Towards a New Era in Galactic Gamma-Ray Astronomy

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Abstract

The field of Very-High-Energy (VHE, E>100 GeV) gamma-ray astronomy is entering an era of precision measurements. Over the last decade, innovations in instrumentation have led to a drastically improved understanding of the most energetic objects in the Universe. New results by the High Altitude Water Cherenkov Observatory (HAWC) have shown the unique insights that large-field-of-view survey instruments like HAWC can provide to the field. The recent HAWC catalog and other publications have revealed gamma-ray emission from several large extended sources such as TeV halos surrounding pulsar-wind nebulae. Synergies between ground- and space-based survey and pointing instruments have already led to the identification of several new sources and source candidates. In this poster, we will explore the potential of future improvements to the field: Upgrades to current instruments as well as the planned Southern Gamma Survey Observatory (SGSO) which will further improve our view of the VHE sky. These innovations will also open the door for further synergies between different instrument types. In particular, we will discuss future opportunities in using the Fermi-LAT data to constrain the origin of the positron flux at Earth, as well as the possibility to discover invisible pulsars.

Current and Future Ground-Based Instruments

<table>
<thead>
<tr>
<th>Detector</th>
<th>Latitude</th>
<th>Field-of-View</th>
<th>Threshold (GeV)</th>
<th>Collection Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAWC [1,2]</td>
<td>19°N</td>
<td>2 sr</td>
<td>500 GeV</td>
<td>5.0×10² (1.6-10⁵)</td>
</tr>
<tr>
<td>VERITAS [3]</td>
<td>31.7°N</td>
<td>0.003 sr</td>
<td>85 GeV</td>
<td>2.0×10²</td>
</tr>
<tr>
<td>MAGIC [4]</td>
<td>28.8°N</td>
<td>0.003 sr</td>
<td>50 GeV</td>
<td>1.0×10⁵</td>
</tr>
<tr>
<td>H.E.S.S. [5]</td>
<td>23.3°S</td>
<td>0.006 sr</td>
<td>30 GeV</td>
<td>2.0×10⁵</td>
</tr>
<tr>
<td>LHASO [6]</td>
<td>29.3°N</td>
<td>2 sr</td>
<td>100 GeV</td>
<td>8.0×10⁴</td>
</tr>
<tr>
<td>CTA North [7]</td>
<td>28.8°N</td>
<td>0.016 sr</td>
<td>20 GeV</td>
<td>1.0×10⁶</td>
</tr>
<tr>
<td>CTA South [7]</td>
<td>24.7°S</td>
<td>0.020 sr</td>
<td>20 GeV</td>
<td>5.0×10⁶</td>
</tr>
<tr>
<td>SGSO [8]</td>
<td>15°-25°S</td>
<td>~2 sr</td>
<td>100 GeV</td>
<td>~2.0×10⁵</td>
</tr>
</tbody>
</table>

Acknowledgements

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References


Molecular Clouds

- Extended region of cold, molecular gas.
- Up to tens of degrees apparent size.
- Concentrated along Galactic plane.
- Passive clouds: γ-ray emission due to interactions with CR 'sea'.
- γ-ray emissivity proportional to CR flux; important tracer of CR distribution throughout the Galaxy.
- SGSO will have access to molecular clouds on the southern sky.