

TeV Shells in the H.E.S.S. Galactic Plane Survey

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F. Brun, C. Deil, A. Donath, V. Marandon, R. Terrier (HGPS)

M. Capasso, D. Gottschall, G. Puehlhofer (New Shells)

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



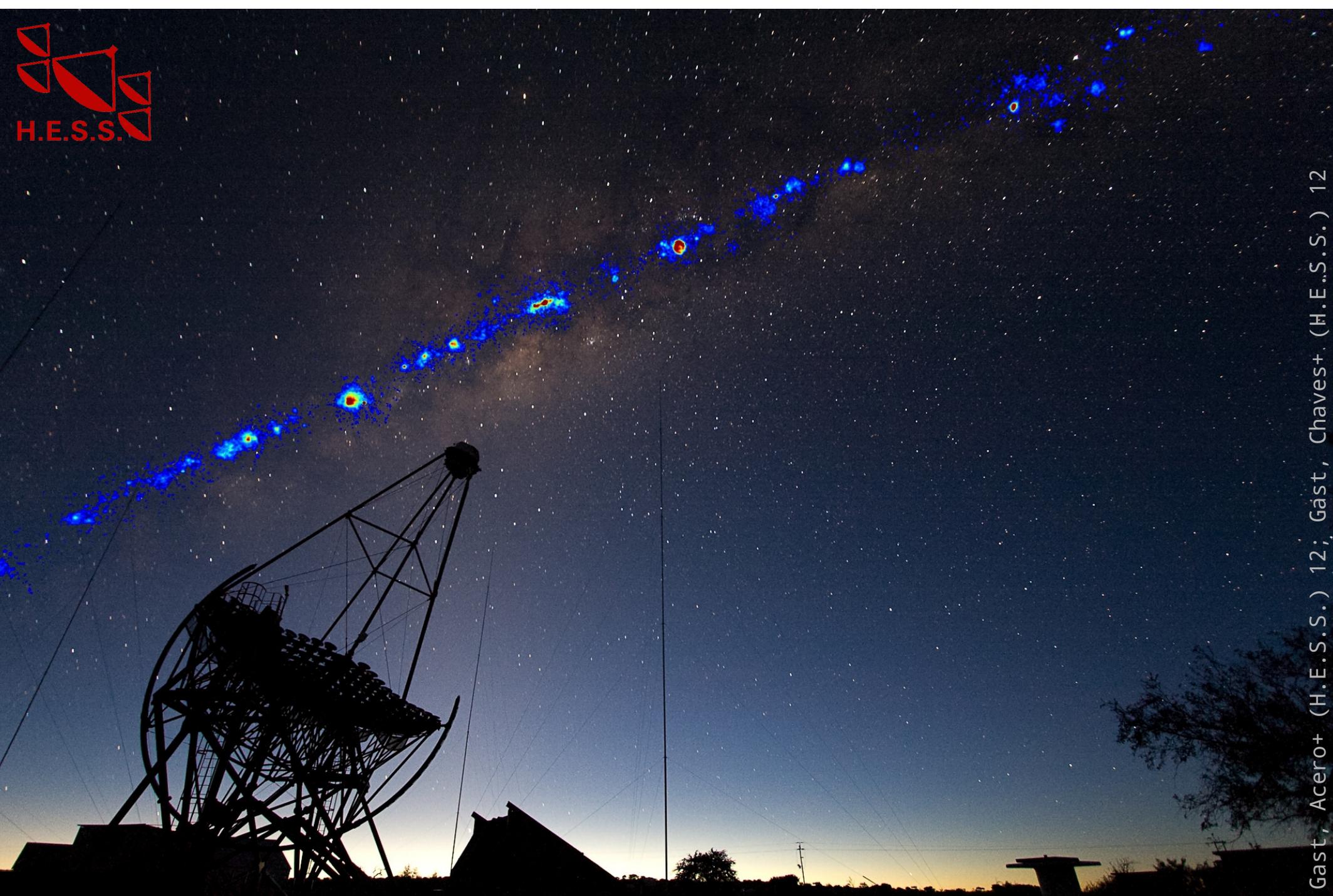
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Montpellier, France



The TeV Galactic plane from Namibia



The TeV Galactic plane from Namibia







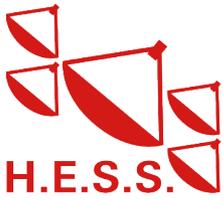
The 5-tel hybrid Cherenkov telescope array

4 12-m IACTs w/ recoated mirrors + 1 28-m IACT
(*camera electronics upgrade in progress*)

CT5: 2048 PMTs 614 m² 3.2° FoV $E_{\min} \sim 0.02$ TeV $f = 38$ m

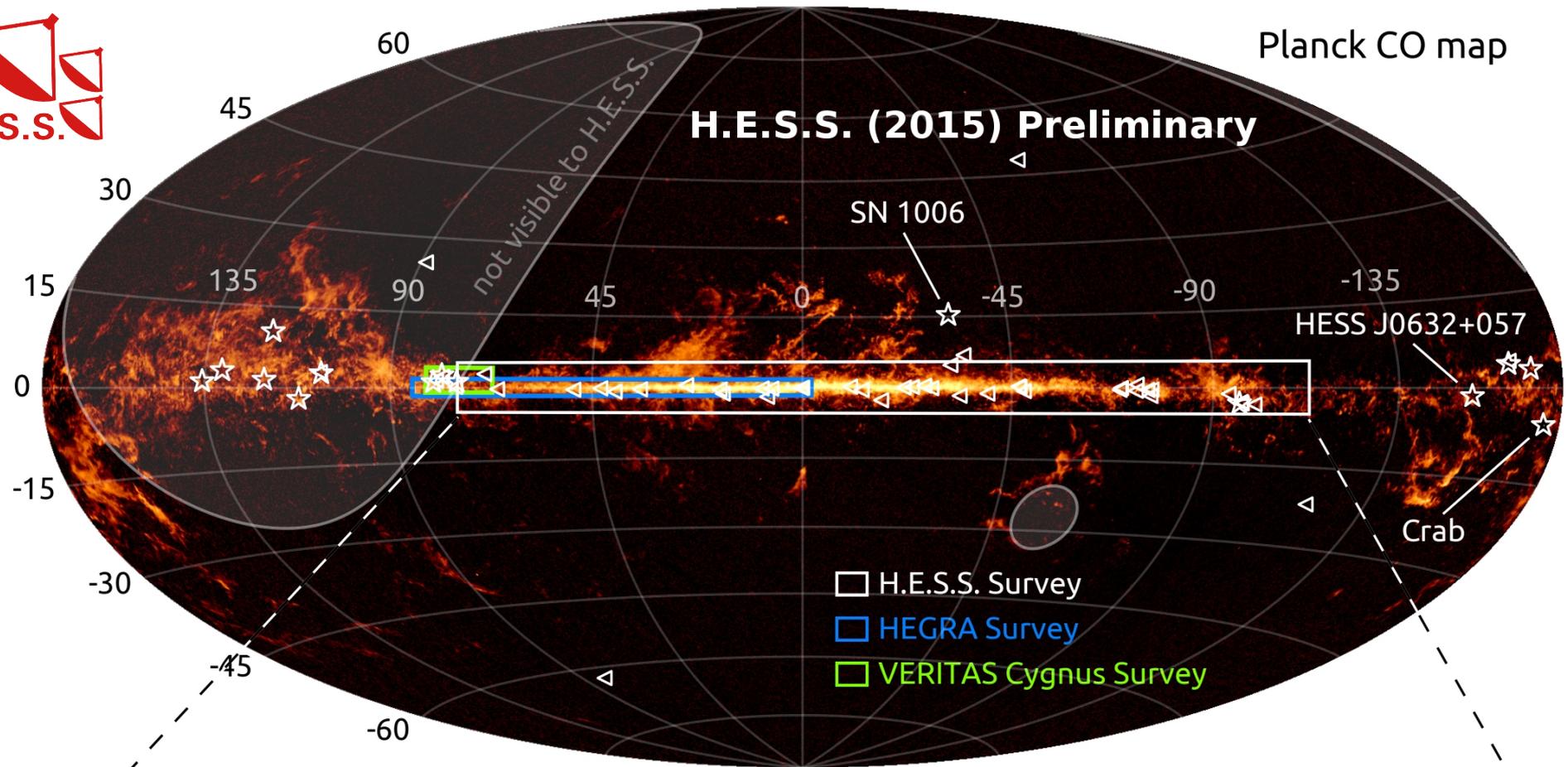


vs. 5.0° FoV (CT1-4)



