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Investigation of In-Flight Annihilation of Positrons using Coincidence Doppler Broadening Spectroscopy

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Doppler Broadening Spectroscopy (DBS) of the positron electron annihilation line allows the analysis of defects inside materials. DBS uses the fact that during the annihilation momentum has to be conserved and is therefore transferred to the annihilation gammas. As a sufficient approximation the positron is assumed to be thermalized in the solid when it annihilates with an electron. In that case, the majority of the transferred momentum originates from the electrons.

However, when implanting high-energy positrons a small fraction of positrons will annihilate with electrons before thermalizing. This process of in-flight annihilation can be differentiated from annihilation of thermalized positrons by Coincidence DBS (CDBS). We used the CDB Spectrometer at the NEutron induced POsitrone source MUniCh (NEPOMUC) in order to get a deeper understanding of in-flight annihilation in several materials of different densities and core annihilation probabilities. As positron source we utilized a ^{22}Na source to supply high energy positrons. This not only gives insight into the thermalization process of the positron but also further expands the capabilities of the CDB Spectrometer.

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