

Preliminary simulation for Scintillator Fiber Tracker (SFT)

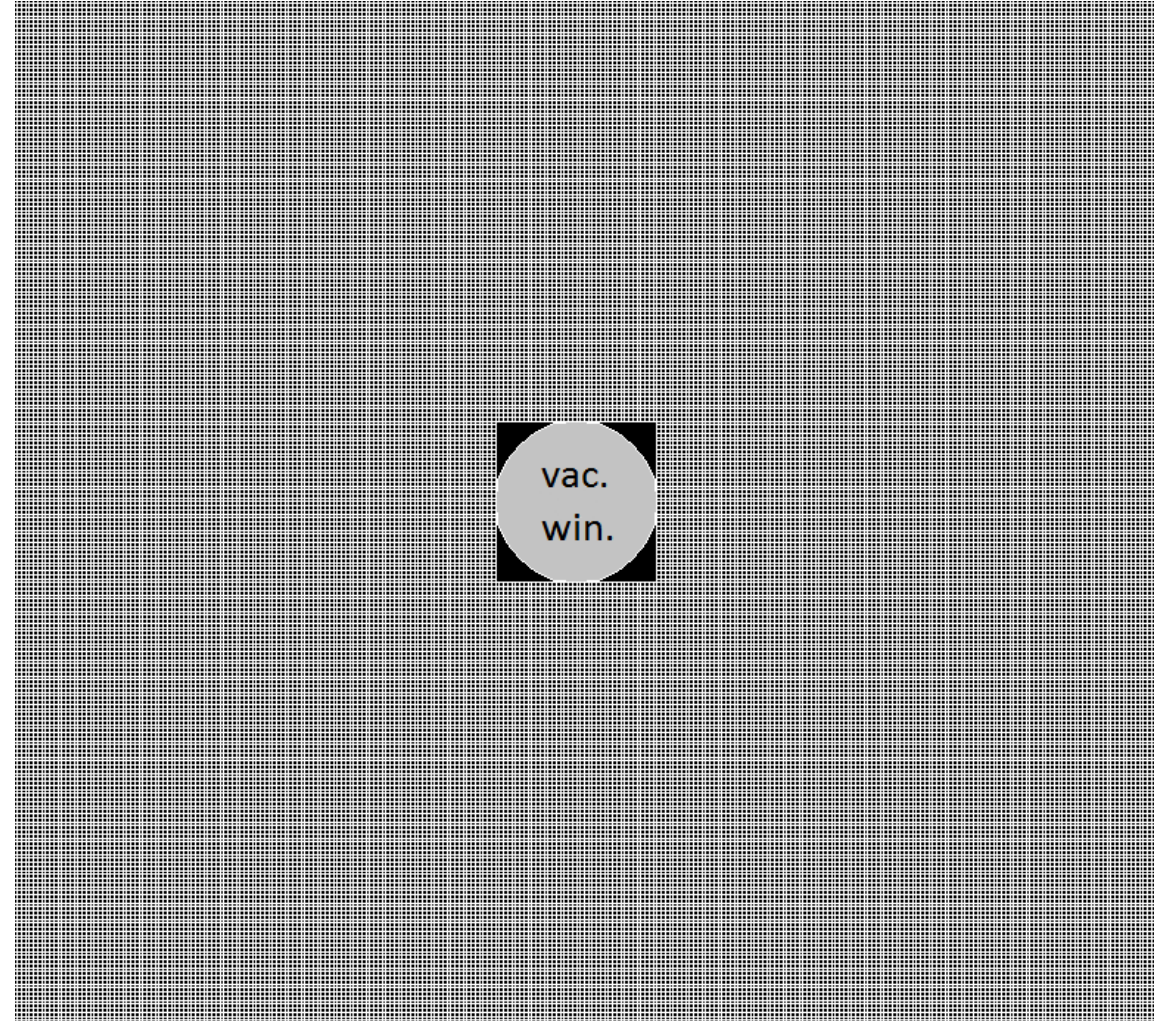
- To check if there are more particles hitting the scintillator fiber in one time window
 - The event cannot be reconstructed in this case due to ambiguity
- Time jitter of trigger ~ 10 ns, time window 2 ~ 20 ns
 - So the total open time is set to be **30 ns** in the simulation
- Implement time information in the simulation
 - Can only assume the incident electrons are uniformly distributed in time
 - For 10 nA beam, there will be **1875 incident electrons** in 30 ns