Planck CO map

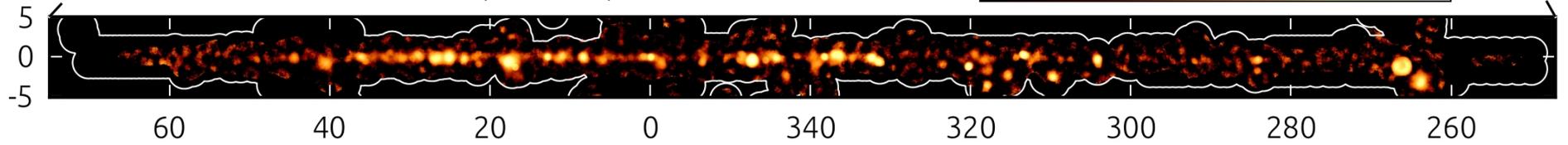
H.E.S.S. (2015) Preliminary

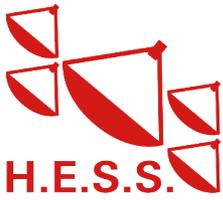


- H.E.S.S. Survey
- HEGRA Survey
- VERITAS Cygnus Survey



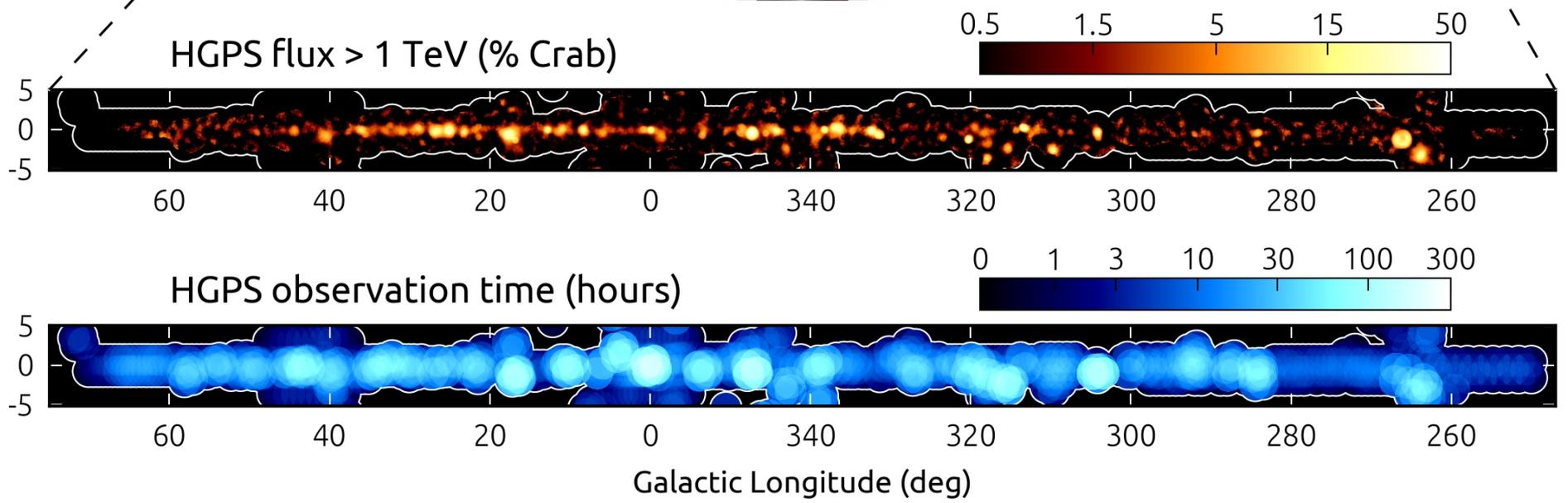
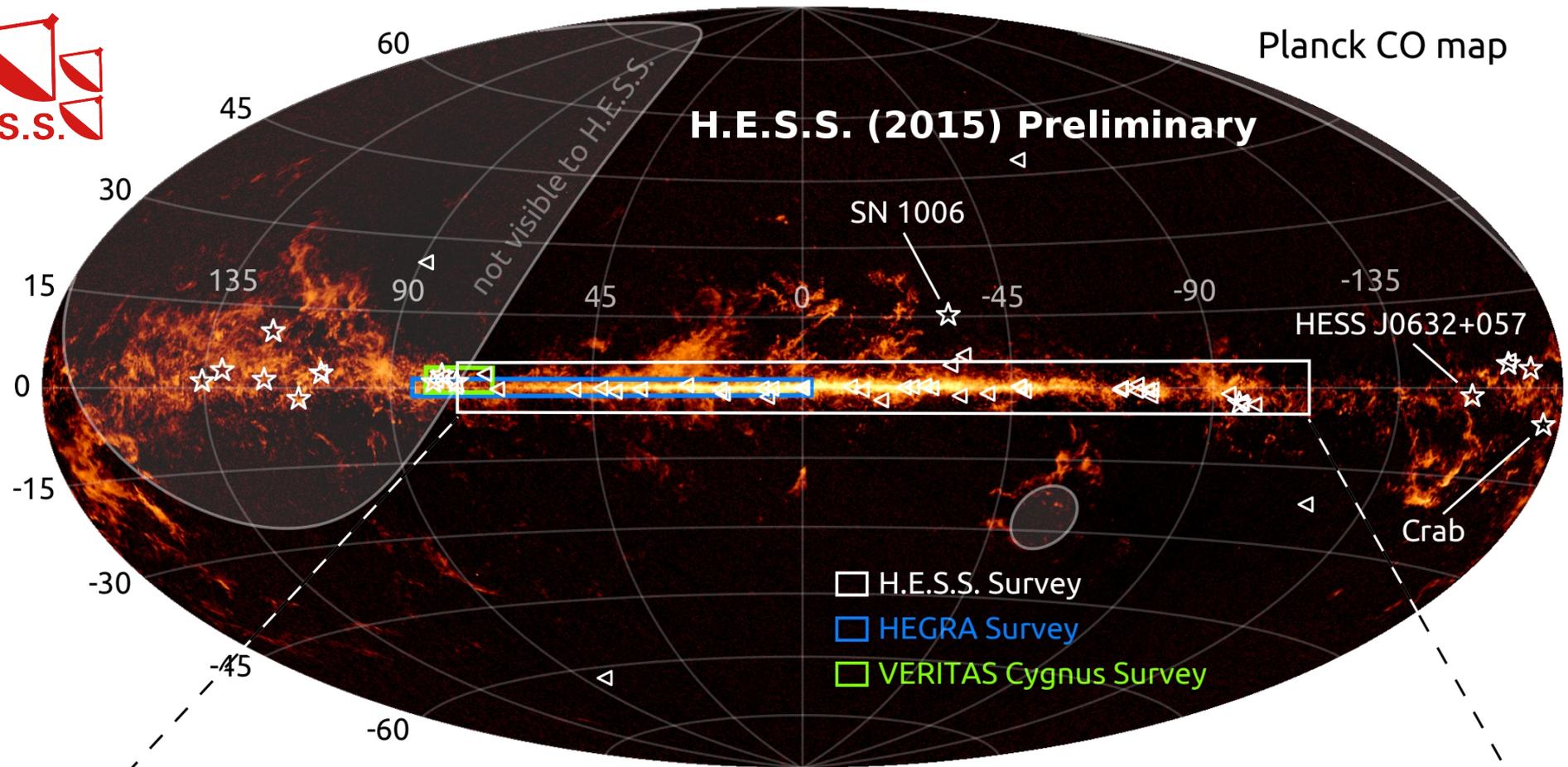
HGPS flux > 1 TeV (% Crab)





