Tracking for the pilot-run

Aleksei Dziuba / PNPI

21st of April 2021

AMBER-PRM Meeting

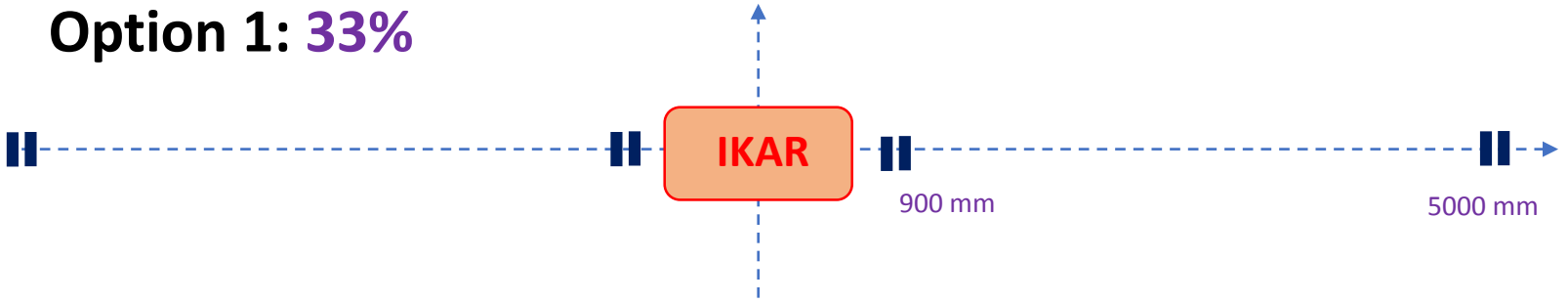
ALPIDE carrier boards solution

- Same technology as proposed for the main run
- Small sensors (15 x 30 mm each)
- PCB material around
- To timing information
- Sensor+PCB were integrated to a prm-mc
  - https://github.com/aleksha/prm
  - I put 8 µm gaussian resolution spatial resolution (but could be even better)

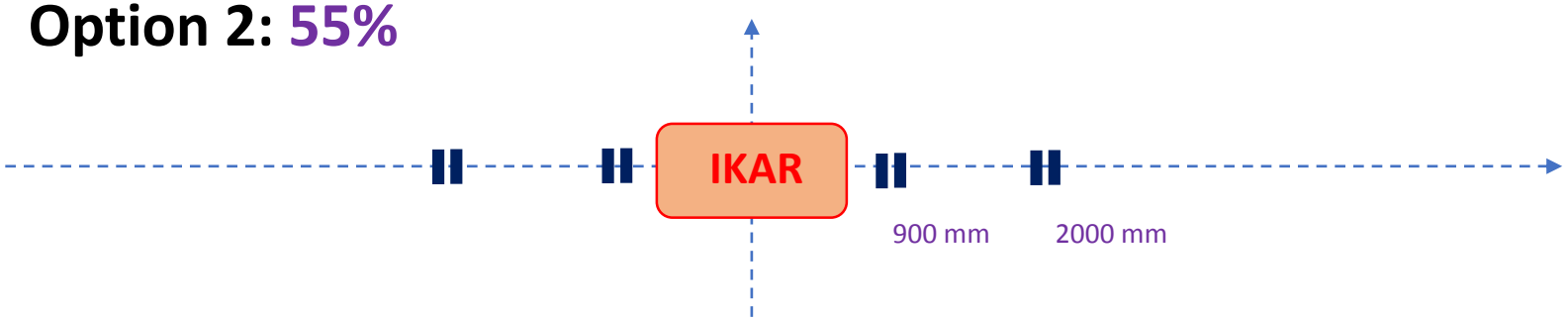
Geometrical efficiency

- How many of true elastic events can be tracked by sensors?

