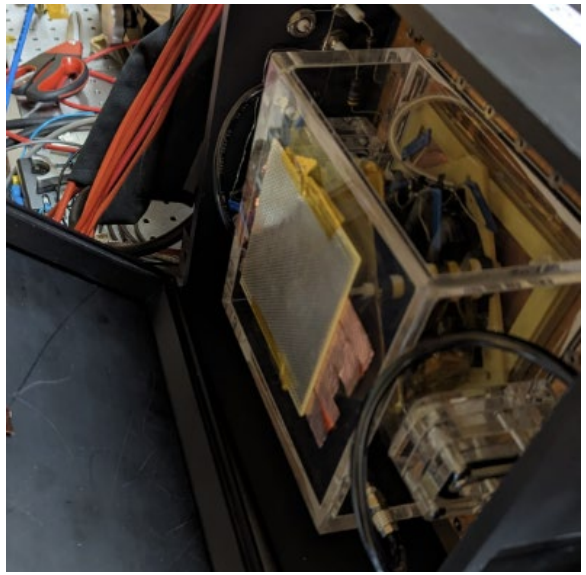
ON analysis procedure Directionality
90Sr
29/04/2024

Concept

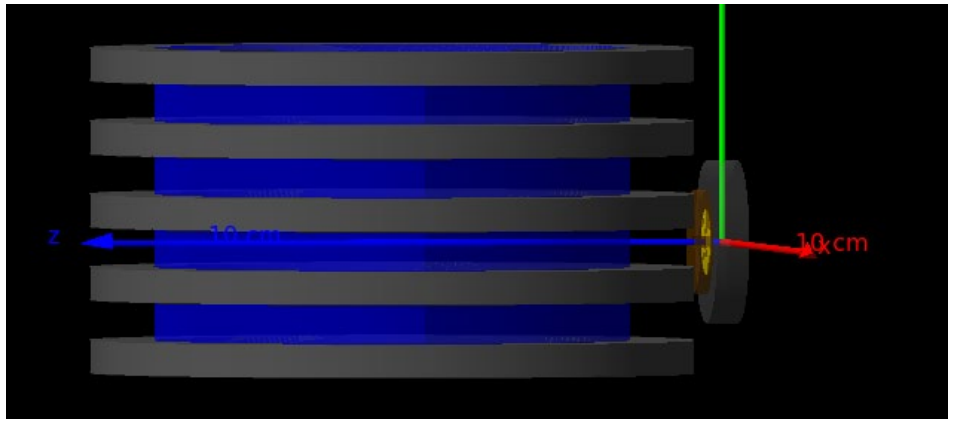
Measure MANGO Angular resolution with 90Sr

Simulate 90Sr spread inside the MANGO active volume



$$f = g * h$$

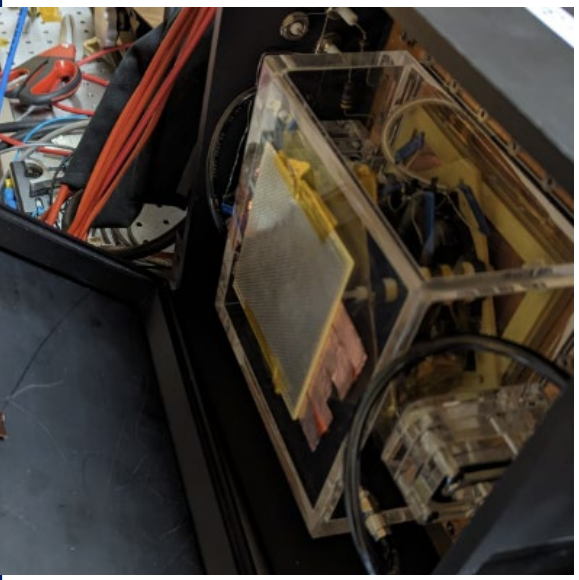
Angular Resolution!



If everything is Gaussian we may subtract variances
However this will not be the case eheh

MANGO measurment

Measure MANGO Angular resolution with 90Sr



Only this for now!

- 55Fe Run
- 109Cd Run (Cu peak)
- 90Sr Run

Calibration with 2 points:

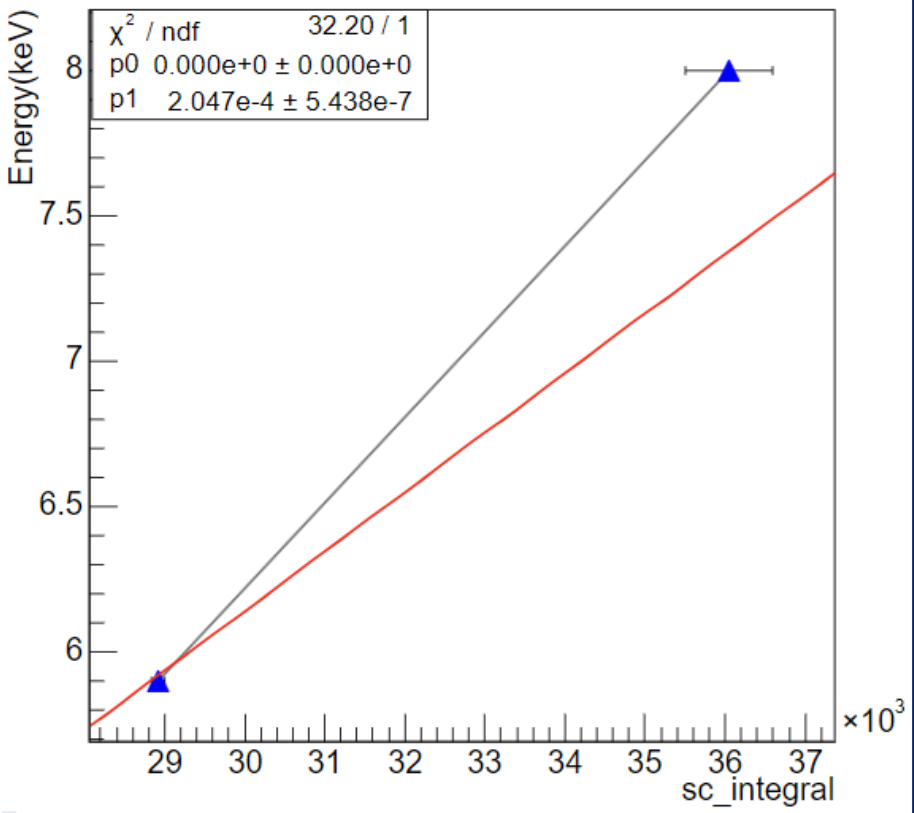
- Line passing to 0 to increase dof

Gases atm pressure:

