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Performance of the DAMPE Silicon-Tungsten tracKer-converter (STK) during the first 5 years of in-orbit operations

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on behalf of the DAMPE Collaboration

DARK MATTER PARTICLE EXPLORER DAMPE

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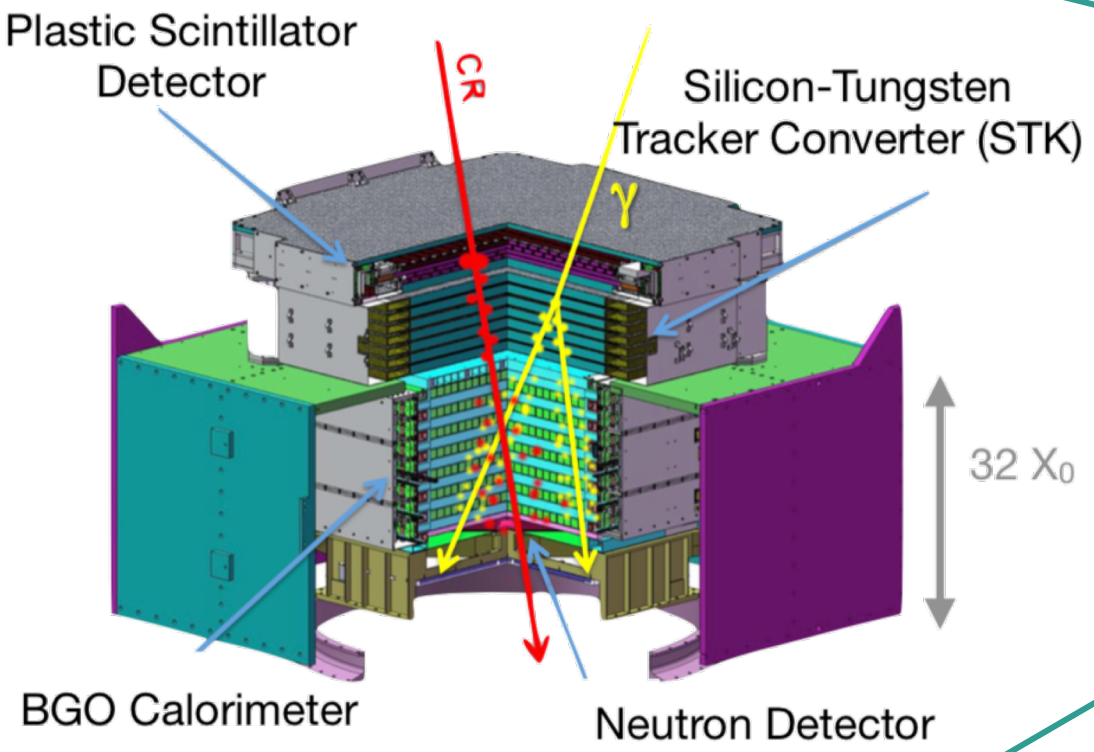
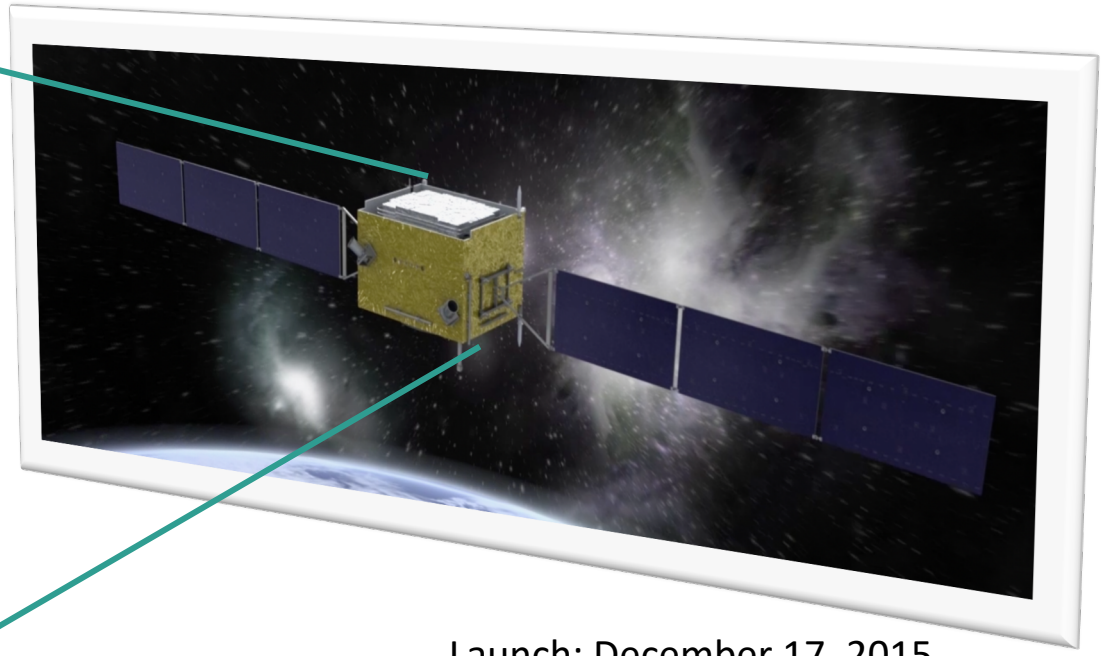
STK: DAMPE sub-detector





