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Rethinking Galaxy Evolution: A Multidisciplinary Perspective via a Simple Growth Model (and polls from 2 international conferences)

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Our current knowledge of galaxy formation and evolution relies on the comprehensive analysis of data which are analyzed using SED fitting techniques. The insights from these observations have been used for the development of sophisticated cosmological hydrodynamic simulations. Currently at the forefront of exploring galaxy evolution our community uses extensively data from JWST and cosmological hydrodynamic simulations like IllustrisTNG. In this talk I will share the results of opinion polls conducted at the 2021 European Astronomical Society meeting and the 2025 International Astronomical Union meeting, These two polls illustrate the significant challenges both observers and theorists/simulators are currently facing. In sight of many apparent limitations, the particularly disturbing poll results and the uncertainties our community currently face I propose a simple approach relying on growth models tested here on Planet earth. The Gamma growth pattern (which combines a power law growth and an exponential decline), a widely used parameterization across diverse scientific fields (ranging from biology to economics) and scales (from bacterial colonies to the spread of infectious diseases), serves to depict/study growth across many disciplines. In this presentation, I put forth the idea that this same Gamma growth pattern can be broadly applied to describe the cosmic star formation rate density, the mass accretion histories of dark matter halos, and the evolution of the Galaxy Stellar Mass Function (GSMF). The simplicity, minimal parameters, lack of resolution effects, multidisciplinary approach and the ability to link the smallest and largest scales of star formation provided by our methodology, offers a surprising perspective on the Physics of galaxies that I am looking forward to share in the 7th China-Chile Bilateral Conference for Astronomy.

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