3-7 July 2023

STRING PHENO 2023

Institute for Basic Science
Daejeon, South Korea

Gravitino in nonlinear supergravity and the Swampland

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BONNEFOY, CASAGRANDE, DUDAS *2206.13451*
& ongoing work with E. Dudas, M. Peloso and Q. Bonnefoy

Plan of the talk

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I. Nonlinear supergravity

- Nonlinear SUSY and the goldstino
- Superfield constraints
- $\mathcal{N} = 1$ orthogonal SUGRA

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- Potential superluminality: $c_s > 1$
- Unbounded particle production: $c_s = 0$

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III. Causality constraints in the rigid limit

- The equivalence theorem & positivity bounds
- Improved setup & full causality

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IV. Remarks on $c_s = 0$

- EFT breakdown
- Backreaction & QFT in curved spacetime

Nonlinear supergravity

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- The goldstino couplings are such that *supersymmetry is realised nonlinearly*: $\delta_\epsilon G = f \epsilon + \frac{i}{f} \left(G \sigma^\mu \bar{\epsilon} - \epsilon \sigma^\mu \bar{G} \right) \partial_\mu G$

  [Volkov, Akulov '73]

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EFT construction

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Spectrum in the unitary gauge $G = 0$
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Einstein-Hilbert term

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scalar potential $V(\varphi)$

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field-dependent mass parameter

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gravitino sector

Gravitino in FRW

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[Kallosh, Kofman, Linde, Van Proeyen '00]
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$$\omega_k^2 = c_s^2 k^2 + a^2 m^2$$

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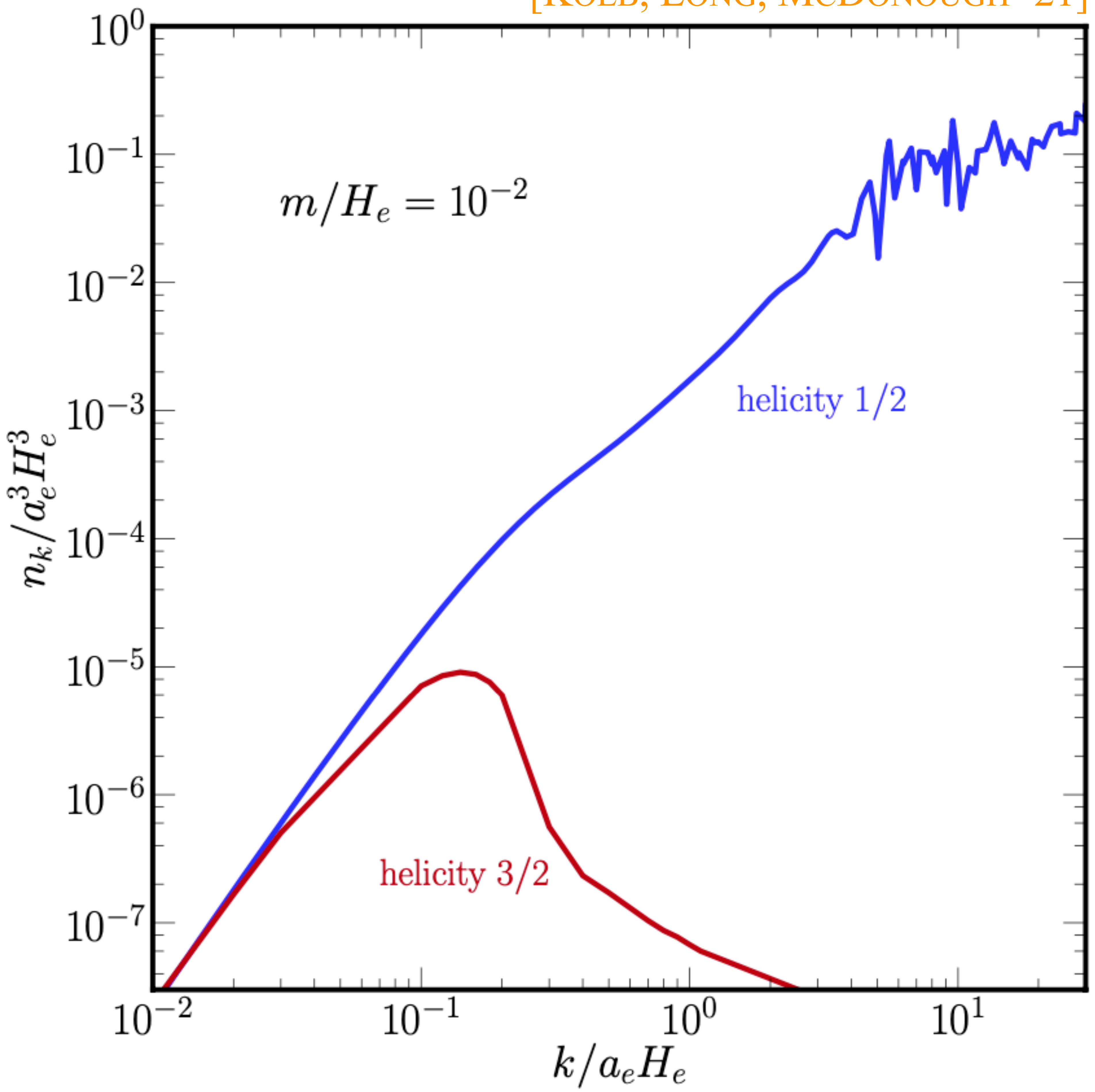

