NA62 Italia: Timing

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- Global time candidate
- First attempt: weighted average of candidates from Cedar, GigaTracker and RICH
- Weights given by candidates time resolution
- Cuts on time coincidence between the three detectors and quality cuts on candidates (>5 sectors on Cedar, > 4 hits on RICH)
- Resolution as a function of Nhits

$$T_{\text{cand}} = \frac{\left(\frac{T_{\text{Cedar}}}{\sigma^2_{\text{Cedar}}} + \frac{T_{\text{GTK}}}{\sigma^2_{\text{GTK}}} + \frac{T_{\text{RICH}}}{\sigma^2_{\text{RICH}}} \right)}{\left(\frac{1}{\sigma^2_{\text{Cedar}}} + \frac{1}{\sigma^2_{\text{GTK}}} + \frac{1}{\sigma^2_{\text{RICH}}} \right)}$$

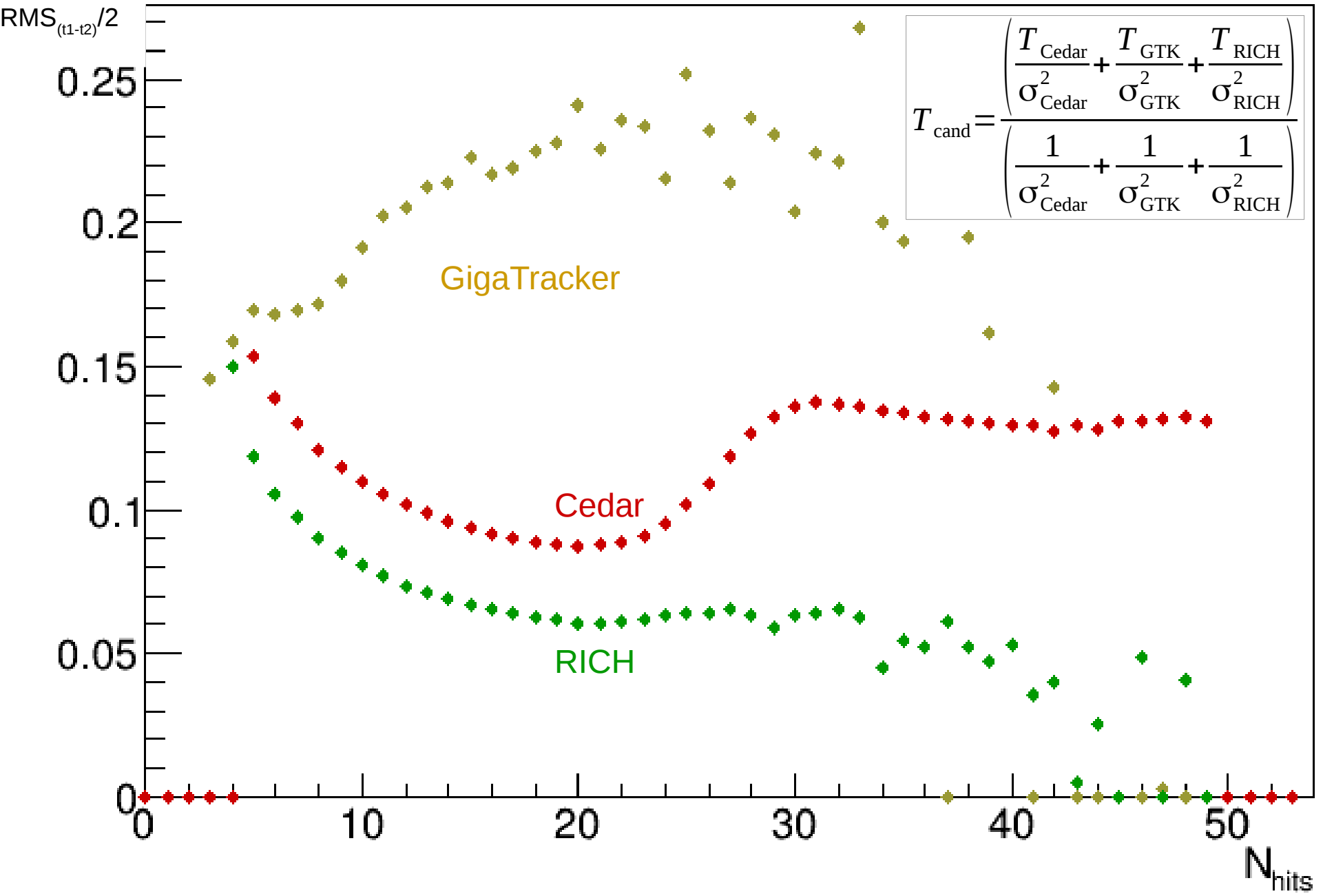
where σs are the time resolutions of the respective detectors.

