The Imminent Peaks of World Population and CO2 Emissions

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In a Science paper [1] published in 1960, Heinz von Foerster et al. argued that human population growth is hyperbolic $N(t) = \frac{C}{t_s - t}$ with a singularity in the year $t_s = 2026$. Using current empirical data from 10,000 BCE to 2023 CE, we re-examine this claim [2]. We find that human population initially grew exponentially in time as $N(t) \sim \exp(t/T)$ with $T \sim 3000$ years. This growth then gradually evolved to be super-exponential with a form similar to the Bose function in statistical physics. Population growth further accelerated around 1700, entering the hyperbolic regime with the extrapolated singularity at $t_s = 2030$, which essentially confirms the claim of Ref. [1]. We attribute the onset of the hyperbolic regime to the transition to massive use of fossil fuels upon the Industrial Revolution, as evidenced by a linear relation that we find between world population and the increase in CO_2 level from 1700 to 2000. But in the 21st century, the inverse population curve $1/N(t)$ deviates from a straight line and follows a pattern of "avoided crossing". As a result, the singularity transforms into a square-root Lorentzian peak at $t_s = 2030$ of the width $\tau = 32$ years. Our predicted year 2030 of the peak in world population is much earlier than in other demographic forecasts. We also find that the increase in the CO_2 level since 1700 is well fitted by $\mathrm{arccot}[(t_s - t)/\tau_F]$ with $\tau_F = 40$ years. It implies a Lorentzian peak in the annual emissions $\mathrm{d}(CO_2)/\mathrm{d}t$ at the same year $t_s = 2030$.

References:

[1] H. von Foerster et al. "Doomsday: Friday, 13 November, A.D. 2026" Science, 132, 1291 (1960) https://doi.org/10.1126/science.132.3436.1291

[2] V. M. Yakovenko "The end of hyperbolic growth in human population and CO2 emissions" Physica A 661, 130412 (2025) https://doi.org/10.1016/j.physa.2025.130412 Links to video:
https://physics.umd.edu/ỹakovenk/population/