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METHODS FOR EXPERIMENTAL VERIFICATION OF ISODUAL LIGHT

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Abstract

In this paper, we review the mathematical and physical foundation of the 1997 R. M. Santilli's paper on the hypothesis that light emitted by antimatter is an anti-Hermitean image of ordinary light, called by the author "isodual light," thus having all characteristics opposite to those of ordinary light, including negative energy and expected repulsion by a matter gravitational field; we review evidence obtained via Santilli telescopes with concave lenses of film traces that appear to be caused by galactic light with negative energy; and we propose a new method for producing isodual light in laboratory for subsequent measurements of the effects of isodual light on targets.

1 Introduction

Since the time of Dirac's prediction of antiparticles and their detection, the theory of antimatter has been essentially developed at the level of second quantization.

This occurrence has created an unbalance between the theories of matter and antimatter at the classical and first quantization levels, as well as a number of shortcomings, such as the inability for the classical theory of antimatter to have a quantized formulation which is the correct charge (or PTC) conjugate of that of matter.

In order to resolve these shortcomings, in 1995 Santilli proposed a new anti-isomorphic image of conventional mathematics [2] characterized by the map of the conventional unit called isodual map, or isoduality:

$$+1 \rightarrow 1^d = -1^t = -1 \qquad (1)$$

It should be noted that the change of the basic unit implies a simple, yet unique and non-trivial change of the totality of conventional mathematics, including numbers, angles, functions transforms, vector and metric spaces, algebras and geometries, etc.

This new map and isodual mathematics provide a novel classical representation of anti-matter not just on the charge conjugation level but also at gravitational level with the prediction of anti-gravity defined as the reversal of the sign of the curvature tensor for massive antiparticles in the field of matter with subsequent predictions of relevance in a number of fields [1]:

Prediction 1: Massive stable isodual particles (anti-matter made of positrons and anti-protons, such as the anti-hydrogen) experience anti-gravity (repulsive gravity) in the field of matter and ordinary gravity in the field of anti-matter.

The implications at cosmological level are profounds since this prediction suggests that galaxies made of matter naturally repel and isolate themselves from galaxies made of anti-matter except from rare instances where anti-matter objects possess too high kinetic energy to be effectively swerved away from each other and they subsequently impact against each other.

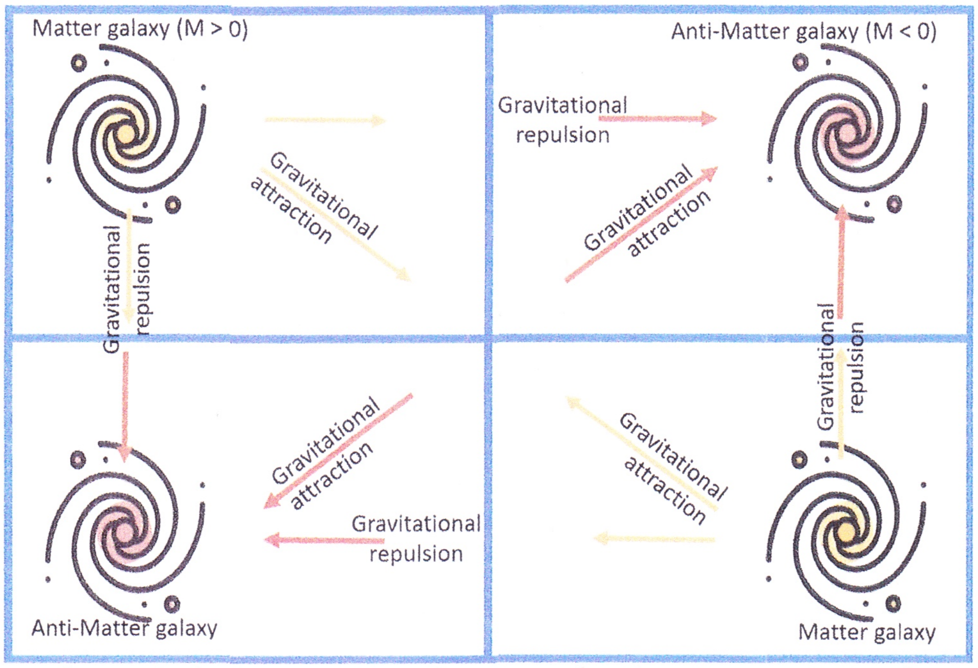

Image 1: An interpretation of matter and anti-matter gravitational interactions showing how it is possible for the two to remain gravitationally segregated.

One candidate particle for testing this prediction in a laboratory setting would be to measure the gravitational deflection of a horizontal positron beam with low enough kinetic energy so that the deflection upward or downward caused by earth gravity would be apparent at the end of the flight tube [10].

