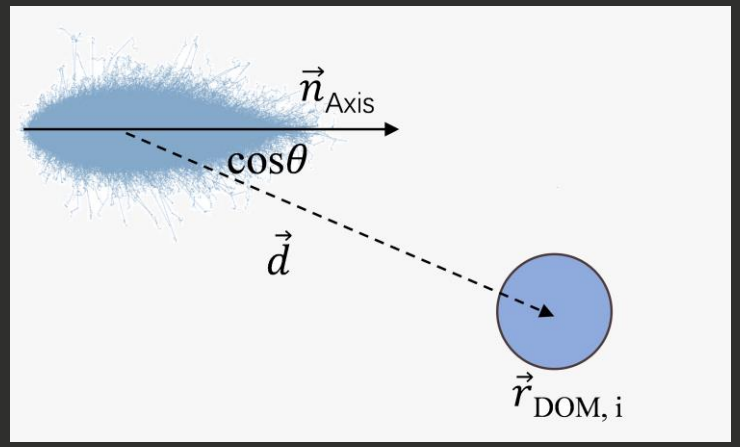
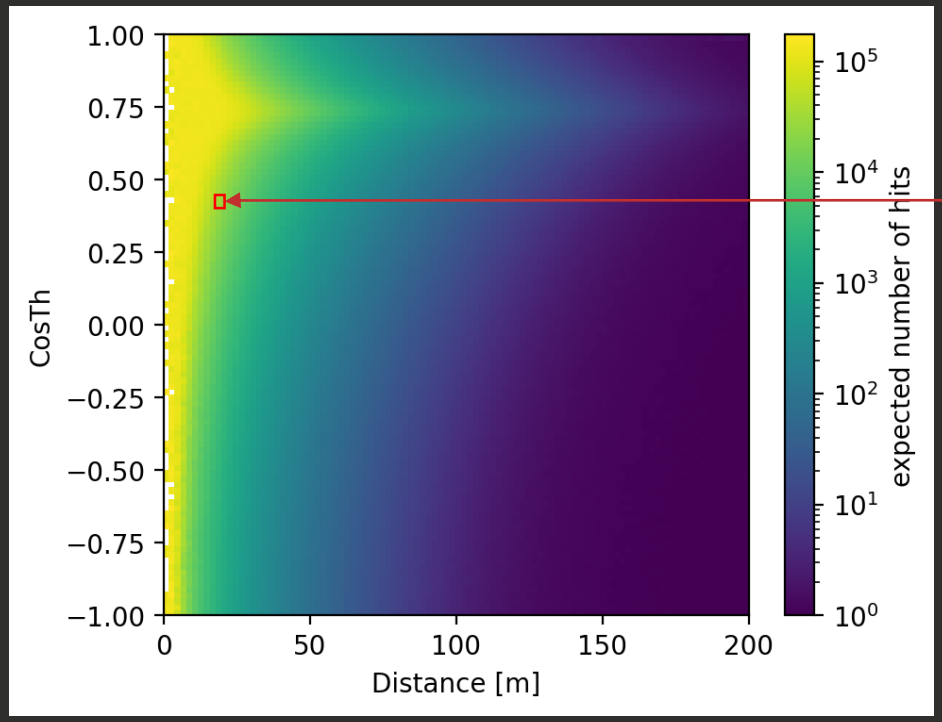
Updates on Cascade Direction Reconstruction

2-dimensional **PDF :** P (n | distance, costh)

-> expected #hits on bin [distance, costh]





