

# **A detailed Morphology of the W 28 Region at TeV Energies as revealed by H.E.S.S.**

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# The H.E.S.S. Collaboration

|                               |   |
|-------------------------------|---|
| MPI Kernphysik Heidelberg     | Durham Univ.                                      |
| Humboldt Univ. Berlin         | Leeds Univ.                                       |
| Ruhr-Univ. Bochum             | Dublin Inst. for Adv. Studies                     |
| Univ. Erlangen-Nürnberg       | Nicolaus Copernicus Astronomical Center<br>Warsaw |
| Univ. Hamburg                 | Astronomical Observatory Cracow                   |
| LSW Heidelberg                | Institute of Physics Cracow                       |
| Univ. Tübingen                | Institute of Nuclear Physics Cracow               |
| Ecole polytechnique Palaiseau | Space Research Centre Warsaw                      |
| Univ. Paris VI – VII          | Charles Univ. Prag                                |
| APC Paris                     | Yerevan Physics Institute Yerevan                 |
| CEA Saclay                    | Univ. Adelaide                                    |
| Paris Observatory Meudon      | Univ. Namibia Windhoek                            |
| LAPP Annecy                   | North West Univ. Republic of South Africa         |
| Univ. Grenoble                | <b>~ 30 institutes</b>                            |
| Univ. Montpellier II          | <b>~ 130 physicists and astrophysicists</b>       |
| CESR Toulouse                 | <b>(mainly in France and Germany)</b>             |

# H.E.S.S.

4 telescopes  
individual mirrors **107 m<sup>2</sup>**  
4 cameras 960 PMT  
field of view **5°**

fast online analysis

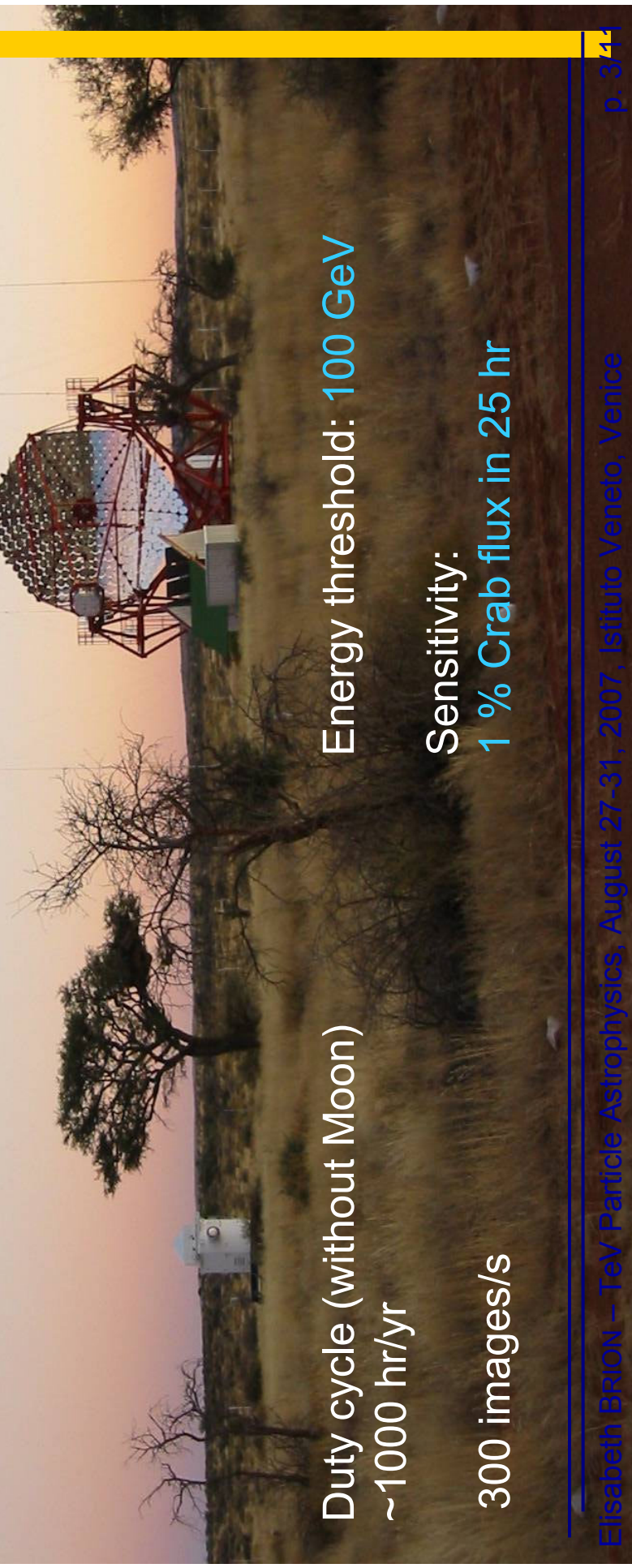
final analysis and calibration:  
2 independent chains  
(France + Germany)

