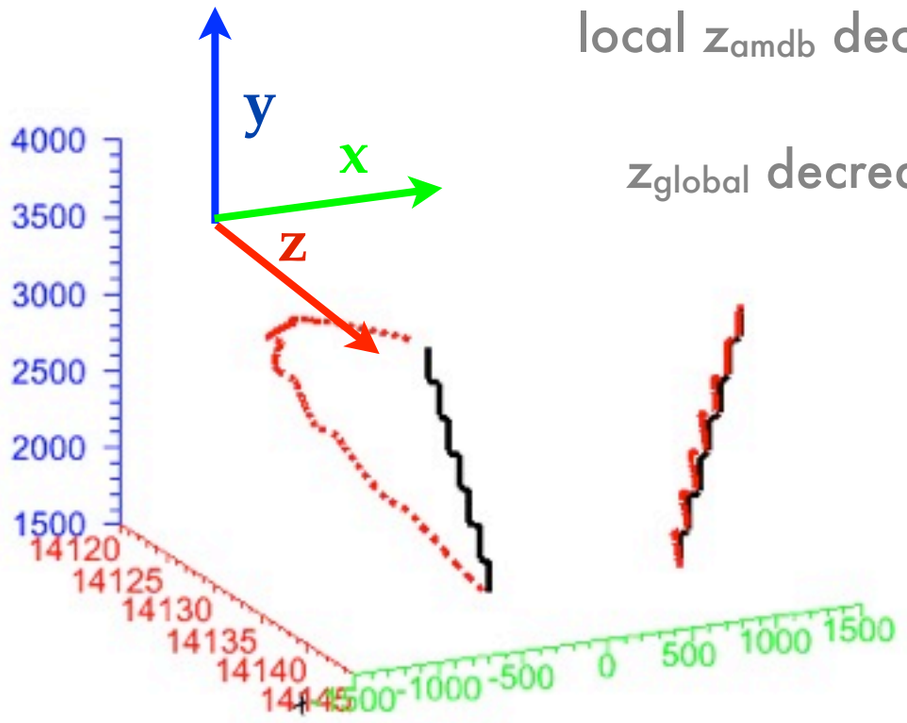
sn=10mm EMLA





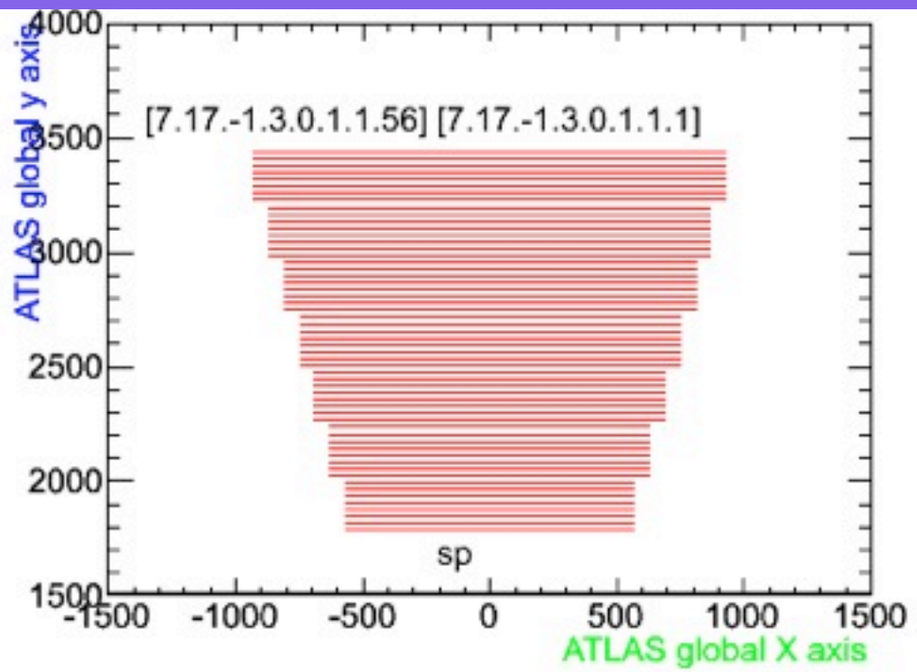
szt ➽ x,z,y

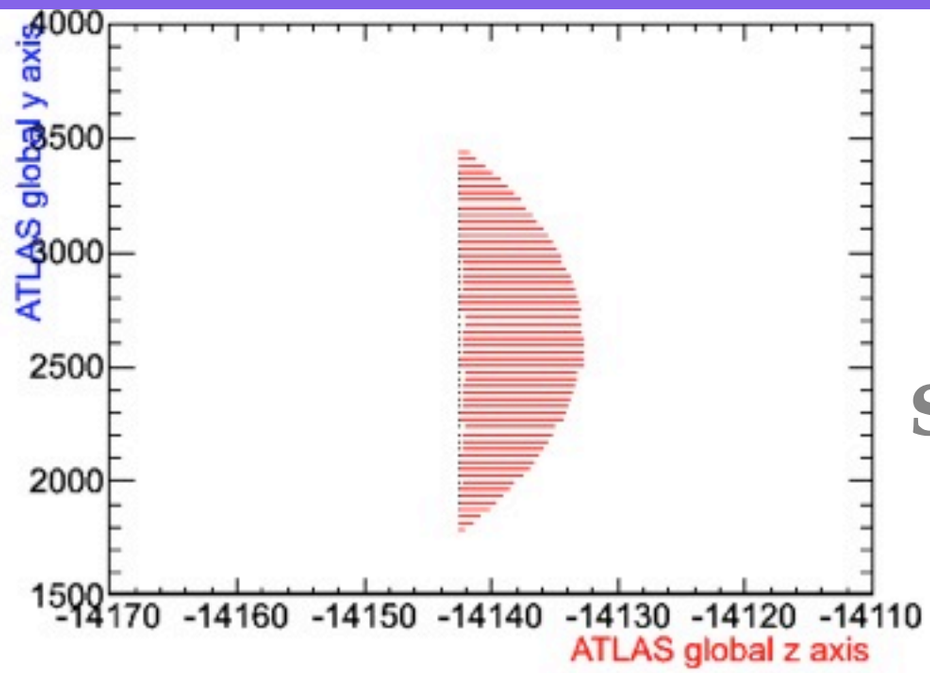




