An Accelerator for Leptonic Magnetic Monopoles

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Avertissement: Cet accélérateur initialement proposé par Georges Lochak a fait l'objet d'un brevet conjoint de Maurice Bergher et Georges Lochak et a été realisé, par la suite, sous la direction de Maurice Bergher

***Abstract**: Leptonic magnetic monopoles are generated via high voltage capacitive discharges (or electric arcs). The principle of an accelerator for monopoles - a **Monopole Cyclotron** – is suggested in the present paper.*

I. Historical Background of the Invention. What is a magnetic monopole?

A magnetic monopole is a particle that carries only one magnetic pole ($+$ or $-$: south or north). The existence of monopoles was conjectured in the past by some great physicists, among whom Coulomb, in the eighteens century, and J.C. Maxwell and Pierre Curie in the nineteens century, who made similar conjectures concerning symmetry.

Two theories due to P.A.M. Dirac, 'tHooft and Polyakov discuss the hypothesis of a magnetic monopole, which would be a heavy boson with strong interactions. The heaviest monopole predicted by 'tHooft and Polyakov would have the mass of $1cm^3$ of hydrogen!

Here, we consider a massless, fermionic monopole with weak interactions, predicted by the author of the present paper [4]-[7], confirmed by a large range of experiments. The most important experimental results are due to the Urutskoiev group (Recom , Kurchatov Institute, Moscow) [8], [9], [10], [12] and confirmed by the Kuznetsov group (Unified Institute of Nuclear Researches, Dubna) [11]. Theory and experiments will be the subject of an extensive Bibliography at the end of the present paper. For the present, we need only a few details to have a clear discussion of the merits of a propulsion device.

The light monopoles of this disclosure are created by high voltage electric discharges in a liquid medium (generally water), by two different methods:

a) The Urutskoiev experiments (at Moscow) are performed with a powerful capacitive discharge source and give important results, concerning notably the transmutation of chemical elements and the modification of isotopic spectra [8], [9], [12_1].

b) A less powerful device was used by Ivoilov (Kazan) with an arc of only 40 A and 80 volts. In spite of the low energy, interesting experiments were realized, in particular on emulsion traces of monopoles [12_2]. These traces were extensively described for the first time by Urutskoiev [8], [9], but Ivoilov proved the chiral properties predicted by theory [5], [6]. While the Urutskoiev system is based on a large capacitors, it seems that important experiments can nevertheless be accomplished by lower energy systems and designs at smaller dimensions.

Efficient production of magnetic monopoles and their control is precisely the aim of the accelerator project that will now be described.

II - The accelerator:

a) Accelerated particles : The idea of an accelerator was derived from the theory but one only needs to know, for the moment, that the magnetic monopoles employed in this device are *massless particles carrying a magnetic charge with a definite sign.*

b) Focusing of monopoles: The magnetic radiation emitted by both sources of monopoles is a mixture of $+$ and $-$ monopoles in all directions. *In order to focus* the monopole radiation, Ivoilov placed his source (which is small) inside a pair of *Helmholtz coils*. As a result he got strong effects at a distance of several meters from the source, in spite of the weakness of this source and of the presence of atmosphere.

c) <u>The accelerator</u> (Fig. 1) :

Little attention was paid until now to two aspects of Ivoilov's focusing device:

1) *The beam emerging from Helmholtz coils is* **monopolar**, because monopoles of opposite signs are carried by the magnetic field in opposite directions, with different chiralities, which is important for certain experiments, particularly in biology and in beta radioactivity.

2) *The monopoles are not only focused by the field : they are* **accelerated**. *More exactly, their* <u>*impulse increases*</u>. The last expression is used because our monopoles are ultra light particles (even massless) and so their velocitiy is *relativistic*, close to the velocity of light. The motion does not obey the equation :

$$m\frac{d^2x}{dt^2} = gH \qquad (m = \text{mass}, \qquad g = \text{magnetic charge}, \; H = \text{magnetic field})$$

It obeys the relativistic equation : $\frac{dp}{dt} = gH$, where $p = \text{impulse}$.

p is not equal to mv with a constant m, excepted when the energy, E is constant, which defines a kinetic mass : m = E / c^2 although the rest mass is zero. But in an accelerator, the energy increases. Thus, we can only assert that **the impulse increases in proportion to the time and to the magnitude of the applied magnetic field.**

Therefore, an **electromagnet** acts as a **linear accelerator for magnetic monopoles**.

3) **The circular accelerator - Fig. 1**. Consider a **circular electromagnet,** i.e. a toroidal pipe wrapped by a coil of electromagnet wire : i.e. the preceding electromagnet wound about a circular tube. If the diameter of the torus is sufficiently large with respect to the diameter of the pipe, **the magnetic field lines will be circular and parallel inside the tube**. Each monopole will follow one of these lines, with an impulse tangent to the circle and the impulse will increase as long as the monopoles remain inside the tube.

4) **Injection.** An aperture at the external side of the tube is positioned tangentially to the axis of the Helmholtz coils of the Ivoilov source. These coils will direct the motion of monopoles, like in an electric accelerator. The coils will be oriented towards the *interior* of the torus, under a small angle with respect to the impulse of particles.

5) **Ejection.** A second aperture is positioned with a second set of Helmholtz coils oriented from the torus at a small angle, oriented to the exterior. During the acceleration stage, the power in these coils will be cut off, and then, at precisely timed intervals, the power will be turned on in the ejector, creating a magnetic field that attracts the monopole to the exterior.

