



# Track Reconstruction in NA62

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*Monday, March 31st, 2014*



# Goal of NA62



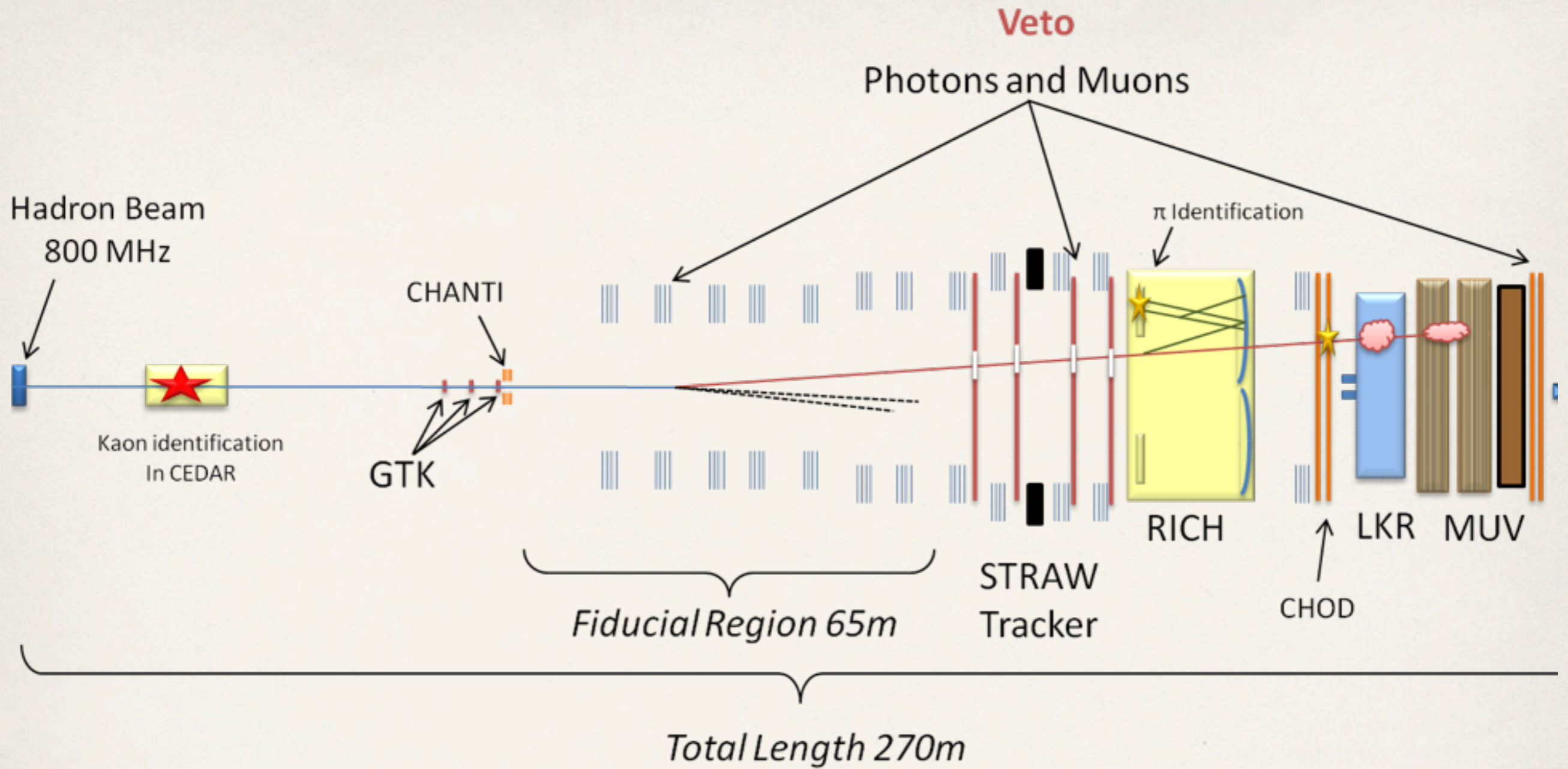
- ❖ Measure the decay of  $K^+ \rightarrow \pi^+ \nu \bar{\nu}$
- ❖ The probability of this decay is about  $10^{-12} - 10^{-13}$
- ❖ This will be the first experiment in the world to examine charged kaon decays with this rarity
- ❖ The results from this experiment will be used to compare to the known likelihood of top quarks decaying into bottom quarks

# My goal contribution

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- ❖ Understand where, how, and why reconstructed tracks back from the GTKs differ from the path they must have taken to the GTKs
- ❖ This will tell us how precise the GTK is and allow us to eliminate poorly reconstructed tracks





# Understand and reconstruct the beam line

At least to the GTKs



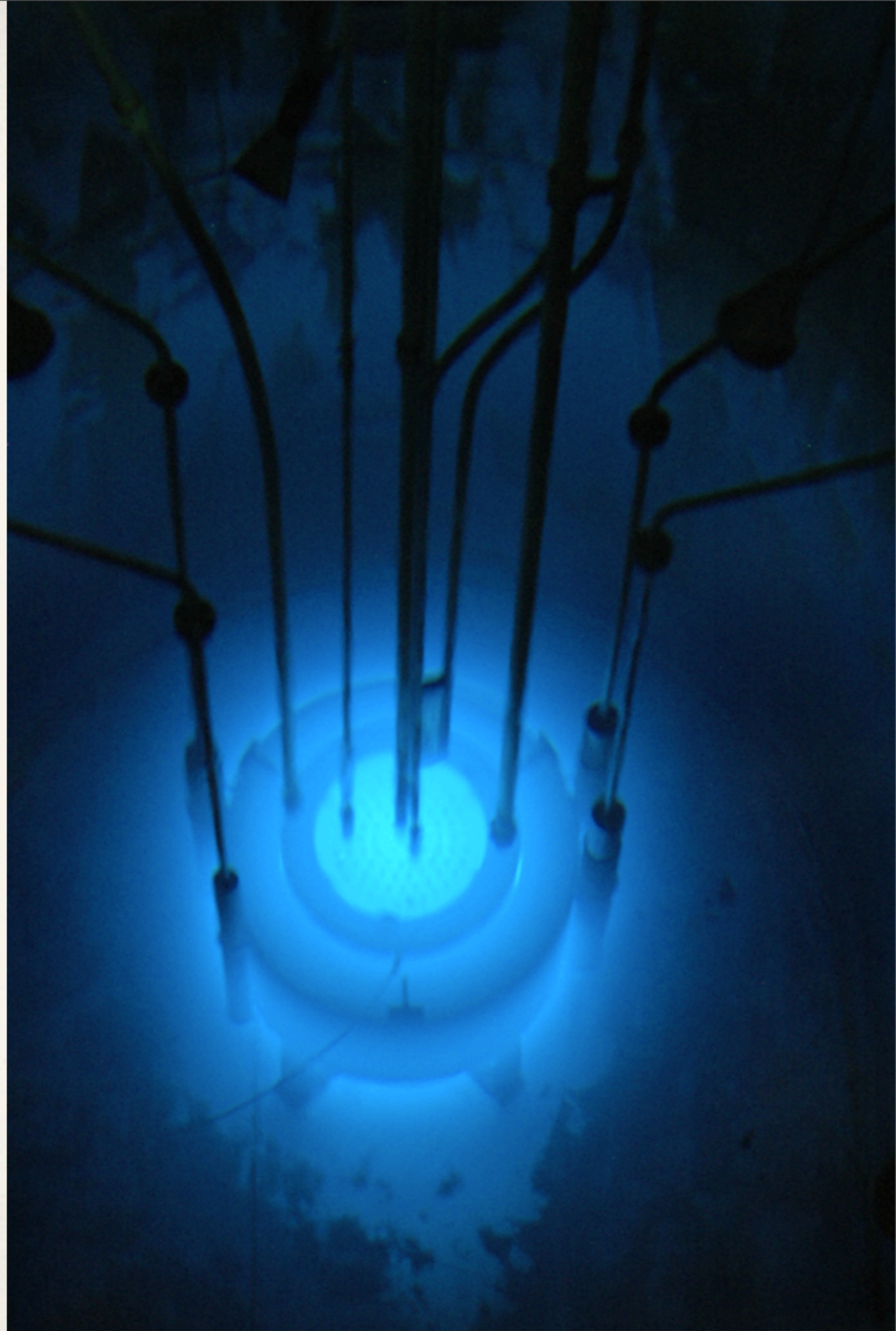
# CEDAR

## Cool side note

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- ❖ In a medium, particles traveling faster than light will emit Cherenkov radiation
- ❖ The momentum (related to mass) determines the angle of the emitted light cone. This can be used to determine what type of particle is passing through at a given time
- ❖ Similar to waves moving away from a boat in water or sound waves moving away from a plane going faster than the speed of sound

