* **Abstract**

Nowadays, production of ultrashort and high current electron bunches of few fs to hundred fs with several pc charge is a very attractive subject in the context of many recent applications specially in free electron lasers [[[1]](#endnote-1)]. In free electron lasers, the radiation gain is directly proportional to the beam pick current [[[2]](#endnote-2)] and so obtaining very short bunches on the order of fs plays an essential role for high gain machines. Unfortunately, direct production of such electron bunches from an electron source is impossible. This is due to huge effect of nonlinear space charge forces at low energies where electrons are generating from a cathode [[[3]](#endnote-3)], [[[4]](#endnote-4)]. Consequently, recent approaches for production of such electron bunches are based on usage of photo injectors in combination with a chain of bunch compressors [[[5]](#endnote-5)]. In this approaches, first a long (≈ ps) but high quality electron bunch is generated in a photocathode RF gun and than accelerated up to an optimum value where the space charge forces would be suppressed significantly. In the next step, the produced bunch which possess now a negligible space charge, is injected into a magnetic chicane to provide more bunch compression. In the chicane, using the correlated energy spread of the electrons, a convenient series of magnets brings the bunch length under control and compress it up to a great extent. Unfortunately, in this approach not only the whole structure becomes large, but also, due the unavoidable effect of coherent synchrotron radiation in magnets [[[6]](#endnote-6)], the bunch quality damages significantly. In the European compact light project [[[7]](#endnote-7)], attempts are directed toward the designing a novel compact hard X-ray free electron laser beyond the state of the art, using the latest advanced studies worldwide. The project will be started form a novel photo injector which can provide very high quality and in the meantime ultra-short electron bunches in a compact structure. This injector for further bunch acceleration, would be followed by a high gradient x-band linac (100 MeV/m) up to few GeV and completed with a initiative compact short undulator for hard X-ray extraction. The design of the required electron source is a very challenging part of the design procedure since it has a great impact on the other parts of the project from the quality and cost point of view. Currently, the designing of the required electron source as an important part of this project has been awarded to the IPM accelerator group and the first proposal on this subject presented.

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