TPC Cosmic Event Display

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For the sPHENIX TPC Group
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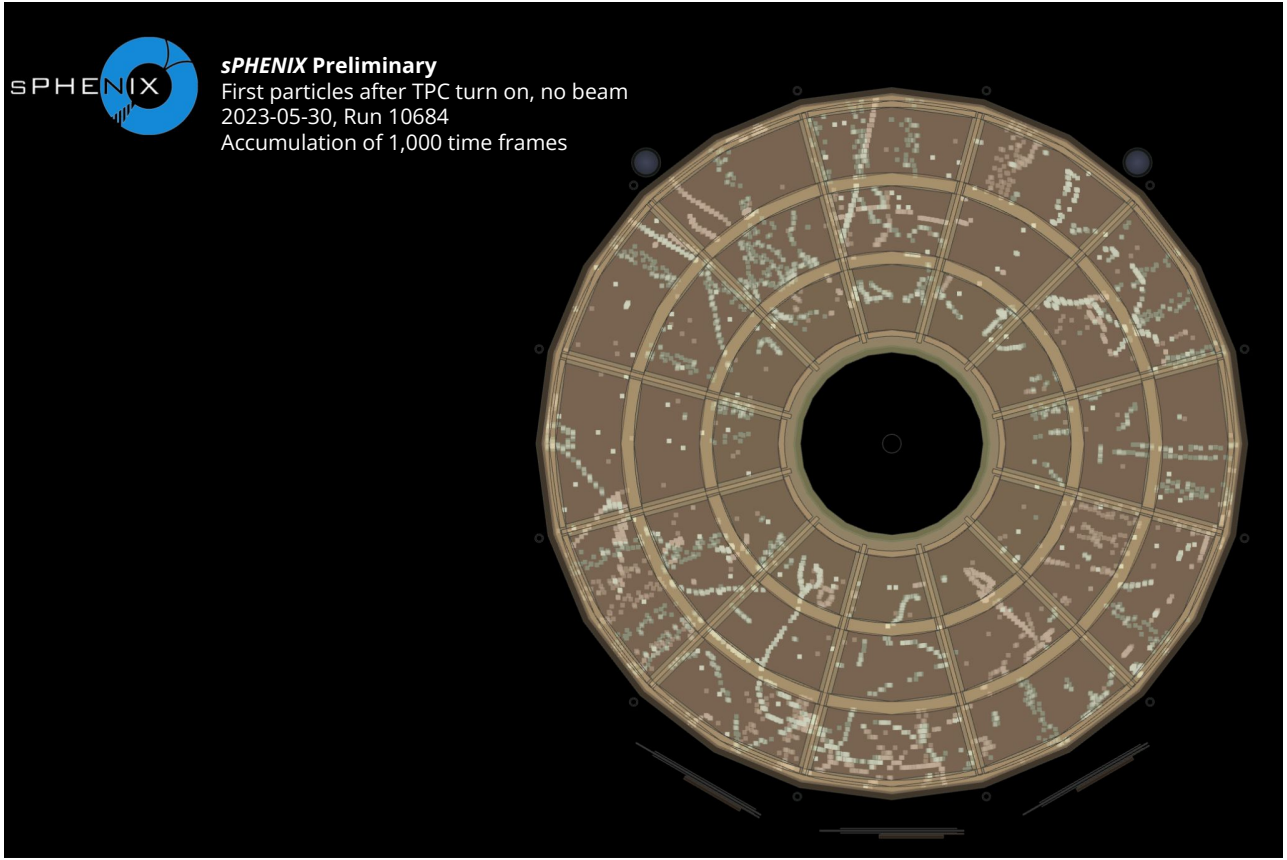
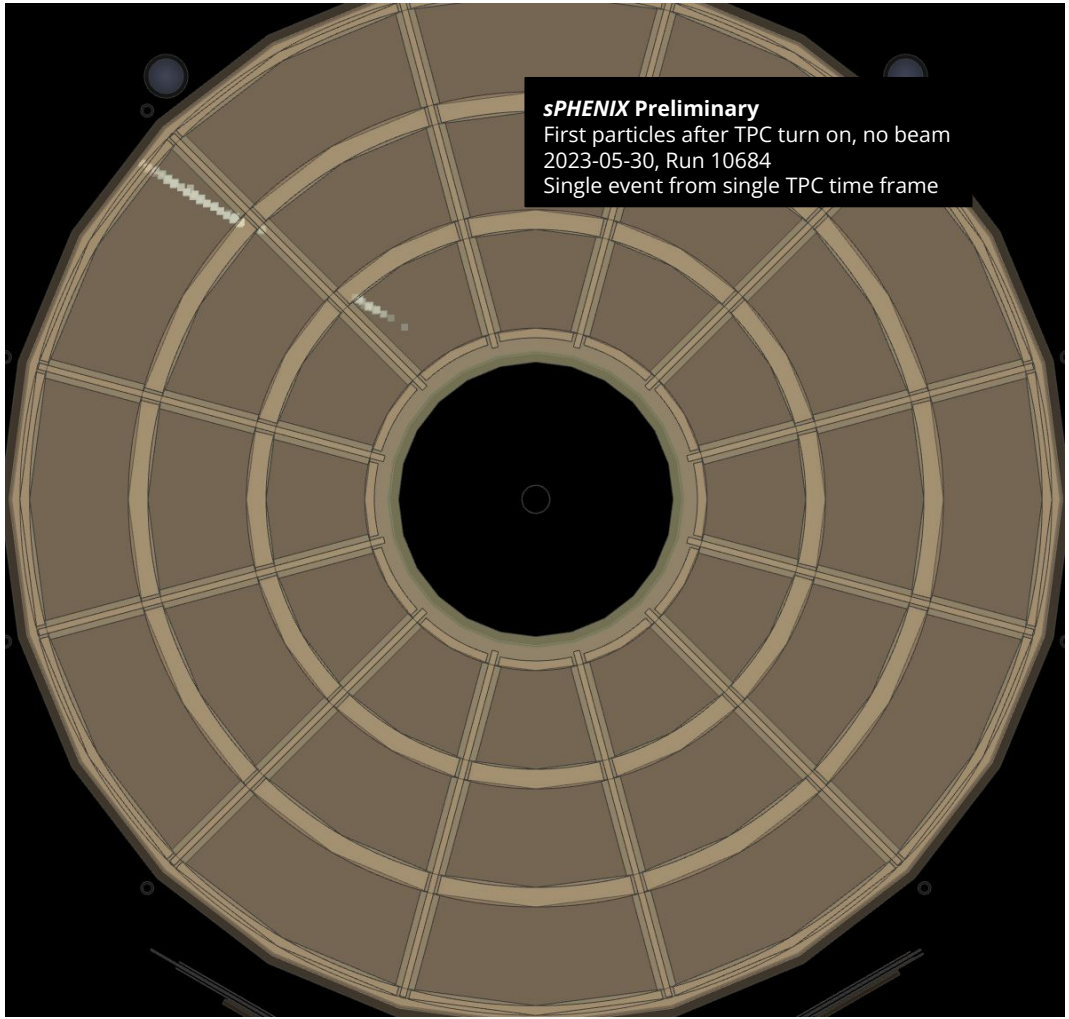
- First 1k time frame within few minutes after TPC with full HV in IR
- No beam, random triggered: most tracks are low energy particle (residual radiation, etc.)
- Significance:
  - First full TPC data with tracks
  - TPC is very low noise
  - Live area is high



