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Concepts of Short Period RF Undulators

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Several concepts for room-temperature RF undulators, fed by cm- or mm- wavelength radiation and aimed to produce ~1 nm wavelength radiation using relatively low energy electron beams, are considered. The preliminary analysis shows that requirements to electron beam quality and to RF power become more severe with wavelength reduction (the undulator parameter and the acceptable energy spread in electron beam are to be scaled almost linearly). In order to satisfy these requirements, we suggest to build an undulator of several separate segments, each segment introduces a high-Q cavity fed by its own multi-megawatt RF source. The 30 GHz pulsed gyroklystron or possibly gyrotrons at 30 - 300 GHz, already elaborated and tested in IAP RAS, are appealing candidates. These sources can provide the effective undulator period of 0.5 - 0.05 cm, the undulator parameter of the level from 0.01 to 1, and the effective field length of 50 cm for each segment. The design of undulator cavity at centimeter waves is based on waveguide technique, but at millimeter waves the three-mirror cavity design is proposed. All designs avoid problems with a co-propagating wave destroying beam optics and spectra of the scattered optical radiation.

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