Liu *et al.* Respond: In our Letter,[1] we proposed a nonlinear mechanism for exciting high-frequency slow plasma waves by lower-hybrid (LH) waves of high phase velocity via runaway electrons in order to sustain an electron distribution function with a long tail. A steady-state distribution has been assumed but remains to be demonstrated. In order to demonstrate whether a given steady state is accessible, one must explore a range of parameters, particularly if one can only do it by numerically solving the time-dependent equations. The failure to achieve a specific steady state by one set of parameters does not preclude its accessibility by another set of parameters. The accessibility of the steady state of Ref. 1 depends on many parameters, such as the ratio of quasilinear diffusion coefficient due to LH wave D_q to the classical value D_c; the ratio of the minimum phase velocity of the LH wave v_{min} to the minimum velocity of anomalous Doppler resonance $v_D = (\Omega/\omega_p)v_c$, where v_c is the minimum phase velocity of the excited plasma waves; the initial distribution, and how many particles are initially in the phase velocity range of LH waves $[v_{max}, v_{min}]$.

In the Comment by Muschietti, Appert, and Vaclavik,[2] only two values of D_q/D_c, 10^2 and 10^3, are used, while the form of the initial distribution is not specified. In particular, the length of the tail is not given. Furthermore, only the very extreme case of $v_{min}/v_e = 9.9$ and $v_{min} = v_D$ is considered. On the basis of this extreme and unrealistic case, they claim that the preformed runaway tail cannot be sustained by rf because of the positive-slope (bumps) formation even in the realistic case. The nonlinear bump formation by wave-induced pitch-angle scattering observed in this work is a well-known process for runaway distributions.[3] Once the bump is formed, the plasma wave is excited and a plateau between v_c and v_D results rapidly.

In a more general case, however, LH waves with $v_{min} < v_D$ can restretch out the tail to form a new plateau between v_c and v_{max}, on a longer time scale than the plateau formations. This new state, being anisotropic, is again unstable to the excitation of $\omega_p \cos\theta$ waves which leads to pitch-angle scattering and the nonlinear processes restart again so that a fast-time-scale relaxation oscillation results. We have demonstrated this relaxation oscillation over many periods with a two-dimensional Fokker-Planck quasilinear code. In a time-averaged sense, a negative slope between v_c and v_D has been observed and a quasi-steady state can be reached for $v_{min} \lesssim v_D$. These results were presented at an open scientific meeting, and will be submitted for publication.[4] We also note that to follow accurately these relaxation oscillations, a very small time step must be used in the numerical scheme during the unstable phase; otherwise the tail, after having relaxed toward the bulk, cannot be recreated, similar to that described in the Comment.[2] Furthermore, if the initial distribution function has too few particles in the velocity space between v_{min} and v_{max} (for example, a very short tail beyond v_{min}), it also is difficult for the LH waves to catch the tail.

Because the initial distribution is not specified in the Comment,[2] nor is their numerical procedure (such as initial or boundary conditions or time step) mentioned, and because only one value of v_{min}/v_D was considered, it is difficult to assess the validity of the authors' claim. However, we suspect that because of their choices of initial distribution and v_{min}/v_D value, the tail distribution retreats significantly as a result of the wave pitch-angle scattering, leaving too small a population in resonance with the lower-hybrid waves for the tail to be recreated. Other choices might result in a more gradual retraction, allowing a re-formation of the tail by lower-hybrid waves.

This work was supported by the U. S. Department of Energy under Contract No. DE-AT03-76ET51011.

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Received 23 December 1982
PACS numbers: 52.35.-g, 52.50.Gj

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