

**Table-top soft x-ray lasers: 30 years of development and applications
at Colorado State University**

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Plasma-based soft x-ray lasers (SXRL) enable experiments requiring bright, high energy, pulses of coherent soft x-ray radiation to be conducted in compact set ups. This talk will review 30 years in the development of plasma-based table top soft x-ray lasers at Colorado State University and their use in applications in several areas. This work and that of other groups around the world evolved what initially devised that made use of plasmas generated by high energy pump lasers that could often fire only several shots per day into high repetition rate table-top devices. New excitation schemes such as transient excitation and more efficient plasma heating schemes have allowed a dramatic reduction of the pump energy required to reach gain saturation. However, the development of soft x-ray lasers has also been limited by the available pump source technology. The introduction of direct discharge pumping using capillary discharges and new advances in high energy ultrashort pulse solid state lasers have made it possible to increase their repetition rate, extend their wavelength range, and generate shorter (ps and sub-ps) pulses. Compact, high power solid state lasers have enabled the operation of gain-saturated compact repetitive x-ray lasers at wavelengths down to $\lambda=6.85$ nm in Ni-like Gd. In turn, the development of Joule-level diode-pumped ultrashort pulse optical lasers has made it possible to increase the repetition rate of SXRLs to 100 Hz, with for example an average power of > 0.1 mW at $\lambda=13.9$ nm. Injection seeding with high harmonic pulses has enabled the soft x ray lasers with practically full spatial and temporal coherence. The application of these lasers in multiple application affecting several different fields including dense plasma diagnostics, nanoscale imaging, nanofabrication, photochemistry and photophysics, and nuclear forensic will be reviewed. Future prospects will be discussed. These research often included international collaborations that resulted not only in scientific and technical results, but also in lasting friendships that honor the memory of Pierre Jaegle.

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