Geometries in the simulation

- Vacuum box window: 2 mm Aluminum, and a 0.2 mm Aluminum window at the center (radius: 2 cm)
 - The distance between the SFT and vacuum box window is 2.5 cm
- Target gas, target cell, collimator (20 cm long, and a hole of 4 mm in diameter)

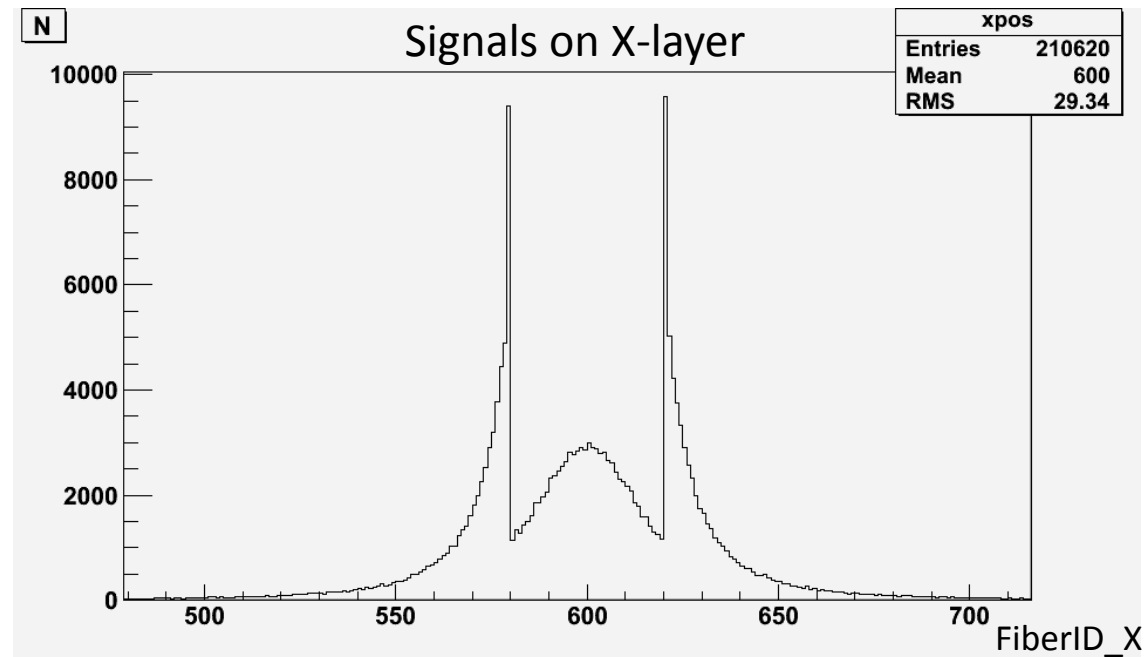
Geometries in the simulation

- Front view of the SFT
- 4 layers with the size of $1.2 \times 1.2 \text{ m}^2$, each layer has 1200 fibers, $4 \times 4 \text{ cm}^2$ hole at the center
 - Fiber diameter is 1 mm
 - The distance between each layer is 1 cm



