“Einstein Dark Matter” Versus Cold Dark Matter

Jerome Drexler
NJIT Research Professor, Department of Physics
New Jersey Institute of Technology
E-mail: jerome.drexler@NJIT.edu

This presentation is based upon and is a supplement to:

Identifying Dark Matter Through the Constraints Imposed by Fourteen Astronomically Based “Cosmic Constituents”

Posted April 22, 2005 as e-print No. astro-ph/0504512

“Nearly Normal Galaxies in a ΛCDM Universe” Conference,
August 8-12, 2005, University of California at Santa Cruz, Santa Cruz, CA

"EINSTEIN DARK MATTER" VERSUS COLD DARK MATTER

INTRODUCTION

Mankind is now almost capable of explaining the nature of dark matter, the accelerating expansion of the Universe, the departing locations of earthbound cosmic-ray protons with energies above 10^16 eV, how to detect dark matter particles, why dark matter halos have hollow cores, why dwarf galaxies with very high percentages of dark matter have low star formation rates, how dark matter particles create the galactic magnetic fields, and why strongly interacting dark matter particles could form dark matter halos more easily than could weakly interacting massive particles.

In order to explain these phenomena, scientists must analyze and evaluate alternative dark matter candidates beyond cold dark matter, which doesn't seem to be able to explain any of these mysteries, and look to Albert Einstein's relativistic proton as a dark matter candidate that appears to be able to explain almost all of them.

THE NATURE AND CHARACTERISTICS OF COLD DARK MATTER (CDM)

- CDM particles are uncharged and weakly interacting massive particles (WIMPs).
- CDM particles are slow moving.
- CDM particles contain no protons or neutrons.
- CDM particle mass is theorized to be 35 to 10,000 times the mass of a proton at rest.
- CDM particles follow the gravity-based laws of Newton and Kepler.
- Gravity-based CDM halo morphology would be expected to follow the shape of the enclosed galaxy.
- Bottom-up theory of galaxy formation -- small galaxies merge to form large ones.
- Theoretical CDM particles are WIMPs and neutralinos.

SOME LAWS AND PRINCIPLES OF PHYSICS AND ASTROPHYSICS RELEVANT TO RELATIVISTIC PROTONS (RPs)

- Astrophysical dynamo effect -- RPs in Larmor orbits create galactic magnetic fields through the astrophysical dynamo effect; i.e., the RP paths determine the magnetic fields and the magnetic fields determine the RP paths, after an evolutionary period.
- Baryonic limit to dark matter -- there are no constraints regarding dark matter that preclude the possibility that the number of RPs in dark matter could total as much as 15% of the total number of baryons in the Universe.
- Law of Conservation of Linear Momentum -- the total linear momentum of a group of linearly moving objects must remain constant; if the combined mass of a moving galaxy and its DM halo declines, its linear velocity should increase.
- Larmor Radius equation (see page 7) determines radii of curvature of the paths of RPs moving through magnetic fields -- the Larmor Radius of such paths increases directly with proton energy and inversely with magnetic field strength.
- Principles of astrophysical emergence/emergent evolution -- see page 8 footnote.

SOME LAWS AND PRINCIPLES OF PHYSICS AND ASTROPHYSICS RELEVANT TO RELATIVISTIC PROTONS (Continued)

- RP proton synchrotron radiation increases directly with magnetic field and inversely with proton velocity. (Proton synchrotron radiation is lower than electron synchrotron radiation by a factor of 11 trillion.)
- Einstein's Special Theory of Relativity explains that a proton traveling near the speed of light could have a relativistic mass that is orders of magnitude greater than the mass of a proton at rest. Therefore, if the average relativistic mass of the dark matter protons is greater than 35 times the rest mass of a proton and the number of dark matter protons in the Universe is less than 15% of the total number of baryons in the Universe, then the total dark matter mass could be about five times the mass of the ordinary matter in the Universe. This matches scientists' estimates.
- A top-down theory of galaxy formation -- intersecting long, large RPDM filaments create clusters of RPDM protons, which then form cored RPDM halos through emergent evolution principles (see page 8 footnote). Proto-galaxies then form within the halo cores through accretion of protons/hydrogen from the RPDM halos (see astro-ph/0504164).

THE NATURE AND CHARACTERISTICS OF RELATIVISTIC PROTON DARK MATTER (RPDM)

- RPDM strongly interacting protons orbiting the Milky Way probably number about 11 orders of magnitude greater than the number of cosmic-ray protons entering the Milky Way annually from its RPDM halo.

- The number of RPDM protons is <15% of the number of baryons in the Universe; the RPDM proton mass is >35 times the proton rest mass; thus, the total RPDM mass could be about five times greater than the mass of ordinary matter in the Universe.

