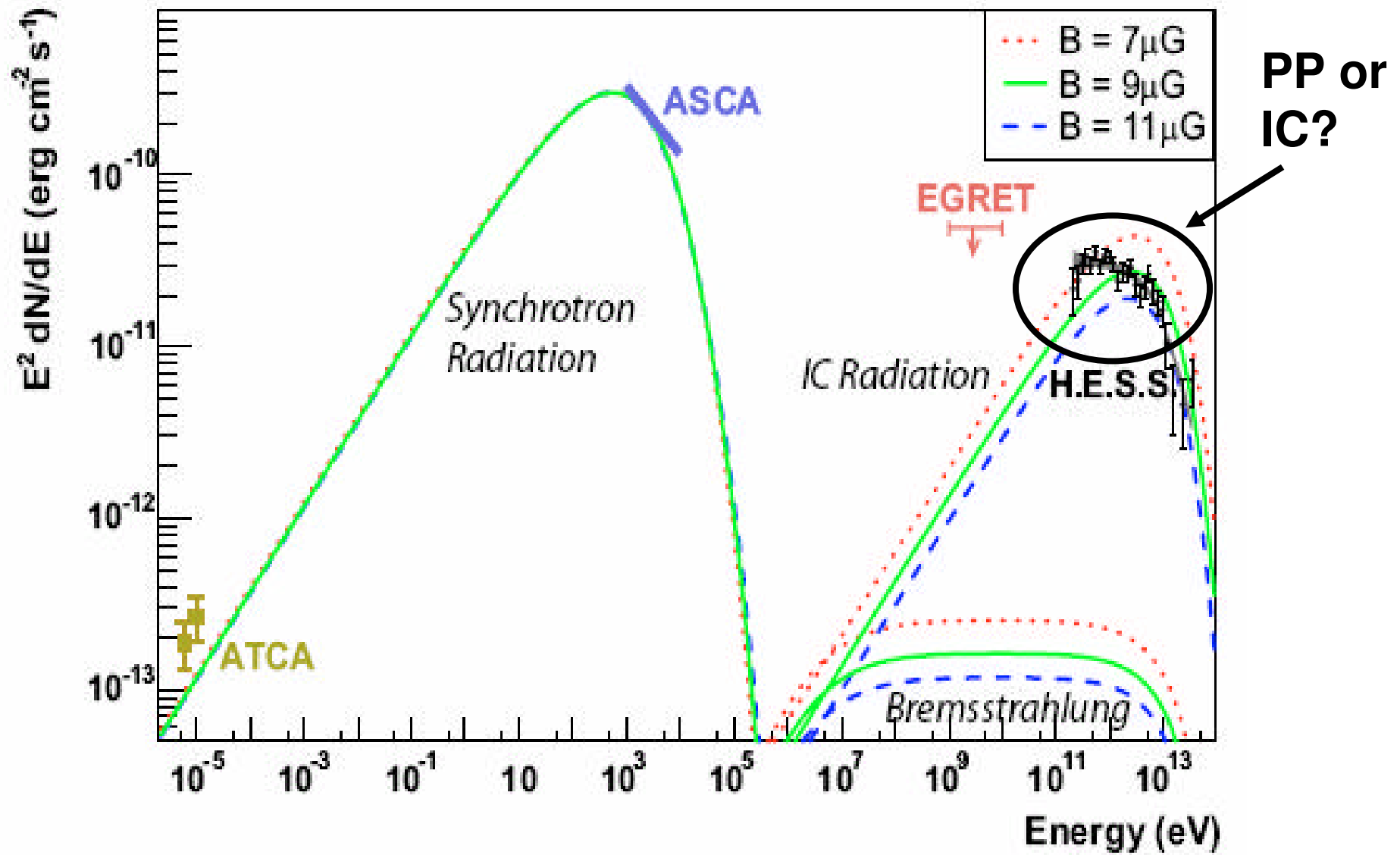


In which shell-type SNRs should we look for gamma-rays and neutrinos from p-p collisions?