Launch: December 17, 2015

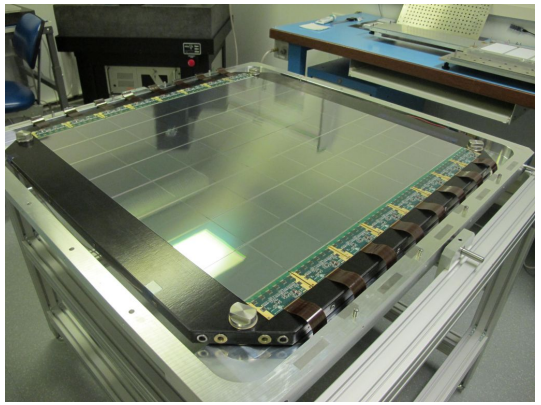
STK tasks:

- **Track reconstruction**
- **Charge measurement (|Z|)**
- **Gamma ray conversion ($\gamma \rightarrow e^+ e^-$)**

- **Outer envelope: 1.12 m x 1.12 m x 25.2 cm**
- **Detection area: 76 cm × 76 cm**
- **Total mass: 155 kg**
- **Total power consumption: 90 W**

STK layout

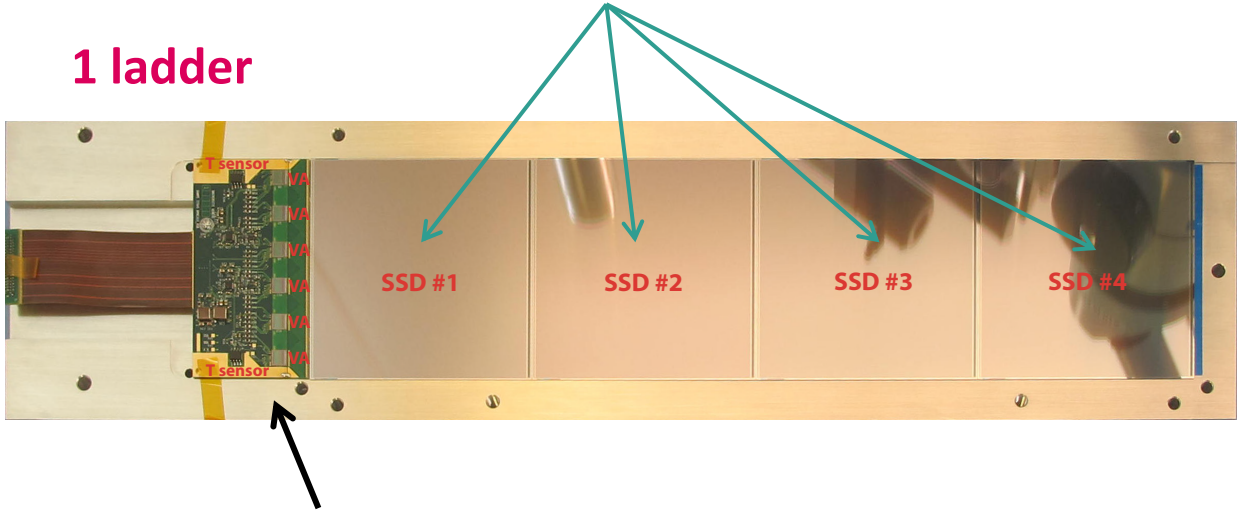
- 12 tracking layers (6x, 6y) of single-sided silicon strip detectors (SSDs) mounted on 7 support trays.
  - Tray: two carbon fibre sheets with Al honeycomb core
- 1 tungsten layer (1 mm thick) integrated in the 2nd, 3rd and 4th tray from the top.
  - Total thickness: 0.85 X_0 for photon conversion



