

The supercooling window at weak and strong coupling

Noam Levi

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Seminar @ EuCAPT

May 23, 2022

Based on:

arXiv: 22XX.XXXX, NL, Toby Opferkuch, Diego Redigolo

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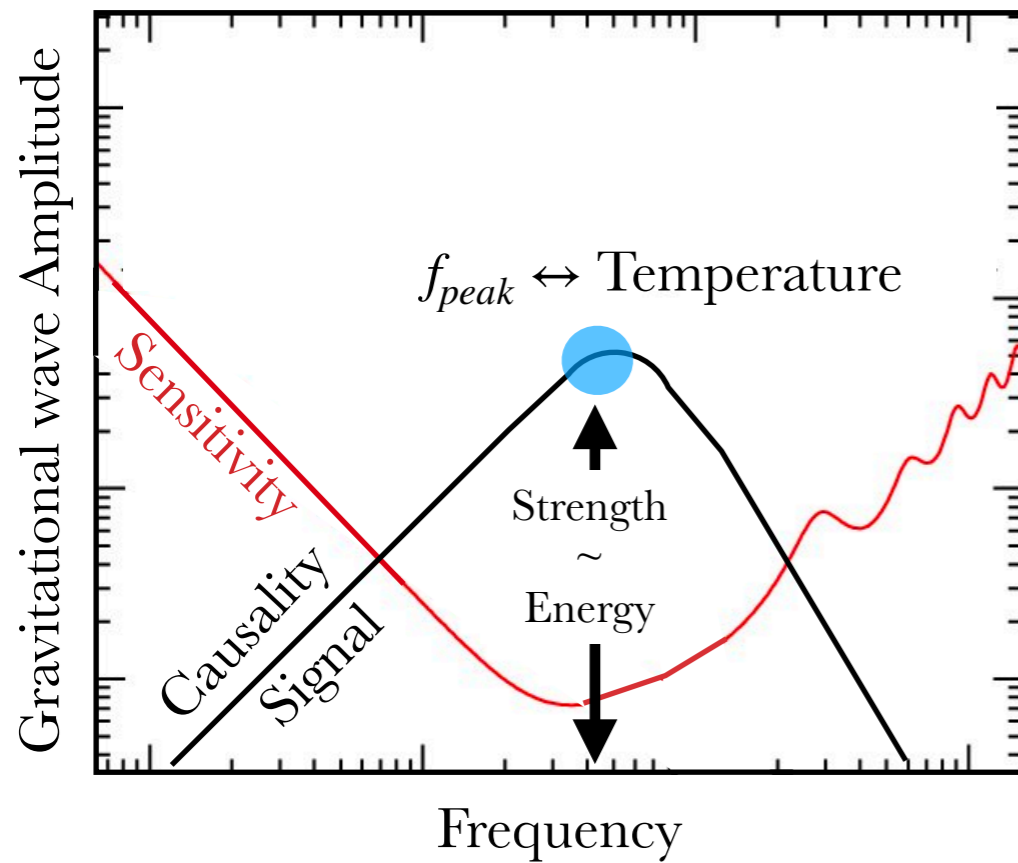


The SGWBs are powerful probes to shed light on astrophysics, cosmology and fundamental physics

How tightly can a SGWB detection be correlated with the parameters of the UV theory?

