Belle Starr atmo muon suppression

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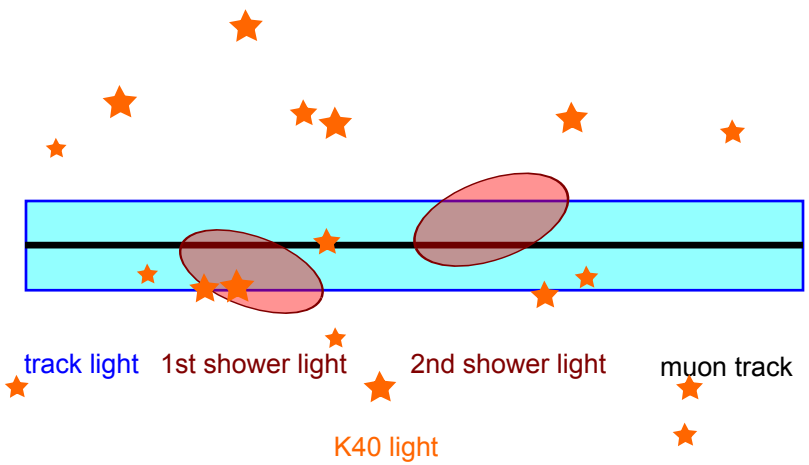
Further Muon suppression

Method

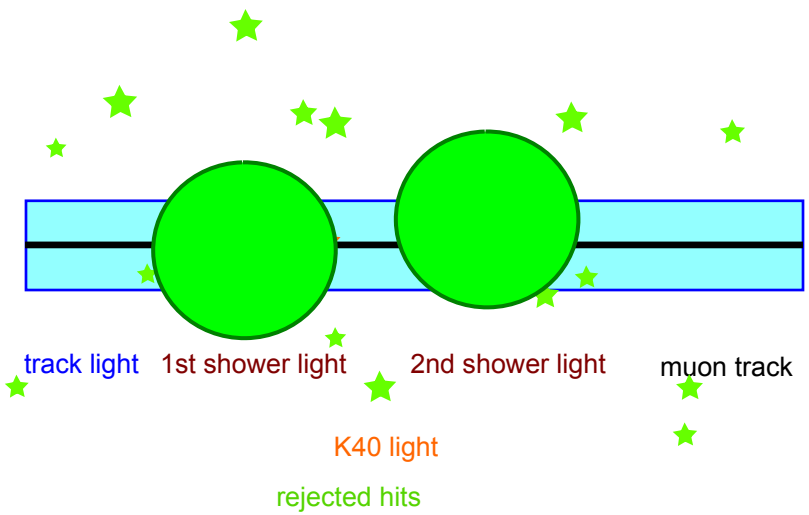
Use the fact that the muon track produces light before and after the two reconstructed showers!



Further Muon suppression

Hit Selection

- window[ns]≥hit.residual(vertex12)≤–20 ns
- 4 fold coincidences on DOM within 20 ns