1 layer

Si detectors with 768 strips each

1 ladder

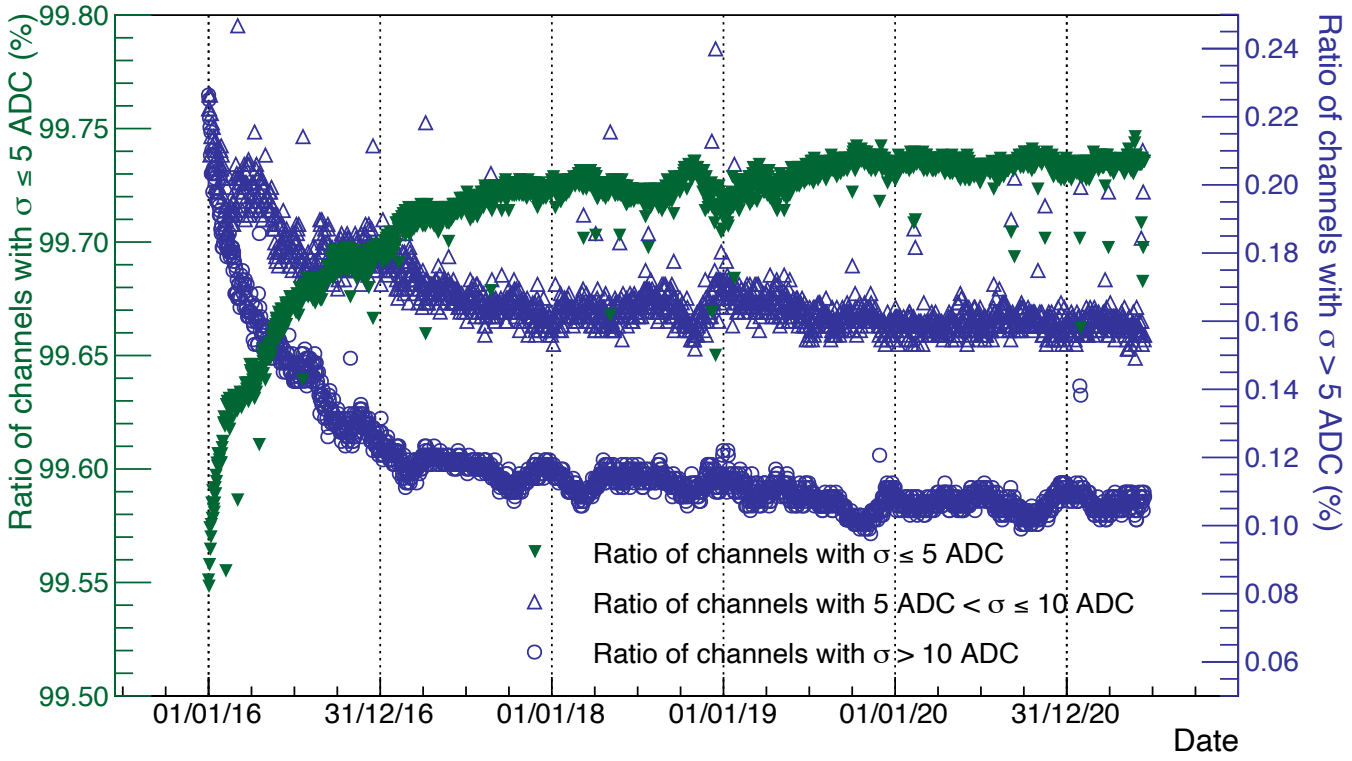


VA140 (front-end chip)