- He/CF 60/40 VGEM 420
- He/CF4 40/60 VGEM 460
- Ar/CF4 80/20 VGEM 405
- Ar/CF4 60/40 VGEM 450

Cameras:

- Quest
- Fusion

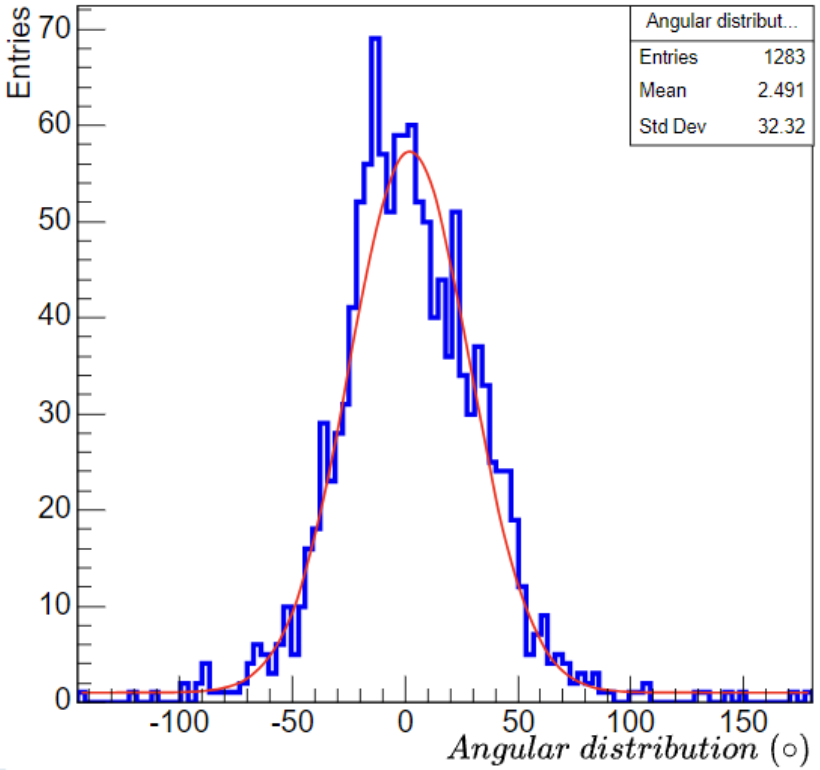


MANGO Directionality

fiorotto8/Directionality (github.com)
Derived from Flaminia, Samuele et al.

Cut for Directionality analysis (x and y are exchanged)

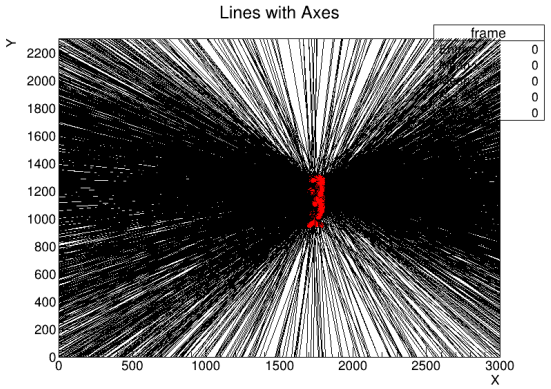
y_max>1650 && y_max<1800 &&scint>0 && recowidth/recolength<0.4



Cut for full containment

condition = (df['X_ImpactPoint'] > 1700) & (df['X_ImpactPoint'] < 1900) & (df['Y_ImpactPoint'] > 950) & (df['Y_ImpactPoint'] < 1300) & (df['Ymin'] >550)

- 55Fe Run
- 109Cd Run (Cu peak)
- 90Sr Run



Gases atm pressure:

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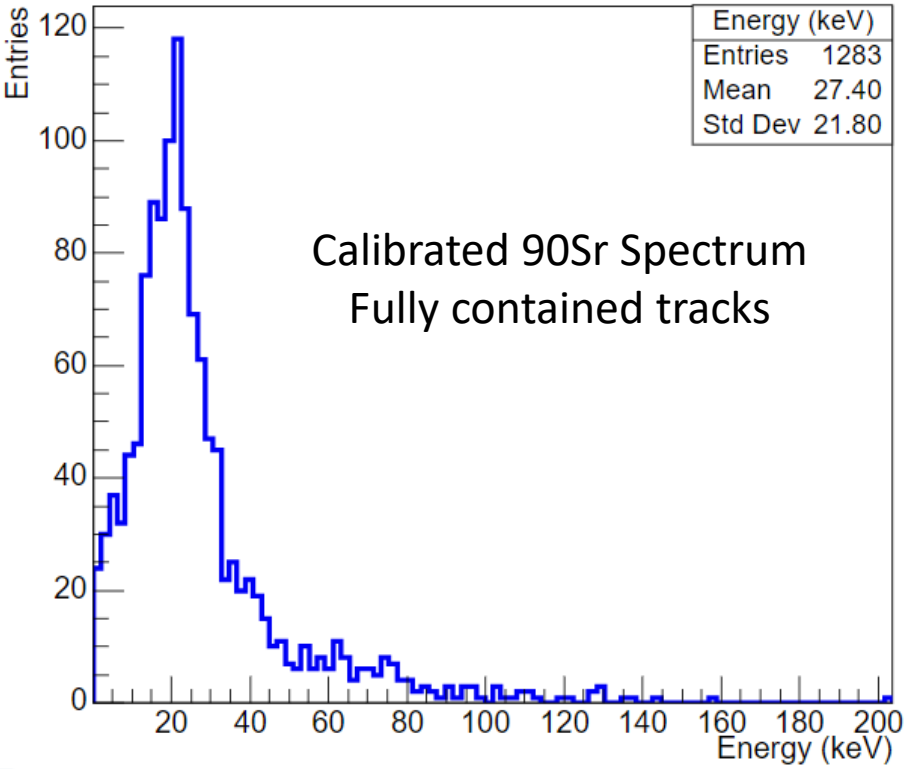
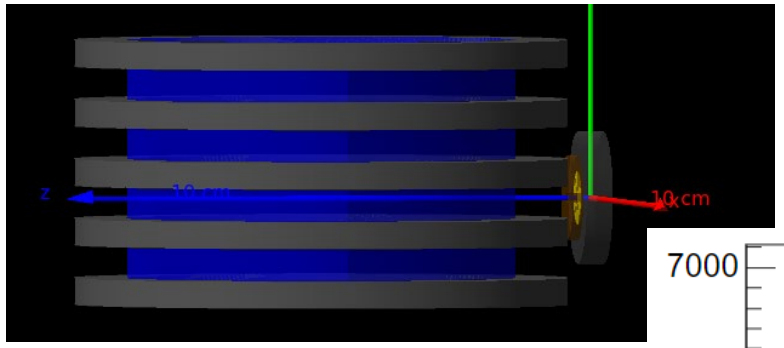
Only this for now!