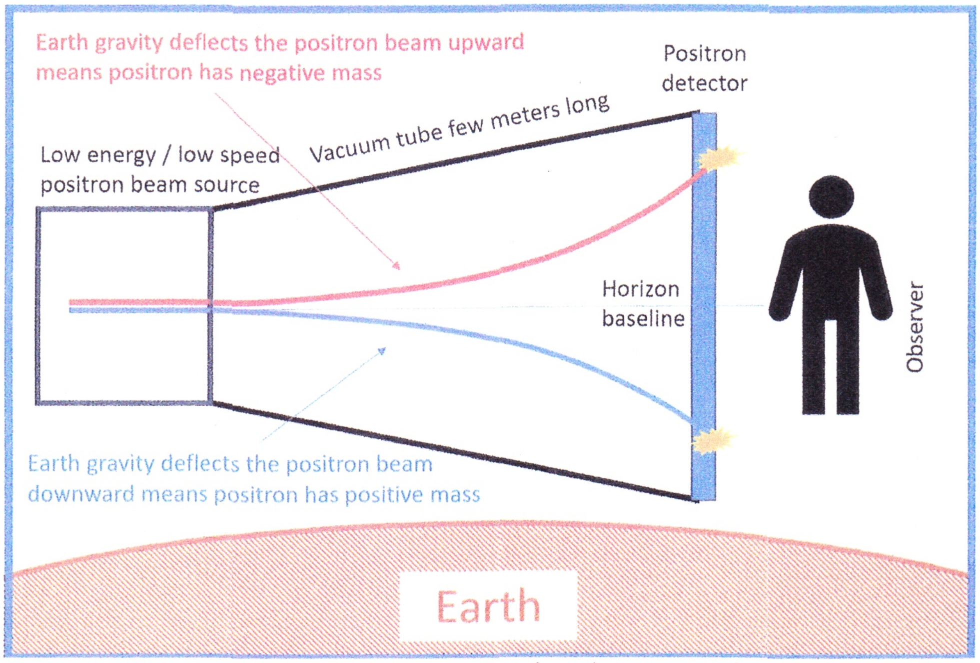

Image 2: Testing the negative mass of isolated positrons by measuring their gravitational deflection on a horizontal flight within a sufficiently shielded vacuum tube.

Prediction 2: Bound states of massive stable particles and their isoduals (such as the positronium) experience ordinary gravity in both fields of matter and anti-matter.

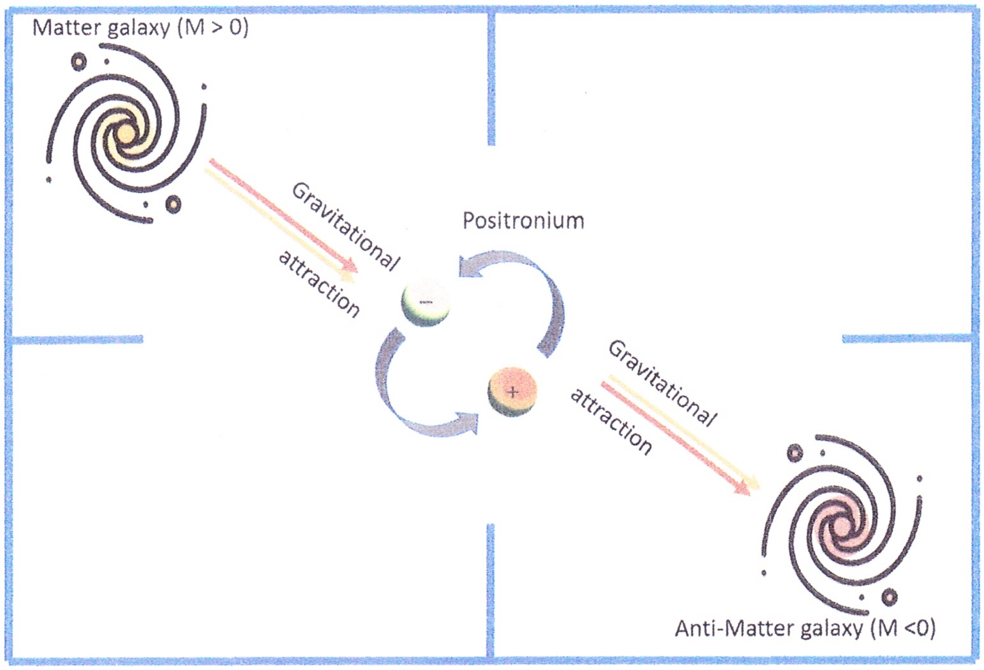

Image 3: Graphical interpretation of the positronium and the effects of gravity and anti-gravity fields being both attractive

We should hereby clarify the nature of the positronium as an isoself dual particle since it is evidently invariant under the isodual map interchanges $e \rightarrow e^d, e^d \rightarrow e$.

As such it possesses a positive spectrum E_n as referred to our spacetime, as well as exhibiting a negative spectrum when studied in the isodual spacetime.

