

OBSERVING DARK MATTER: A “STRANGE” PROPOSAL.*

Michael McNeil Forbes[†]

Nuclear Theory Group, University of Washington, Seattle, USA.

In this talk, I will discuss the idea that much of the missing Dark Matter in our universe may consist of nuclear density nuggets of cold strange quark antimatter. Not only is this model consistent with the many known cosmological constraints, but it naturally explains some puzzling diffuse emissions from the core of our galaxy. Furthermore, this model makes definite predictions that should soon be confirmed, or ruled out. If correct, the model provides a natural explanation for both dark matter and baryogenesis.

Synopsis:

1. There is only 5 times more dark matter than baryonic matter, $\Omega_{\text{DM}} \approx 5\Omega_B$, suggesting they may be related.
2. Baryogenesis requires CP violation that is naturally provided by QCD: aka. the strong CP problem.
3. Domain walls resolving the strong CP problem can form quark (anti)nuggets at the QCD phase transition.
4. This CP asymmetry results in more antimatter nuggets, creating the observed baryon excess (baryogenesis).
5. Formation stops when the nuggets become colour superconductors, naturally explaining the photon/baryon ratio.
6. Constraints on dark matter interactions are easily satisfied by the geometric size of the nuggets $B \sim 10^{20-33}$.
7. Nugget properties are firmly rooted in nuclear physics: There are no free parameters.
8. Electrons and protons annihilating on the antimatter nuggets in the core of the galaxy should produce a variety of emissions from eV to GeV scales.
9. These emissions have been observed, and are non-trivially consistent with the properties of the nuggets.
10. We can make model independent predictions that will confirm or rule out this proposal in the next few years.

In this talk, I will present this basic picture, and discuss how observations of galactic emissions can confirm or rule out this proposal in the next few years. In a later talk, Kyle Lawson will discuss details about the emission mechanisms and observations.

*Work supported by the US Department of Energy under Grant DE-FG02-97ER41014.

[†]E-mail: mforbes@u.washington.edu