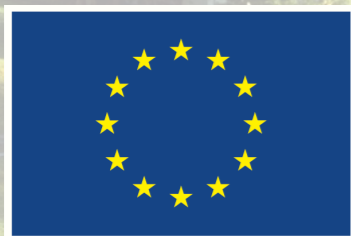# Exploring ALPs beyond the canonical

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Invisibles17 Workshop, University of Zurich
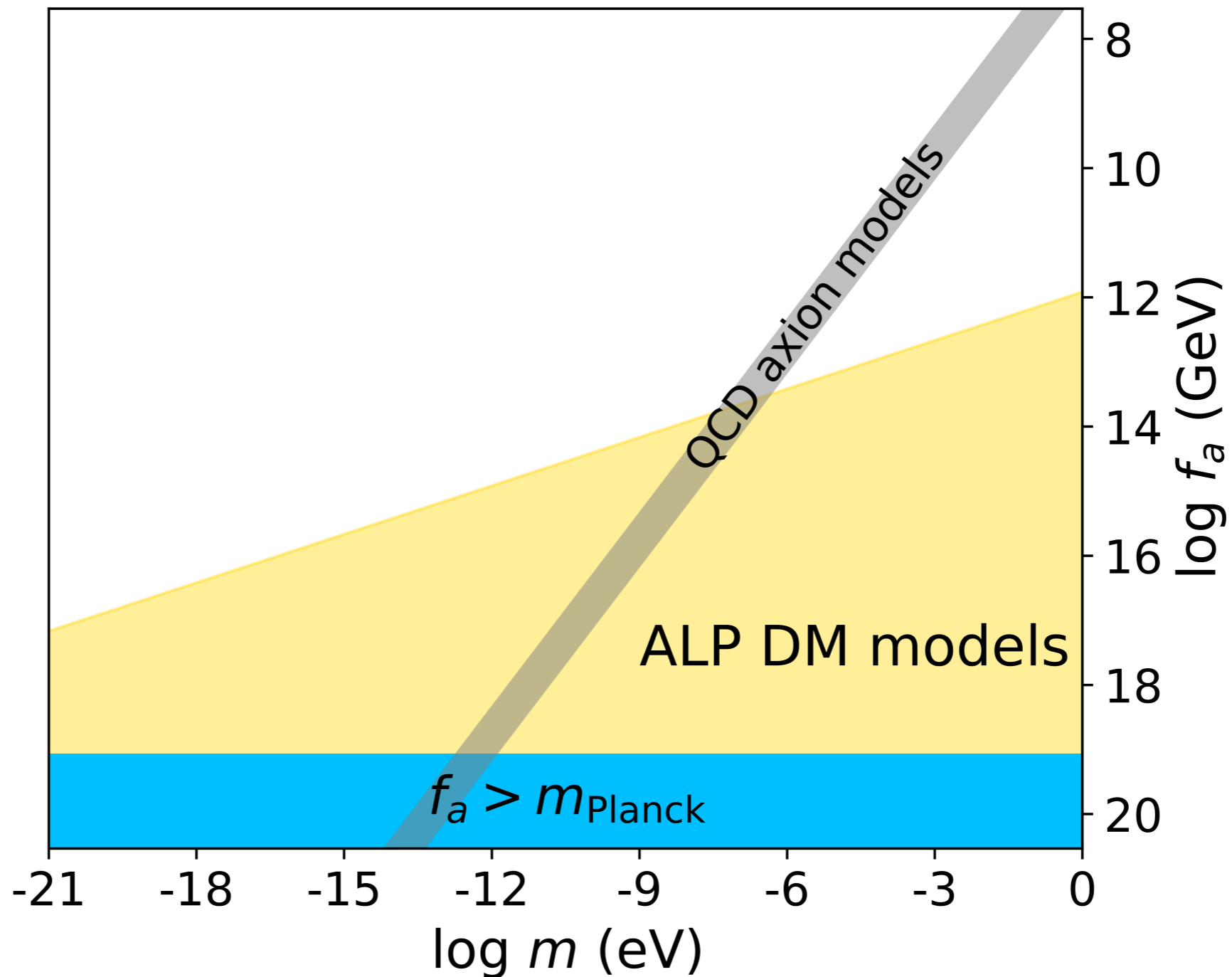*13 June 2017*