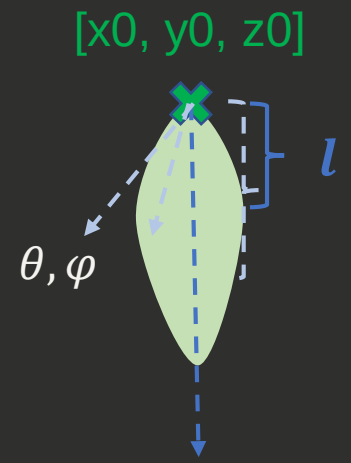
Likelihood expression:

$$-\log\mathcal{L} = -\sum_{\text{all DOMs}} \log P_i = -\sum_{\text{all DOMs}} (k_i \log\mu_i - \mu_i)$$

k_i : measured #hit on i-*th* DOM

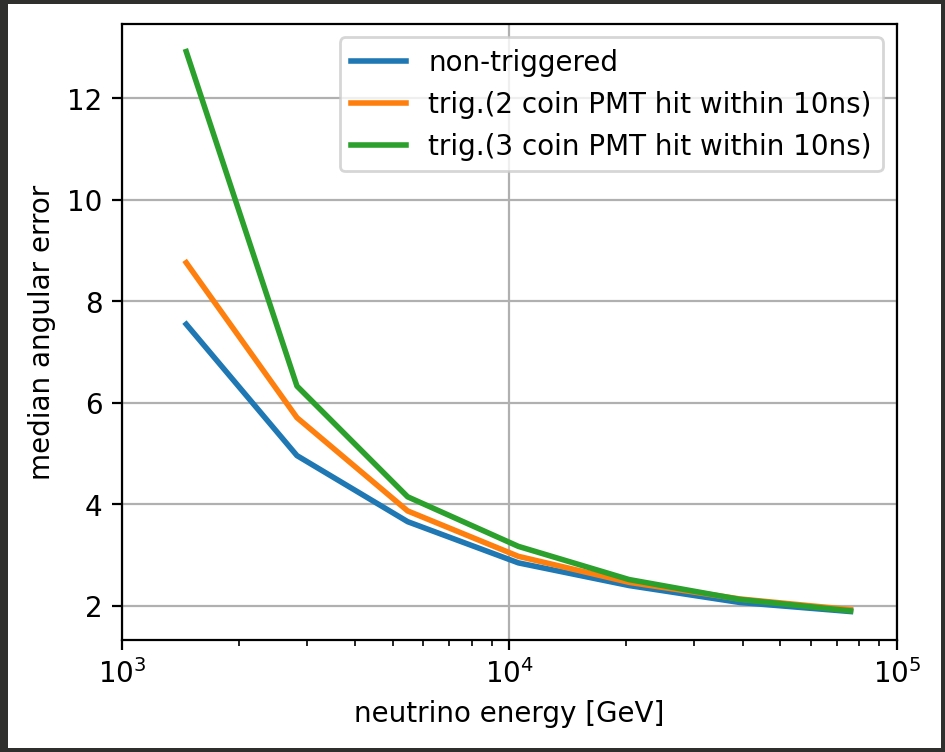
μ_i : expected #hit on i-*th* DOM

- Cascade hypothesis: vertex (x0, y0, z0), direction (θ,φ), shift to max. position (l)
- Assuming **true vertex**
- Gauss smeared direction (2 degs in each theta & phi) as the starting point
- Fit parameters: θ, φ, l
- median angular resolution ~ 2 degrees @ 100 TeV



Trigger Strategies Impact

Coin. PMT	Time windows [ns]
2	10
2	20
3	10
3	20



40k events nue-CC
Sample energy: [1, 100] TeV
Sampled volume: detector center region
Spectrum: -1.01

