Axion/ALP scenario with high scale inflation

Dan Kondo (IPMU)

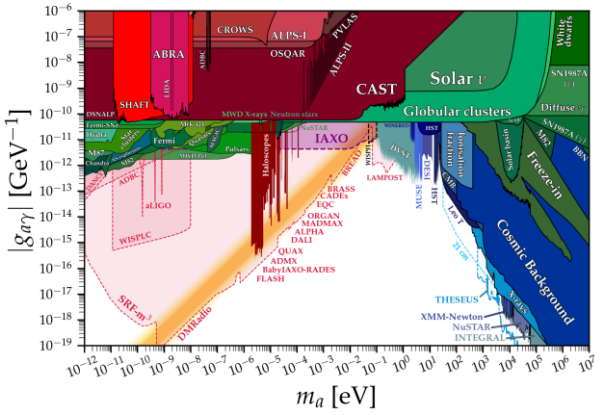
Short talk at Cargese: July 25th

with Hitoshi Murayama
arxiv:2507.07973

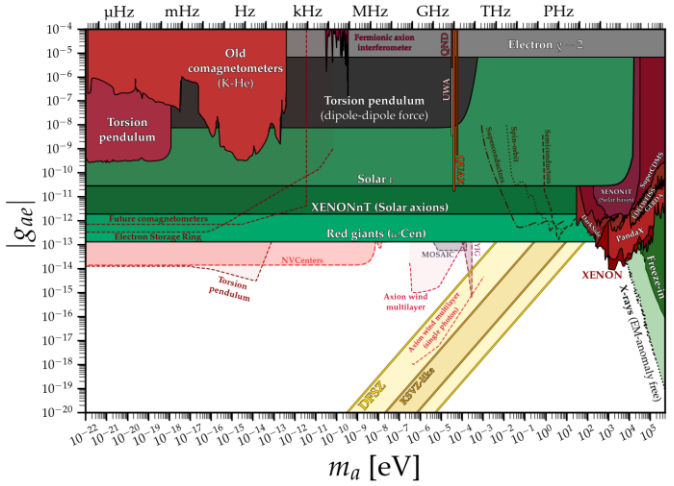
DFSZ axion

SM fermions have PQ charges

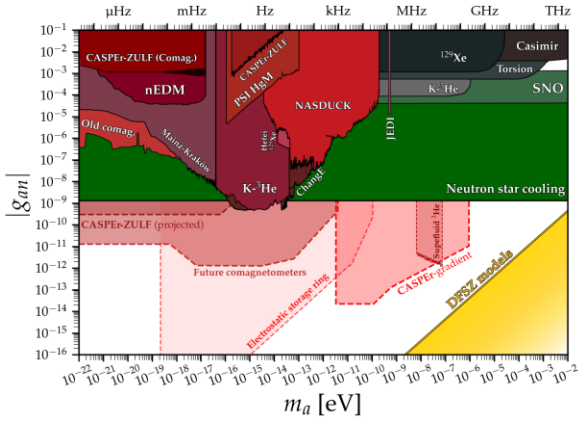
→experimentally attractive!



