The H.E.S.S. Galactic Plane Survey

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on behalf of the H.E.S.S. Collaboration

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The 5-tel hybrid Cherenkov telescope array

4 12-m IACTs w/ recoated mirrors + 1 28-m IACT

Multiple triggering & pointing schemes available

CT5: 2048 PMTs 614 m² 3.2° FoV $E_{\text{min}} \sim 20$ GeV $f = 38$ m

vs. 5.0° FoV (CT1-4)
Significance, in full detail
Full detail TeV sky images, catalog, & MWL associations
Sensitivity

% Crab
HGPS Sensitivity along $b = 0^\circ$ for a 5-$\sigma$ detection.
TeV Horizon

1% and 10% Crab
Reflects zenith angle dependency on longitude
~6000 observations → ~3000 h dataset
RoI-based analysis pipeline
A 2D likelihood approach

- Semi-automated, MLE-based source detection & morphology fitting
- Model sources as Gaussian plus an underlying “diffuse” component
Empirical not physical model: 20 deg sliding window w/ Gaussian in $b$
Background estimation

Adaptive background estimation with exclusion region masks
Galactic TeV sources

66 HGPS pipeline sources
+ 11 sources treated manually (Galactic center region, TeV shells)
+ 3 sources outside HGPS region (Crab Nebula, SN 1006, HESS J0632)
= 80 Galactic sources detected by H.E.S.S.
TeV source distribution

H.E.S.S. (2015) Preliminary

Galactic Latitude (deg)

Number of sources

Sensitivity (% Crab)

- Planck CO
- PSR
- SNR
- GeV
- HGPS

glon = -27 deg

glon = 0 deg
HGPS Firm identifications

MWL counterparts:
- **Pulsars** (ATNF)
- **PWN** (SNRcat)
- **SNRs** (SNRcat)
- **HE sources** (1FHL, 3FGL)

N.B. associations (spatial coincidences) vs. identification

- 12 PWN
- 6 Composite
- 6 SNR
- 3 Binary

Mostly sources with multiple associations

Preliminary

77

50 Unidentified
New source discoveries
HESS J1813-126

- Position: 
  $(l, b) = (17.31, 2.49)$ deg
  $(a, \delta) = (273.34, -12.69)$ deg
- Extension: 0.21 deg
- Flux: 4.2% Crab
HESS J1826-130

- Position: 
  \((l, b) = (18.48, -0.39)\) deg 
  \((\alpha, \delta) = (276.51, -13.02)\) deg 
- Extension: 0.15 deg 
- Flux: 3.3% Crab
HESS J1828-099

- Position: 
  \((l, b) = (21.49, 0.38) \text{ deg}\)
  \((\alpha, \delta) = (277.25, -9.99) \text{ deg}\)
- Extension upper limit:
  \(< 0.07 \text{ deg}\)
- Flux: 1.7\% Crab
• Position:  
  \((l, b) = (23.21, 0.29)\) deg  
  \((\alpha, \delta) = (278.13, -8.51)\) deg

• Extension upper limit:  
  \(< 0.05 \) deg

• Flux: 0.8% Crab
HESS J1844-030

- Position:
  $(l, b) = (29.41, 0.09)$ deg
  $(\alpha, \delta) = (281.17, -3.10)$ deg

- Extension upper limit:
  $< 0.05$ deg

- Flux: 1.0% Crab
Conclusion

Demonstrated power of surveying with wide-FoV imaging atmospheric Cherenkov telescopes → TeV gamma-ray astronomy

Decade-long H.E.S.S. I Galactic Plane Survey completed
  Legacy paper in preparation
  Final catalog, high-level FITS data release, including spectra
  17 new source discoveries
  Associations & firm identifications
  Coupled with population studies (SNRs, PWNe) & new TeV shells
Backup slides
## Firm identifications