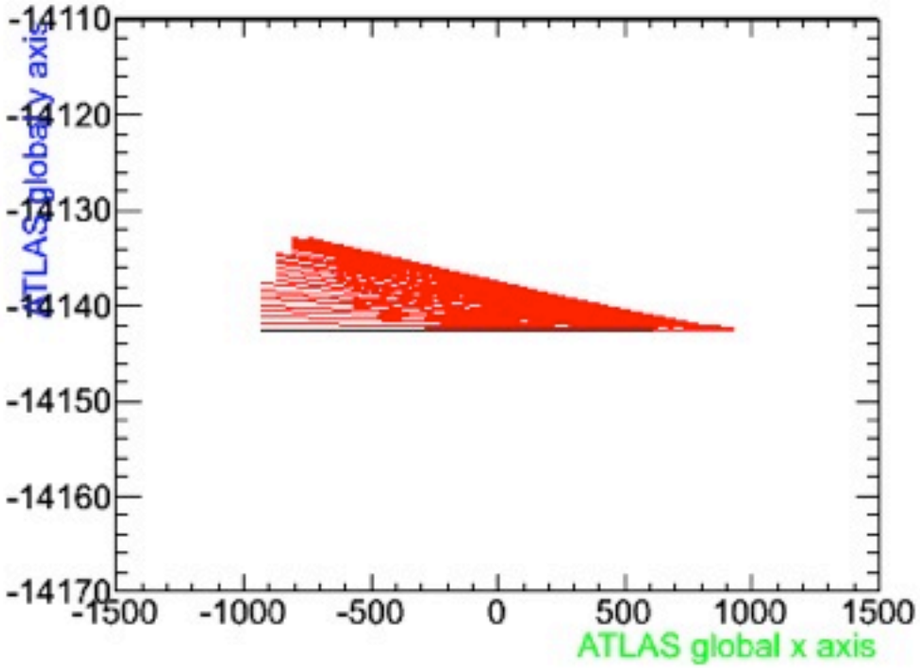
local z_{amdb} decreasing at $s_{amdb}<0$
i.e.
z_{global} decreasing at $x_{global}<0$