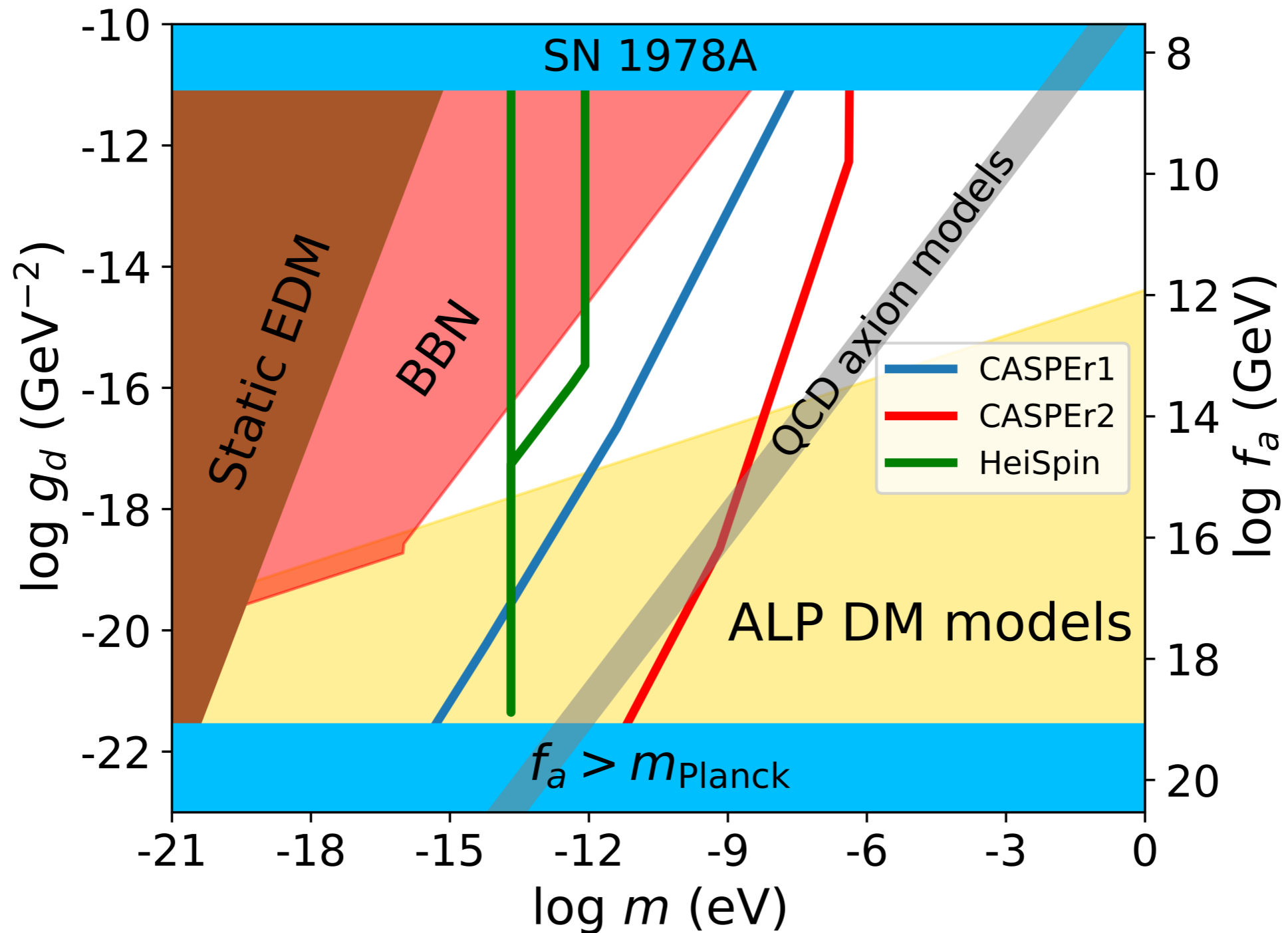elusives
neutrinos, dark matter & dark energy physics