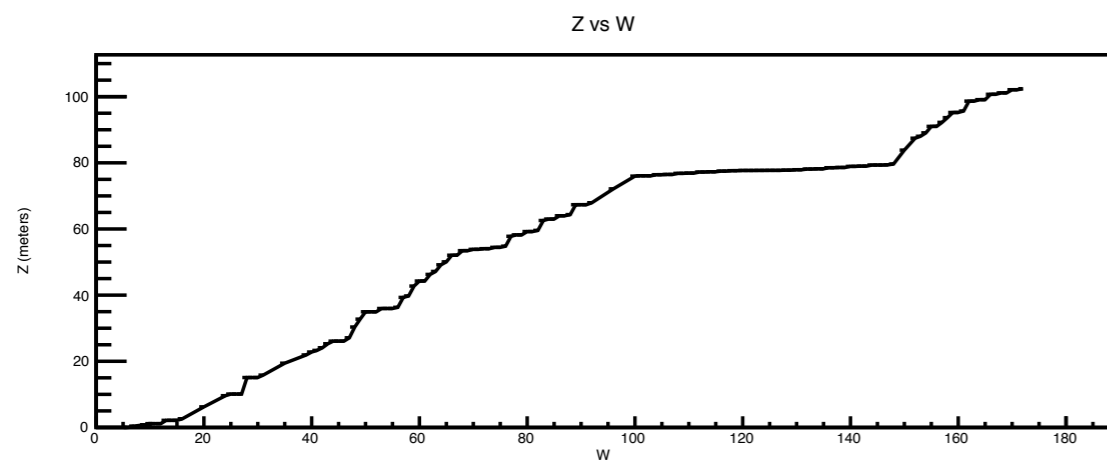
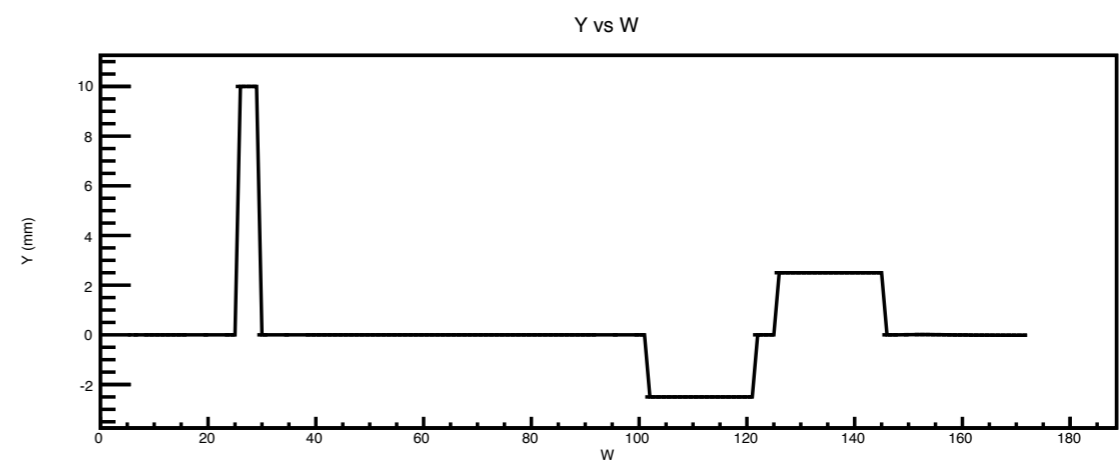
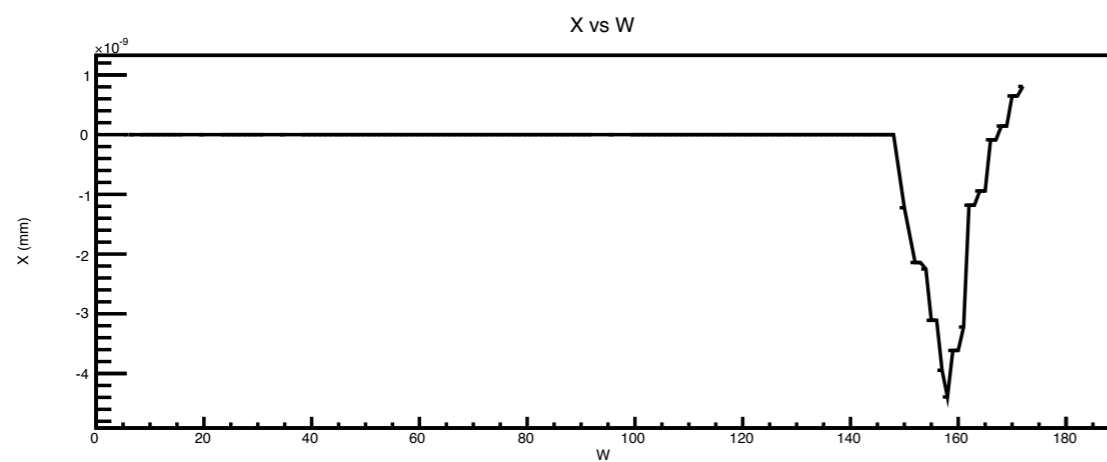
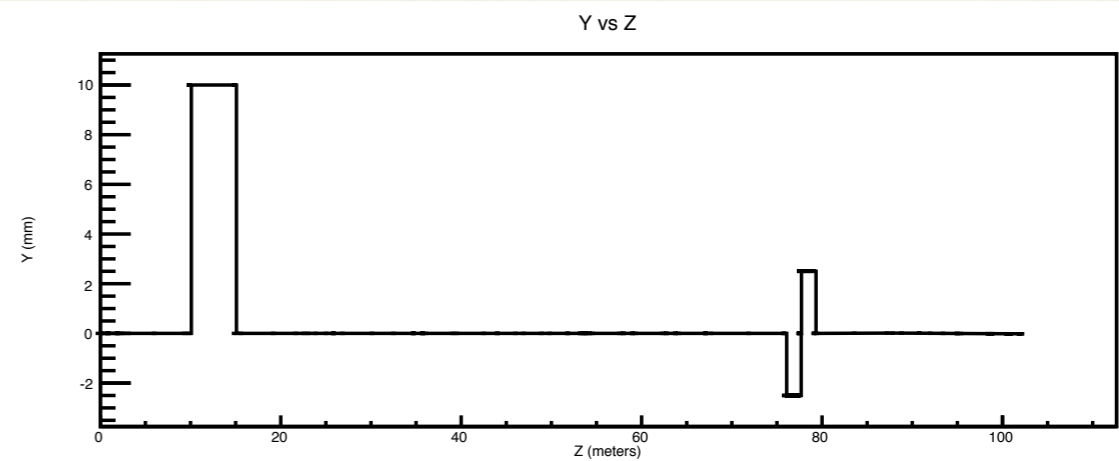
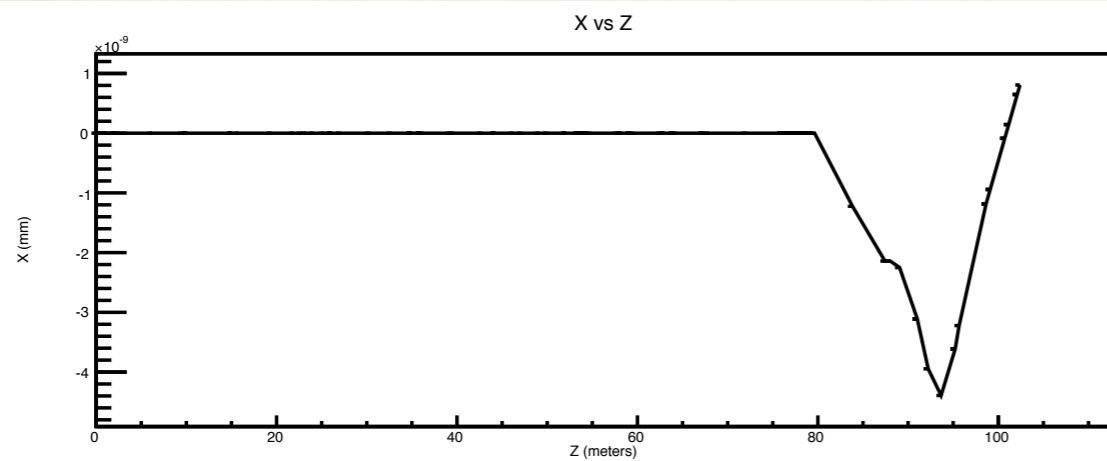