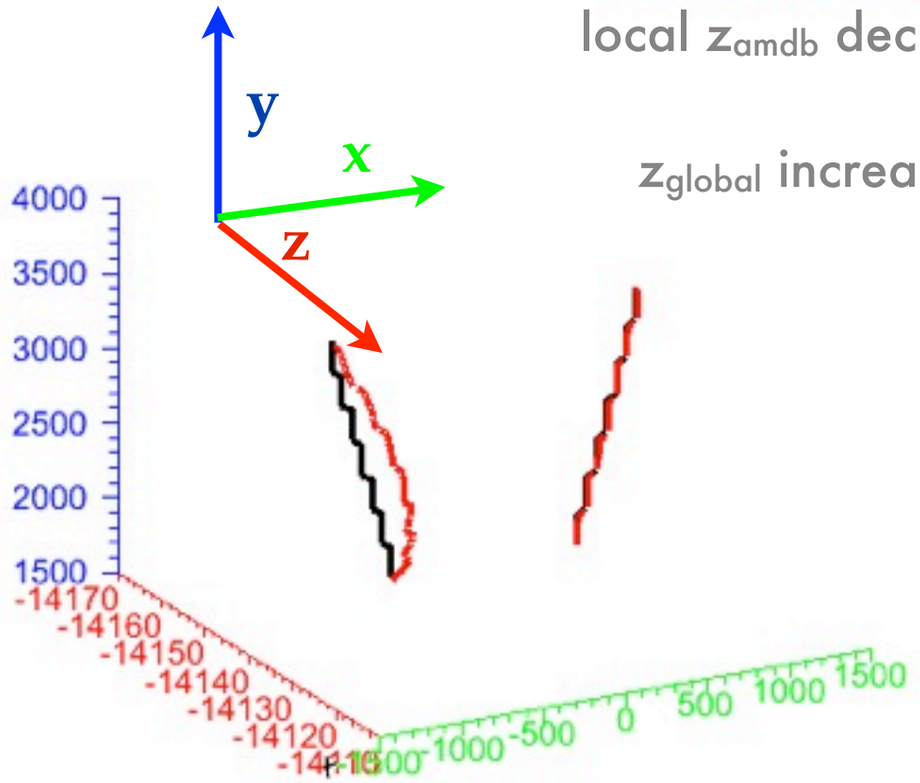
sn=10mm EMLC





szt ➽ -x,z,-y





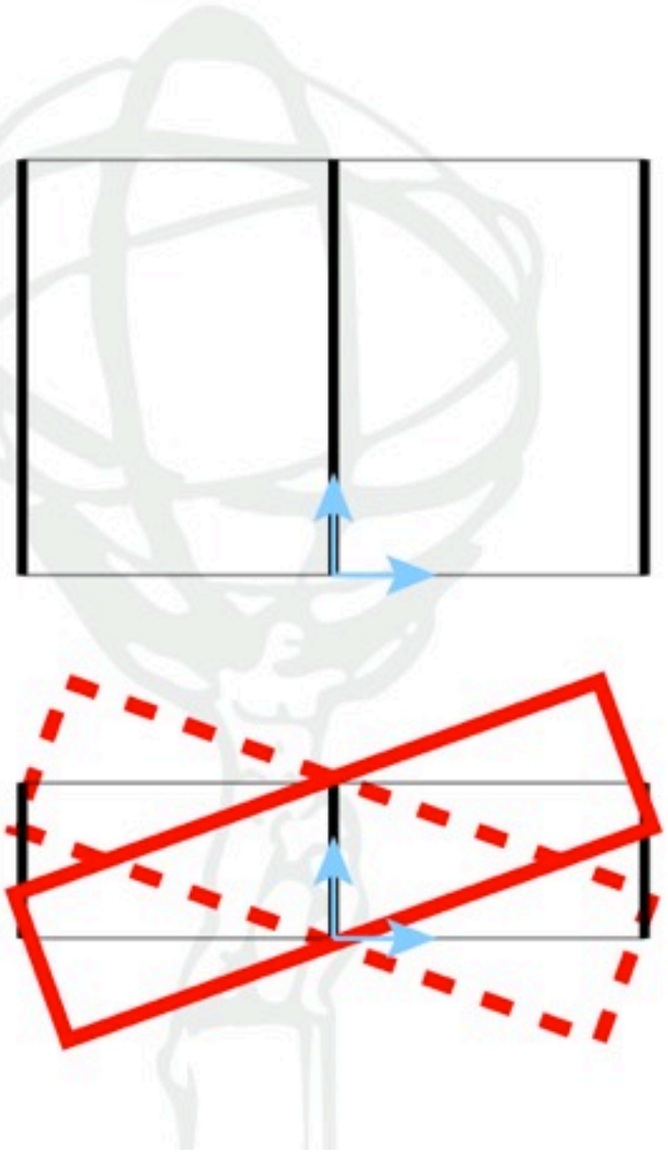
local z_{amdb} decreasing at $s_{amdb}<0$

i.e.

z_{global} increasing at $x_{global}<0$

twist

Twist: tw (1 Parameter)



