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Plasma-vacuum interface: a new medium for attosecond pulse generation[1]

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The relativistic interaction of an intense laser pulse with overdense plasma constitutes a very promising approach towards the generation of ultra-intense attosecond pulses using novel high-power laser systems currently available or those envisioned for the near future. The plasma medium converts the incident laser light into higher harmonics more efficiently than gaseous media and in addition, it exhibits no inherent limitation on the laser intensity that can be used. To date, substantial theoretical and experimental evidence has been accumulated indicating that the harmonic emission from plasma medium possesses nearly all the essential characteristics required by a source delivering coherent, extreme ultraviolet (XUV) pulses of attosecond duration and unprecedented brightness. Indeed, it was only recently demonstrated that the individual harmonics in the emission spectrum are phase-locked. This is the key requirement for the temporal bunching of the emission to sub-cycle duration. Moreover, our understanding of the generation process has advanced considerably and additional parameters assuring the usability of the source to practical applications have been investigated in detail. The availability of attosecond pulses carrying enough number of photons to enable the performance of XUV-pump XUV-probe type experiments would, for the first time, allow researchers to look at an assortment of dynamic processes requiring attosecond temporal resolution in various branches of physics, chemistry, material science and biology. We will discuss the most recent results pertaining to the development of this new source.

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