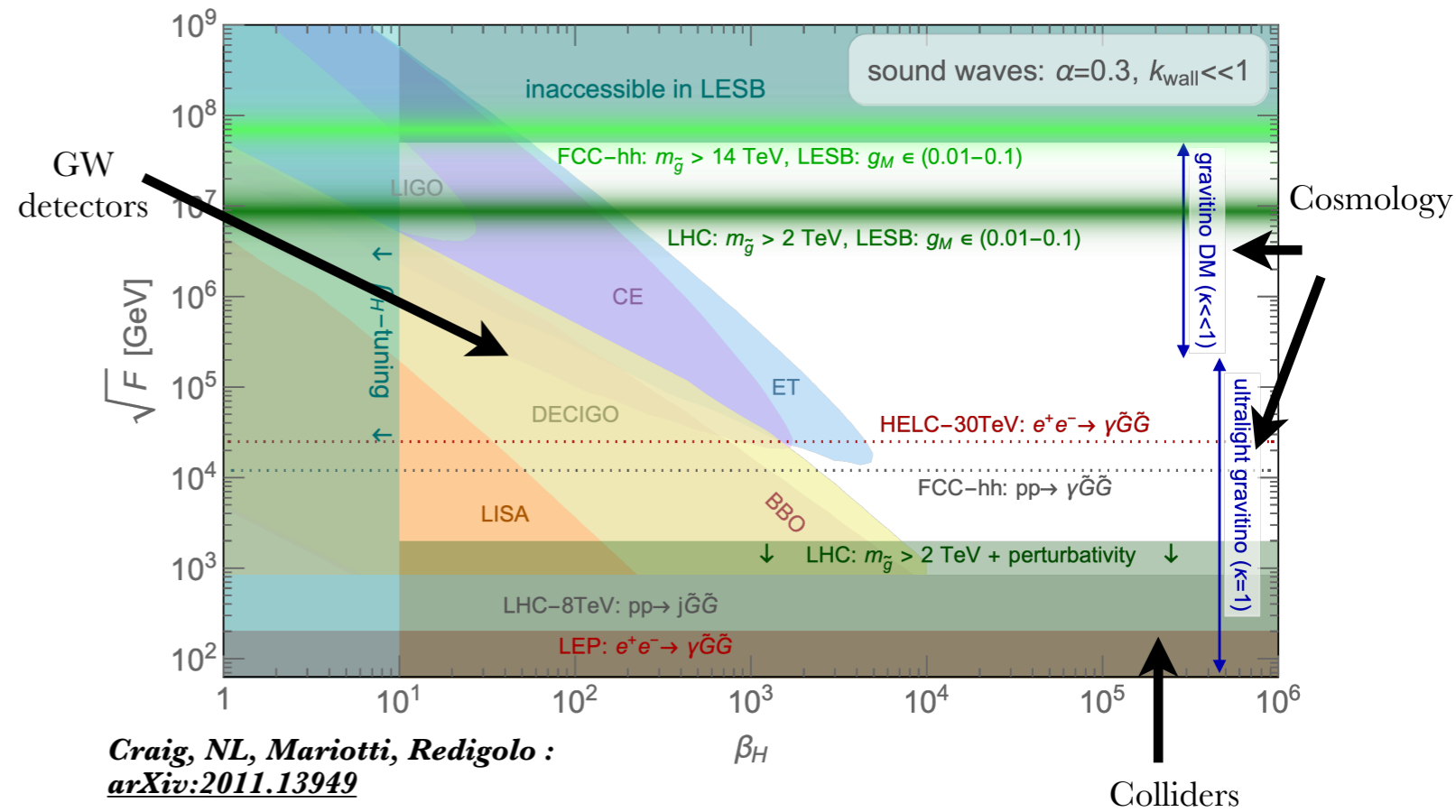
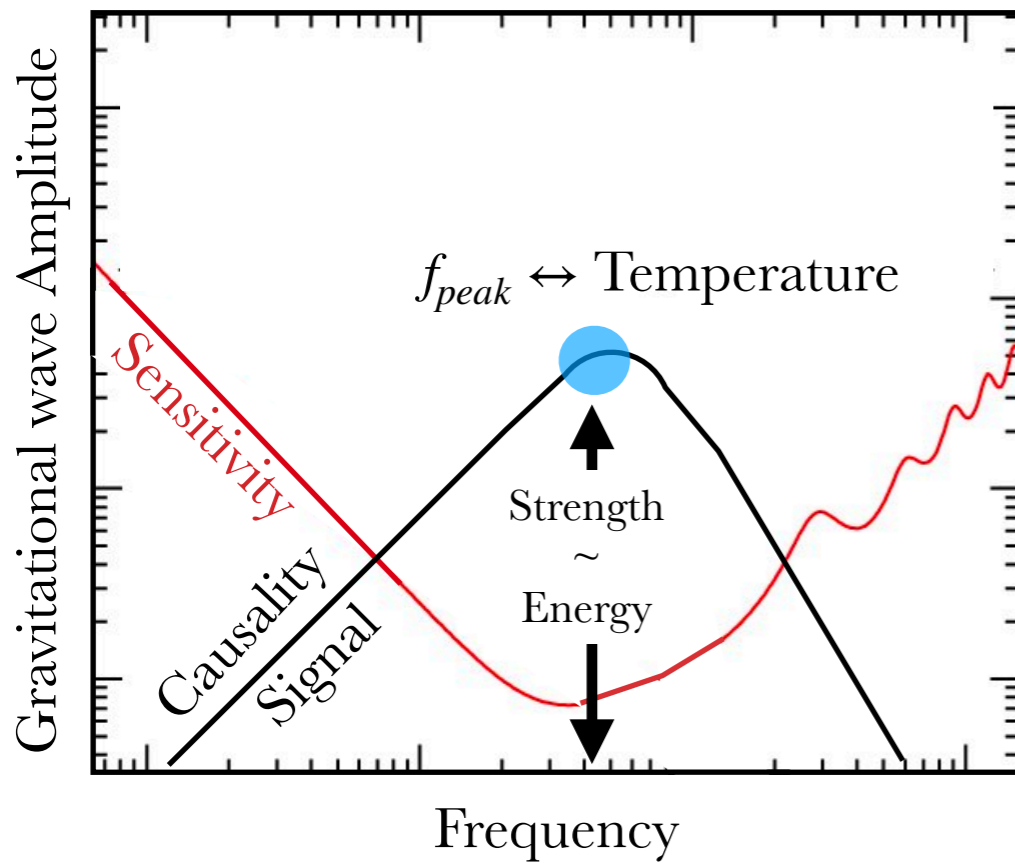
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Stochastic signal (FOPT)