- **tw:**

out-of-plane rotation of both outer cross-plates in opposite directions, tubes remain straight

maximum out-of-plane shift (at corners) equals tw, positive for shift of corner at $s_{\mathrm{rel}} = 1, z_{\mathrm{rel}} = 1$ towards negative t

unit: mm

typical: $\mathcal{O}(100\,\mu\mathrm{m})$

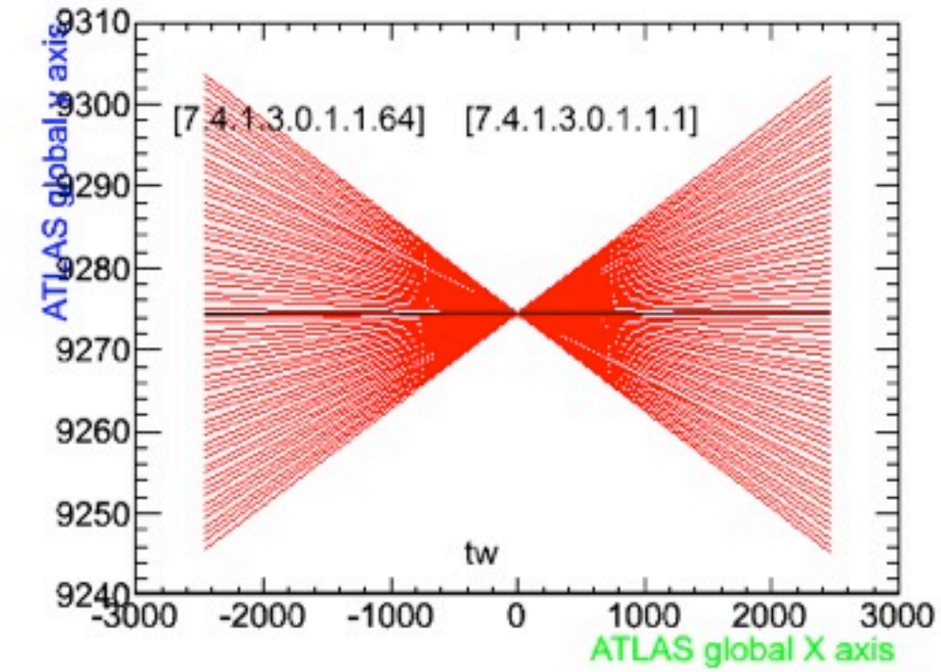
formula:

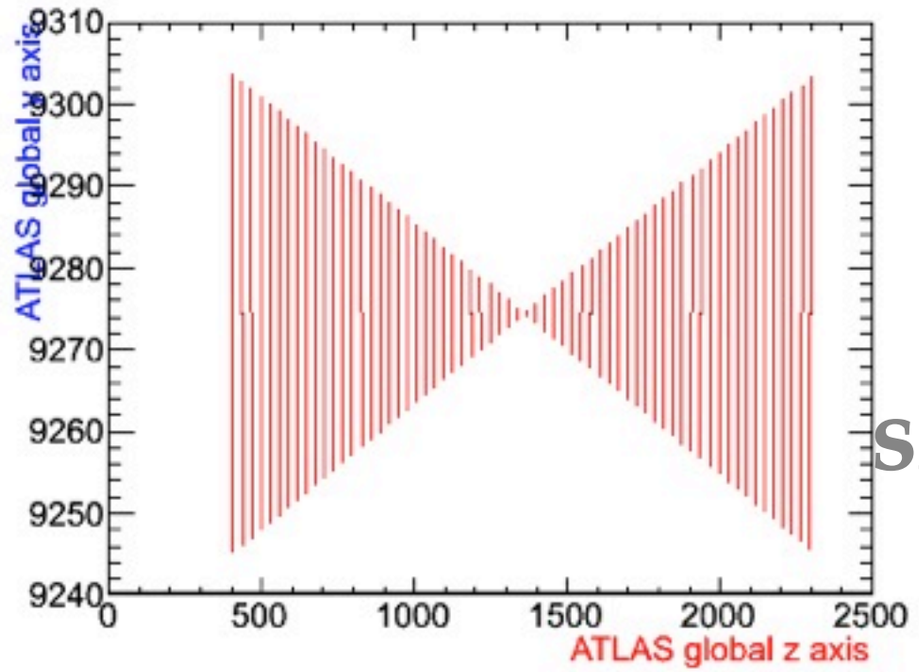
$$\phi = -\mathrm{tw} \cdot s_{\mathrm{rel}}$$

transformation:

