An electrostatic charged particle recycling spectrometer

P Hammond* [1], **T J Reddish**[†] [2], **M R Sullivan**[†], **P A Thorn***[,†], **T L Spanjers**[†]

[*] School of Physics, CAMSP, University of Western Australia, Perth WA 6009, Australia
[†] Department of Physics, University of Windsor, Windsor N9B 3P4, Canada

The electrostatic Charged Particle Recycling Spectrometer (RS) consists of two 180° hemispherical deflector analysers (HDA) connected by two mechanically identical lens stacks as shown in figure 1 with an overall orbit circumference of 0.65 m and typical orbit times of ~300 ns for 30 eV electrons. Each lens stack has two 3-element cylinder lenses separated by a central field-free region, labeled M and T in the figure. The RS was originally designed to enable ultra-narrow energy resolution electron spectroscopy by generating electrons in region M via laser photoionisation and directing these electrons after passage through an HDA onto a target gas jet in region T. Unscattered electrons were to be collected and redirected through the second HDA, lens stack and first HDA and back onto the gas jet. In this way unscattered electrons were to be recycled.

The apparatus has been developed using a pulsed charged particle source, initially with electrons [1], and more recently using positive ions. A detailed study has been undertaken of the charged particle optics [2] for the symmetric voltage setting of the system leading to storage stability. In symmetric operation the voltages applied to equivalent components in both HDA's, regions M and T, and the middle element of all four lenses are the same. More recent work extends this analysis to asymmetric settings.

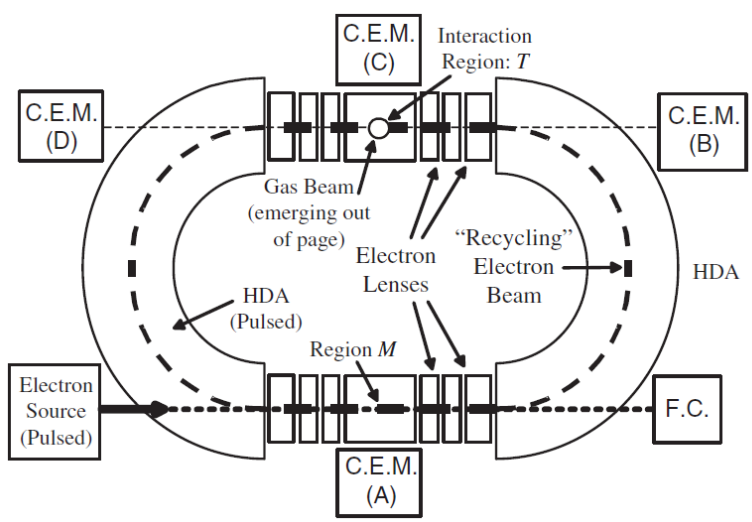

Figure 1. Schematic layout of the Charged Particle Recycling Spectrometer configured for electrons. Charged particle detection is achieved using a Faraday Cup (F.C.) during set-up and channel electron multipliers (C.E.M.) located in key positions as shown, during storage studies.

References

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[1] E-mail: hammond@physics.uwa.edu.au

[2] E-mail: reddish@uwindsor.ca