MANGO Simulation

Simulate 90Sr spread inside the MANGO active volume



fiorotto8/MANGO_RadioactiveSource: Simulation of Cd-109 Radioactive source in MANGO (github.com)

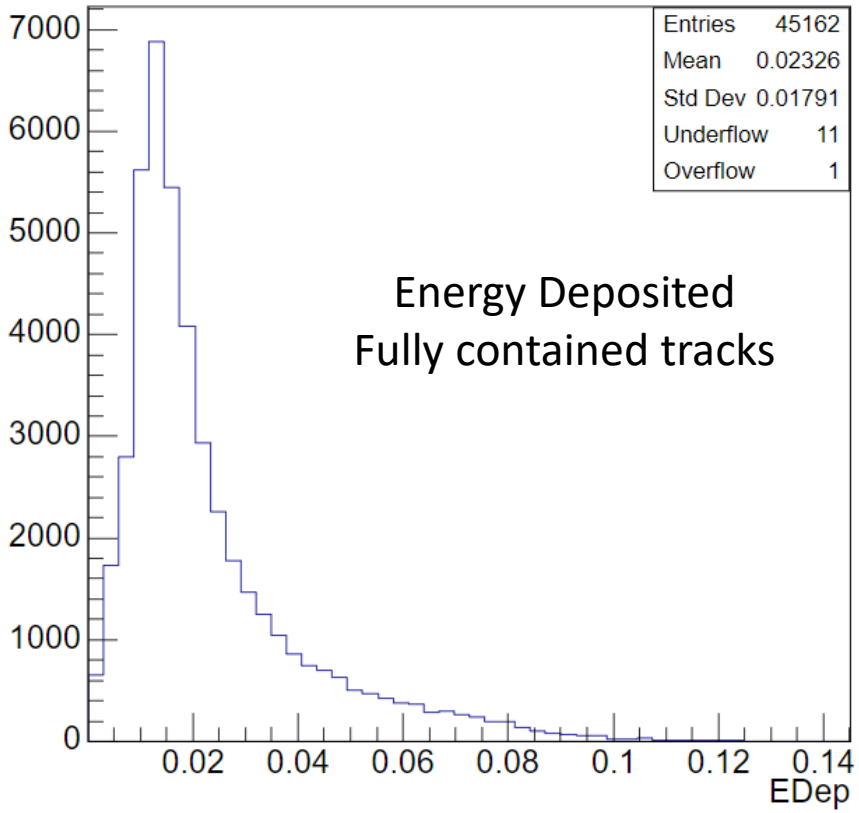
- Source at the 2° Ring from GEM
- Tungsten collimator 2mm diameter

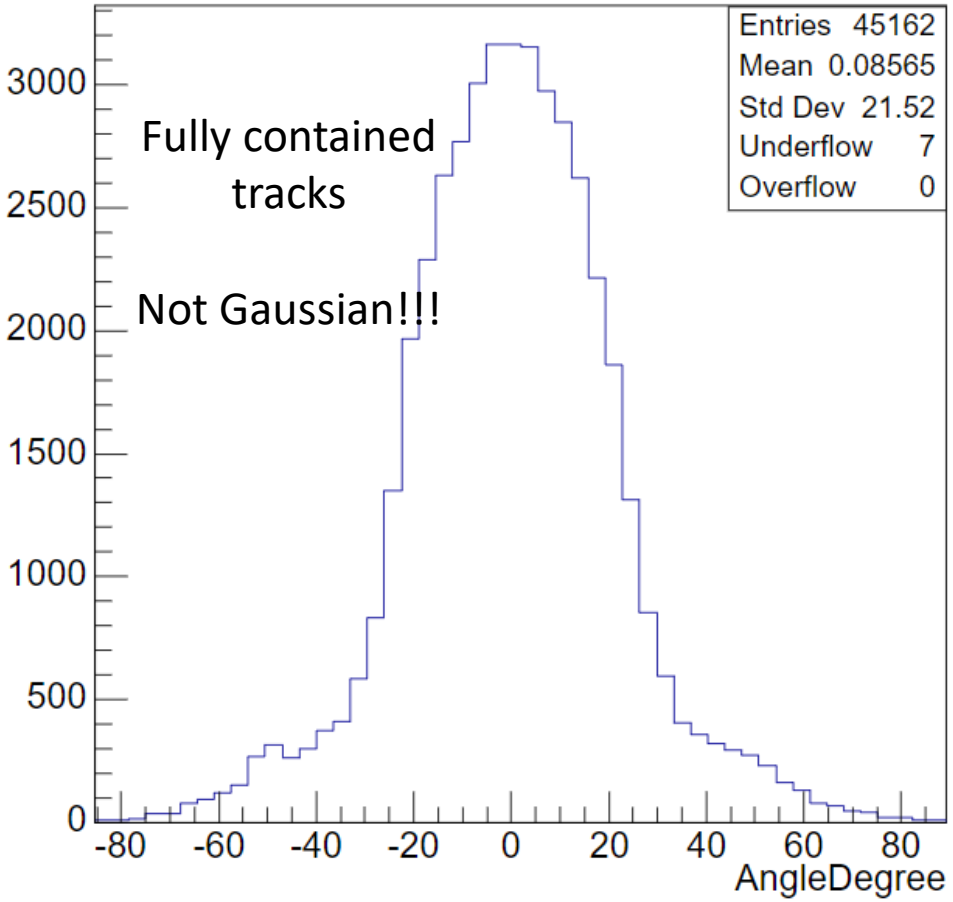
Full containment:

