Relativistic surface plasmons in laser-plasma interaction

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Relativistic surface plasmons (SPs) excited by intense \( I_L \geq 10^{18} \text{ W/cm}^2 \), ultra-high contrast laser pulses on solid grating targets may provide a new strategy to the development of short, energetic, laser-synchronised radiation sources. Their role in increasing the laser-target coupling and consequently affecting electron and ion acceleration and high order harmonic generation has been recently studied via numerical simulations [1] and experiments [2, 3], hence inaugurating the domain of Relativistic Plasmonics.

Here we report our latest results on the experimental investigation of highly intense laser-grating interaction in the presence of relativistic SPs. When the resonance condition is met, electron bunches of about 100 pC charge and 8 MeV energy are obtained close to the target surface (Fig.1) [3], along with an intensity enhancement of high order harmonic generation in the same direction [4]. Distinctive properties of both these emission were studied by varying the laser incidence angle, the grating type, by creating an optimized pre-plasma on target and with the support of PIC simulations, which remarkably agree with the experimental data. Further characterization on these processes is likely to contribute to both developing the theoretical description of Relativistic Plasmonics and to designing compact radiation sources for many different applications.

References