Recent Gamma-ray Results from DAMPE

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on behalf of the DAMPE collaboration

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Outline

• Introduction of DAMPE
• Fundamental works for gamma-rays
• Scientific results for gamma-rays
• summary
DArk Matter Particle Explorer

Proposed: 2005
Founded: 23 Dec. 2011
Launched: 17 Dec. 2015

Orbit: Sun-synchronous
Altitude: ~500 km

Data rate: ~5M events/day
Total: ~6.5G all-particle events up to now

Scientific objectives:
(a) Probing the nature of dark matter
(b) Understanding acceleration and propagation of cosmic rays
(c) Studying γ-ray emission from Galactic and extragalactic sources
The payload

- Plastic Scintillator Detector (PSD)
- Silicon-Tungsten Tracker (STK)
- BGO Calorimeter (BGO)
- Neutron Detector (NUD)

- Charge measurement (dE/dx in PSD, STK and BGO)
- Pair production and tracking (STK and BGO)
- Precise energy measurement (BGO bars)
- Hadron rejection (BGO and NUD)
The rare gamma-rays in the cosmic rays
Fundamental works: Selection

proton

electron

gamma
Fundamental works: Selection

- proton
- electron
- gamma
Fundamental works: Selection

proton

electron

gamma
Fundamental works: Selection

proton

electron

gamma

Acceptance

Event rate

See Xu et al., 2018, RAA, 18, 27 for details
Instrument response functions (IRFs) are the parameterized representations of the instrument performance, and they are dependent on the algorithm of gamma-ray selection.

The IRFs of DAMPE are factorized into three parts: (a) the effective area, (b) the point-spread function (PSF) and (c) the energy dispersion function.

See Duan et al. [arXiv: 1904.13098] for details.
Fundamental works: Boresight alignment

See Jiang et al. [PS1-248(ICRC2019)] for details
Fundamental works: Boresight alignment

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Fundamental works: Boresight alignment

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# Overall performance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Range</strong></td>
<td>2 GeV - 10 TeV</td>
</tr>
<tr>
<td><strong>Field of View</strong></td>
<td>~ 1 sr</td>
</tr>
<tr>
<td><strong>Effective Area</strong></td>
<td>~ 1200 cm² @ 100 GeV</td>
</tr>
<tr>
<td>(normal incidence)</td>
<td></td>
</tr>
<tr>
<td><strong>Angular Resolution</strong></td>
<td>0.1° @ 100 GeV</td>
</tr>
<tr>
<td>(normal incidence)</td>
<td></td>
</tr>
<tr>
<td><strong>Energy Dispersion</strong></td>
<td>~1% @ 100 GeV</td>
</tr>
<tr>
<td>(normal incidence)</td>
<td></td>
</tr>
</tbody>
</table>
Data collected in the first three years

- Six full-sky scans
- \( \sim 0.2M \) photons (>2GeV)

![Exposure map (around 10 GeV)](image)

![Counts map (> 2 GeV)](image)
Bright gamma-ray source list

- Blind search for all-sky bright sources
- Events from 2 GeV to 2 TeV
- TS map within 0.1° pixels

143 sources with TS > 20
120 sources with TS > 25

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGN</td>
<td>100</td>
</tr>
<tr>
<td>Pulsar</td>
<td>27</td>
</tr>
<tr>
<td>SNR / PWN</td>
<td>9</td>
</tr>
<tr>
<td>Binary</td>
<td>2</td>
</tr>
<tr>
<td>Globular cluster</td>
<td>1</td>
</tr>
<tr>
<td>Unassociated</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>143</strong></td>
</tr>
</tbody>
</table>

Source classes
Bright gamma-ray source list

- Sensitivity of source detection for 3 years

Integral flux sensitivity

Broadband sensitivity Galactic center, intermediate latitudes, north Galactic pole, and north Celestial pole
Gamma-ray line search


See Shen et al. [PS1-256(ICRC2019)] for details
Gamma-ray line search

Fermi-LAT Coll. (2013)

Liang et al. (2016)

Energy resolution

All-sky SED (w/o Gal plane)

See Shen et al. [PS1-256(ICRC2019)] for details
Gamma-ray line search

Galaxy clusters

TS values for 16 GCls

See Shen et al. [PS1-256(ICRC2019)] for details
Gamma-ray line search

Diffuse regions

Galaxy clusters

Upper limits for R90 region

TS values for 16 GCls

See Shen et al. [PS1-256(ICRC2019)] for details
Pulsars

Five most significant pulsars

See Muñoz et al. [GAD2d(ICRC2019)] for details
GeV variable AGNs

Preliminary

See ATel #9901, #11246, #12562, #12705 for details
Summary

• More than three years’ sky-survey observation

• All-sky blind search with 3-year data above 2 GeV reveals 143 bright sources with TS > 20.

• No statistically significant line is identified between 10 GeV and 300 GeV and upper limits of $<\sigma v>$ are obtained.

• Further analyses are being carried, along with more data collected as well.
Thanks for your attention!