# The actual detector

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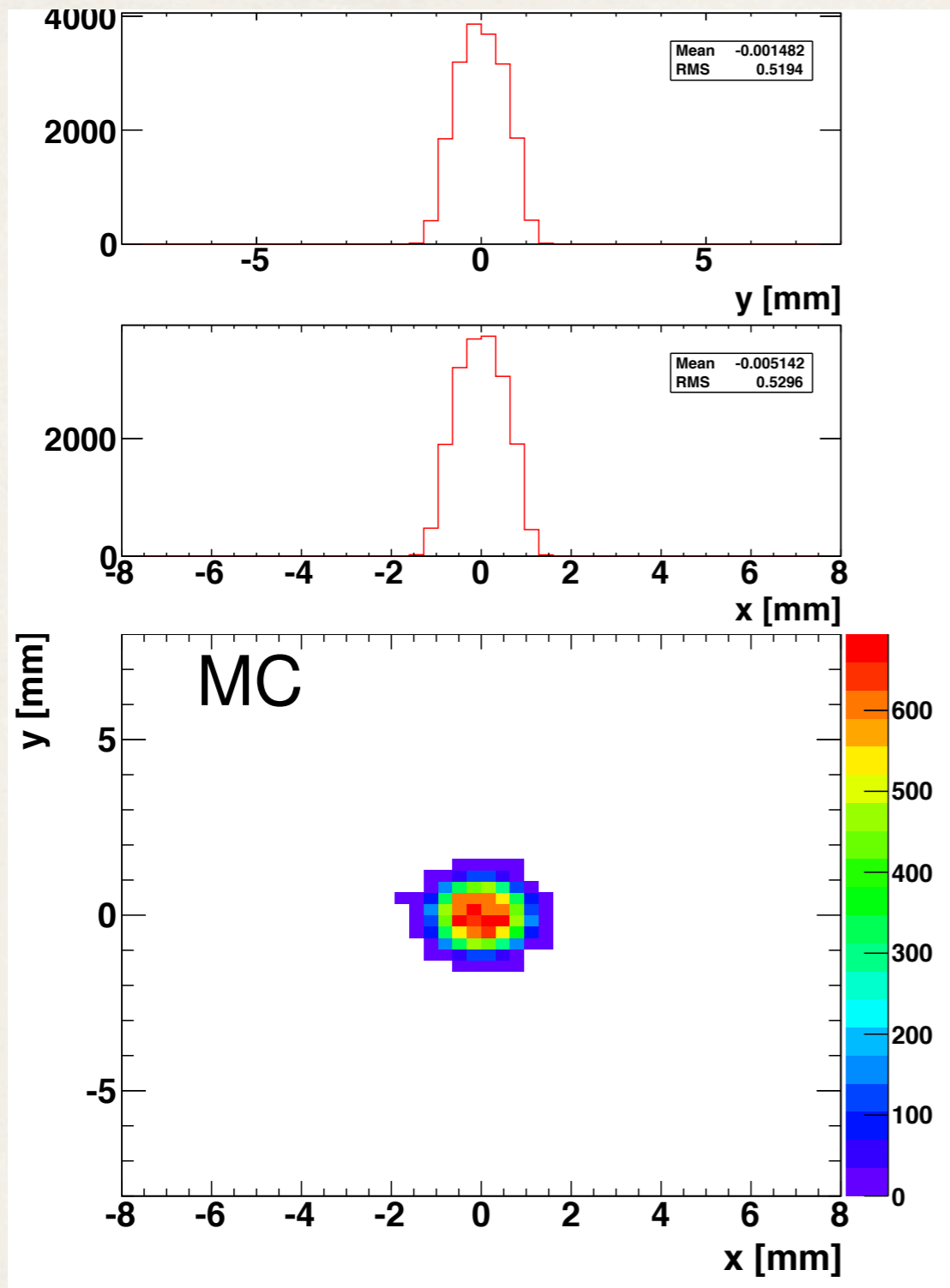


# Backward beam line

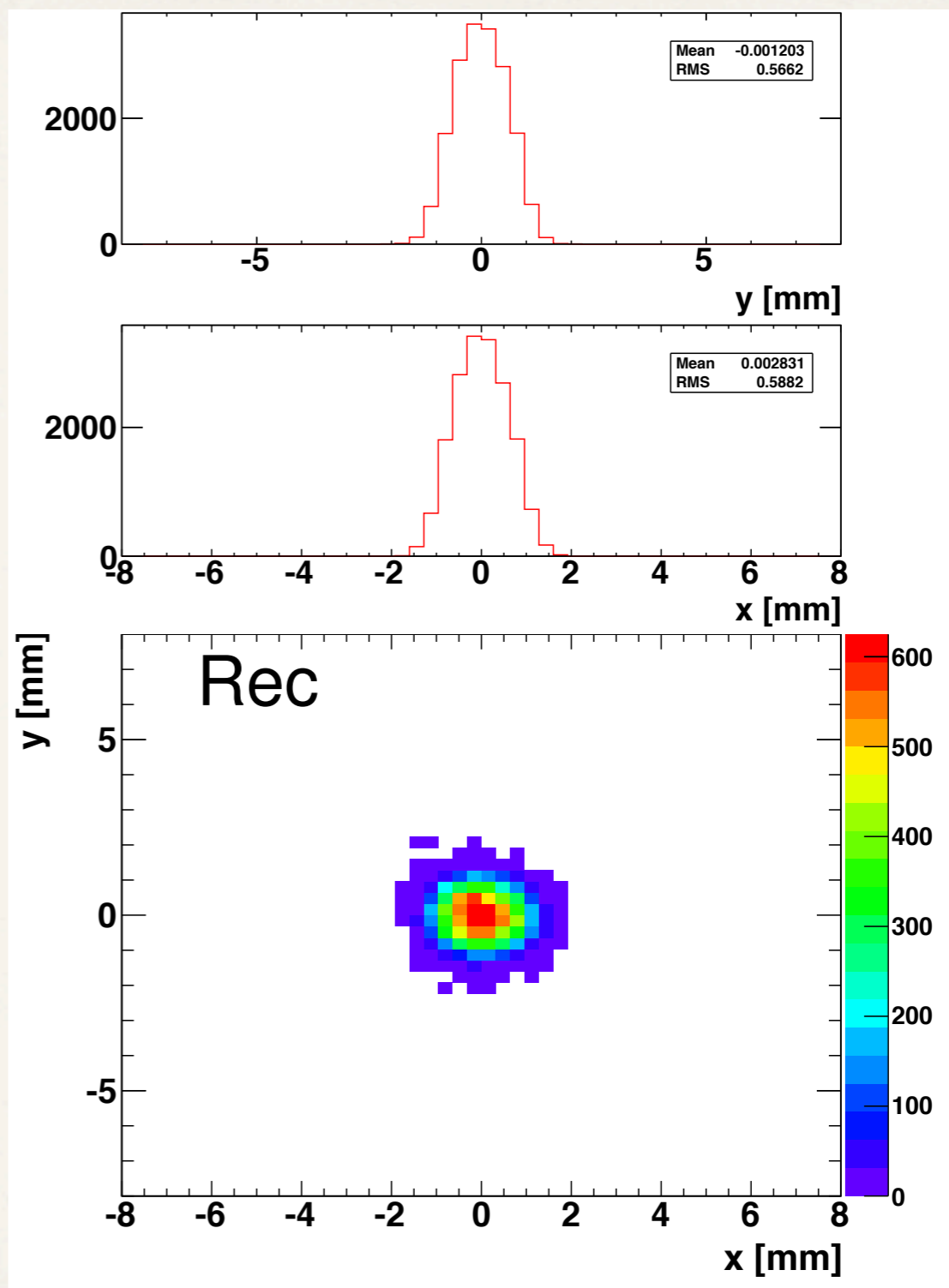
- Kink in X: order of magnitude =  $10^{-9}$
- Bends in Y: quadrupoles



