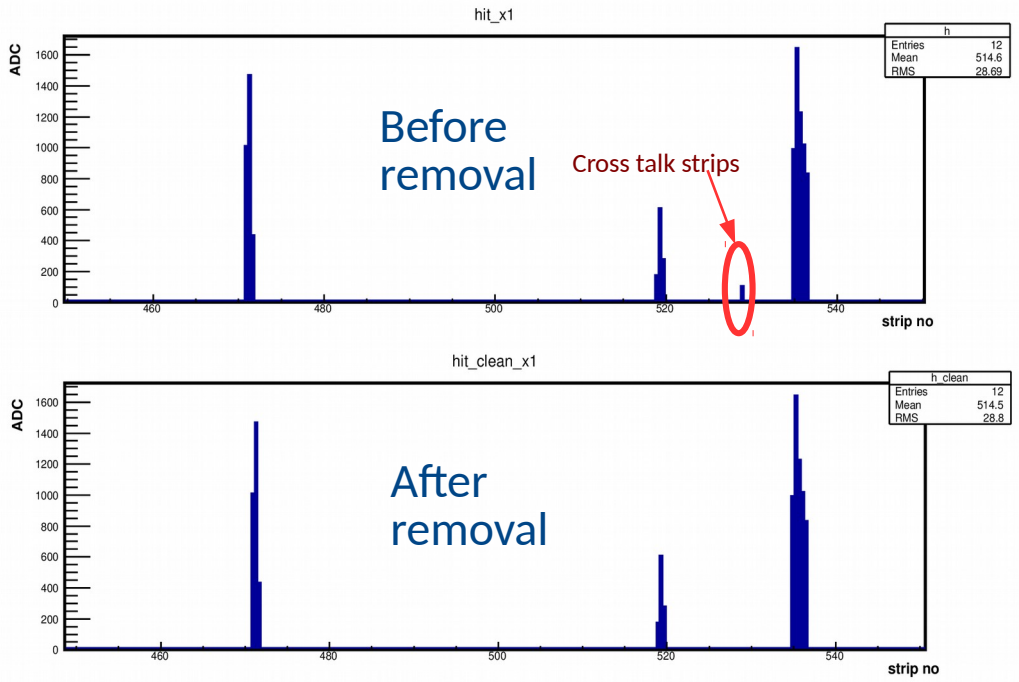
Cluster level cross-talk removal

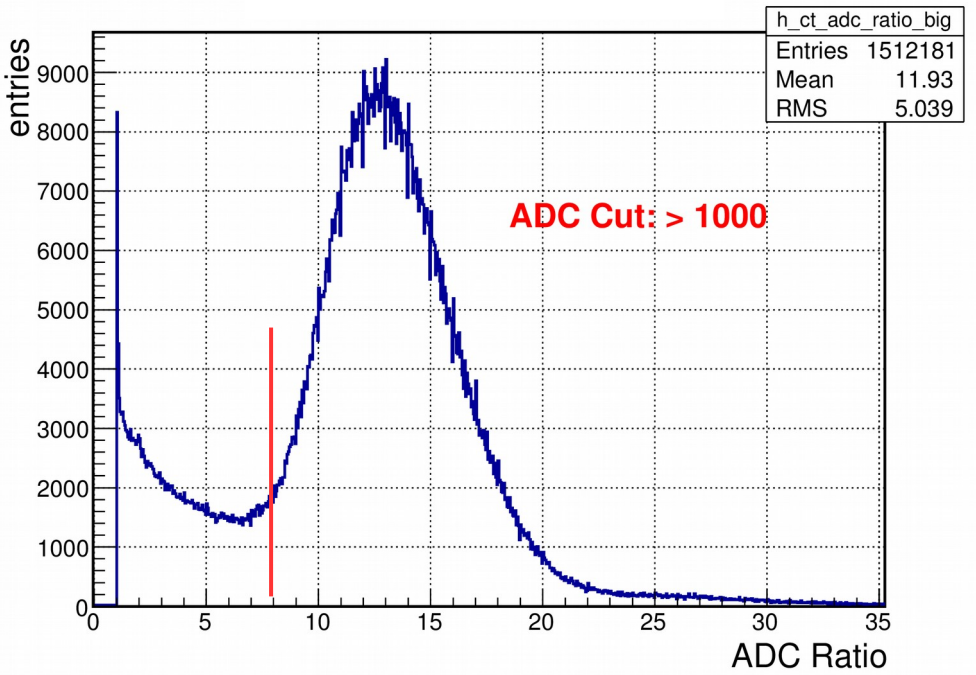
General description:

Basic criteria:

- Cross talk occurs inside APV25 chip.
- Two APV channels neighboring each other.
- One APV channel has <1/8 ADC of the other APV channel.
- Characteristic distance: 6.4mm, 17.6mm, 24.4mm, 24.8mm, 25.2mm, 25.6mm, 26mm, 26.4mm, 26.8mm, 33.6mm, 44.8mm.