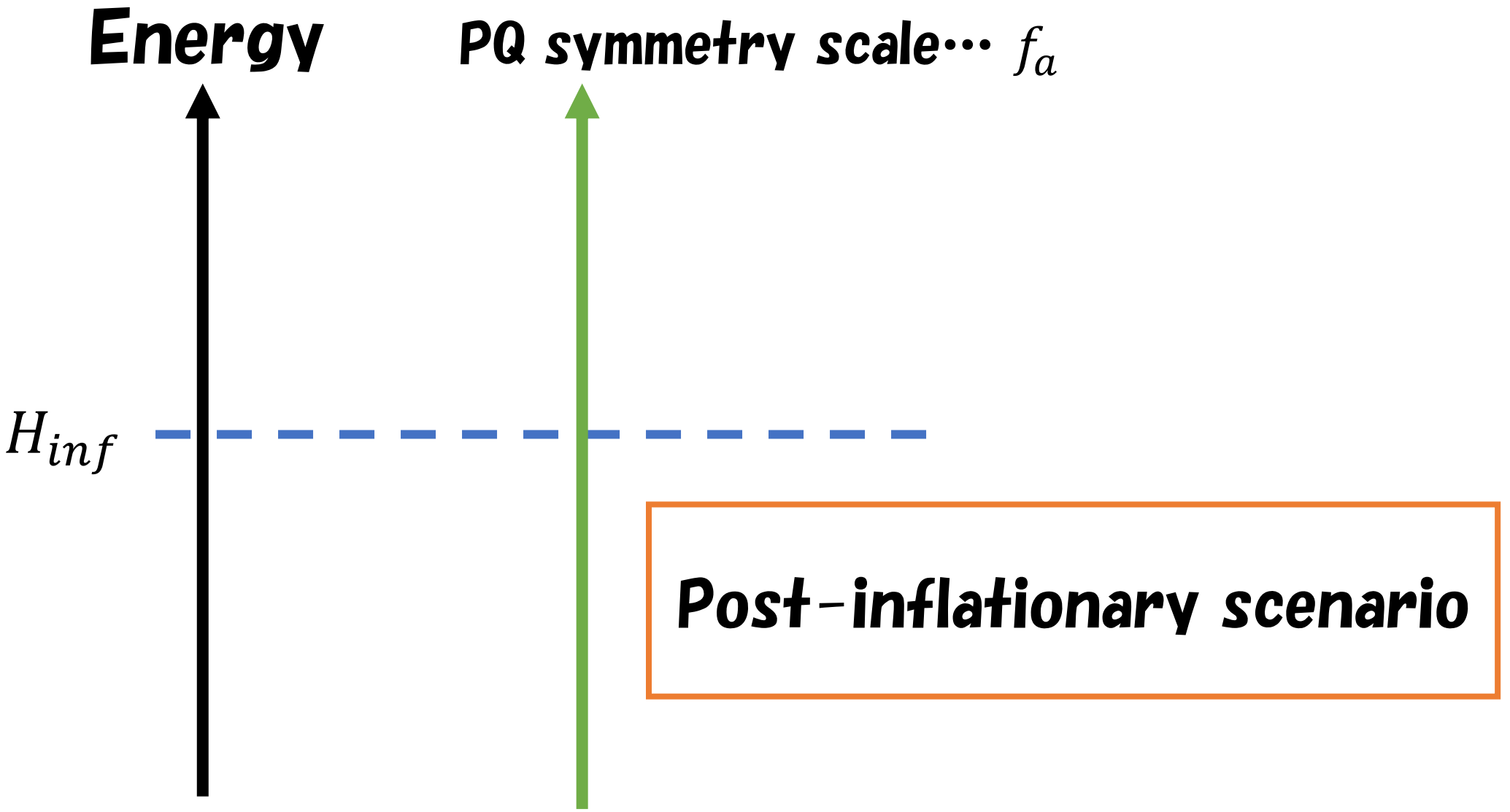
Photon coupling



Electron coupling



Neutron coupling


Energy
PQ symmetry scale… f_a
H_{inf}
Post-inflationary scenario

Domain wall problem for $N_{DW} \geq 2$

When (more than) two vacuum degenerate, DW arises.

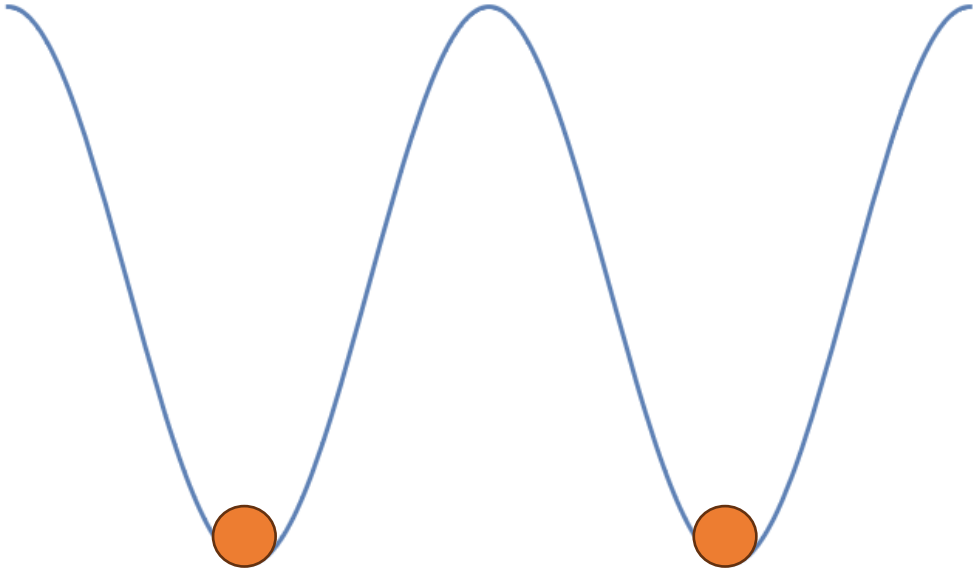
The energy density of DW is

$\rho_{DW} \simeq \frac{\sigma}{t}$

σ is DW tension

The energy density of radiation is

$$\rho_{rad} \simeq \frac{M_{pl}^2}{t^2}$$



DW eventually dominates the universe unless they collapse.