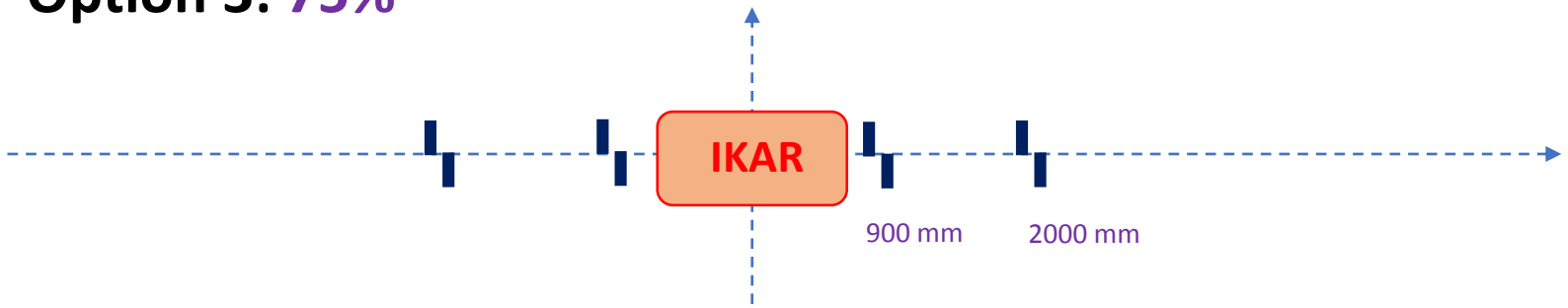
Option 1: 33%



Option 2: 55%



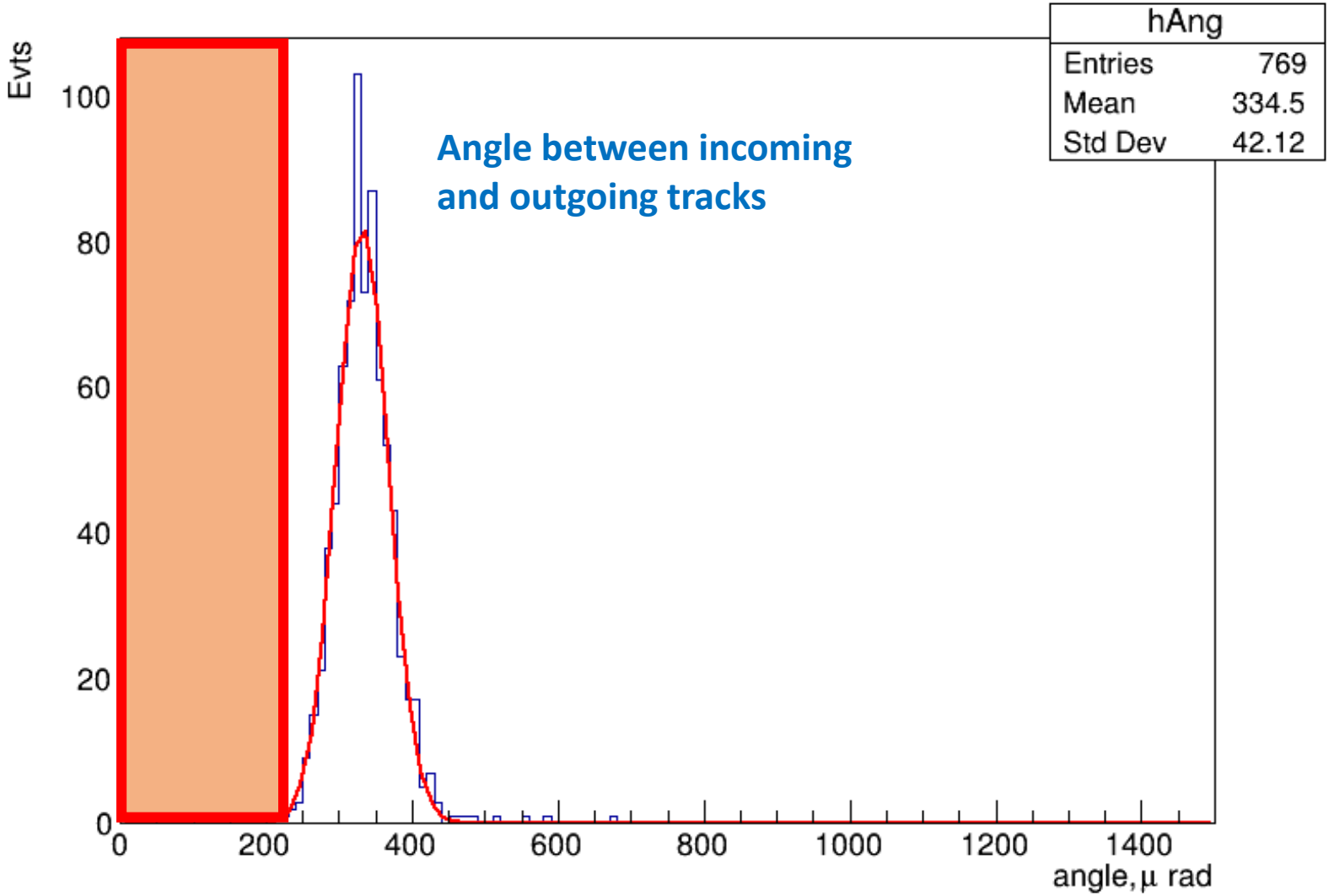
Option 3: 75%



- Sensors oriented vertically according to the available beam profile
- 8 bar of H_2 in IKAR TPC
- Rather weak dependence on a recoil energy