The total state of positronium in our spacetime ($\hbar = 1$) is given by $|Pos> = |e> \times |e>^d$ and subsequent Schrodinger equation: [3]

$$i\frac{\partial}{\partial t}|Pos> = (p_k \times p^k/2m)|e> \times |e>^d + |e> (p_k \times p^k/2m)^d \times^d |e>^d + V(r) \times |e> \times |e>^d = E_n|Pos>, \ E_n > 0 \quad (2)$$

With a conjugate expression in isodual space-time here omitted for brevity.

This isodual interpretation of the positronium recovers the available information on electromagnetic and weak interactions of antiparticles.

When annihilating the positronium will yield one iso photon and one isodual counterpart:

$$Pos. = (e\,,e^{d})_{IQM} \;\rightarrow\; \gamma + \gamma^{d} \tag{3}$$

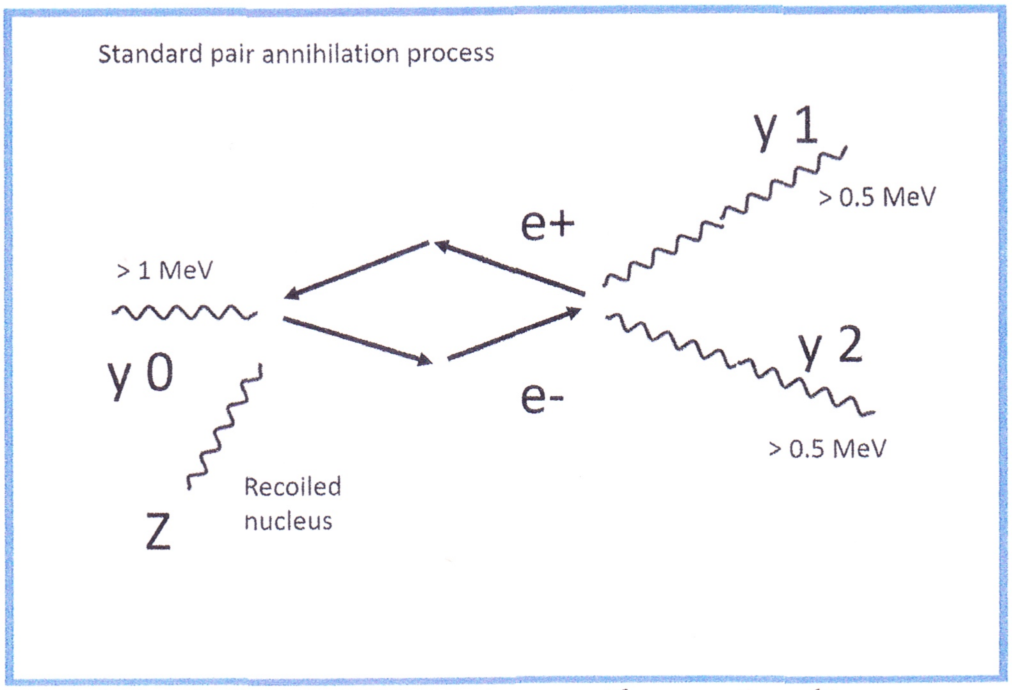

Image 4: Standard pair annihilation process with generation of 2 gamma rays both with positive energy

Prediction 3: Antimatter produces isodual photons who experience antigravity in the field of matter and anti-gravity in the field of anti-gravity.

