EGU21-14279
https://doi.org/10.5194/egusphere-egu21-14279
EGU General Assembly 2021

Shock Acceleration of ~1-100 Kev Electrons at Earth's Bow Shock

Zixuan Liu[1], Linghua Wang[1], Liu Yang[1], Wimmer-Schweingruber Robert[2], Quanqi Shi[3], and Bale Stuart[4]

[1]School of Earth and Space Science, Peking University, Beijing, 100871, China
[2]Institute of Experimental and Applied Physics, University of Kiel, Leibnizstrasse 11, D--24118 Kiel, Germany
[3]School of Space Science and Physics, Institute of Space Sciences, Shandong University, Weihai, Shandong, 264209, China
[4]Department of Physics and Space Sciences Laboratory, University of California, Berkeley, CA 94720, USA

We present a statistical study of in-situ shock acceleration of ~1-100 keV solar wind suprathermal electrons at Earth's bow shock, by using Wind 3D plasma and energetic particle measurements in ambient solar wind and MMS measurements in shock downstream. We pick out 74 shock cases (1 quasi-parallel shock, 73 quasi-perpendicular shocks) during 2015 October - 2017 January, and classify them into 4 types according to their energy spectra in downstream: type 0 (23 cases) without significant electron acceleration after shock passage, type 1 (24 cases) with power-law spectrum, J □$\varepsilon^{\beta 1\_dn,}$ at ~0.8-10 keV, type 2 (16 cases) with power-law-spectrum at ~0.8-10 keV and significant flux enhancement above 30 keV, and type 3 (11 cases) with a clear double-power-law spectrum, J □ $\varepsilon^{\beta 1\_dn}$ (J □ $\varepsilon^{\beta 2\_dn}$) when $\varepsilon \ll \varepsilon^{dn}_{tr}$ ($\varepsilon \gg \varepsilon^{dn}_{tr}$), bending down at ε^{dn}_{tr} ~20-90 keV. The spectral indexes at lower energies for type 1, type 2 and type 3, β_1^{dn}, range from 2.5 to 5, while the spectral indexes at higher energies for type 3, β_2^{dn}, range from 4 to 9, and all the spectral indexes have no significant correlation with those in ambient solar wind. Among the 4 types, type 3 is the strongest acceleration with the largest flux enhancement and the lowest β_1^{dn}. Besides, we find that the flux ratio between downstream and ambient solar wind J_{dn}/J_{ab} is field-perpendicular for most cases in both low and high energies, and J_{dn}/J_{ab} (β_1^{dn}) has positive (negative) correlations with θ_{Bn} and magnetic field compression ratio, r_B, which favor the shock drift acceleration (SDA) mechanism. However, J_{dn}/J_{ab} has no correlation with the drift electric field E_d, while the normalized drift time, T_d/T_{tr}, has a positive correlation with θ_{Bn}, it suggests that θ_{Bn} can influence electron drift time and thus influence the acceleration efficiency.