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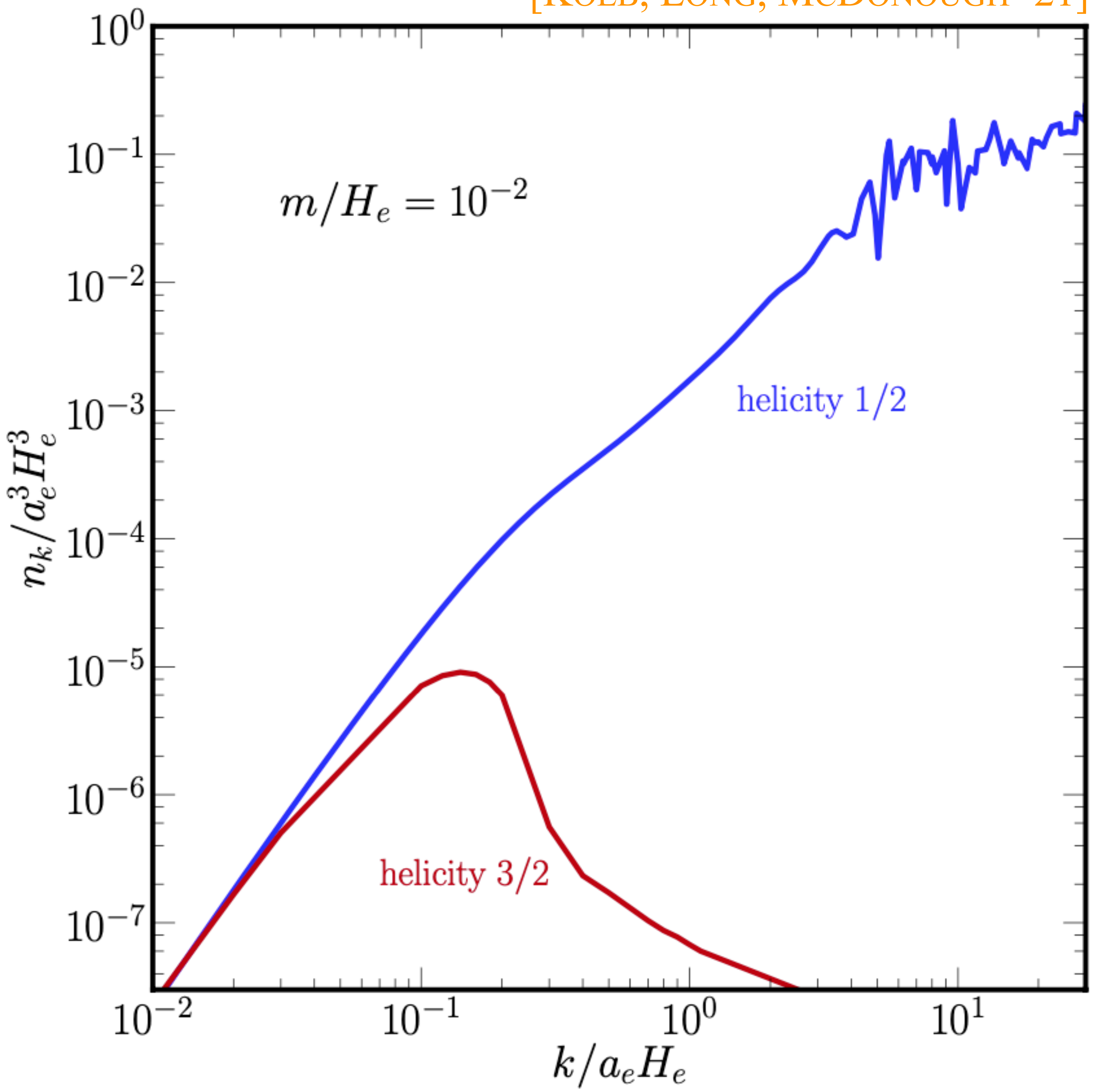

