



Magnetic signatures recorded in rocks and trees located inside the Tunguska blast 100 years ago, implications for Mirror Matter hypotheses

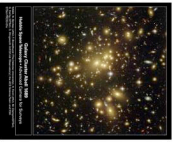
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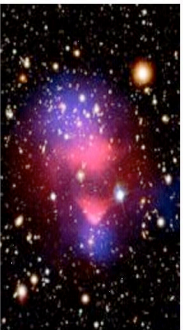


Dark matter

- Evidence for dark matter comes from the study of the motions of galaxies
 - due to only the visible matter of the galaxy, stars far from the center of galaxies rotate faster than predicted
 - velocities are higher than predicted
- The visible material makes up most of the mass of galaxies, but not all of it is Dark matter
 - Galaxies show signs of being composed largely of a roughly spherical halo of dark matter
 - concentrated halo of dark matter in a disc at the center.



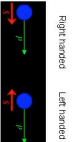
Dark Matter



Composite image of the Bullet cluster shows distribution of ordinary matter, inferred from X-ray emissions, in red and total mass, inferred from gravitational lensing, in blue.

Mirror Symmetry

- Mirror symmetry (MS) is Fundamental property of nature
- General consideration of MS that is invisible but has gravity and weak interactions even regular
- Ordinary matter experiences left-right handedness (right-handed for ordinary matter and left-handed for mirror matter)
- Left-right handedness illustrated on the history of a spin-1/2 particle, in the same way as the direction of the structure of spin and motion are opposite.



Mirror – ordinary matter interactions

- Theoretical constraints
 - Gauge invariance
 - Gauge renormalizability
- Possible types of interactions
 - Photon-mirror photon kinetic mixing
 - Neutrino-mirror neutrino mass mixing
 - Higgs-mirror Higgs interactions



Photon-Mirror Photon Interaction

$$\Lambda = \frac{\epsilon}{2} F^{\mu\nu} F'_{\mu\nu}$$

Λ – Lagrangian (Lagrangian of the system, contravariant covariance of the wave functions)
 ϵ – coefficient related to the amount of (ordinary) matter from ordinary mirror matter
 $F^{\mu\nu}$ – strength tensor for electromagnetic field

ϵ experimental estimate

- Orthopositronium decays faster than expected
- Experimentally measured lifetime of orthopositronium is 142 ns, while the theoretical prediction is 126 ns
- Theoretical prediction is based on the assumption that the annihilation of orthopositronium yields 3γ and not 2γ
- Hypothesized a dark photon that is produced from the annihilation of orthopositronium and decays into two photons
- Theoretical prediction for the lifetime of orthopositronium is 130 ns, which is in agreement with the experimental value of 142 ns
- The dark photon is a vector boson with a mass $m_{A'}$ in the range $10^{-5} - 10^{-3}$ eV

Mirror matter interaction during the impact with Earth atmosphere

- Atmospheric resistance is similar to ordinary matter but has an important difference
- Along the surface of ordinary matter object – Within the volume of mirror matter object

Impact characteristics of mirror/ordinary matter



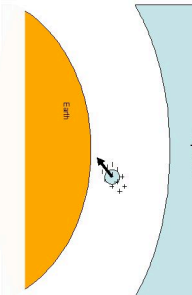
Both types of matter ionize air creating loose protons and electrons

- Weak force acts on the charges of the ordinary matter
- Electrons accelerate several orders of magnitude more
- $a = F/m_{el} \Rightarrow a = F/m_{had}$
- Result is: Charge separation

Tunguska: mirror matter related electric discharge phenomena

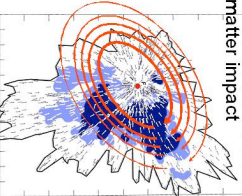
- Mirror matter collides with air with its whole volume
- Heating will not show until body is deeper within the atmosphere
- Mirror matter will melt and suddenly increase the surface area and drag force leading to the explosion
- The explosion will manifest mostly via charge separation and subsequent discharge will generate magnetic pulse of specific geometry

Magnetic pulse due to mirror matter impact

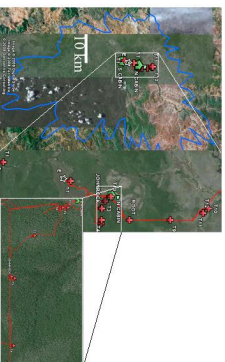


Magnetic field structure during the mirror/ordinary matter impact

- Charge separation leads to continuous discharges that peaks at the time of mirror matter melting
- Discharge due to mirror matter must have specific cylindrical geometry



Site collection



Magnetic signature in trees

- Trees and soil are capable of recording magnetic events
- Magnetic record prior 1908 should have been erased and remagnetized
- Magnetic strength should decrease exponentially with epicenter distance
- Geometry of the magnetic signature should reveal the impact direction and/or multiple objects



Preliminary tree magnetism results

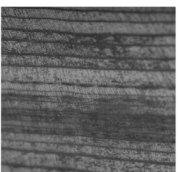
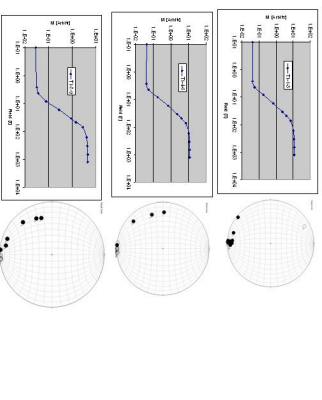


Rock magnetism results

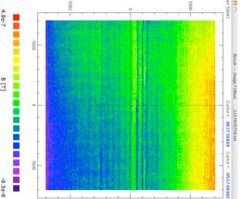


Type of magnetic record due to electric discharge - ED

- Electric discharge creates short term magnetic pulse
- Objects that are exposed must have magnetic carriers in order to record the discharge event
- Record of ED relates to magnetic coercivity of the magnetic carriers



Magnetic scan over the polished section of the wood containing the Tunguska event (in the middle) reveals tree rings and slight magnetic contrast



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