# H2 Begin searching for the most “constraining” “collimator”



Stopped in Collimators:  
956/19,426



Stopped in Collimators:  
1,466 / 19,118



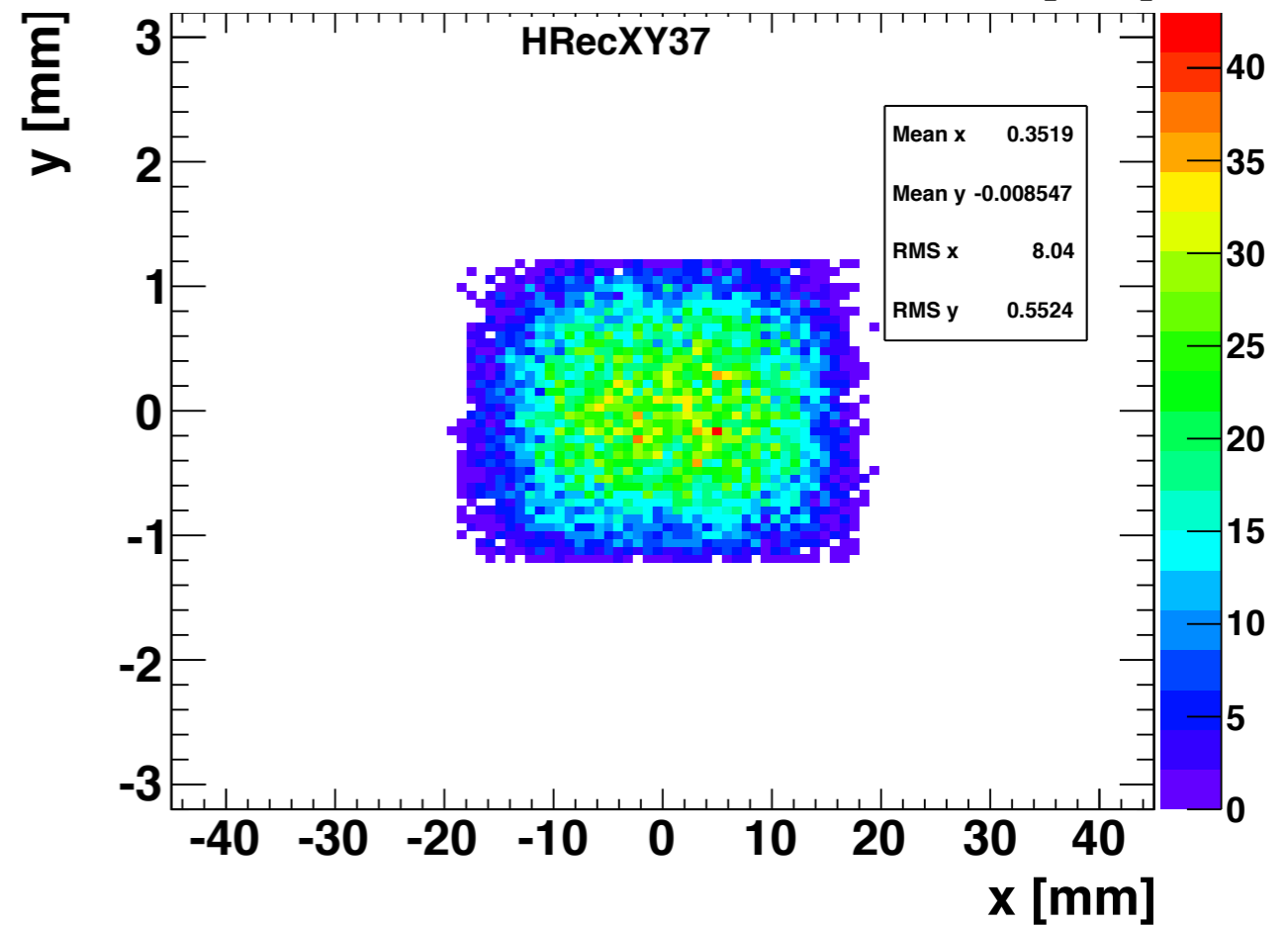
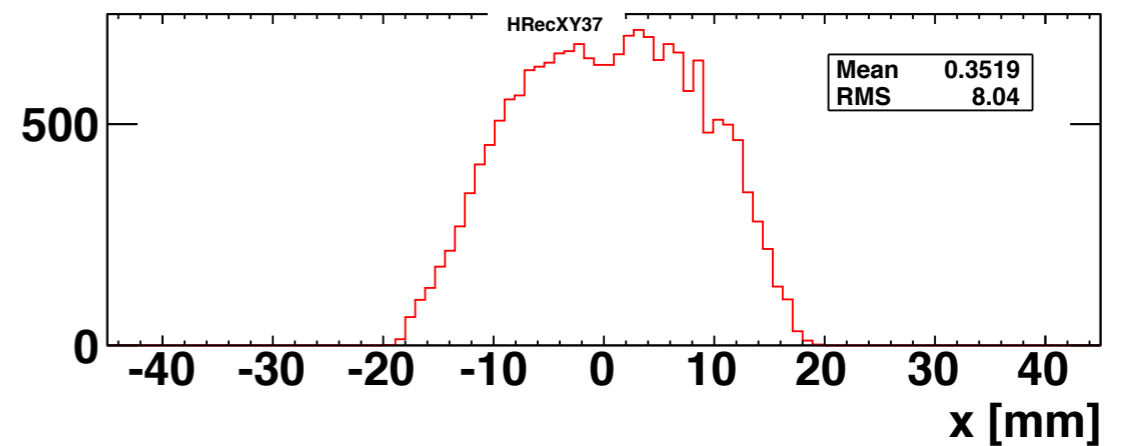
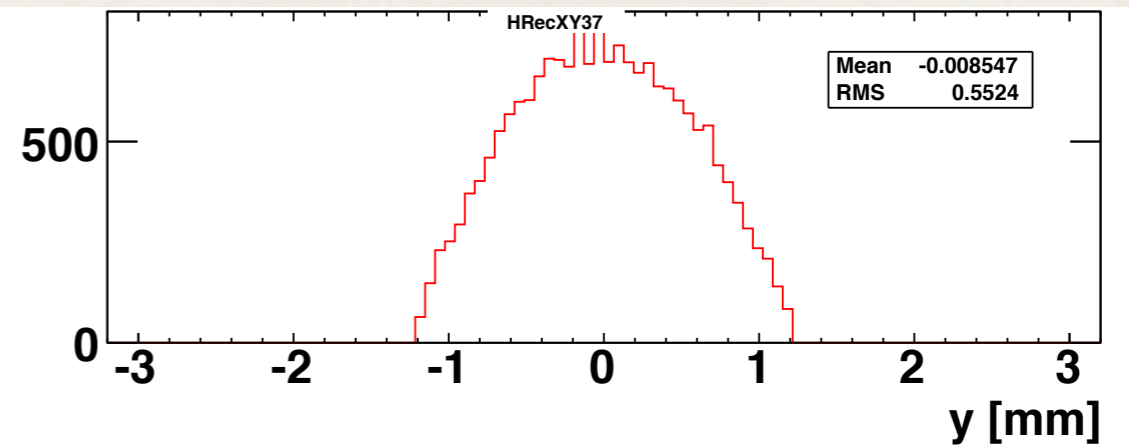
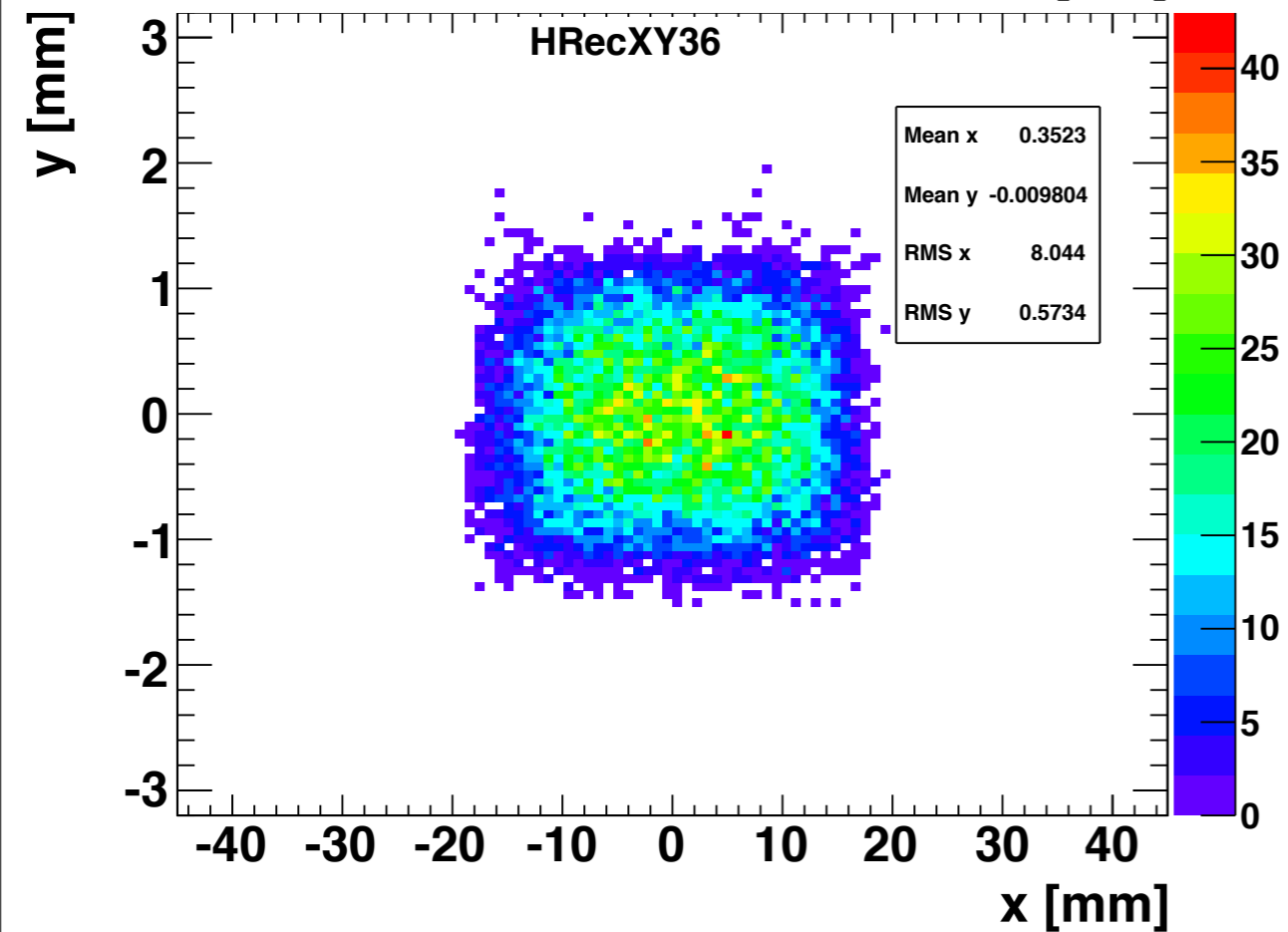
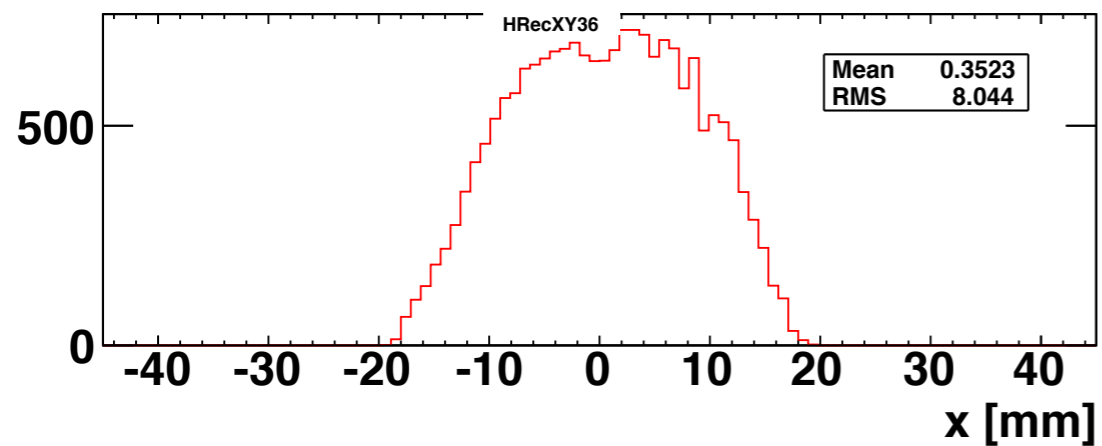
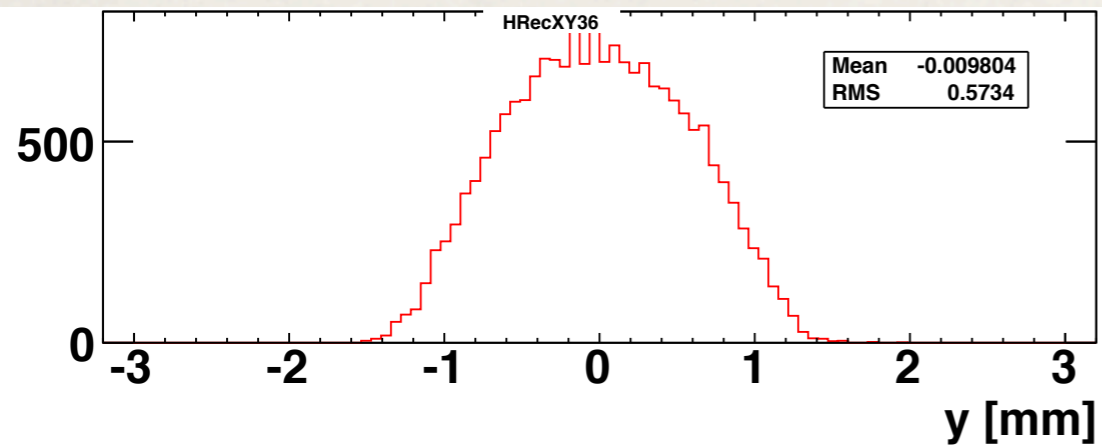
| Element<br>(Card Number) | Number (Percent) of tracks stopped |                 |
|--------------------------|------------------------------------|-----------------|
|                          | Monte Carlo                        | Reconstructed   |
| Collimator<br>(37)       | 258<br>(1.33 %)                    | 326<br>(1.72 %) |
| Collimator<br>(39)       | 222<br>(1.17 %)                    | 240<br>(1.29%)  |
| Quadrupole<br>(128)      | 385<br>(2.04 %)                    | 452<br>(2.47 %) |