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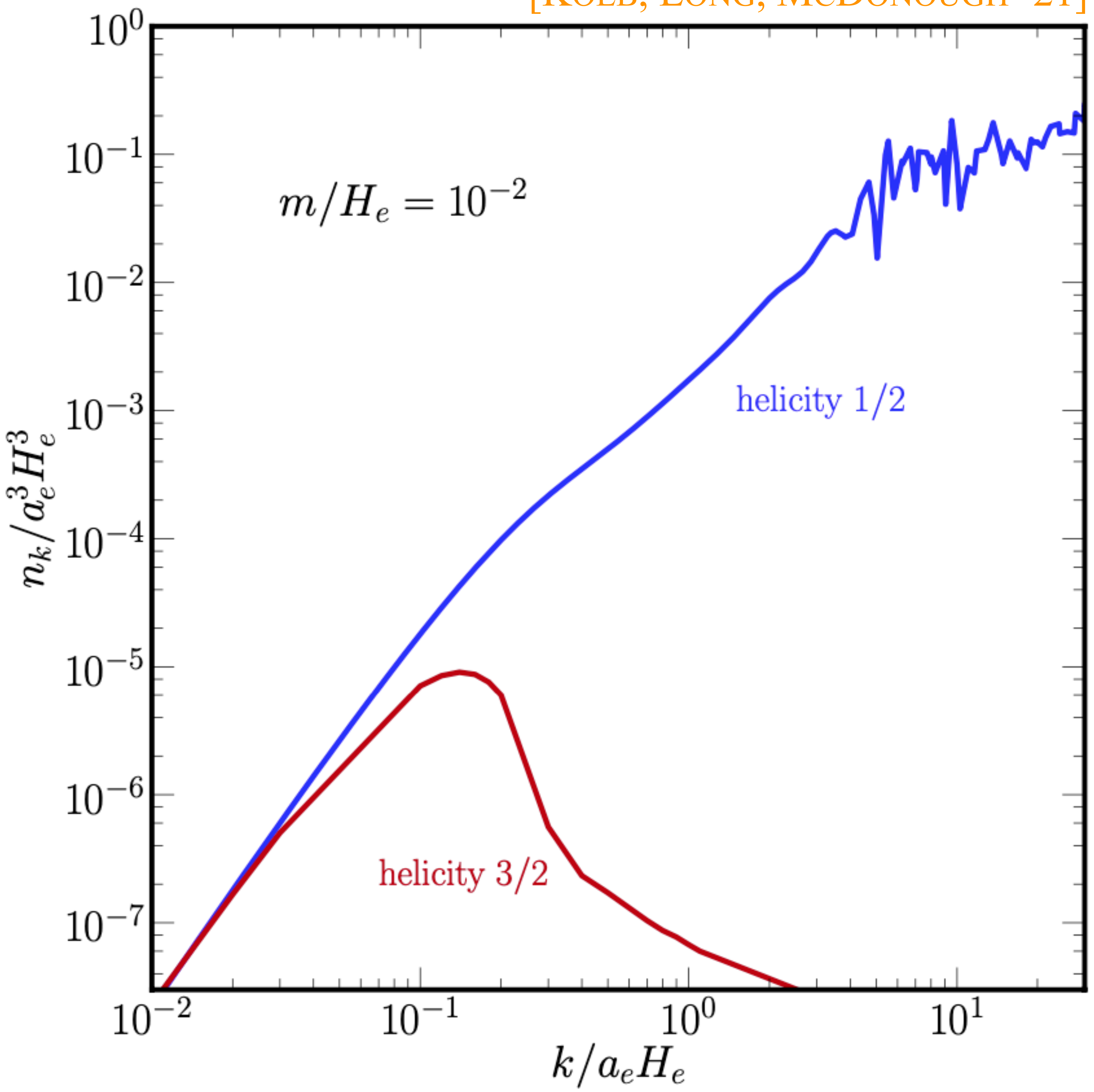

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gravitinos with *arbitrary high momentum* can be produced

