ISR-RF/WS/1s

9th August, 1971

ISR RUNNING-IN

Pressure decrease after dumping

During Run 74, H. Hereward recorded the rate of decrease of pressure immediately after a stack was dumped. From this he deduced the quantity

$$\eta = \frac{\text{excess number of molecules released from the walls}}{\text{number of primary ionising collisions}}$$

which he found to be approximately equal to unity over a certain range of currents.

I have repeated the experiment a few times during Run 89 (all it needs is to run the pressure recorder at a high speed when the beam is dumped) and analysed the result. To simplify the analysis I have used the following formula (cf. derivation at the end)

$$\eta = a \frac{\dot{x}}{x_o I} \qquad (1)$$

with

$a = 1.0$ for a circular chamber of 161 mm diameter

$a = 0.35$ for an elliptic chamber of 161 x 56 mm^2.

I assume that the pressure is recorded on a pen recorder in logarithmic scale. In Eq. (1) $\dot{x}$ is the initial rate of decrease of pen travel in mm/min and x_o is the pen travel for one decade, i.e., $\dot{x}/x_o$* is the initial rate of decrease, measured directly on the paper, in decades/minute. The beam current I is in A.

Applying this to my results of Run 89 (gauge 349.1) I find

η	I [A]
0.34	3.8
1.35	4.66

*The pressure should be constant before dumping. Otherwise one may subtract the value of $\dot{x}$ prior to dumping.

η	I [A]
0.48	3.32
1.9	4.8
1.7	5.0
0.73	2.92
0.89	4.32

The graph (Fig. 1) shows the same information. The scatter is considerably larger than in Hereward's case, although the order of magnitude of $\eta \sim 1$ is confirmed once more.

I would recommend that anyone recording pressure on a pen recorder at high currents should change the paper speed to at least 250 mm/min just before dumping the beam. This would permit us to get better statistics with rather less effort.

Derivation of Eq. (1) (cf. Hereward's note)

We assume that

$$x = x_o \, {}^{10}\log \frac{P}{P_o}$$

(P : pressure)

hence

$$\frac{\dot{x}}{x_o} \, \ln 10 = \frac{\dot{P}}{P}$$

or

$$\frac{q\dot{x}}{Ix_o} \, \ln 10 = \frac{V\dot{P}}{\ell IP}$$

where V is the volume of a piece of vacuum chamber of cross-section q and length ℓ. $V\dot{P}/\ell$ is the rate of gas liberation per unit length, in torr $\ell \, s^{-1} m^{-1}$ say, produced by the beam. We change to the number of molecules released, taking

$$\frac{3.2 \cdot 10^{19} \text{ molecules}}{\text{torr } \ell}$$

at 300° abs. Assuming (as does Hereward) 1.2 primary ionising events per second at 10^{-9} torr and 2.08 x 10^{10} protons per metre at 1 A in the ISR one finds Eq. (1).

W. Schnell

Distribution

ISR Group Leaders
Running In Committee
Engineers in Charge
RF Group
E. Brouzet MPS
M. Höfert HP

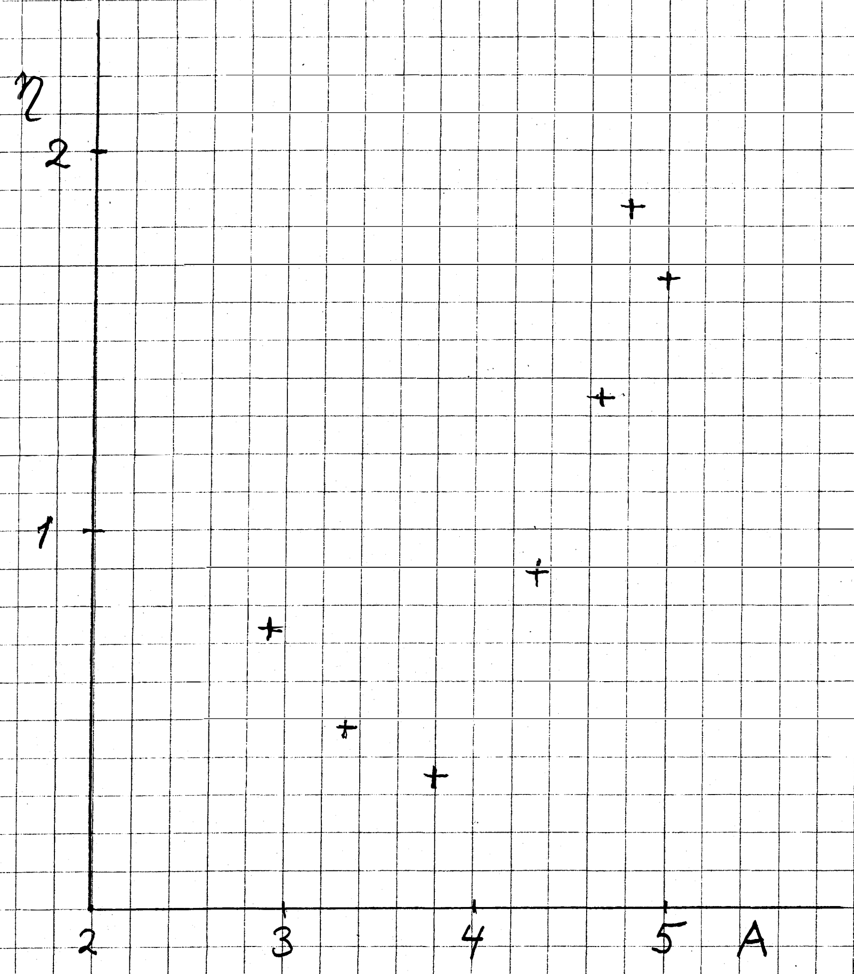

Fig 1