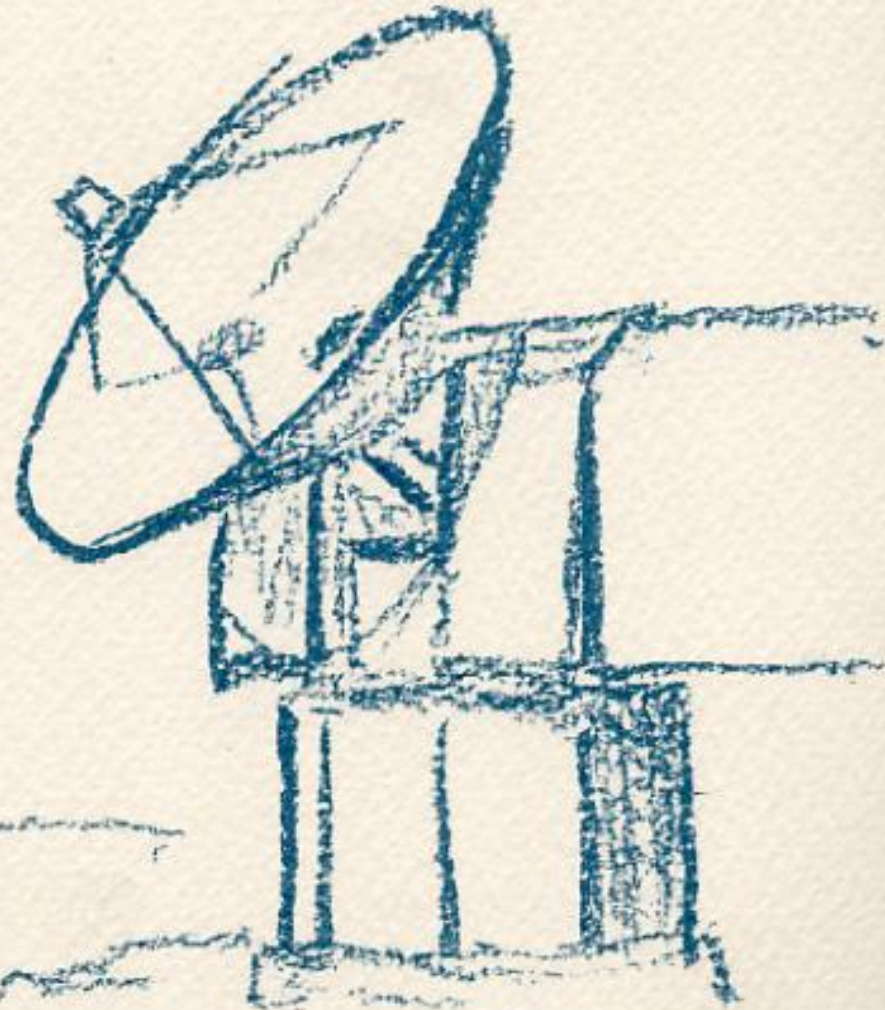


Molecular clouds and gamma ray emission: Young TeV γ -ray SNRs

Yasuo Fukui
Nagoya University
Southern Observatories



AGILE 5th yr meeting
April 16-17, 2012
ESRIN, Frascati

Y.F.

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Two young TeV γ -ray SNRs, 1600-3000yrs, non-thermal X rays:

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If hadronic, **target ISM protons correspond to γ rays.**

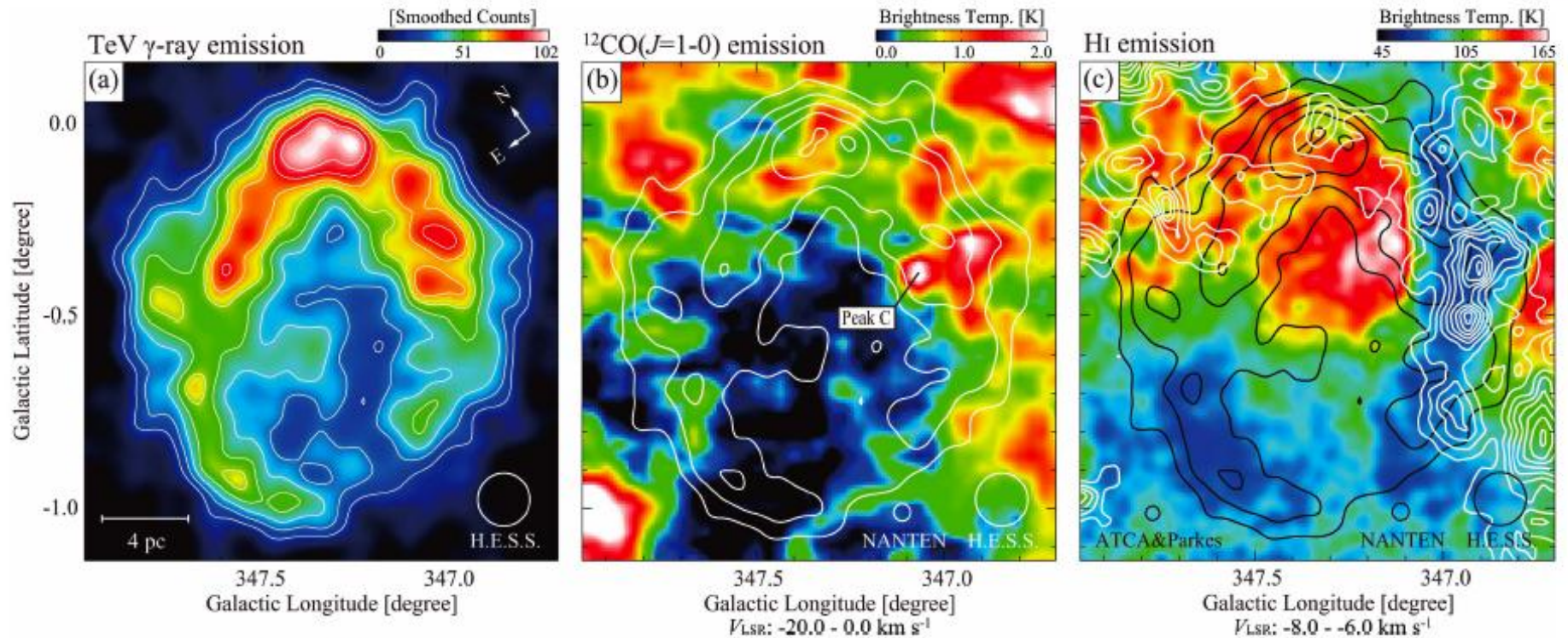
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Collaborators

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- HESS team: F. Aharonian, G. Rowell +
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TeV γ -ray SNR RXJ1713