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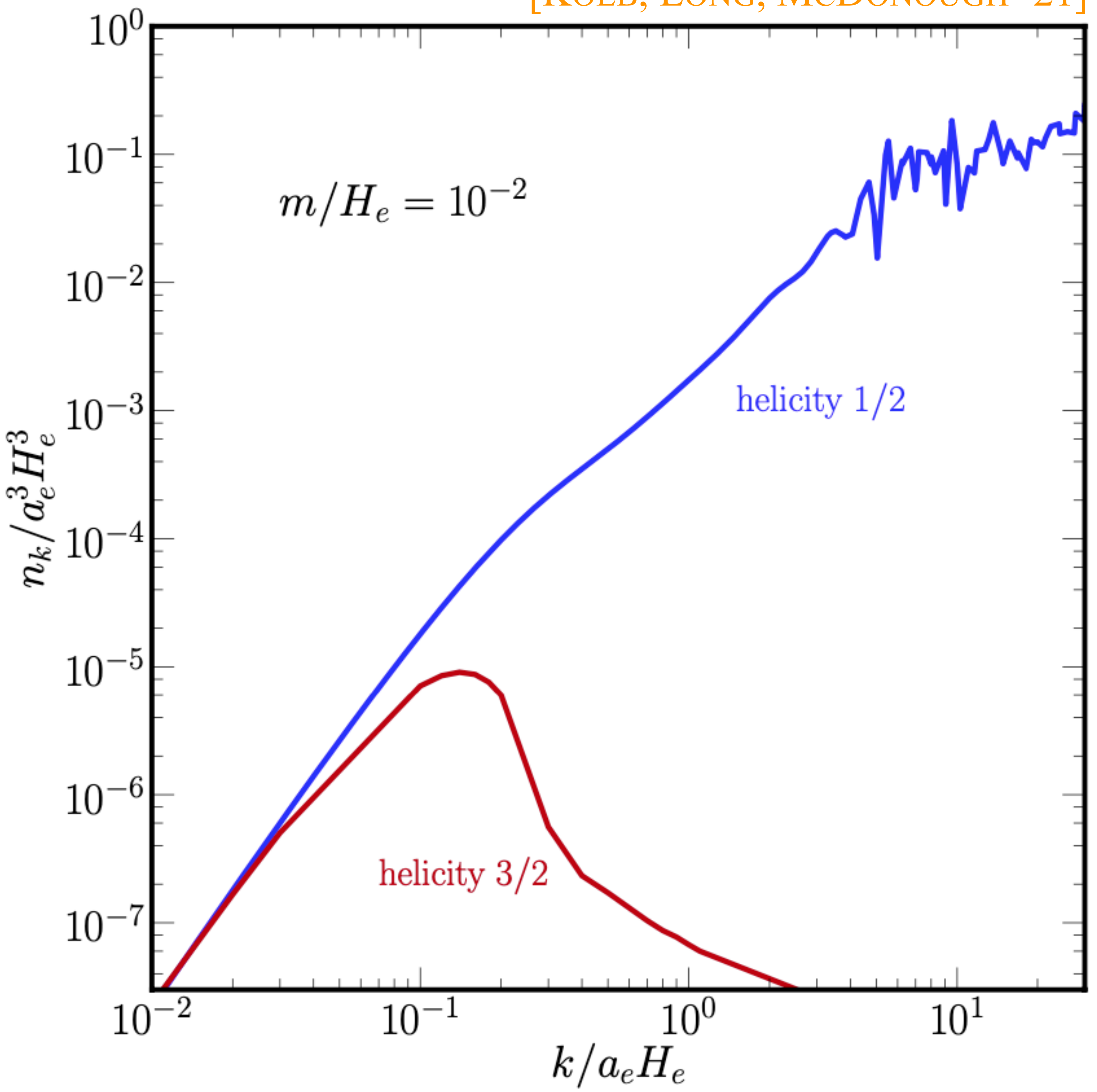