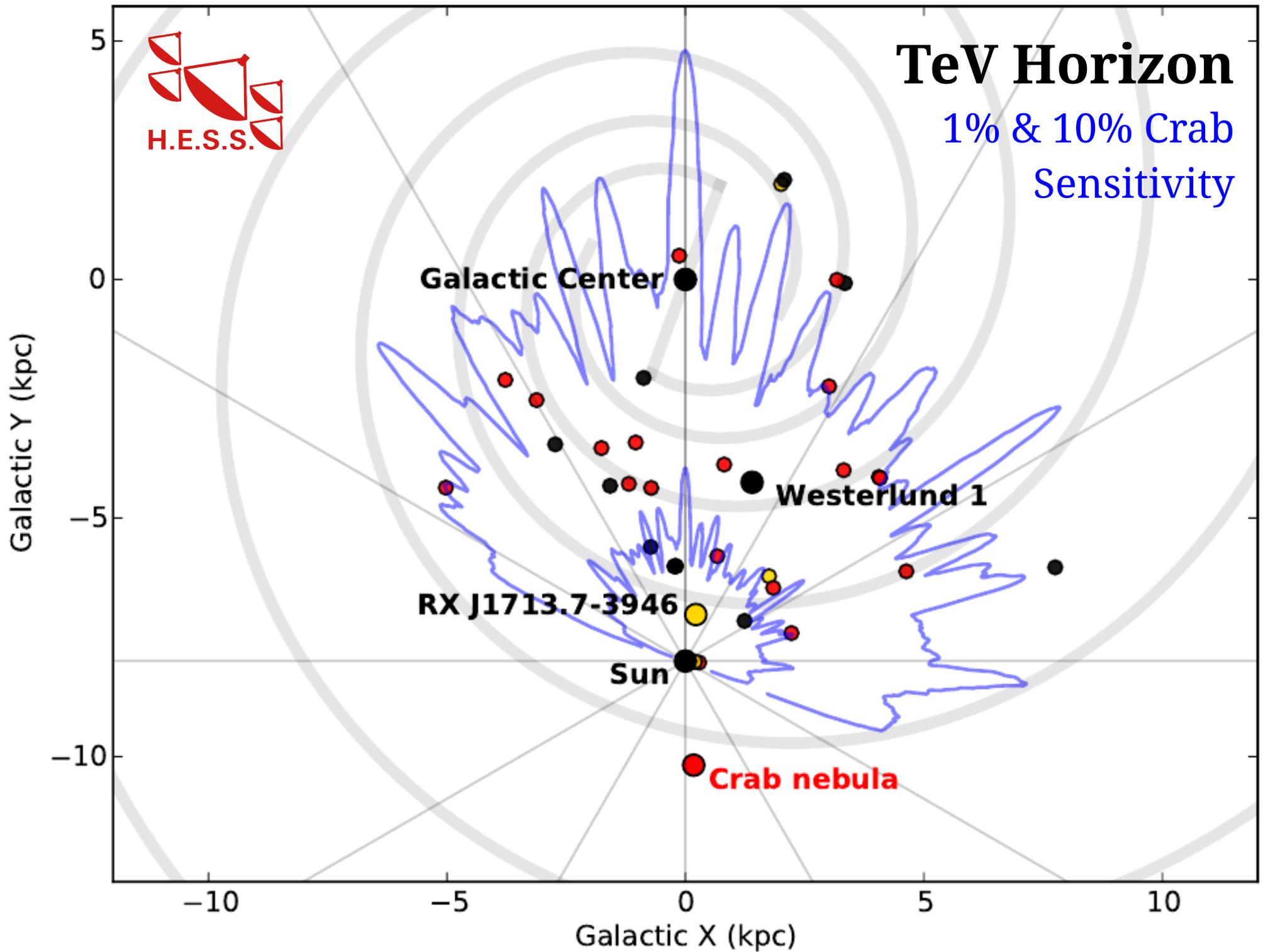
Planck CO map

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





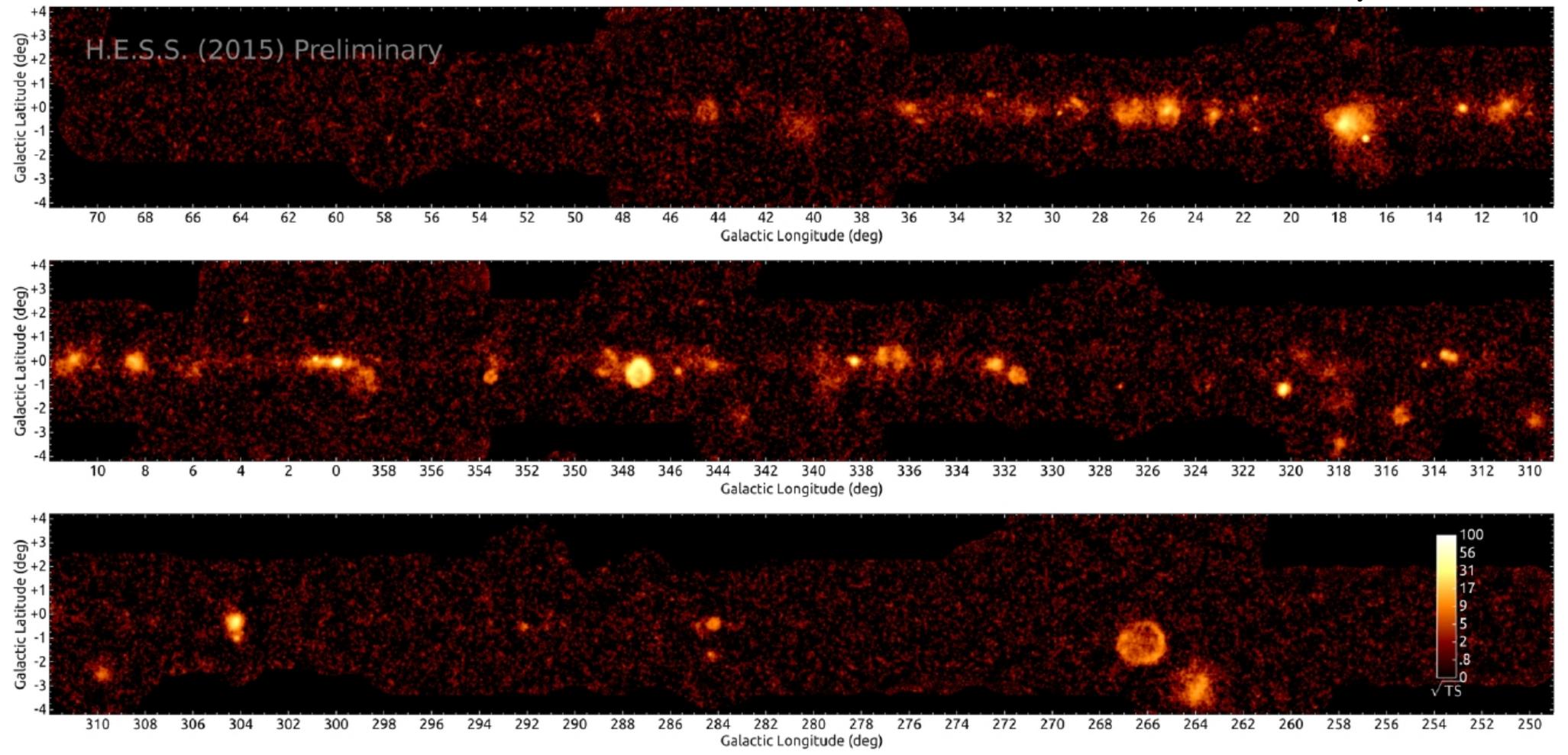
TeV Horizon





γ -ray significance

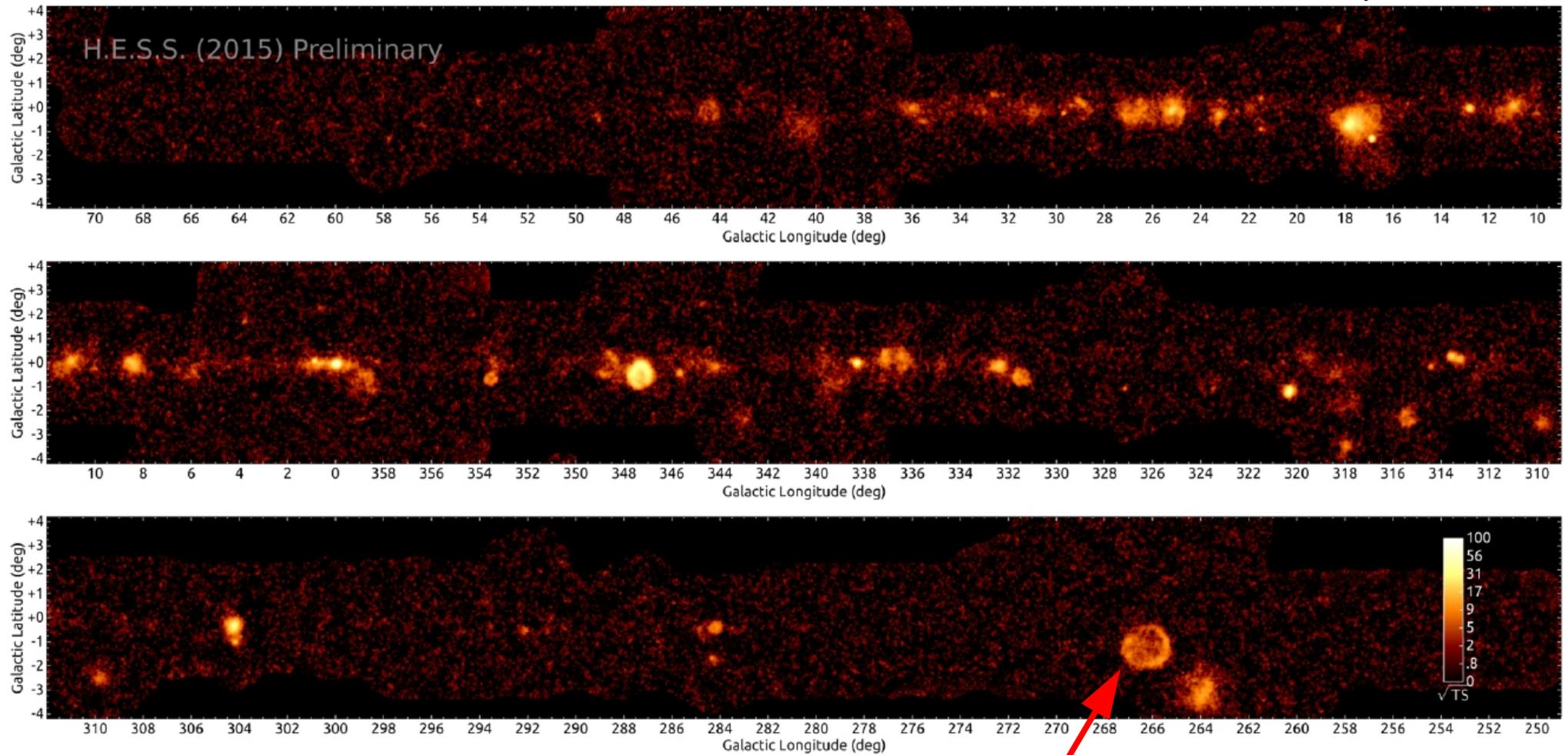
$E_\gamma > 1$ TeV





γ -ray significance

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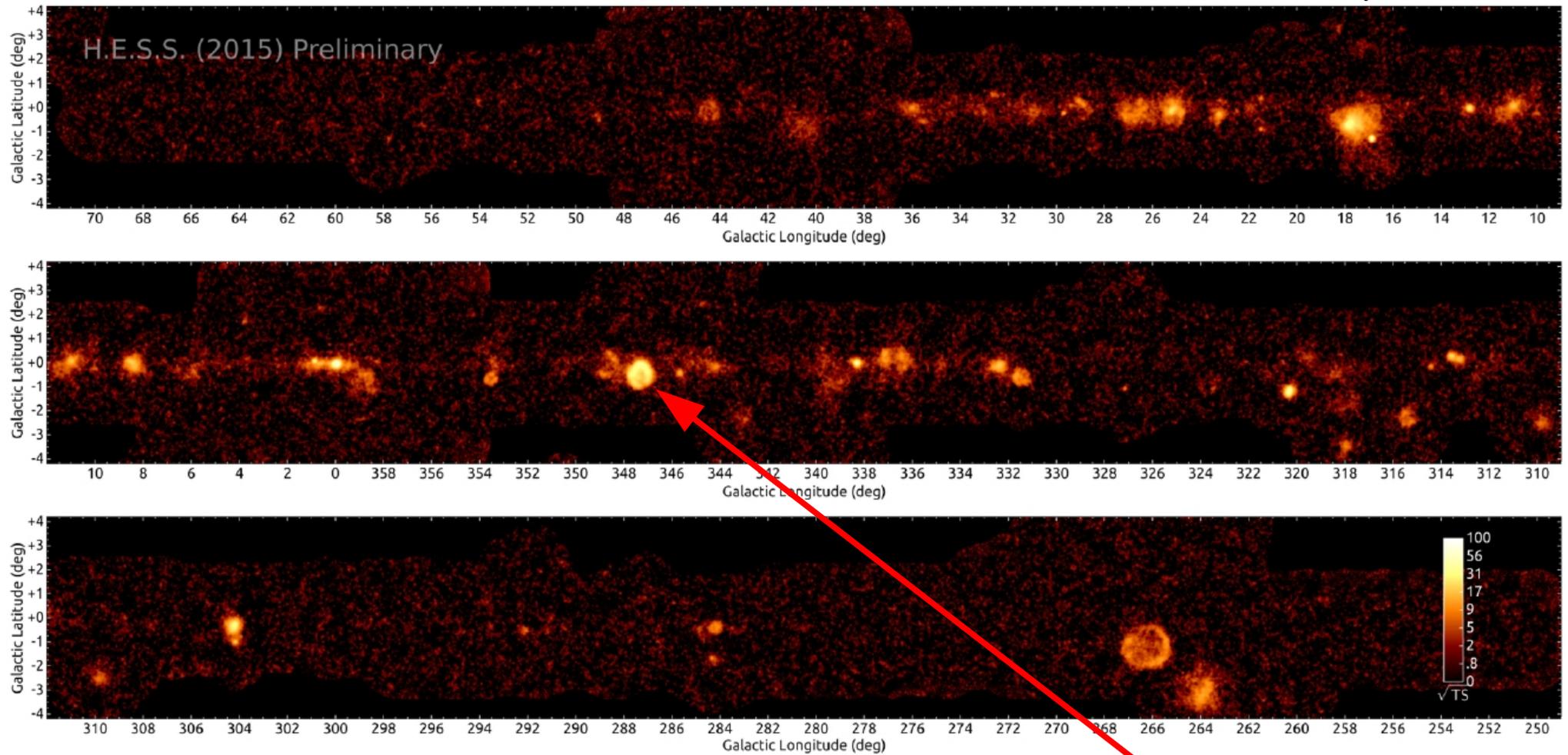