Trigger Strategies Impact

Coin. PMT	Time windows [ns]
2	10
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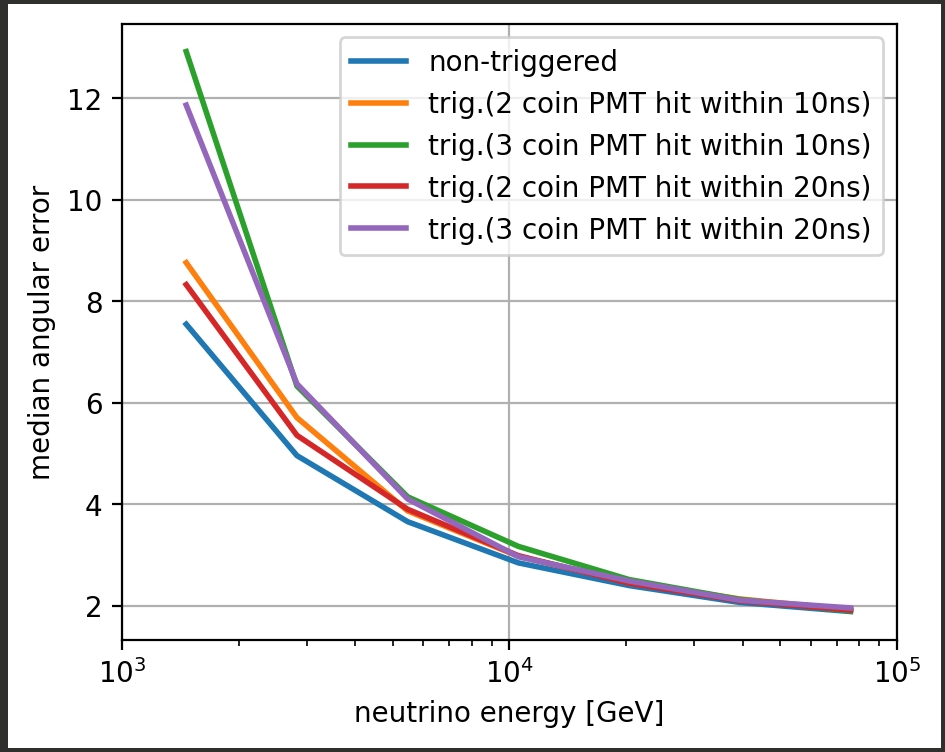

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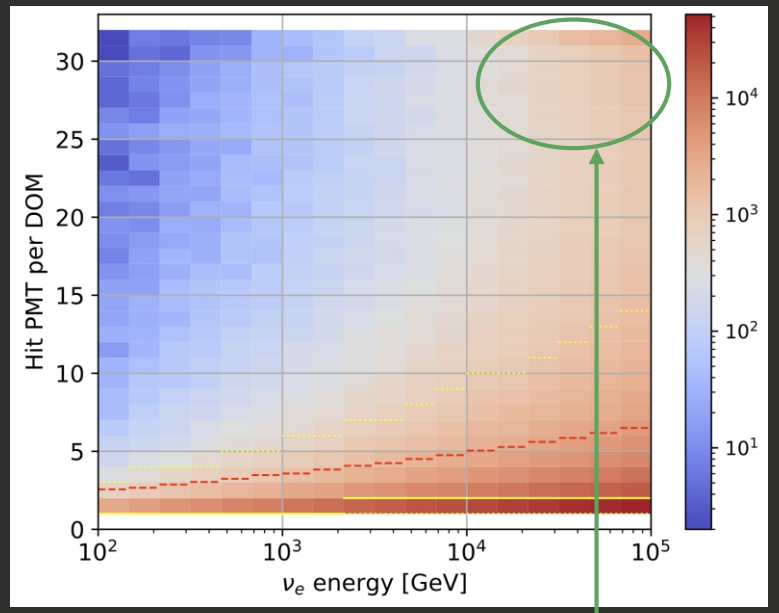
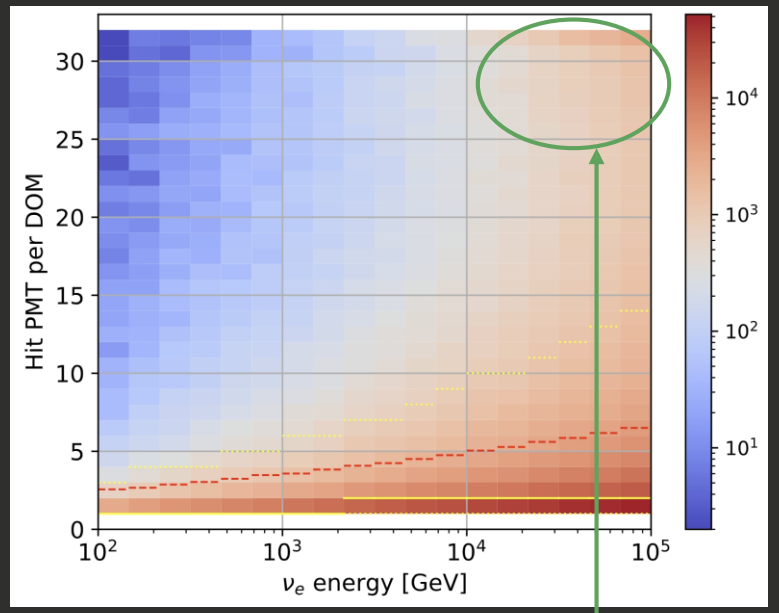
Investigating Issues - Multi-Fire-PMT DOM