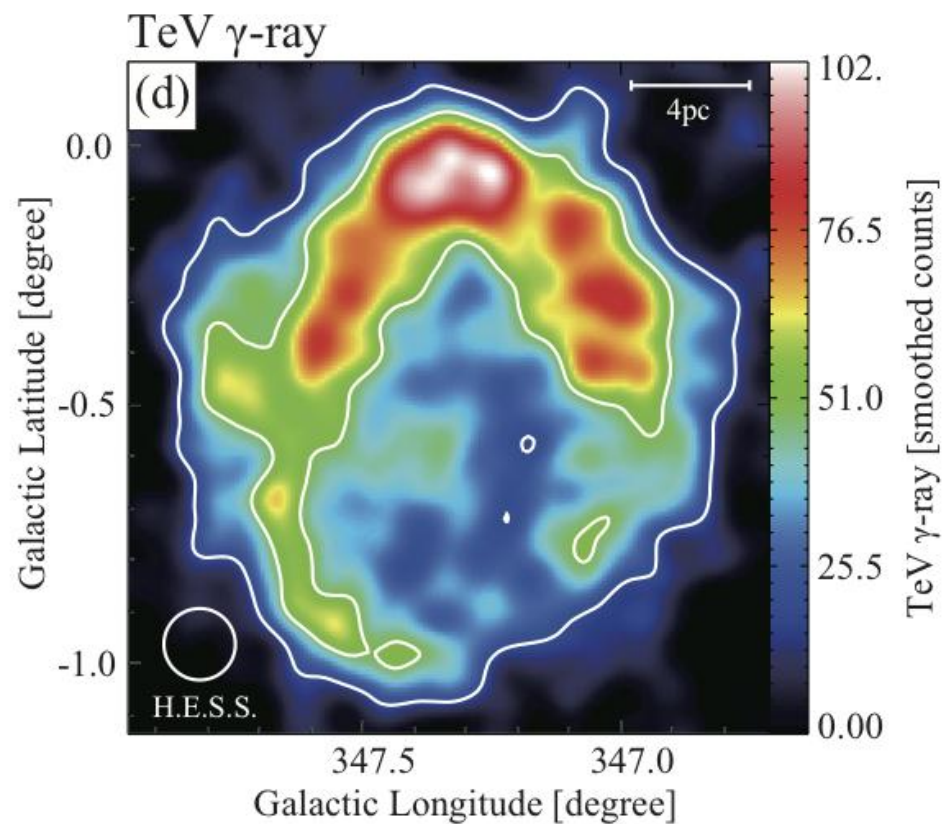
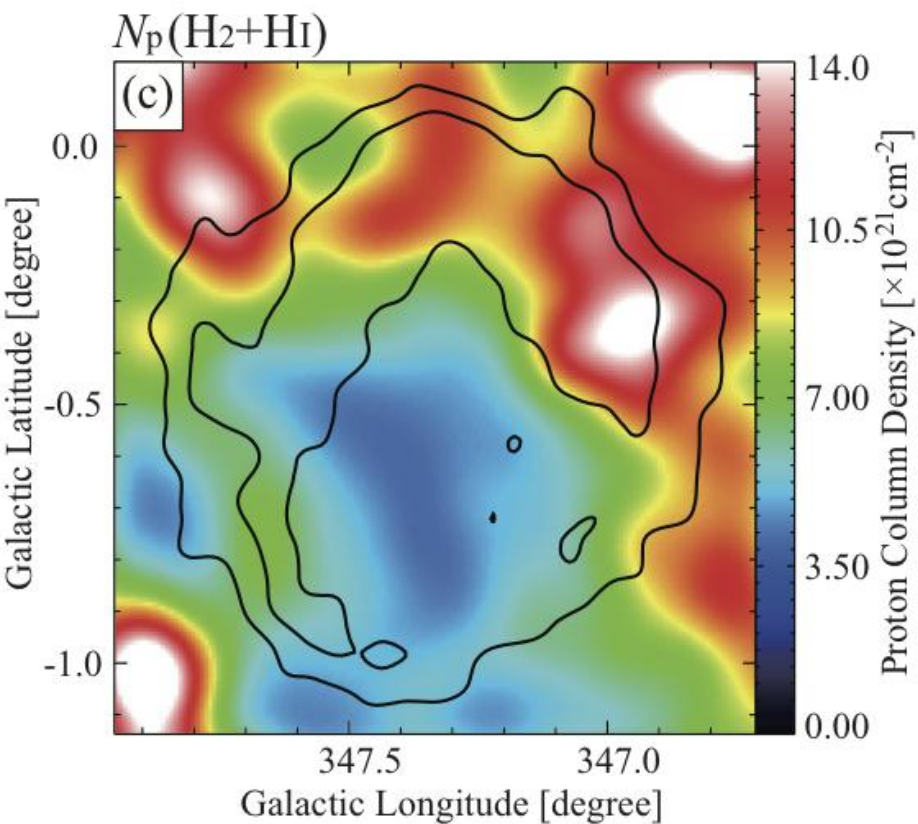
3



