Helvetica Physica Acta
Vol. 59, 1986 561-562

018-0238/86/040561-02$1.50+0.20/0

IDEAS FOR A SATURNE NEW SOURCE

R. Vienet

Centre d'Etudes Nucléaires de Saclay
Laboratoire National Saturne
91191 - Gif sur Yvette, Cedex, France

If we consider a classic ionizer, due to the 0.2 Tesla magnetic field and to the 14 mm aperture diameter, the beam emittance is, at least, 5.10^{-6} m.Rad. normalized. Furthermore due to the space charge of an intense electron beam inside the ionizer, the energy spread is $\pm$ 400 eV. So, the measured normalized emittance at the output of the electrostatic accelerator (400 kV) is about 10.10^{6} m.Rad in our device. Consequently the overall efficiency up to the injection in the accelerator ring Saturne of the polarized beam is only 9 %.

While, with the low emittance heavy ion source (Cryébis), this efficiency is about 30 %. Even though the energy spread at the output of the R.F.Q. injector is $\pm$ 1.8 kV at 400 kV.

In order to gain this factor of 3, we propose a new scheme which would also provide a more intense ion beam, in Saturne.

1. **First step**

Suppose we install 10 beams of 7 mm diameter with an energy spread 200 eV. Those beams being separated, in energy, from one to another, by 200 eV ; after an electrostatic mirror these 10 beams will take the same path, as shown in figure n° 1.

So at 400 keV (for polarized deutons), we will obtain a total emittance of $\frac{5}{4}.10^{-6}$ m.Rad n., with an energy spread which will fit the linac injector and the synchrotron admittance, like it is with the R.F.Q. scheme.

The total gain will be $3 \times \frac{10}{4} = 7,5$. That means Saturne will provide $7,5.10^{10}$ polarized particules.

2. **Second step**

In our synchrotron due to the multiturn injection process the horizontal admittance is small, but the vertical admittance is large. So we can take advantage of a different shape of the magnetic field at the source output, as shown in figure n° 2.

3. **New source scheme (Figure n° 3)**

The atomic beam is flat and it is focused by a spacial alternate magnetic field,* the R.F. transitions should also have a rectangular symmetry. The central electrodes of the ionizer (E3) are made with 10 electrically isolated small pipes. A voltage of 200 V is applied beetween every one. So the ions will have a final energy difference depending upon the pipe where they have been created.

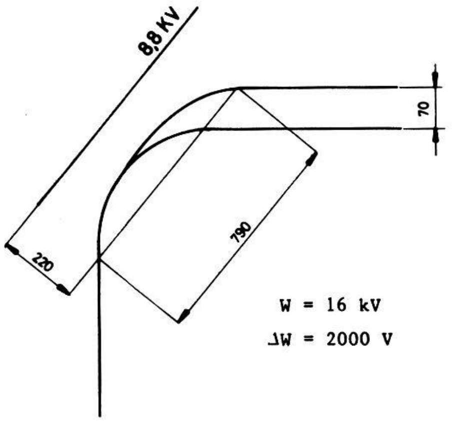
After the electrostatic mirror the 10 beams become only one with the same elementary emittance but with an energy spread of $\pm$ 1000 eV.

This beam is accelerated at 187 keV/nucleons by an electrostatic D.C. voltage.

4. Conclusions

The programs of our Laboratory is first to build and test MIMAS, our new injector and to improve the actual polarized ions sources. Furthermore to focus a flat beam with an alternate magnetic field devices, we need a 1000 m/sec velocity atomic beam. Untill, now, we did'nt succeed to get a lower than 200 m/s beam. Before to start the building of such a source, there are theoretical and experimental developments to carry on.

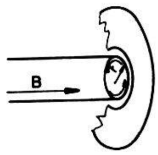
*Internal report, J.C. CIRET - LNS/SD 82-02



W = 16 kV

ΔW = 2000 V

Figure n° 1 : The 10 beams become 1 beam after, the electrostatic mirror,

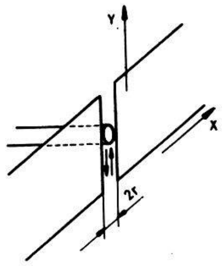


$$E_{rr'} = \frac{\pi r^2 \, e \, Bo}{2 \, mo \, C}$$

B = 0,2 Tesla

r = 0,7 mm

S = 5.10^{-6} m.Rad n.



$Exx' \simeq 0$

$$Eyy' = \frac{\pi r^2 \, e \, Bo}{mo \, C}$$

Figure n° 2 : The x x' emittance is 0 with a rectangular symmetry magnetic field,

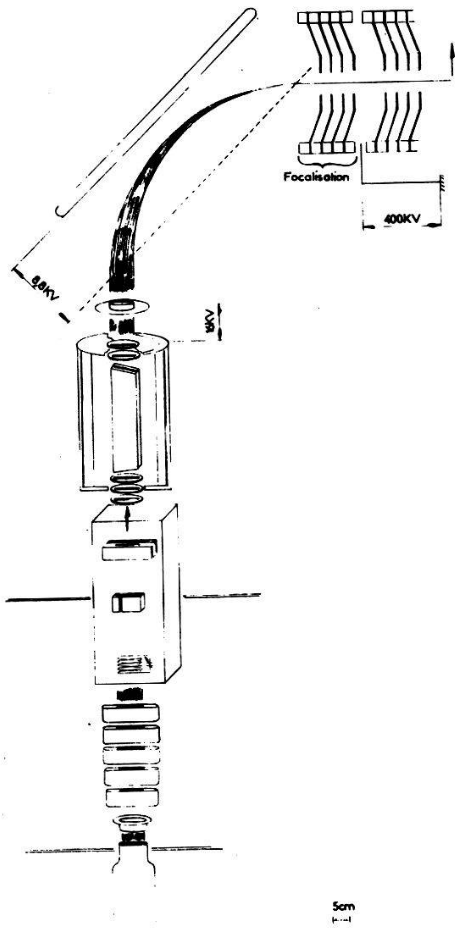


Figure n° 3 : Ions source scheme