CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Ryan A. Dinubilo

Project Number
31078

Project Title
On the Transparency of the Universe and Cosmic Expansion

Abstract

Objectives/Goals
The objective is to propose a theory that solves the apparent "transparency paradox" of the universe; how the universe transitioned from being physically opaque to transparent after the Epoch of Re-ionization. We define the mechanism to be an intrinsic and unavoidable property of the universe, based on its expansion rate and the ionization rate of the intergalactic medium.

Methods/Materials
An algebraic ratio of the expansion rate to the ionization rate of the universe at a given time is used to determine the corresponding physical state of the universe: opaque or transparent. Mathematical calculations of the expansion rates starting at the end of the Re-ionization Era up until present day are obtained by solving the Friedmann equations for the Hubble Parameter as a function of redshift. The corresponding ionization rate of the intergalactic medium is defined in recent scientific papers and the current ionization rate is obtained by linear extrapolation of this data. The two values are then compared to give the physical state of the universe at that time.

Results
It was determined that by the end of the Re-ionization Era, the expansion of the universe had diluted the opaque contents of the intergalactic medium, lowering its density fraction below a threshold value that allowed large-scale transparency.

Conclusions/Discussion
Our calculations supported our hypothesis of the effects of the homogenous expansion of space on the density of the ionized intergalactic medium and indicated that transparency is directly related to metric expansion. The widely overlooked "transparency paradox" was a fundamental problem in physical cosmology, providing an unexplained gap in the timeline of the universe. Our research provides a possible method of filling this hole using simple mathematical tools and current astrophysical data.

Summary Statement
Mathematical manipulation of current astrophysical theories and data is used to solve a fundamental problem in cosmology about the transition of the universe between physical states.

Help Received