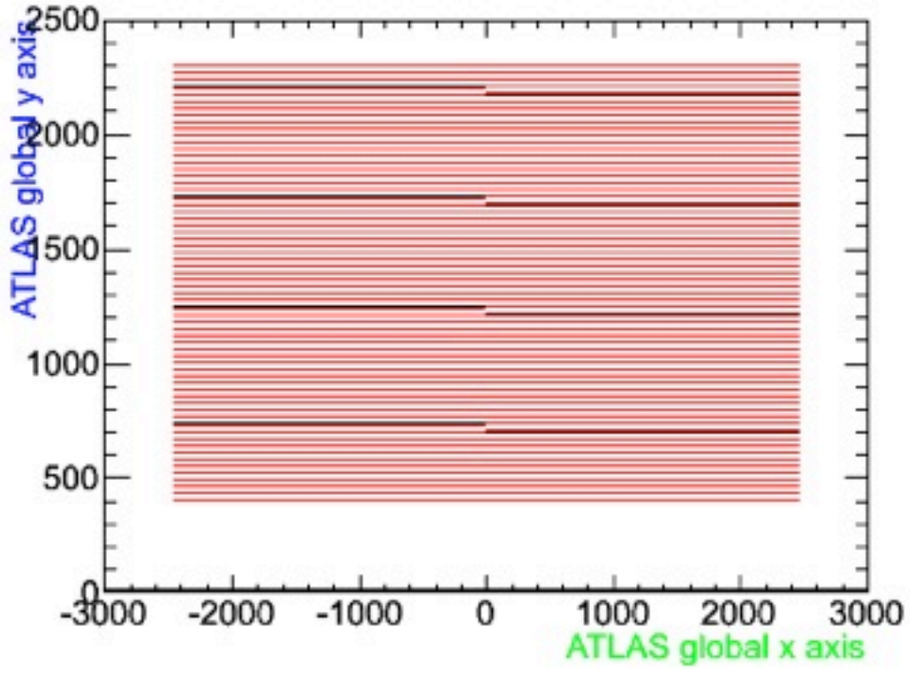
$$s \longrightarrow s$$
$$t \longrightarrow t + \phi \cdot z_{\mathrm{rel}}$$
$$z \longrightarrow z - \phi \cdot t_{\mathrm{rel}} \cdot \frac{\mathrm{height}}{\mathrm{length}}$$