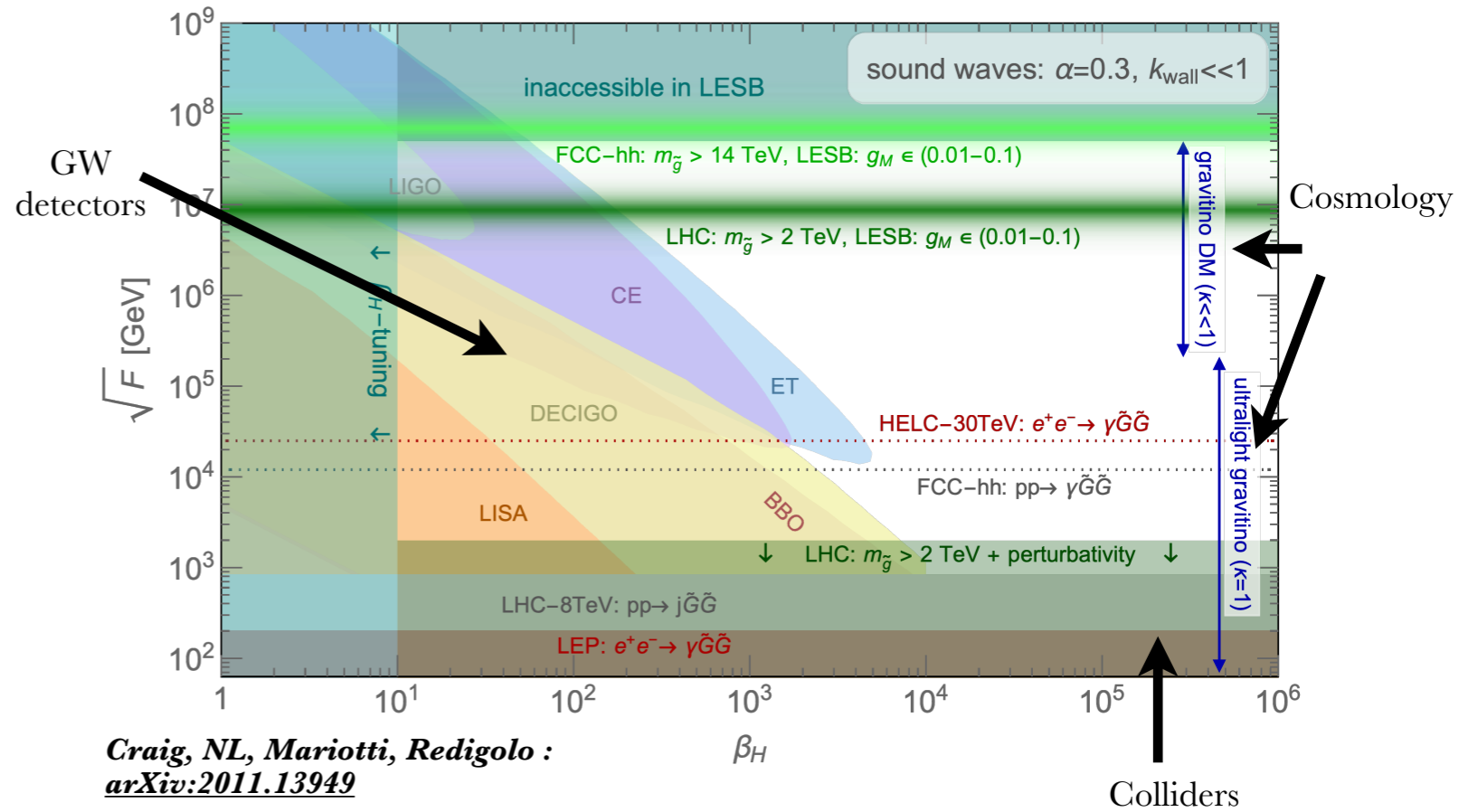
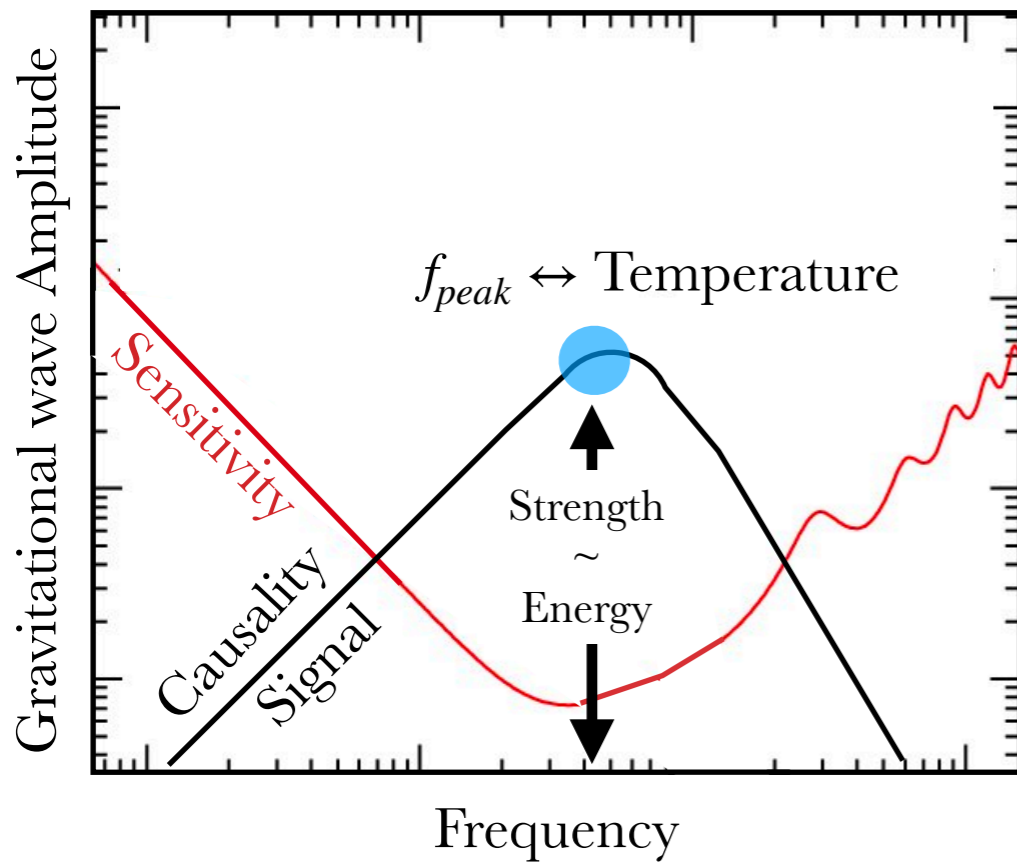