- is_fully_contained() function in analysis/RecoTrack.C checks if there are hits in 5mm distance from the sensitive volume

Original direction:

- Linear fit on the first 4 hits of the electron in the sensitive volume





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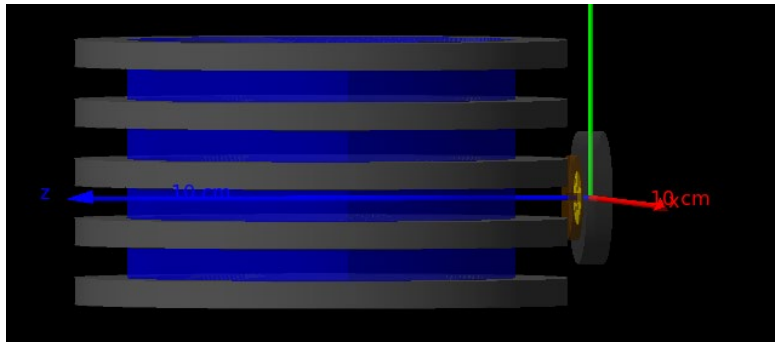
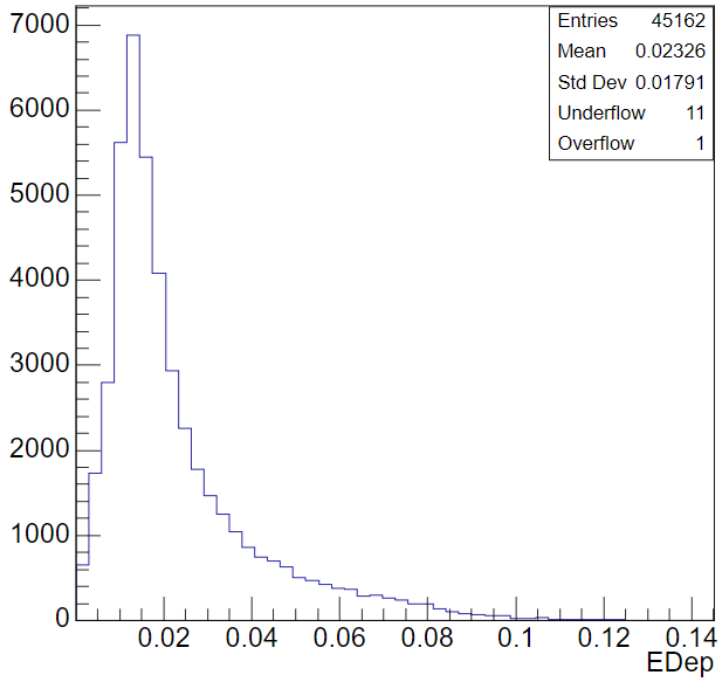
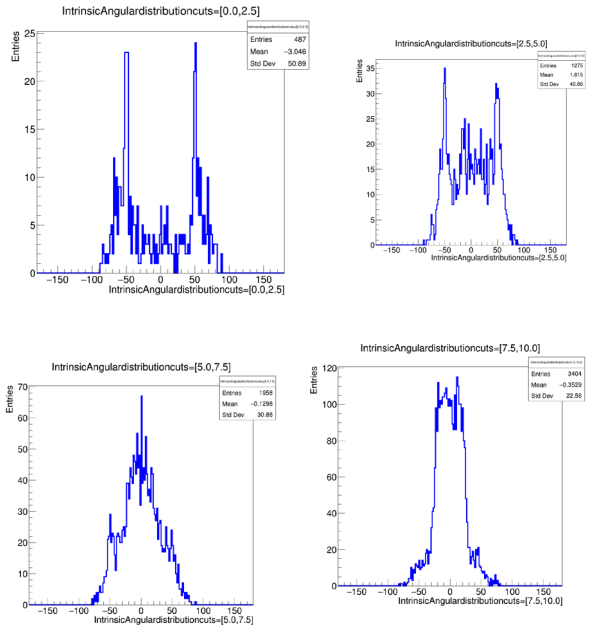
Simulate 90Sr spread inside the MANGO active volume