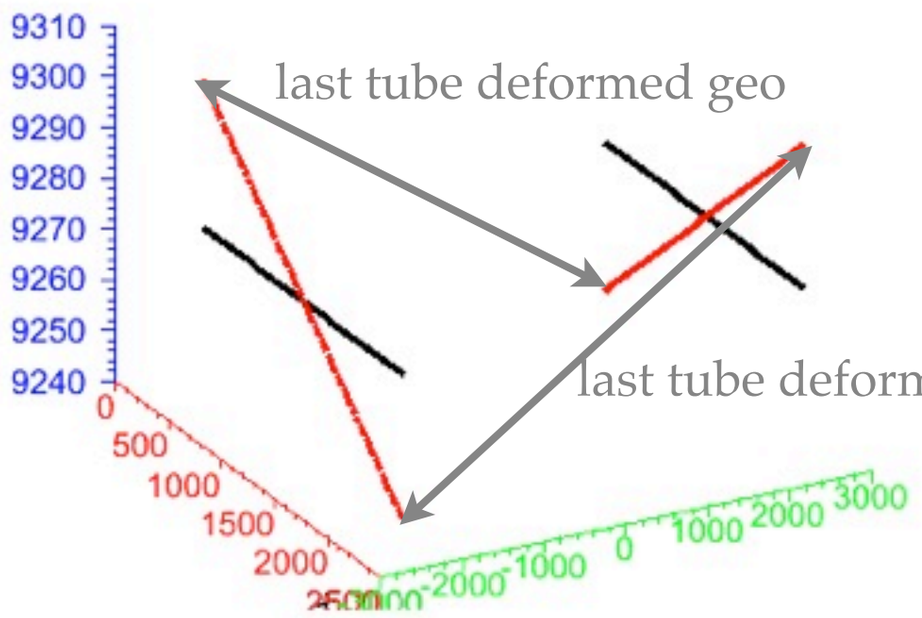
tw=30mm BOLA





szt ➽-x,z,y

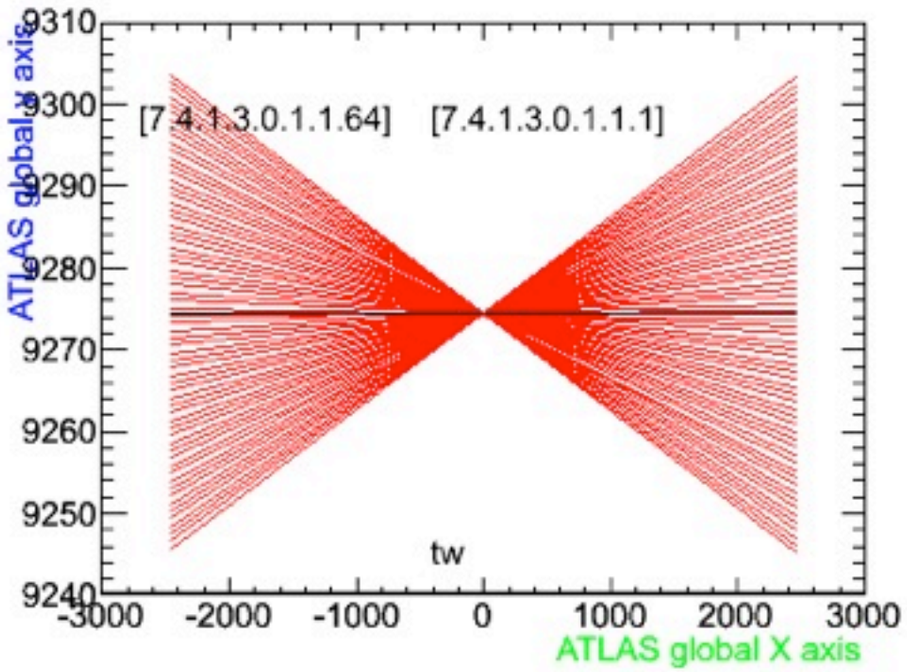


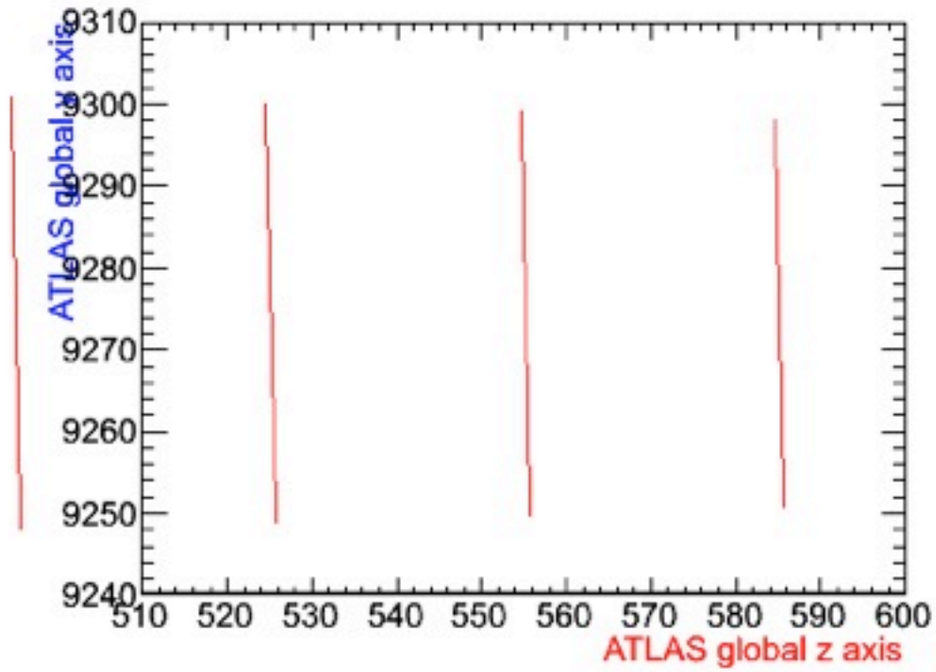


NOTE: in 2008 MGM and Aramys agreed on the tw effect - definition changed later to account for the z (amdb) correction

