Abstract for an Invited Paper
for the DNP06 Meeting of
The American Physical Society

Axion Astrophysics and Cosmology[1]

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Experimental evidence suggests that the strong interactions conserve the discrete CP symmetry. Standard Model QCD, however, predicts that CP should be violated unless the angular parameter Θ is exceedingly small ($< 10^{-10}$). The most elegant and compelling solution to this so-called Strong-CP problem was proposed by Peccei and Quinn and involves the spontaneous breaking of a new $U(1)_{PQ}$ global symmetry. The axion arises as the pseudo-Goldstone Boson associated with this SSB. Astrophysics has played an important role in constraining the allowed axion mass. I will review the arguments from stellar evolution and supernovae that lead to an upper bound of 1-10 meV for the mass. Axions with μeV mass have not been ruled out and would have sufficient relic density to be a very plausible candidate for cold dark matter. I will describe different scenarios for axion production in the early universe and comment on their compatibility with current measurements of cosmological parameters. Finally, I will summarize the current experimental and theoretical bounds of the axion-to-photon coupling constant.

[1]Supported by the U.S. DOE contract W-7405-ENG-48.