Axion-ALP potential

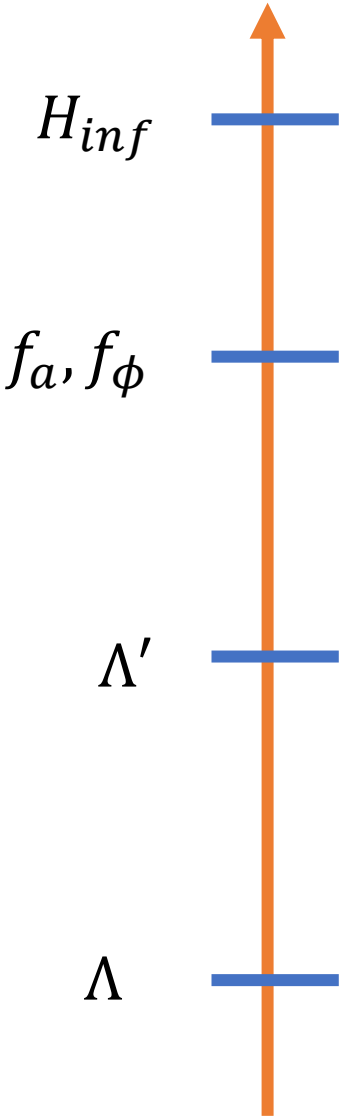
$$V(a_1, a_2) = \Lambda^4(1 - \cos(n_{11}a_1 + n_{12}a_2)) + \Lambda'^4(1 - \cos(n_{21}a_1 + n_{22}a_2))$$

$$N_{DW} \equiv n_{11}n_{22} - n_{12}n_{21}$$

When $N_{DW} = 1$, the scenario is safe !

		SU(5)	$U(1)_{PQ}$	$SU(N)_S$	$U(1)_S$
DFSZ	10	10	0	1	0
	5^*	5^*	1	1	0
	N	1	-1	1	0
	H_u	5	0	1	0
	H_d	$\bar{5}$	-1	1	0
additional	$5'$	5	0	1	1
	$5^{*'}$	$\bar{5}$	0	1	1
	ψ	1	1/2	N	0
	ψ'	1	1/2	$\bar{N}$	0
	χ	1	0	N	1/2
	χ'	1	0	$\bar{N}$	1/2