- One event within few minutes after TPC with full HV in IR
- No beam, random triggered, no field. Likely a low energy track
- Significance:
  - First full TPC data with straight tracks
  - Channel mapping works cross sector boundary
  - TPC is very low noise



Extra Information

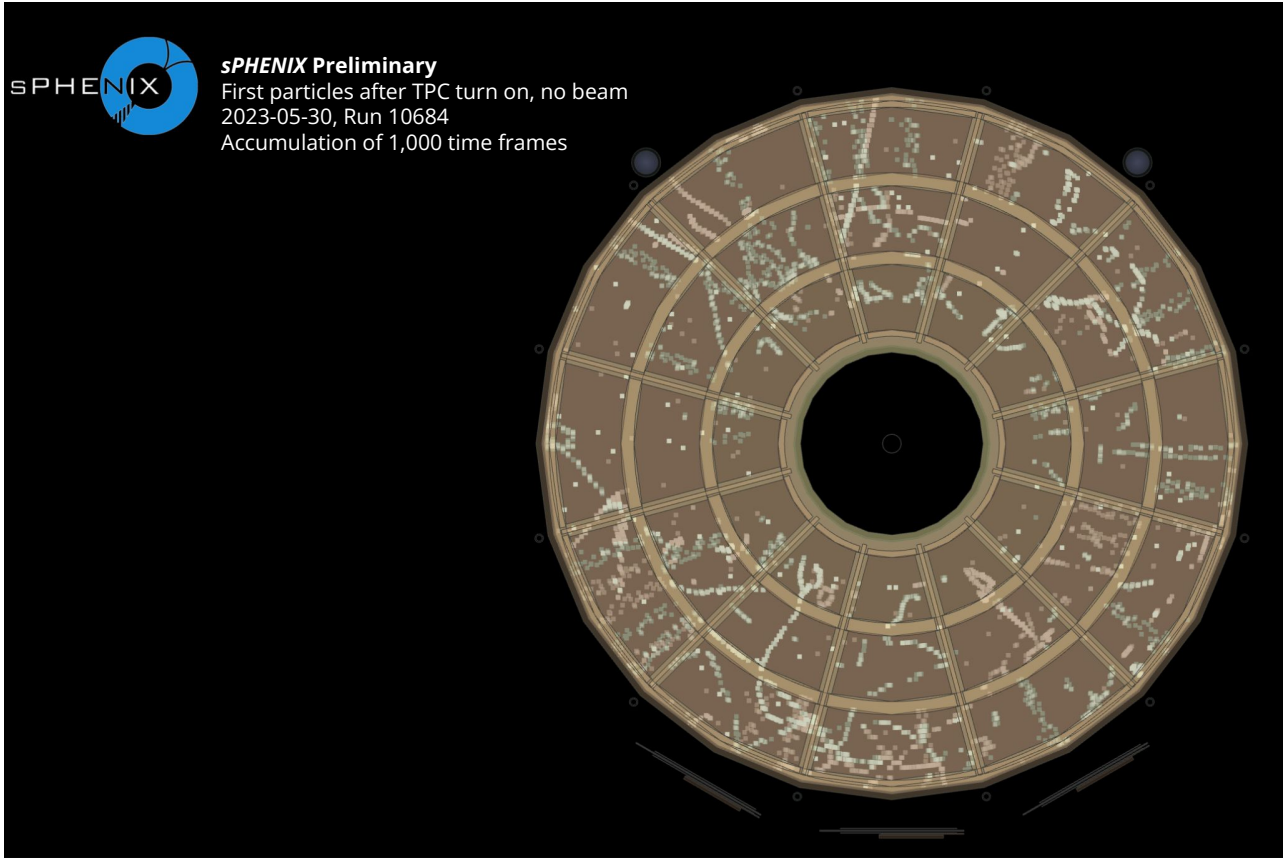
Previous Presentations Where Figures Were Shown

Physics Coordination Meeting June 2, 2023 - Thomas Marshall

sPHENIX General Meeting June 9, 2023 - Kin Yip

sPHENIX General Meeting June 9, 2023 - Tom Hemmick

- 1000 time frames accumulated from segment 0000 of run 10684
- Displaying approximate x,y,z position of all samples in all waveforms with an ADC at least 100 counts above the first ADC sample in the waveform
- X,Y mapping from channel information within a sector done using phi and PadR values for R1, R2, and R3 csv files here, global phase shift done using factors of 2π/12 radians to get correct sector position
- Z mapping estimated using the first sample in the waveform as approximately occurring at +/- 105 cm (endcaps), then each sample afterwards 0.4 cm inwards (50 ns/sample, 8 cm/us drift speed) towards the central membrane
- Output processed into both a json file that can be passed to the sPHENIX Event Display website and a root file containing the x,y,z positions of all samples passing the cut