Further Muon suppression

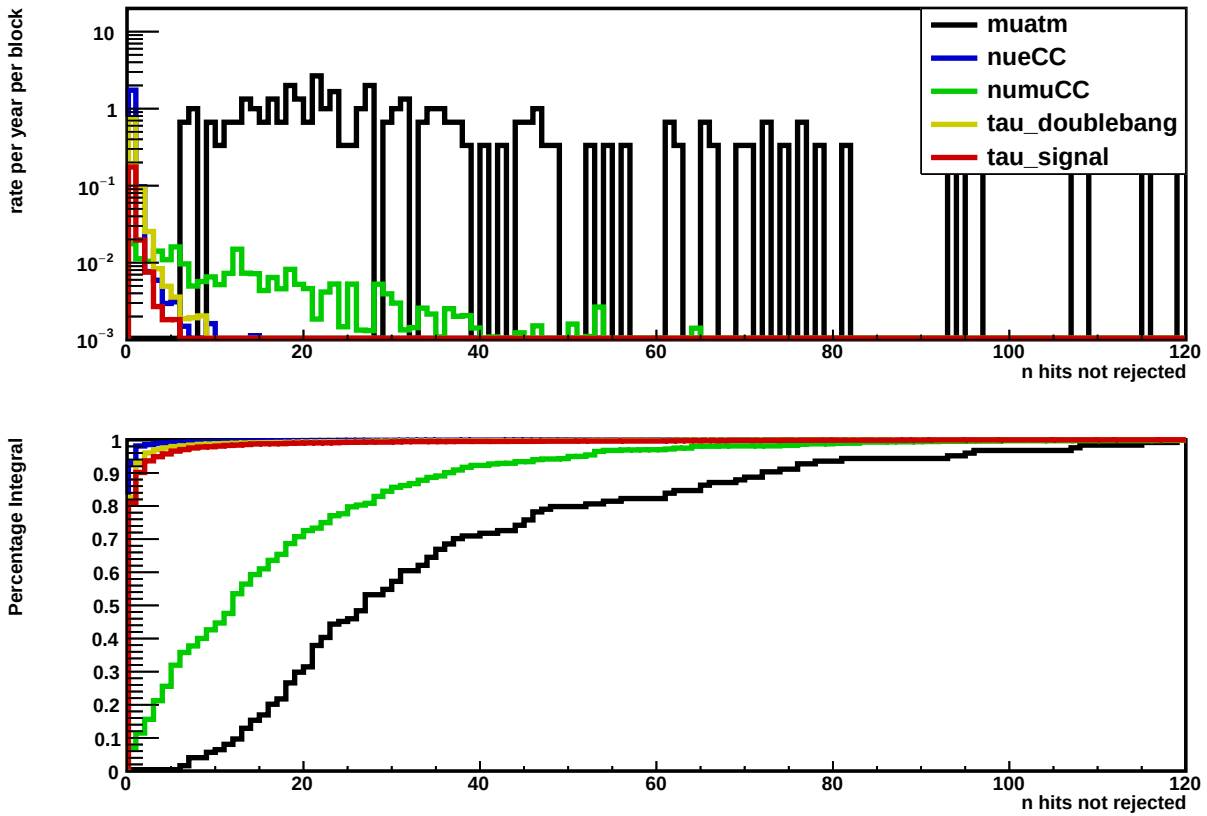


Figure : top: Number of early hits for different channels; bottom: cumulative distribution

New Idea - as suggested by Maarten

Background hypothesis test

Instead of making a coincidence selection in order to distinguish K40 hits from signal hits, count the hits and compare to background hypothesis (independent of parameter choice, almost)

- Select region of interest in detector: 200 m radius around both rec vertices
- Find number of PMTs present (on average around 2150 PMTs per 200 m radius)

↪ compute expected number of K40 hits: nPMTs $*$ window $*$ K40-Rate

- Find number of hits recorded in 200 m radius

↪ use Poisson statistics to test probability of pure bkg hypothesis

Time window size

What is the maximal time a muon hit can be too early?

A: the earliest hit possible is one on the muon track on the edge of the considered region

$\hookrightarrow$ window $= 200\,\mathrm{m}/0.3\,\mathrm{m\,ns^{-1}} + 200\,\mathrm{m}/0.2\,\mathrm{m\,ns^{-1}} \approx 1700\,\mathrm{ns}$

