Efficient positron trapping at a linac based positron source using a silicon carbide remoderator

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A modified buffer gas positron trap is described, with a silicon carbide single crystal remoderator which replaces the gas in the first trapping stage. The device is used to accumulate positrons from a low energy electron linac based positron source [1]. Compact accelerator based positron generators are viable alternatives to radioactive isotope based slow positron sources when high and constant intensity is needed without persistent radioactivity. The broad energy distribution and the pulsed time structure of the primary beam limits their use for positron annihilation spectroscopy and other experiments. Accumulation and cooling of the positrons in a buffer gas trap produce a low energy positron cloud which can fill a high field positron accumulator [2] or can be directly used to form a continuous beam of good quality downstream. We constructed and tested a trap system, filled by a 9 MeV electron linac based positron generator, which can accumulate and cool the particles efficiently for further use. The new trapping scheme replaces the nitrogen gas, usually applied in the first stage of the trap, with a silicon carbide single crystal, used as a remoderator. The positrons are subsequently cooled into a potential well by carbon dioxide gas between the linac pulses. The trapping efficiency of the remoderator assisted scheme is significantly higher than that of a conventional buffer gas trap. We present details and performance of the new device and discuss how the new trap is integrated into the positron line of the GBAR (Gravitational Behavior of Antihydrogen at Rest) experiment at CERN [3].

[1] M. Charlton et al, Positron production using a 9 MeV electron linac for the GBAR experiment, *Nuclear Instr. and Methods A* **985**, 164657 (2021).
[2] Niang, S.; Charlton, M.; Choi, J. J.; et al., Accumulation of Positrons from a LINAC Based Source, *Acta Physica Polonica A* **137**, 164(2020).
[3] B. Mansoulié, GBAR Collaboration, Status of the GBAR experiment at CERN,
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