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astro-ph/0706.3485

H.E.S.S. RX 1713.7-3946



Luminosity (νL_ν) ratios

$$\frac{dN_e}{d\varepsilon_e} \Big|_{\varepsilon_e=\varepsilon_p} = K_{ep} \frac{dN_p}{d\varepsilon_p} \propto \varepsilon_p^{-p} \quad \rightarrow$$

$$\text{Inverse Compton/PP} \approx 10 \left(\frac{K_{ep}}{10^{-2}} \right) \left(\frac{h\nu}{\text{TeV}} \right)^{(p-1)/2} \left(\frac{n}{1 \text{ cm}^{-3}} \right)^{-1}$$

$$\text{PP/Thermal Bremsstrahlung} \lesssim 3 \times 10^{-3} \left(\frac{\varepsilon_p}{0.1} \right) \left(\frac{T_e}{T_p} \right)^{-1/2} \left(\frac{T_p}{\text{keV}} \right)^{1/2}$$

$$\text{PP/Syn} \lesssim 50 \left(\frac{K_{ep}}{10^{-2}} \right)^{-1} \left(\frac{B}{10 \mu\text{G}} \right)^{-3/2} \left(\frac{n}{1 \text{ cm}^{-3}} \right) \left(\frac{\nu}{\text{GHz}} \right)^{-1/2}$$

Ratio of PP to Synchrotron Emission

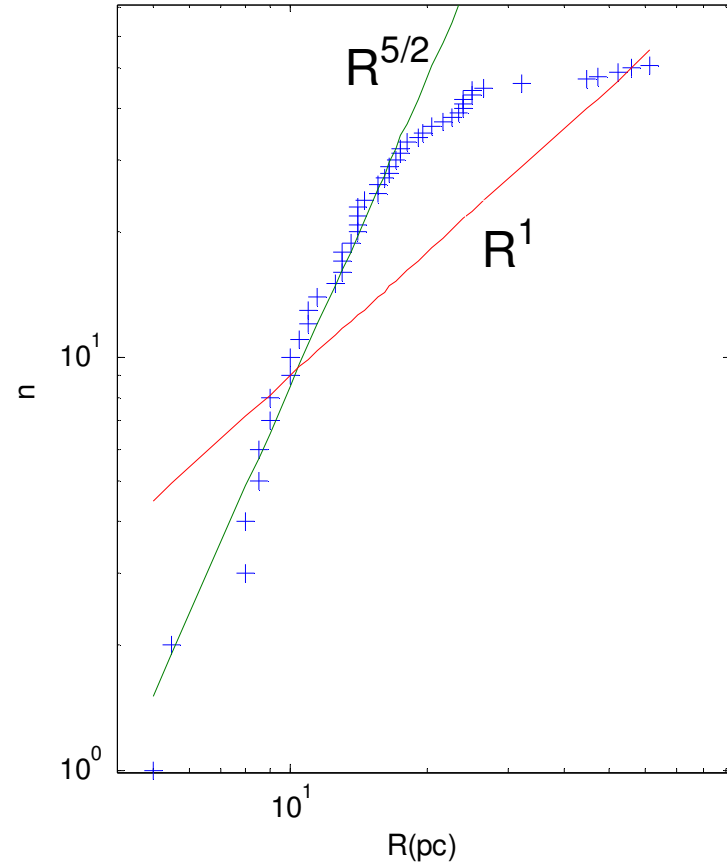
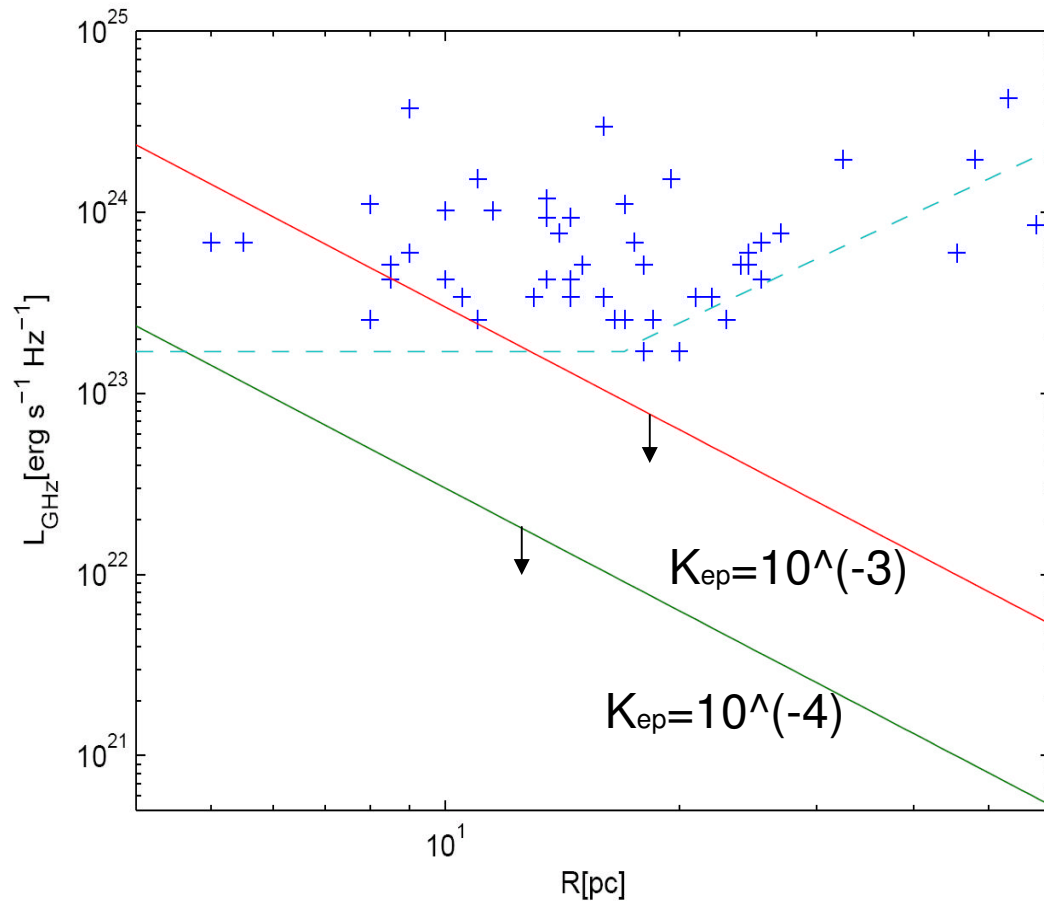
Ref.	Model	K_{ep}	n [cm^{-3}]	B [μG]	p	PP/Syn in ref	PP/Syn power-law model
1	PP	$\approx 10^{-4}$	1	130		≈ 200	100 (for $p=2$)
2		$\approx 5 \times 10^{-4}$	1	15	2.07	≈ 250	300
3		2.4×10^{-6}	0.2	120	2.1	≈ 300	400
3		4.5×10^{-4}	2	85	2	≈ 70	100
3	IC	1.7×10^{-3}	0.008	6	2.4	≈ 0.5	0.3
3		3.5×10^{-2}	0.01	6.5	2.4	≈ 0.3	0.15
4		10^{-2}	0.2	≈ 6	2.1	≈ 2	10

