

Quarks to Quasars

Paper #3 Assignment: Cosmology in Crisis?

Draft due Tuesday Feb. 26 by 6 pm
Final Version due Friday Mar. 7 by 6 pm
[Submit to Sakai drop box]

Type: critical analysis
Format: Word document (double spaced)
Length: 4-5 pages

In their 1995 article entitled "The Cosmological Constant is Back" Lawrence Krauss and Michael Turner suggest that "we are currently facing a crisis in cosmology".¹ Eight years later, in an article entitled "Supernovae, Dark Energy, and the Accelerating Universe" Saul Perlmutter (leader of the Supernova Cosmology Project or SCP) speculates that recent developments in the standard model of cosmology may be nothing more than a collection of "add-ons, like Ptolemaic epicycles, to preserve an incomplete theory".² More recently, in a 2007 article entitled "Modern Cosmology: Science or Folktale?", Michael Disney notes that the current standard model of cosmology has "fewer observations than free parameters" and thus concludes that "modern cosmology has at best very flimsy observational support".³

So, is there a crisis in cosmology? Is the standard model of cosmology (the Λ CDM model) more than a collection of add-ons? What is the observational support for this current standard model? Are there any outstanding observational challenges to the model? The goal of this paper is to construct a critical analysis of the current state of modern cosmology. You will need to summarize the current standard model and explain the observational evidence that has driven the development of this model. **Your analysis should focus on the question: "Is the standard model of cosmology a self-consistent, well-tested, scientific theory?"** Regarding the last point of this question, you will recall that one of the features that makes the standard model of particle physics a "scientific theory" (rather than a collection of observations) is that it has predictive power. Thus, you should investigate what predictive power, if any, is found in the standard model of cosmology. Finally, you should also take up the issue of the inherent validity of a scientific theory whose core ingredients are, according to Perlmutter, "mysterious substances".²

Although our textbooks will serve as primary references for this paper, I would like you to seek out additional information. Thus you must make use of (and properly cite) at least one technical article (from Science, Nature, Physical Review Letters, Astrophysical Journal, etc.) and at least one article from the popular press (i.e., New York Times, Science News, Time magazine, etc.).

1. L. Krauss and M. S. Turner, *Gen. Relativ. Gravit.* **27**, 1137 (1995).
2. S. Perlmutter, *Physics Today* **56**, 53 (2003).
3. M. J. Disney, *American Scientist* **95**, 383 (2007).