- Internal time resolutions are evaluated (standard procedure) dividing the hits of a candidate into two sets and the mean time of each set is calculated (t1 and t2).
- The difference (t1-t2) is plotted for each candidate. Time resolution is:

$$\sigma_{\text{detector}} = \sigma^{\text{detector}}_{\text{t1-t2}} \; / \; 2$$

Using Cedar, GigaTracker and RICH to define the candidate is particularly important. With GigaTracker and RICH there's an upstream and a downstream track. Cedar guarantees that the upstream track is a kaon.

Time Resolution vs N_{Hits}



- New strategy: global time candidate is a weighted average of single hits from detectors
  - Cedar + RICH + NewCHOD + CHOD + LKr
- Weights are given by single hit resolutions, evaluated separately

$$T_{\text{cand}} = \frac{\left(\frac{t_1}{\sigma_1^2} + \frac{t_2}{\sigma_2^2} + \frac{t_3}{\sigma_3^2} + \frac{t_4}{\sigma_4^2} + \frac{t_5}{\sigma_5^2} + \ldots + \frac{t_N}{\sigma_N^2} \right)}{\left(\frac{1}{\sigma_1^2} + \frac{1}{\sigma_2^2} + \frac{1}{\sigma_3^2} + \frac{1}{\sigma_4^2} + \frac{1}{\sigma_5^2} + \ldots + \frac{1}{\sigma_N^2} \right)}$$

- New strategy: global time candidate is a weighted average of single hits from detectors
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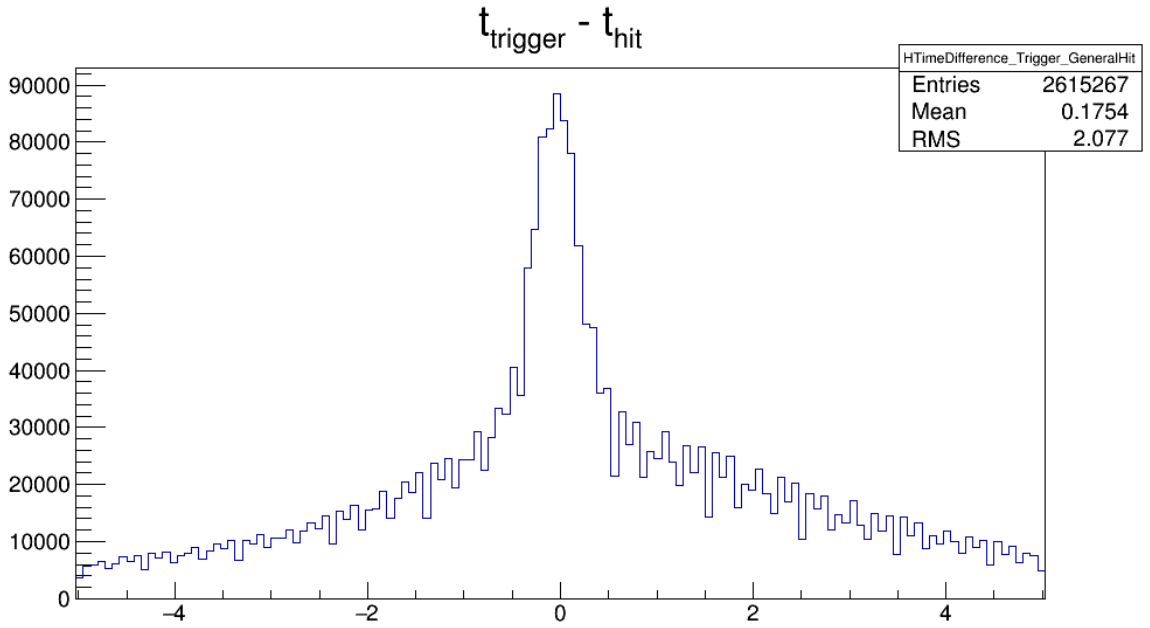
$$T_{\text{cand}} = \frac{\left(\frac{t_1}{\sigma_1^2} + \frac{t_2}{\sigma_2^2}\right) + \left(\frac{t_3}{\sigma_3^2} + \frac{t_4}{\sigma_4^2} + \frac{t_5}{\sigma_5^2}\right) + \ldots + \left(\frac{t_N}{\sigma_N^2}\right)}{\left(\frac{1}{\sigma_1^2} + \frac{1}{\sigma_2^2}\right) + \left(\frac{1}{\sigma_3^2} + \frac{1}{\sigma_4^2} + \frac{1}{\sigma_5^2}\right) + \ldots + \left(\frac{1}{\sigma_N^2}\right)}$$

