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Extreme Light Compression JONATHAN WHEELER, GERARD MOUROU, Ecole polytechnique – IZEST, TOSHIKI TAJIMA, University of California Irvine (UCI) — A fundamental limit for the volume in which a given pulse energy achieves the maximum intensity is defined by its wavelength and is called the λ^3 regime. In applying this limit to a Petawatt system, one finds the capability to achieve maximum intensities just surpassing the ultra-relativistic threshold (10^{24} W/cm^2) where the ponderomotive energy becomes comparable to the proton rest mass. To go beyond this toward the Schwinger limit (10^{29} W/cm^2) is difficult due to challenges in accommodating the required energy. It is likely that the future will bring a plateau in the peak intensity with little gain in the achievable level unless a dramatic change is introduced. Considering the lambda-cubed limit also illuminates a solution: a shift to shorter wavelengths. The efficient production of a single-cycled, high energy laser pulse enables conversion through relativistic compression into a sub-femtosecond X-ray laser pulse. This is an efficient and innovative way to ascend to exawatt (EW) and zeptosecond (zs) science. Application of these High Field X-rays (HFX) in topics such as imaging, particle acceleration, and QED studies inspires the motivation for a concerted program to produce and employ such sources as the next stage in high intensity science.

Jonathan Wheeler
Ecole polytechnique – IZEST

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