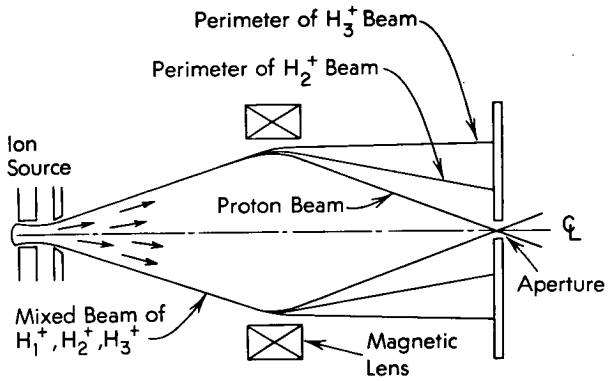
NASA TECH BRIEF

Ames Research Center

Mass Separator for Low Velocity Ions

The problem:

To provide a broad beam of protons free of other charged species in order to simulate the solar wind in experiments that are designed to determine its effect on materials.



The solution:

Purify the effluent beam from an RF discharge or other source operating with hydrogen by separating the protons from the H_2^+ and H_3^+ ions with the aid of a magnetic lens.

How it's done:

The separator is based on the fact that the focal length of a magnetic lens depends on the momentum of the charged particle that traverses it.

Referring to the figure, it is evident that only particles of a particular mass will be focused through the aperture. Other masses will be focused at different axial positions and thus will form a larger image at the plane of the aperture. When properly designed, the magnetic lens system will permit essentially all ions of the desired mass to pass through the aperture. Only a small fraction of the others will be transmitted along the axis of the beam. These unwanted ions plus charge-exchange neutrals and photons from the source can be more or less completely eliminated by a small opaque stop placed on axis. Further purification of the beam could be achieved by adding another lens and aperture in series with the first.

The large $\Delta m/m$ associated with low-mass ions aids in making this simple system highly efficient for the purification of proton beams. The magnetic lens system is small and lightweight and, moreover, it requires only a single DC power supply; it can operate at high voltage and thus be used to separate the ions before acceleration. Transmission approaches 100%, compared to less than 10% for the RF separator commonly used for this application.

Notes:

1. This type of mass separator should be generally useful for separating all types of low-energy ($<$10 keV) light ions.
2. The following documentation may be obtained from:

   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)
   Reference: NASA CR-73443 (N70-40901),
   Solar Wind Simulation Techniques
3. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B72-10123

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

Source: Harry J. King of
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