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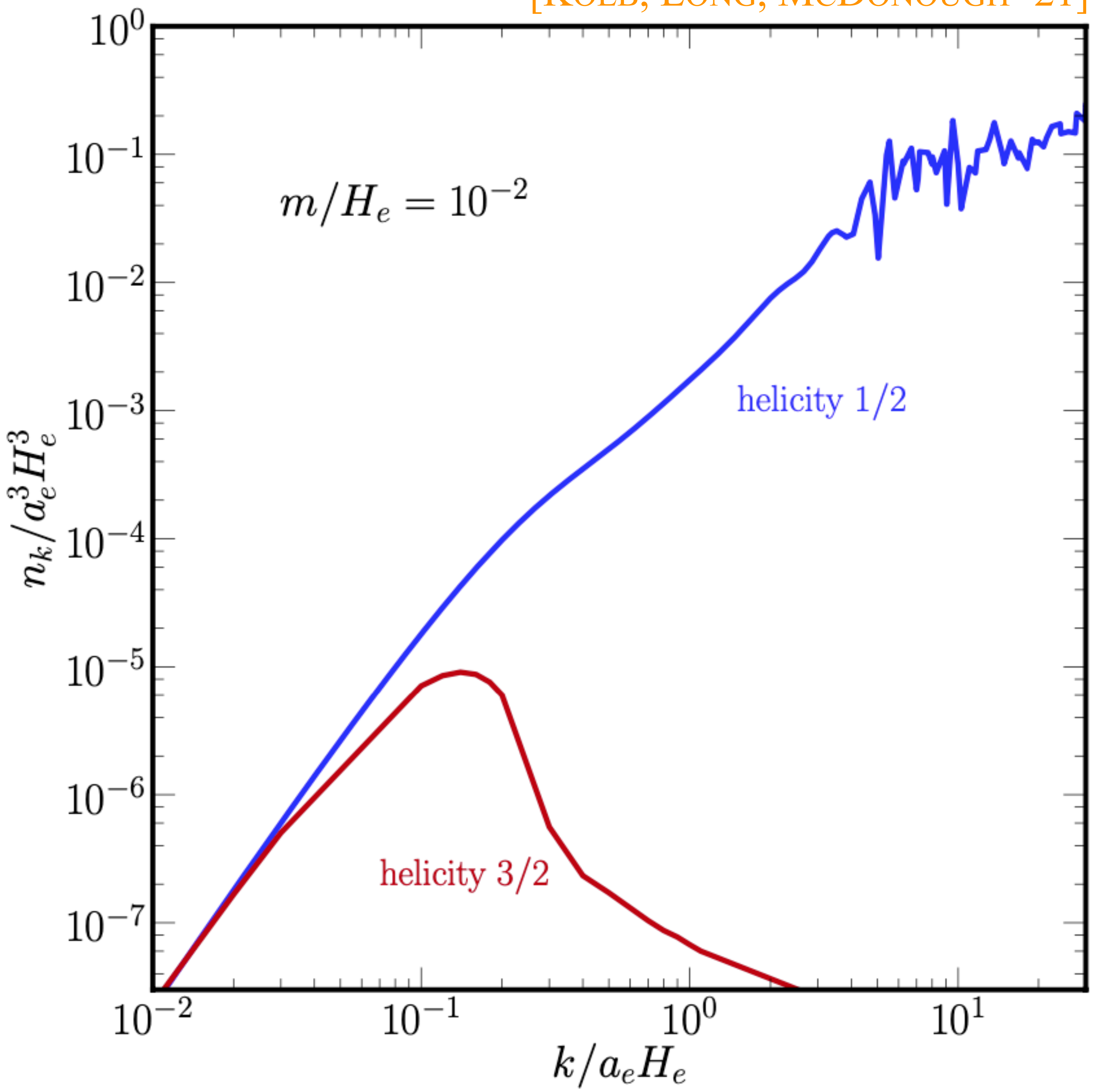