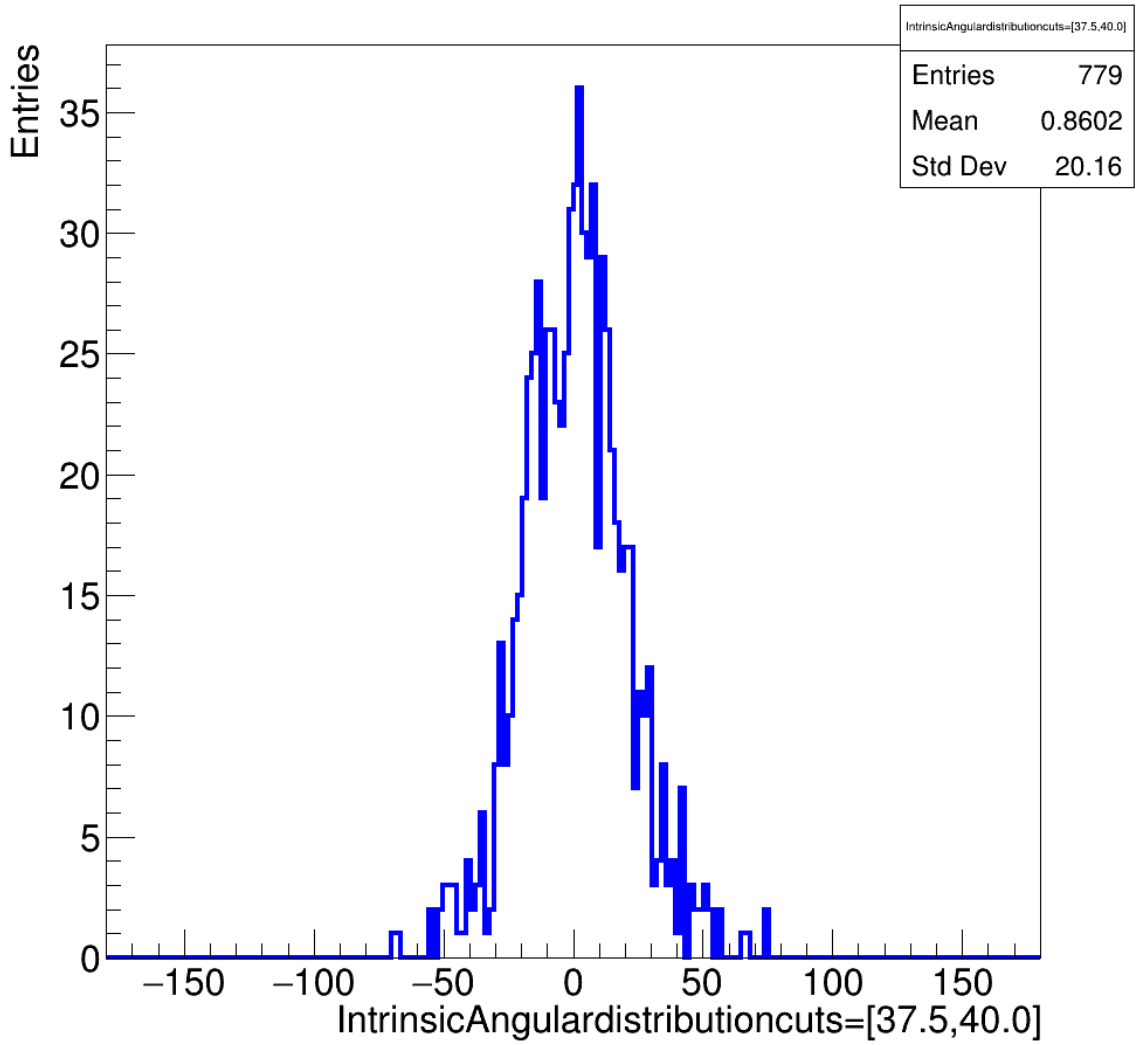


- Gaussian until 20keV
- Flat distribution…
- Below 10keV 2 horns at 50° appear

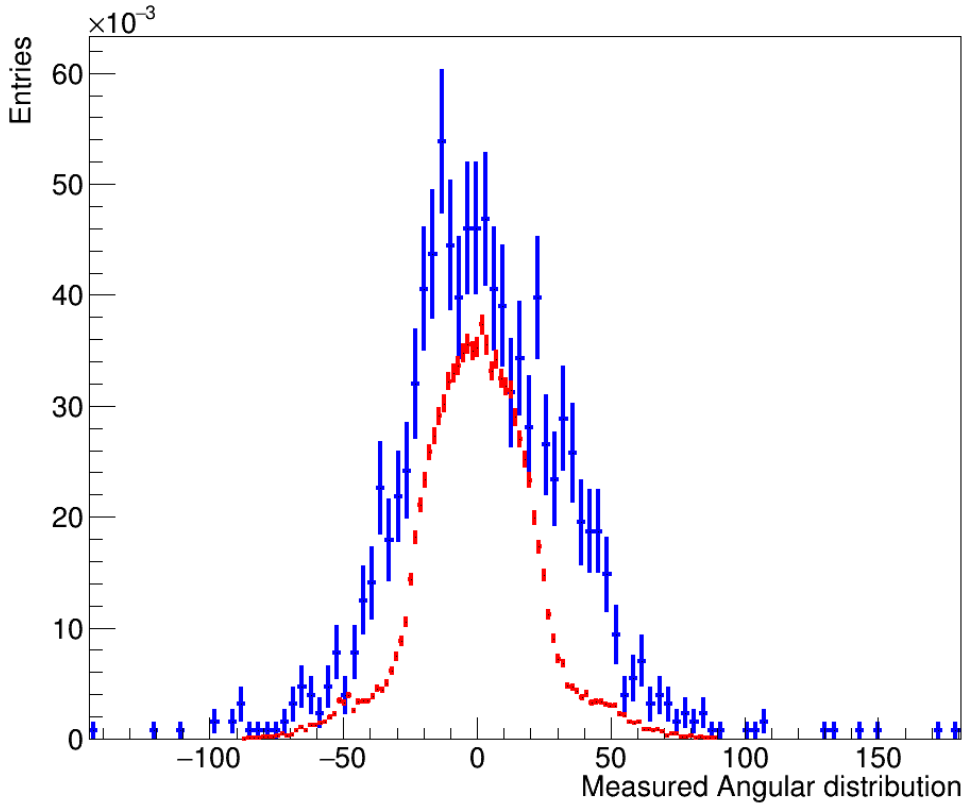




IntrinsicAngulardistributioncuts=[37.5,40.0]



