Information energy accounts for dark energy, resolves Hubble tension, avoids the 'big chill,' and is falsifiable

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Stellar heated gas and dust in the Centaurus-A galaxy. Credit: NASA Hubble.

Stellar heated gas and dust has an entropy, or information content, with an equivalent energy of 10^{70} joules, directly comparable to the mc^2 equivalent energy of the universe baryon mass. In a study published in *Entropy*, Professor Paul Gough at the University of Sussex shows that this information energy can account for the dark energy causing the accelerating universe expansion.

Earlier, the information energy density grew rapidly with increasing star formation, but leveled off around a red-shift of 1.4, remaining near constant to the present. In this way information energy emulates a cosmological constant in the late universe but also resolves much of the Hubble tension and s8 fluctuation parameter tension between early and late universe measurements. Most importantly, Gough proposes a measurement whereby this source of dark energy can be clearly experimentally falsified, to confirm or refute this role of information energy.

Information energy resolves other problems of the standard ΛCDM cosmology model. Accounting for all dark energy with information energy effectively solves the Cosmological constant problem, allowing the cosmological constant to take the zero value, the preferred value before we found the universe expansion to be accelerating.

Information dark energy also effectively solves the cosmological coincidence problem, which poses the question "Why now?" Why are we living in the accelerating expansion epoch of the universe when the matter and dark energy densities are similar? Star formation had to have proceeded to such an extent for the information energy of stellar heated gas and dust to be strong enough to initiate accelerating expansion, and also star formation had to have proceeded sufficiently for the likelihood of intelligent beings evolving to observe it.

Unlike a universal cosmological constant, this information energy is naturally clumped around stars and galaxies. Those clumps of energy cause additional local distortions of space-time, producing gravitational attractions like extra unseen dark matter. Dark matter attributed effects in galaxies have been found to be primarily determined by baryon location, an observation considered incompatible with ΛCDM but one that follows naturally from the information energy of stellar heated gas and dust.

Also, when galaxies collide, the locations of dark matter effects pass straight through the collision as would the information energy of stellar heated gas and dust. In this way information energy might account for many effects previously attributed to dark matter. Thus information energy joins both aspects of the dark side, being locally attractive mimicking dark matter, but repulsive universe wide as the dark energy causing the universe expansion to accelerate.

An information source of dark energy also leads us to expect a different future. In the standard model the cosmological constant causes the universe expansion rate to continue accelerating until the "big chill," when no stars are visible in the sky. In contrast, the information dark energy density of stellar heated gas and dust will eventually fall when more stars die than are newly formed. Then universe expansion will revert back to deceleration as was occurring prior to the present dark energy dominated epoch.

More information: Michael Paul Gough, Information Dark Energy Can Resolve the Hubble Tension and Is Falsifiable by Experiment, *Entropy* (2022). DOI: 10.3390/e24030385

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