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Canonical ALP dark matter

Canonical ALP dark matter

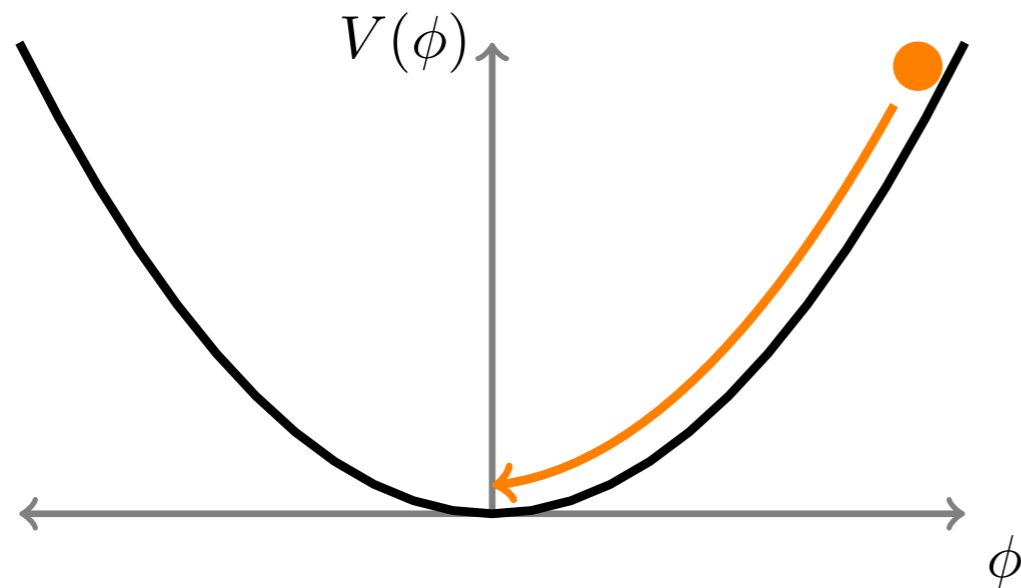and its effective coupling to nucleons from $\frac{a}{f_a}G\tilde{G}$

Non-canonical kinetic terms
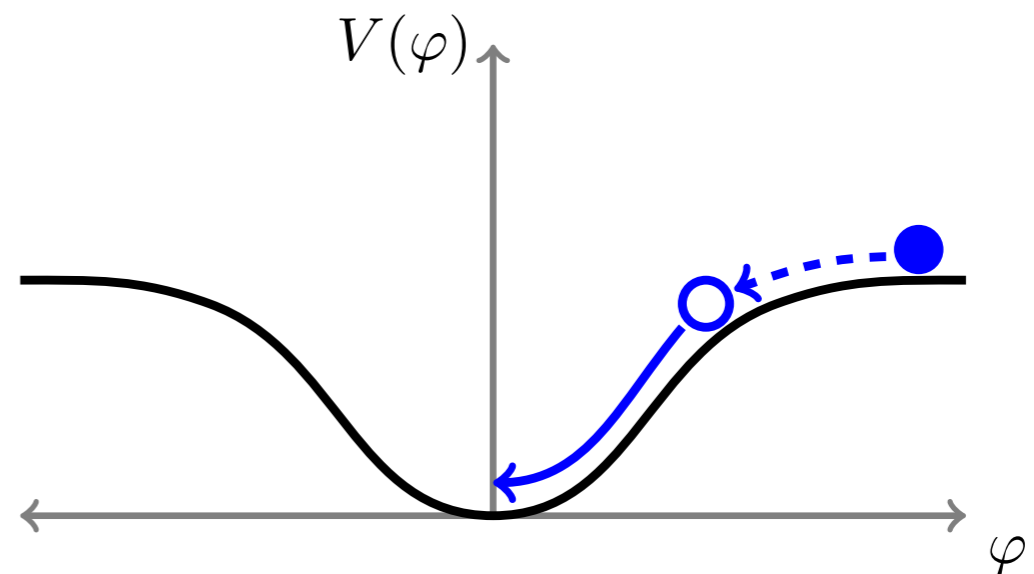
We start with the Lagrangian

$$\mathcal{L} = \frac{1}{2}T^2(\phi)\partial^\mu\phi\partial_\mu\phi - \Lambda^4\left(1 - \cos\frac{\phi}{f_a}\right),$$