Raised by Ruike:

For those DOMs,
> 25 PMTs per DOM are hit

Investigating Issues - Multi-Fire-PMT DOM



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For those DOMs,
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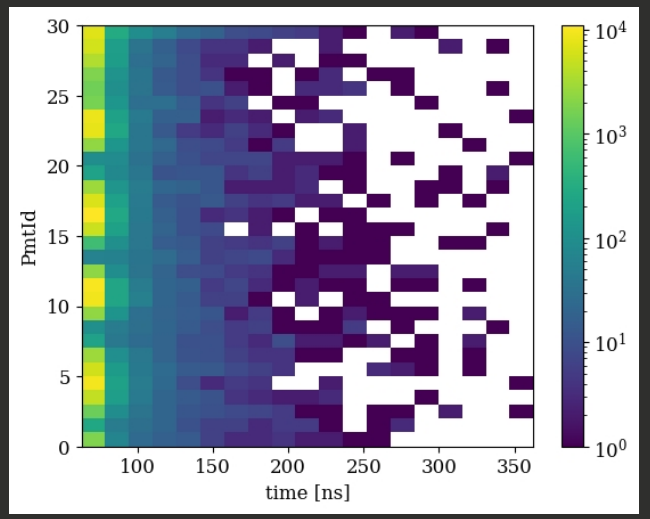
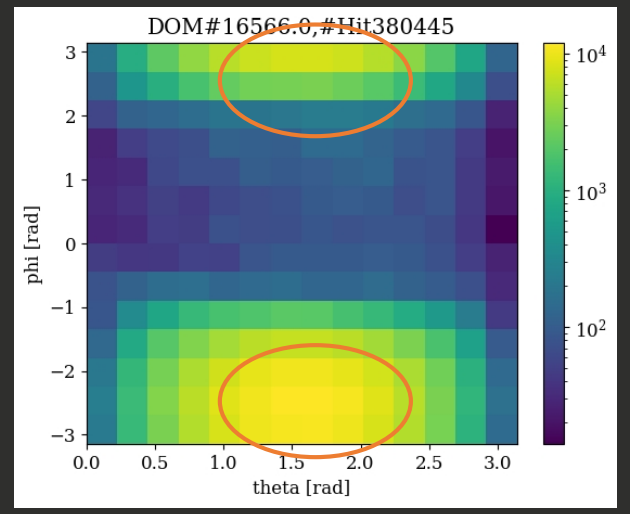
Example of MULTI-FIRE-PMT DOM