Total for each is  $\approx 19,000$  tracks

Percents were calculated adjusting for previously stopped tracks

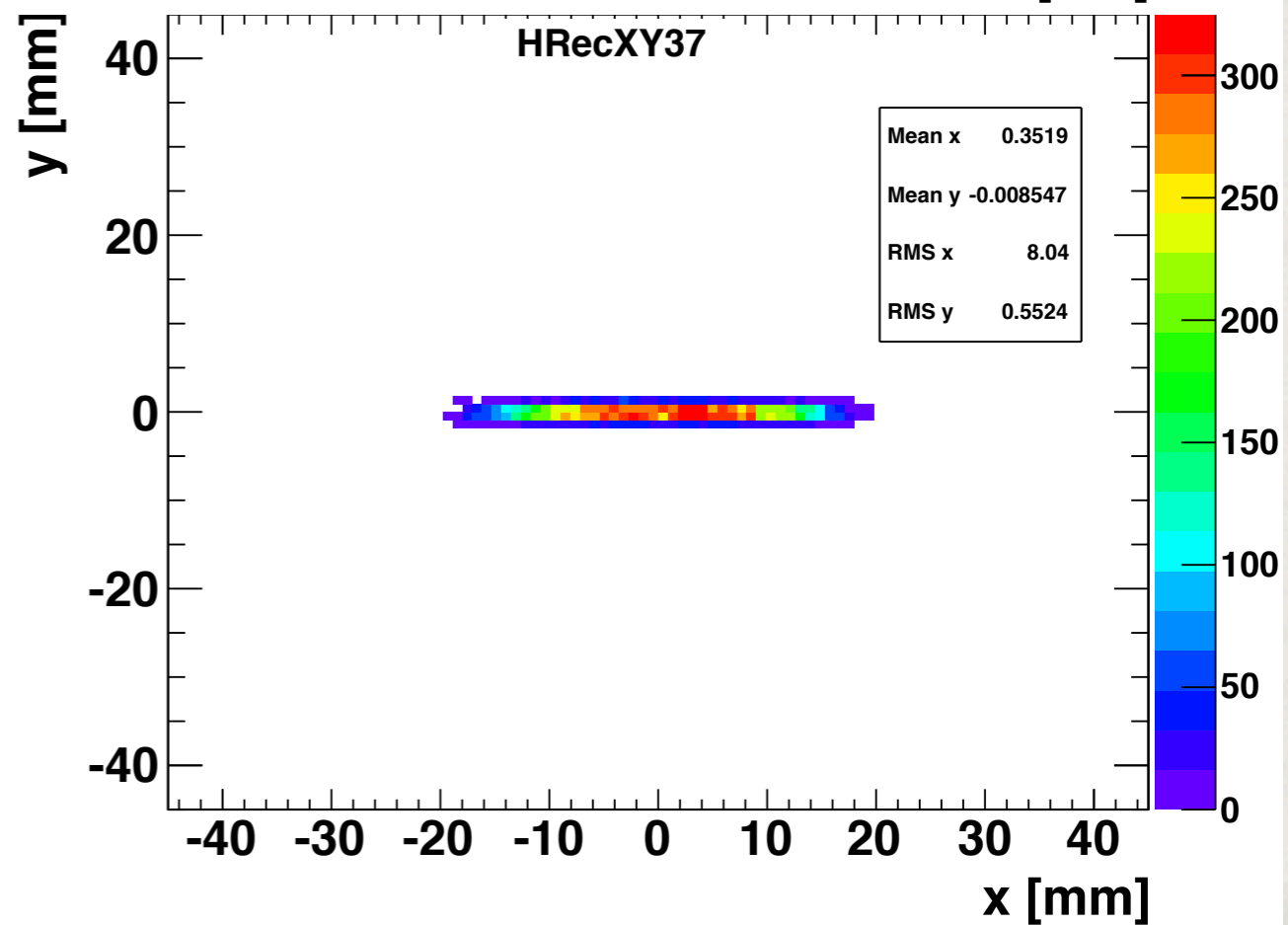
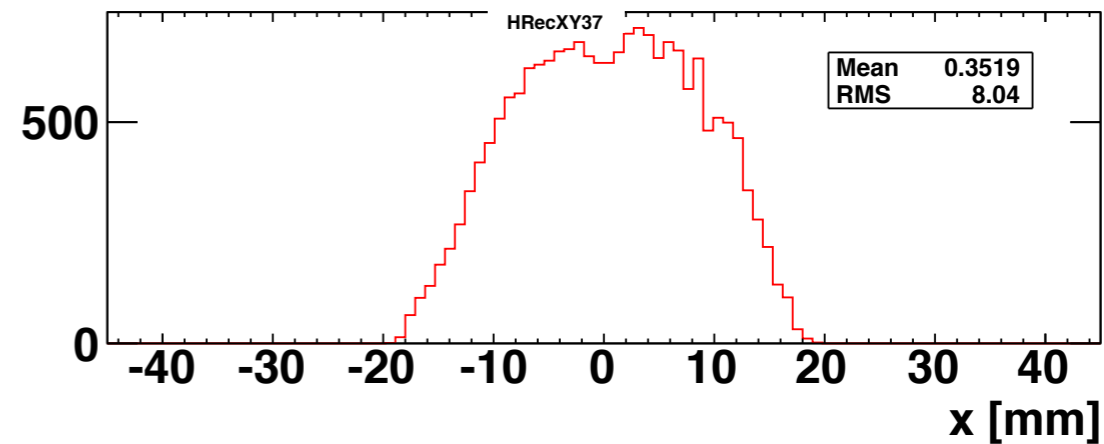
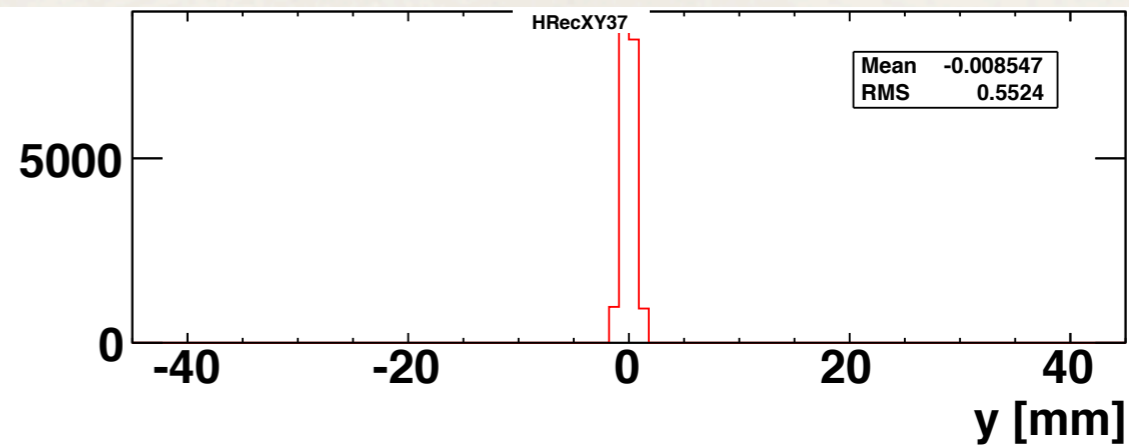
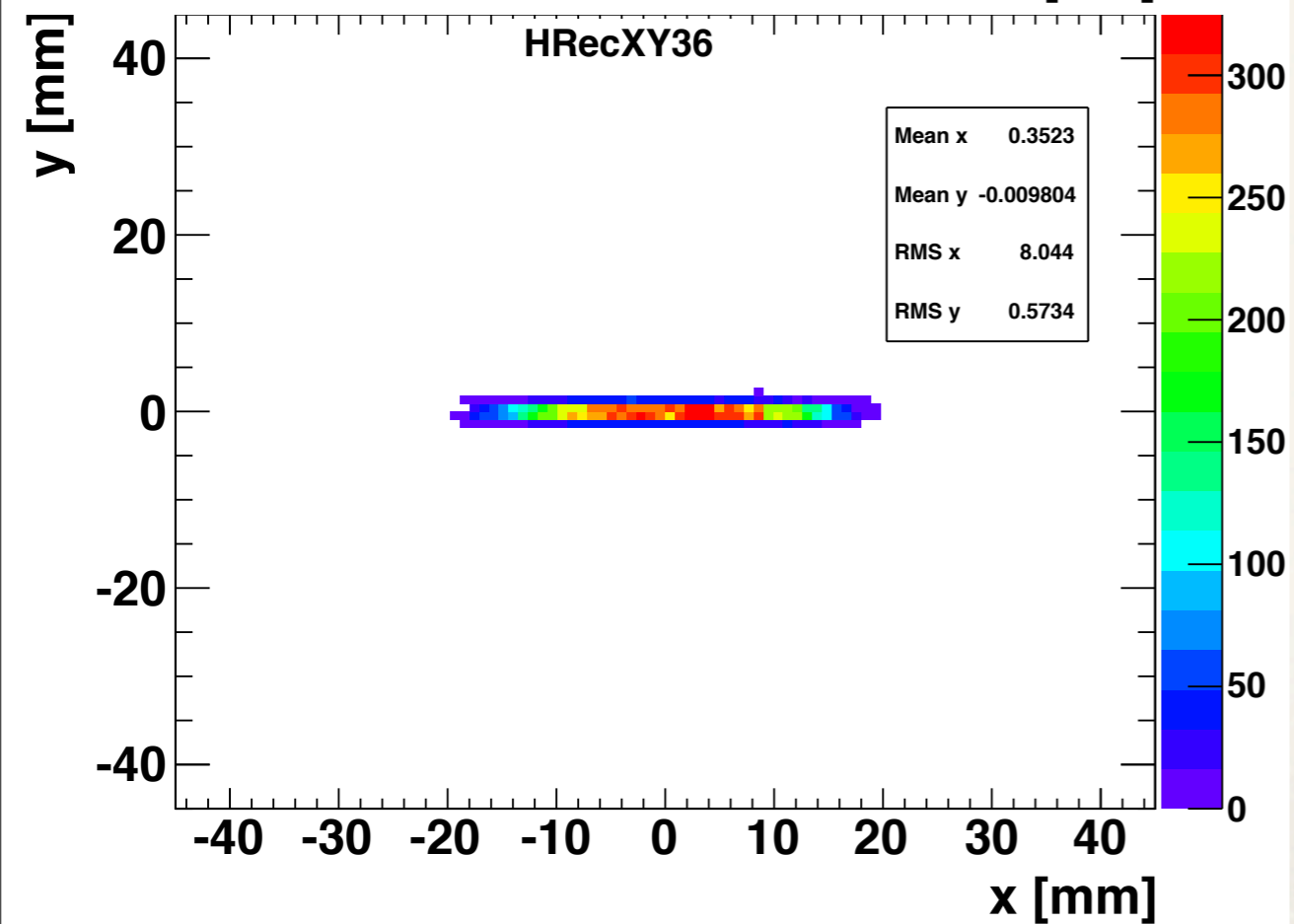
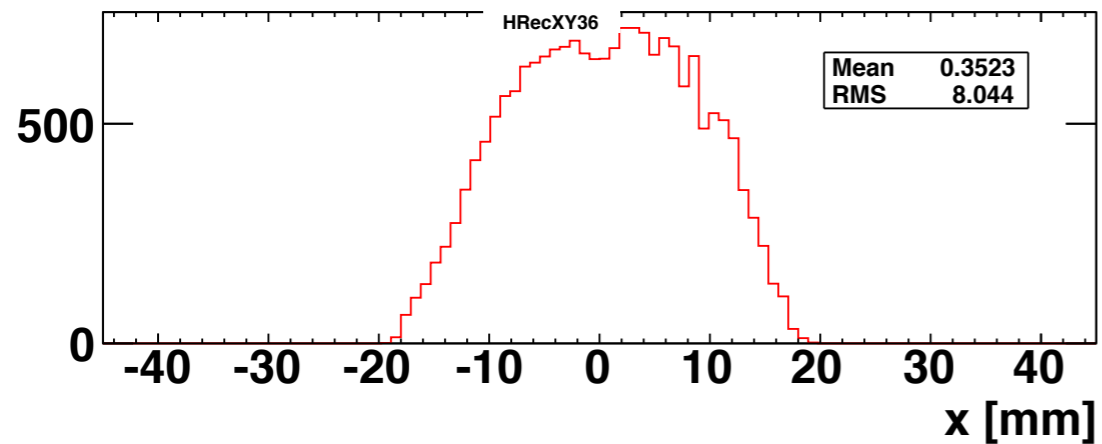
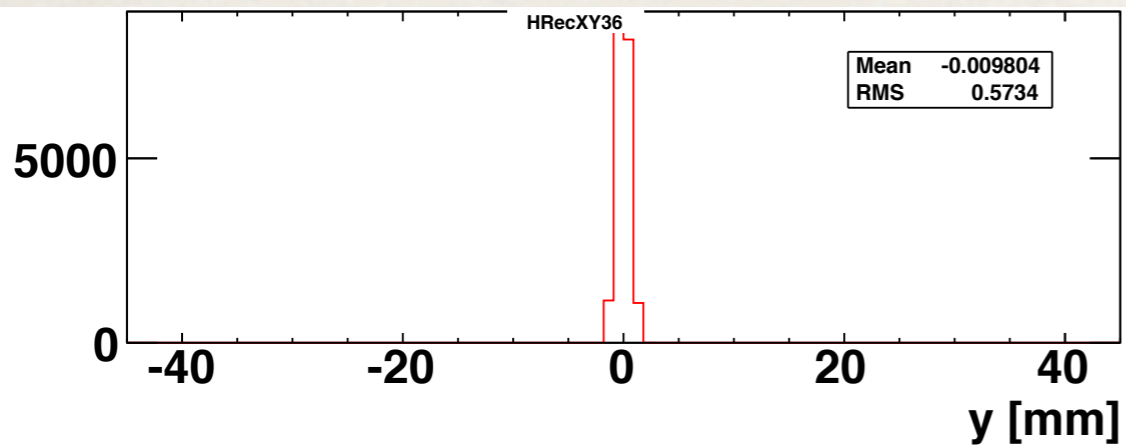


