

Abstract

A new practical method to determine the ion recombination correction factor (k_s) for plane-parallel and Farmer-type cylindrical chambers in particle beams is investigated.

Experimental data were acquired in passively scattered and scanned particle beams and compared with theoretical models developed by Boag and/or Jaffé. The new method, named the three-voltage linear method (3VL-method), is simple and consists of determining the saturation current using the current measured at three voltages in a linear region and dividing it by the current at the operating voltage (V) (even if it is not in the linear region) to obtain k_s .

For plane-parallel chambers, comparing k_s -values obtained by model fits to values obtained using the 3VL-method, an excellent agreement is found. For cylindrical chambers, recombination is due to volume recombination only. At low voltages, volume recombination is too large and Boag's models are not applicable. However, for Farmer-type chambers (NE2571), using a smaller voltage range, limited down to 100 V, we observe a linear variation of k_s with $1/V^2$ or $1/V$ for continuous or pulsed beams, respectively. This linearity trend allows applying the 3VL-method to determine k_s at any polarizing voltage.

For the particle beams used, the 3VL-method gives an accurate determination of k_s at any polarizing voltage. The choice of the three voltages must to be done with care to ensure to be in a linear region. For Roos-type or Markus-type chambers (i.e. chambers with an electrode spacing of 2 mm) and NE2571 chambers, the use of the 3VL-method with 300 V, 200 V and 150 V is adequate. A difference with the 2V-method and some 3V-methods in the literature is that in the 3VL-method the operational voltage does not have to be one of the three voltages. An advantage over a 2V-method is that the 3VL-method can inherently verify if the linearity condition is fulfilled.