Identification of neutrino flavor in the ANITA experiment

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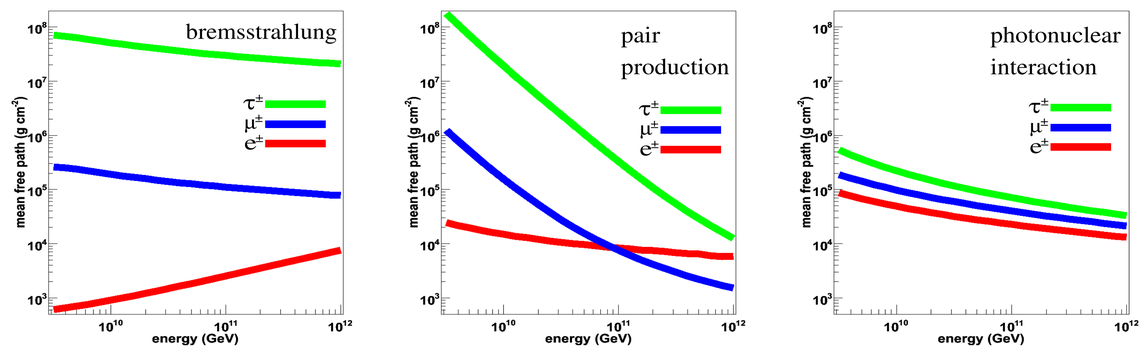
introduction

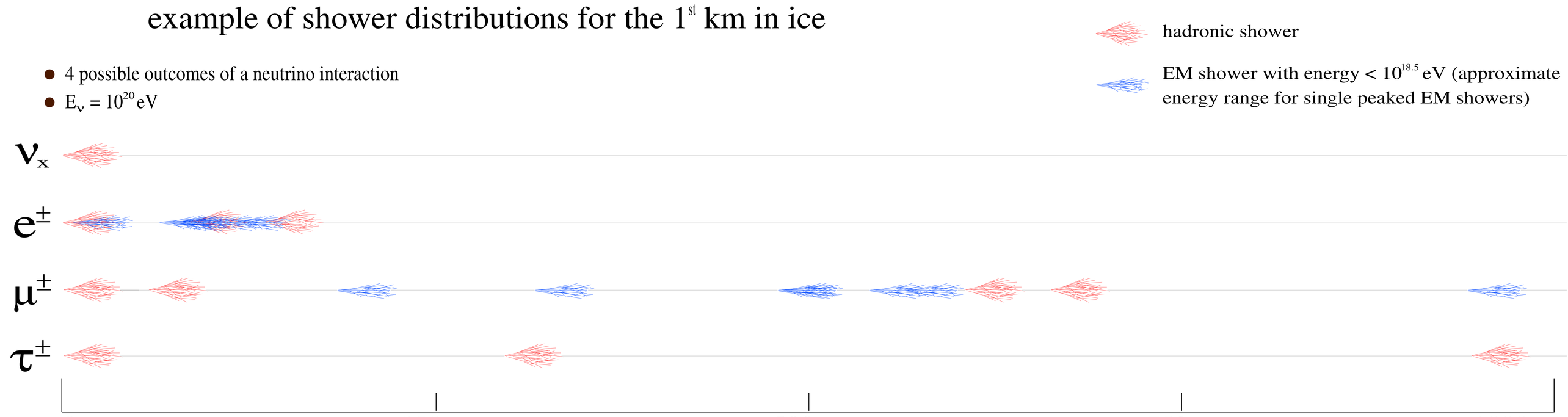
If a charged lepton experiences a hard energy loss in a dense transparent medium such as ice, the particle shower resulting from the energy transfer produces a coherent radio Cherenkov pulse. For shower energies greater than ~$10^{17.4}$ eV, the radio pulse can be detected by ANITA. Because the cross sections of bremsstrahlung, pair production, and photonuclear interactions depend on the flavor and energy of a charged lepton, the distribution of the showers can indicate the flavor and energy of the neutrino. A Monte Carlo simulation has been developed with a focus on multiple bang events, which are neutrinos that produce more than one detectable radio pulse.