See poster **Sushch+** (H.E.S.S.) (S1.21) – **Vela Jr SNR**
Deep H.E.S.S. Observations of the SNR RX J0852.0-4622



γ -ray significance

$E_\gamma > 1$ TeV

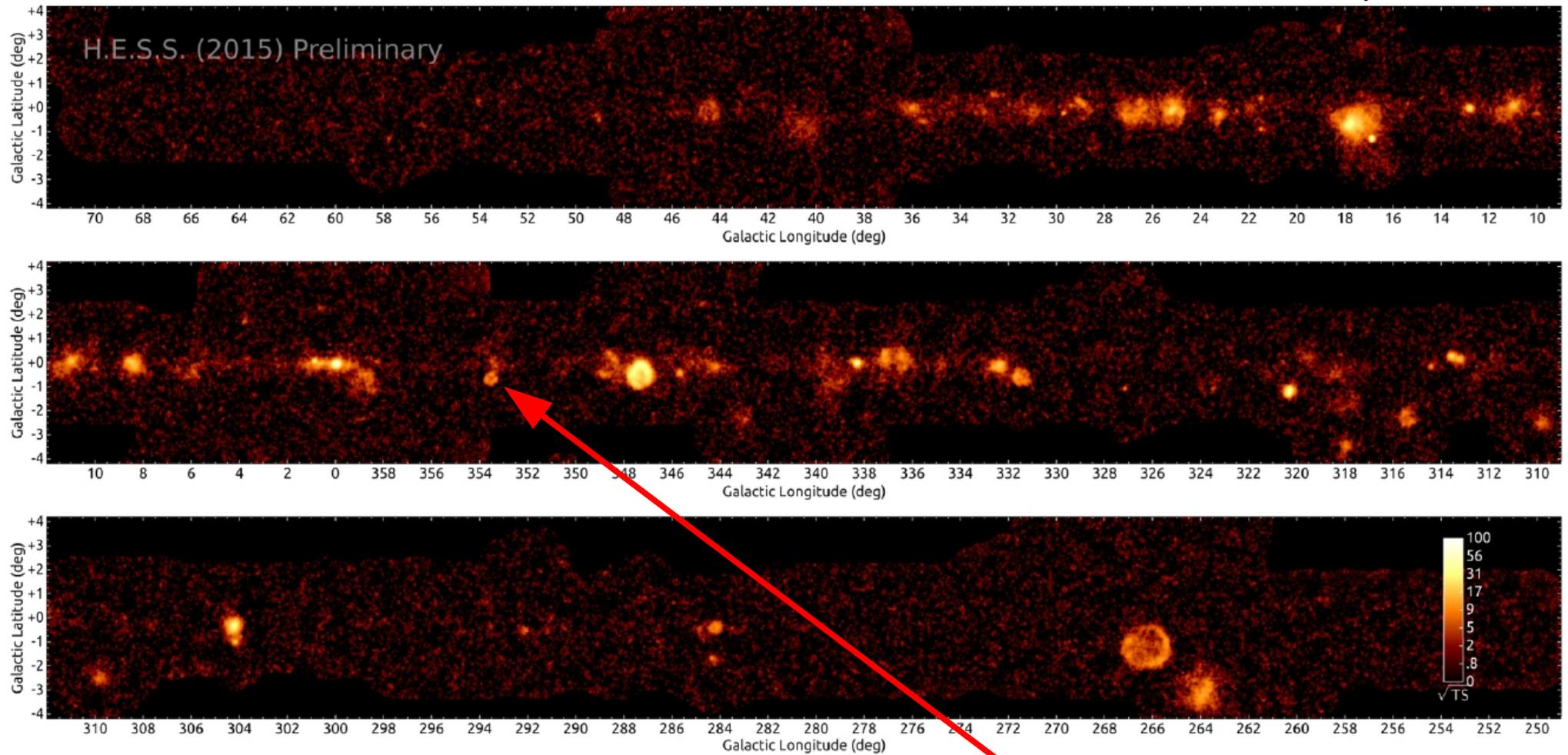


See poster **Puehlhofer+** (H.E.S.S.) (S1.17) – **RX J1713** SNR
New constraints on the TeV SNR shells RX J1713.7-3946 & HESS J1731-347



γ -ray significance

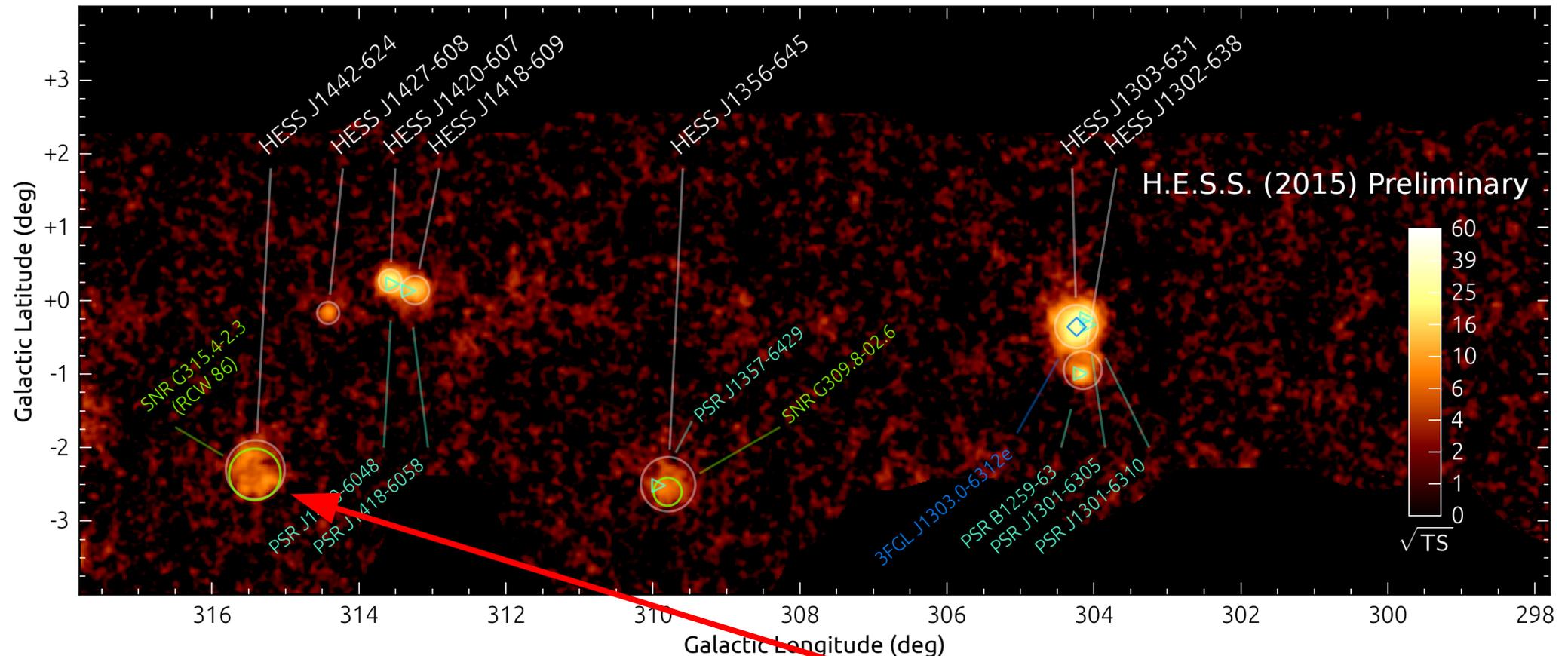
$E_\gamma > 1$ TeV



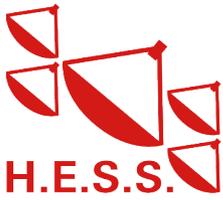
See poster **Puehlhofer+** (S1.17) – **HESS J1731 SNR**
New constraints on the TeV SNR shells RX J1713.7-3946 & HESS J1731-347

γ -ray significance (zoom-in)

