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New theory of magnetic pumping as applied to spacecraft observations of particle heating[1] EMILY LICHKO, JAN EGEDAL, University of Wisconsin - Madison, WILLIAM DAUGHTON, Los Alamos National Laboratory — Energetic particle generation is an important component of a variety of astrophysical systems, from seed particle generation in shocks to the heating of the solar wind. Starting from the drift kinetic equation, we have derived a magnetic pumping model, where particles are heated by the largest scale turbulent fluctuations. We have shown that for a spatially-uniform flux tube, this is an effective heating mechanism up to $v \leq \omega/k$, and naturally produces power-law distributions like those observed in the solar wind, as verified by particle-in-cell simulations [1]. When this model is extended to a spatially-varying flux tube, magnetic trapping renders magnetic pumping an effective Fermi heating process for particles with $v \gg \omega/k$. To test this, we used satellite observations of the strong, compressional magnetic fluctuations near the Earth's bow shock from the Magnetospheric MultiScale mission and found strong agreement with our model. Given the ubiquity of such fluctuations in different astrophysical systems, this mechanism has the potential to be transformative to our understanding of how the most energetic particles in the universe are generated. [1] E. Lichko, J. Egedal, W. Daughton, and J. Kasper. Astrophys. J. Lett. 2, 850 (2017)

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