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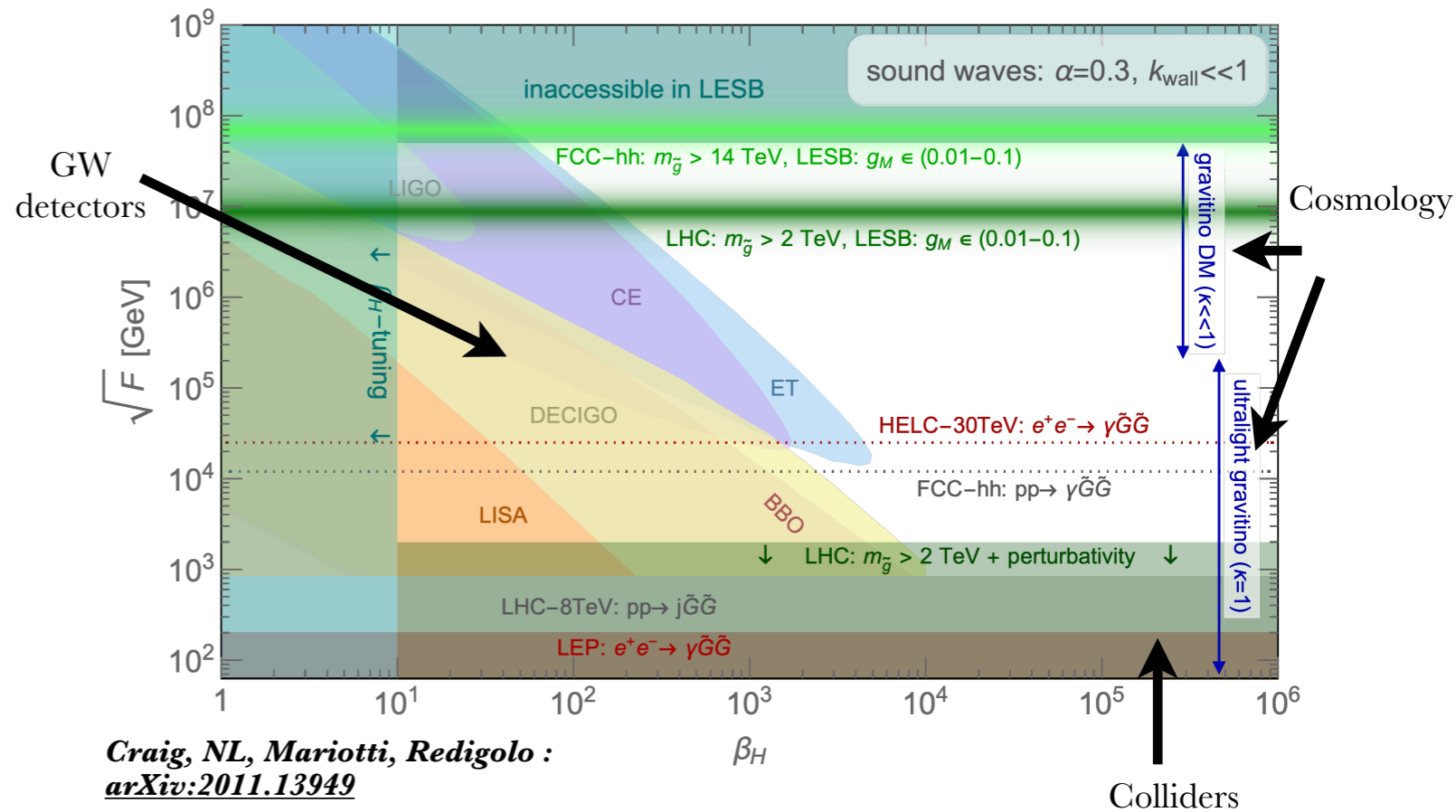
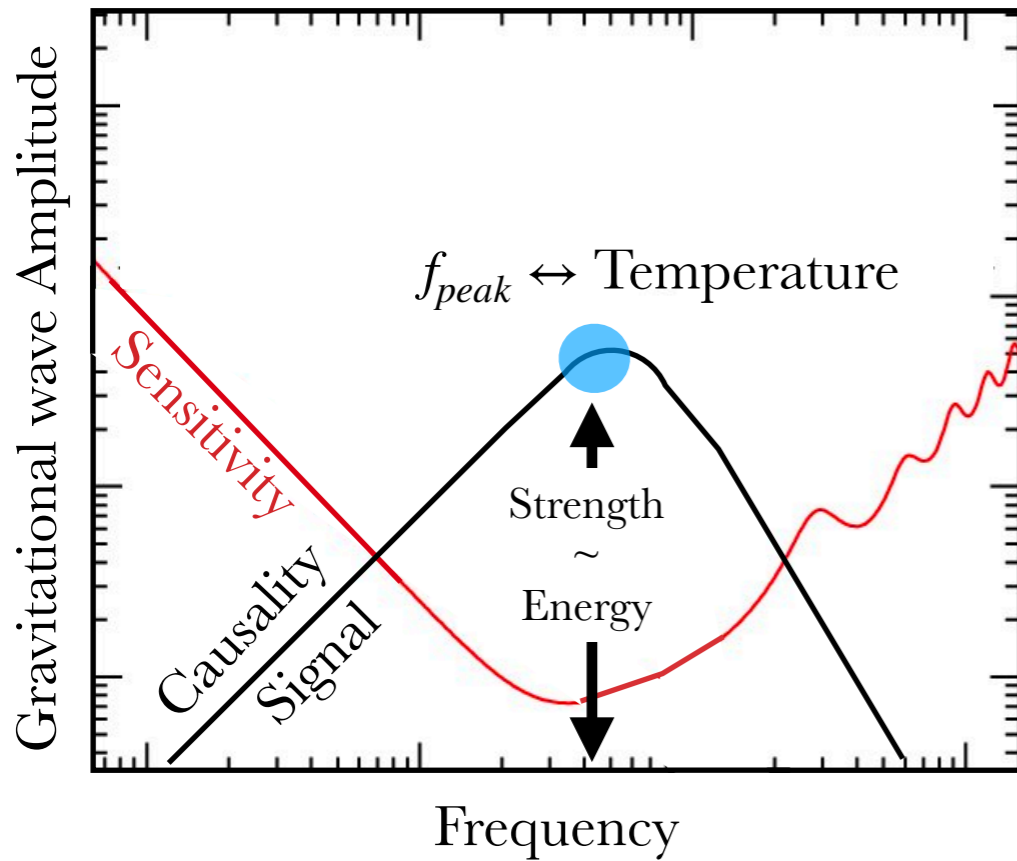