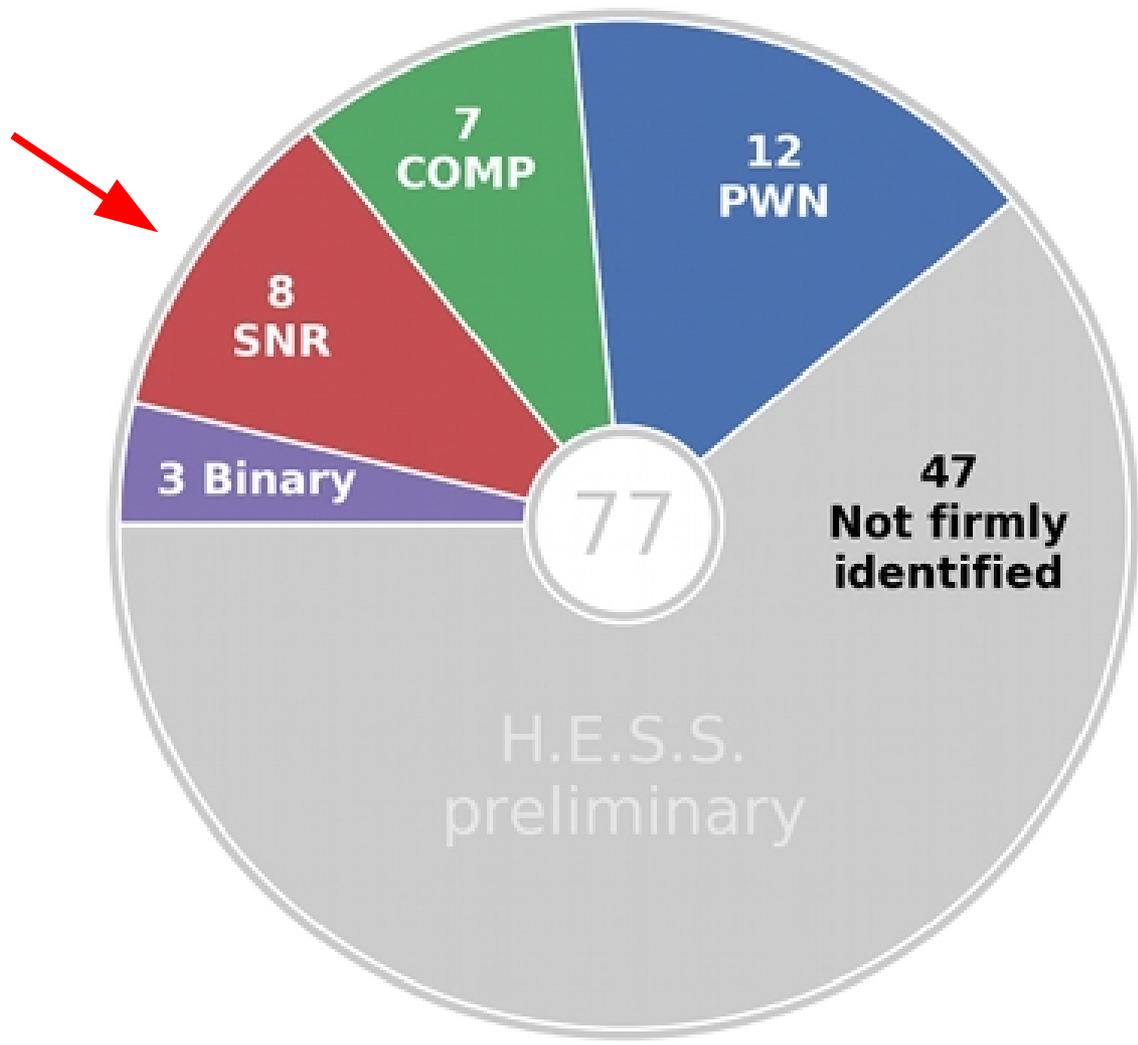
Full-detail TeV sky images, catalog, & MWL associations



See paper Abramowski+ (H.E.S.S.) 2016 – **RCW 86** SNR
Detailed spectral & morphological analysis of the shell type SNR RCW 86



HGPS firm identifications



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

* doesn't include SN 1006
 (outside HGPS)

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



HGPS firmly identified SNRs

HESS J0852–463	Vela Junior	SNR	Morphology
HESS J1442–624	RCW 86	SNR	Morphology
HESS J1534–571	G323.7-01.0	SNR	Morphology
HESS J1713–397	RX J1713.7–3946	SNR	Morphology
HESS J1718–374	G349.7+0.2	SNR	Position
HESS J1731–347	G353.6–0.7	SNR	Morphology
HESS J1801–233	W 28	SNR	Position
HESS J1911+090	W 49B	SNR	Position

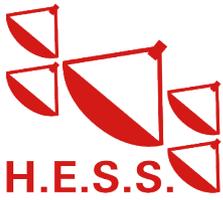
5 / 8 firm IDs → shell-like in TeV gamma-rays



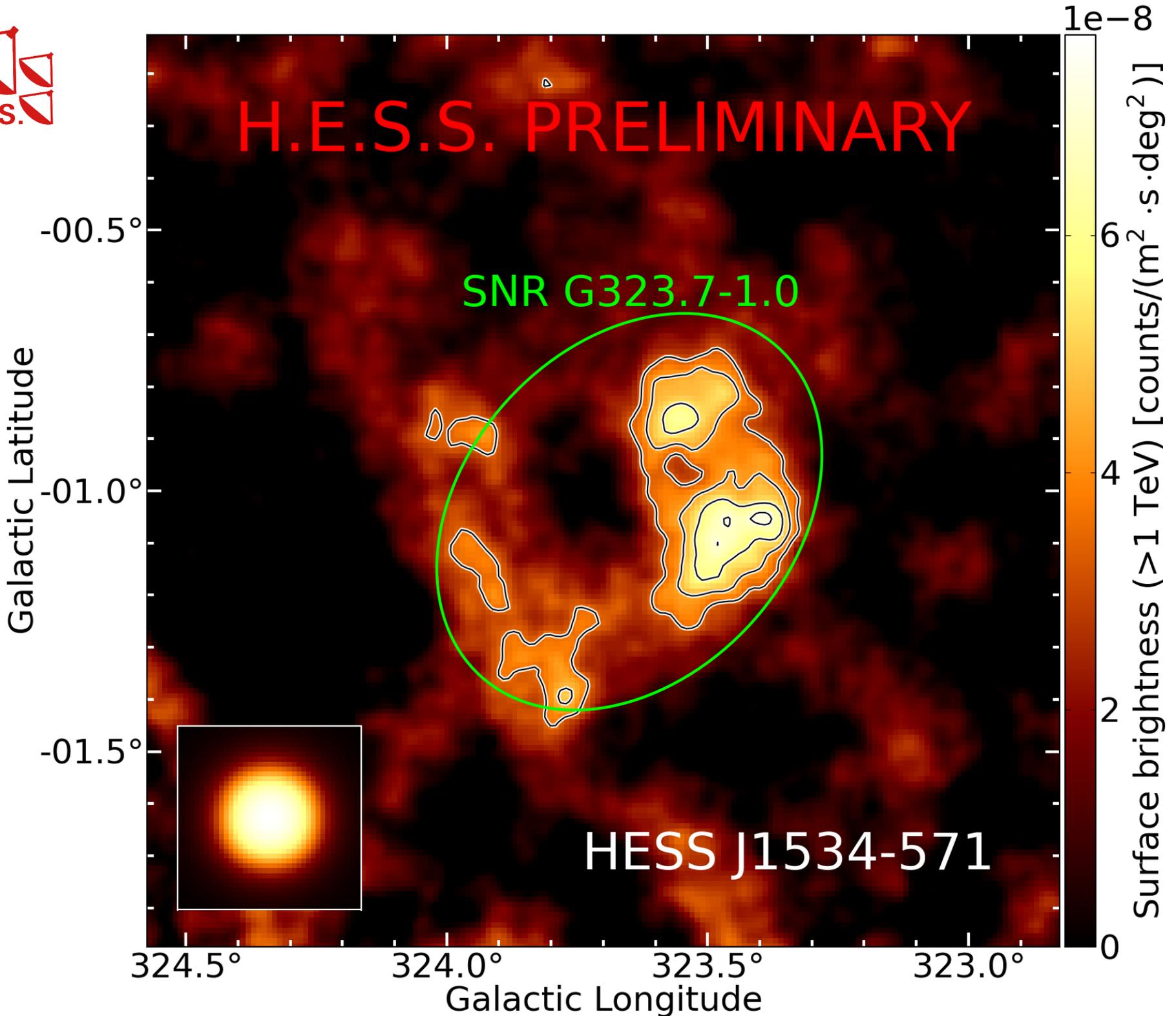
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H.E.S.S. PRELIMINARY





HESS J1534-571

Discovered during a systematic search for shell-like TeV morphologies in the HGPS

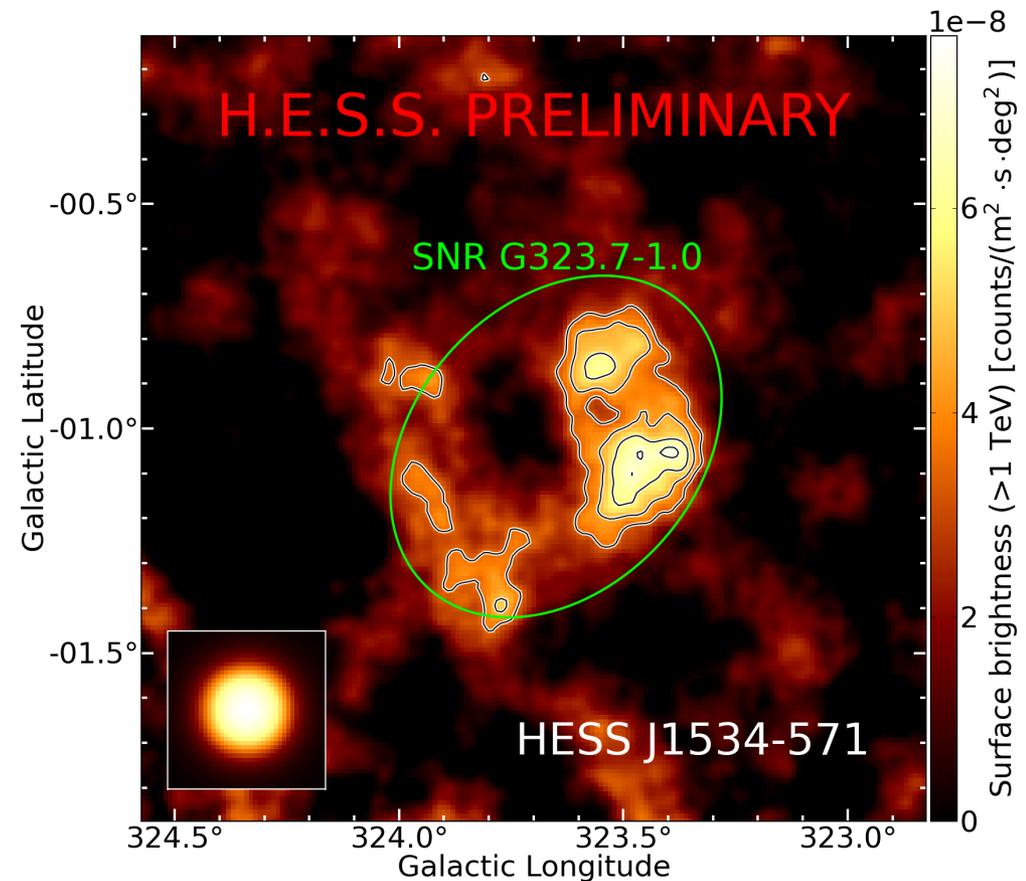
Target morphology:

Azimuthally-symmetric, homogeneous, projected 3D shell

Null hypothesis:

2D symmetric Gaussian

$$p = 6.4 \times 10^{-3}$$





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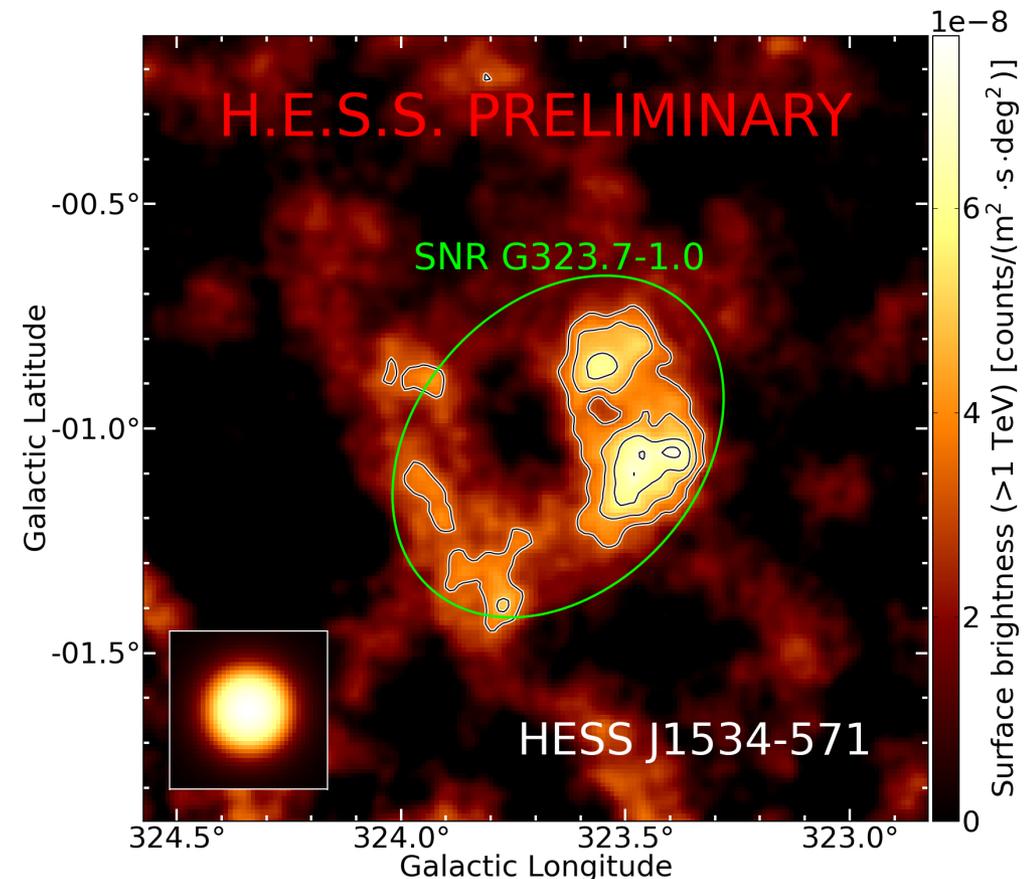
VHE data

57 h live-time

9.3 σ significance

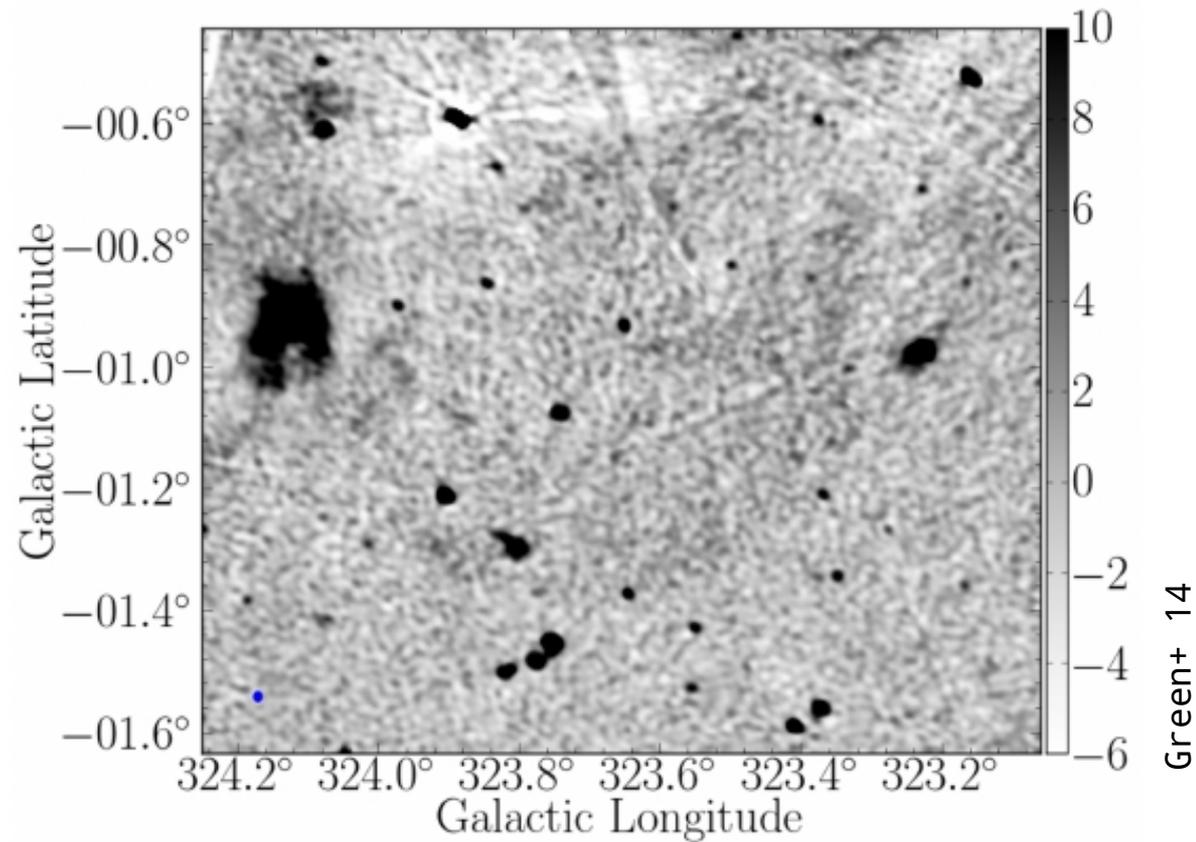
outer radius $\sim 0.40^\circ$

(spectrum will be provided in paper in preparation)



New radio SNR *candidate* discovered during MGPS-2

843 MHz
51 x 38 arcmin
“extremely faint oval region”
6 mJy/beam
no obvious match w/ MIR





G323.7-1.0

New radio SNR *candidate* discovered during MGPS-2

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51 x 38 arcmin

“extremely faint oval region”

6 mJy/beam

no obvious match w/ MIR

X-ray dark

No *ROSAT* counterpart

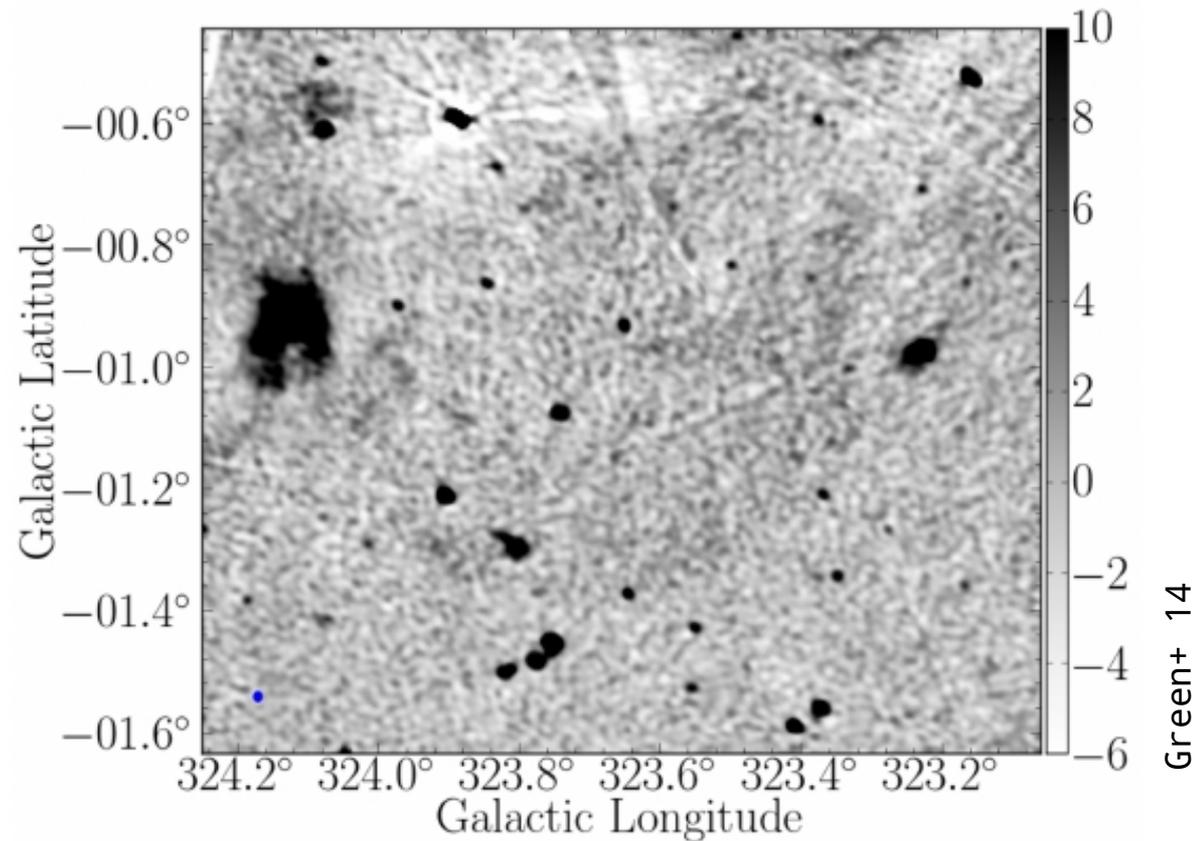
($E < \sim 2.4$ keV)

