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A Dark Matter WIMP That Can Be Detected and Definitively Identified with Currently Planned Experiments

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We have proposed a dark matter candidate which is consistent with all current experiments, and observable in the near or foreseeable future through a wide variety of direct, indirect, and collider detection experiments [1,2]. This particle is unique in that it has (i) precisely defined couplings and (ii) a well-defined mass of about 72 GeV/c^2, providing specific cross-sections and other experimental signatures as targets for clean experimental tests. It has not yet been detected because it has no interactions other than second-order gauge couplings, to W and Z bosons. However, these weak couplings are still sufficient to enable observation by direct detection experiments which should be fully functional within the next few years, including XENONnT, LZ, and PandaX. The cross-section for collider detection at LHC energies is small – roughly 1 femtobarn – but observation may ultimately be achievable at the high-luminosity LHC, and should certainly be within reach of the even more powerful colliders now being planned. It is possible that the present dark matter candidate has already been observed via indirect detection: Several analyses of gamma rays from the Galactic center, observed by Fermi-LAT, and of antiprotons, observed by AMS-02, have shown consistency with the interpretation that these result from annihilation of dark matter particles having approximately the same mass and annihilation cross-section as the present candidate. Finally, there is consistency with the observations of Planck, which have ruled out many possible candidates with larger masses. The present theory also requires supersymmetry at some energy scale [3], and the lightest supersymmetric particle (as a subdominant component) can stably coexist with the present dark matter candidate.

[1] Reagan Thornberry, Maxwell Throm, Gabriel Frohaug, John Killough, Dylan Blend, Michael Erickson, Brian Sun, Brett Bays, and Roland E. Allen. "Experimental signatures of a new dark matter WIMP", EPL (Europhysics Letters) 134, 49001 (2021), arXiv:2104.11715 [hep-ph].
[2] Caden LaFontaine, Bailey Tallman, Spencer Ellis, Trevor Croteau, Brandon Torres, Sabrina Hernandez, Diego Cristancho Guerrero, Jessica Jaksik, Drue Lubanski, and Roland E. Allen, "A Dark Matter WIMP That Can Be Detected and Definitively Identified with Currently Planned Experiments", Universe 7, 270 (2021), arXiv:2107.14390 [hep-ph].
[3] Roland E. Allen, "Predictions of a fundamental statistical picture", arXiv:1101.0586 [hep-th].

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