Complementarity

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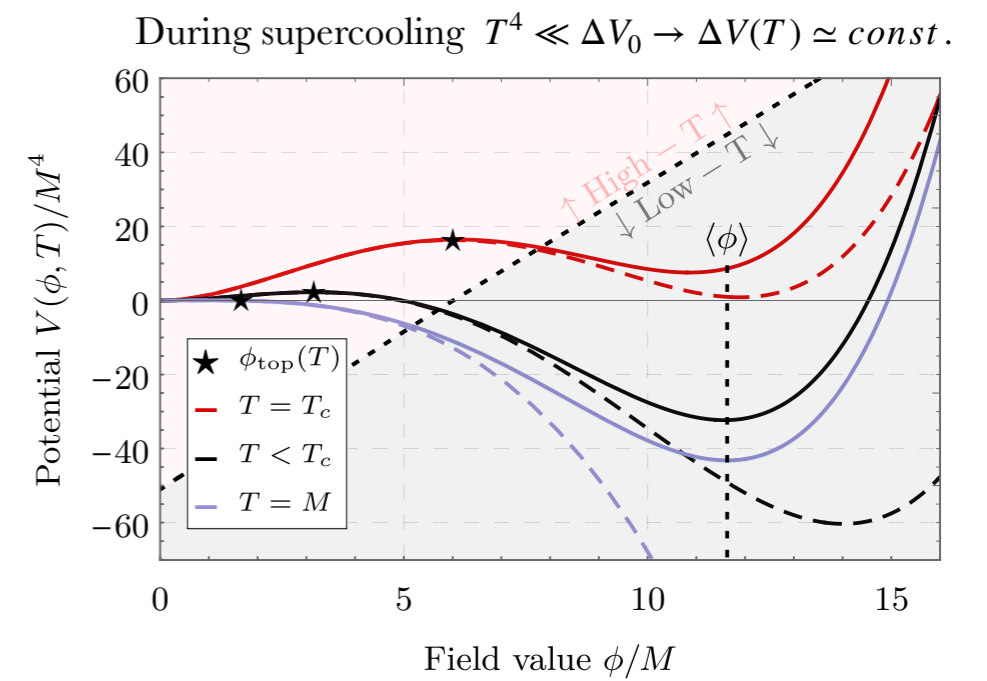
Focus on the strongest FOPT signals - supercooled transitions

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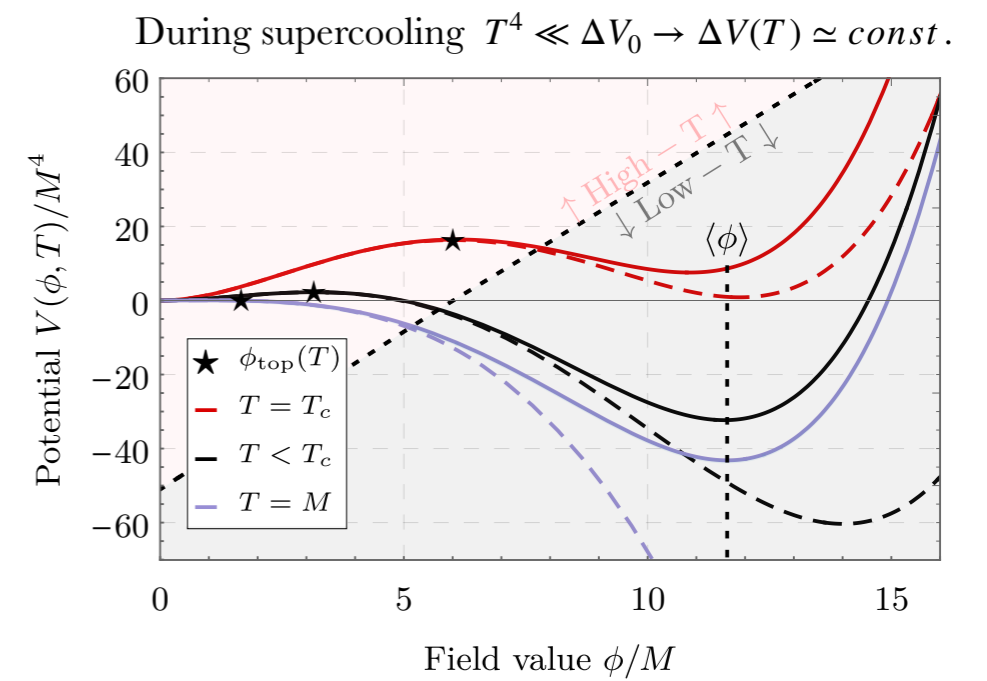


