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Abstract for an Invited Paper
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Robert R. Wilson Prize: The Quest for Bright, Coherent X-Rays: A Personal Story[1]

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Stories associated with the advances in x-ray source techniques during the last several decades will be told from a personal viewpoint. I will start from the "third-generation" x-ray sources based on storage-ring-based undulators and a struggle to find a proper way to quantify the radiation strength. I will then discuss how the initially incoherent undulator radiation evolves into an intense-quasi-coherent radiation via free-electron laser (FEL) interaction. This so-called self-amplified spontaneous emission (SASE) in the x-ray region could be realized with the advent of laser-induced electron guns and forms the basis of the linac-driven "fourth generation" x-ray facilities. An x-ray FEL oscillator (XFELO) will also be feasible if Bragg reflectors, such as diamond crystals, are used as cavity mirrors. An XFELO driven by a CW superconducting linac would be a "real x-ray laser," producing a steady stream of fully coherent, spectrally pure x-ray pulses. An XFELO can be mode-locked, thus producing x-ray spectral comb, if the cavity length can be fixed to a fraction of the x-ray wavelength by referencing to a narrow nuclear resonance. A mode-locked XFELO will enable x-ray quantum optics experiments, such as matter-wave interferometry, for fundamental physics. Alongside these main themes, stories for novel and "cute" schemes, such as a crossed undulator for polarization switching and an emittance exchanger for swapping the transverse and longitudinal phase space, will also be presented.

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