$$16\ \frac{\text{ladders}}{\text{layer}} \times 12\ \text{layers} = \mathbf{192\ ladders}$$

$$\frac{768}{2}\ \frac{\text{channels}}{\text{ladder}} \times 192\ \text{ladders} = \mathbf{73'728\ channels}$$

Channel noise time evolution



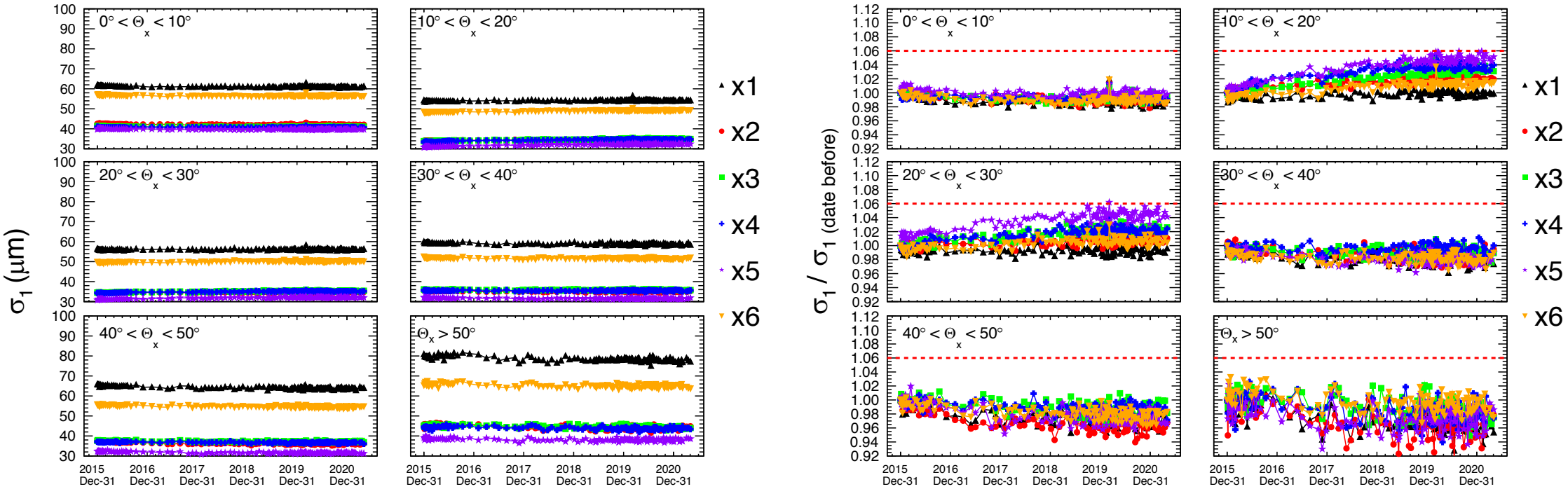
Time evolution of the fraction of

1. good channels ($\sigma \leq 5$ ADC);
2. quite good channels (5 ADC $< \sigma \leq$ 10 ADC);
3. bad channels ($\sigma >$ 10 ADC).

- The fraction of good channels increased over time thanks to the stabilization in space and since two years its value is stable around 99.74%.
- Only 0.11% of the channels are “bad”.

Position resolution evolution

In order to fully exploit the track reconstruction capabilities of the STK, a precise alignment of the instrument is performed once every two weeks.



Thanks to the alignment, the optimal position resolution remains stable and the deviation from the initial values is below 6% for all STK layers and particle incidence angles.