Comparison

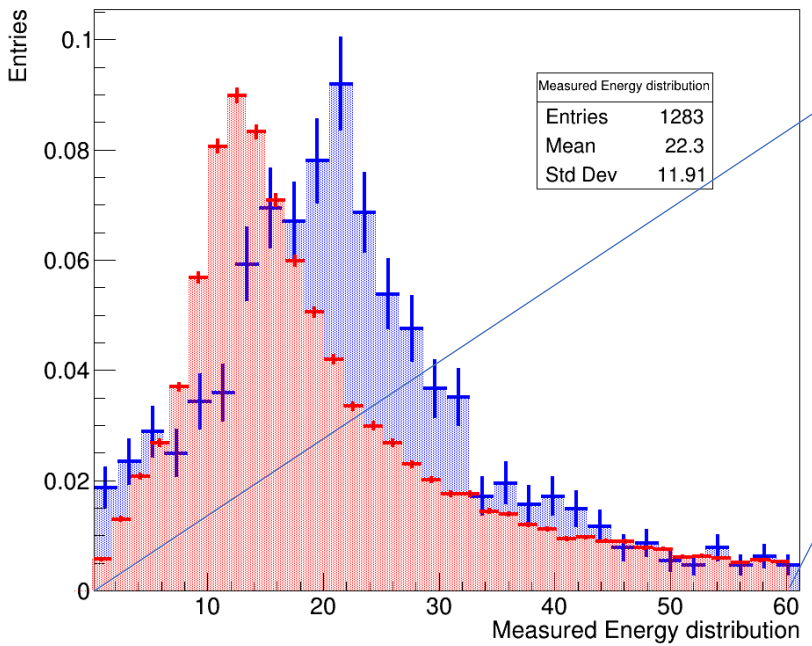


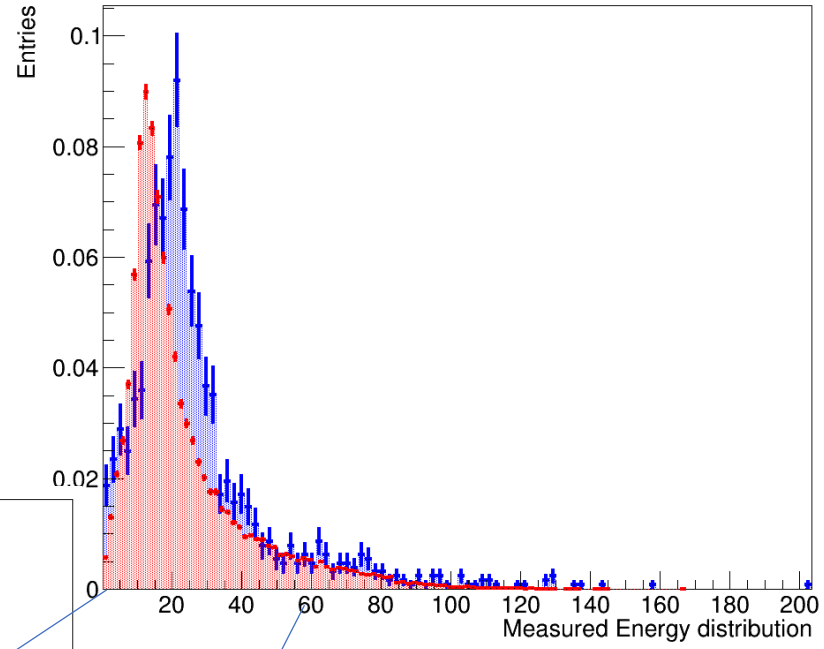
Measured

Simulated

Total Energy resolution:

- Gauss subtraction: **24.4°**
- Deconvolution: **20.6°**





Clear shift in the Energy

Why is the measured size larger than the simulated?

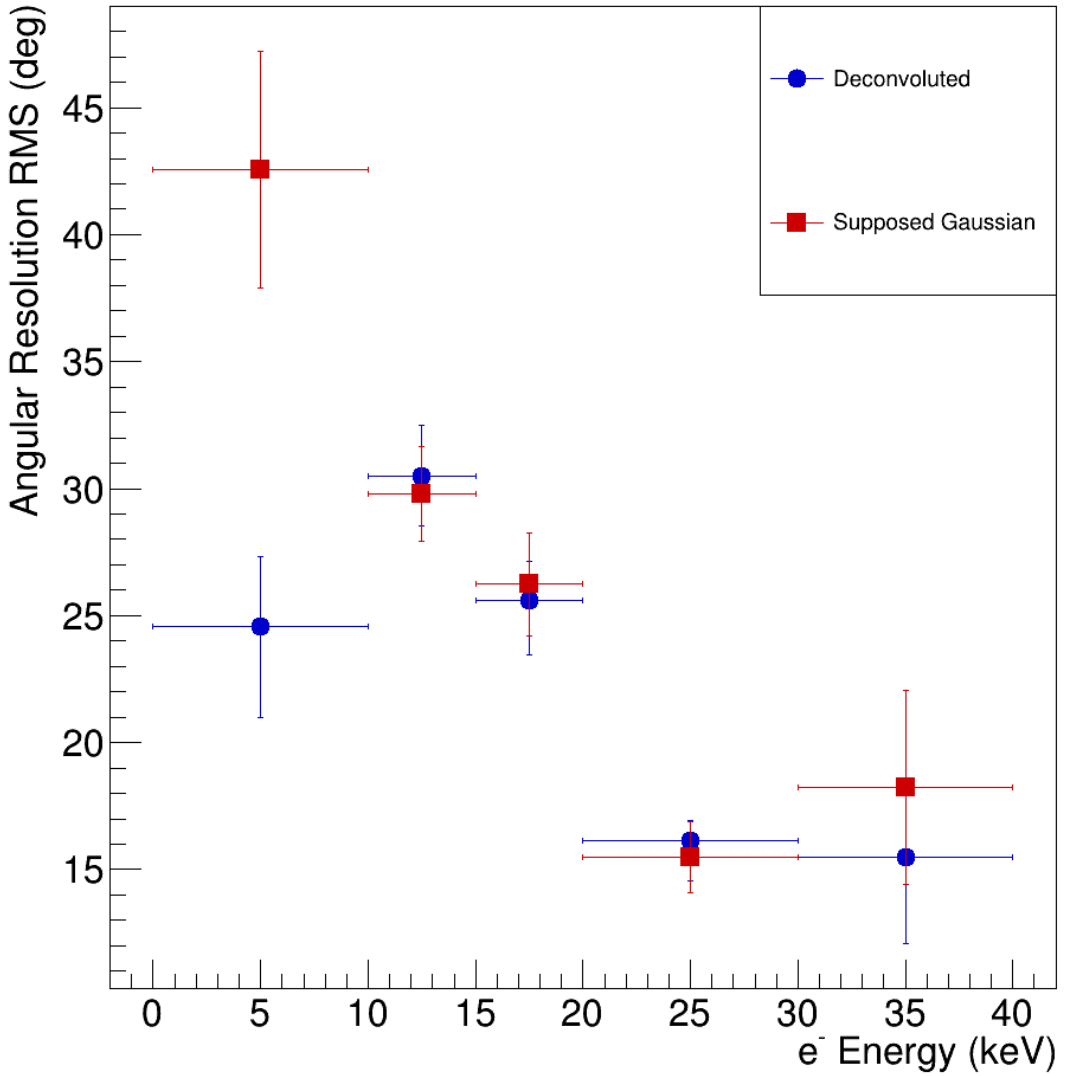
Deconvolution and energy selection

```python
def richardson_lucy(histogram, psf, iterations):
    # histogram is the measured distribution f
    # psf is the point spread function (intrinsic distribution h)
    # iterations is the number of iterations
    rl_estimate = np.copy(histogram)
    for i in range(iterations):
        relative_blur = histogram / np.convolve(rl_estimate, psf, mode='same')
        rl_estimate *= np.convolve(relative_blur, psf[::-1], mode='same')
    return rl_estimate
```