- 2 time frames from segment 0000 of run 10684 that showcase a single particle traversing multiple sectors
- Demonstrates the ability to reconstruct particle tracks in the TPC
- Displaying approximate x,y,z position of all samples in all waveforms with an ADC at least 100 counts above the first ADC sample in the waveform
- X,Y mapping from channel information within a sector done using phi and PadR values for R1, R2, and R3 csv files here, global phase shift done using factors of 2π/12 radians to get correct sector position
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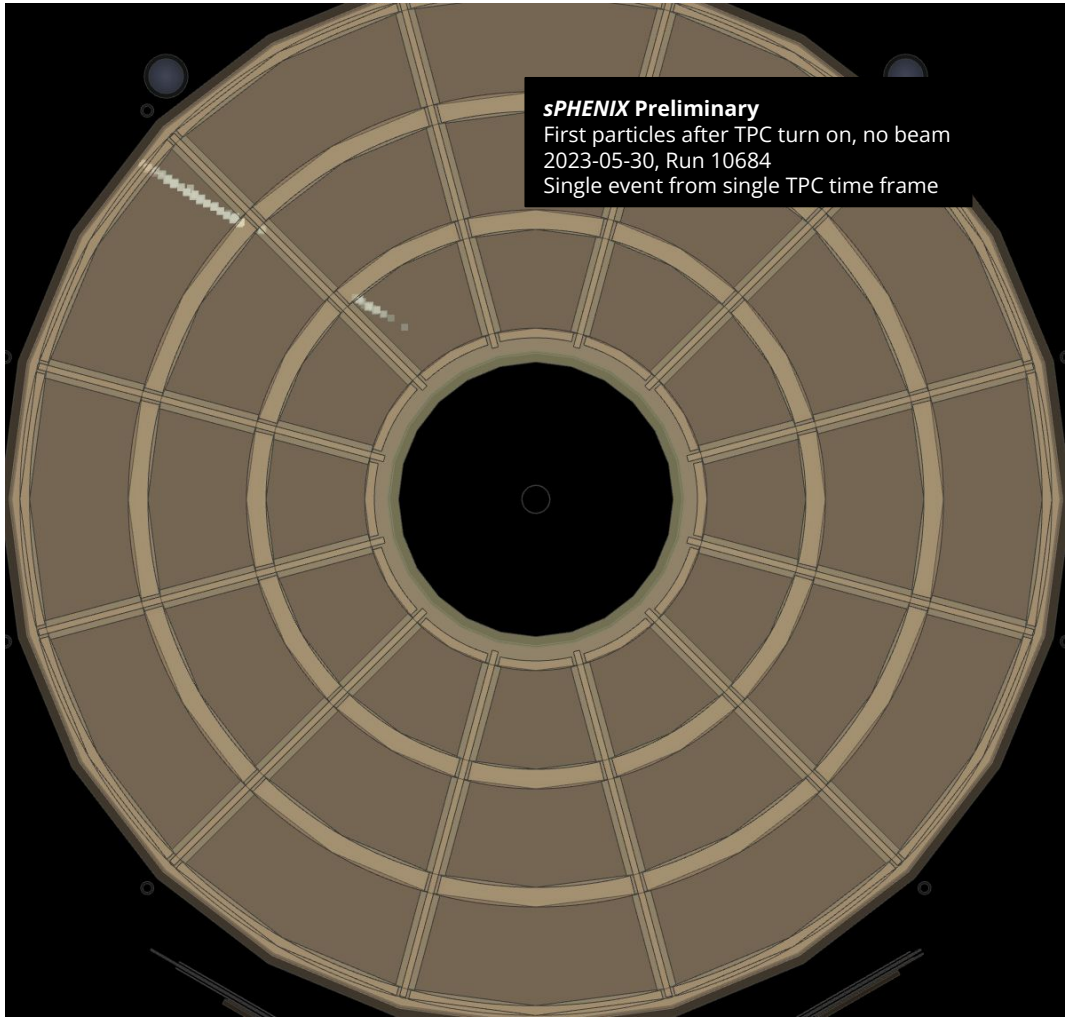

Figure 1: This figure displays approximate X,Y,Z positions of hits accumulated over 1000 TPC time frames observed after complete turn-on of the TPC without beam. A hit in this instance is considered any waveform sample with an ADC value at least 100 counts larger than the first ADC value observed in the waveform, which we use an effective pedestal approximation. To reconstruct the precise X,Y position of each hit using the channel information associated with it, the channel mapping csv files for TPC sector segments R1, R2, and R3 (https://github.com/sPHENIX-Collaboration/calibrations/tree/master/TPC/Mapping/PadPlane) are used to obtain local phi and PadR values within a given sector. A global phase shift in factors of 2pi/12 depending on sector number is then applied to get the correct R,Phi position of a given hit. To reconstruct an approximate Z position for a hit, we assume the first sample in each waveform occurs at +/- 105 cm, depending on which endcap received the signal, and each following sample occurred 0.4 cm closer to the central membrane. The 0.4 cm assumption comes from the known 50 ns/sample rate for each waveform and an 8 cm/us drift speed. The X,Y,Z position of each sample is written out to both a JSON file which can be passed to the sPHENIX Event Display website to view in 3 dimensions, and a root file which can be analyzed at a later time.

Figure 2: This figure displays approximate X,Y,Z positions of hits accumulated over 2 TPC time frames for a single particle traversing multiple sectors in the TPC observed after complete turn-on of the TPC without beam. A hit in this instance is considered any waveform sample with an ADC value at least 100 counts larger than the first ADC value observed in the waveform, which we use an effective pedestal approximation. To reconstruct the precise X,Y position of each hit using the channel information associated with it, the channel mapping csv files for TPC sector segments R1, R2, and R3 (https://github.com/sPHENIX-Collaboration/calibrations/tree/master/TPC/Mapping/PadPlane) are used to obtain local phi and PadR values within a given sector. A global phase shift in factors of 2pi/12 depending on sector number is then applied to get the correct R,Phi position of a given hit. To reconstruct an approximate Z position for a hit, we assume the first sample in each waveform occurs at +/- 105 cm, depending on which endcap received the signal, and each following sample occurred 0.4 cm closer to the central membrane. The 0.4 cm assumption comes from the known 50 ns/sample rate for each waveform and an 8 cm/us drift speed. The X,Y,Z position of each sample is written out to both a JSON file which can be passed to the sPHENIX Event Display website to view in 3 dimensions, and a root file which can be analyzed at a later time.