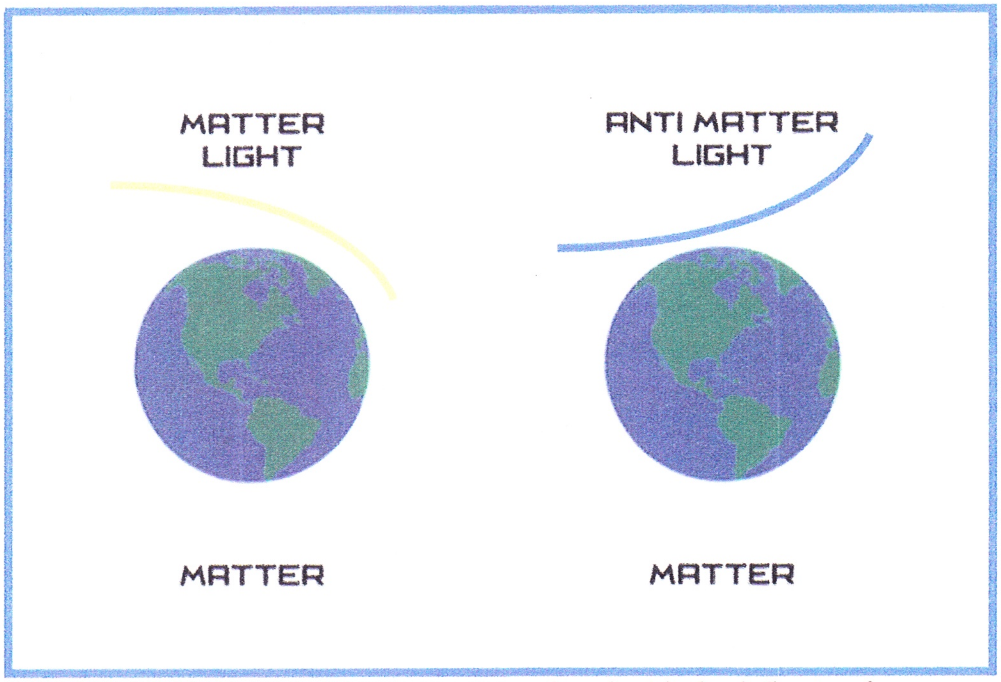

Image 5: Graphical interpretation of isodual light deflection by a gravitational field

To explain this last point we shall compare the photon and isodual photon plane wave and energy equations [3] / (2.3.59 …).

For a conventional photon we have:

$$\psi(t,r) = N \times e^{i\times(k\times r - E\times t)}, N \in R \tag{4A}$$

$$\psi(x) = N \times e^{i\times k_\mu \times x^\mu} \tag{4B}$$

$$E = h \times \nu \tag{4C}$$

Whilst the isodual photon has:

$$\psi^d(t^d, r^d) = N^d \times^d e_d^{i^d \times^d (k^d \times^d r^d - E^d \times^d t^d)}, N^d \in R^d \tag{5A}$$

$$\psi^d(x^d) = N^d \times^d e_d^{i^d \times^d k_\mu^d \times^d x^{d\mu}} \tag{5B}$$

$$E^d = h^d \times^d \nu^d \tag{5C}$$

To note that both types of photons travel in vacuum with the same absolute speed |c| for which we can verify: $k_\mu^d \times^d k^{d\mu} \equiv \; k_\mu \times k^\mu = 0$, and since the term *i* is isoselfdual then the exponents of the wave representations remain invariant thus confirming lack of contradiction between charge conjugation and isoduality.

Despite the above identities, there is a fundamental difference when describing particles in the basic $\mathcal{R}$ field (like gr, sec, cm) as opposed to an anti particle mapped into the isodual field $\mathcal{R}^d$ for which negative units of reference must be considered thus yielding $gr^d = -gr, sec^d = -sec, cm^d = -cm$, etc.

Through this transformation we then have that a negative energy particle moving backward in time remains causal in our frame of reference as our normally observed positive energy particles moving forward in time.
Therefore the energy of the normal photon above becomes:

$$E = h \times \nu > 0_{\mathcal{R}} \tag{4D}$$

Whilst the isodual photon is expressed as:

$$E^d = h^d \times^d \nu^d < 0_{\mathcal{R}^d} \tag{5D}$$

Thus verifying repulsion of the isodual photons in matter gravitational fields.

2 Additional experimental verification of anti-matter light

During recent years experiments were conducted to test isodual light theory by observing the night sky by means of specially conceived telescopes featuring concave lenses, and subsequent observations of dark streaks on the camera sensor [4], [5].

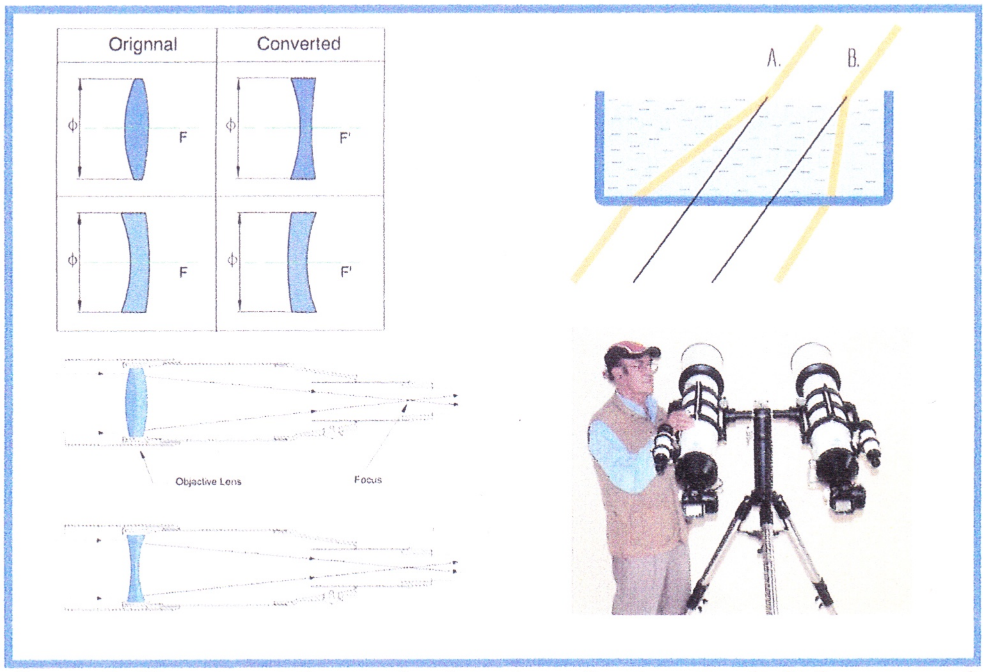

Image 6: Experimental setup for detection of anti-matter light by means of concave lenses as opposed to convex ones because of the negative angle of refraction.

