Harmonics-Femtosecond, Coherent XUV and Soft X-ray Light Sources

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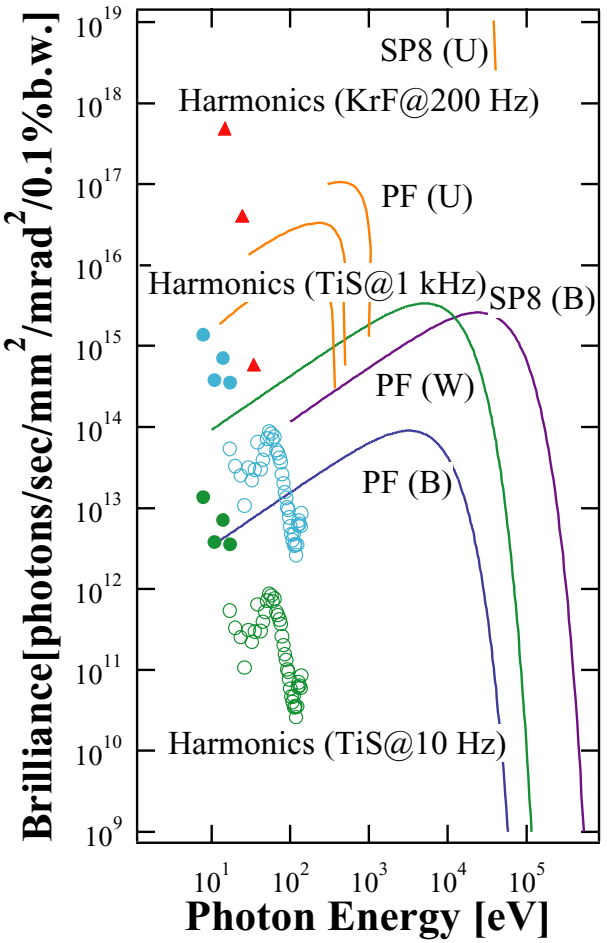
Harmonics are attractive as femtosecond coherent light sources in the XUV and soft x-ray region. Harmonics are now being used for the study on dynamics of core excitation in solids and high resolution photo electron spectroscopy.

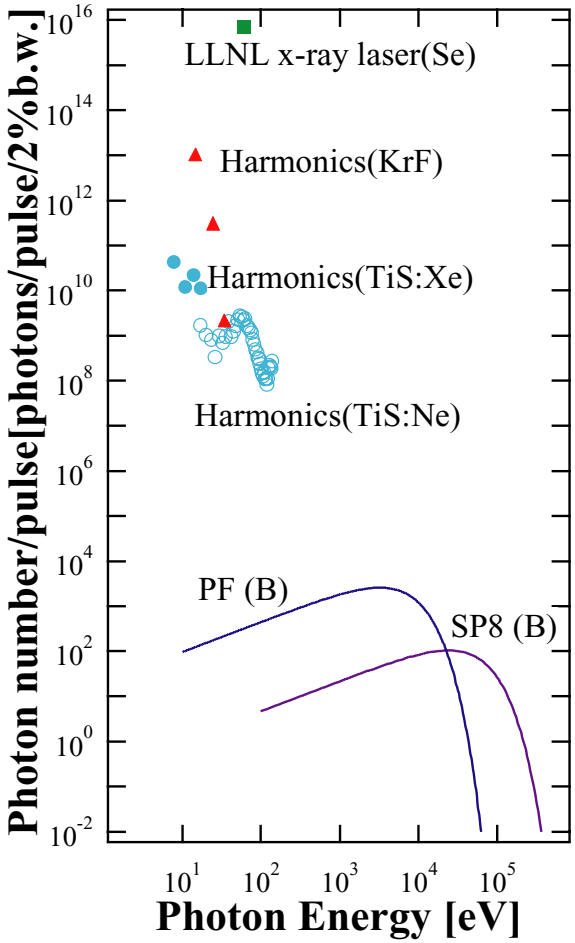
Properties of harmonics are summarized in Table. Harmonics are compared with synchrotron radiation and x-ray lasers in Figure about brilliance, photon number/pulse and peak intensity. From these data the prominent advantage over synchrotron radiation and X-ray lasers is the coherence in the frequency and time domains originated from the property of excitation lasers, which enables the generation of femtosecond or even attosecond pulses. The ultrashort pulses gives naturally high peak power. Therefore, harmonics become mighty if they are used for nonlinear phenomena and dynamics in the XUV and soft x-ray regions.

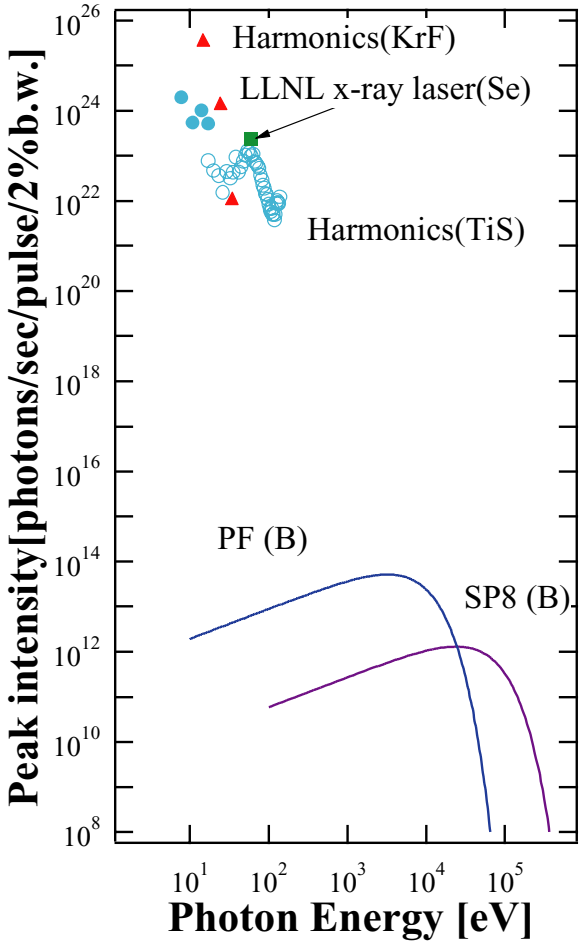
There are some disadvantages to be improved, such as photon number/pulse, average power and stability. The efforts for the improvement and the development of spectroscopic method for harmonics will be introduced.

Term	Comments	Term	Comments
Energy range	down to 0.5keV	brilliance	See Fig
Band width	<10 meV at 14eV. →continuum	Spatial coherence	Full size coherence for optimized phase matching
Number of photons/pulse	See Fig	Temporal coherence	near pulse width (Fourier transform limit)
Peak power	6MW at 25eV (1.2 μ J/200fs)	Tunability	・ tunable by excitation laser tuning ・ selectable by multiplayer mirror from continuum
Average power	0.1mW at 25eV	Reliability stability	depends on excitation laser
Emittance (source size× divergence)	can be near λ/2 (diffraction limit)	Pulse width	10fs at 10eV 0.5fs at 95eV
		Pep. Rate	10kHz

Table Properties of Harmonics







SOR

PF:Photon Factory
SP8:Spring8
B:bending magnet
W:wiggler
U:undulator

X-ray laser

Lawrence Livermore National Laboratory

Harmonics

ISSP, Univ. of Tokyo TiS,Xe or Ne
KrF,Ne