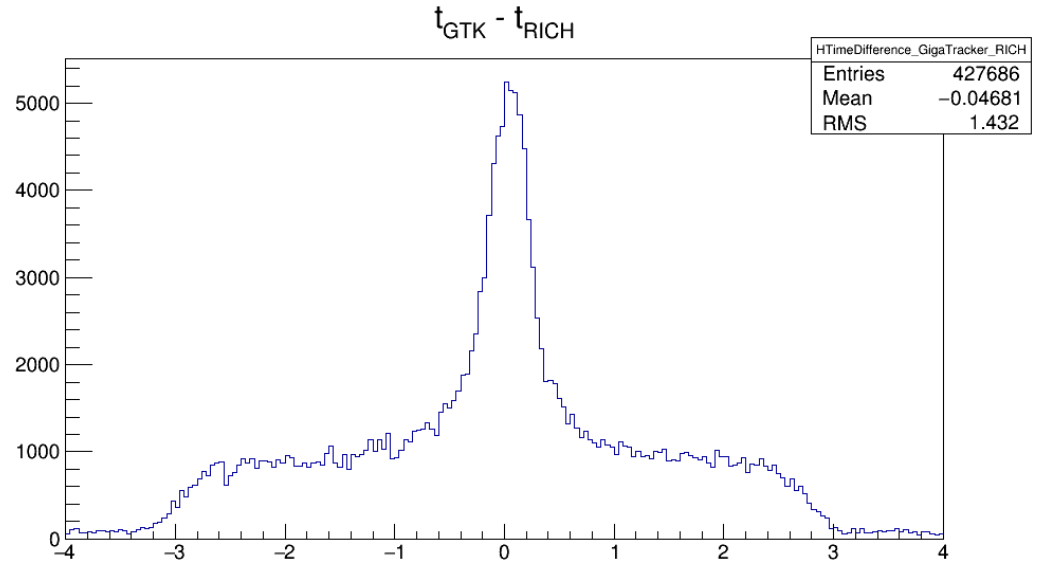
Cedar **RICH** **NewCHOD**

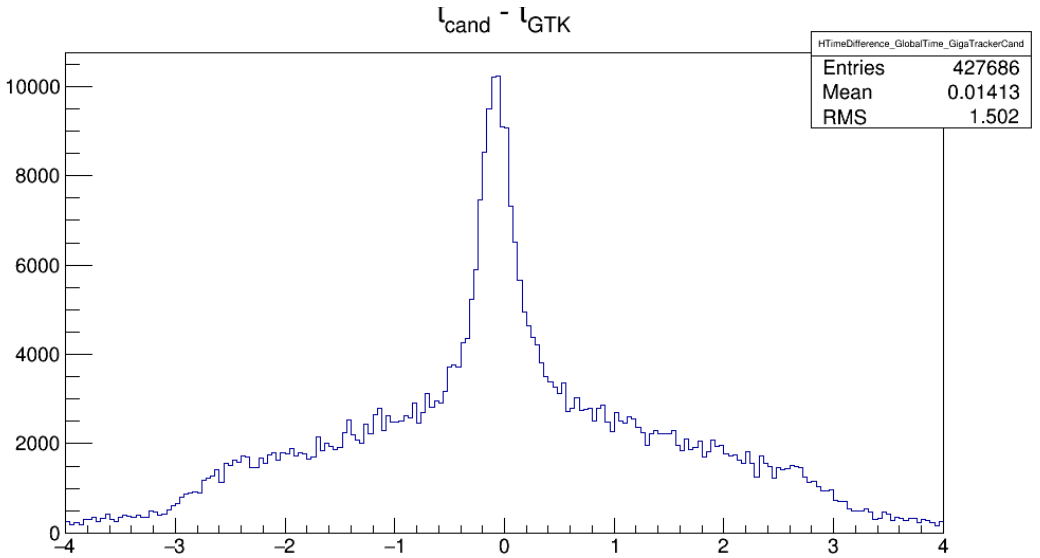
Some checks on GigaTracker

- Control trigger
- Basic cuts: $N_{sectors}$(Cedar) ≥ 5 sectors, N_{hits}(RICH) ≥ 4 hits, $N_{iterations}$(single ring) ≤ 2
- Selected hits close to trigger time (±5ns)
- Cuts on N_{hits}(GigaTracker) == 3

