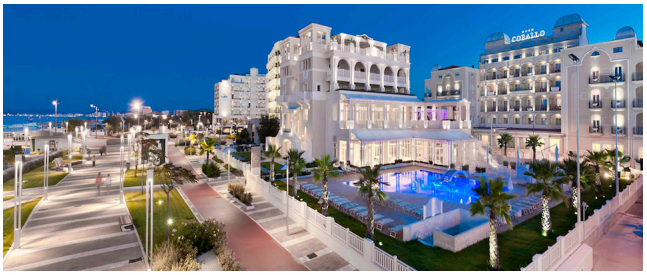

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Experimental Demonstration of Super-radiant Emission of Coherent Cherenkov Diffraction Radiation

Tuesday, 6 June 2023 12:00 (20 minutes)

Recent years have witnessed an intense development of accelerator-based sources generating radiation from radiowaves to hard X-rays. Intense electromagnetic radiation in the far-infrared spectral range is an advanced tool for scientific research in biology, chemistry, and material science because many materials leave signatures in the radiation spectrum. Monochromatic lines in the spectrum with variable frequency enables researchers to investigate the matter response in greater detail. The development of variable frequency far-infrared radiation sources has therefore become a broad area of research. High energy electron beams consisting of a long train of dense bunches of particles provide a super-radiant regime and can generate intense highly monochromatic radiation due to coherent emission in the spectral range from a few GHz to potentially a few THz. At Tomsk microtron we have employed a novel coherent Cherenkov diffraction radiation mechanism in super-radiant regime. This effect occurs when a fast charged particle moves in the vicinity of and parallel to a dielectric interface. Two key features of the ChDR phenomenon are its non-invasive nature and its photon yield being proportional to the length of the radiator. The bunched structure of the very long electron beam produced several spectral lines that were observed to have frequencies from 7 upto 21 GHz with a relative bandwidth of 0.001 –0.01 % defined by the shape and the length of the bunch train. A compact linear accelerator can be utilized to control the resonant wavelength by adjusting the bunch sequence frequency. These mechanism can potentially be integrated in X-ray free electron lasers. After the undulator the still powerful electron beam is terminated in a beam dump. By integrating a compact radiator (or even a series of radiators) one may extract a fraction of the residua beam power and convert it into a THz radiation source to be used for fundamental and applied research.

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