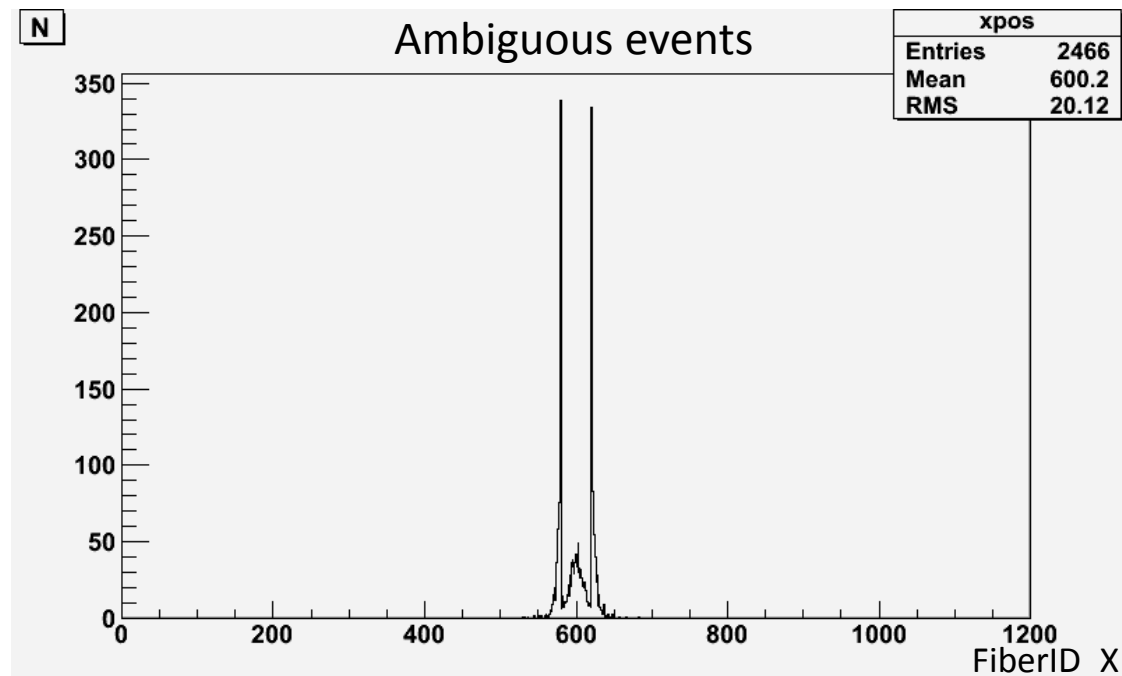
Events on SFT

- With no cuts, the plot shows the events on each fiber in the first layer, 600 is the center of the SFT
- 2×10^8 incident electrons at 1.1 GeV, event rate is 65.6 MHz (mostly from vacuum box window)
- The highest local rate (on 1 fiber) is about 3 MHz
- The fall at 580 or 620 is due to the central hole



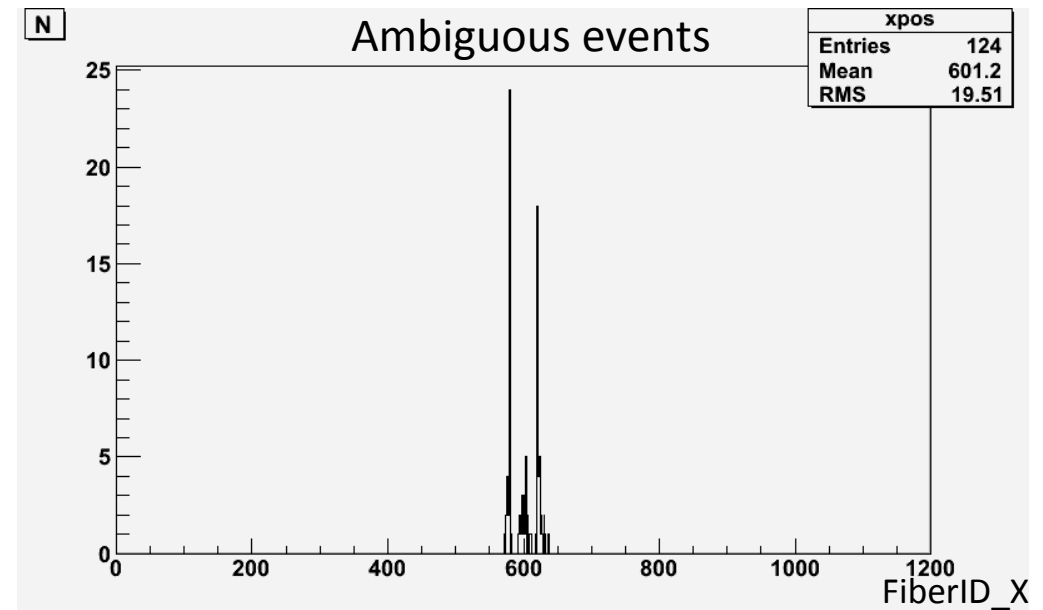
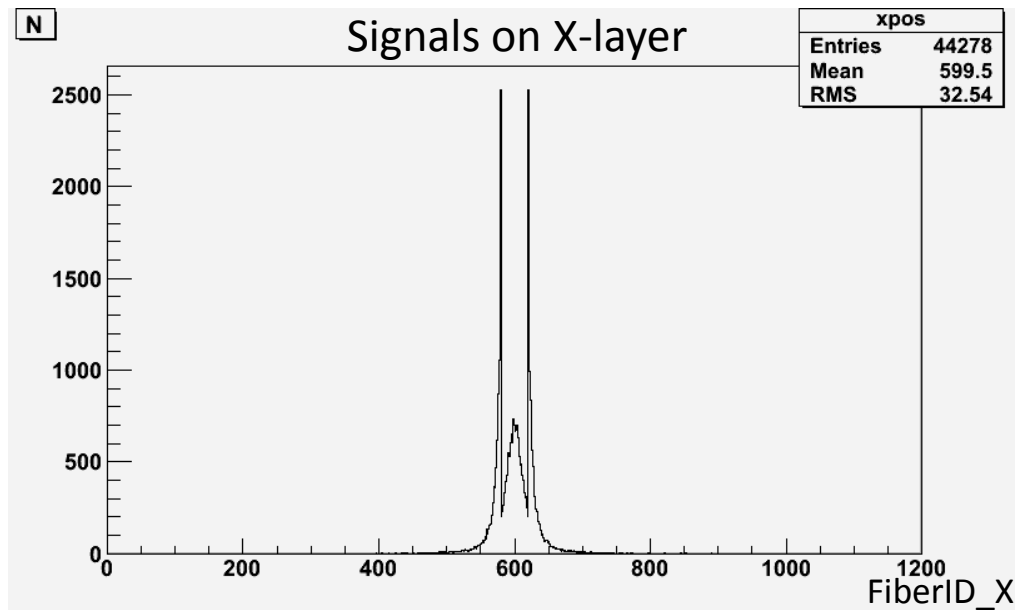
Multi-signals in one time window