A cross talk signal sample



ADC ratio between the cross-talk strip and its mother strip. (require mother strip ADC > 1000)

Methods description:

Method 1 (strip level removal).

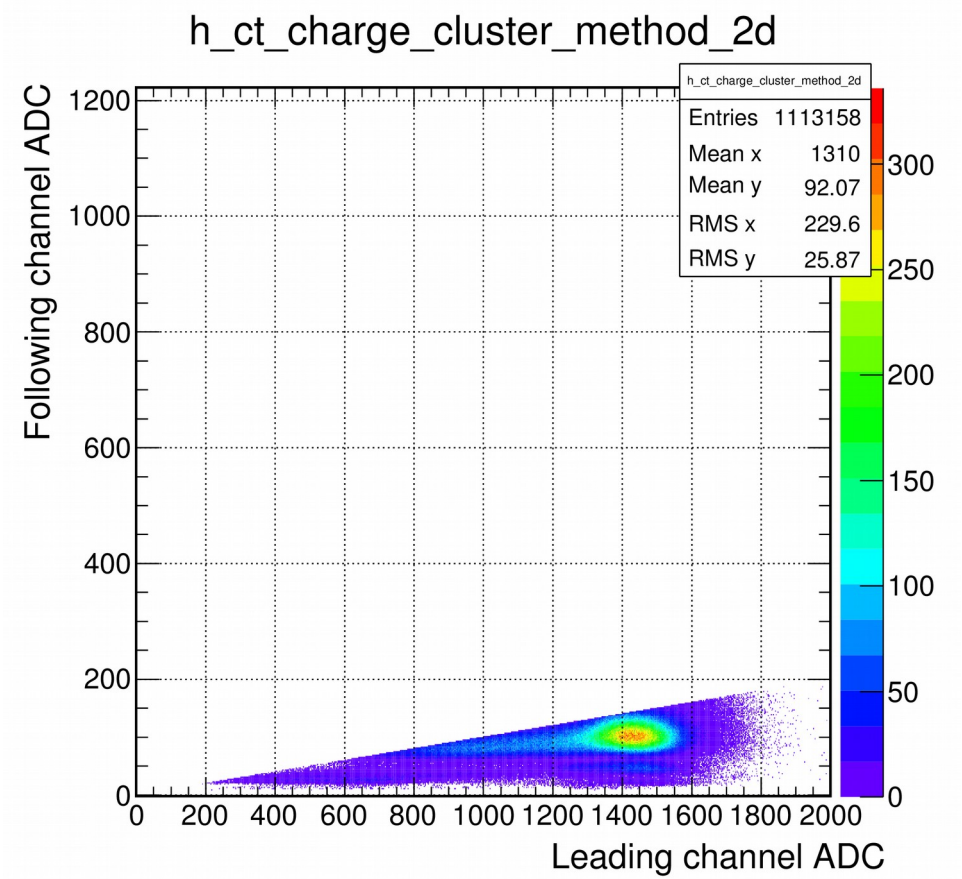
- For each APV, check if it has neighboring channels.
- If found neighboring channels, see if one channel ADC < 1/8 the other channel ADC.
- If true, discard the small ADC channel. If false, leave it.