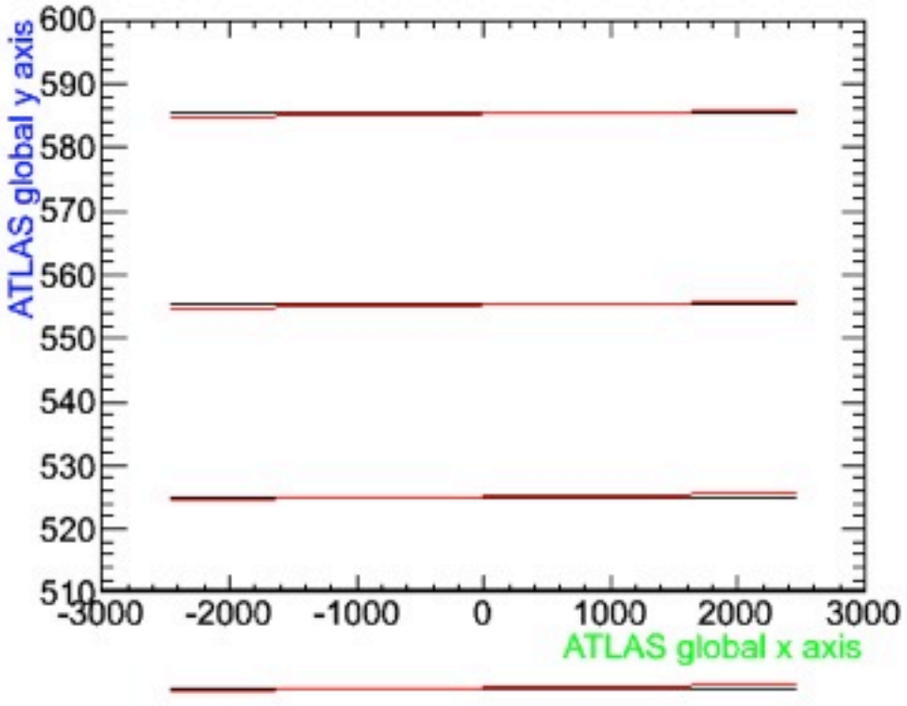
Here new MGM implementation of tw

tw=30mm BOLA

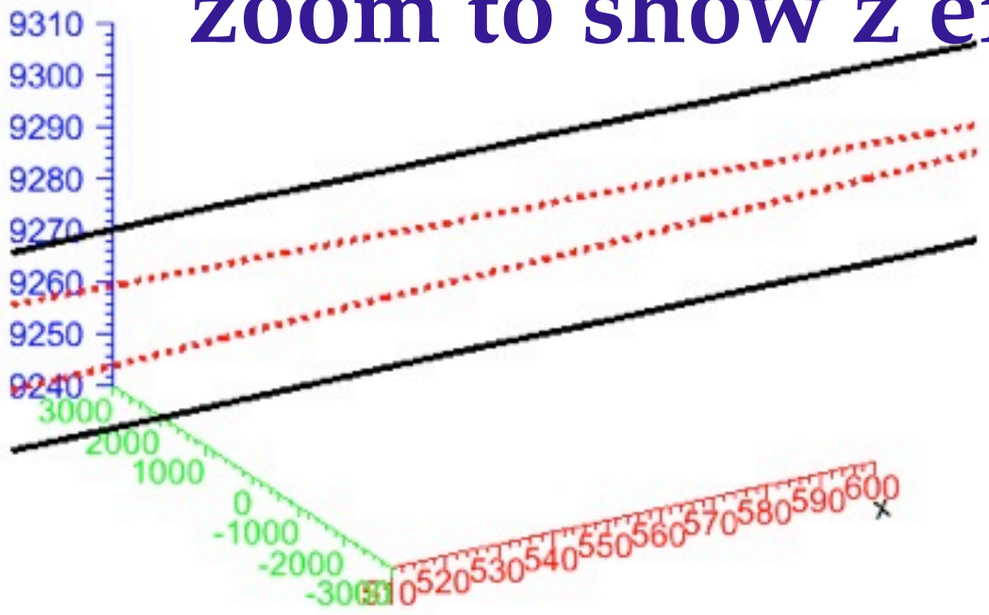




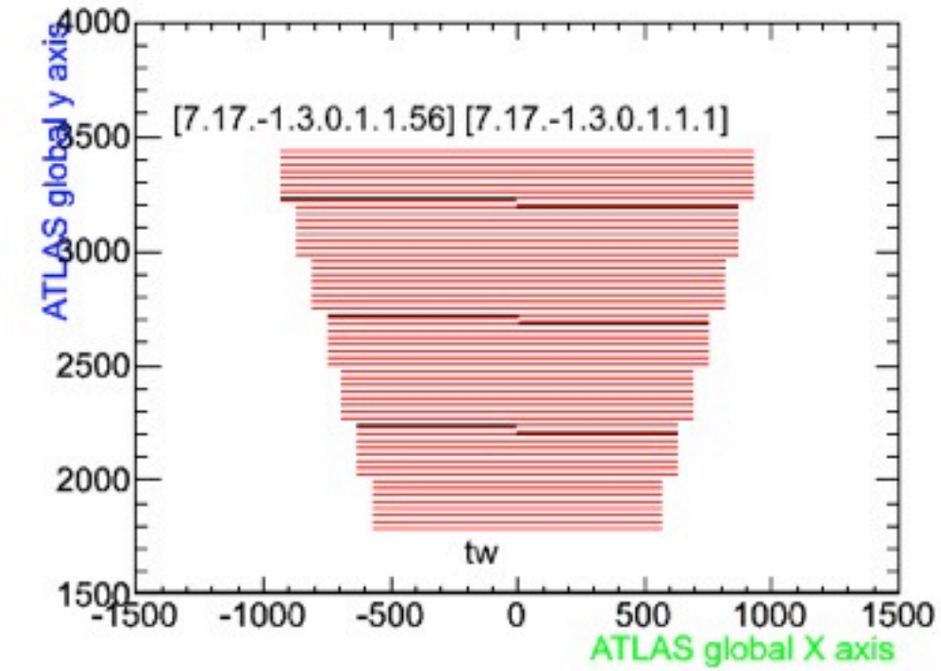
Here new MGM implementation of tw