Fukui et al. 2012, ApJ, 746, 82

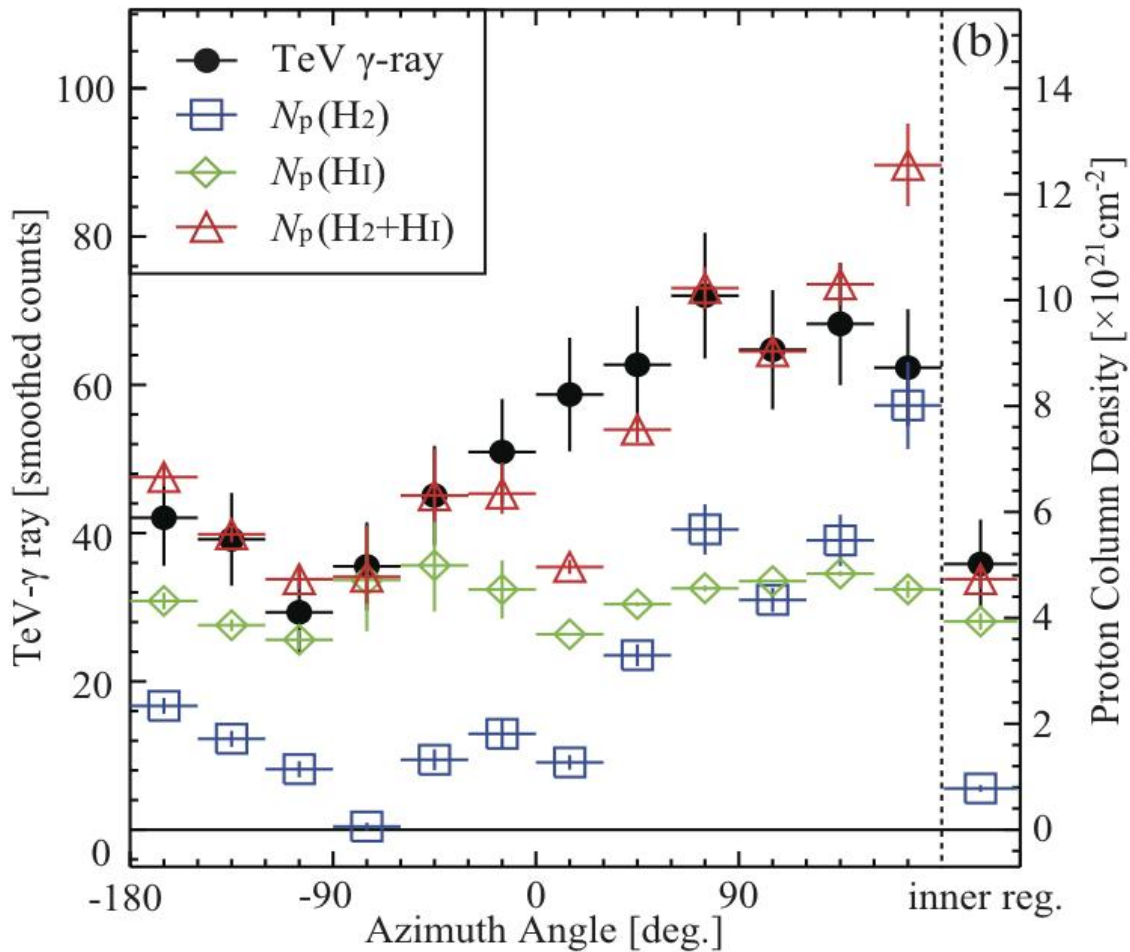
TeV γ -Ray SNR RXJ1713

ISM Proton Column Density Distributions



TeV γ -ray SNR RXJ1713

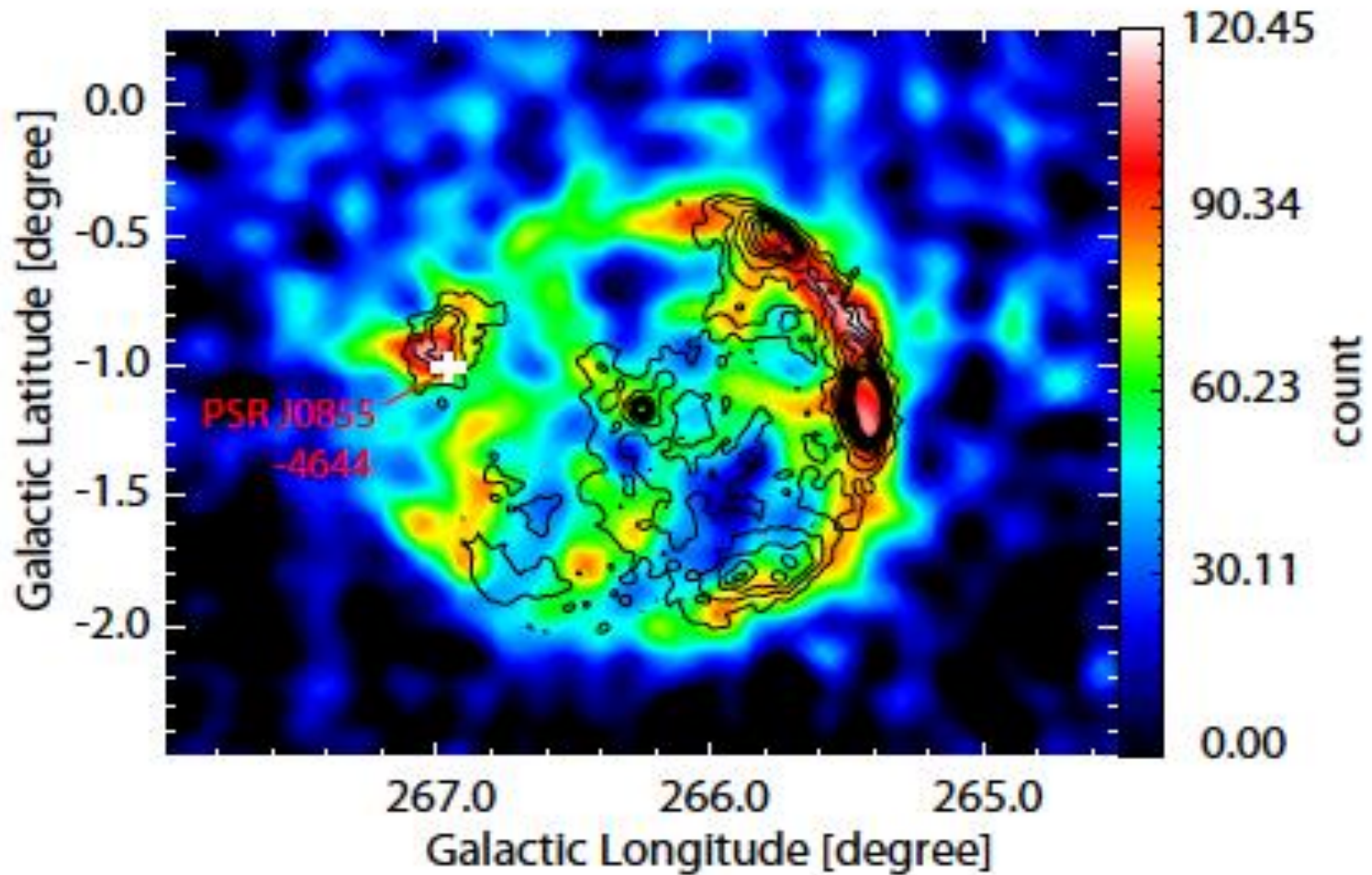
ISM Proton and TeV γ -ray Distributions



γ rays
ISM protons
good correspondence

ISM protons
as targets for cosmic
ray protons

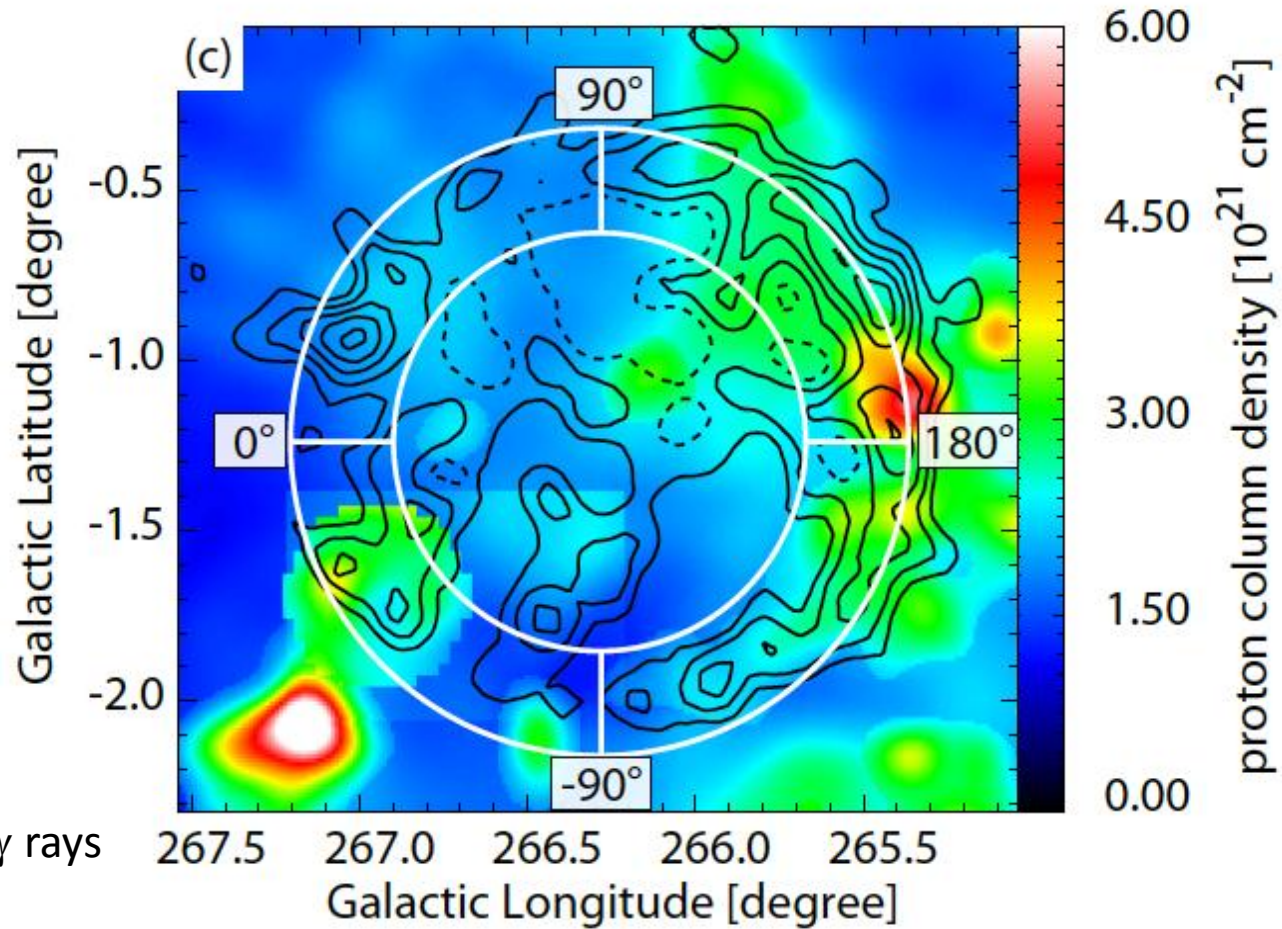
TeV γ -ray SNR RX J0852