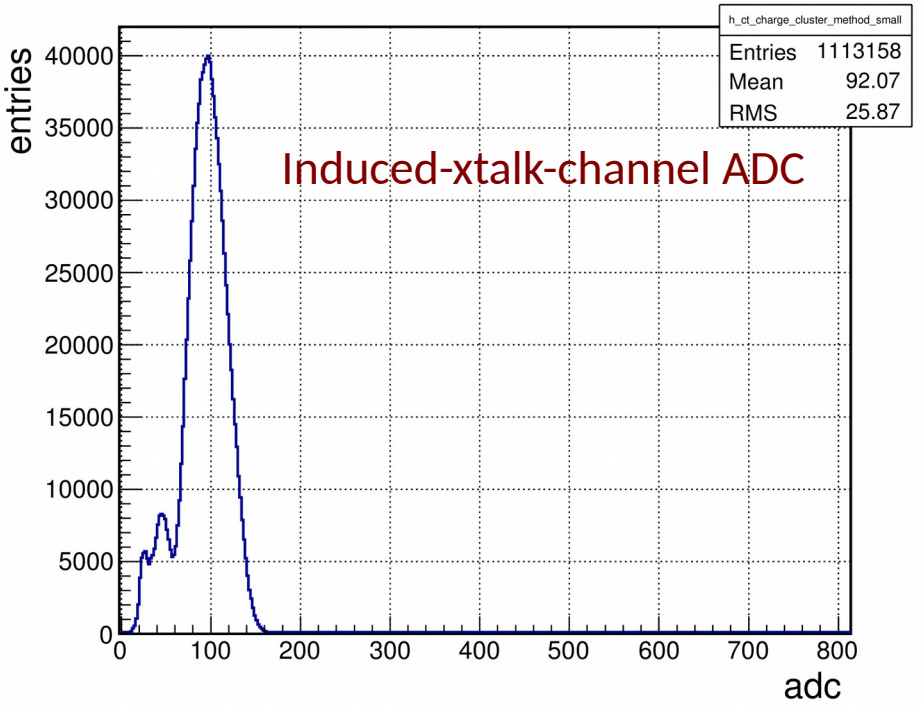
Method 2 (cluster level removal). ✓

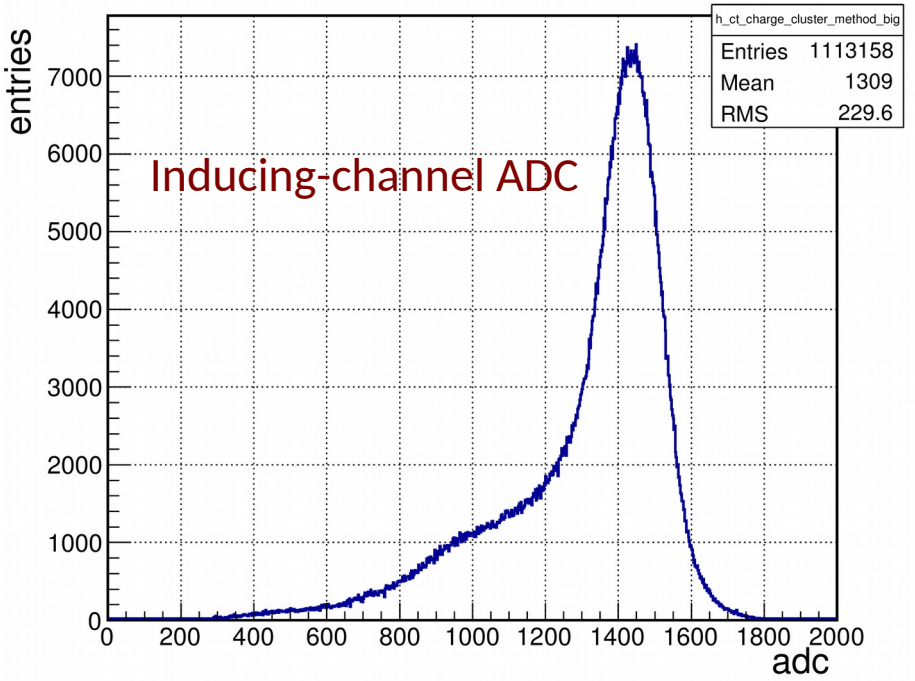
- Using the same methodology to find cross-talk strips (APV chip level). No removal in this step.
- For each strip, set a flag. (cross-talk strip: flag=1, non-cross-talk strip: flag=0).
- Use all strips to construct clusters.
- For each cluster, set two flags, has_cross_talk_strip and has_normal_strip.
- If found normal strip inside cluster: has_normal_strip=1, if found cross-talk strip inside cluster: has_cross_talk_strip=1.
- Remove clusters (1): with has_normal_strip=0 AND has_cross_talk_strip=1, AND (2): has characteristic distance. <at a characteristic distance away, exists another accompany cluster (inducer)>.

Cross talk ADC (cluster-method)

- Channels: APV chip channel level.
- Always the leading APV channel crosstalking the following channel, *ch1 induces ch2, …, ch n induces ch n+1*.





