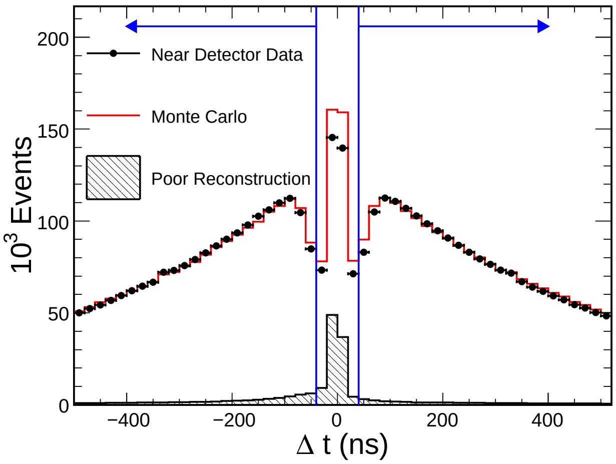

FIG. 1: The distribution of time separation between events Δt for data (solid points) and Monte Carlo simulated data (solid histogram). A background component arising from poorly reconstructed events (hatched histogram) is confined to a narrow region of low Δt values. Events accepted for further analysis are indicated by the arrows.

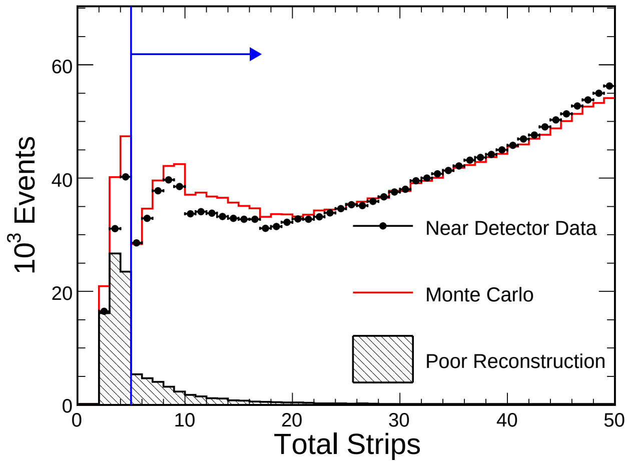

FIG. 2: Section of the distribution of the number of strips with nonzero pulse-height, per event, after all other selections are applied. The region displayed, in which the contribution from poorly reconstructed events (hatched histogram) is significant, corresponds to low strip counts and represents a small fraction of the total number of events. The event range accepted for the analysis is identified by the arrow.

Leakage events are typically cosmic-ray muons causing steep showers with a high concentration of hit strips in a small number of detector planes. These events can be removed by selecting on this topological characteristic. Thus, a requirement is placed on the ratio of the average number of active strips per plane to the total number of planes with active strips in the event, represented more concisely as (active event strips)/(active event planes)^2. Only events for which the ratio is less than 1.0 are accepted by the analysis.

Another type of leakage event is due to secondary particles from interactions occurring outside of the fiducial volume. In the partially covered planes of the near-detector, the steel is instrumented with scintillator to within 16 cm from the left-hand-side edges of the steel plate and 1.4 m from the right-hand-side edges as viewed from along the beam direction. Consequently, secondary particles may enter the detector laterally due to the sparse instrumentation on the sides. For such cases the reconstruction algorithm is likely to fail in associating hits to events. Nevertheless, the extra activity at the edges of the fully covered planes is recorded and can be used to veto events within a time window. The veto criterion uses the number of active strips and the pulse-height in the edge regions of the detector. An event is accepted if the number of active strips in the veto region recorded within a ± 40 ns window around the event vertex time is less than four and the pulse-height deposited in the veto region is less than 2 MIP[a]. These veto criteria are applied to events with visible energy less than 5 GeV in which the number of planes assigned to the reconstructed shower is greater than the number of planes assigned to the reconstructed track, as leakage events are reconstructed as low-energy showers without a clearly defined track.

Incomplete events arise when the shower reconstruction fails to assign all event-related strips to the shower. This type of reconstruction failure occurs if there are large gaps in a shower or if the shower is generally sparse. In a majority of these cases, events have a very low number of reconstructed strips. Figure 2 shows the distribution of the number of strips for the events, after applying the selection requirements. To minimize the number of incomplete events in the near-detector data sample, an event is required to have total number of strips greater than four.

In summary, the selection criteria applied to the near-detector data are as follows: (i) the modulus of the time separation between events, $|\Delta t|$, must exceed 40 ns; (ii) if 40 ns $< |\Delta t| <$ 120 ns, the modulus of the spatial separation between events, $|\Delta z|$, must exceed 1 m; (iii) the ratio (active event strips)/(active event planes)^2 must be less than unity; (iv) for events with less than 5 GeV of reconstructed energy in which the number of planes is larger in the reconstructed shower than in the recon-

[a] Minimum ionizing particle, equivalent to the response produced by a 1 GeV muon traversing a detector plane at normal incidence.