For second vertex use maximal negative time window for lower edge

Cut flow

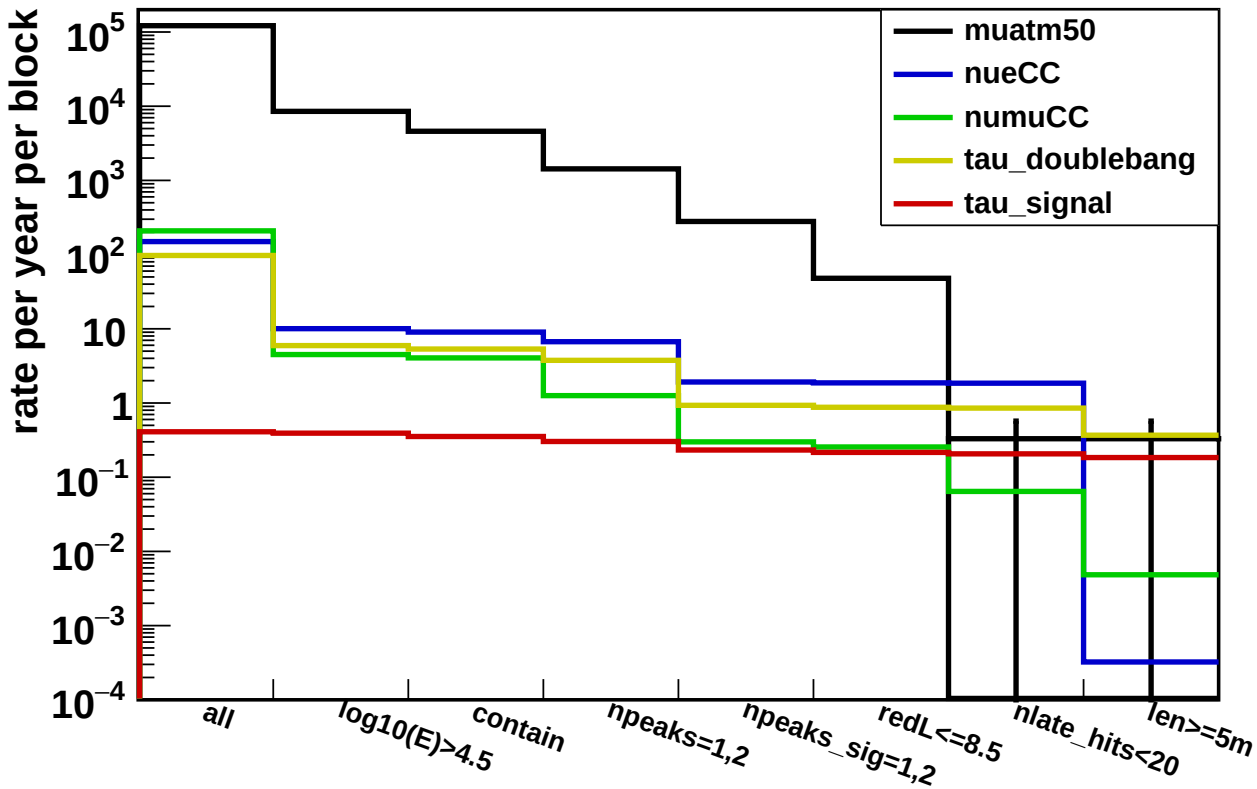


Figure : Cut flow, nlate_hits added will be replaced with new probability cut

Poisson Probability

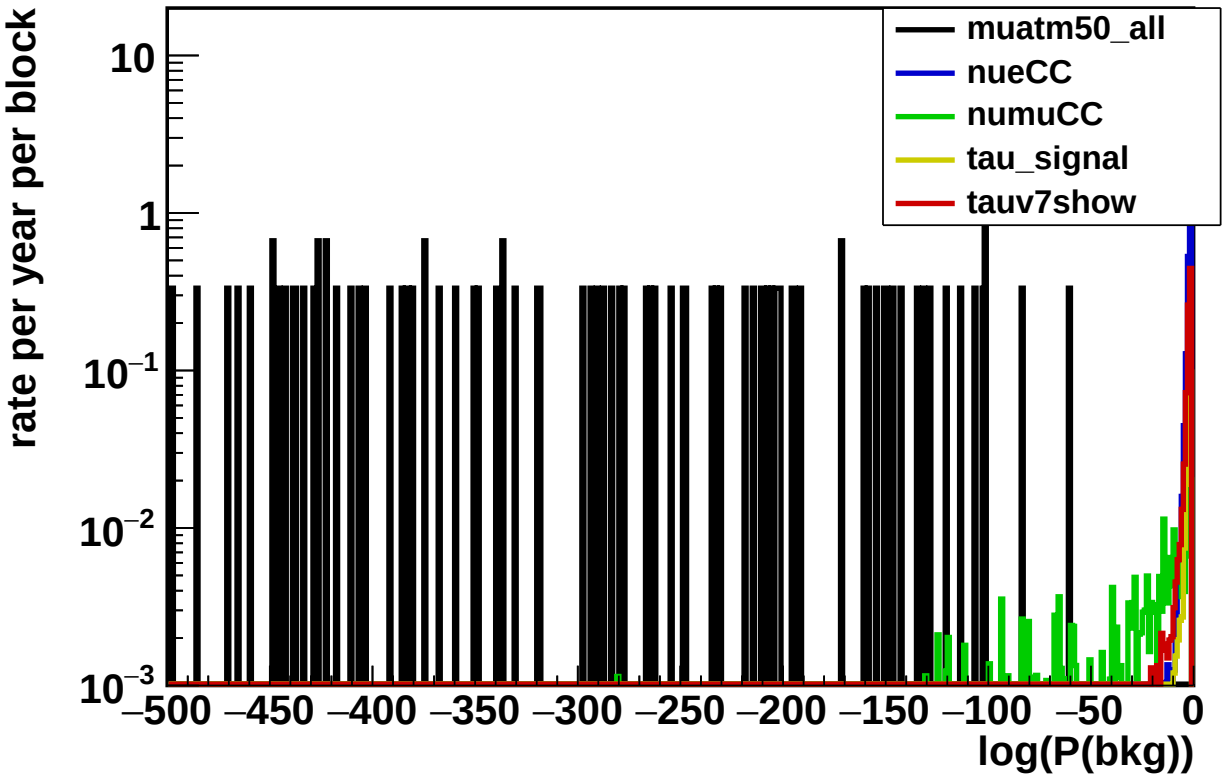