Duty cycle (without Moon)  
~1000 hr/yr

300 images/s

Energy threshold: **100 GeV**

Sensitivity:  
**1 % Crab flux in 25 hr**



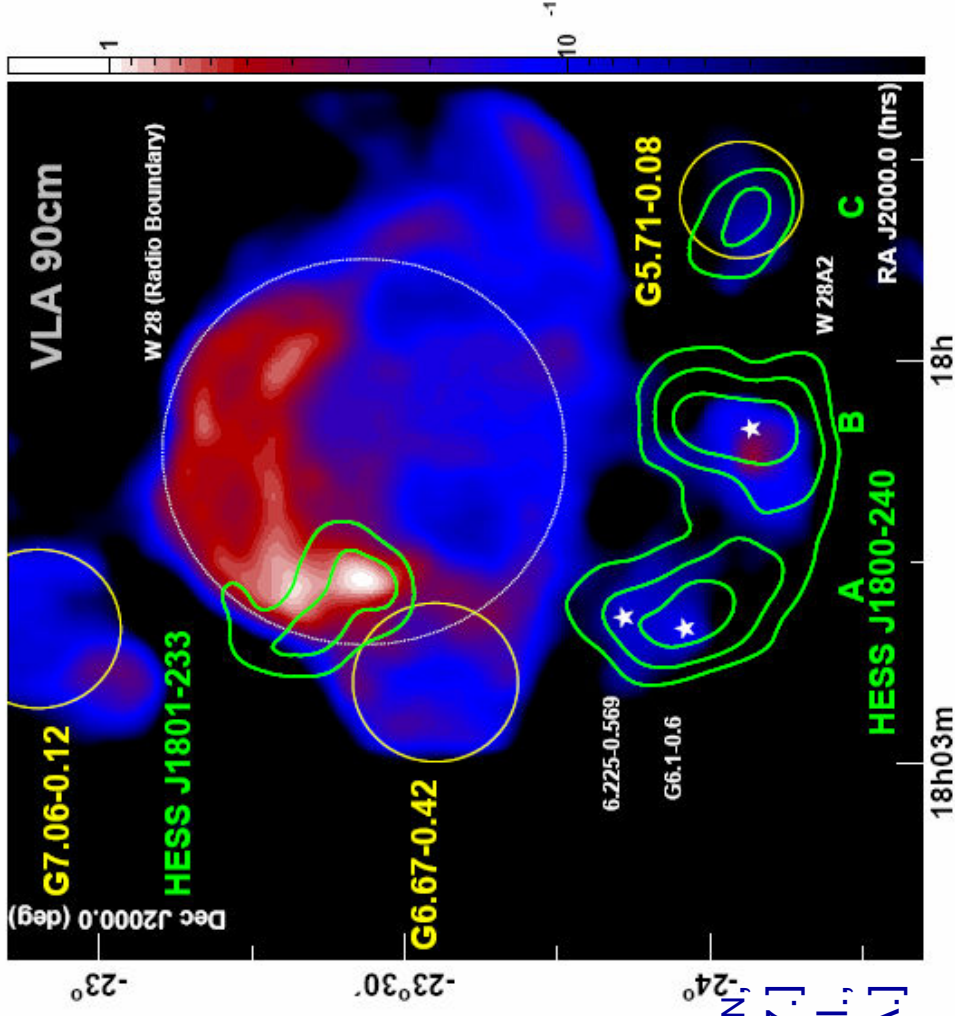
# The W 28 Region

- **SNR W 28** (also G6.4-0.1):  
centrally filled in X-rays + shell-like radio morphology
- size       $50' \times 45'$
- age       $\sim 3.5 - 15 \times 10^4$  yr
- distance    $\sim 1.8 - 3.3$  kpc
- associated with GRO J1801-2320
- Several **HII regions** and **dense molecular clouds** with high concentration of OH masers (1720 MHz).

