MODIFICATION OF THE ENERGY AND SPATIAL SPECTRA OF RELATIVISTIC LPI ELECTRONS BY FRONT-SURFACE TARGET STRUCURES

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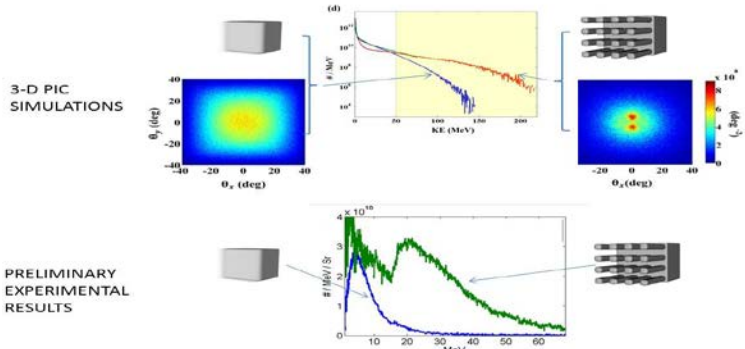
We present 3-D PIC simulations of the effects on the energy and spatial distribution of relativistic LPI electrons from regular, wave-length sized, structures placed on the front surface of the laser target. We show that by choosing the geometry with care, substantial modification of the LPI electron spectrum can be realized: In energy, the spectrum becomes hotter with a greatly increased maximum energy; in addition, the spatial distribution is narrowed prominently, yielding an effective beam of relativistic electrons. We also present preliminary experimental evidence showing that these enhancements can, in fact, be realized. Implications for alternate fusion energy schemes, such as fast ignition, are discussed.

The upper part of the figure shows a summary of our 3-D simulation work. The case of a 2-D regular array of "towers" is compared to a flat target in both the resulting LPI energy and spatial distributions. The towers are typically several wavelengths in lateral dimension, and



10's of wavelengths long, although the effects are not overly sensitive to the exact sizes. (The targets were designed and produced at Caltech) The effect of the structured surface is to move lower energy electrons to higher energy. The structure target also dramatically collapses the spatial distribution of the higher energy electrons. The lower portion of the figure shows our preliminary measurement of the energy spectrum using the SCARLET laser at The Ohio State University, operating with a peak focused intensity of approximately 10^{21} W/cm^2. A significant increase in the number of high energy electrons compared to the flat target is observed. We discuss further experimental efforts to verify the spatial narrowing, as well as a systematic study of this effect as to its potential applications.