<table>
<thead>
<tr>
<th>Source Name</th>
<th>Associated object</th>
<th>Class</th>
<th>Evidence</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>HESS J1018–589A</td>
<td>IFGL J1018.6–5856</td>
<td>Binary</td>
<td>Variability</td>
<td>H. E. S. S. Collaboration et al. (2015a)</td>
</tr>
<tr>
<td>HESS J1302–638</td>
<td>PSR B1259–63</td>
<td>Binary</td>
<td>Variability</td>
<td>Aharonian et al. (2005a)</td>
</tr>
<tr>
<td>HESS J1826–148</td>
<td>LS 5039</td>
<td>Binary</td>
<td>Variability</td>
<td>Aharonian et al. (2006c)</td>
</tr>
<tr>
<td>HESS J0852–463</td>
<td>Vela Junior</td>
<td>SNR</td>
<td>Morphology</td>
<td>Aharonian et al. (2005b)</td>
</tr>
<tr>
<td>HESS J1442–624</td>
<td>RCW 86</td>
<td>SNR</td>
<td>Morphology</td>
<td>Aharonian et al. (2009)</td>
</tr>
<tr>
<td>HESS J1534–571</td>
<td>G323.7–01.0</td>
<td>SNR</td>
<td>Morphology</td>
<td>HESS SNR shell paper (2015)</td>
</tr>
<tr>
<td>HESS J1713–397</td>
<td>RX J1713.7–3946</td>
<td>SNR</td>
<td>Morphology</td>
<td>Aharonian et al. (2004)</td>
</tr>
<tr>
<td>HESS J1731–347</td>
<td>G353.6–0.7</td>
<td>SNR</td>
<td>Morphology</td>
<td>H.E.S.S. Collaboration et al. (2011b)</td>
</tr>
<tr>
<td>HESS J0835–455</td>
<td>Vela X</td>
<td>PWN</td>
<td>Morphology</td>
<td>Aharonian et al. (2006a)</td>
</tr>
<tr>
<td>HESS J1514–591</td>
<td>MSH 15–52</td>
<td>PWN</td>
<td>Morphology</td>
<td>Aharonian et al. (2005a)</td>
</tr>
<tr>
<td>HESS J1825–137</td>
<td>PSR J1826–1334</td>
<td>PWN</td>
<td>ED Morph.</td>
<td>Aharonian et al. (2006d)</td>
</tr>
<tr>
<td>HESS J1356–645</td>
<td>PSR J1357–6429</td>
<td>PWN</td>
<td>Position</td>
<td>H.E.S.S. Collaboration et al. (2011a)</td>
</tr>
<tr>
<td>HESS J1418–609</td>
<td>PSR J1418–6058</td>
<td>PWN</td>
<td>Position</td>
<td>Aharonian et al. (2006b)</td>
</tr>
<tr>
<td>HESS J1420–607</td>
<td>PSR J1420–6048</td>
<td>PWN</td>
<td>Position</td>
<td>Aharonian et al. (2006b)</td>
</tr>
<tr>
<td>HESS J1554–550</td>
<td>G327.1–01.1</td>
<td>PWN</td>
<td>Morphology</td>
<td>Section 5.7.5</td>
</tr>
<tr>
<td>HESS J1747–281</td>
<td>G0.9+0.1</td>
<td>PWN</td>
<td>Morphology</td>
<td>Aharonian et al. (2005b)</td>
</tr>
<tr>
<td>HESS J1818–154</td>
<td>G015.4+00.1</td>
<td>PWN</td>
<td>Morphology</td>
<td>H. E. S. S. Collaboration et al. (2014)</td>
</tr>
<tr>
<td>HESS J1849–000</td>
<td>PSR J1849–0001</td>
<td>PWN</td>
<td>Position</td>
<td>Section 5.7.15</td>
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<tr>
<td>HESS J1640–465</td>
<td>G338.3–0.0</td>
<td>Composite?</td>
<td>Position</td>
<td>Abramowski et al. (2014b), Gotthelf et al. (2014)</td>
</tr>
<tr>
<td>HESS J1119–614</td>
<td>PSR J1119–6127</td>
<td>Composite</td>
<td>Position</td>
<td>Section 5.7.1</td>
</tr>
<tr>
<td>HESS J1833–105</td>
<td>G21.5–0.9</td>
<td>Composite</td>
<td>Position</td>
<td>Section 5.7.10</td>
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<tr>
<td>HESS J1846–029</td>
<td>PSR J1846–0258</td>
<td>Composite</td>
<td>Position</td>
<td>Section 5.7.13</td>
</tr>
<tr>
<td>HESS J1930+186</td>
<td>G54.1+0.3</td>
<td>Composite</td>
<td>Position</td>
<td>Acciari et al. (2010), Section 5.5</td>
</tr>
</tbody>
</table>
GPS IN CONTEXT

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~mCrab and uniform sensitivity with CTA GPS in just 2 years