One generation

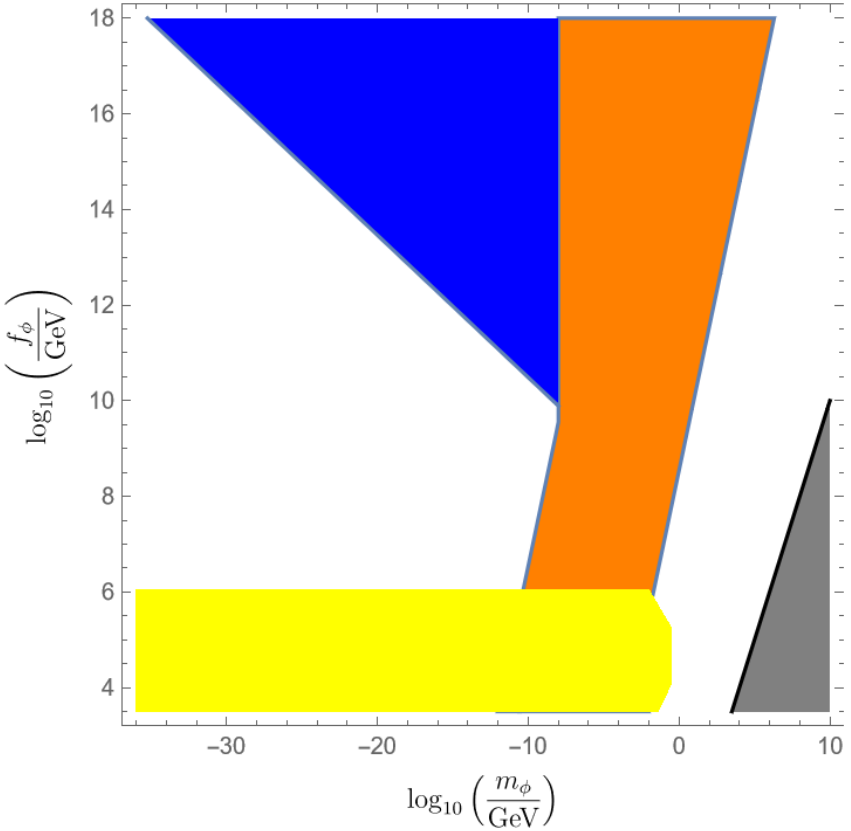


H_{inf} **Inflation ends**

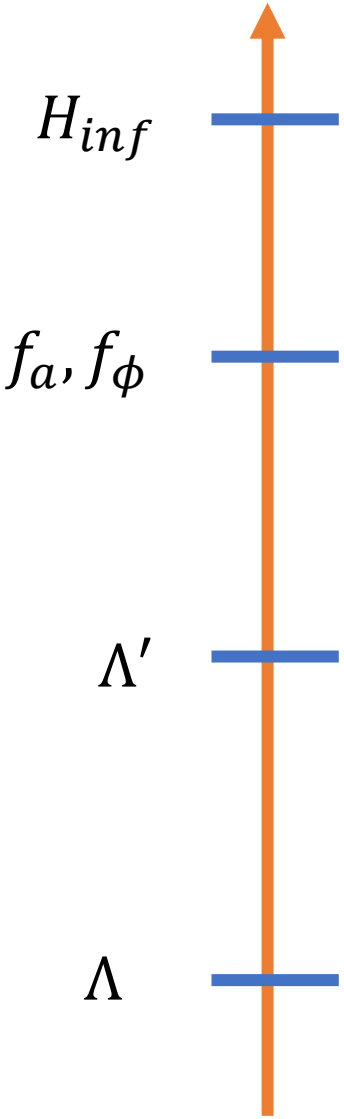
f_a, f_ϕ $U(1)_{PQ}$, $U(1)_S$ **is broken**
→cosmic string is generated

Λ' **ALP potential is generated**
→string bundle is formed and decays soon.

Λ **QCD axion potential is generated.**



More than One generation

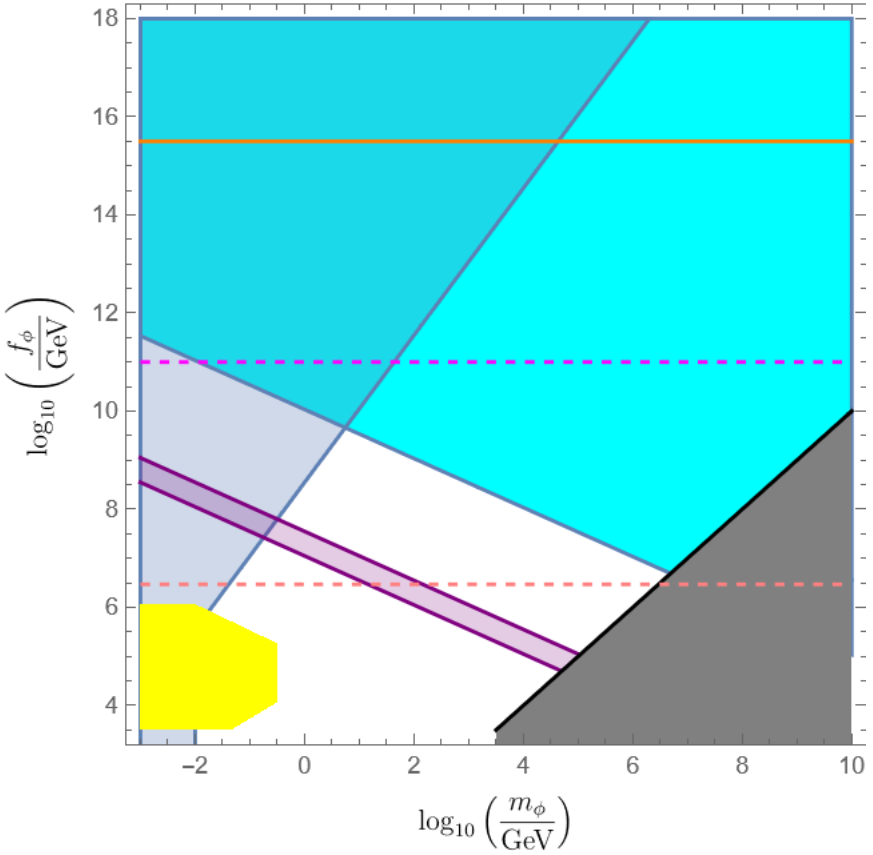


H_{inf} **Inflation ends**

f_a, f_ϕ $U(1)_{PQ}$, $U(1)_S$ **is broken**
→cosmic string is generated

Λ' **ALP potential is generated**
→string-wall network is formed.

Λ **QCD axion potential is generated, and the network decays due to the bias.**



PTA/Nanograv…possible