Figure : Distribution of log(P(bkg)) for different channels

Poisson Probability

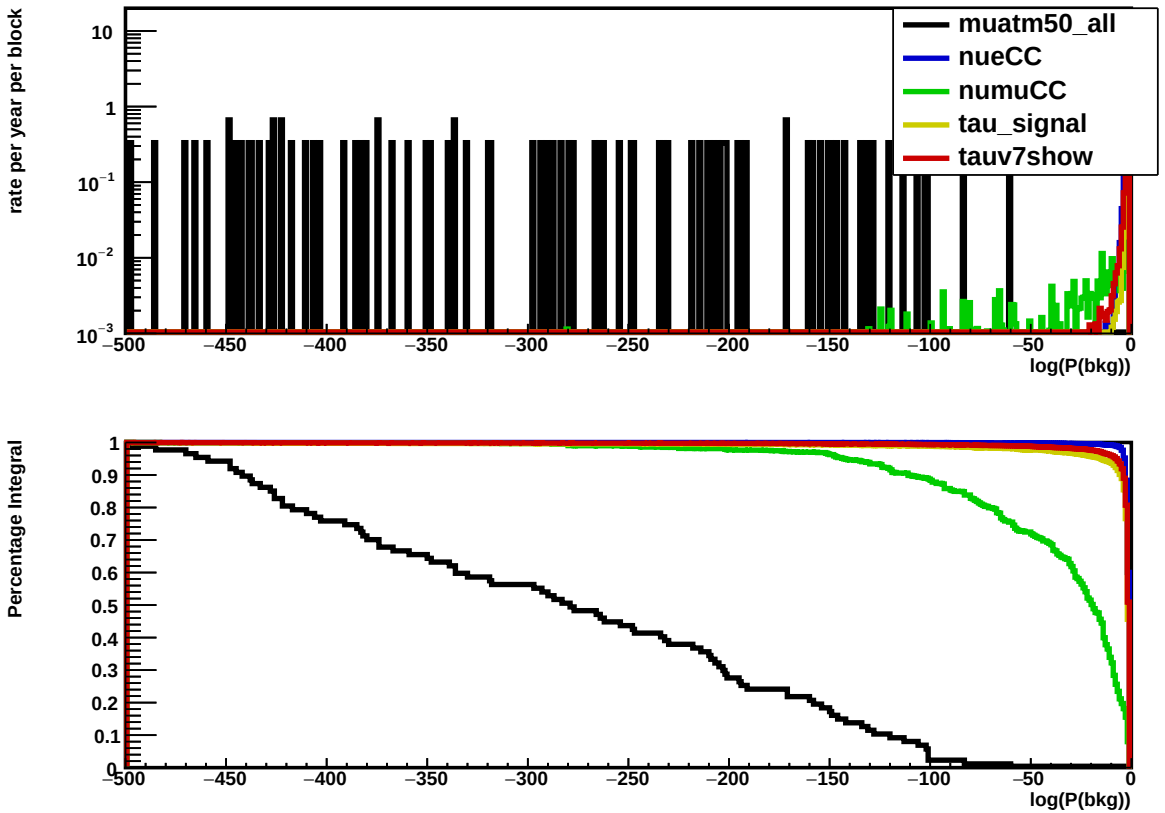


Figure : Distribution of log(P(bkg)) for different channels; bottom is the cumulative distribution

Poisson Probability