mean free path for an energy transfer greater than $10^{17.4}$eV



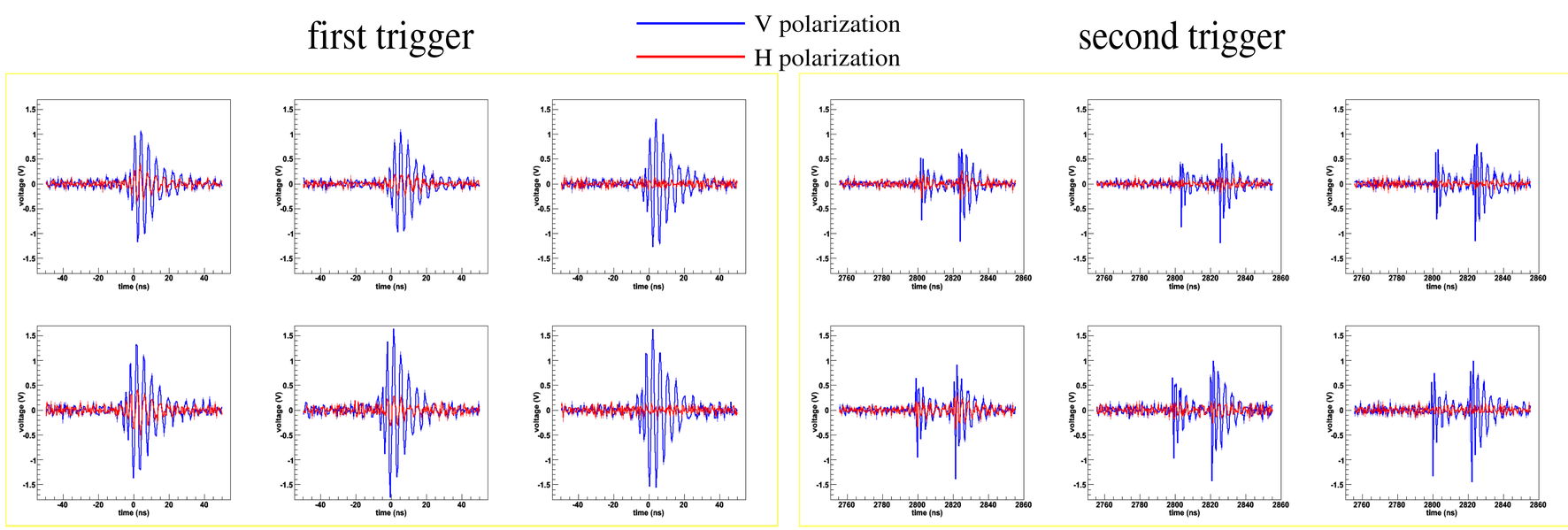
example of shower distributions for the 1st km in ice

- 4 possible outcomes of a neutrino interaction
- $E_\nu = 10^{20}$ eV



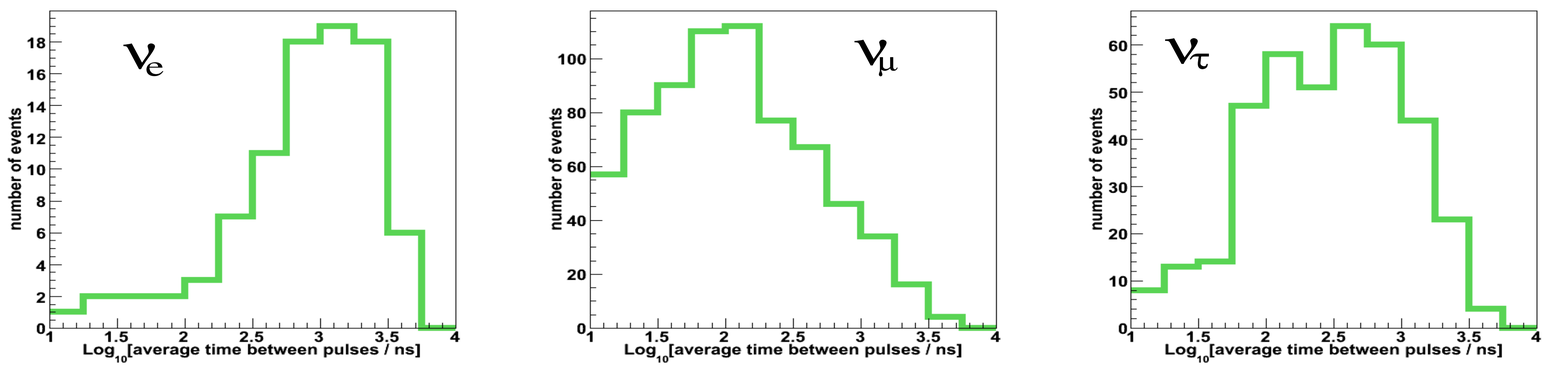
simulated wave forms for a triple bang event

- ν_τ
- 10^{20} eV
- 3 radio pulses
- detector triggered twice
- wave forms shown for the 6 antennas that are hit most directly by the pulses



average time between pulses

- ice shelves used as the target
- 10^{20} eV
- time between pulses can be > 3000 ns
- similar distribution at other energies
- large number of events required to determine the flavor ratio



pulses per event

- ice shelves used as the target
- 1:1:1 flavor ratio
- on average, more pulses per event at higher neutrino energy
- large number of events required to determine the spectrum based only on the number of pulses per event