# Observations of the W 28 Region

## Intensity map obtained by the VLA at 90 cm.

In green: 4-6  $\sigma$   
H.E.S.S.  
significance  
contours.



H.E.S.S. Hillas  
analysis  
parameters:

Image cuts  
> 200  
photoelectrons  
(p.e.).

PSF  $\sim 0.1''$ .

Exposure: 42 hrs.

Gaussian smooth  
of  $\sigma = 4.2''$ .

[G. ROWELL, E. BRION,  
et al., 30th ICRC, 2007.]  
[F. AHARONIAN et al.,  
submitted to A&A.]

# (Preliminary!) W 28 Region with the « Model + Hillas Analysis »

**H.E.S.S.**  
**Excess map** obtained with the Model analysis giving a lower threshold and a better sensitivity at low energies.

[Description of this analysis in M. DE NAUROIS, astro-ph/0607247, 2006.]

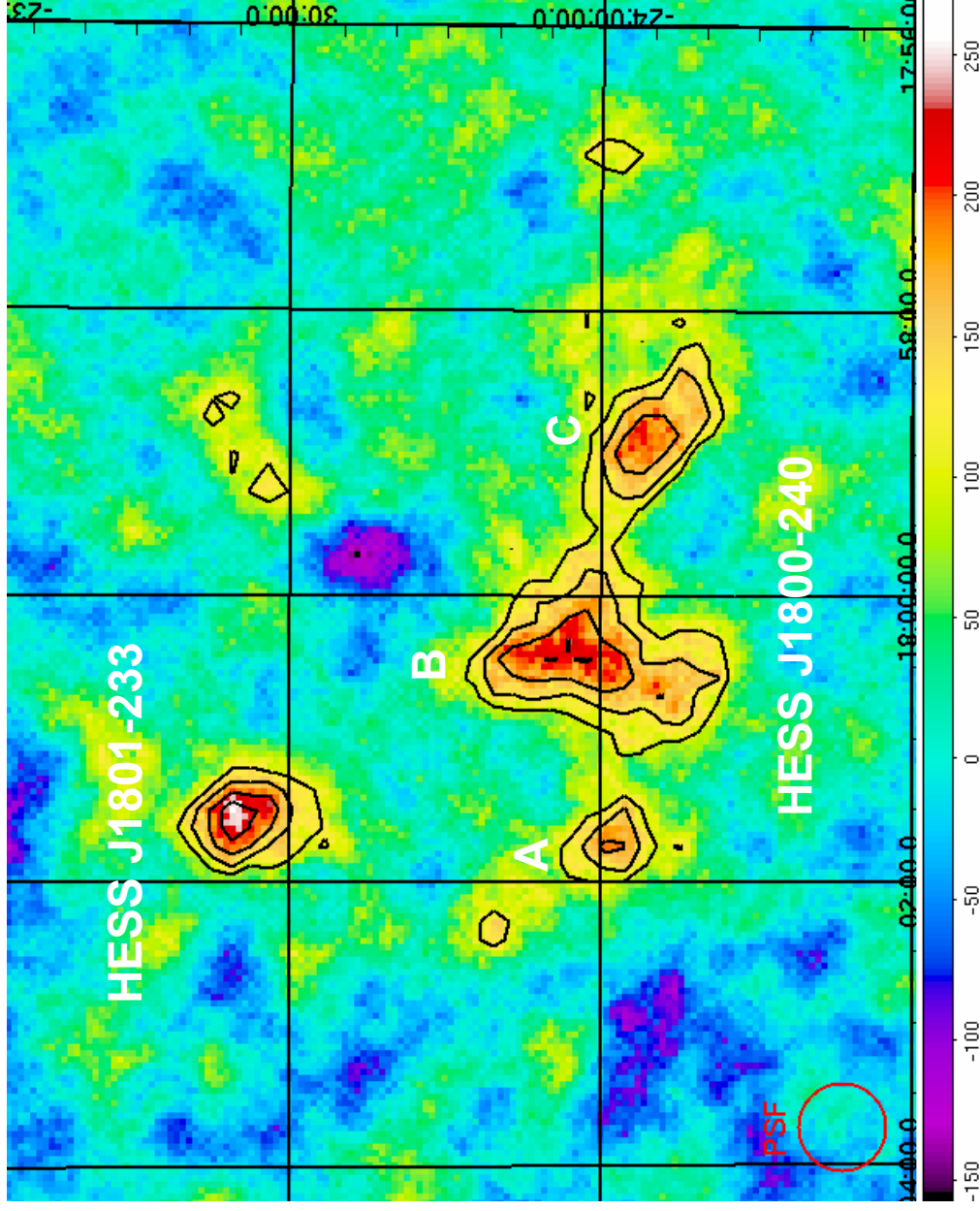


Image cuts  
> 60 p.e.

PSF:  
 $R = 0.07^\circ$   
at half max.

Exposure:  
50.3 hr.

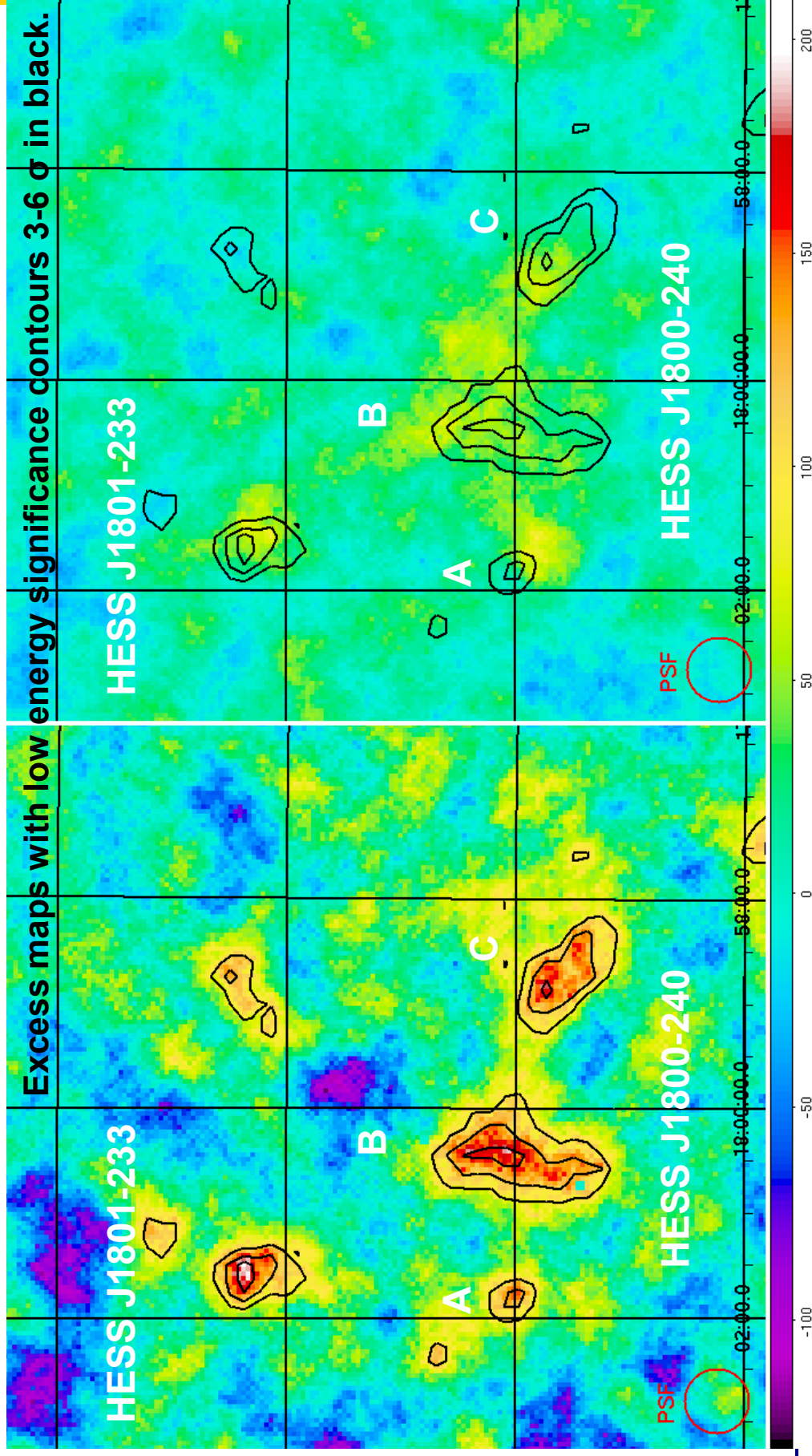
Map  
oversampling  
of  $0.07^\circ$ .