- Each incident electron was given a unique ID (from 1 to 2×10^8), If there are events hit the same fiber, and if the ID number difference of their corresponding incident electrons is less than 1875 (30 ns), the events are ambiguous
- About 1.2% of the events will be ambiguous



Multi-signals in one time window

- Assuming 1 MeV is the threshold of SFT, the rate is reduced to 13.8 MHz
- There are about 0.28% ambiguous events

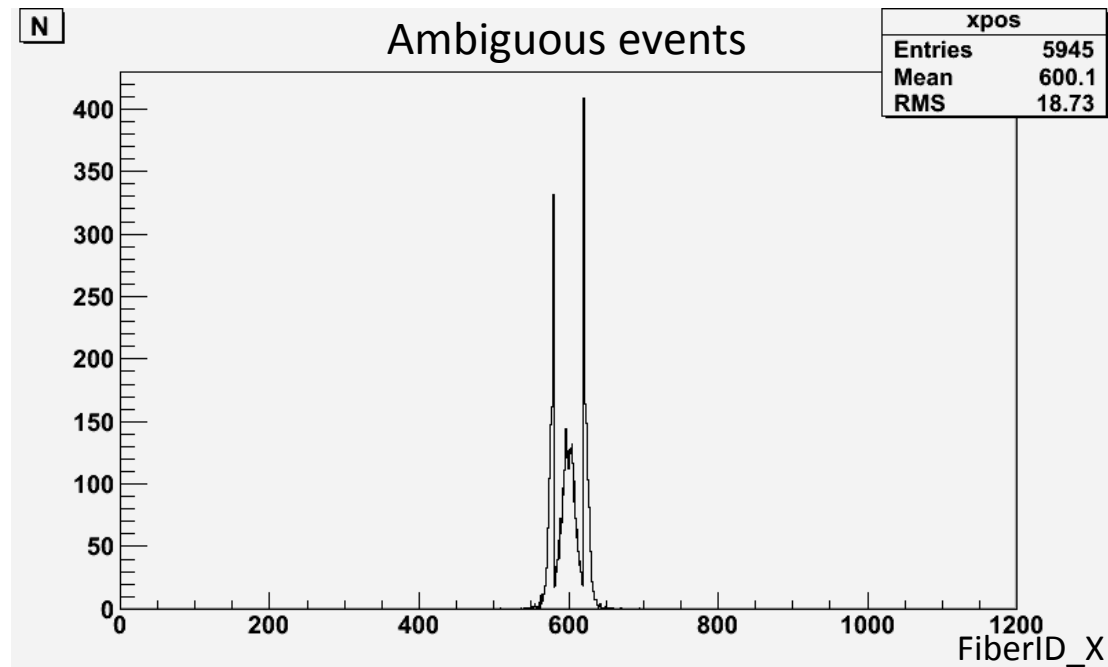


Discrimination with HyCal

- Looking at the signals on the same fiber may **underestimate** the number of ambiguous events
- If there are multiple-events (anywhere) in one time window, we can only discriminate the event that triggered the DAQ by the position information from HyCal
- If the multi-events are closer enough, they cannot be discriminated by HyCal due to the large position resolution, and thus are ambiguous

