Crab Nebula Flares: Too much ado about not too much?

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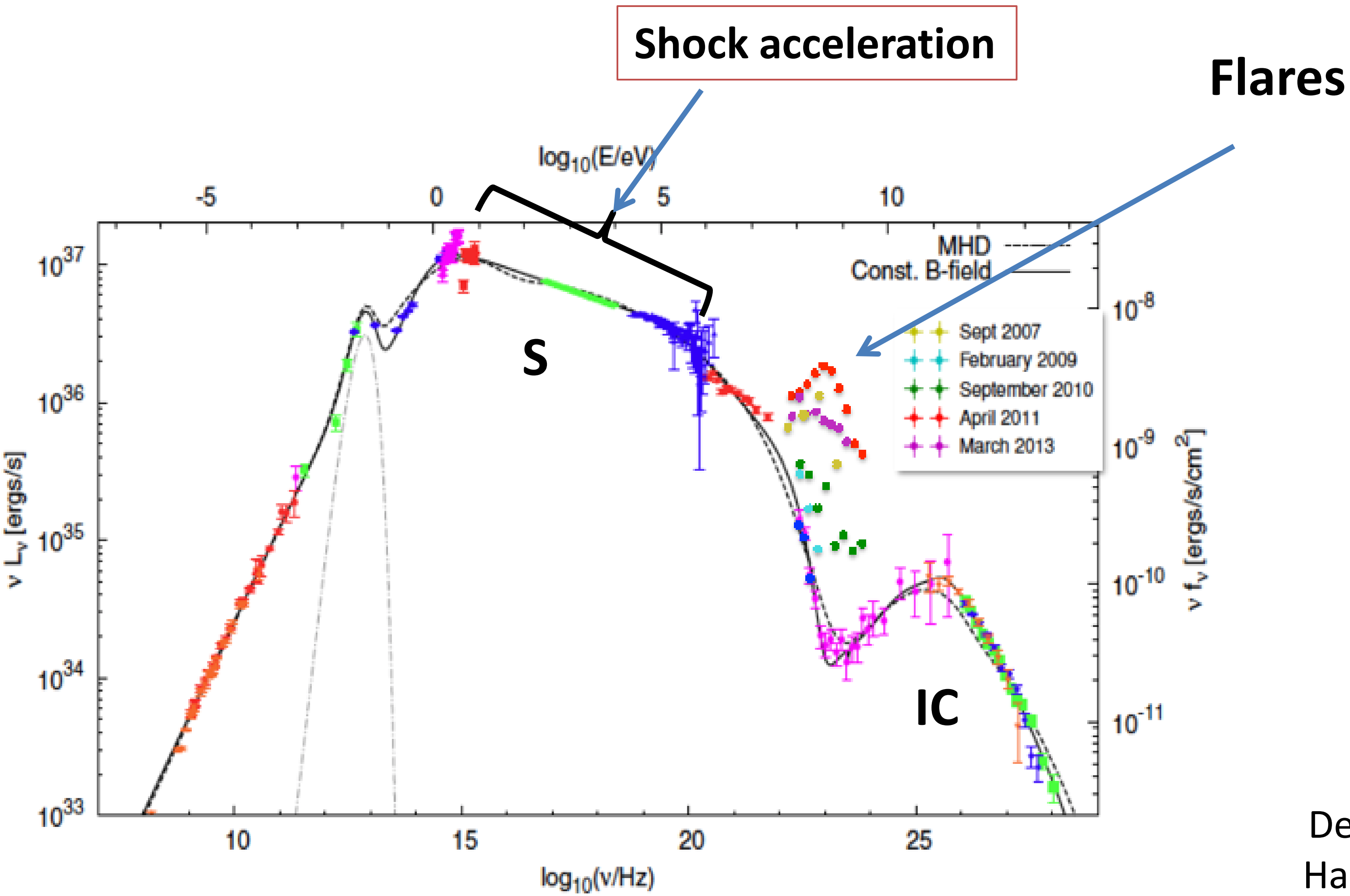
The Crab Nebula Spectrum