# Before and after collimator for Reconstructed



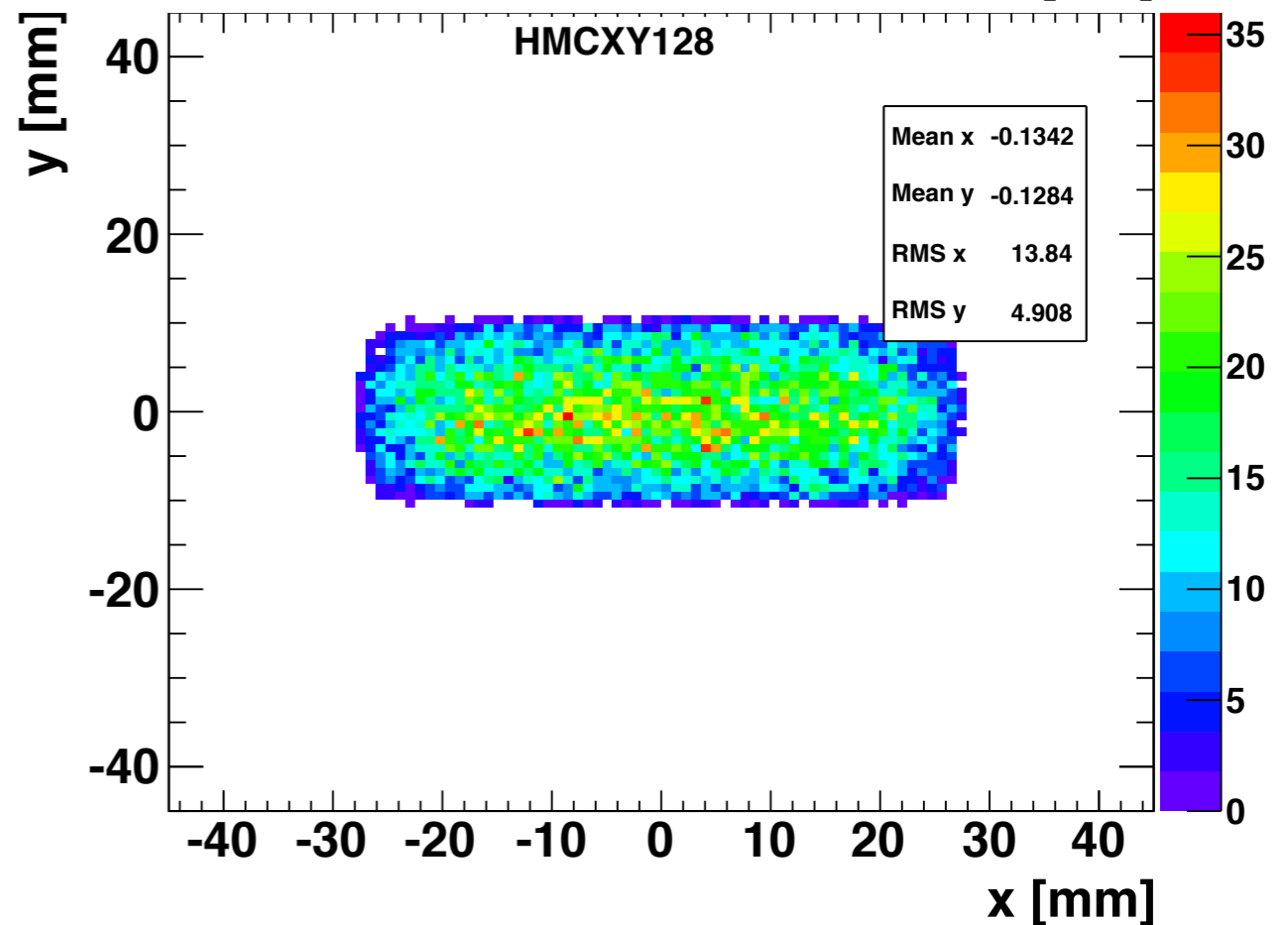
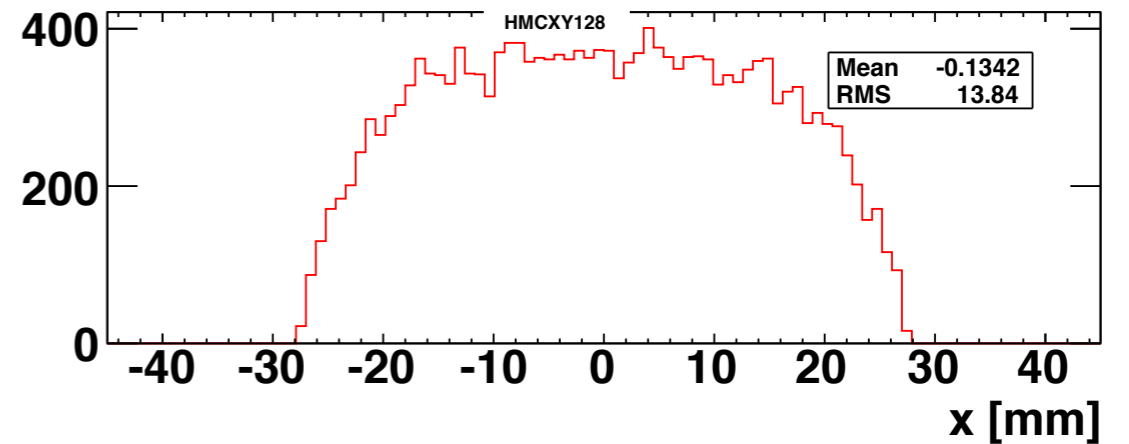
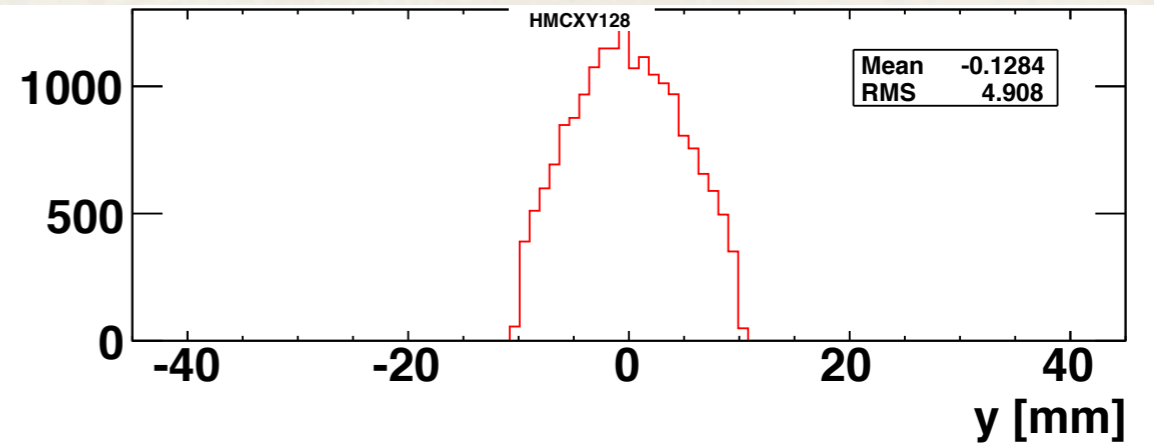
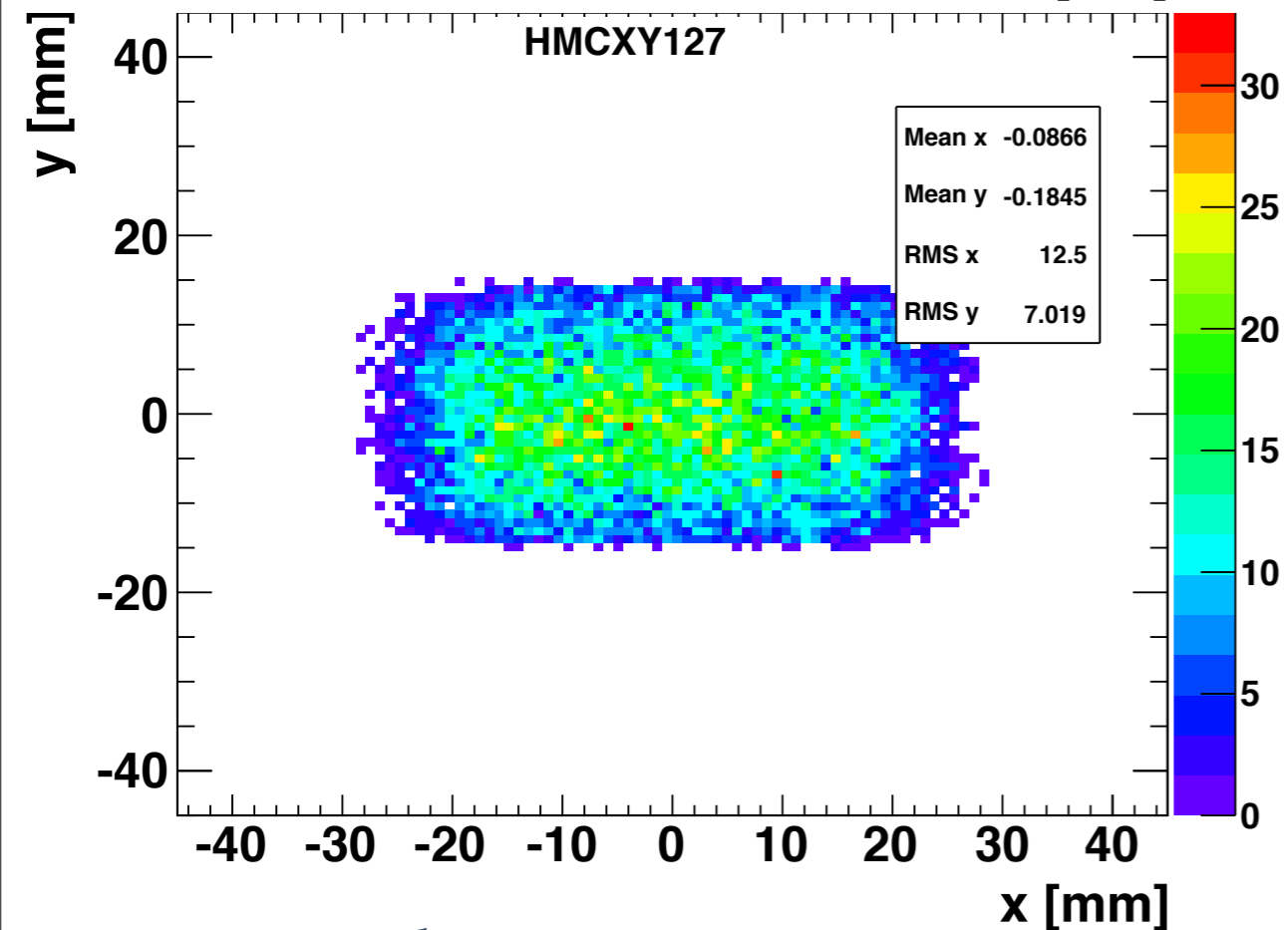
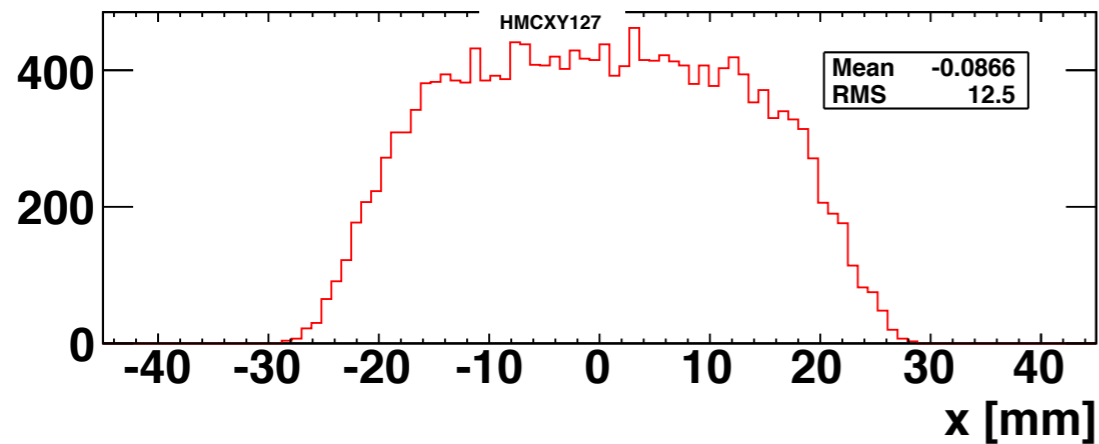
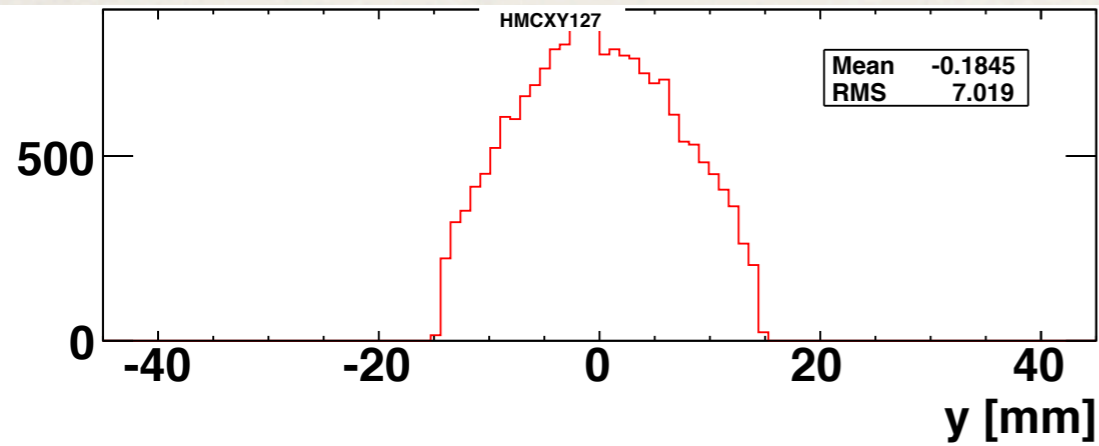