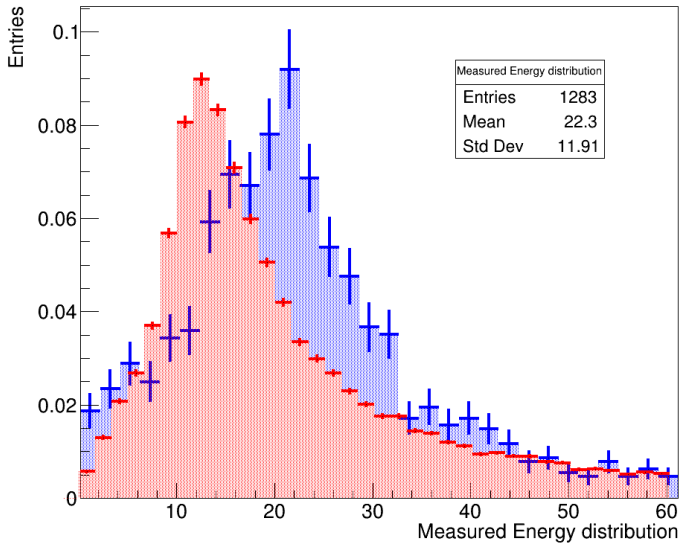
Usually used to unblur images
In our case, we do the opposite to get the response function (i.e. detector response)

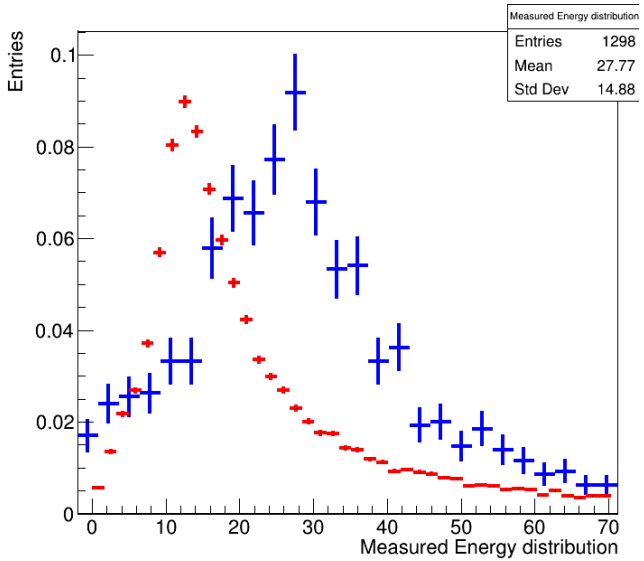
- The measured angular resolution is Gaussian but the intrinsic distribution is not (understandable)
- Convolving should be the best approach
- However, the difference is not that much, and the convolution is very sensible to small statistics…

- Main issue is the non-overlapping of the Energy spectrum
- When cutting, you may cut on the wrong energies for one or the other spectrum