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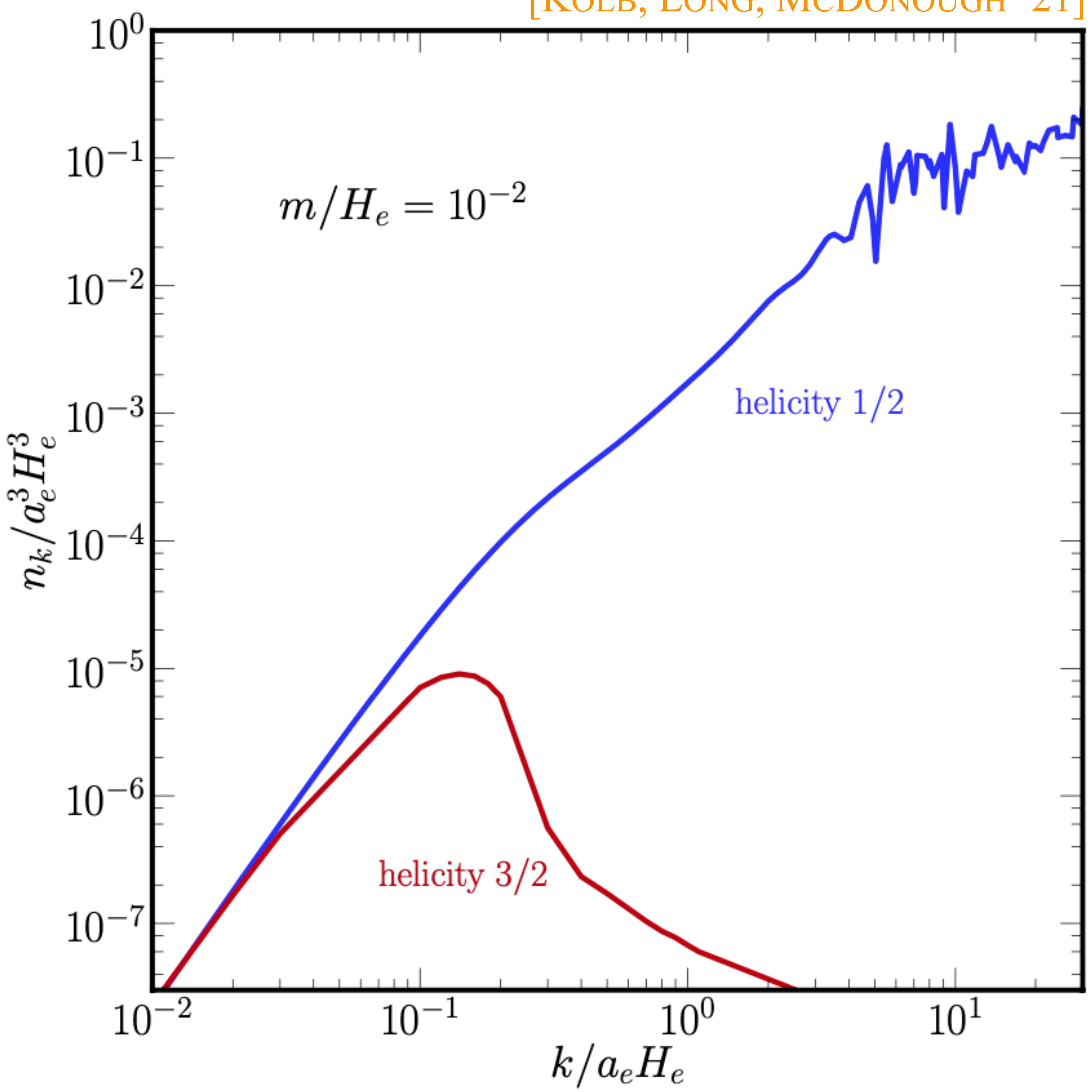

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$\Longrightarrow$ We can address the superluminality problem in terms of positivity bounds on the operators of the low-energy, SUSY goldstino theory.

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- Goldstino - real scalar SUSY lagrangian:

$$\mathscr{L} = -f(\varphi)^2 + \frac{1}{2}\partial_\mu\varphi\partial^\mu\varphi + i\partial_\mu G\sigma^\mu\bar{G} + (\dots)$$
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it coincides with the $c_s < 1$ condition

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right setup to build minimal inflation in Supergravity

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Gravitino Swampland Conjecture: $c_s = 0 \in$ Swampland

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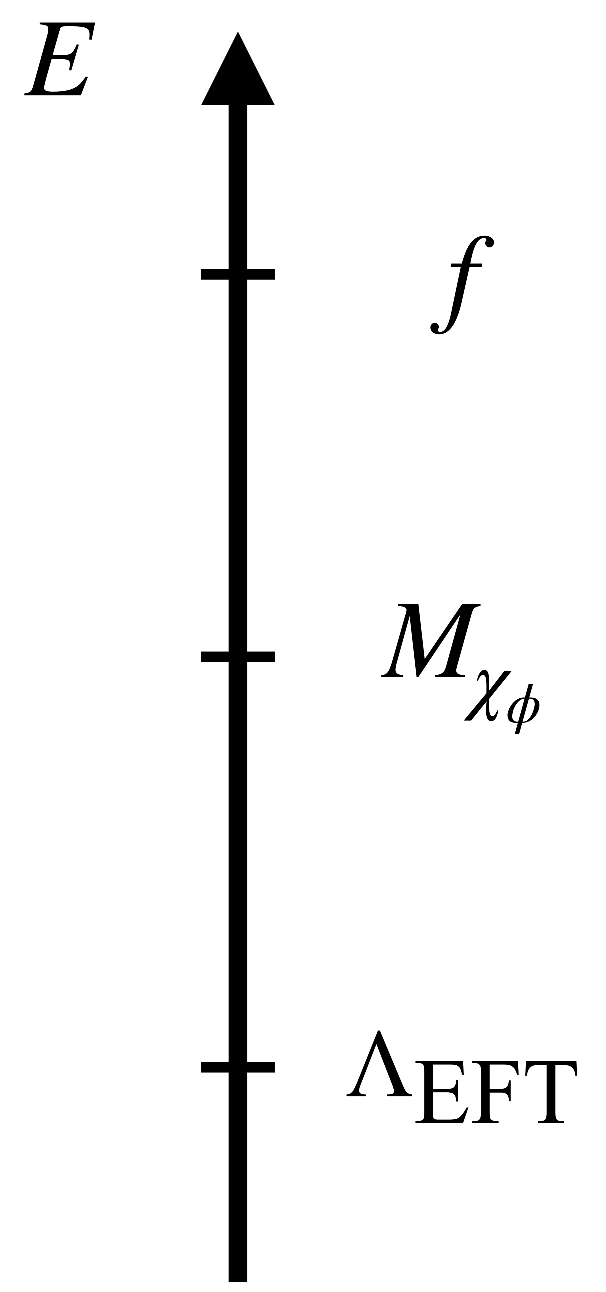