In black: 3-6  $\sigma$   
significance  
contours.

# Morphology seems Energy dependent

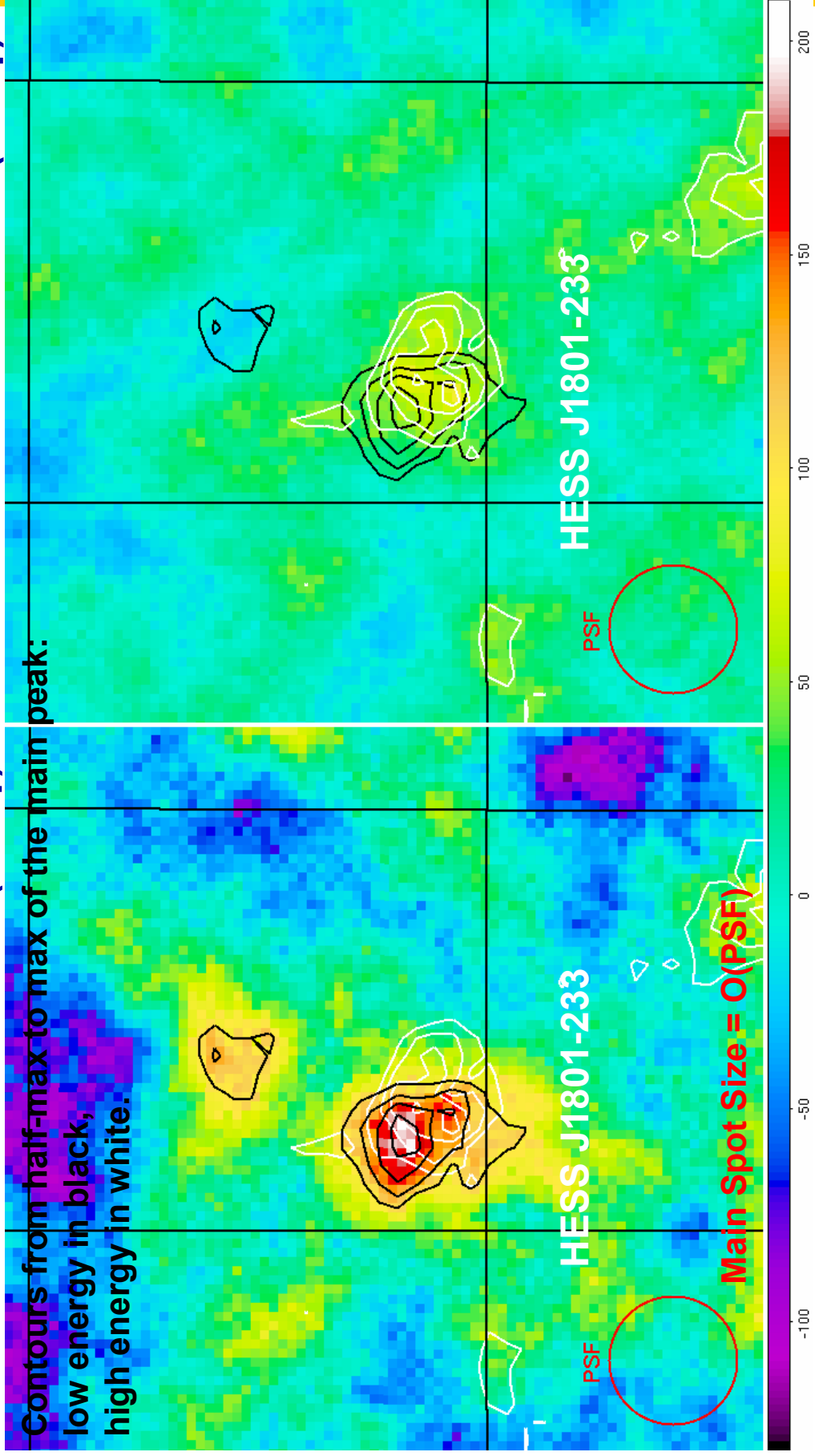
$E < 0.8 \text{ TeV}$

$E > 0.8 \text{ TeV}$

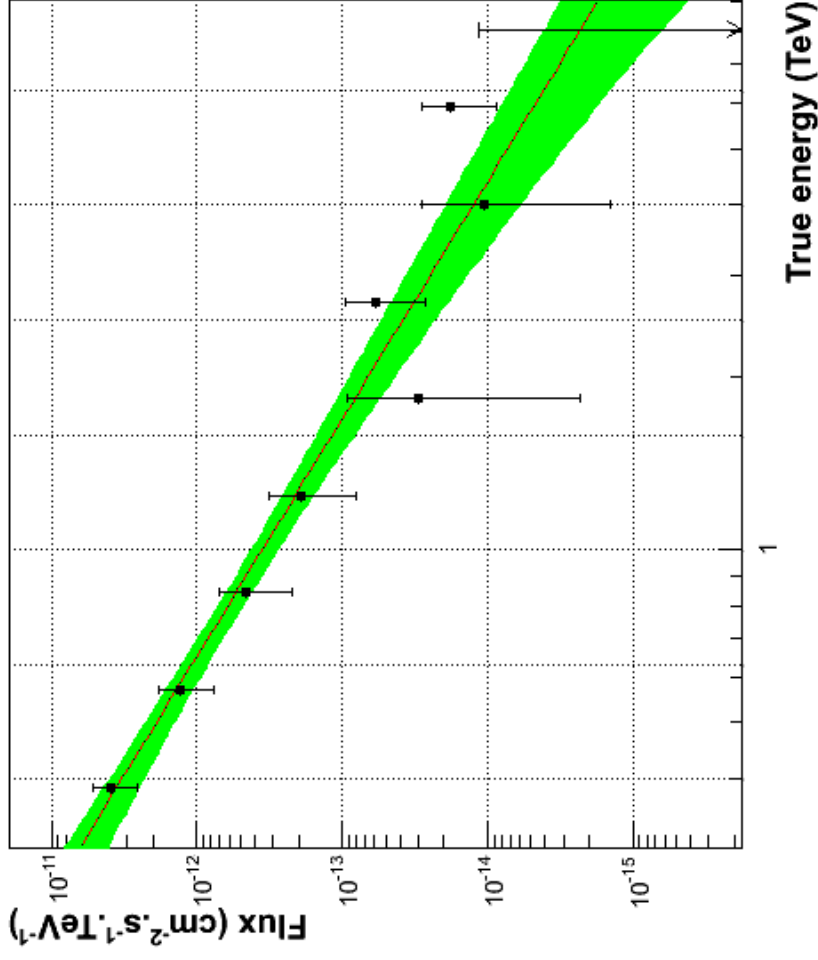


# HESS J1801-233: Excess Maps

$E < 0.8$  TeV: 7.7  $\sigma$  excess (375 y)     $E > 0.8$  TeV: 5.2  $\sigma$  excess (140 y)



# (Preliminary!) HESS J1801-233 Power Law Spectrum Fit



With « Model + Hillas analysis »,  
within 0.12°:

Spectral index  $2.4 \pm 0.3_{\text{stat}}$

Flux  $\Phi(E > 300 \text{ GeV})$

$= (1.3 \pm 0.3) \times 10^{-12} \text{ cm}^{-2} \text{ s}^{-1}$   
( $\approx 1\%$  Crab flux)

Flux  $\Phi(1 \text{ TeV}) \approx 4 \times 10^{-13} \text{ cm}^{-2} \text{ s}^{-1} \text{ TeV}^{-1}$

