Do we need a mono-energetic spin-polarized positron beam?

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In the framework of the Helmholtz national roadmap for large scientific infrastructures, the Helmholtz-Zentrum Dresden-Rossendorf [1] plans a significant upgrade of the existing ELBE center for high-power radiation sources. The new facility DALI (Dresden Advanced Light Infrastructure) will feature an increased number of beam lines dedicated to super-radiant coherent THz radiation [2] with high repetition rates and high intensities. Various applications in solid-state physics, biological systems, and material sciences are envisioned which will focus on fs-resolution pump-probe techniques, angular-resolved photoelectron spectroscopy, high-pressure cells, and in-situ bio-sample handling.
Additionally, the available intense electron beam (50 MeV energy, 2 mA average current) with MHz repetition rates serves as a driver for intense secondary positron sources thus extending the available positron beam intensity beyond the existing MePS (Mono-energetic Positron Source) installation [3]. Besides a high-intensity positron source for depth-resolved positron annihilation lifetime spectroscopy studies, a spin-polarized mono-energetic positron beam could be realized which would open a new field of applications for electron-spin sensitive studies.
With Helmholtz' mission in mind to serve the (inter-)national scientific community with large scale infrastructures for the advancement of science, the focus is now on the feasibility of such an installation and scientific visions of the communities justifying the effort of realizing such a project. Pioneering work by the BEPPO collaboration at the Thomas-Jefferson National Accelerator Facility (TJNAF) on polarized positron production from an energetic spin-polarized electron beam [4] demonstrated the proof-of-concept of spin-transfer up to 82%. However, the high-repetition rate DC photo-injector at TJNAF features only a small electron bunch charge and a new source for nC of spin-polarized electrons with repetition rates of 1 MHz has to be developed.
In the contribution, we will discuss possible spin-related phenomena ranging from surface magnetism as shown in [5,6], defect related magnetism and predictions of spin-dependent annihilation lifetimes [7].

References

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