Distance: 17 m
Costh 0.94

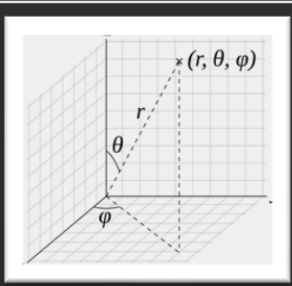


Hit time distribution

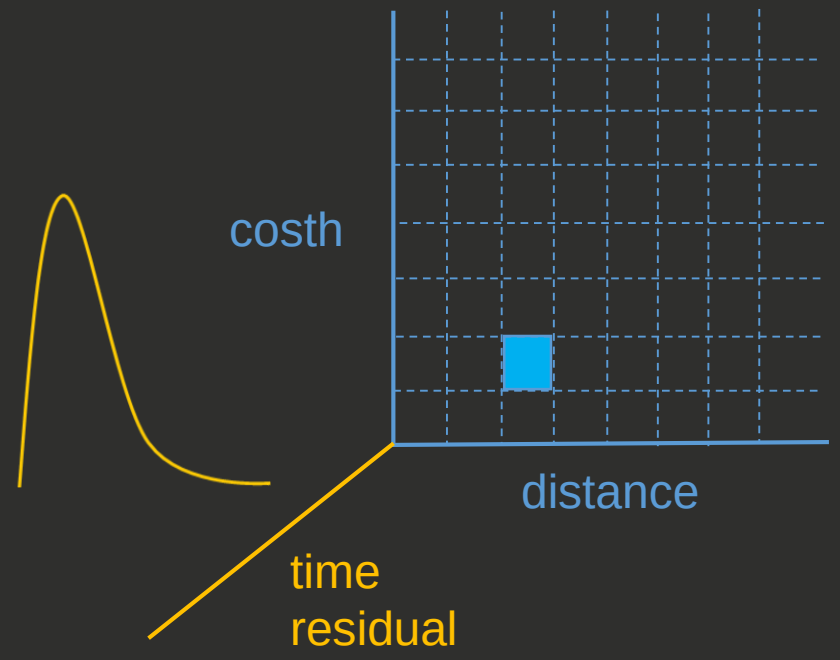


2 hotspot regions?

Hit position distribution on the glass surface



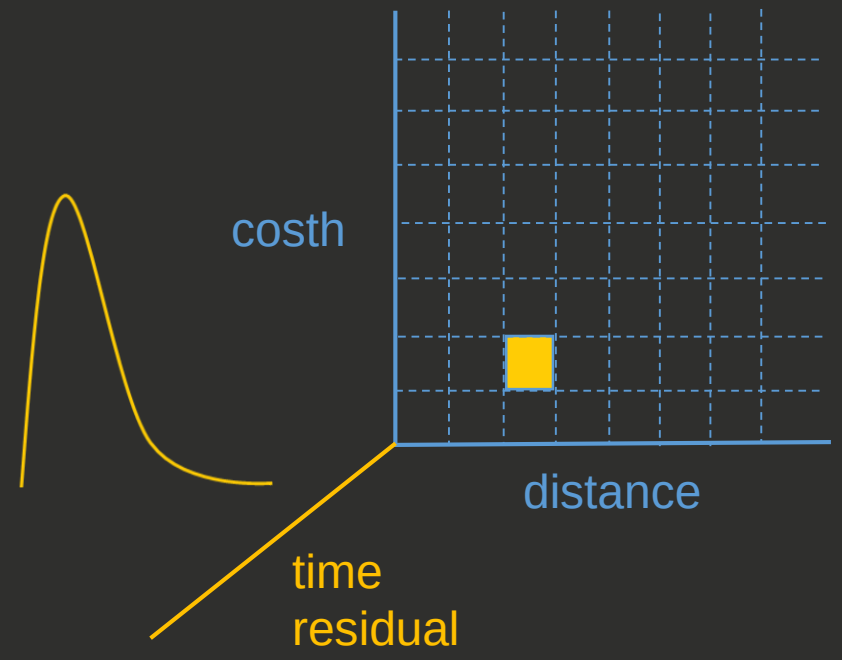
To 3-dimension: time residual



For tracks: PDF (rst, distance)