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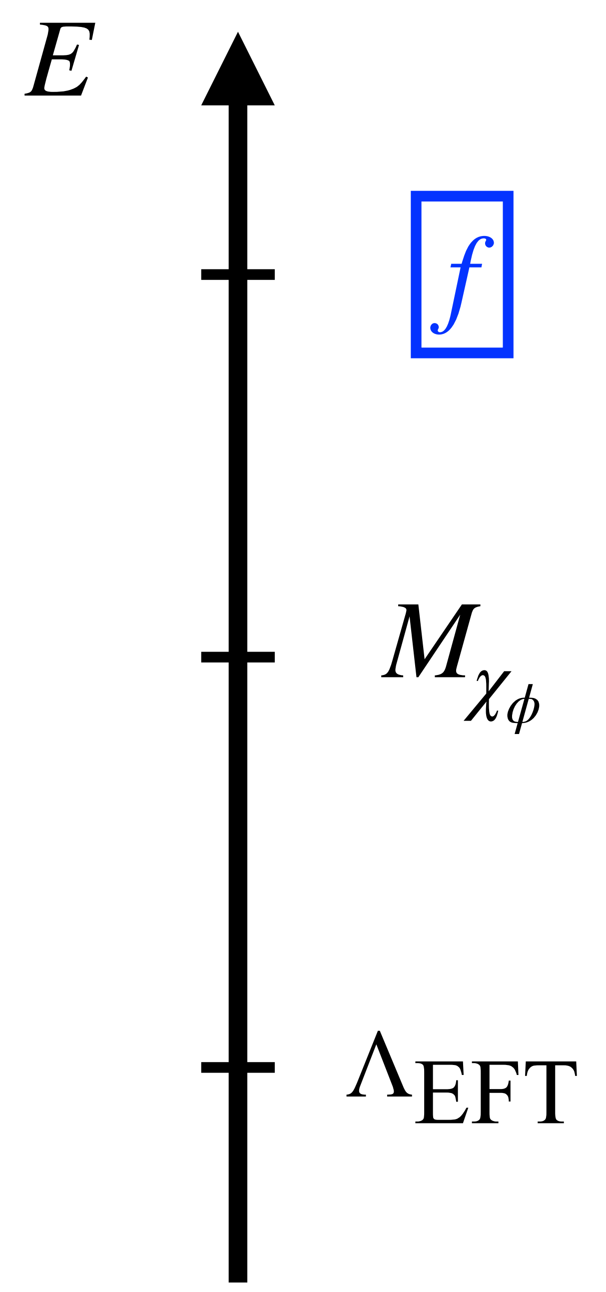