- Relativistic Proton (RP) motion follows Coulomb's law and the Larmor Radius equation (see next page) -- the Larmor Radius of the RP proton paths is proportional to the RP energy and inversely proportional to the magnetic field strength.

- RPs create muons and electrons through collisions with dust, hydrogen, helium, and CMB photons; RPs then can combine with electrons to form hydrogen.

- Some RPDM protons are transformed over millions to billions of years into hydrogen, and others become cosmic-ray protons plunging into galaxies.

- Intersecting long, large DM filaments create galaxy clusters at their intersections.

THE NATURE AND CHARACTERISTICS OF RELATIVISTIC PROTON DARK MATTER (Continued)

- The RPDM protons' spiral paths in the RPDM halo are determined by the Larmor Radius equation, as follows:

$$r = 110 \text{ Kpc} \times \frac{10^{-8} \text{ gauss}}{B} \times \frac{E}{10^{18} \text{ eV}}$$

where Kpc means kilo parsec and one parsec equals 3.26 light-years

- RPDM halo morphology is determined by the Larmor Radius equation; i.e., they would be spherical/ellipsoidal DM halos with hollow cores.

- RPs in Larmor orbits increase their synchrotron radiation loss when they move into a higher magnetic field or if they slow down.

- Top-down theory of galaxy formation -- galaxies form and grow through the accretion of hydrogen and protons, from an RPDM halo, into its hollow core and onto its enclosed proto-galaxy.

THE NATURE AND CHARACTERISTICS OF RELATIVISTIC PROTON DARK MATTER (Continued)

- The enclosed galaxy disc may be larger or smaller than the RPDM halo hollow core diameter; if smaller, the galaxy should exhibit a low star formation rate (see astro-ph/0504512).
- RPs in Larmor orbits create galactic magnetic fields through astrophysical dynamo effect; i.e., the RP paths and magnetic fields are doubly interrelated, in that each is determined by the other.
- RPs in Larmor orbits emit synchrotron radiation continuously and, thereby, their orbital velocities and relativistic mass decline; thus, the DM halo mass declines and the galaxy separation velocity increases under the Law of Conservation of Linear Momentum to yield an accelerating expansion of the Universe.
- Strongly interacting and randomly moving multitudinous RPs may evolve into the RPDM galaxy halos over millions to billions of years through *emergent evolution** principles (or emergence or collective self-organization).

**Emergent evolution* -- A theory that new characteristics and qualities appear in the evolutionary process at more complex organizational levels which cannot be predicted by studying less complex levels of organization, but which are determined by a rearrangement of pre-existing entities. Also, for emergent evolution principles to succeed, the pre-existing entities must be strongly interacting in conjunction with collective self-organization. (*Emergent evolution* is also known as emergence, astrophysical emergence, or collective self-organization.)

INFLUENCE OF DM ON "COSMIC CONSTITUENTS"

What type of dark matter particles could --

- Form spherical/ellipsoidal dark matter halos around disc galaxies?
- Cause the accelerating expansion of the Universe?
- Be transformed into hydrogen and into cosmic ray protons?
- Create the magnetic fields within and around spiral galaxies?
- Be concentrated in very long, large DM filaments that form galaxy clusters at filament intersections?
- Create large, mature spiral galaxies less than 2.5 billion years after the Big Bang?
- Create spherical/ellipsoidal DM halos having predictable outer and "hollow" core diameters?
- Provide angular momentum to spiral galaxies and their DM halos?
- Create galaxies without a central DM density cusp?

INFLUENCE OF DM ON "COSMIC CONSTITUENTS"

What type of dark matter particles could --

- Create a starless galaxy or a low-surface brightness (LSB) dwarf galaxy with low star formation rates?
- Lead to linearly rising galaxy rotation curves for LSB dwarfs and flat rotation curves for spirals?
- Form 80% to 90% of the mass of the Universe, the remainder being hydrogen and helium?
- Ignite hydrogen fusion reactions of stars utilizing relativistic protons, muons, dust, hydrogen, and helium?
- Create the first "knee" at 3×10^{15} eV, the second "knee" between 10^{17} eV and 10^{18} eV, and the "ankle" at 3×10^{18} eV of the cosmic-ray proton energy distribution at the Earth?

CONCLUSIONS

The RPDM charged particle is a much stronger dark matter candidate than the CDM uncharged particle for a number of reasons:

- The RPDM protons appear to have an influence on or a relationship with 10 to 14 "cosmic constituents" compared to only 3 to 5 for CDM particles.
- The RPDM protons appear to be detected every day as relativistic cosmic ray protons, which bombard the Earth uniformly from all directions; neither the theoretical CDM WIMPs or CDM neutralinos have ever been detected.
- RPDM protons in collision with dust, hydrogen, helium, or CMB photons in space create muons and electrons that can transform the decelerating RPDM protons into hydrogen, the principal building block of ordinary matter.
- The RPDM protons appear to provide an explanation for the departing locations of earthbound cosmic-ray protons with energies above 10^{16} eV.
- The RPDM protons appear to provide an explanation for the accelerating expansion of the Universe.