For cascade: PDF (rst, distance, costh)

To 3-dimension: time residual



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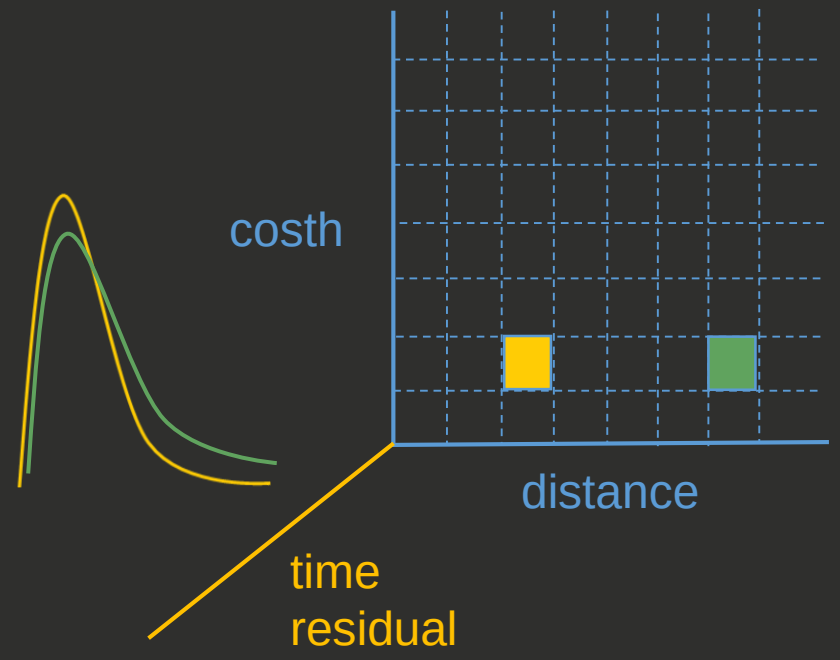
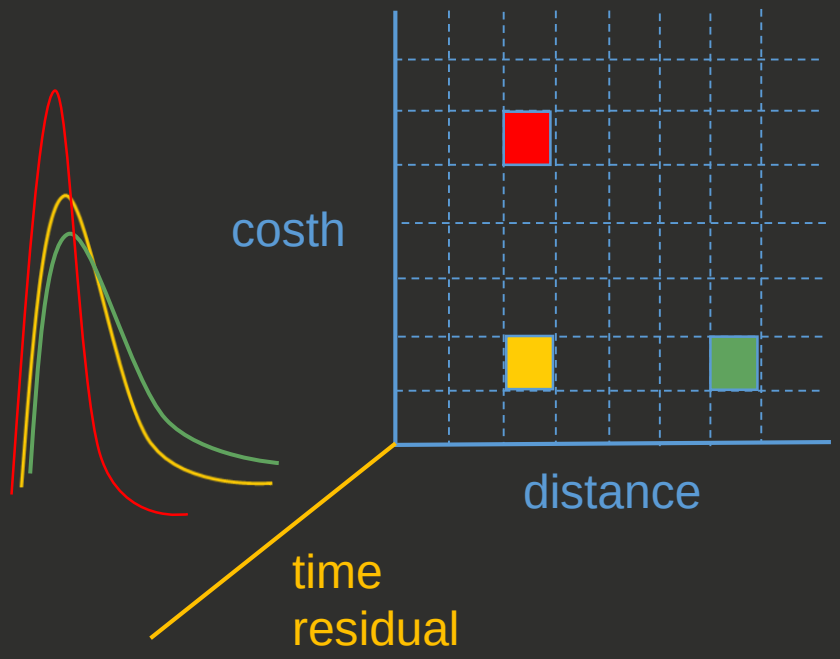


For cascade: PDF (rst, distance, costh)