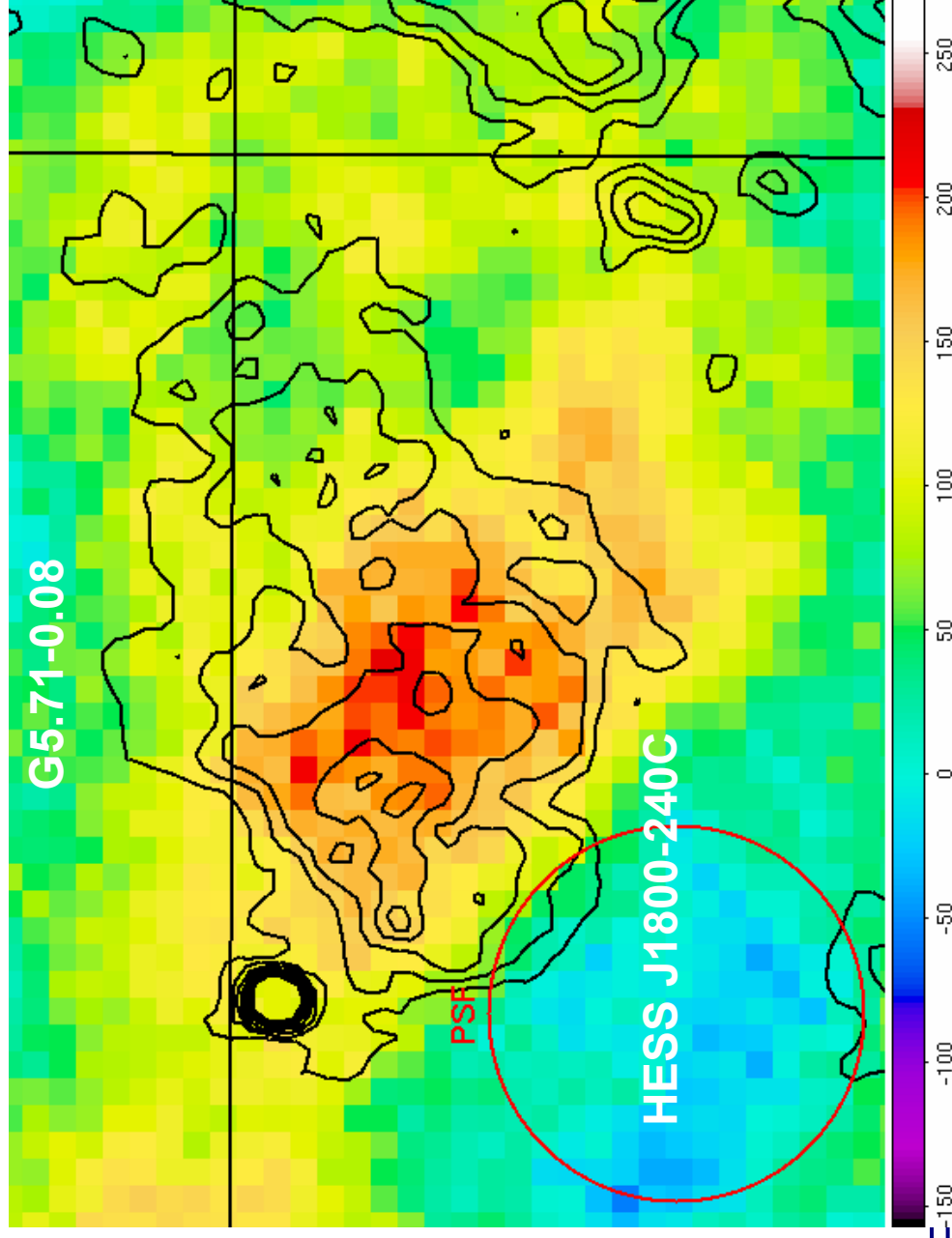
With Hillas analysis, within 0.2°:

Spectral index  $2.7 \pm 0.3_{\text{stat}}$

Flux  $\Phi(1 \text{ TeV}) \approx 10^{-12} \text{ cm}^{-2} \text{ s}^{-1} \text{ TeV}^{-1}$

# HESS J1800-240C

H.E.S.S. excess map with VLA observations at 90 cm (black contours) from C. L. BROGAN et al., ApJ 639, 2006. The H.E.S.S. excess coincides with the radio SNR candidate G5.71-0.08.