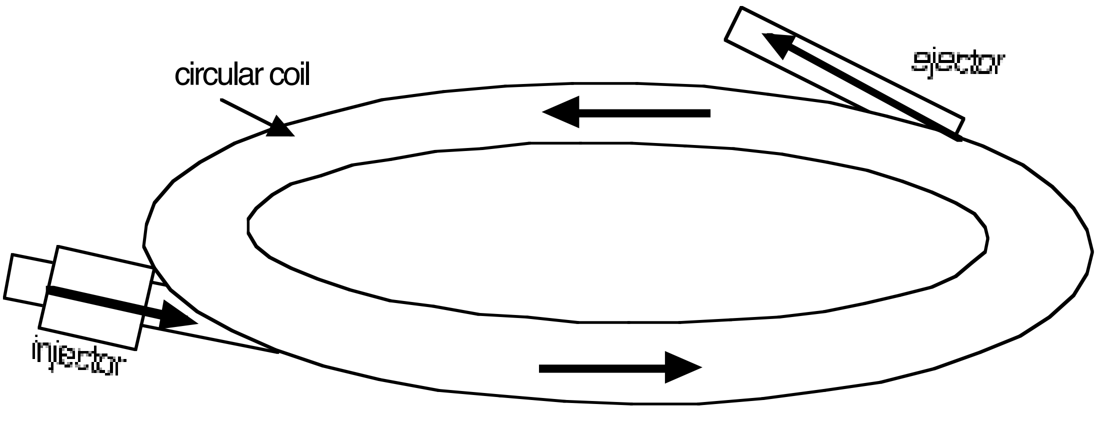

Fig. 1 Accelerator for monopoles of one sign. The other sign is lost.

6) This concept naturally lends itself to consideration of a **double accelerator Fig. 2** : an obvious choice since the source produces a mixture of monopoles of opposite signs. The aim of the double accelerator is to accelerate the monopoles of both signs. This opens a new difficult question because the two signs of monopoles are fundamentally different particles:

a) They can have opposite charge *constants,* which can, in principle, happen after a collision between a monopole and a coulombian electric charge [5], [6].

b) They can be mutually *antiparticles*, i.e. monopoles with the same charge constant but with opposite chiralities, as a neutrino and an antineutrino [5], [6].

c) They are spin ½ particles with relativistic velocities. So, the spin lies along the velocity vector, but according to the charge, it is oriented in the direction of velocity and so is the direction of rotation, or in the opposite direction.

Thus, a double accelerator opens a large range of potential uses.

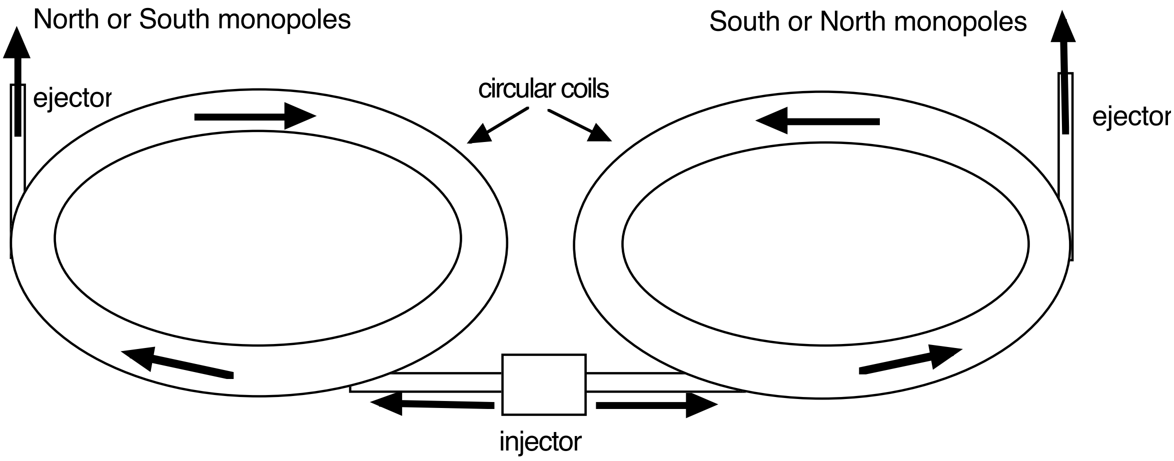

Fig.2. Double accelerator. Monopoles of both signs are available.

7) **General remarks. C**uriously, it seems simpler to build an accelerator for monopoles than for electric particles. There are three reasons :

a) There is only one manner to direct charged particles: a magnetic field. For magnetic monopoles the toroidal field carries particles along circular magnetic lines. For electric particles, we need Laplace force and so on.

b) The acceleration of monopoles is a consequence of conveying particles along the Magnetic field lines. We cannot do so with electric particles because we cannot create a long curved electric field, which could continuously accelerate the particles (we can do so only in a Van de Graaf accelerator). Short accelerating intervals are required, with many difficulties.

c) The third reason is that our monopole accelerator design is rough and quite elementary. It's current design is similar to the low complexity of the first cyclotron, with its 6.5cm diameter and several thousands electron volts. That device was naturally less difficult to operate than today's synchrotrons of many Gev!

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