To 3-dimension: time residual

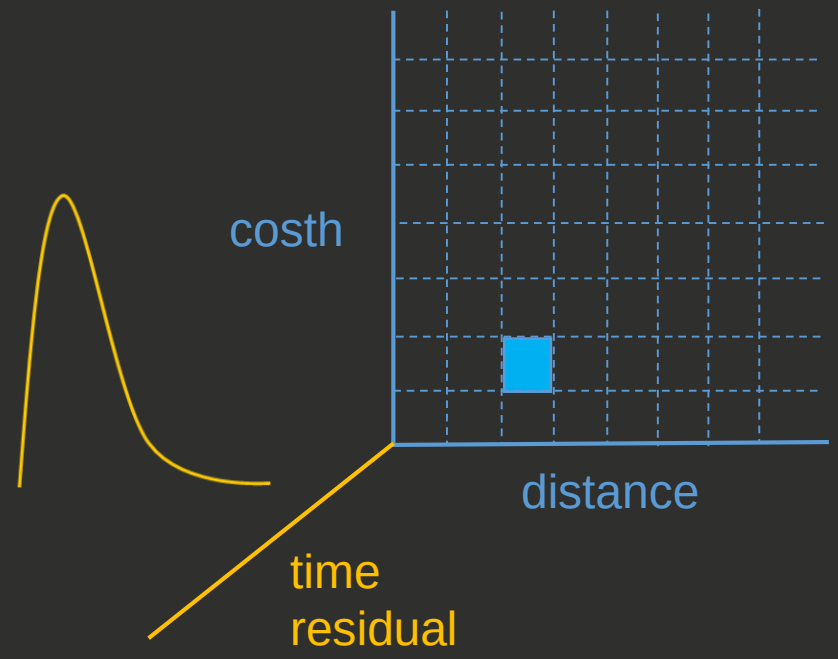


Likelihood expression:

$$\log \mathcal{L} = \sum_{\text{all hits}} \log P_i$$

For cascade: PDF (rst, distance, costh)

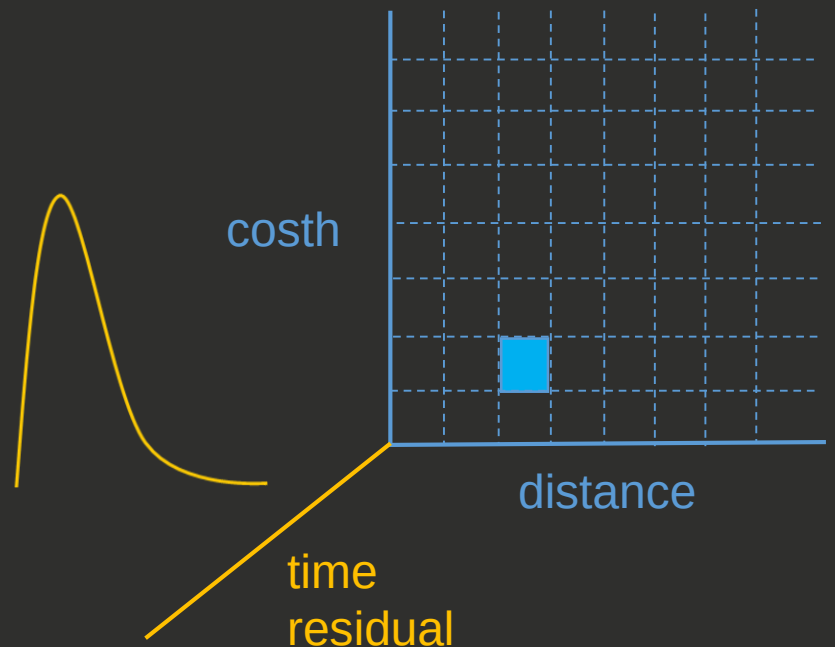
Extended Likelihood



Likelihood expression:

$$\mathcal{L} = \prod_i \frac{\lambda_i^{q_i}}{q_i!} e^{-\lambda_i} \prod_j [p_i(t_j)]^{q_j}$$

