Probes of reheating after non-Abelian axion-like inflation

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in collaboration with

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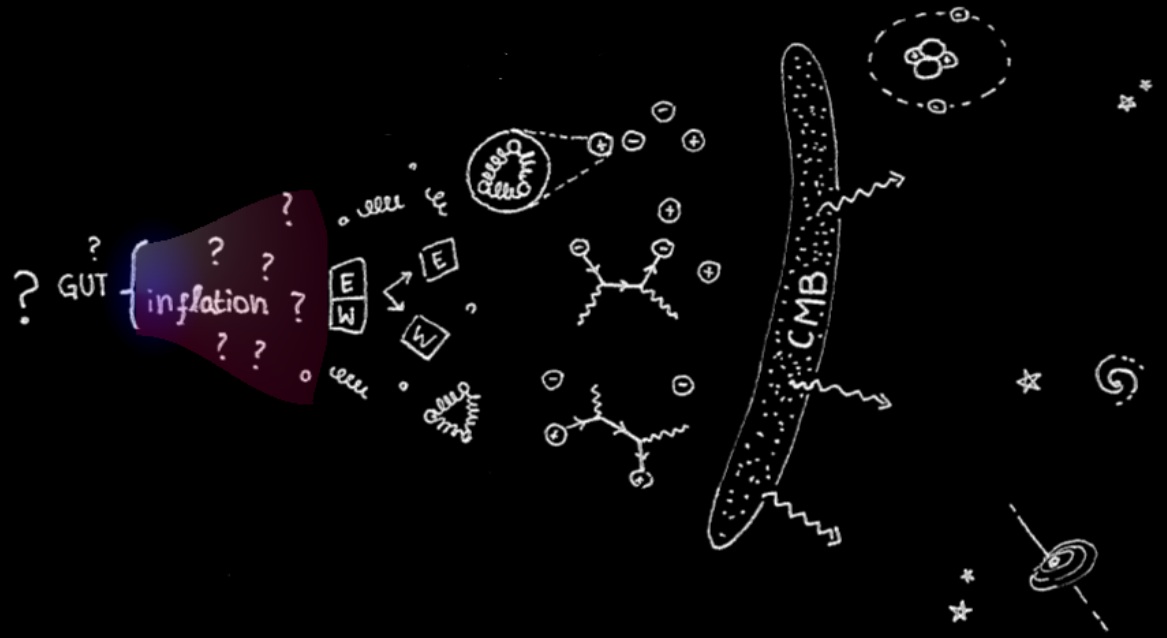
CERN - May 16, 2024

simple and popular model:

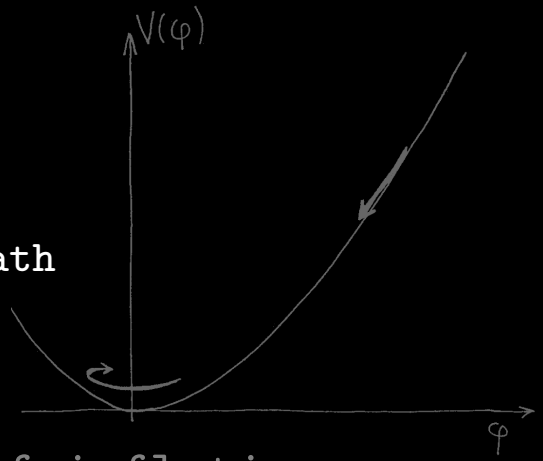


* early vacuum domination at $t \sim 10^{-32}\,\mathrm{s}$
* transition period is what we aim to describe
* SM fields in thermal equilibrium at $t \sim 10^{-12}\,\mathrm{s}$

embed inflaton within heat bath[1]

$$\mathcal{L} = -\tfrac{1}{2}\,\partial^\mu\varphi\,\partial_\mu\varphi - V(\varphi) - \varphi J + \mathcal{L}_{\mathtt{bath}}$$

$$\downarrow$$



effective evolution equations at the end of inflation

inflaton:

$$\ddot{\bar{\varphi}} + (3H + \Upsilon)\dot{\bar{\varphi}} + \partial_\varphi V(\bar{\varphi}, m_{\mathtt{T}}) \approx 0$$

$$\Upsilon \approx \frac{\mathtt{Im}\,\langle JJ\rangle|_m}{m}\,, \qquad m_{\mathtt{T}}^2 \approx m^2 - \mathtt{Re}\,\langle JJ\rangle|_m$$

medium:

$$\dot{e}_{\mathsf{med}} + 3H(e_{\mathsf{med}} + p_{\mathsf{med}} - T\partial_T V) - T\partial_T \dot{V} = \Upsilon\dot{\bar{\varphi}}^2$$

