N90-18978

MULTIPLE-IONIZATION OF XENON ATOMS BY POSITRON IMPACT

Georg Kruse, Andreas Quermann, Wilhelm Raith, Günter Sinapius

Fakultät für Physik, Universität Bielefeld, D-4800 Bielefeld 1
Federal Republic of Germany

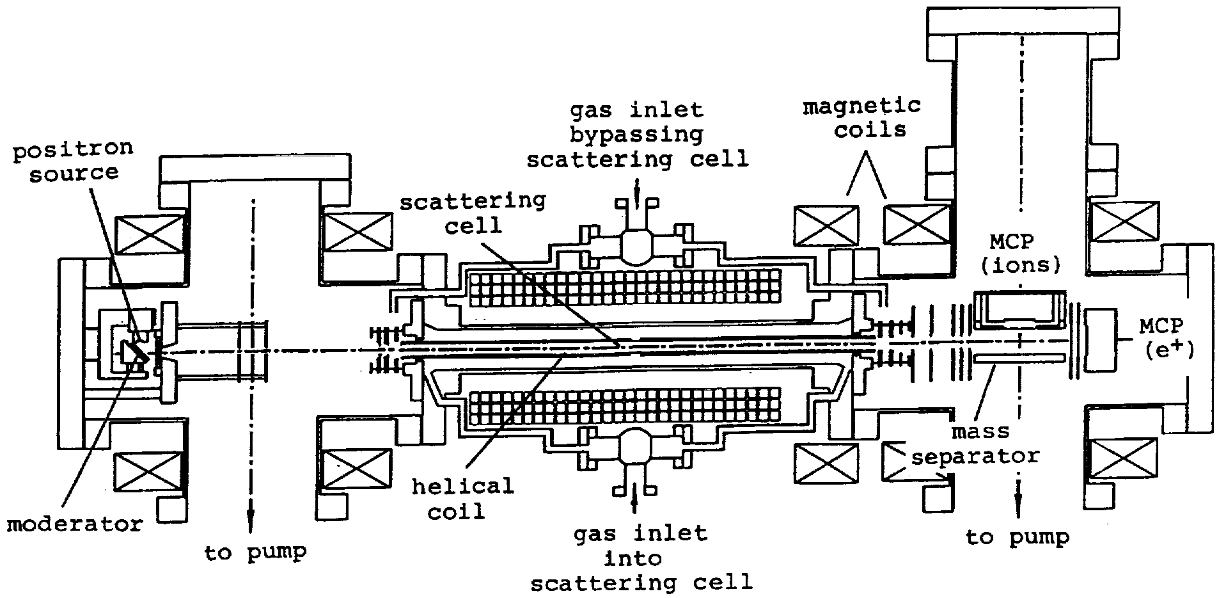

Figure 1 Cross section of the apparatus

Previously we measured the cross sections for positronium formation (σ_{Ps}) and single ionization by positron impact (σ_{ion}^{1+}) for He and H_2.[1,2] With the same apparatus, slightly modified, we are now investigating the single and multiple ionization of xenon. The principle of our method is the detection of ion and positron in time correlation which allows the discrimination of positronium formation (whereby the positron vanishes) and the destinction of single, double and triple impact ionization (which lead to different ion flight times from the gas target to the ion detector).

By using secondary electrons from the positron moderator we also perform similar measurements on electron impact ionization. By comparing with literature values for electron multiple ionization cross sections[3] we determine the detection-probability ratios for the differently charged ions.

Fig.1 shows a cross section through our apparatus. The main difference to the set-up used earlier[1,2] consists of a much stronger magnetic field (about 0.12 T in the center of the scattering cell), produced by a water-cooled coil. The higher field strength reduces the loss of ions due to wall collisions.

One of our goals is the measurement of the following ratios as functions of energy for positrons as well as electrons:

$$R_2 = \sigma_{ion}^{2+}/\sigma_{ion}^{1+}$$
$$R_3 = \sigma_{ion}^{3+}/\sigma_{ion}^{1+}$$

First results, demonstrated in Fig. 2, indicate that at 1 keV for positron impact both these ratios are considerably larger than for electron impact. For the ratio of double to single ionization cross section of helium above 200 eV Charlton et al.[4] found the opposite behavior.

References

1) Fromme D, Kruse G, Raith W, and Sinapius G 1986, Phys.Rev.Lett. 57, 3031-4

2) Fromme D, Kruse G, Raith W, and Sinapius G 1988, J.Phys.B: At.Mol.Opt.Phys. 21, L261-5

3) Krishnakumar E and Srivastava S K 1988, J.Phys.B: At.Mol.Opt.Phys. 21, 1055-82

4) Charlton M, Andersen L H, Brun-Nielsen L, Deutch B I, Hvelplund P, Jacobsen F M, Knudsen H, Laricchia G, Poulsen M R, and Pedersen J O 1988, J.Phys.B: At.Mol.Opt.Phys 21, L545-9

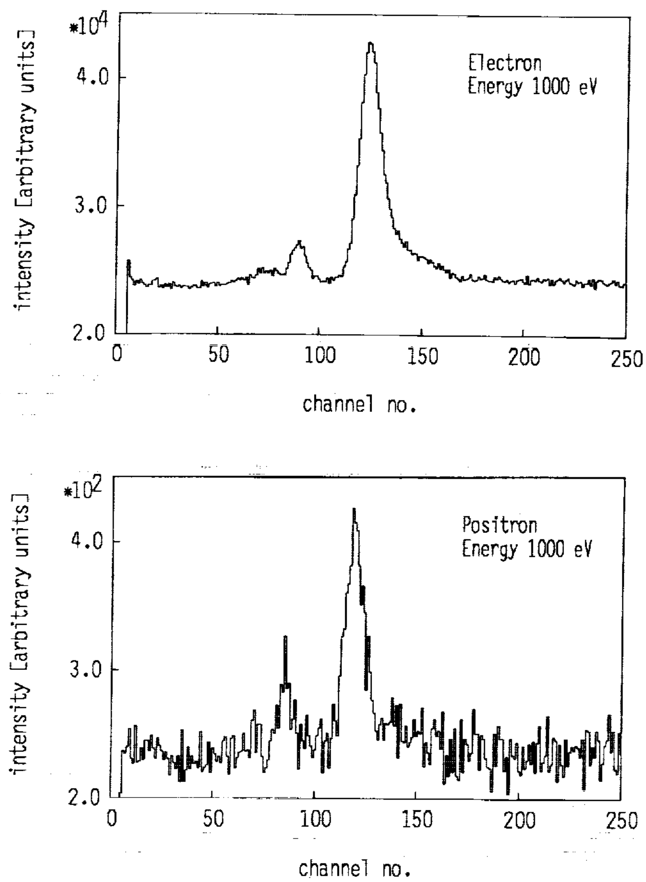

Figure 2 Time-correlation spectra obtained with 1000 eV electrons (top) and 1000 eV positrons (bottom).