

Industrial Charged Particle Beam Applications in Medical Imaging, Electron Beam Additive Manufacturing and Circuit Breakers

Charged particle beams have multiple applications in industrial settings: medical imaging, radiation therapy, material processing, communications, additive manufacturing, sterilization, pollution control etc. This talk will present an industrial perspective of charged particle beam applications at General Electric (GE). GE has been innovating in the area of charged particle beams for more than 100 years – with seminal work for the modern X-ray tube and the magnetron at the beginning of the 20th century; these seminal contributions continued towards the middle of the past century in relevant areas such as dispenser cathode electron emitters and synchrotrons.

In today's GE, charge particles beams are researched, developed and implemented in multiple industrial applications such as X-ray sources for medical and industrial imaging, electron beam 3D printing machines (for manufacturing aerospace and medical implant components), circuit breakers and cyclotrons for positron emission tomography (PET). In this talk, the specific challenges in terms of R&D, technology trends and technology wish lists, productization, market needs for the charged particle beam applications at GE will be discussed. More specific highlights include electron emission physics, electron emitters, beam optics opportunities, leveraging artificial intelligence and data analytics for charged particle beams, electronics for beam control and high voltage topologies for beam acceleration in bremsstrahlung-based X-ray sources (beam lengths on the order of several centimeters) and electron beam additive manufacturing machines (beam lengths of about 1 meter). Other applications of charged particle beams at GE to be discussed include inverse Compton scattering X-ray sources (tunable, monochromatic) and gas discharge tubes as medium-voltage direct-current (MVDC) circuit breakers.