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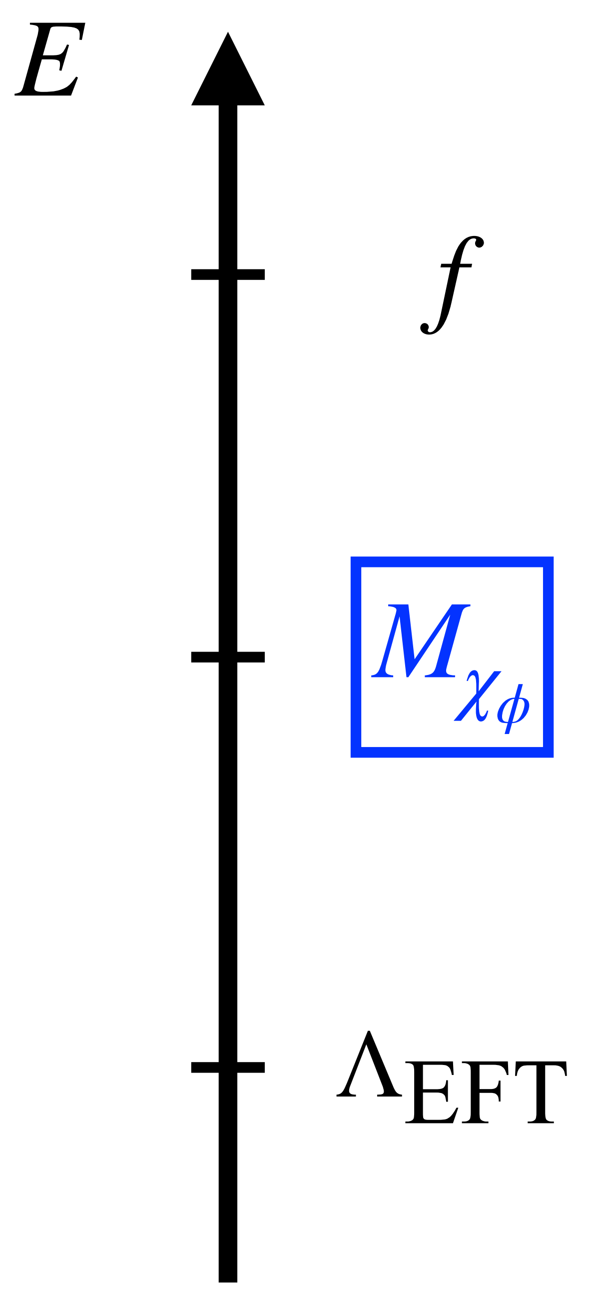

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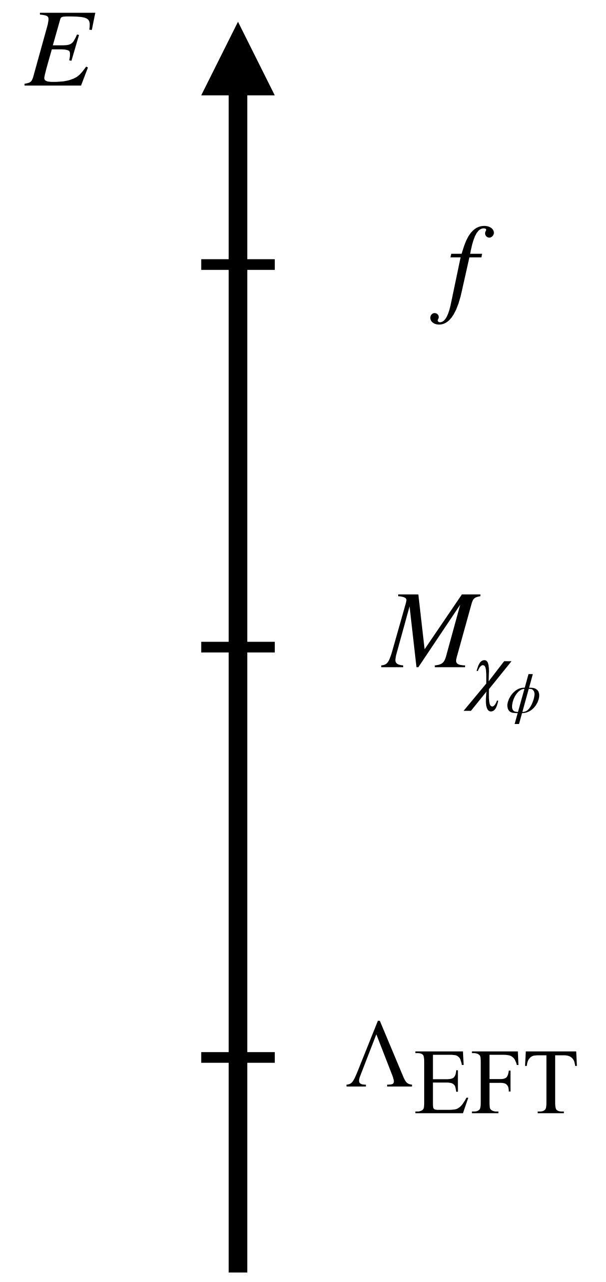
the goldstino-inflatino mixing prevents the overproduction

[Dudas, Garcia, Mambrini, Olive, Peloso, Verner '21]



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background

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the fermion mixing prevents the overproduction

Thank you!