CONCLUSIONS (Continued)

The RPDM charged particle is a much stronger dark matter candidate than the CDM uncharged particle for a number of reasons:

- RPDM protons could lead, through the Larmor Radius equation, to cored DM halos and thereby to low star formation rates for dwarf galaxies (see astro-ph/0504512).

- Multitudinous relativistic protons in Larmor orbits throughout the Universe are probably responsible for the galactic/extragalactic magnetic fields (whereas electrons in Larmor orbits would lose their kinetic energy too rapidly, through synchrotron radiation losses, to maintain the magnetic fields).

- DM particles may have formed the spherical/ellipsoidal DM halos around the spiral galaxies throughout the Universe, through the principle of astrophysical emergence or emergent evolution (see page 8 footnote). This emergence principle relies on strong interaction among the DM particles to achieve collective self-organization; the RPDM protons are strongly interacting, meeting this emergence requirement, whereas the weakly interacting massive particles (CDM WIMPs) do not appear to meet this requirement.

“EINSTEIN DARK MATTER” VERSUS COLD DARK MATTER

ADDENDUM

HISTORICAL DEVELOPMENT OF THE RELATIVISTIC PROTON DM THEORY

Jerome Drexler
NJIT Research Professor, Department of Physics
New Jersey Institute of Technology

One hundred years ago, Albert Einstein announced the Special Theory of Relativity, which predicted and explained that a proton traveling near the speed of light could have a relativistic mass a thousand, a million, or even a billion times greater than the mass of a proton at rest. The gravitational strength of groups of such massive particles would create extremely large gravity-related tidal forces on nearby matter.

Ever since astronomer Fritz Zwicky discovered the presence of dark matter near the Coma galaxies in 1933, and astronomer Vera Rubin confirmed the existence of a dark matter halo in 1977, cosmologists and astrophysicists have been trying to identify the dark matter particles.

HISTORICAL DEVELOPMENT OF THE RELATIVISTIC PROTON DM THEORY (Continued)

In 1984, scientists developed a Cold Dark Matter theory based upon a theoretical particle, called the Weakly Interacting Massive Particle, or WIMP. They determined over the years that the WIMP dark matter particles would require a mass of 35 to 10,000 times greater than the mass of a proton at rest in order to exhibit the observed gravity-related forces of dark matter. However, searches for WIMP particles during the past 20 years have all come up empty handed.

For this reason, and knowing that the Einstein relativistic proton easily could meet the mass requirement for dark matter particles, the author has endeavored to bring Einstein's relativistic proton idea to the attention of dark matter astronomers, astrophysicists, and cosmologists as well as to NASA, NSF, and the DOE through two recent publications. The author's book, *"How Dark Matter Created Dark Energy and the Sun"* was published in December 2003; and on April 22, 2005, the author's 19-page follow-up paper, *"Identifying Dark Matter Through the Constraints Imposed by Fourteen Astronomically Based 'Cosmic Constituents'"* was posted on the Cornell University Library's arXiv.gov website as e-Print No. astro-ph/0504512. It is available at http://arxiv.org/ftp/astro-ph/papers/0504/0504512.pdf.

HISTORICAL DEVELOPMENT OF THE RELATIVISTIC PROTON DM THEORY (Continued*)*

According to the author, Einstein's relativistic proton appears to have the necessary characteristics of the long-sought dark matter particles, which are estimated by most scientists to comprise 80% to over 90% of the total mass of the universe. Relativistic protons do have the required mass and the required difficulty of detection and can transform themselves into hydrogen by creating and combining with electrons.

Therefore, they are capable of forming galaxies, galaxy clusters, and the associated stringy dark matter filaments and also may be instrumental in igniting the hydrogen fusion reaction in newborn stars. It is estimated that the number of relativistic protons orbiting the Milky Way within the dark matter halo is about eleven orders of magnitude greater than the total number of cosmic ray protons plunging into all the star systems of the Milky Way each year.

HISTORICAL DEVELOPMENT OF THE RELATIVISTIC PROTON DM THEORY (Continued)

However, for this Einstein-based dark matter theory to become fully accepted, there also should be astronomical evidence of multitudinous relativistic protons within the spherical dark matter halo surrounding the Milky Way (and Earth). According to the author, the cosmic ray relativistic protons bombarding Earth every day, uniformly from all directions, go a long way toward providing such astronomical evidence.