TeV γ -Ray SNR RX J0852

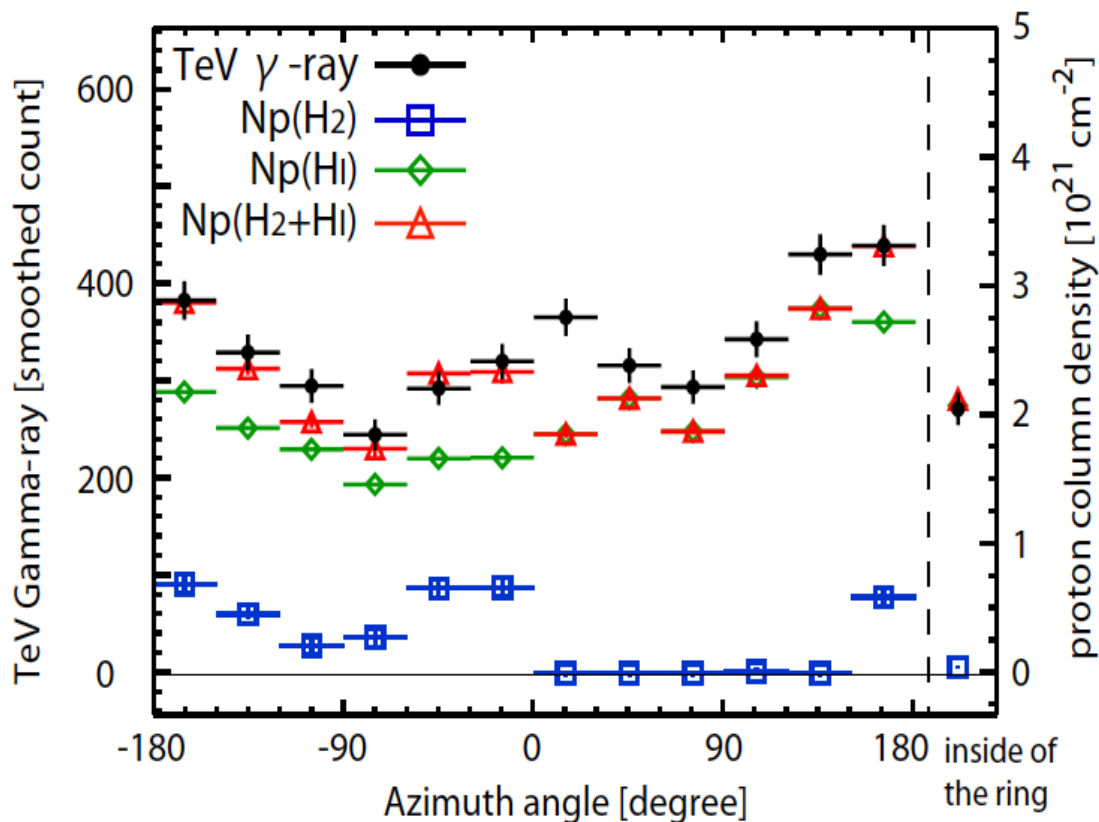
ISM Proton Column Density Distributions

Fukui et al. 2012, in prep.



TeV γ -ray SNR RX J0852

ISM Proton and TeV γ -ray Distributions



γ rays

ISM protons

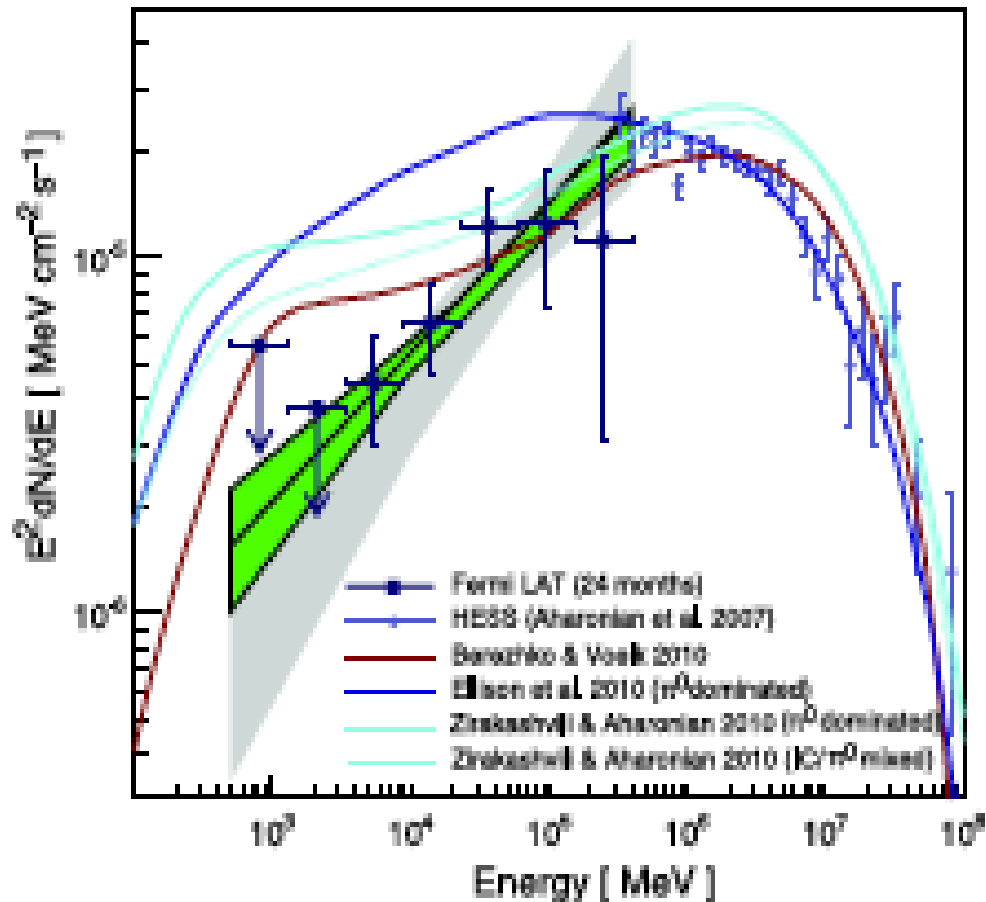
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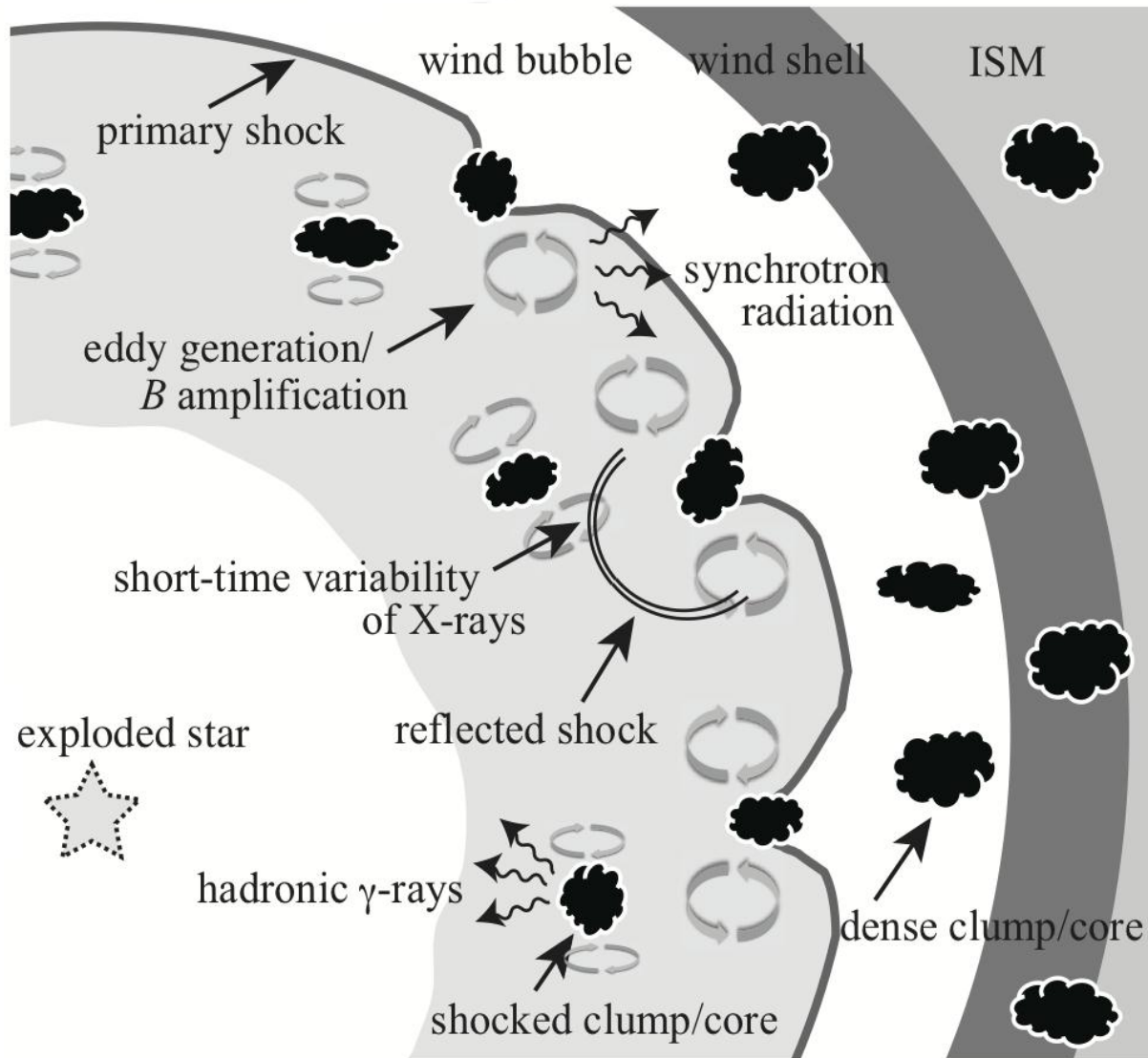
γ -ray spectrum of RX J1713