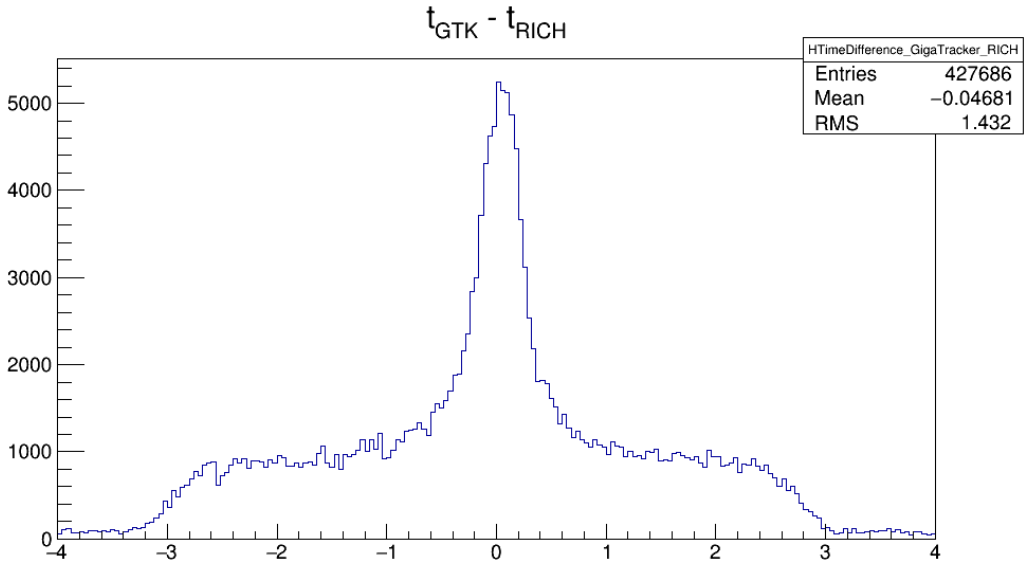


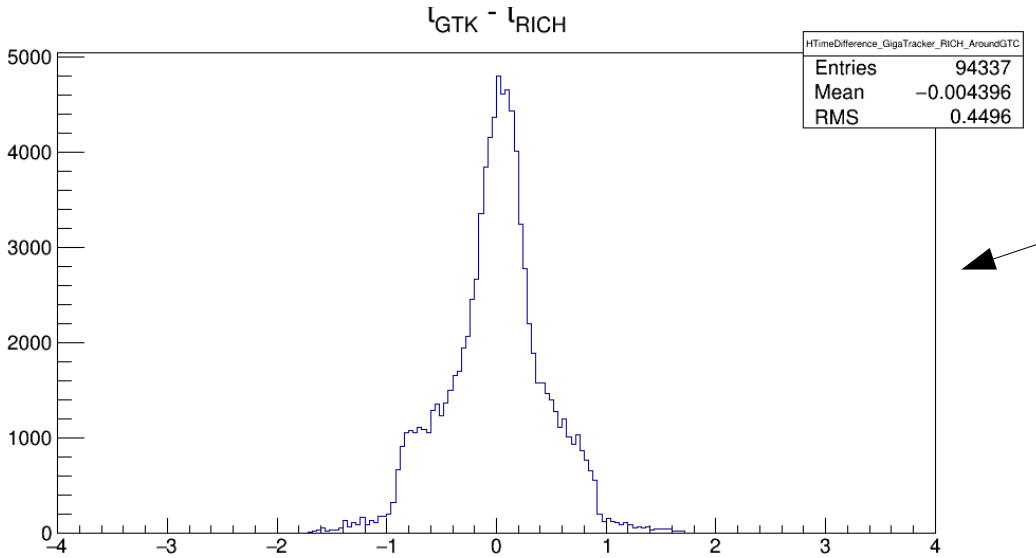
Some checks on GigaTracker





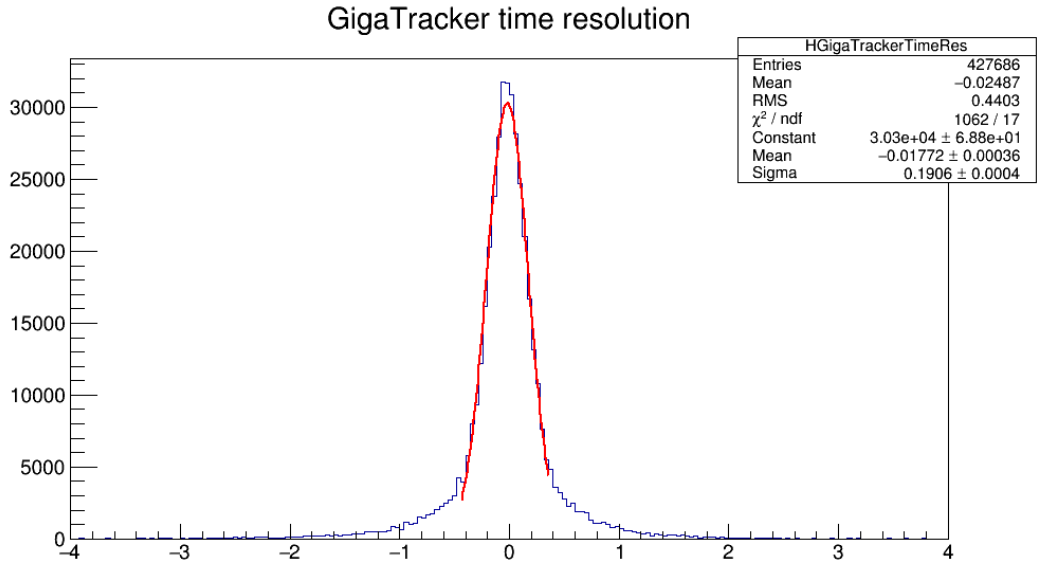
Some checks on GigaTracker



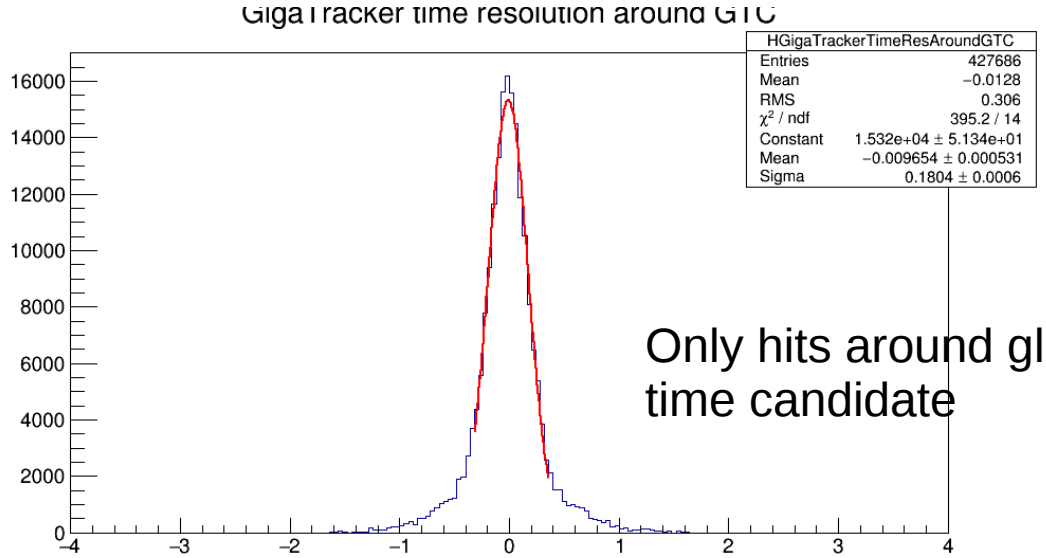


Only hits around global time candidate

Some checks on GigaTracker



$$\sigma_{GTK} = \frac{0.1906}{2} = 0.095\,ns$$



$$\sigma_{GTK} = \frac{0.1804}{2} = 0.090\,ns$$

Only hits around global time candidate