Complementarity

Supercooled transitions in weakly coupled ~~conformal~~ models

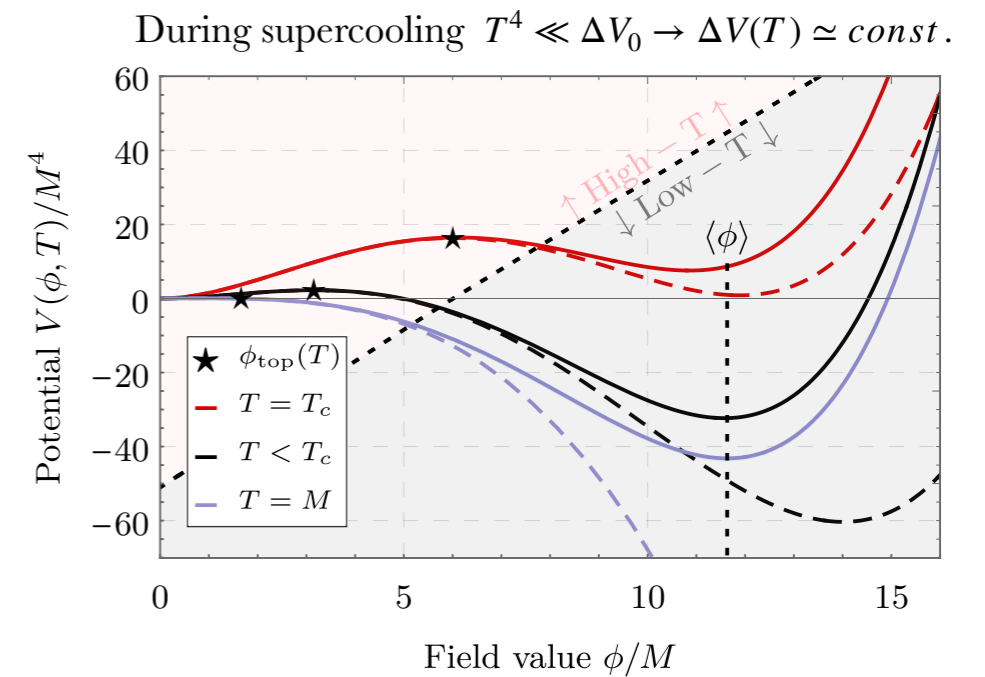


Supercooled transitions in weakly coupled ~~conformal~~ models



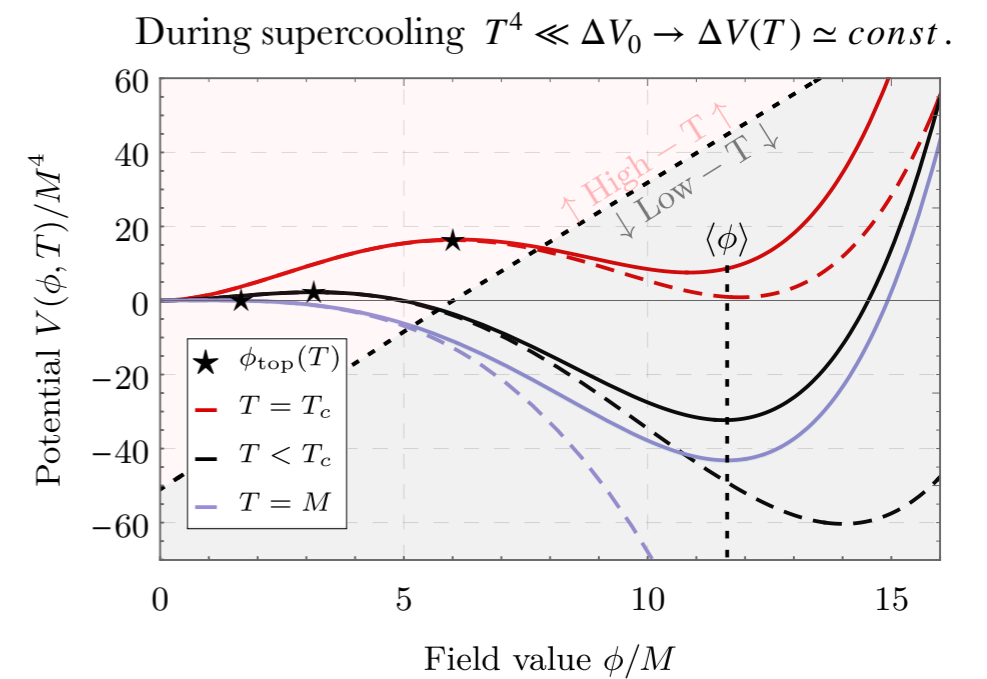
Supercooled transitions in weakly coupled ~~conformal~~ models