- **More tuning is possible, but 70% result is already good!**
- **Beam intensity issue – how to associate hits with tracks?**
- **Assume we found a signal in TPC**

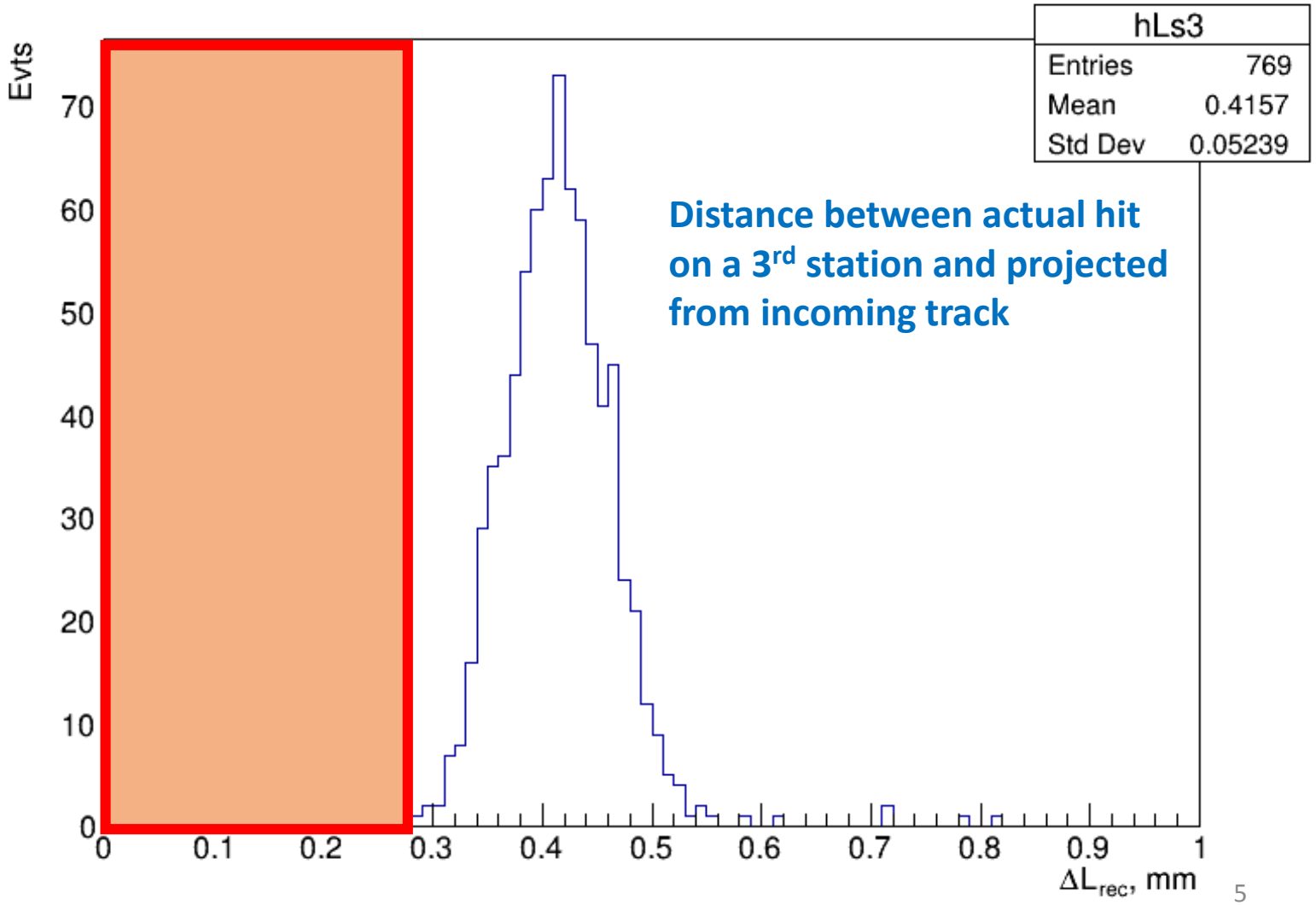
Kink-track properties (T_R=0,5 MeV)

