

Observed lepton spectra

CR electron spectrum shows:

- break at $\sim 1\text{TeV}$
- no visible cut-off up to $\sim 20\text{ TeV}$

CR positron fraction shows:

- rises between $\sim 1\text{-}200\text{GeV}$
- Saturates at ~ 0.15 at $\sim 200\text{ GeV}$
- Drops above $\sim 400\text{-}500\text{ GeV}$

Implications on sources

energy losses:

- at multi-TeV synchrotron (on the interstellar magnetic field) and inverse Compton scattering (on the interstellar radiation field) dominates
- $T_{\text{loss}}(20\text{ TeV}) \sim 2 \times 10^4\text{ yr}$

diffusion plus losses:

- $D(E) \sim 10^{28} E^{0.3}\text{ cm}^2/\text{s}$
- Maximum distance of sources $\sim 100\text{-}500\text{ pc}$

Few sources, maybe only one source may dominate the multi-TeV electron spectrum.

Such source(s) should produce mainly electrons over positrons.

Model with local electron TeVatron

distant sources:

- continuous, stationary and homogeneous distribution in a disk beyond $\sim 500\text{ pc}$ from Earth
- power-law injection spectrum $E^{-2.4}$

local point source:

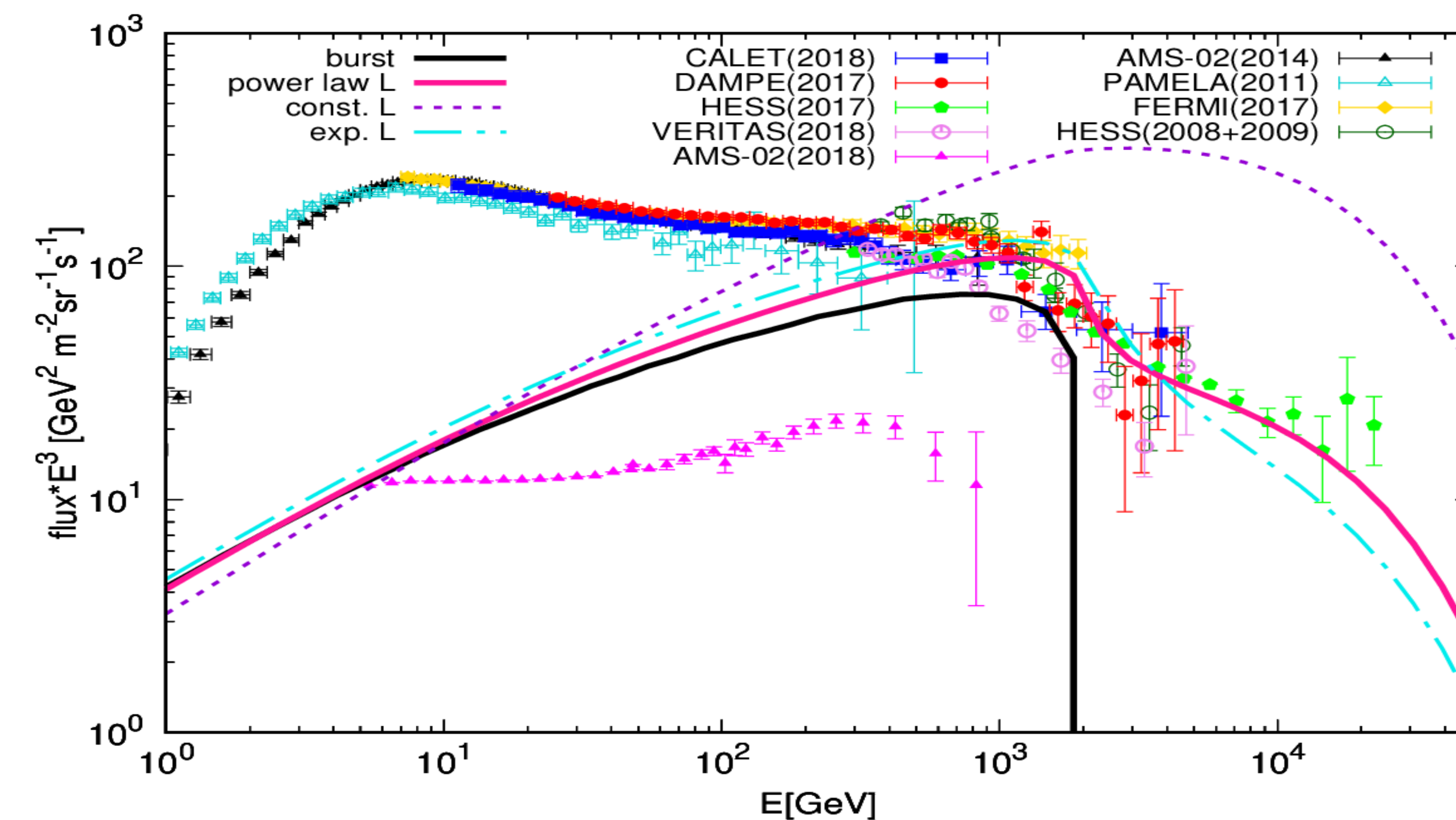
- tested various injection histories
- Source electron luminosity, $L(t)$, can vary with time
- **Burst-like injection, continuous (fading) injection**
- power-law injection spectrum $E^{-2.3}$, distance $\sim 100\text{ pc}$

spectral break at 1 TeV:

- Loss rate at 1 TeV = age of the source
- $T_{\text{loss}}(1\text{ TeV}) \sim t_a \sim 10^5\text{ yr}$

Above the break, up to 20 TeV:

- Fading injection of electrons from the source
- Depends on the ratio between the fading time-scale and the age, $\tau/t_a \sim 0.08$



Conclusions

- A local fading accelerator can account for the entire multi-TeV electron spectrum, from the $\sim 1\text{ TeV}$ break up to 20 TeV
- Such accelerator should produce preferentially electrons over positrons, its age should be $\sim 100\text{ kyr}$ and its fading timescale should be $\tau \sim 10\text{ kyr}$
- The nature of such accelerator should be investigated (SNR, stellar winds...?)

<https://journals.aps.org/prd/abstract/10.1103/PhysRevD.99.103022>

