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Very high intensity ions selective source

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The proposed system allows the focusing of the ions created in a large volume V, on a narrow slit S located at a short distance, with a special configuration of an electrostatic field E and a magnetic induction B. The ions having the same number of mass n are focused on the slit S for a determined value of E.

1) Sensitivity

The sensitivity is evaluated in Amp per Torr of partial pressure. (Other ways generally depend on the specification of the associated pumping system and therefore, are not suitable for comparing the performances.) In the tests recorded here, only the total pressure P was measured and is equal to $4\ 10^{-6}$ Torr , 30 minutes after starting the pumping run from atmospheric pressure. In these conditions , the partial pressure P_{14} for N+ is at the most equal to 10^{-7} Torr. With a gain of 10^{7} given by a MOS amplifier, the height of the peak 14 is equal to 0.25 Volt , corresponding to a signal $i_{14} = .25\ 10^{-7}$ A. The sensitivity in A per Torr is then :

$$i_{14} \times 1 / P_{14} = 0.25 \text{ A / Torr.}$$

2) Resolution

Resolution depends of course of the size of the instrument, the volume of ionization space, the width of the slits ... In this case, these parameters are optimized for the detection of He with the maximum sensitivity while keeping a perfect separation of peaks 2, 3, 4, 5.

3) Conclusion

The proposed system is an Helium detector with an exceptional sensitivity of 0.25 A / Torr. The easy quantitative detection of N_{14} is an advantage in leak detection procedures, as the level of N_{14} is roughly proportional to the leakage rate.
Remark :

a) These results can still be improved, using a more powerful power supply.
b) With a gain at 10^{13} (commonly used with leak detector) the signal would be 1 million time bigger.

4 Technical data for the prototype

Prototype Reve II

E for He $25.\ 10^{3}$ Volt / Meter
B $2\ .\ 10^{-1}$ Weber / m 2
Magnet surface pole 28 cm^{2}
Total ions trajectory's length : 4 cm

Vacuum gauge : 59822A gauge controller (from Hewlett Packard)
Vacuum system : Turbo-Dry 70 (from Varian)
Data Acquisition system : Force7 (from Acquisition Solutions k)

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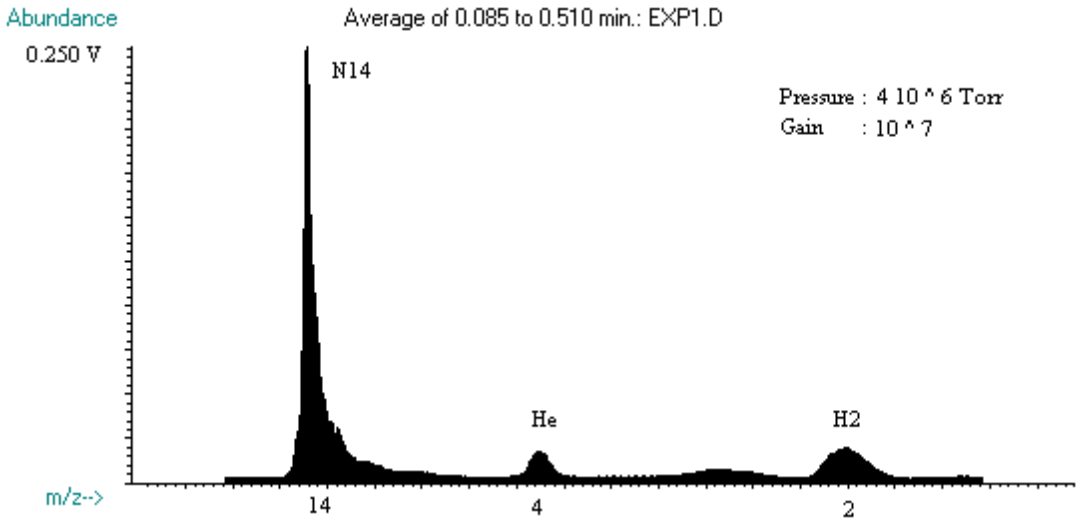

Figure 1 : The signal, 0.25 A / Torr

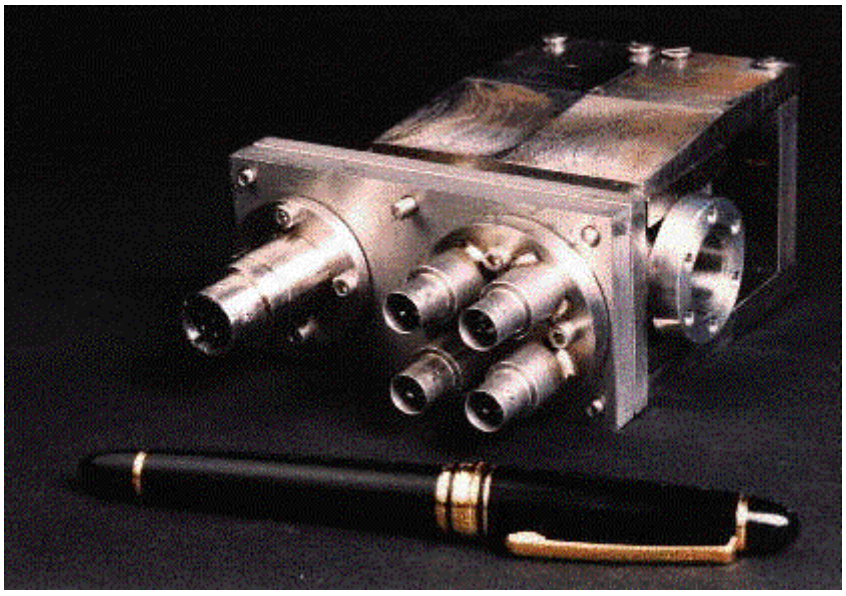

Figure 2 : The Detector