Abdo et al. 2011

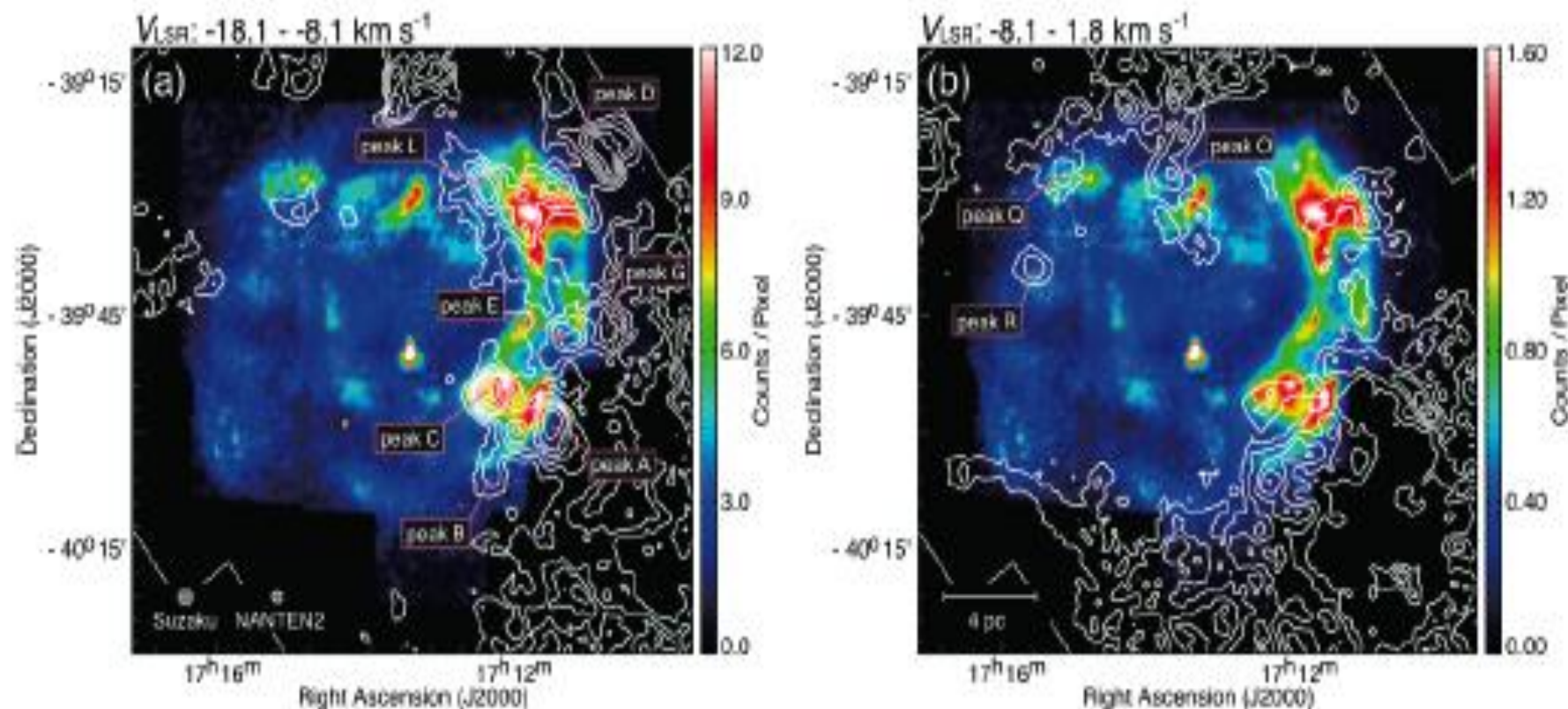


The hard spectrum is not unique to the leptonic scenario

The hard spectrum is explained by energy dependent penetration of CR protons into dense molecular gas.