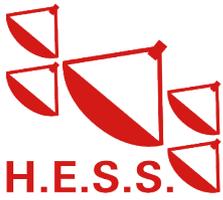
Follow-up *Suzaku*

observations (PI: Bamba)

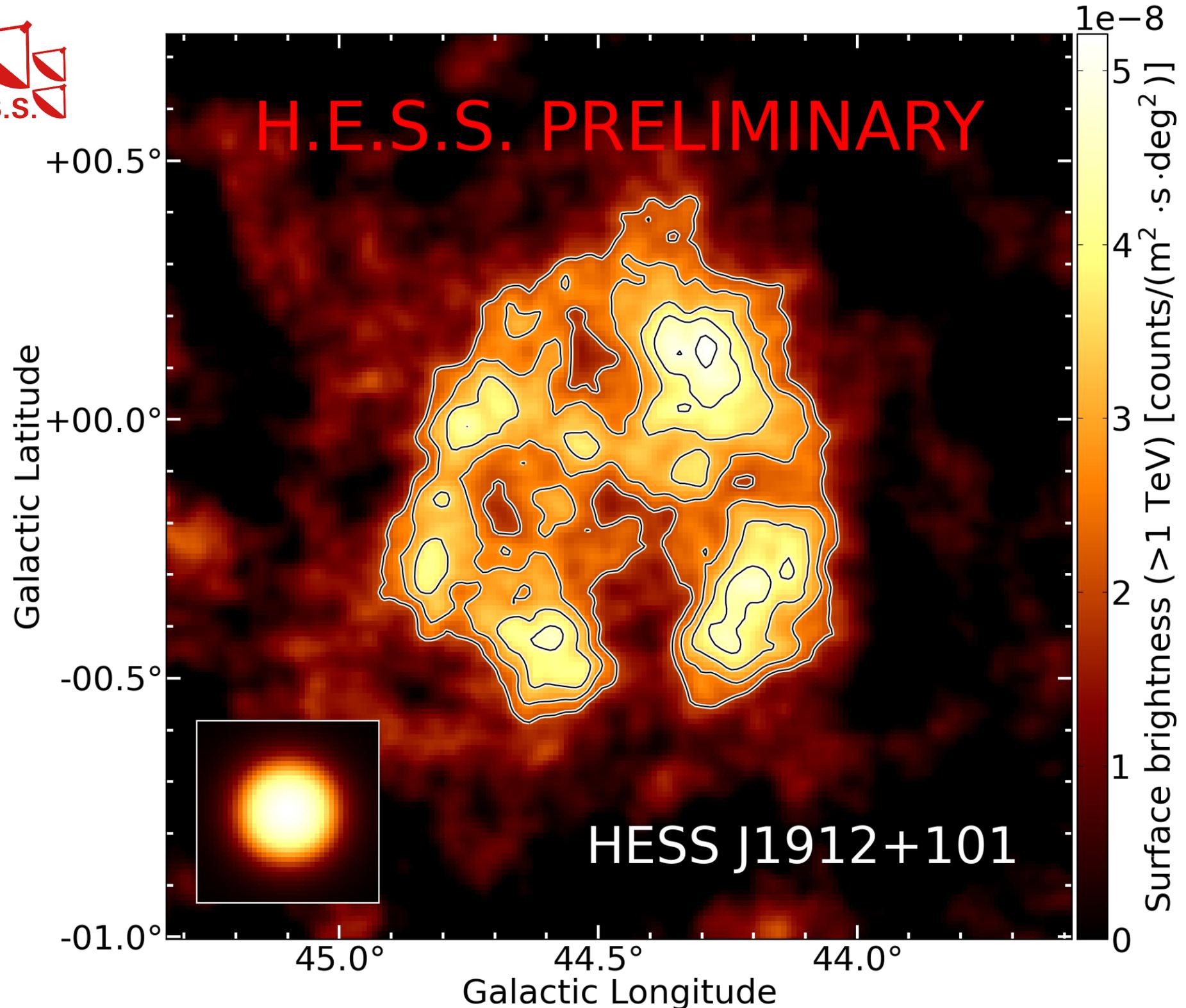
4 x 40 ks

Excludes non-thermal X-ray emission
at current X-ray satellite sensitivity level





H.E.S.S. PRELIMINARY





HESS J1912+101

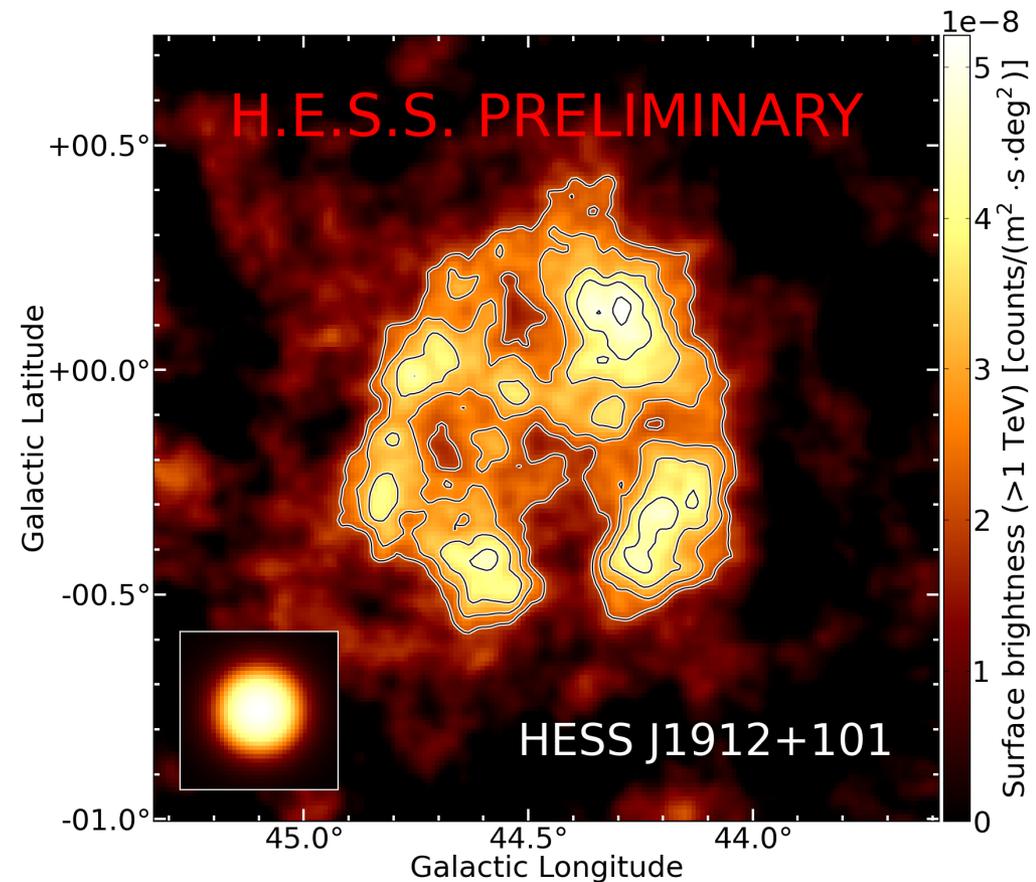
Previously discovered (2009) but suspected to be PWN

Azimuthally-symmetric, homogeneous, projected 3D shell
 $P = 1.7 \times 10^{-6}$ (vs Gaussian)

VHE data

122 h (6x previous dataset)
17 σ significance
outer radius $\sim 0.49^\circ$

(spectrum will be provided in
paper in preparation)





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Previously discovered (2009) but suspected to be PWN

