

LOW ENERGY LEPTON SCATTERING – RECENT RESULTS
FOR ELECTRON AND POSITRON INTERACTIONS

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Abstract. The interaction of low energy electrons with atoms, molecules and materials underpin a large number of technological, environmental and biomedical processes that impact on our everyday lives. Many of these areas have been well studied over the years and in some cases a large body of important and relevant cross section data has been gathered to assist in the understanding and development of the technology or phenomena. A perfect example of this is the area of low energy gaseous electronics where microscopic cross section information for a whole host of scattering processes (vibrational and electronic excitation, dissociation, ionization) have been critical to an understanding of the macroscopic behaviour of a range of gas discharge environments – large area plasma processing discharges being a case in point.

More recently there has been a realisation that fundamental information about both low energy electron and positron interactions also have significant bearing on issues of radiation damage in biological materials. Low energy electrons have been shown to cause significant damage to DNA strands, for instance, as a result of processes such as dissociative attachment – a process which can occur at energies down to 0 eV. These processes result from the production of copious low energy electrons (< 20 eV) when high energy ionizing radiation thermalises in the body. This realisation has provided an enormous boost to the field of low energy electron physics and spawned an enormous number of new studies of interactions with biologically relevant molecules.

In a similar fashion, low energy positron interactions are thought to be fundamentally important for an understanding of the atomic and molecular processes that underpin technologies such as Positron Emission Tomography (PET). PET scans image the coincident 511 keV γ -rays that arise from the annihilation of an electron-positron pair. During a PET scan, high energy positrons thermalise in the body through scattering (ionization and excitation of molecules) until their energy is low enough (typically below ~ 100 eV) for positronium formation, quickly followed by annihilation, or free electron annihilation, to occur. Essentially no information exists on the fundamental positron scattering processes from important biological molecules that lead to the γ -ray emission.

This talk will attempt to provide an overview of these aspects of the field of low energy lepton interactions with atoms and molecules and discuss some recent experimental advances in the field.