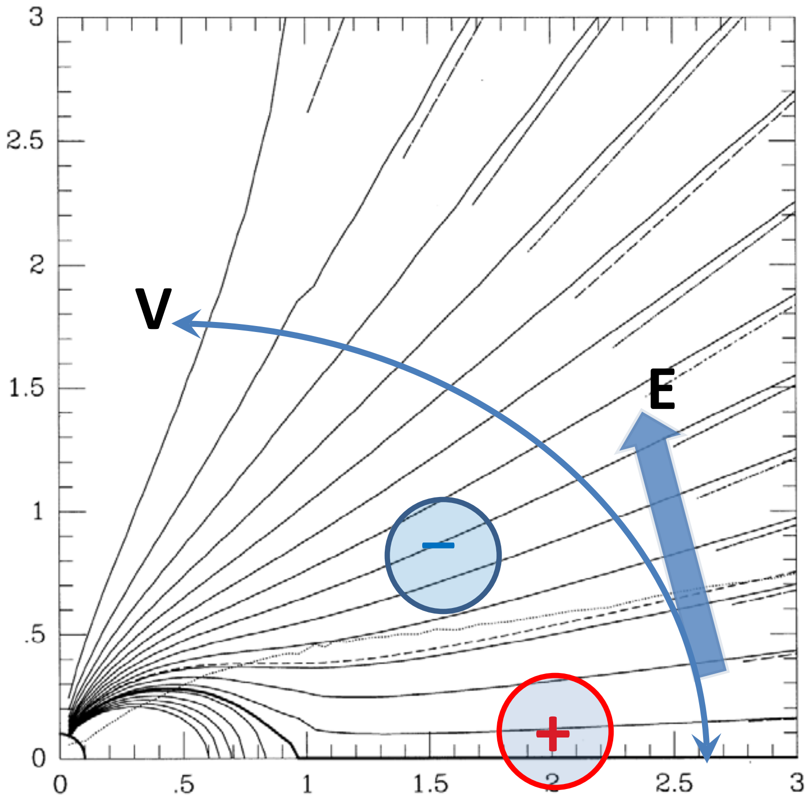


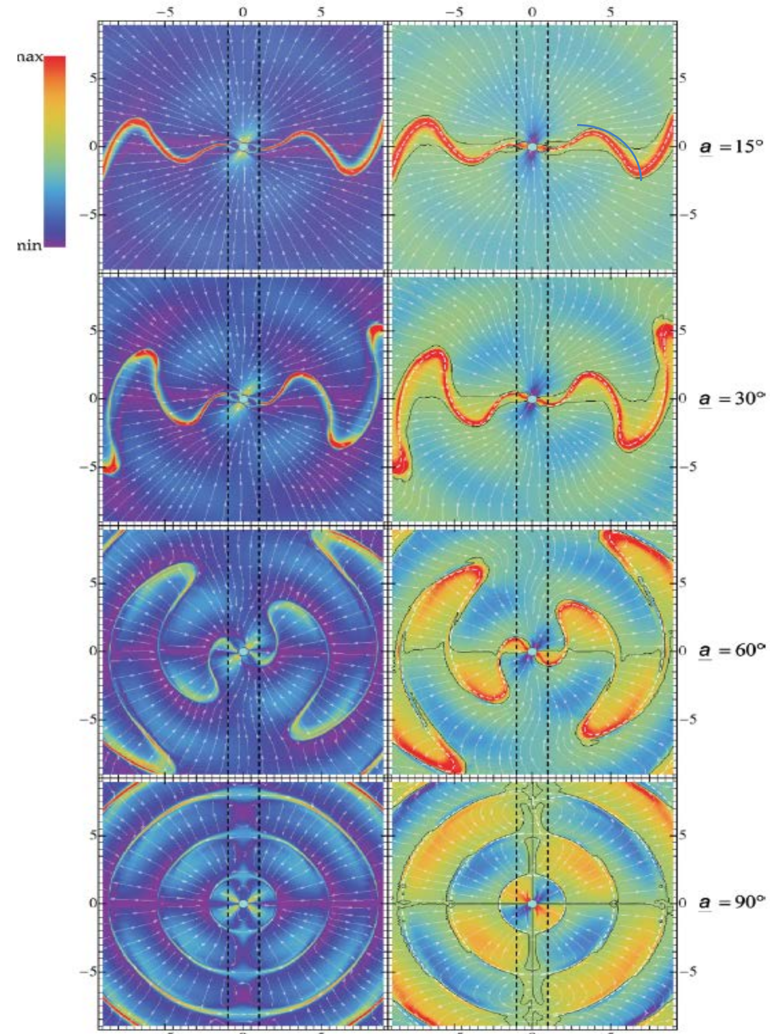
De Jaeger
Harding 94

Maximum Shock Acceleration Energy

- The shortest shock acceleration time is that of the Bohm time scale, i.e. $\tau_{acc} \sim R/c \sim \kappa (\gamma/B)$ (κ is a constant involving e, c, m_e).
- During acceleration, electrons suffer also synchrotron losses on a time scale $\tau_{loss} \sim \gamma/(d\gamma/dt) \sim \lambda (1/B^2 \gamma)$ (λ is also a constant).
- The maximum electron γ is obtained when $\tau_{acc} \sim \tau_{loss}$ i.e for $B\gamma^2 \sim (\lambda/\kappa)$, and the corresponding synchrotron energy will then be $\nu \sim B\gamma^2 \sim (\lambda/\kappa) \sim$ **50 MeV** dependent only on ***e, c, h,*** m_e.
- The existence of photons at energies about 10 times larger has cause sensation and re-evaluation of acceleration processes.
- *It turns out that the electrons needed to produce these γ-rays are fraction of the Crab polar cap voltage.*

Magnetospheric balance between electric and magnetic forces➔CKF





- At the termination shock, the balance can be disturbed.
- Bringing the (+) and (-) regions closer could increase E to have particles close the curcuit.
- These particles could get a fraction of the total potential voltage across the polar cap.
- This will lead to synchrotron emission at energies larger than the maximum obtained from shock acceleration.

- Clearly these are not detailed arguments by any sense.
- However, if correct, imply a correlation between the polar cap **V** and the **γmax** of PWN *(it is not inconsistent with the γ ~ a few x 10^8 of Vela estimated in Pavlov et al. 2003).*
- Detailed simulations of this process (reconnection?) should bear in mind that different field lines correspond to different values of the polar cap V.