References:

- (1) Berezhko & Völk (2006)
- (2) Moraitis & Mastichiadis (2006)
- (3) Aharonian et al. (2007)
- (4) Enomoto et al. (2006)

M33 SNRs

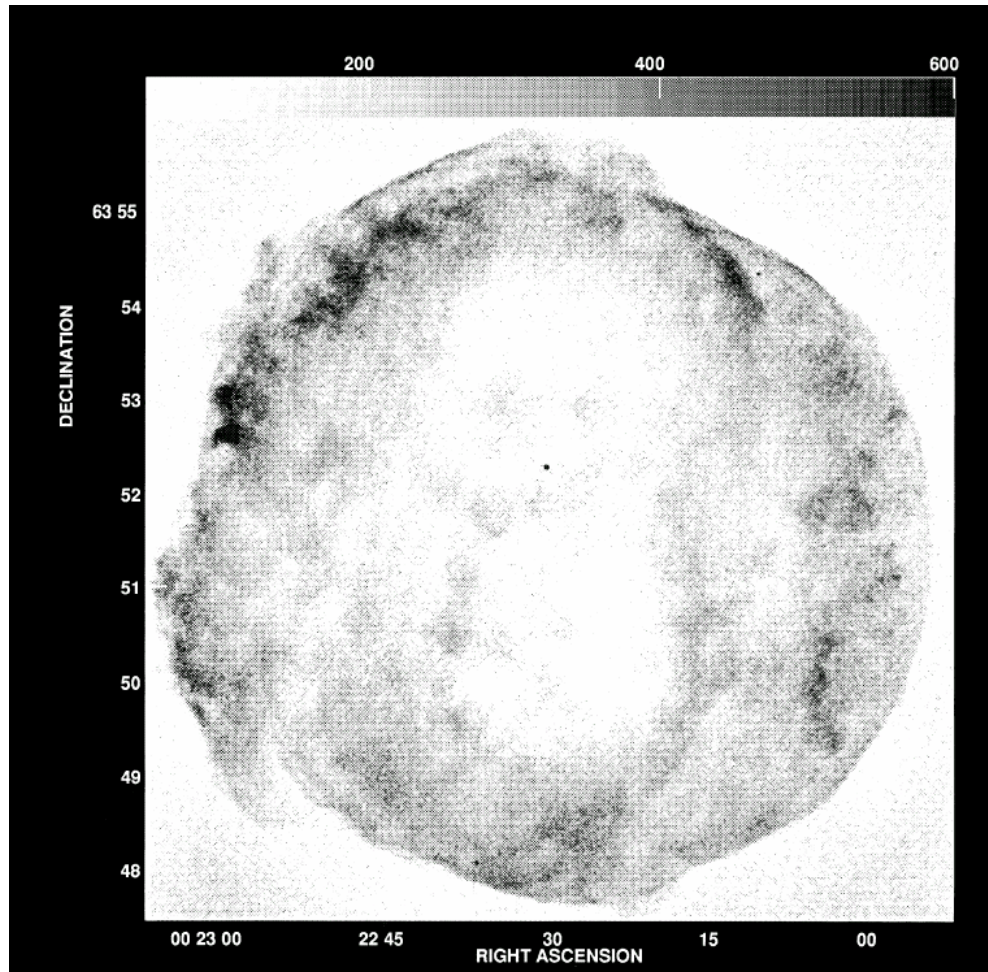
Gordon et al. 1999,
ApJ. Supp. 120, 247



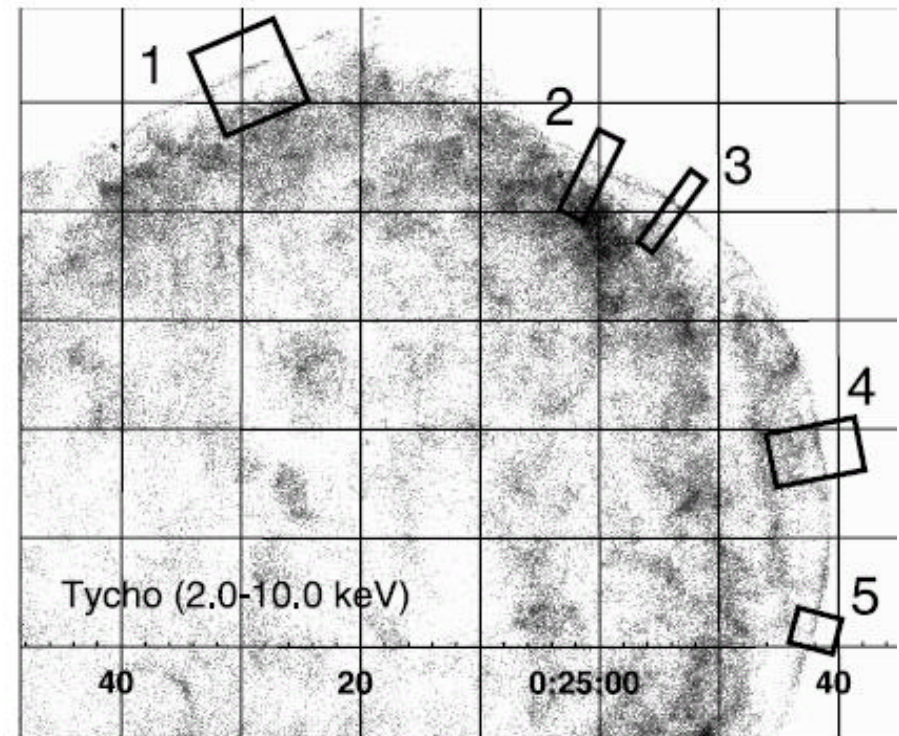
$$L_{\nu, \text{Syn}} (\text{GHz}) \approx 3 \times 10^{24} \left(\frac{K_{\text{ep}}}{10^{-2}} \right) \left(\frac{\eta_p}{0.1} \right) \left(\frac{E}{10^{51} \text{ erg}} \right)^{7/4} \left(\frac{\epsilon_B}{0.1} \right)^{3/4} \left(\frac{R}{10 \text{ pc}} \right)^{-9/4} \text{ erg s}^{-1} \text{ Hz}^{-1}$$

Filaments \longrightarrow Large B?

Tycho SNR



Radio: Dickel et al.(1991). 101, 2151



X-ray: Bamba et al. ApJ, 621, 793

Conclusions

- **The TeV gamma-rays from RX 1713.7-3946 and RX J0852.0-4662 are not from PP collisions.**
- **Neutrino flux probably non detectable,**
 $\varepsilon_\nu f_{\varepsilon_\nu} \lesssim 10^{-12} \text{ erg cm}^{-2} \text{ s}^{-1}$
- **For finding Neutrinos and Gamma rays from PP collisions, look at SNRs with strong thermal X-ray emission.**