Region dominated by a straight track



Kink-track properties (T_R=0,5 MeV)

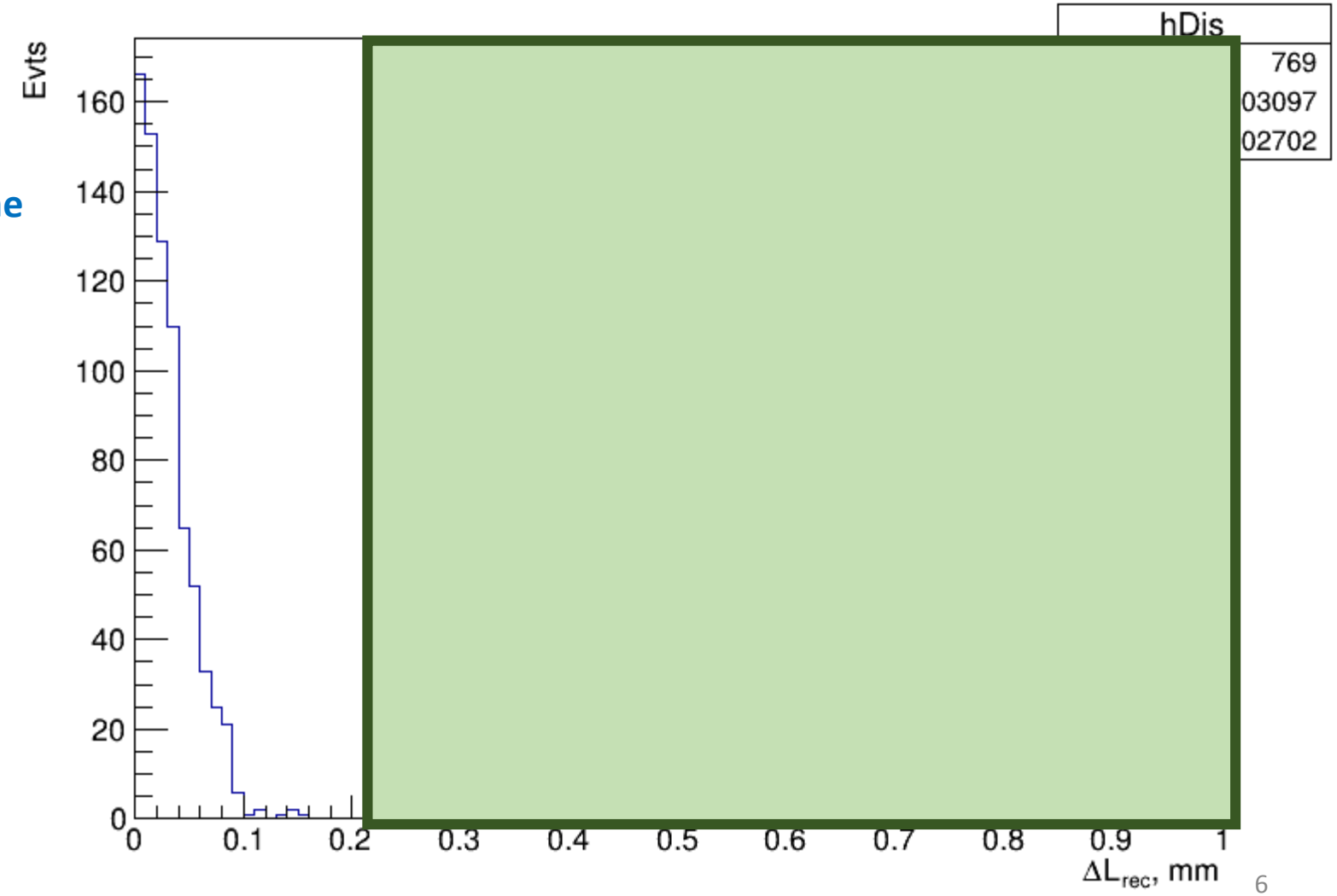
Region dominated by a straight track



Kink-track properties (T_R=0,5 MeV)