Keep in mind that the actual beam shape is:





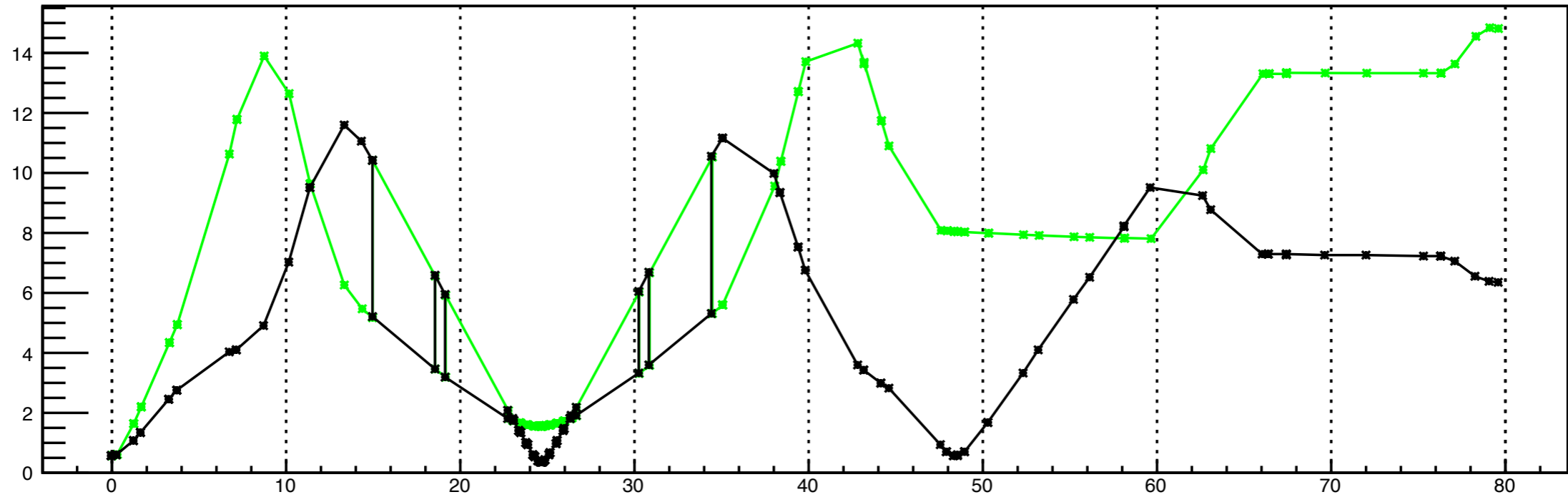
# Quadrupole for Monte Carlo tracks



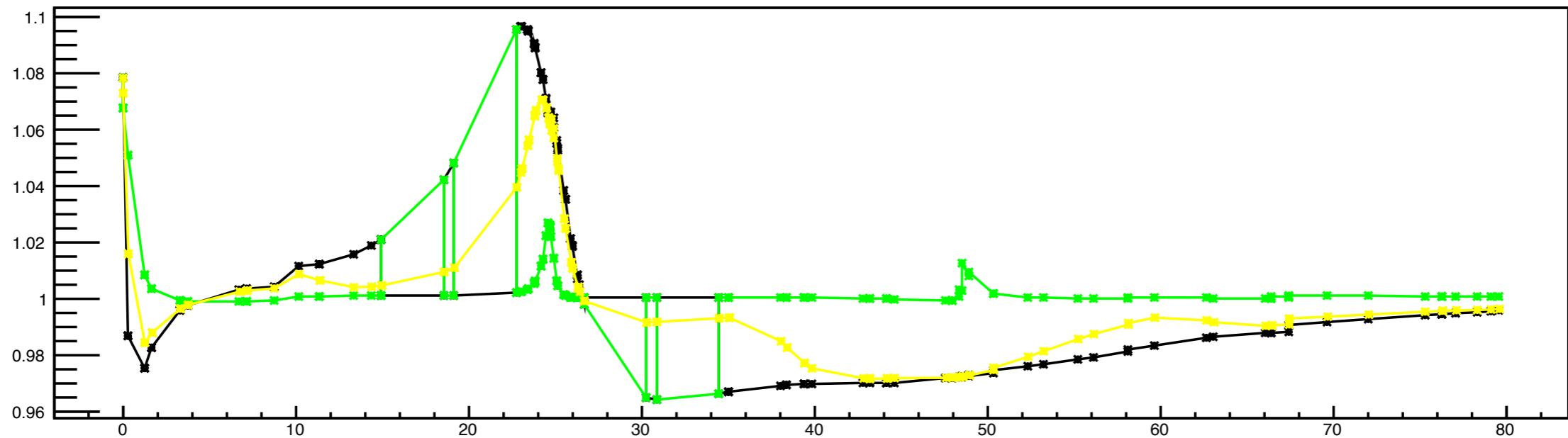
The axes are set wider because I was not expecting a quadrupole to be constraining

# Standard deviation of the beam area propagated backwards

RMS at each Element for Rec Versus Z



Power Ratio vs Z





# What next?

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- ❖ We want to examine what happens when we take out elements in the beam and see how this impacts the ratio of standard deviations
- ❖ Study on fake versus real tracks
- ❖ Implement Kalman Filter - it is a technique used in signal processing, which to my understanding so far works like Euler approximation





# Diamonds

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# Bibliography

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- ❖ [https://na62.web.cern.ch/na62/Documents/Chapter\\_Beam\\_line\\_extract\\_full\\_doc\\_v10.pdf](https://na62.web.cern.ch/na62/Documents/Chapter_Beam_line_extract_full_doc_v10.pdf)
- ❖ <https://na62.web.cern.ch/na62/Home/Aim.html>
- ❖ [http://en.wikipedia.org/wiki/NA62\\_experiment](http://en.wikipedia.org/wiki/NA62_experiment)
- ❖ <http://na62pb.ph.tum.de/na62-logo.jpg>
- ❖ <http://cds.cern.ch/record/1293104/files/NA62%20schematic%20view%20v1.png>
- ❖ <http://www.iggdawg.com/pics/misc/cherenkov/1248269246337.jpg>
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