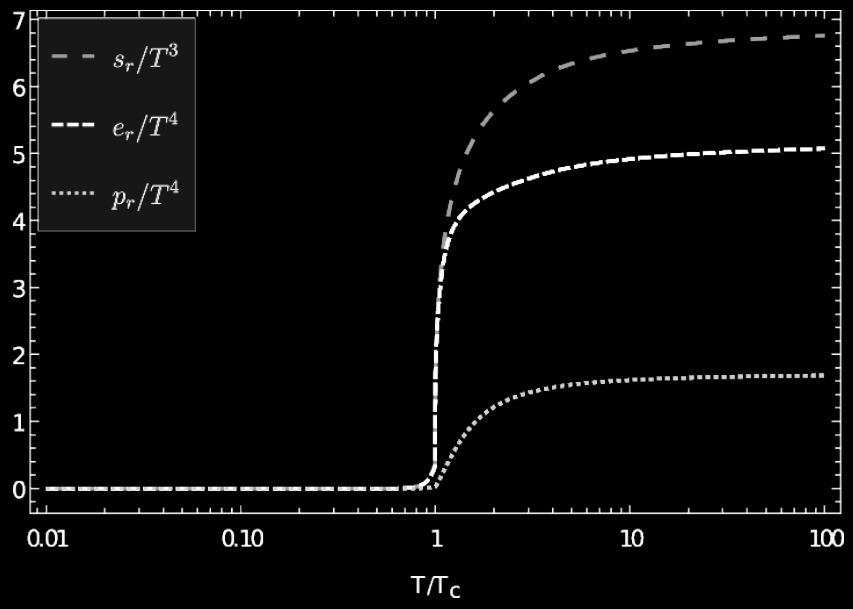
[1] M. Laine and S. Procacci, JCAP 06 (2021) 031

working example: non-Abelian gauge plasma

* $\boxed{\mathcal{L} \supset -\varphi \frac{\alpha(\Lambda_{\rm IR})}{16\pi f_a} F\tilde{F}}$ $\Rightarrow$ ✓ friction, ✓ slow-roll[2]

* medium thermalizes quickly[3] $\sim \alpha(\Lambda_{\rm IR})^2 T$

* self-interactions become strong at $T_c \sim \Lambda_{\rm IR}$



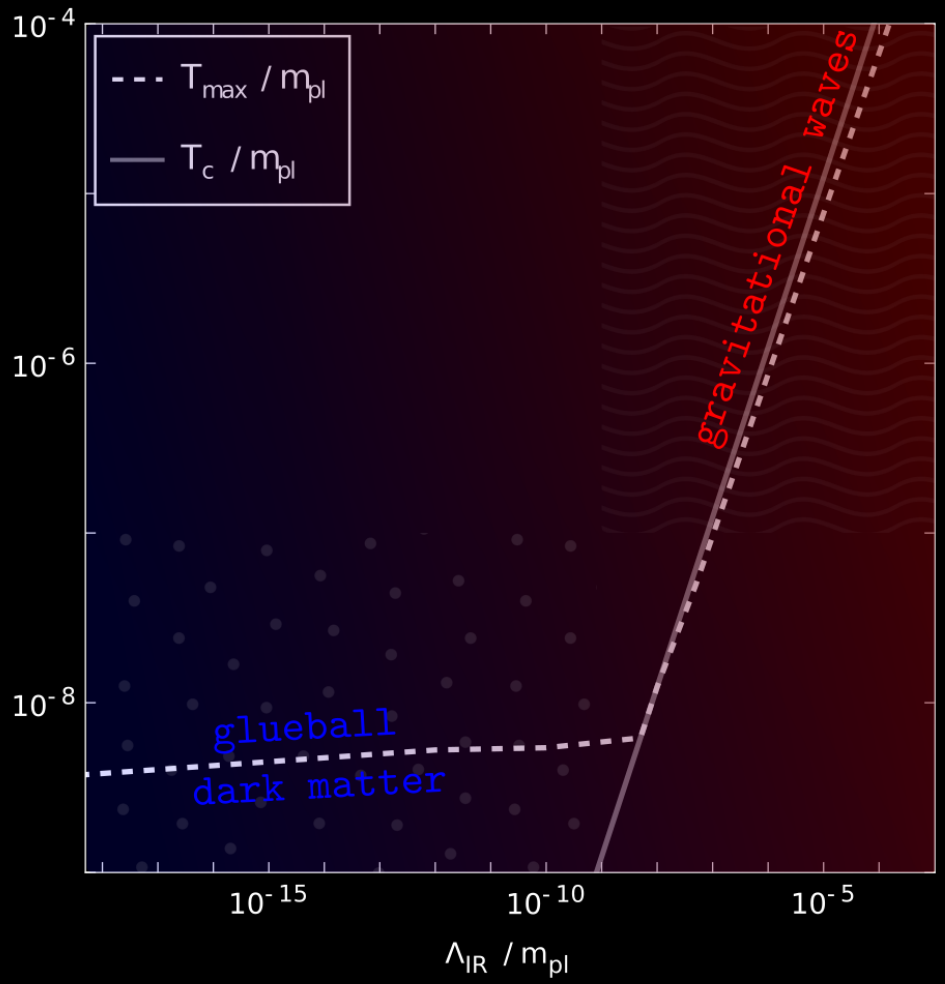
fit to lattice results,[4] $N_c = 3$

[2] e.g. W. De Rocco, P.W. Graham and S. Kalia, JCAP 11 (2021) 011

[3] e.g. Y. Fu, J. Ghiglieri, S. Iqbal and A. Kurkela, Phys. Rev. D 105 (2022) 054031