Closest distance in XY-plane between incoming and outgoing tracks

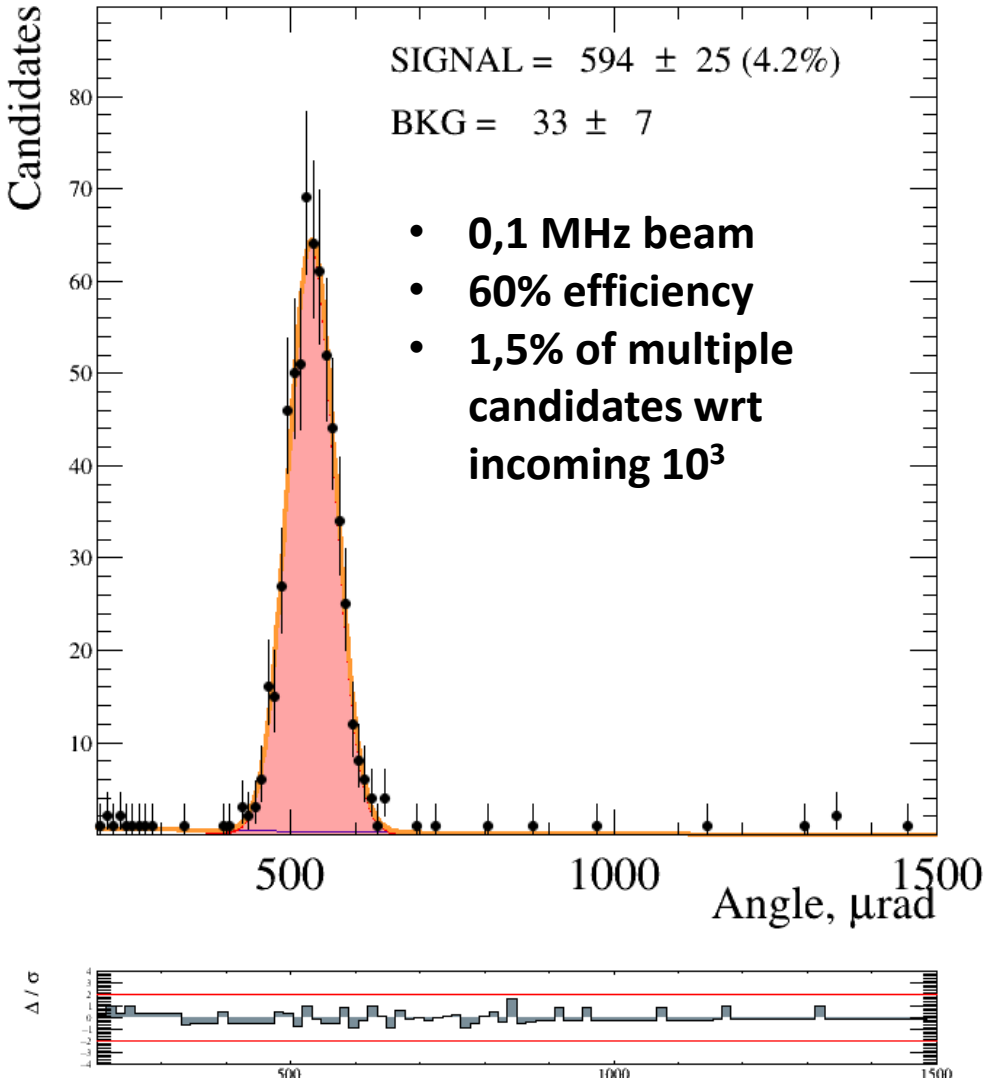
Region dominated by combinatorics



Tracking procedure for each event

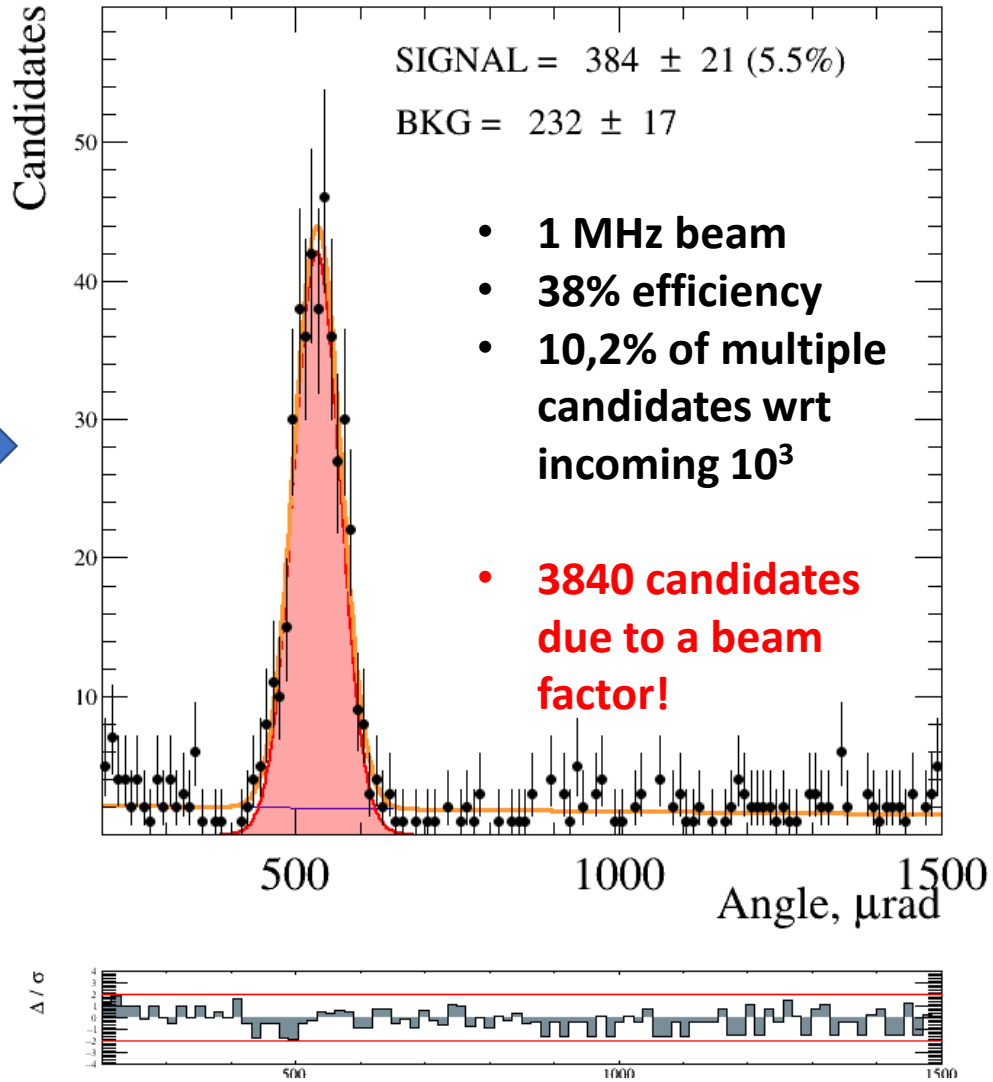
1. **Close hits → one hit** (close means **50 µm**)
2. **Remove hits associated with a straight tracks**
   - Remove hits on a 3rd stations, which are in a **radius less than 150 µm** from the point derived from the info of 1st and 2nd stations.
   - If previous, remove hits on a 4th stations, which are in a radius less than **150 µm** from the point derived from the info of 2nd and 3rd stations.
   - Remove such hits on 1st and 2nd stations.
3. **Distance in XY-plane between incoming and outgoing tracks** to be greater than **200 µm** (100% efficiency for the signal)
4. **Angular cut**
   - Scattering angle between incoming and outgoing tracks to be **between 200 and 1500 µrad**.

Preliminary results (10^3 of initial events, T_R=1.5 MeV)



- **0,1 MHz beam**
- **60% efficiency**
- **1,5% of multiple candidates wrt incoming 10^3**

Increase of beam intensity



- **1 MHz beam**
- **38% efficiency**
- **10,2% of multiple candidates wrt incoming 10^3**
- **3840 candidates due to a beam factor!**

Conclusions

- These are a “prove of concept” studies.
- 38% efficiency at 1MHz with only-TPC timing (100 μs gate)
- **Tuning could improve it at, say, 10% level!**

- We can use more complicated algorithms
- We can add additional detectors
- We can use recoil-muon correlations in tracking algorithm
- **These can give us a factor 2 in efficiency!**