The experimental results seem to extend prediction 3 to the following reformulation:

Prediction 4: In addition to experiencing anti-gravity in the domain of matter, the isolight also experiences negative coefficient of refraction as well as negative energy as referred to the domain of regular matter.

3 Theorical framework of isodual light production

We shall recall in equation (3) how the annihilation of positronium would yield one photon γ along with an anti-photon γ^d .

The energy content of isodual photon γ^d would appear to be positive as seen in the domain of matter, since all experiments involving electron positron annihilation indeed show experimental observation of said photon pairs (on average) and also account for two positive electron masses as opposed to just one positive electron mass (energy) and one negative positron mass (energy).

This fact would also appear to be in conflict with observations with Galileo-Santilli's telescopes where isodual light appears to have negative energy content per prediction 4.

We here present, apparently for the first time, a resolution of said conflicts by proposing that the positron electron annihilation process is in fact the annihilation of 2 electrons and 2 positrons, with equation (3) now being rewritten as follow:

$$Pos. = (e\,, e^d)_{IQM} = e + e^d = e + a_e + e^d + a_{e^d} = 2\,e + 2\,e^d \rightarrow 2\,\gamma + 2\,\gamma^d \quad (6)$$

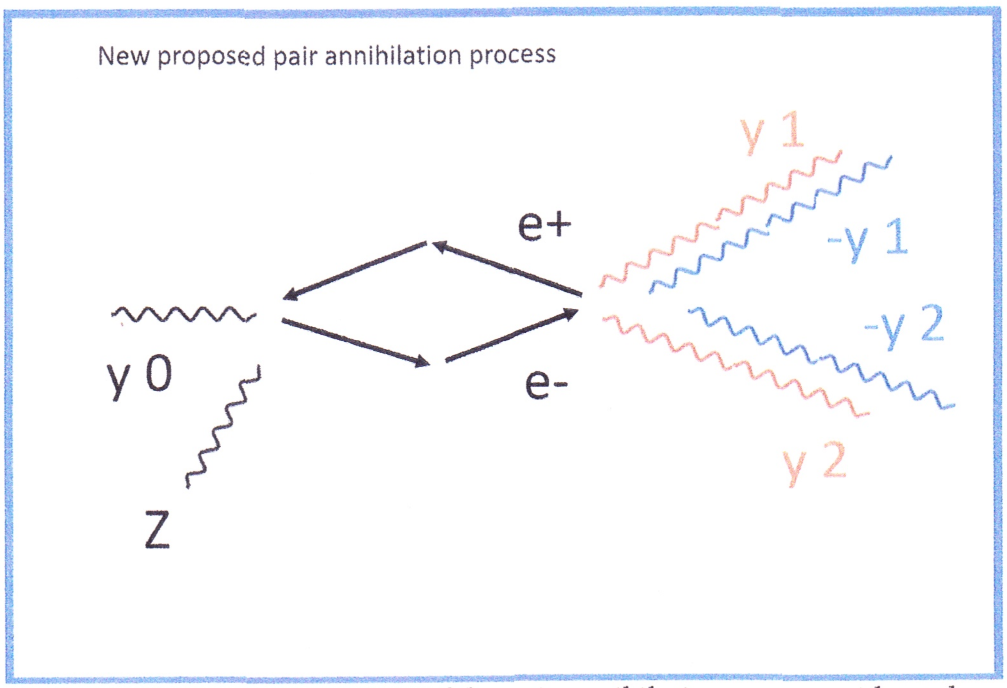

Image 7: New interpretation of the pair annihilation process with total generation of 4 photons

Whereas the annihilation process of one electron and one positron yields in fact the annihilation of 2 electrons and 2 positrons with net emission of 2 positive energy gamma rays normally detected in experimental setups as well as 2 negative energy gamma rays.

To understand equation (6) we must also reference the theorical framework of hadron mechanic formulations, where not all strong interactions necessarily conserve mass and energy since excess energy can be provided by aetherinos [7]:

The excess mass of the neutron of 0.78 MeV when referred to a bound state of a proton and electron.

$$p^+ + a_n + e^- \rightarrow n \tag{7}$$

$$E_{a_n} = 0.782\ MeV \tag{8}$$

The excess mass of pions, kahons, etc when referred to bond states of electrons and positrons in a state of partial mutual penetration.

$$e^+ + a_{\pi_0} + e^- \rightarrow \pi_0 \tag{9}$$

$$E_{\pi_0} = 133.95\ MeV \tag{10}$$

In the case of equation (6), the strong interaction of electron and positron within their isoselfdual state seems to imply an aetheric interaction which namely doubles the number of effective particles at play in the annihilation process.

