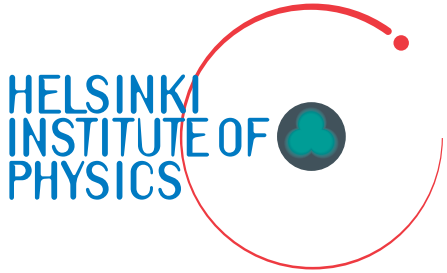

Inflationary Imprints on Dark Matter

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The Model and Low Energy Particle Phenomenology

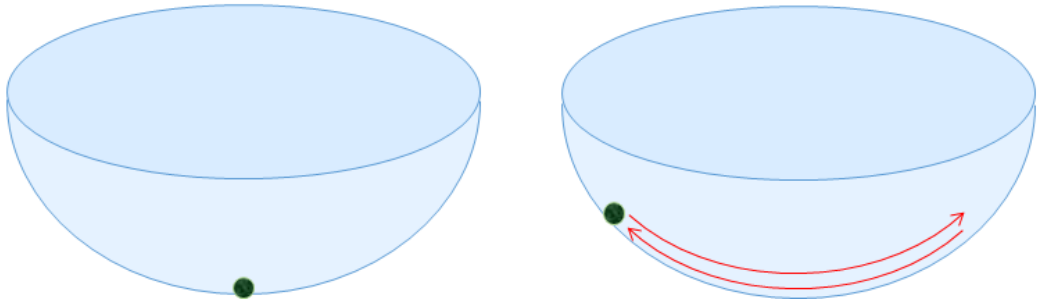
- The scalar sector of the model is specified by the potential

$$V(\Phi, s) = m_h^2 \Phi^\dagger \Phi + \lambda_h (\Phi^\dagger \Phi)^2 + \frac{1}{2} m_s^2 s^2 + \frac{\lambda_s}{4} s^4 + \frac{\lambda_{sh}}{2} \Phi^\dagger \Phi s^2$$

- Here h and s are, respectively, the usual Standard Model Higgs doublet and a real singlet scalar.
- The coupling between h and s acts as a portal between the Standard Model and an unknown Dark Sector (the so-called Higgs portal).

Initial Conditions set by Inflation

- If the scalar fields are light during cosmic inflation, they will typically acquire fluctuations proportional to the inflationary scale, $h, s \simeq H_* \simeq 10^{14}$ GeV[1].
- We take these results as inflationary predictions for the initial values of the scalar condensates.