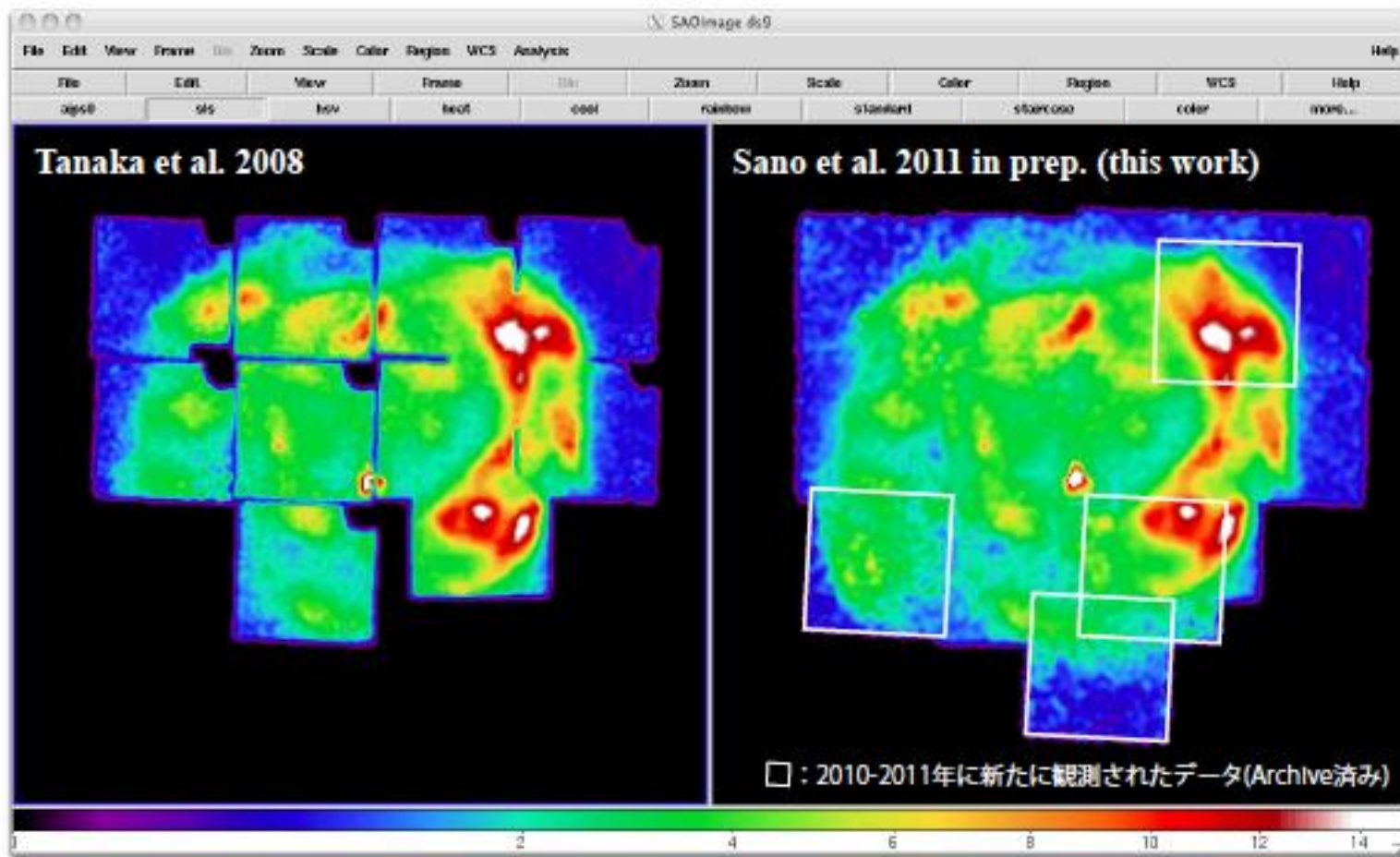


Inoue, Yamazaki, Inutsuka, Fukui 2012, ApJ, 744, 71



Color Image: *Suzaku* XIS 0+2+3 1–5 keV count map

Contours: $^{12}\text{CO}(J=2-1)$ integrated intensity (a) $V_{\text{LSR}}: -18.1 - -8.1 \text{ km s}^{-1}$ (b) $V_{\text{LSR}}: -8.1 - 1.8 \text{ km s}^{-1}$



18 arcsec のガウシアンでスムージング済 (this work については スムーズ前のデータからの動径分布の計算+エラー評価が可能)

RX J1713.7–3946 Azimuthal Plot (TeV gamma-rays and X-rays)

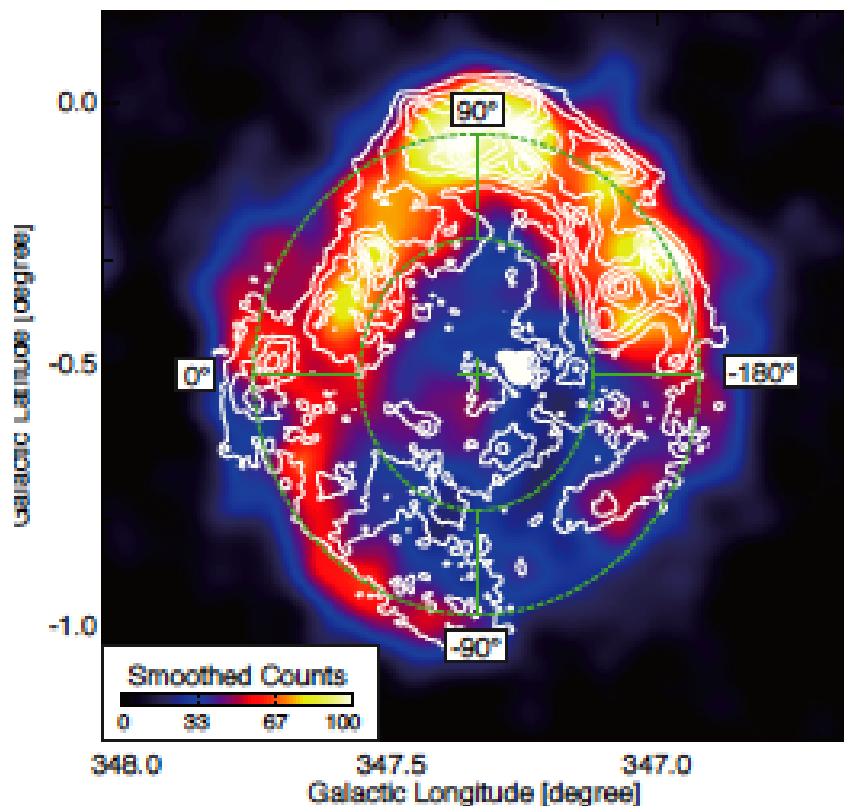
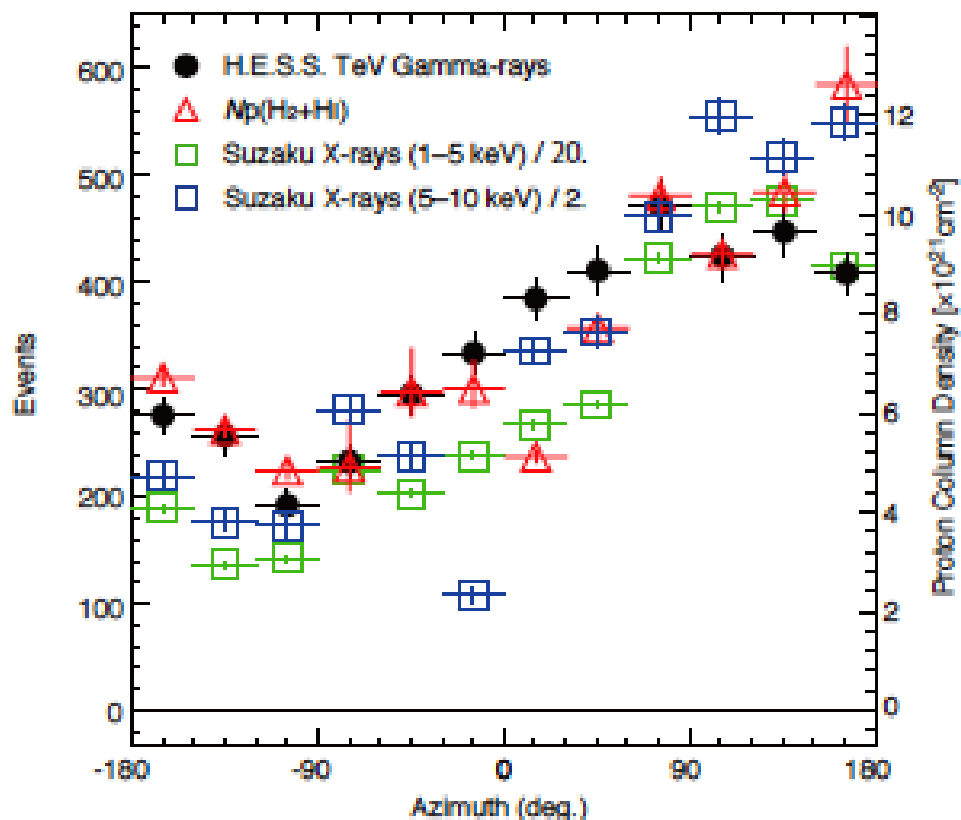


