Kaplan and Shkolnikov Reply: We believe that the negative conclusions of [1] about our results [2] are not supported by the justifications given in [1]. Specifically

1. We never suggested that a single-electron lasetron may have any practical application, and used the case just to give the scale of radiated energy per electron; we do not think that this subject merits more discussion here. Moreover, (i) The statement in [1] that "The authors determine that, with a petawatt laser pump, an electron would radiate 180 W in a single pass as the radiation cone sweeps across a detector" is incorrect, because the radiation is emitted by a single rotating electron all the time with the same power; it is only viewed by an observer as a sequence of pulses. Moreover, the very image of a "radiation cone sweep," while temptingly simple, is misleading [see item (2) below]. (ii) The conclusion of [1] that "to be useful, or even definable, the individual bursts must be much brighter than those produced by a single electron" is partly trivial (see above), and partly incorrect: one can define such as pulse, e.g., by temporal behavior of the field of a single rotating electron.

2. The entire argument in [1] on how diffraction will limit the lasetron pulse duration clearly misses the point. Indeed, if diffraction were a problem here because of the small lasetron target size, as the author of [1] apparently believes (he states, e.g., "For a real, macroscopic synchrotron source, diffraction is unimportant"), then this problem would be much worse for the single-electron radiation, contrary to the fact of relativistic shortening of a synchrotron radiation pulse. Actually, diffraction has very little to do with the observed pulse duration, which represents the distance between the front and the trailing edge of the radiation field (which looks like an expanding "spiral"), and not the time during which some preexisting "radiation cone" sweeps the observer—yet another indication that the lasetron radiation as a beam of a rotating flashlight, which apparently underpins much of [1], is misleading. Furthermore, let is look at the diffraction here from the spectral point of view. The size, A, of the radiative "antenna" for a rotating single electron or tight bunch of them is the diameter of rotation, which in the ultrarelativistic case is $\sim\lambda_L/\pi$. For the fundamental (i.e., laser) frequency, this dipole size would result in a strong diffraction, whereas for all the higher harmonics, $n\omega_L$, with $n \gg 1$, the antenna ratio $R = O(1)\lambda_L/\lambda_n$ becomes large; hence a strongly collimated radiation at those harmonics. This collimation is even more pronounced for the wire target, where the antenna size is a few λ_L, and results in the diffraction angle of most of the spectrum being inversely proportional to R and thus to γ^3. In fact, this issue is addressed by us in [2], see Eq. (11) and related discussion based on the theory [3]. The analytical theory of diffraction of very short, subcycle pulses with a broad spectrum [4] shows that while the diffraction varying across that spectrum affects the shape of the pulse via suppression of lower frequencies, it does not significantly change the pulse duration, since the latter is determined by higher, almost nondiffracting frequencies.

3. Reference [1] comes to its conclusion that the lasetron radiation is incoherent, by considering the interference of radiated photons. Unfortunately, the photon picture is ill suited for treating lasetron radiation that contains thousands of harmonics, while a photon is inherently a single-frequency object. Most significant, however, is the starting point: "Now imagine looking into the beam at the target to see electrons... sporadically emitting photons tangentially." This image might be relevant if the lasetron radiation were incoherent; but this is exactly what [1] purports to prove. If the radiation is coherent—and synchrotron radiation is a fact—then its source is the entire electron cloud, and all considerations based on combining photons from each electron fail completely. The contention [1] that the lasetron radiation pulse will be no shorter than the laser cycle is based on the same irrelevant picture. The real solution needs a theory of the lasetron radiation beyond the "fat electron" model we employed in [2] and may require taking into account the interaction of electrons with the total electromagnetic field; such a theory is yet to be developed. Our further calculations, to be published, show that the pulse duration of the lasetron with a wire target may reach into a few zeptoseconds with a substantial amount of electrons.

We appreciate comments [1] for giving us the opportunity to clarify some of the points in our work [2]. It also goes without saying, of course, that many problems of the lasetron radiation coherence and pulse duration, addressed by us in [2] only preliminary, deserve further investigation. This work is supported by AFOSR.

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