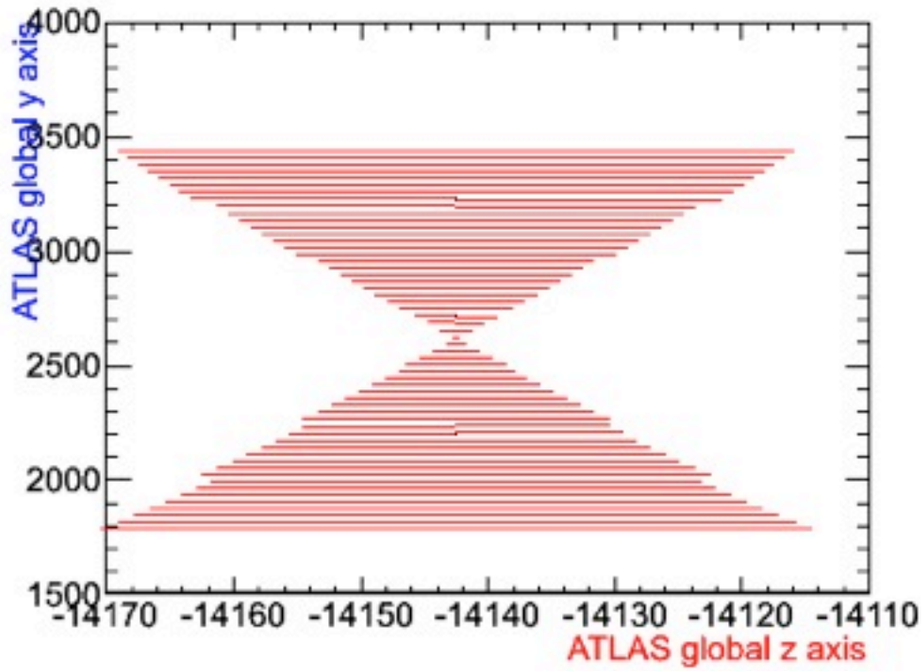


zoom to show z effect

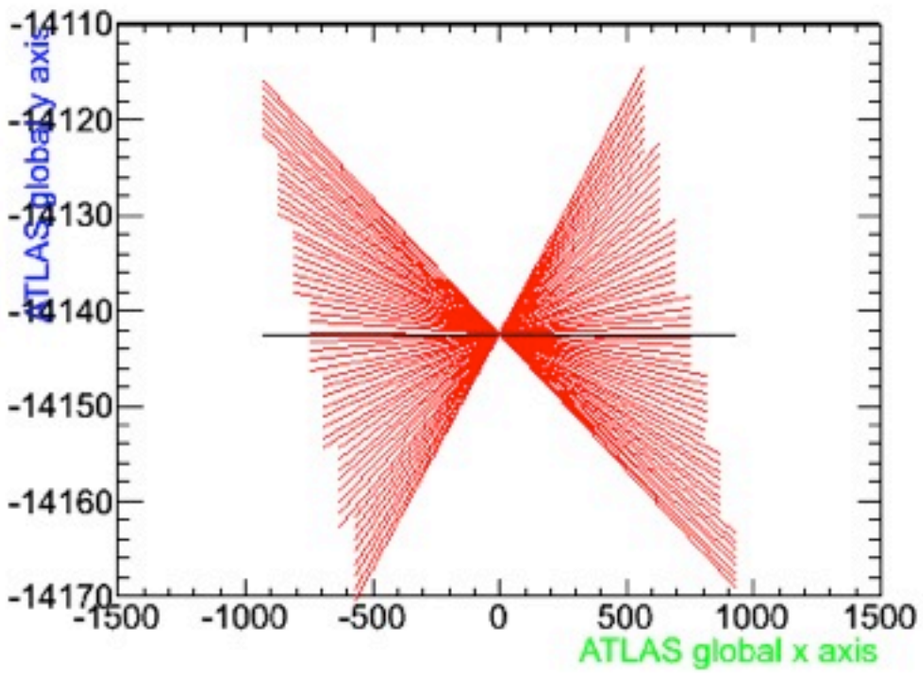


tw=30mm EML-C





Here new MGM implementation of tw



zoom to show z effect