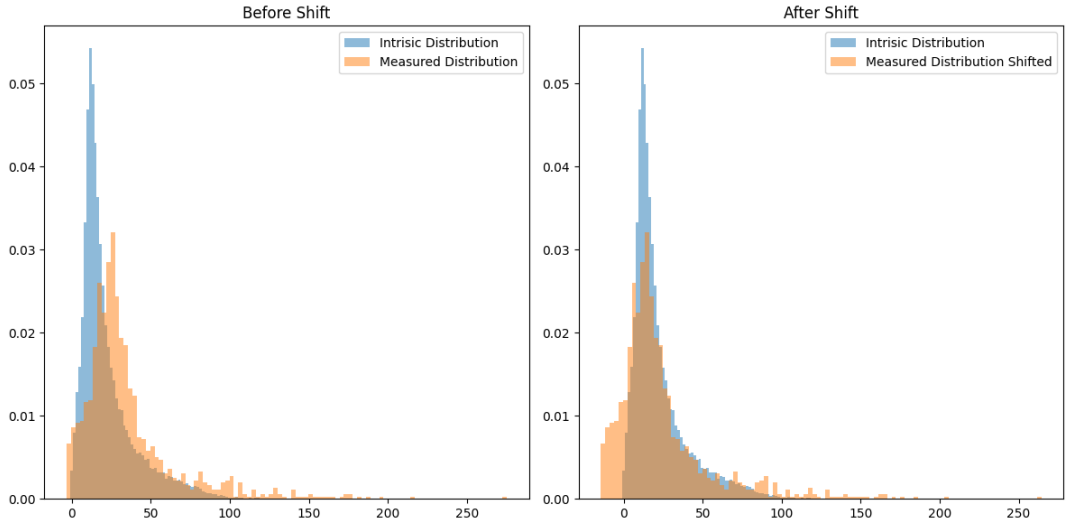


Solve calibration issue

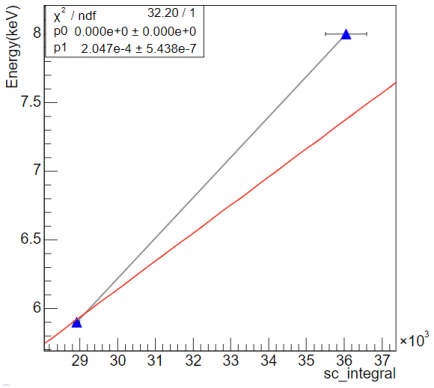




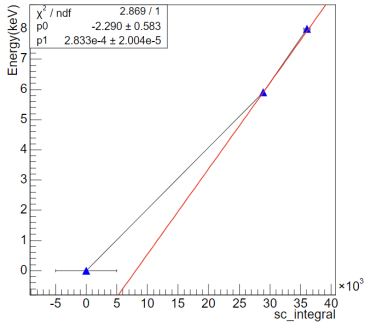
Need a less steep line → also 5.9keV is saturated



With line passing from 0 and 5.9+8keV points



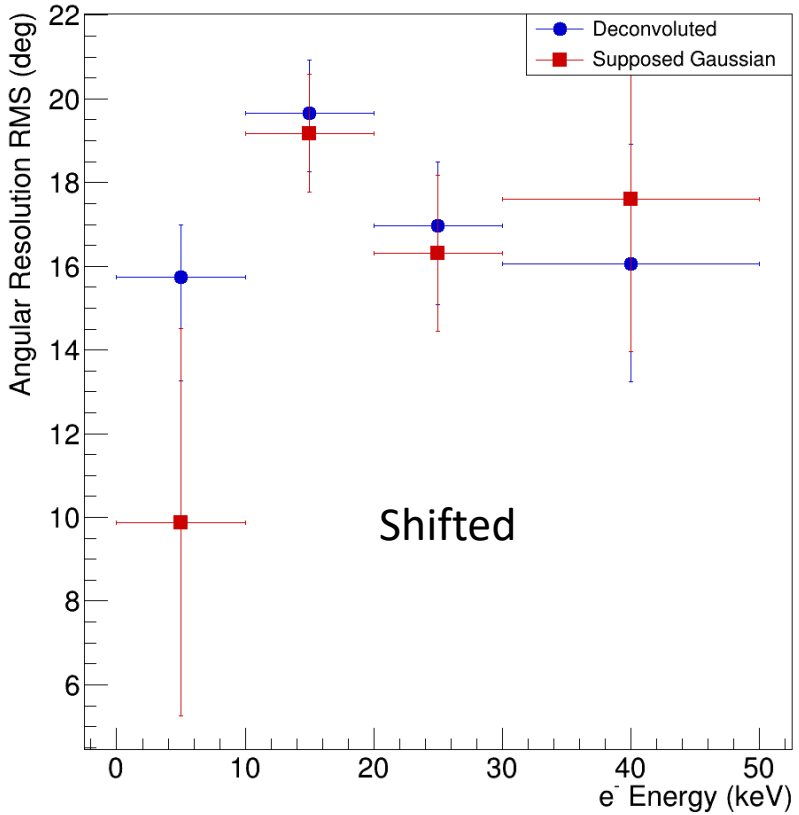
With line 0+5.9+8keV points Basically equivalent to fitting just the 2 peaks

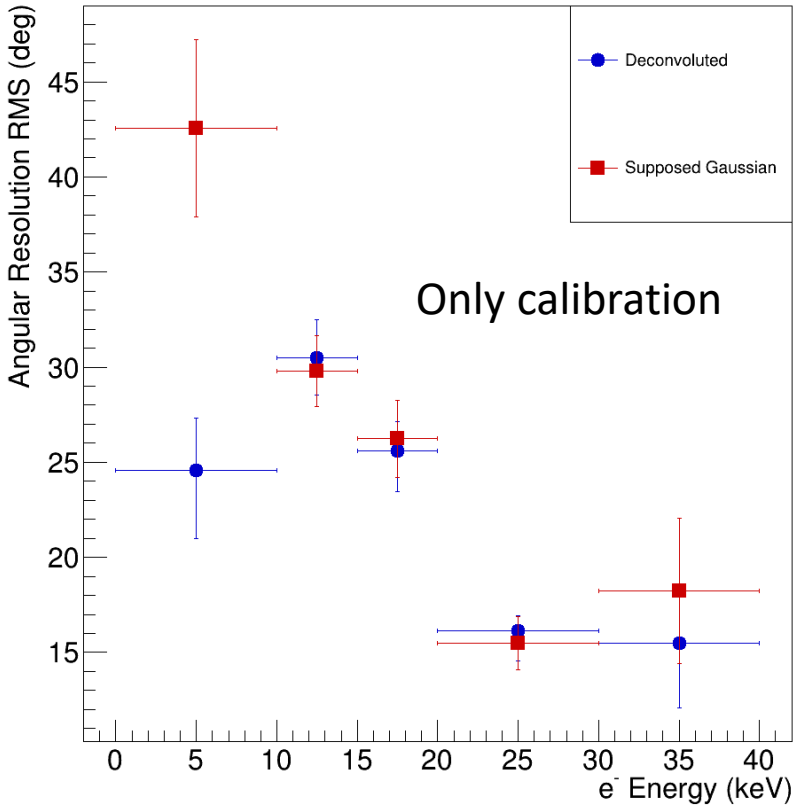


11keV shift!!!!!

Results with shifts

- Same procedure as before
- New option in the DistrfromDirectionality to shift the measaured distirbution after the calibration





- Resolution is a lot better…
- Am I doing the right thing???