Extended Likelihood



Likelihood expression:

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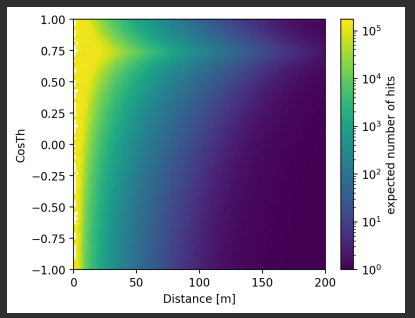
3d Extended LLH

Runs over DOM

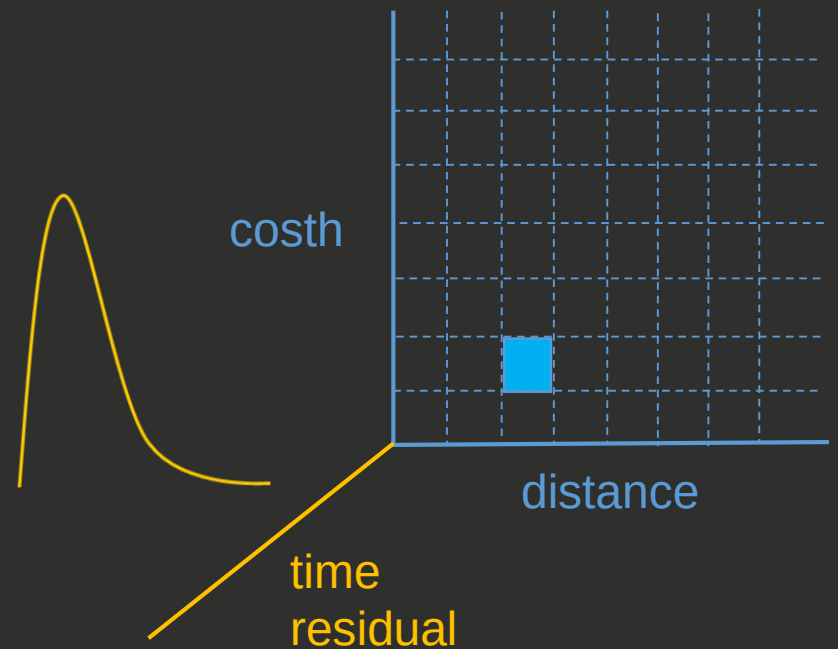
$$\mathcal{L} = \prod_i \frac{\lambda_i^{q_i}}{q_i!} e^{-\lambda_i} \prod_j [p_i(t_j)]^{q_j}$$



2.5d Extended LLH

Runs over DOM

Extended Likelihood



Likelihood expression:

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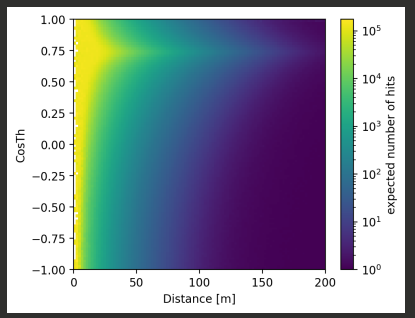
3d Extended LLH

Runs over DOM

Runs over hits on each DOM: P (rst, distance, costh)

$$\mathcal{L} = \prod_i \frac{\lambda_i^{q_i}}{q_i!} e^{-\lambda_i} \prod_j [p_i(t_j)]^{q_j}$$



2.5d Extended LLH

Runs over DOM

Runs over hits on each DOM: P (rst, costh)

Next Plans

- Look more about 31-PMT-Fire DOM
- Compare 3d extended LLH vs 2.5d extended LLH
- Approaching to realistic hit: set saturation cut for each PMT.