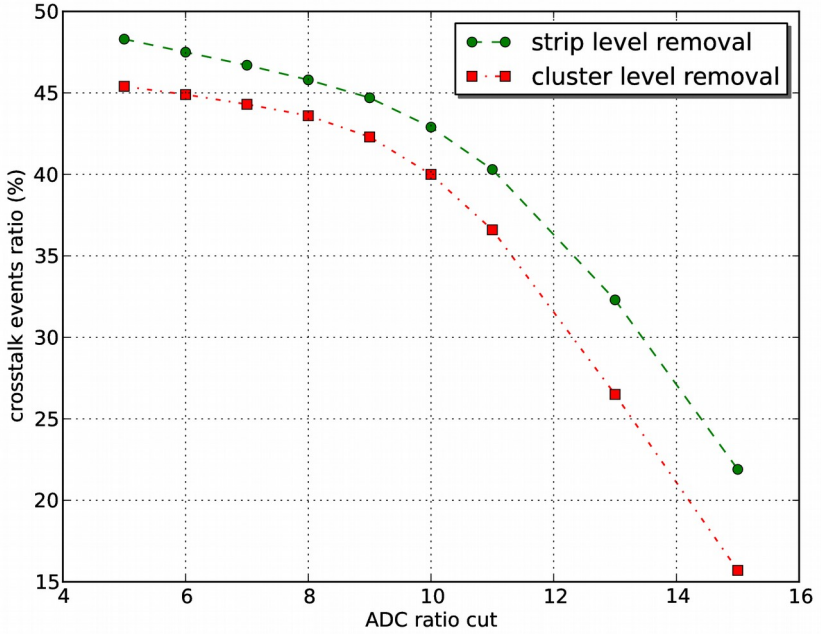


Compare between strip- and cluster- methods

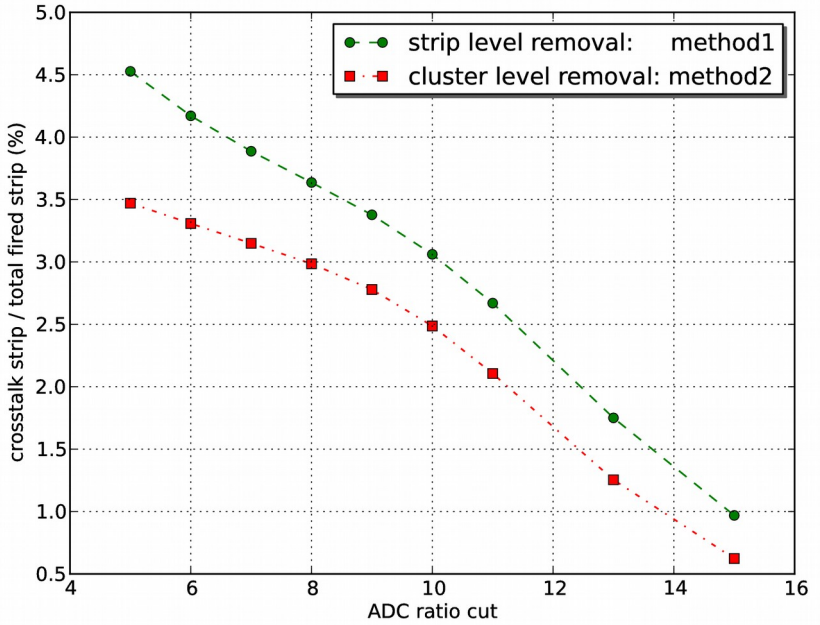
Definition of Events with cross talk signals:

In strip method: events that have at least 1 cross-talk strip.

In cluster method: events that have at least 1 cross-talk cluster.



$$\frac{number\ of\ events\ with\ crosstalk\ signals}{number\ of\ total\ events}$$