[4] L. Giusti and M. Pepe, Phys. Lett. B 769 (2017) 385

pheno depends on plasma self-interaction $\alpha(\Lambda_{IR})$[6]



if Yang-Mills sector is dark and charged under CP[5]

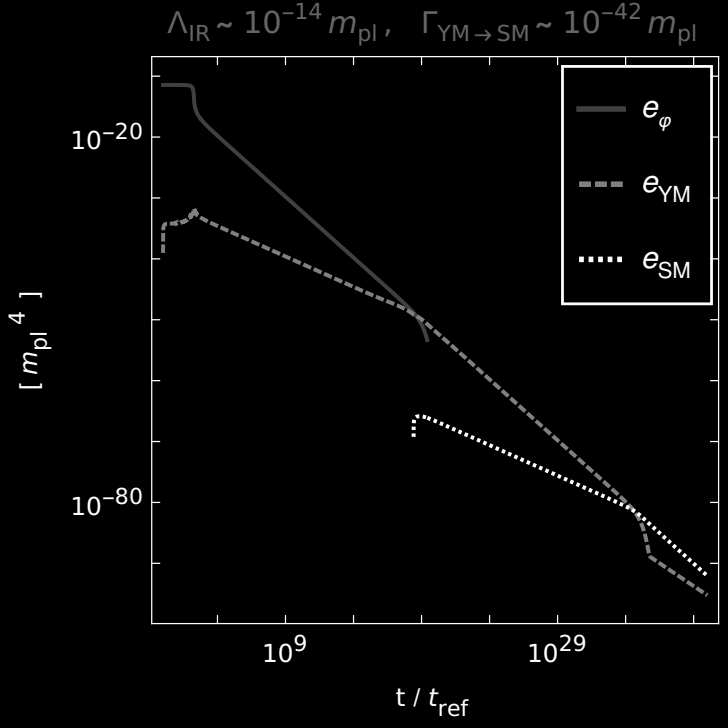
large anisotropies sourced in the heat bath

[5] e.g. L. Forestell, D. Morrissey, K. Sigurdson, Phys. Rev. D 95, 015032

[6] H. Kolesova, M. Laine and S. Procacci, JHEP 05 (2023) 239

$T_{\max} \gg \Lambda_{\rm IR} \lesssim H_{\rm ref}$

glueball dark matter

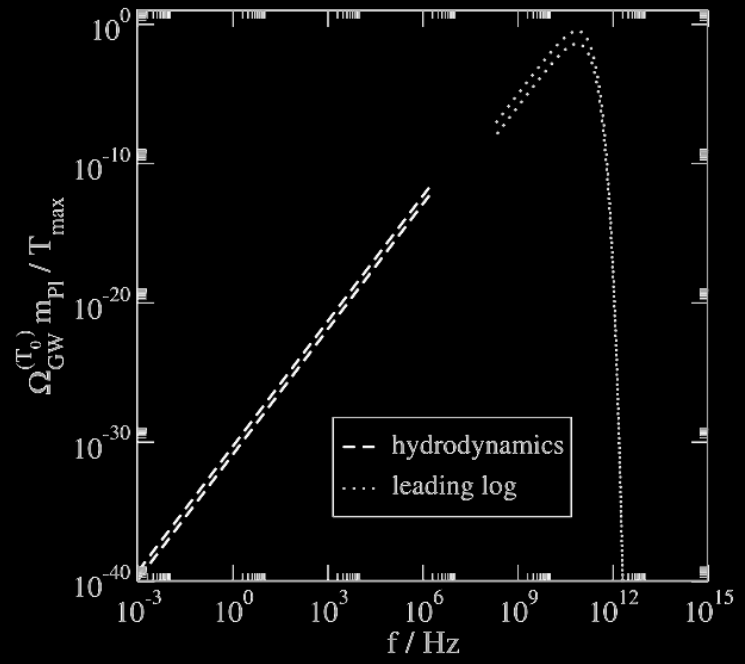


S. Biondini, H. Kolesova and SP, in preparation

$\Omega_{\rm DM}$ and $T_{\rm SM}$ yield predictive bounds on $\Lambda_{\rm IR}$ and $\Gamma_{\rm YM\to SM}$

$T_{\max} \lesssim \Lambda_{\rm IR} \gg H_{\rm ref}$

gravitational waves



by J. Ghiglieri, M. Laine, JCAP 07 (2015) 022

SM channels dominate,[7] no bounds on $\Lambda_{\rm IR}$ from $\Delta N_{\rm eff}$ [8]

[7] J. Ghiglieri, G. Jackson, M. Laine and Y. Zhu, JHEP 07 (2020) 092

[8] P. Klose, M. Laine and S. Procacci, JCAP 05 (2022) 021

more details on the poster