

# Update on tau status

Robert Bormuth

Leiden University and Nikhef

September 30, 2015



# Tau MC status

- 4 weeks ago found bug in tau MC which did not offset the tau decay daughters by the tau travel time  
↳ Reported to Clancy and resolved
- 1 week ago found another bug: sometimes the tau does not decay (for  $\text{tau.len} \geq 50 \text{ m} \approx 1/5$ ) [although it is contained in the active volume]  
↳ Reported to Clancy, reply: not understood and not easily solved

(Did not have a closer look at the events yet to try and characterize them)

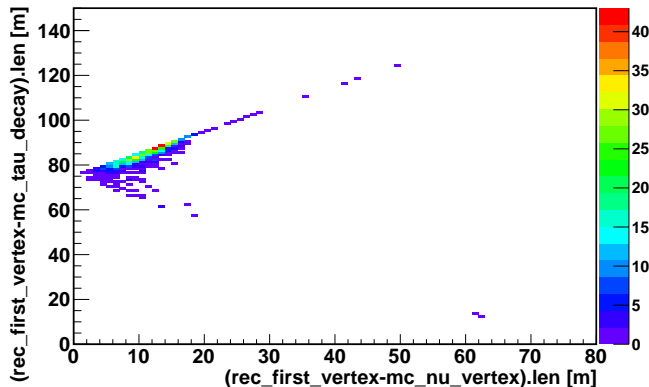
## Method

- Find a innocent looking MC file (used Tau NC file) and remove everything except the neutrino
- Determine second vertex position by going 75 m in neutrino direction
- Put a  $\Lambda$  at both vertices, direction is neutrino direction
- Add preferred energies (used: 200 TeV for first and 1 PeV for second vertex)
- Nomenclature: first vertex is neutrino vertex and second vertex is tau decay vertex

Seems to be the safest solution at the moment, can add different tau travel length and energies

# Default aashowerfit on toy

Applying aashowerfit on the toy MC and looking at the reconstructed vertex I find:



## Default aashowerfit on toy

→ The first (neutrino interaction) vertex is **highly** preferred



The second (tau decay) has the higher energy (1 PeV  $\Leftrightarrow$  2 TeV)  
and therefore has more MC hits ( $\approx$  3 – 4 more)

# Default aashowerfit on toy

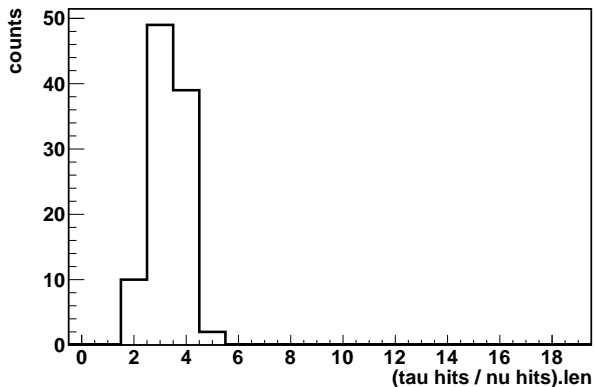


Figure : number of mc tau hits divided by number of mc nu hits

# Hit Residuals

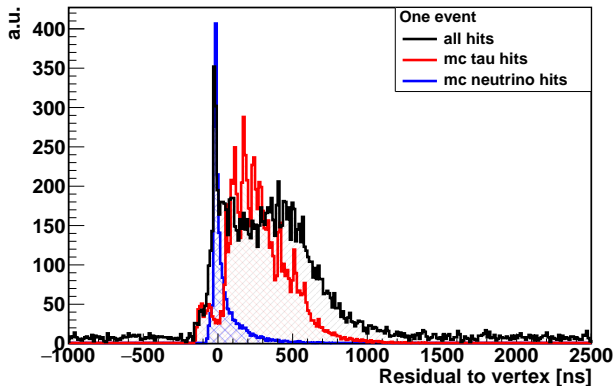


Figure : Hit residuals to first reconstructed vertex for shower hypothesis (one event)

# Reconstructing a second vertex

## Method

Make a selection based on hit residuals  $\pm 40$  ns and apply aashowerfit on these hits

apply aashowerfit:

- select DOM with highest coincidence in selection as start for m-estimator vertex fit
- use coincidence hits (20 ns) for m-estimator fit
- use all hits for energy and direction fit



# Performance of second vertex

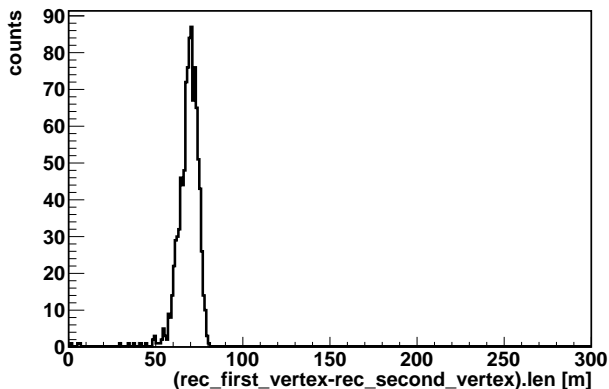
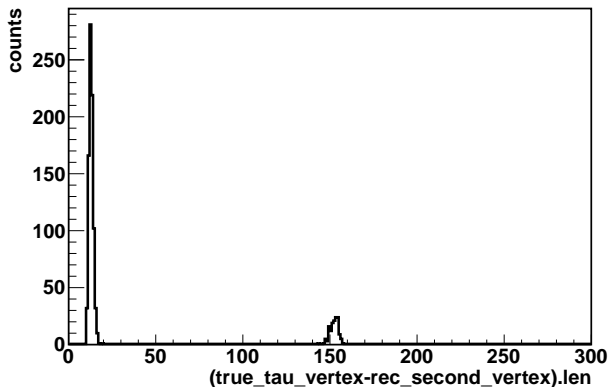


Figure : Distance between first and second vertex

# Performance of second vertex



**Figure :** Distance between reconstructed second vertex and MC tau decay vertex