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Development of a monolithic diamond ΔE-E telescope for particle identification and characterization of diamond detector using the ToF-eBIC technique

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Diamond is a promising material for particle detection due to its very high resistivity, excellent charge transport properties (high mobility and long lifetime) and its high radiation hardness. Therefore, diamond is a particularly interesting material for studying charged particles such as alpha particles or fission fragments. For this purpose, a monolithic diamond ΔE-E telescope is under development. In that kind of detector, an incident particle will first depose a part of its energy (proportional to Q^2/v^2) in the ΔE stage before stopping in the E stage by depositing its remaining energy (proportional to A.v2). The correlation between the two energy deposits will lead to the identification of the incident particle. Thus, the ΔE-E telescope can have various applications in nuclear physics such as fission fragment detection or the identification of particles generated in radiative environment.
In addition, a time resolved eBIC (electron Beam Induced Current) setup has been developed in order to study the signals resulting by the interaction of low range charge particles in diamond detectors and the charge transport properties in diamond. The strength of this setup is its ability to monitor easily the energy deposited in the detector, the number of interactions per second and the spatial position of the area of interest. Thus, charge collection mappings of diamond detectors have been done and the homogeneity of the response has been studied. Moreover, diamond charge properties have been investigated in a large range of temperatures (down to 4 K) and some very interesting effects due to the anisotropy of the conduction band of diamond has been highlighted.

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