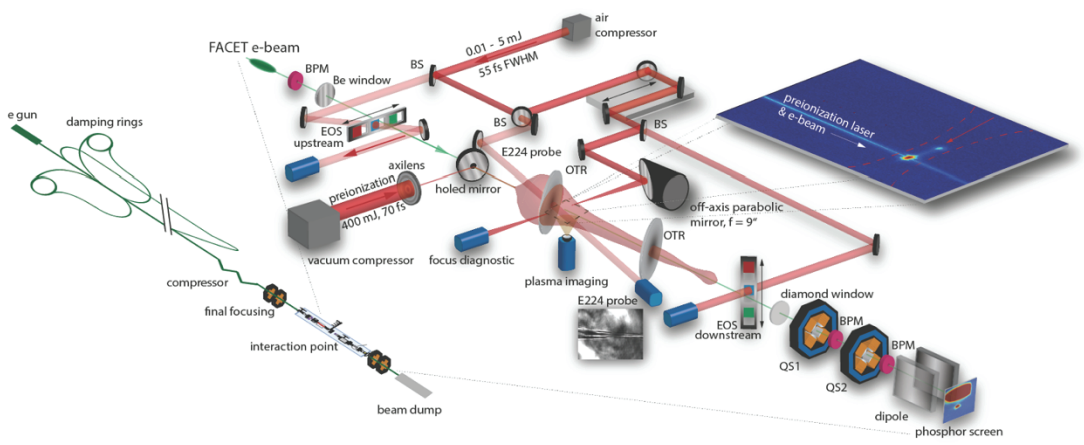
Argonne NATIONAL LABORATORY

# James Rosenzweig

# The Birth of the Fifth-Generation Light Source




Proof-of-principle experiment in femtosecond ultra-high brightness electron source from ionization in GV/m plasma waves.

**The fourth-generation light source — the x-ray free-electron laser (FEL) — has revolutionized the way science at the nano-to-mesoscale is done. UCLA researchers have played a key role in this development, which is moving to a new phase: the birth of what is known as the fifth-generation light source – an ultra-compact FEL or similar scheme that is driven by a beam derived from an advanced accelerator, a new class of accelerator based on lasers, plasmas, wakefields, and exotic structures. We discuss the characteristics of such a system, beginning with an overview of FEL gain mechanisms, noting that the future will bring beams with extreme high brightness and temporal scales down to the attosecond level. These attributes are synergistic with the characteristics of very high field – to the GV/m level – advanced accelerators, which must operate at quite small accelerating wavelength, demanding small charges and short pulses. In order to fully exploit such beams, a compact FEL system must also reimagine the undulator to utilize very short periods. This may be manifested in systems that vary from magnetostatic approaches using nanotechnology to plasma waves, as well as electromagnetic wave solutions that permit new types of narrow-spectrum light sources extending to gamma-ray emission. We highlight in this talk a few of the leading fifth-generation light source techniques, in both acceleration and radiation production, that are currently under active development at UCLA and its collaborators.**

**James Rosenzweig is a Distinguished Professor of Physics in the UCLA Department of Physics and Astronomy, where he served as Chair for five years. He is the Director of a large student-oriented research group at UCLA, termed the Particle Beam Physics Laboratory (PBPL), which has produced >25 Ph.D.s, many of whom hold leadership positions in the beam physics field. The multi-disciplinary PBPL program concentrates on fundamental aspects of high brightness, ultra-fast electron beams, with application to advanced accelerators based on lasers, wakefields, and plasmas, and to radiation production, such as free-electron lasers. This research program is based on-campus at the SAMURAI Laboratory, complemented by a large external program emphasizing wakefield acceleration at user facilities at SLAC, Brookhaven, and Argonne, and collaborating institutions in the U.S., Italy, Germany, and Israel. Prof. Rosenzweig is the author of >525 scientific articles, and has written a textbook on the physics of charged particle and laser beams. He is a lifetime member and Fellow of the American Physical Society. He has been the recipient of Sloan and Wilson Fellowships, and has been awarded the International Free-electron Laser Prize in 2007. He has also co-founded several successful industrial accelerator companies.**

## Wednesday, March 28, 2018 | 3:00 p.m.

Bldg. 402 | APS Auditorium
Argonne National Laboratory

# APS Colloquium