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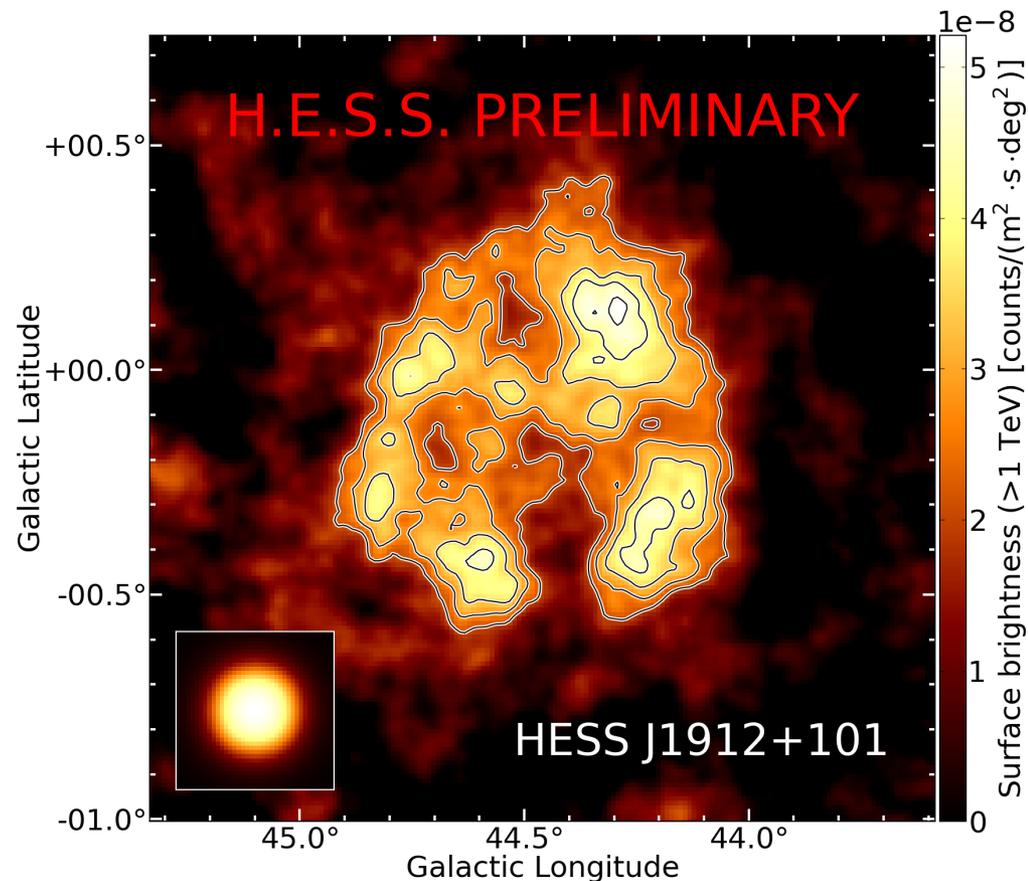
No radio counterpart

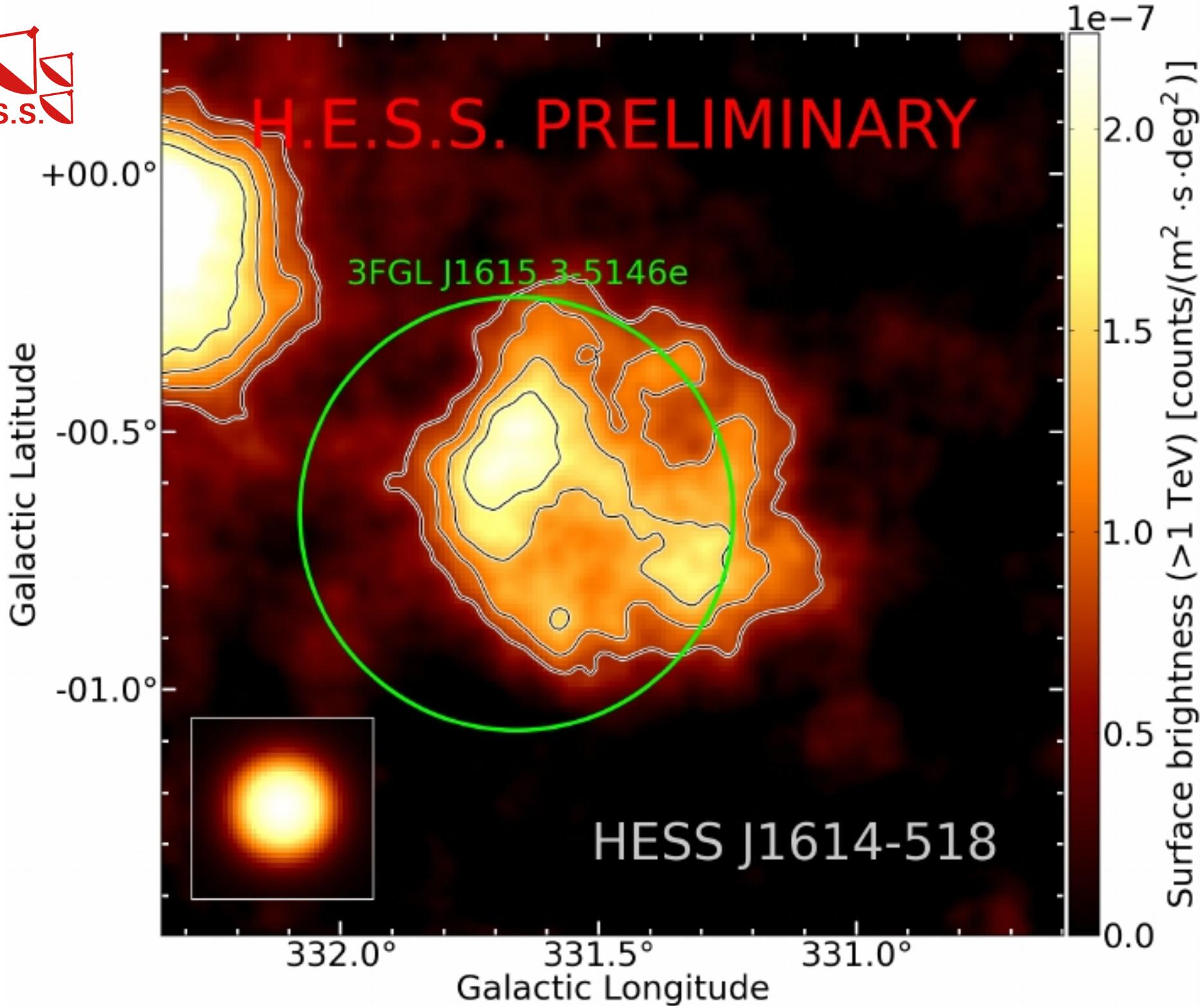
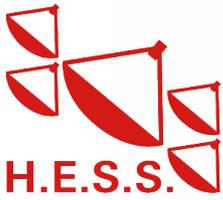
(e.g. not covered by MGPS-2, FIRST)

Energetic PSR also complicates firm ID

(e.g. but not known PWN either)

X-rays uncertain







HESS J1614-518

Previously discovered (2006) very bright unID source

Azimuthally-symmetric, homogeneous, projected 3D shell
 $P = 3.1 \times 10^{-6}$ (vs Gaussian)

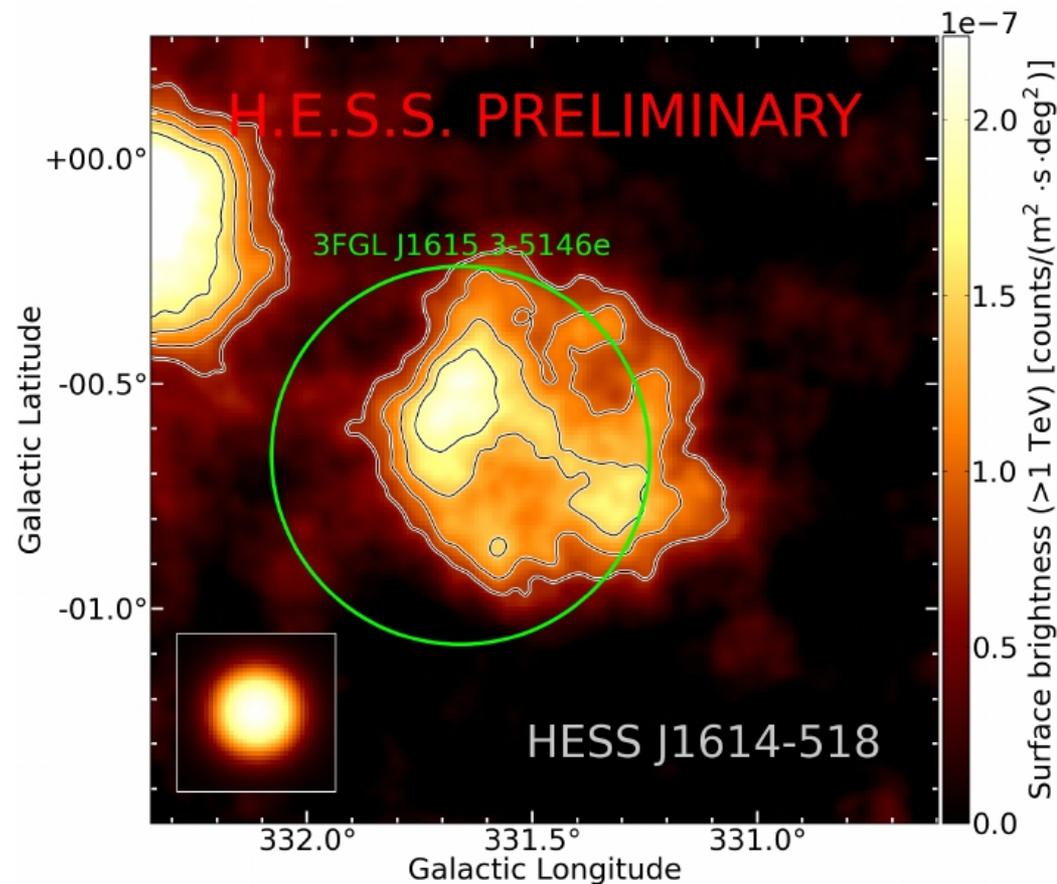
VHE data

34 σ significance
outer radius $\sim 0.42^\circ$

(spectrum will be provided in
paper in preparation)

GeV emission

Lower E counterpart
3FGL & 2FHL extended GeV source
(Acero+15) *Fermi*/LAT





Summary

Decade-long H.E.S.S. I Galactic Plane Survey completed

Legacy paper in preparation, close to submission

Final catalog, high-level FITS data release ready, incl. spectra

16 new source discoveries & a few new source candidates

MWL associations & firm IDs, incl. shell SNRs

Coupled w/ population studies (SNRs, PWNe) & new TeV shells

H.E.S.S. still discovering new shell-type SNRs via TeV γ -rays

HESS J1534-571

→ matching radio counterpart G323.7-1.0

→ no non-thermal X-rays: suggests emission dominantly hadronic

HESS J1912+101

→ new SNR candidate

HESS J1614-518

→ new SNR candidate

→ promising GeV counterpart