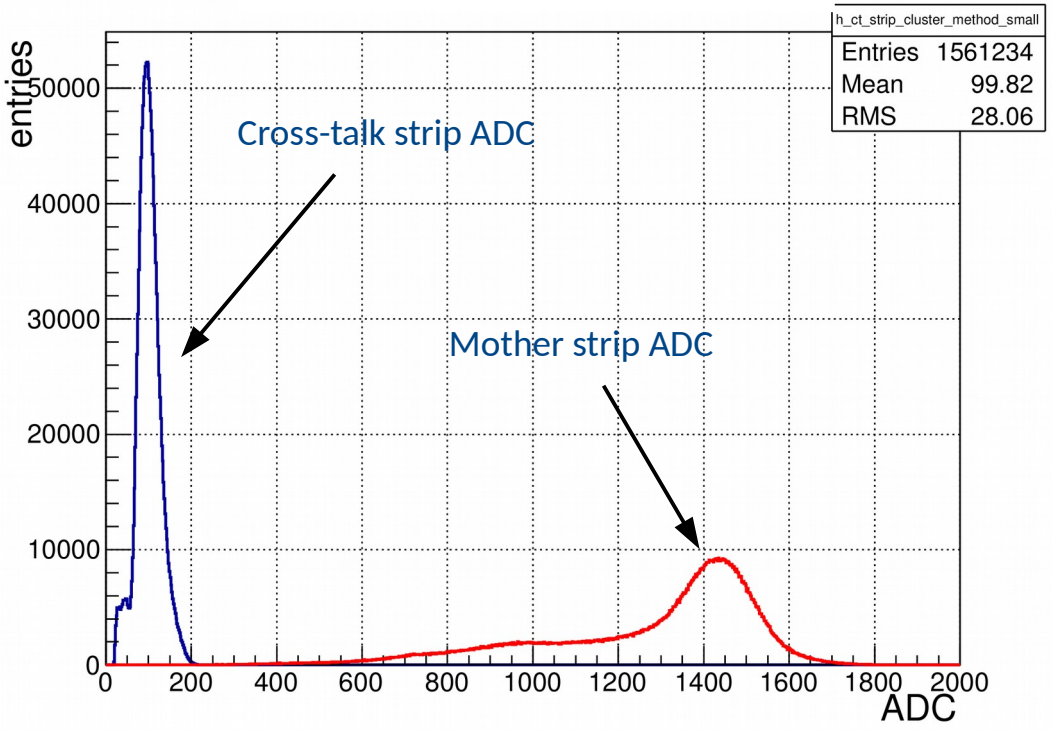


$$\frac{number\ of\ crosstalk\ strips}{number\ of\ total\ fired\ strips}$$

Compare between two methods

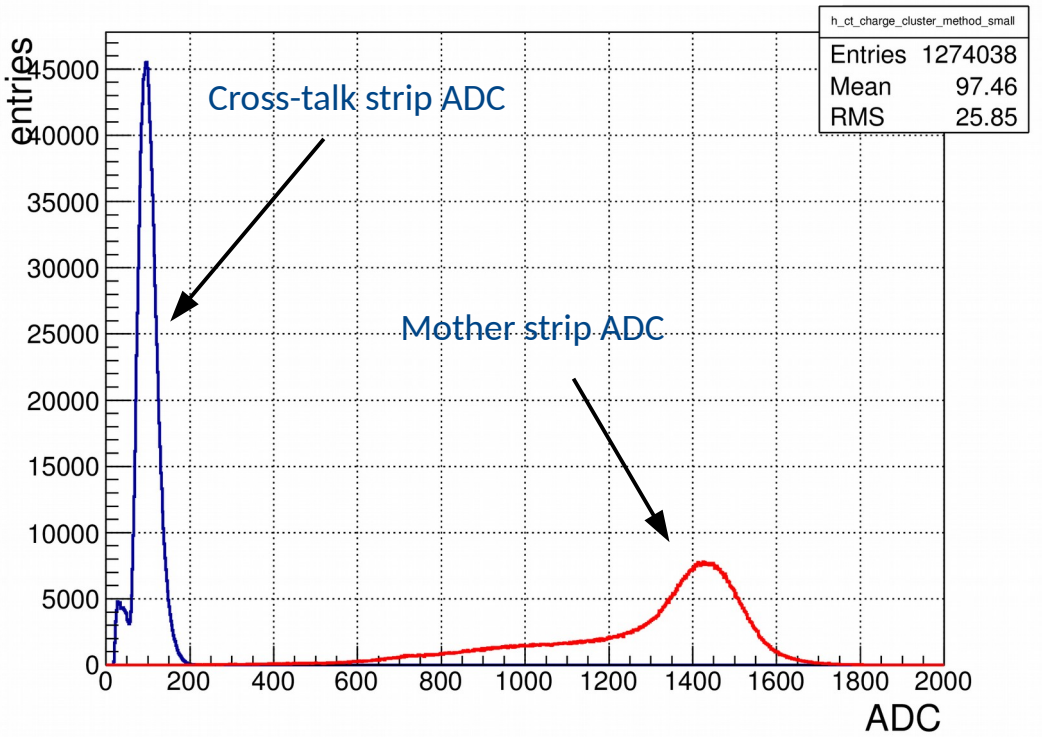
- No ADC cut.
- Mother strip ADC > 8 times cross-talk strip ADC.
- Not very much difference, except that method 2 has less entries.

Method 1 (strip level removal)



ADC distribution of cross-talk strips and its mother strips.

Method 2 (cluster level removal)



ADC distribution of cross-talk strips and its mother strips.

Summary

- Implemented cluster-level cross-talk removal

  1), cluster consists of all cross-talk strips, and have a characteristic distance.

  2), cross-talk strips ADC ratio > 8 (parameterized).

- Efficiency from calibration data:

  1), Geant simulation for <pair production events> and <Compton events> ratio.