Moreover in equation (6) there are no new law of conservation of matter (and separately of anti-matter) because of the finite transition probability among these particles established by the Dirac's equation.

Nominally the mass of the positron, being negative as seen from our ISO state, would not violate mass conservation when its appearance out of the aetheric substrate is associated with an electron paired to said positron which fully balance the total mass of the system when accounting for positive masses (of electrons) and negative masses (of positrons).

4 Production of isodual light by means of laser beams

A first possibility to test the conjecture in (6) is to generate bunches of electron-positron pairs [8] by means of a powerful laser beam pointed toward a suitable metallic target.

The subsequent annihilation of electron positron should yield a great number of gamma rays along with "anti-gamma rays" (isodual photons).

The gamma rays can be focused toward a suitable target by means of standard concave lenses and is focused toward a metallic target (ie lead) capable of adsorbing said gamma rays thus causing the metal to warm up.

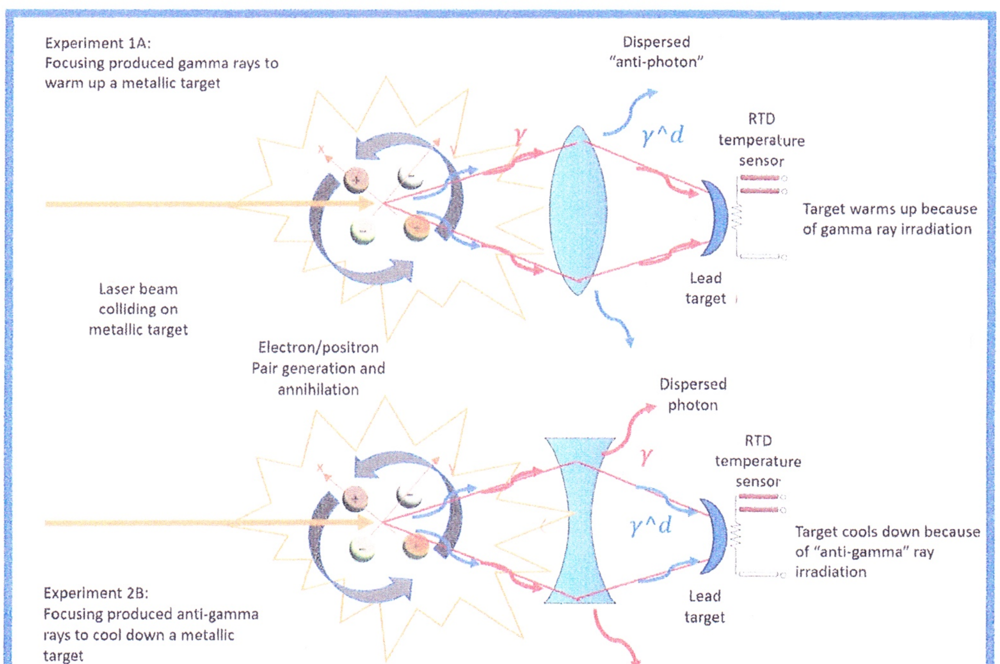

Image 8: A simplified schematic for the detection of isodual light

The anti-gamma ray (or isoselfdual photons) can only be focused by means of concave lenses similarly to what has been done in Santilli's telescopes.

The target should subsequently show a decrease in temperature because of the negative energy content of the isoselfdual photons.

The limits of said experimental method lie in the difficulty of delivering a sufficiently powerful laser capable of exciting pair production beyond the energy threshold of circa 1 MeV per pair.

In this case being 2 x m_e= 2 x 0.511 MeV = 1.022 MeV would require the use of Titan grade laser setup similar to the ones used in inertial nuclear fusion experiments.

5 Production of isodual light by means of positron cyclotron radiation

A possible simplification of the experimental setup depicted in image 8 would be to use a positron source and subsequently use magnetic fields to induce cyclotron or synchrotron radiation to generate a focused isodual light beam.