Image: H.E.S.S. TeV gamma-rays (Aharonian et al. 2007)
Contours: Suzaku X-rays (1–5 keV)

Azimuthal plot (Fukui et al. 2012)
center: $(l, b) = (347.34 \text{ deg.}, -0.52 \text{ deg.})$
outer ring radius: semi-major 0.46 deg., semi-minor 0.42 deg



RX J1713.7-3946 Radial Profiles

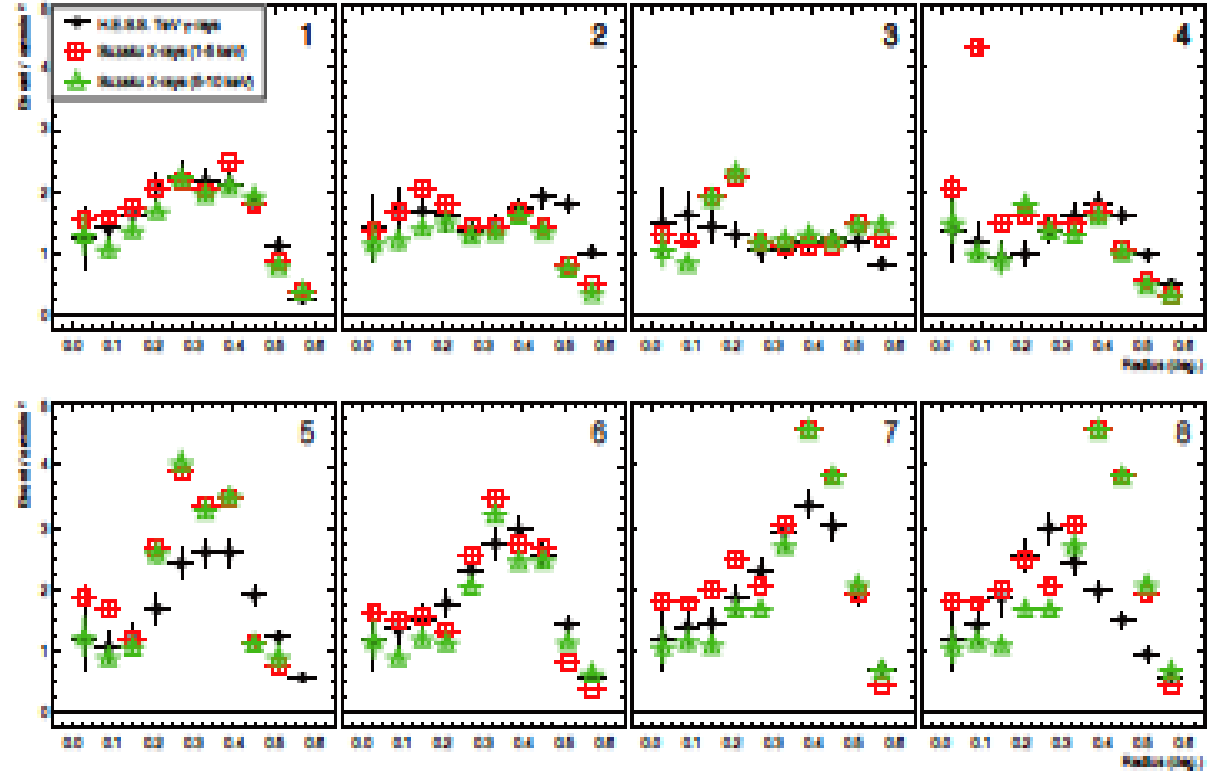
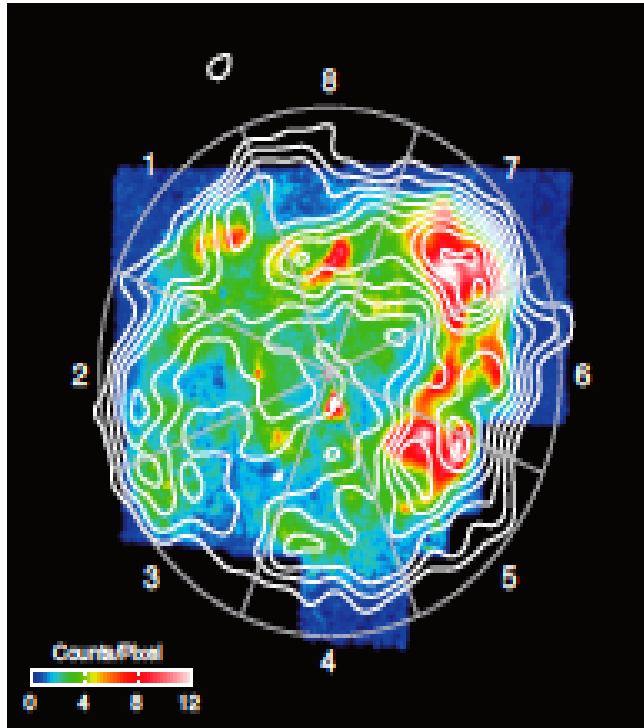
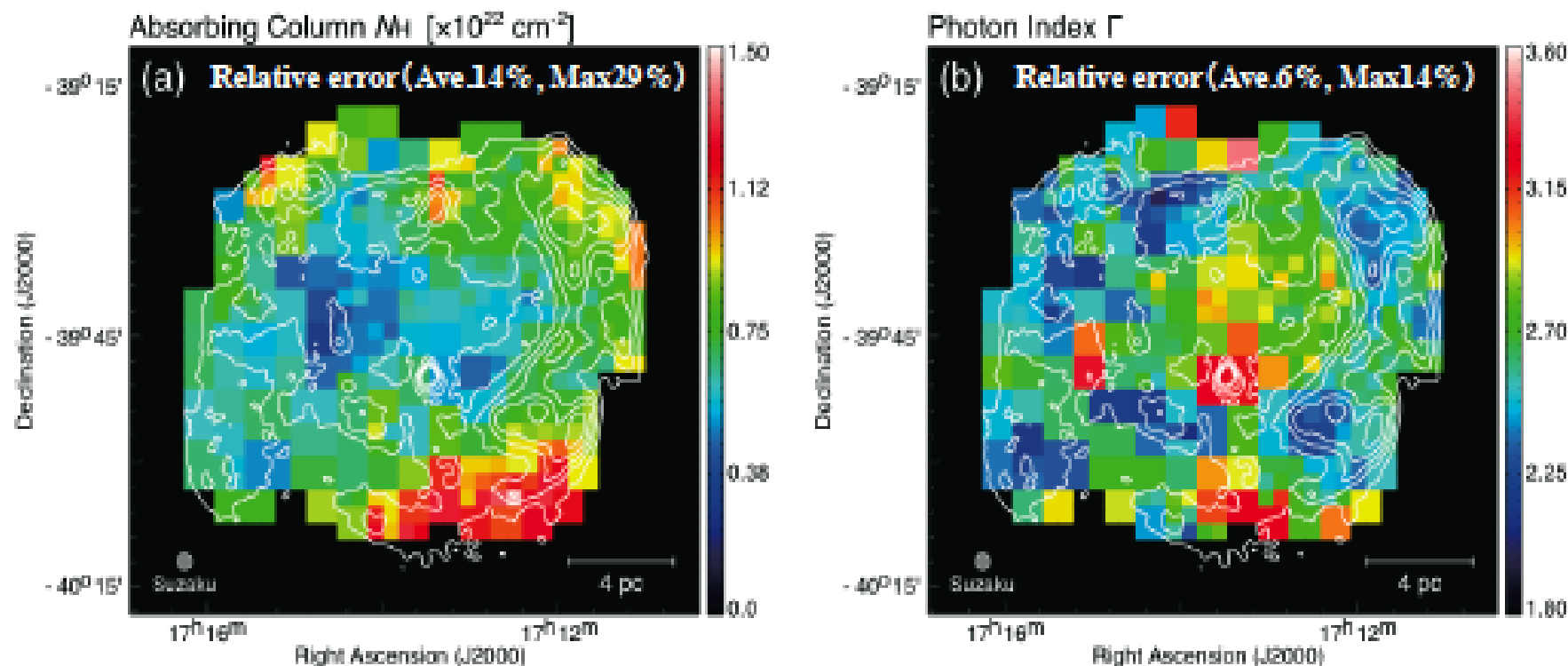


