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An additional production mechanism for the diffuse x-ray background

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Abstract. We propose a mechanism that contributes energy and particles to the diffuse x-ray halos of galaxies and clusters, based on the dark quantum states of large-scale gravity wells.

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X-ray observations have shown that galaxies and clusters of galaxies are surrounded by massive gas halos at temperatures 10^6 to 10^8 K with cooling times << Hubble time. A source of energy is required to maintain the hot gas and following the recent discovery that particles in gravitational fields form stationary quantum eigenstates (Nesvizhevsky *et al.* 2003) we propose that baryonic particles in eigenspectra composed of dark gravitational eigenstates (Ernest 2009, 2012) could supply energy and visible baryonic matter required for continual star formation. Quantum theory shows that baryonic particles in such states are transparent to photons but Coulomb interactions between protons in dark states might conceivably either (1) shift their eigenspectra to mixtures of more visible quantum states appropriate to classical particles or (2) result in direct Bremsstrahlung production from dark-state electron collisions that take place at a reduced rate than would be expected from laboratory cross-section measurements. The multitude of transfer channels, and the complexity of deep state eigenfunctions makes quantitative ab-initio quantum calculations of dark to visible eigensptral mixtures impossible (at this stage) although we can estimate within a few orders of magnitude, the required interaction rate for comparison with observations. Dark eigenstates are unable to collapse via traditional classical processes but carry with them the equivalent kinetic energy of a viralised orbiting particle. In the halos of clusters of galaxies case these energies correspond to 1-15 keV while for isolated galaxies energies are between 0.3-2 keV.

As an example of process (1), taking typical galactic values of the average temperature T (eV), density of visible baryons n_b, and halo radius r, as 0.3-2 keV, 10^5 m^{-3} and 10^{21} m respectively, gives the x-ray luminosity L as 10^{36} W, using $L = n_b^2 T^{1/2}/(7.7 \times 10^{18})^2$ or an energy loss of 10^{-13} eV s^{-1} per particle. To balance this energy loss via eigenstate collisions, assuming a dark eigenstate number density n about 10 times that of the visible baryons gives a transfer-to-visible-state collision rate constant k ($dn/dt = -k\, n^2$) of $10^{-27} - 10^{-28}$ m^{3}s^{-1} and corresponding cross section $10^{-33} - 10^{-34}$ m^2 at these equivalent kinetic energies. This corresponds to a visible baryon production rate of 10^8 solar masses over the Hubble time. For clusters the figure is 10^{10} to 10^{11} solar masses.

References

Ernest, A. D. 2009, *J. Phys A: Math. Theor.*, 42, 115207
Ernest, A. D. 2012, in: I. Cotaescu (ed.), *Advances in Quantum Theory* (InTech), p. 221
Nesvizhevsky, V. V., Borner, H. G., & Petukhov, A. K. 2003, *Nature*, 415, 297