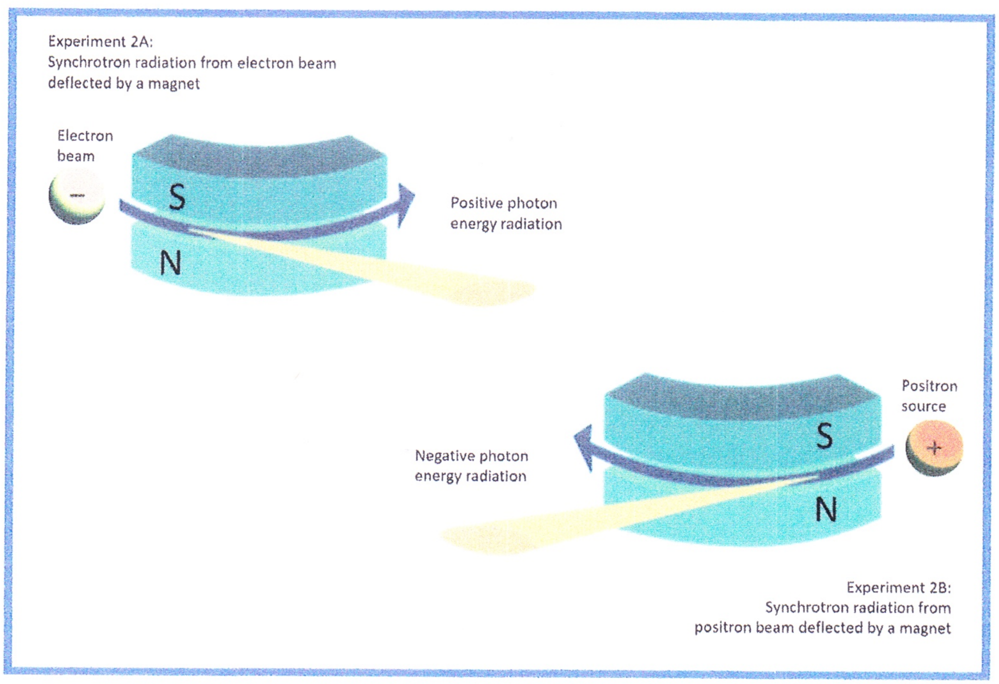

Image 9: Synchrotron radiation from electrons and positron beams should generate photons with positive and negative energy content respectively

Once again a suitable metallic target should be placed radially to intercept the radiation from the positron beam and a cool down effect should be measured.

In this experimental setup the challenge is to obtain a powerful, well focused positron source capable of delivering sufficient radiation power to the target and induce a measurable cooling.

A different approach for the detection and study of positron radiation is to use an undulator setup capable of more effectively converting the positron (negative!) kinetic energy into a well-focused isodual light beam per proposed experimental setup in image 10.

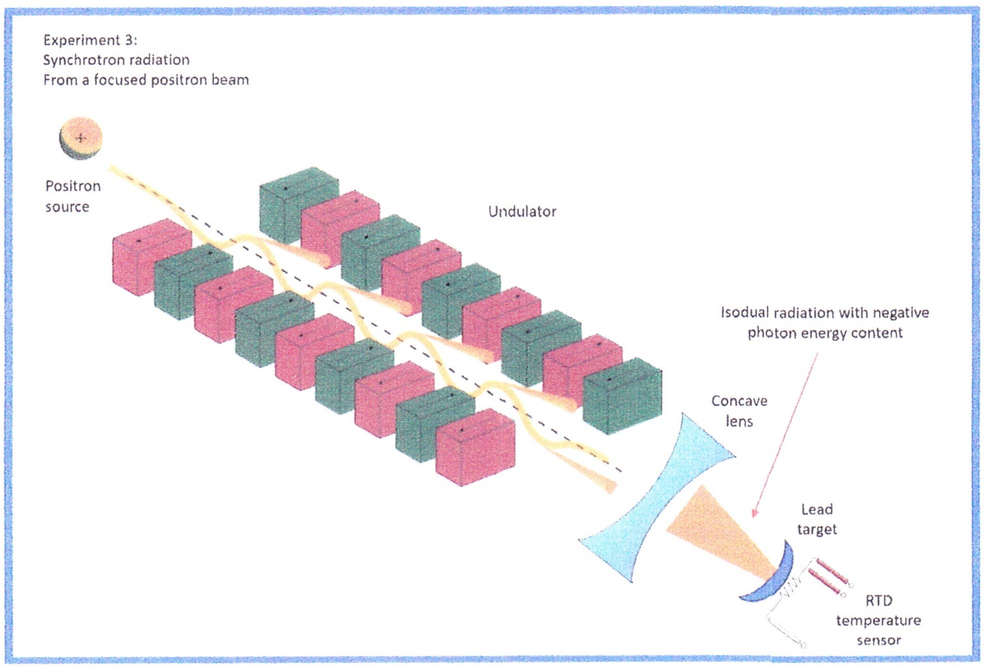

Image 10: Synchrotron radiation from a positron / undulator

In this setup we are once again attempting measuring a temperature drop on the radiation target, however a more precise detection could be achieved by means of a camera sensor and a suitable light source of the same frequency as the produced undulator light per image 11:

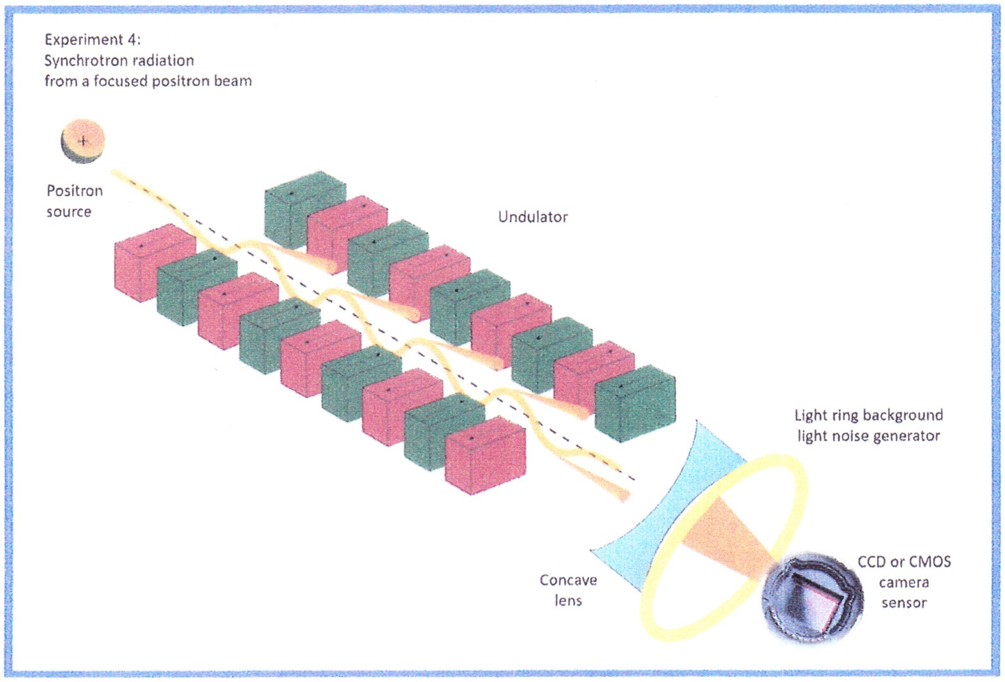

Image 11: Dimming of background radiation by means of a focused isodual light beam

In this final setup we have added a camera sensor similar to a Santilli telescope, as well as an artificial light source or light ring.

This normal light source is meant to provide an electromagnetic background noise toward the camera sensor of the same frequency of the cyclotron radiation produced by the undulator and with a comparable radiated power of the undulator radiation.

The goal of this setup is to measure a dimming of the background noise light from the light ring when positron beams are fed into the undulator in a similar way the detection of anti-matter galaxies leave “dark streaks” on camera sensors otherwise detecting mostly background noise radiation.

6 Possible interactions between isodual light and normal matter

The study of isodual light has been thus far confined to the detection of said radiation emitted by anti-matter galaxies leaving dark streaks on standard camera sensors [5].

This light is indeed very faint and with a fairly low energy content, thus inducing only but minor cooling on electrons or atoms adsorbing it.

The possibility of producing well focused and potentially high (negative!) energy isodual light beams per the methods hereby described can now open a number of applications in the domain of cryogenics and other setups using isodual light beams as the main cooling method as opposed to conventional mechanical cryogenic machines.

An intriguing albeit highly speculative hypothesis at this stage is the possibility to cool electrons or atoms down to temperatures below zero Kelvin.

This has already been achieved [9] on a handful of ions trapped in a lattice matrix at a temperature few billionths of a degree below absolute zero, for which an apparent reversal of gravity was observed as said ions tended to gather toward the top of the magnetic bottle setup as opposed to the bottom prior to sub kelvin cooling.

The apparent reversal of gravity on matter cooled below zero Kelvin could be explained either as a change of the particle mass from positive to negative OR it might have been caused by the reversal of the isodual unit of reference from 1 into -1 (see ref [2] as well as formula (1)), thus implying:

Prediction 5: Matter cooled below zero Kelvin experiences antigravity (repulsion) in the domain of matter and gravity (attraction) in the domain of anti-matter.

Likewise anti-matter heated above zero Kelvin experiences antigravity in the domain of anti-matter and gravity in the domain of matter.

Finally, we would like to propose one last possible interaction of matter with isodual light, when an anti-photon is energetic enough not just to cause an intercepting electron to cool down to below zero Kelvin, but is powerful enough to reverse the mass of the electron from positive into negative, thus causing the electron to flip into a negative mass positron:

$$e^- + \gamma^d = e^{-d} = e^+ \quad (11)$$

Whereas the minimum energy of the anti-photon γ^d for this reaction to occur must be greater than 1.022 MeV in order to energetically offset the "un-creation" of a positive mass electron (0.511 MeV) as well as provide sufficient negative energy for the "creation" of a negative mass positron (-0.511 MeV), whilst the kinetic energy content of the original electron is hereby ignored from this mass balance because of its negligible value compared to the mass terms.

The experimental detection of said reaction should be pretty straightforward to achieve since the subsequent annihilation of the produced positron against common electrons would yield a very characteristic gamma ray signature in the range of 0.5 MeV.

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