Image: Suzaku XIS 0+2+3 count map (1-5 keV, square root scale).
 Contours: TeV gamma-rays (lowest; 20 smoothed counts, interval; 10 smoothed counts)



Color Image: (a) Absorbing column N_{H} [$\times 10^{22}$ cm $^{-2}$], (b) Photon index Γ
Contours: *Suzaku* XIS 0+2+3 1–5 (square root scale)

RX J0852.0-4622 Azimuthal Plot (TeV gamma-rays and X-rays)

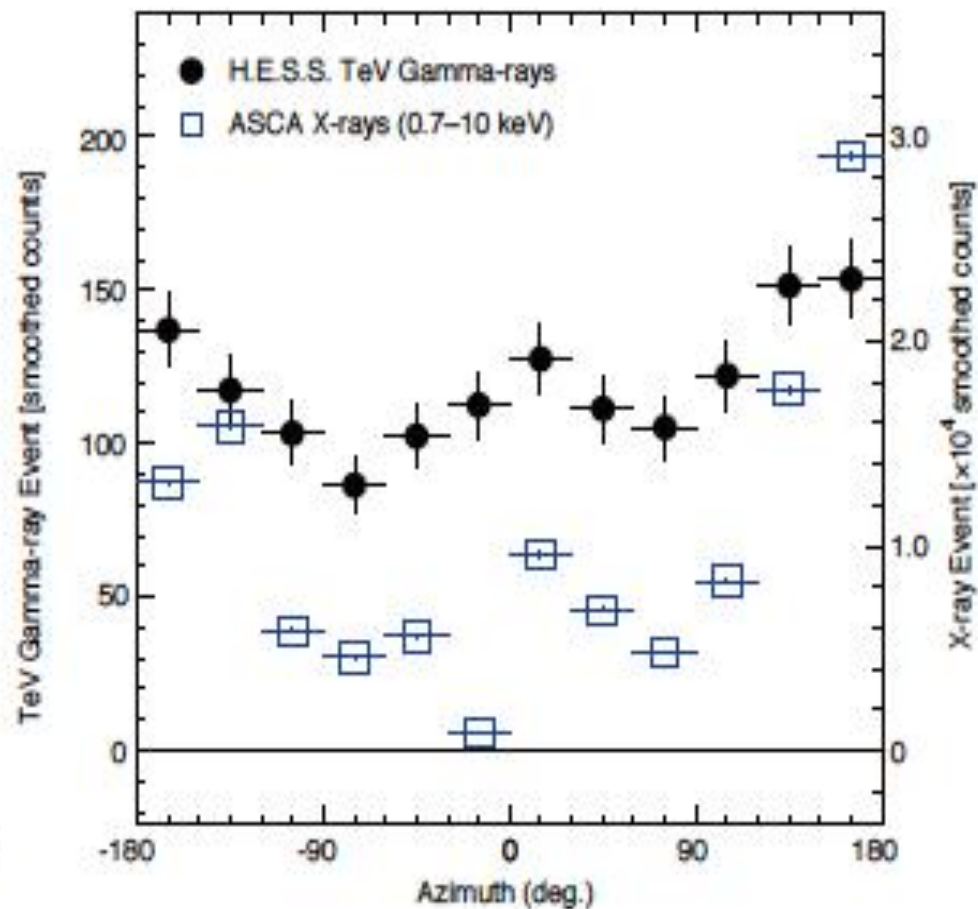
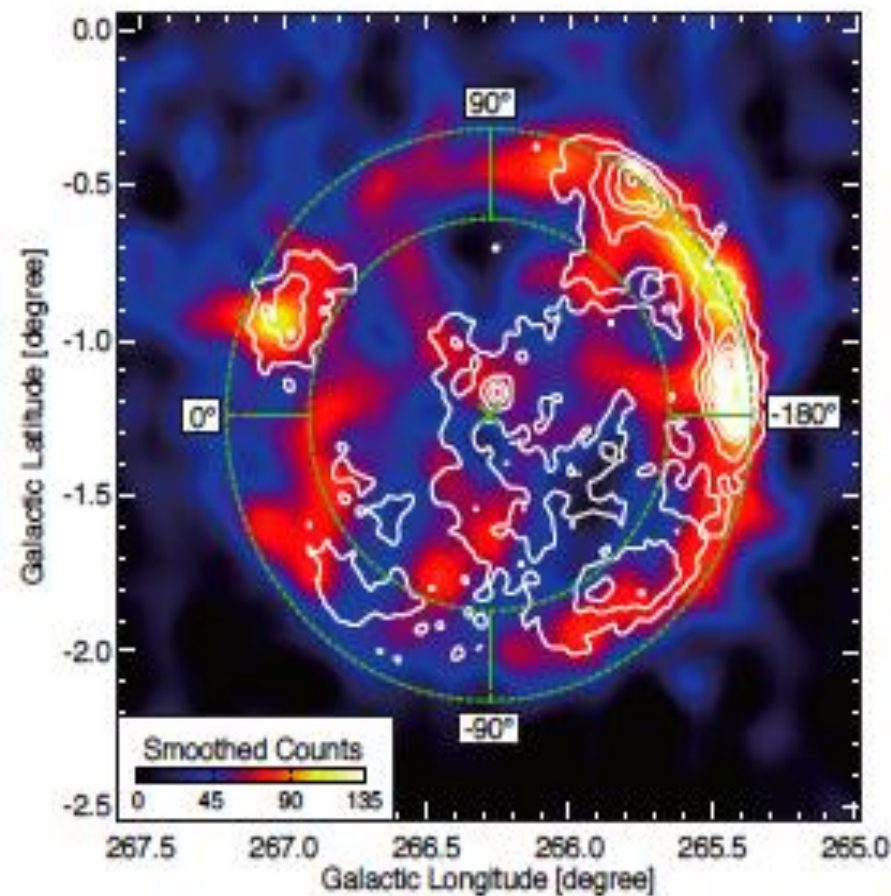


Image: H.E.S.S. TeV gamma-rays (Aharonian et al. 2007)
Contours: ASCA X-rays (0.7-10 keV; Tunemi et al. 2000)

Azimuthal plot (Fukui et al. 2012 in prep.)
center: $(l, b) = (266.28 \text{ deg.}, -1.24 \text{ deg.})$
radius: 0.63 deg. and 0.92 deg

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