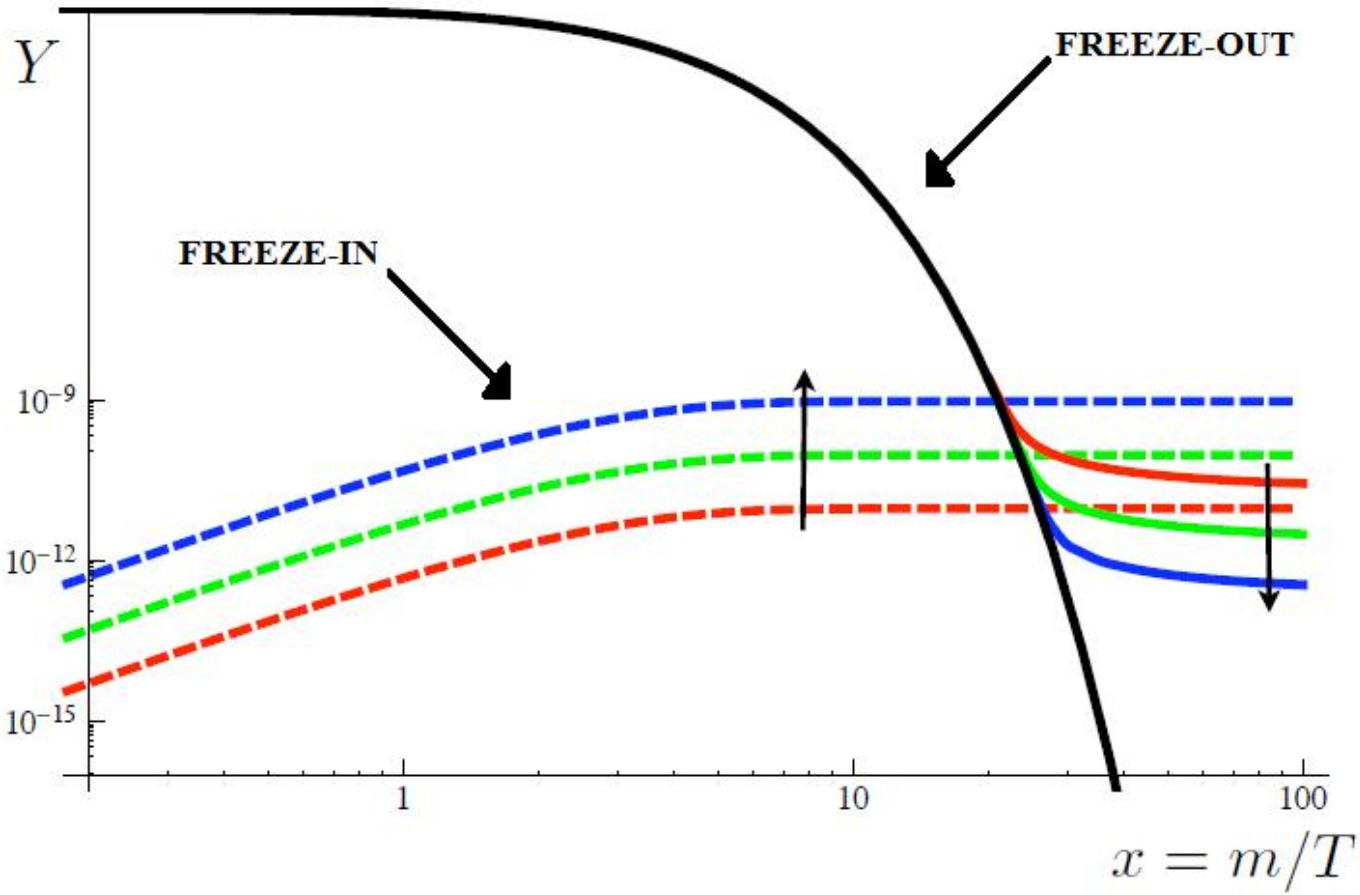


A marble in a bowl.

[1] If the results of BICEP2 were to pass scrutiny.

Dark Matter Production Mechanisms

- There are basically two mechanisms for dark matter production: freeze-out and freeze-in[2]

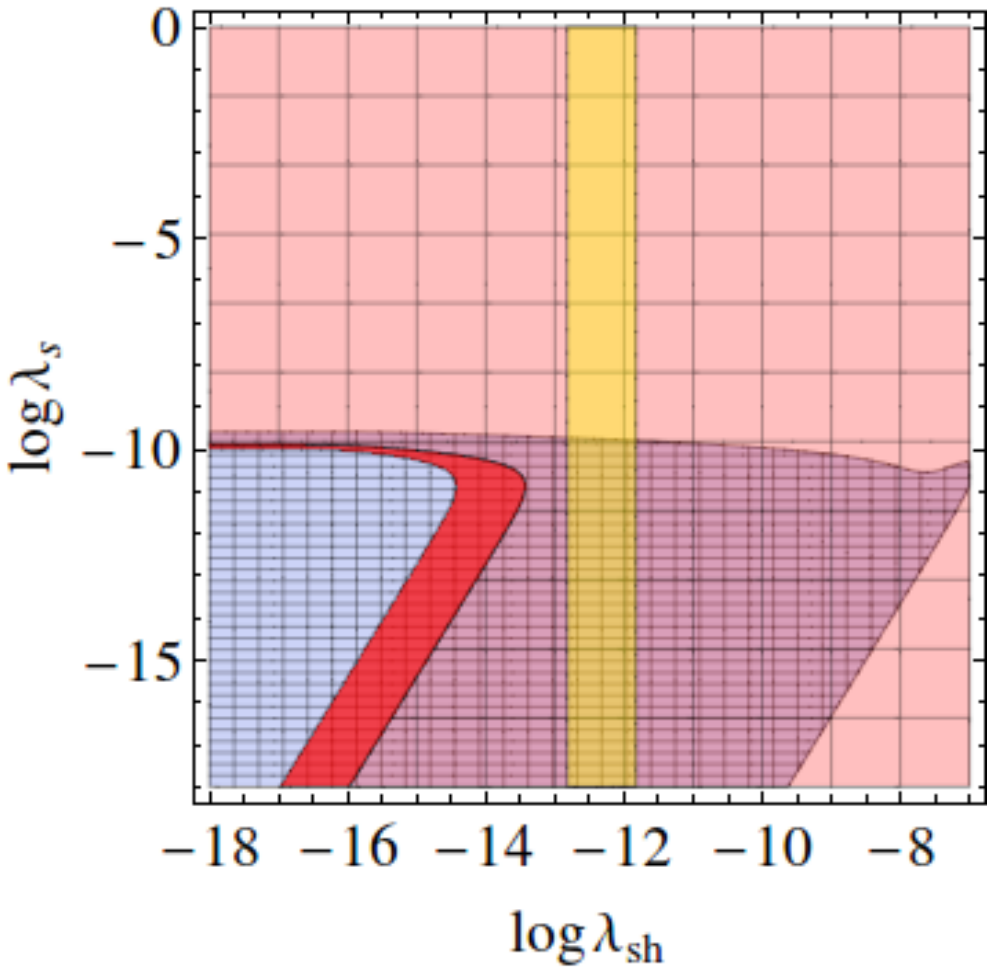


[2] The picture is from Hall et al. (arXiv:0911.1120)

The Freeze-In

- If the portal coupling takes a value $\lambda_{sh} \lesssim 10^{-7}$, the singlet s never thermalizes $\Rightarrow$ only freeze-in is possible.
- With these values of the coupling, it is possible to slowly produce a sizeable fraction of the observed dark matter abundance via singlet condensate fragmentation already at temperatures above the EW scale.
- The Dark Matter is born cold.

The total DM yield



- In this figure $r = 10^{-6}$ (corresponding to $H \simeq 10^{10}$ GeV) and $m_s = 60$ GeV.

Conclusions and Outlook

- Formation and presence of a condensate is a typical consequence in a theory containing scalar fields.
- The inflationary dynamics can affect physics also below the EW scale, and model computations need to be revisited.
- The portal coupling λ_{sh} has to be super-feeble in order not to produce too much dark matter already at high temperatures.