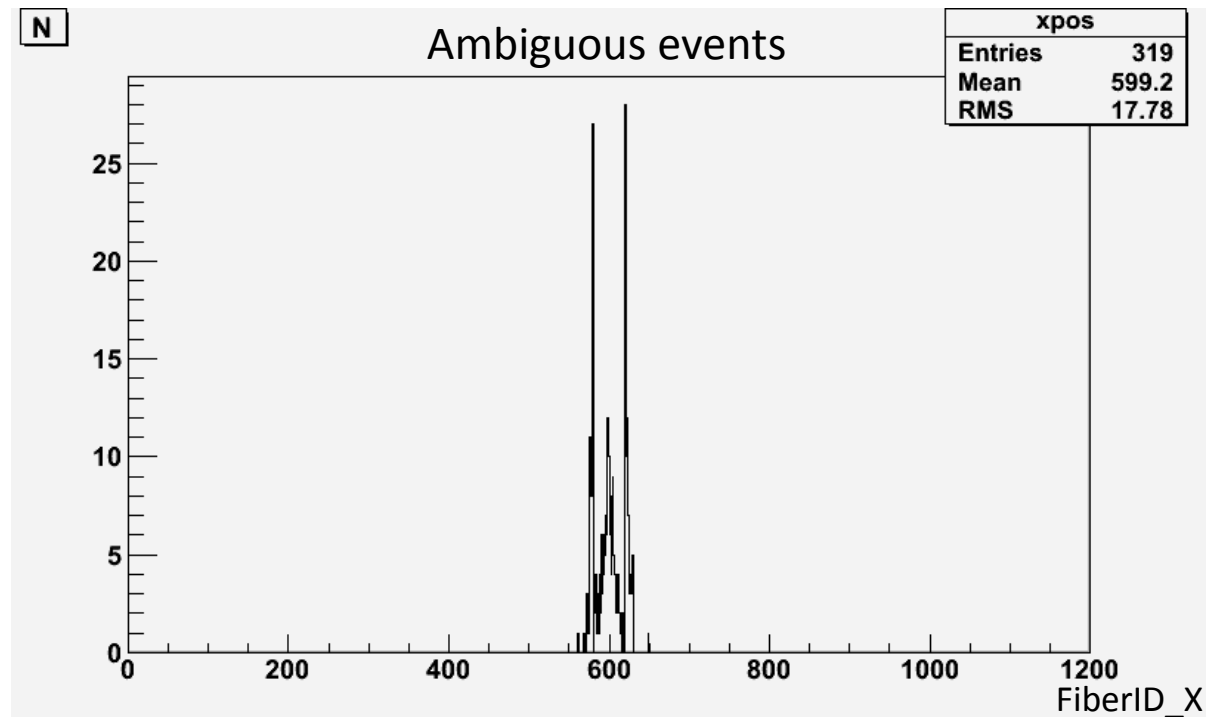
Discrimination with HyCal

- Select the events within the 30 ns window, and with the distance between any two of them $< 7.5 \text{ mm}$ (about 3 times of HyCal's position resolution at 1.1 GeV)
- About 2.8% events are ambiguous under this circumstance



Discrimination with HyCal

- Applying the threshold of $E > 1$ MeV
- About 0.72% ambiguous events



Summary and plan

- The ambiguous events are not negligible, this is mainly due to the high rates (tens of MHz) from vacuum box window
- The rates can be further lowered by increase the size of the hole on SFT
 - Now it is $4 \times 4 \text{ cm}^2$, we may increase it to $8 \times 8 \text{ cm}^2$ for a angle coverage of > 0.5 degree
 - The simulation for this case is ongoing
- Now the code just record the events pass through the fibers, will implement the simulation for scintillation signals in the future