and we choose the kinetic term

$$\boxed{T(\phi) = \frac{1}{\cos\left(\frac{N\phi}{f_a}\right)}.}$$
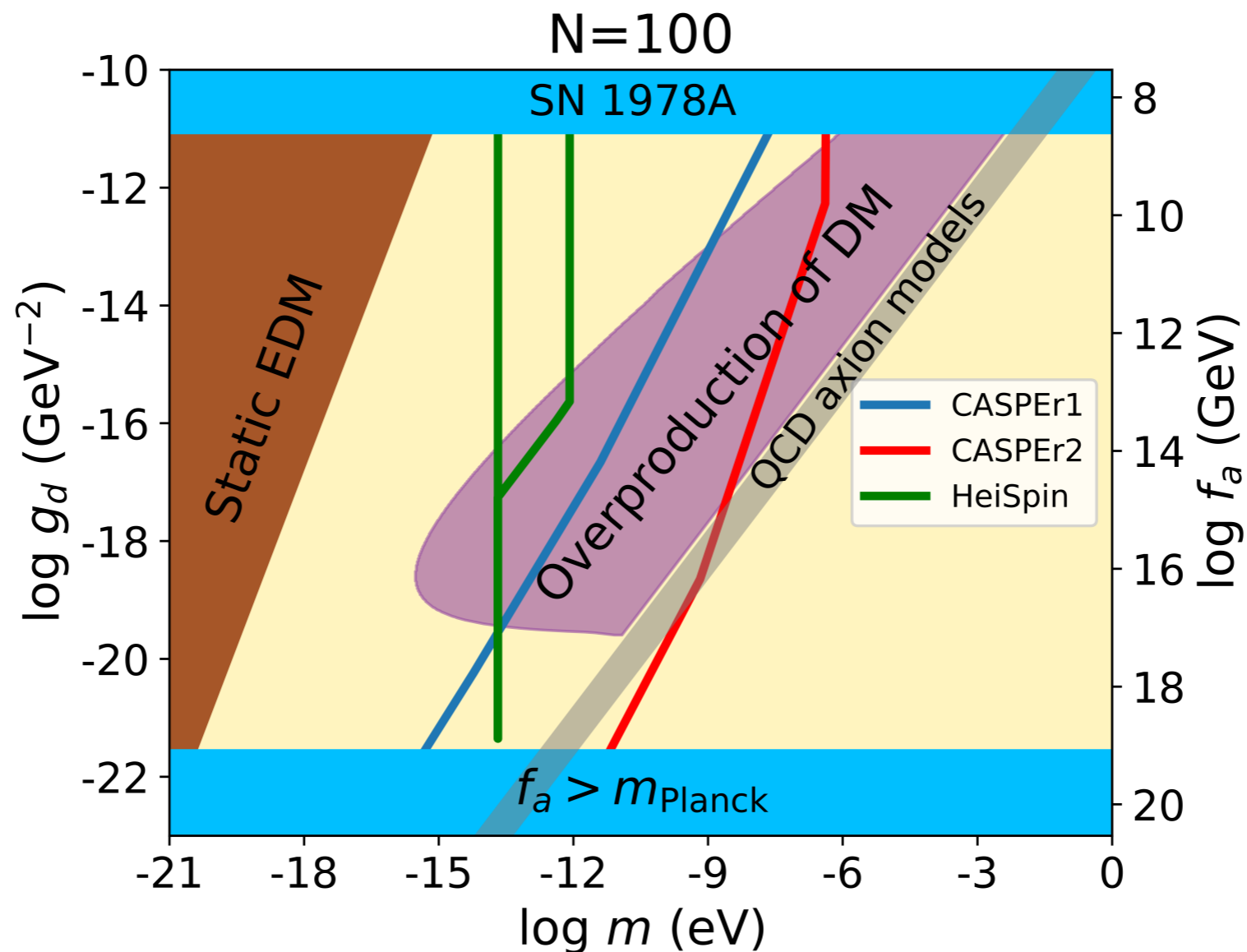

Canonical ALP

Non-canonical ALP

Coupling to QCD

We introduce a coupling of the form $\dfrac{\varphi}{f_a} G\tilde{G}$ and an extra term

to the potential: $V(\varphi) = \Lambda_{\mathrm{QCD}}^4(T)(1 - \cos\dfrac{\varphi}{f_a}) \textcolor{blue}{-\Lambda_0^4(1 - \cos\dfrac{\varphi}{f_a})}$

Summary

Other things we have studied:

- Cosmological production & evolution

- Isocurvature perturbations

- Structure formation

} **See poster!**

Conclusion:

ALPs with a non-canonical kinetic term are phenomenologically viable dark matter candidates that could be tested with near-future experiments and observations.

Thanks for your attention