TO THE NEW SOURCES FOR PHOTO-NUCLEAR REACTION STUDY

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Photo-nuclear reactions give important information on nuclear structure and excited states [1]. Their study, however are considerably hindered by the quality of accessible gamma beams. Namely, while bremsstrahlung radiation has very wide spectrum, gamma beams from both relativistic positron annihilation and tagged electron beams have low intensity [1]. We propose to develop sources of gamma radiation for photo-nuclear reaction study utilizing coherent effects in $e^{\pm}$ radiation in crystals and ordered structures of composed of nanoobjects, such as grapheme and nanotubes. Both narrow spectrum and high intensity of such sources will be ensured by correlated $e^{\pm}$ scattering by ordered atoms, characterized by both enhanced intensity and periodicity. Advantages of such sources will become most pronounced at high $e^{\pm}$ energies (a few GeV and more), they should be preferably realized in a spurious mode at the beams of X-ray lasers and linear e^{+}- e^{-} colliders.

First gamma-source we propose to use is crystalline undulator. This idea was put forward in Belarusian State University [2] and consists in using radiation preferably of more stably channeled e^{+} in the field of crystal planes periodically bent with some undulator period λ_{und}. Unique properties of such radiators are assured by the high strength of averaged planar field equivalent to hundreds Tesla as well as by small λ_{und} values, say, from dozens to hundreds μm. Ultra-relativistic particle oscillation frequencies are directly converted to that of gamma-radiation by Doppler effect [2,3]. The energy 5–20 GeV of the e^{+} beam of FACET [4] allows to cover the region 0.1÷10 MeV of gamma-quanta energy.

However the applications of crystal undulators are considerably limited by the need of positron beams, accompanying intense hard channeling radiation and limitations of the choice of undulator parameters by that of crystal lattice. To overcome this limitations we suggest to use a stack of graphene layers. The latter can consist of one or several graphene sheets, having a nanometer-scale thickness and average internal electric potential reaching 20 eV. Intrinsic grapheme corrugations will effectively smear out the internal atomic structure leaving inside the multilayer graphene sheets a smooth electric field equivalent to a few dozens of Tesla. Varying both the spacing between the graphene layers and direction of the e^{-} beam incidence on them one can adjust the gamma-quanta energy through the whole region of photo-nuclear reactions.

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