

Galaxy dynamics probes weak gravity at accelerations below the de Sitter scale of acceleration  $a_{\text{dS}} = cH$ , where  $c$  is the velocity of light and  $H$  is the Hubble parameter. Low and high redshift galaxies hereby offer a novel probe of weak gravity in an evolving cosmology, satisfying  $H(z) = H_0(1 + A(6z + 12z^2 + 12z^3 + 6z^4 + (6/5)z^5)/(1 + z))$  with baryonic matter content  $A$  sans tension to  $H_0$  in surveys of the Local Universe. Galaxy rotation curves show anomalous galaxy dynamics in weak gravity  $a_{\text{N}} < a_{\text{dS}}$  across a transition radius  $r$  beyond about 5 kpc for galaxy mass of  $1e11$  solar mass, where  $a_{\text{N}}$  is the Newtonian acceleration based on baryonic matter content. We identify this behavior with a holographic origin of inertia from entanglement entropy, that introduces a  $C_0$  onset across  $a_{\text{N}} = a_{\text{dS}}$  with asymptotic behavior described by a Milgrom parameter satisfying  $a_0 = \omega/(2\pi)$ , where  $\omega = \sqrt{1-q}H$  is a fundamental eigenfrequency of the cosmological horizon. Extending an earlier confrontation with data covering  $0.003 < a_{\text{N}}/a_{\text{dS}} < 1$  at redshift  $z$  about zero in Lellie et al. (2016), the modest anomalous behavior in the Genzel et al. sample at redshifts  $0.854 < z < 2.282$  is found to be mostly due to clustering  $0.36 < a_{\text{N}}/a_{\text{dS}} < 1$  close to the  $C_0$  onset to weak gravity and an increase of up to 65% in  $a_0$ .

#### [구 CO-09] Cosmological Gas in RAMSES

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The distribution of gas on cosmological scales is vital to our understanding of galaxy formation. Using the RAMSES cosmological hydrodynamical simulation code we have explored the evolution of the gas properties in a cosmological volume. We have identified the effect of the maximum simulation force resolution, and the resolution of the initial conditions, on the gas density power spectrum, as well as artefacts due to the RAMSES algorithm. The RAMSES methodology can add spurious power on small scales, particularly in low resolution simulations. This effect can be expected to have a strong impact on the results of RAMSES simulations, because this additional power appears at specific epochs, implying a sudden change to the system.

#### [구 CO-10] Effects of large-scale structures on cosmological hydrodynamic simulations

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We in the Korea Institute for Advanced Study are preparing the fifth Horizon Run in a series of large-scale cosmological simulations. For the first time we will include full hydrodynamics and astrophysical processes using a RAMSES code. I will discuss the impact of large-scale structures on smaller scale properties in cosmological hydrodynamic simulation to justify our choice of simulation boxsize, whose one side length is up to 1 Gpc.

### 천문우주관측기술

#### [구 AT-01] Breakthrough Starshot Project: Could Relativistic Spacecraft Make it to Alpha Centauri?

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The Breakthrough Starshot initiative aims to launch gram-scale spacecraft to a speed of  $v \sim 0.2c$ , capable of reaching Alpha Centauri and seeing the Earth-like exoplanet, Proxima b, from close distance, in about 20 years. However, a critical challenge for the initiative is the effects of interstellar matter and magnetic field to the relativistic spacecraft during the journey. In this talk, I will first present our evaluation for the damage to the spacecraft by interstellar gas and dust based on a detailed analysis of the interaction of a relativistic spacecraft with the ISM. Second, I will discuss the deflection and oscillation of spacecraft by interstellar magnetic fields.

Third, I will discuss the gas drag force at high energy regime and quantify its effect on the slowing down of the relativistic lightsails. Finally, we will discuss practical strategies to mitigate the damage by interstellar dust and to maintain the spacecraft aiming at the intended target.

#### [구 AT-02] Critical Design Status of the G-CLEF Flexure Control Camera

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