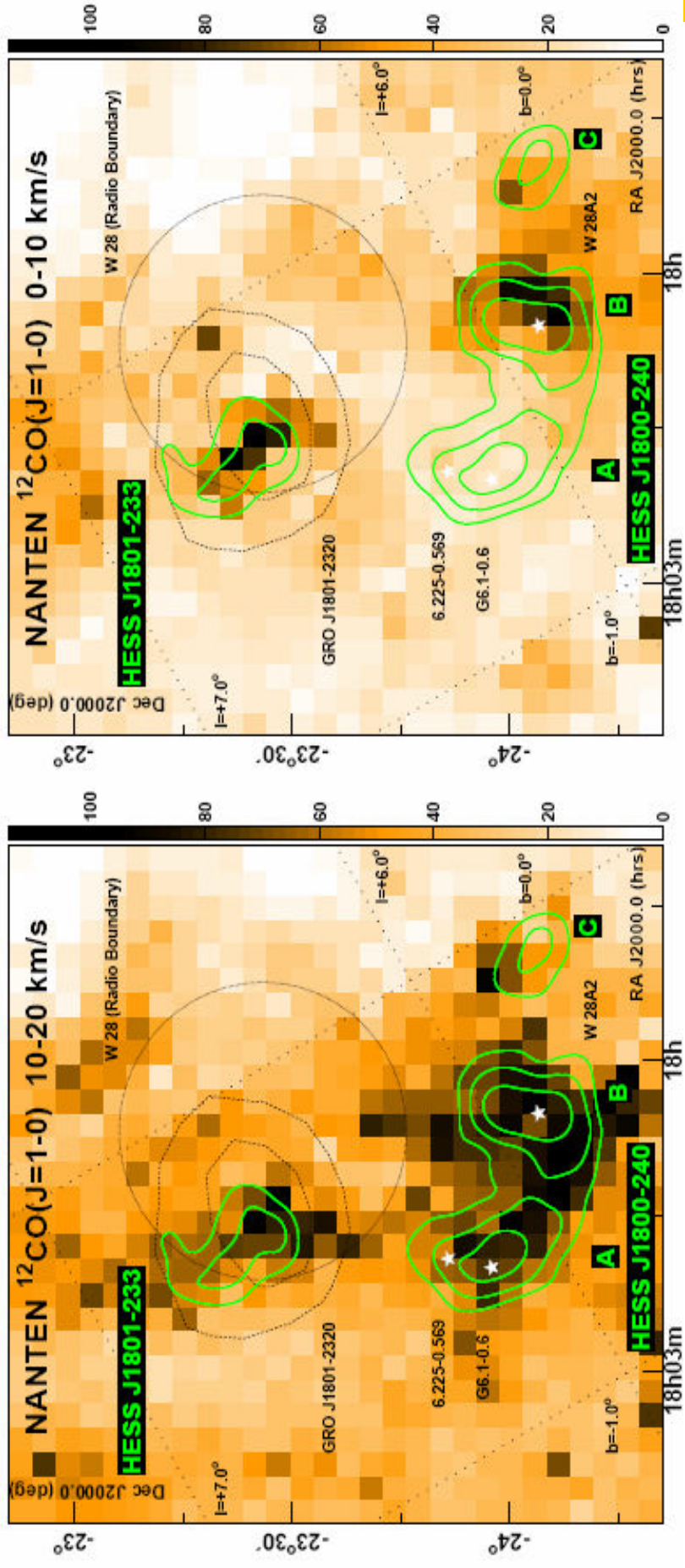


# Summary

- **HESS J1801-233**: the main spot is compact with a moderately hard spectral index ( $2.4 \pm 0.3_{\text{stat}}$ ). Another weaker spot is detected at  $4.7 \sigma$  but visible at low energy only, implying a softer energy spectrum (to be confirmed).
- **HESS J1800-240**: the overall morphology of this extended and complex emission region also appears to vary with energy.
- **HESS J1800-240C**: the compact TeV source is spatially coincident with the newly proposed SNR candidate G5.71-0.08.

# Observations of the W 28 Region

## NANTEN observations.



**In green: 4-6  $\sigma$  H.E.S.S. significance contours.**

[G. ROWELL, E. BRION, et al., 30th ICRC, 2007.]  
[F. AHARONIAN et al., submitted to A&A.]