- Classically flat direction lifted at one loop by Radiative Symmetry Breaking



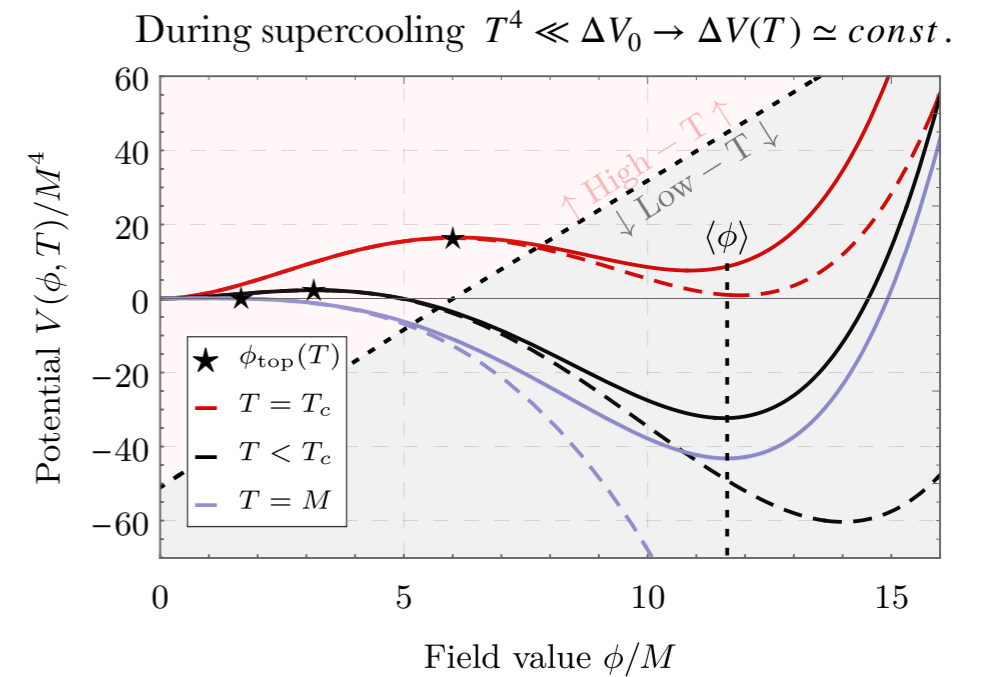
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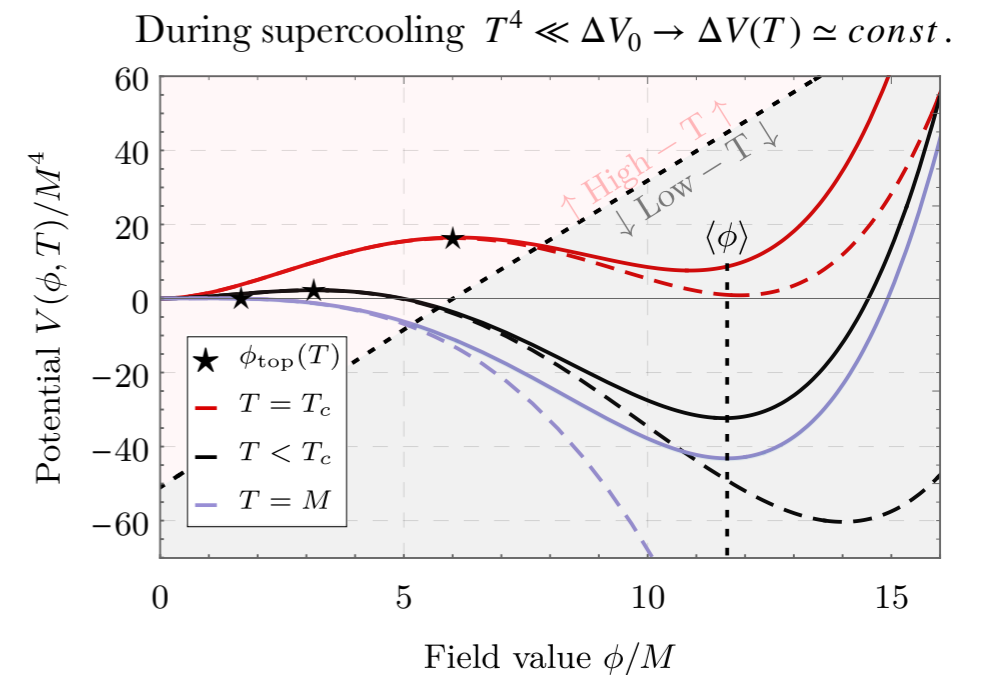
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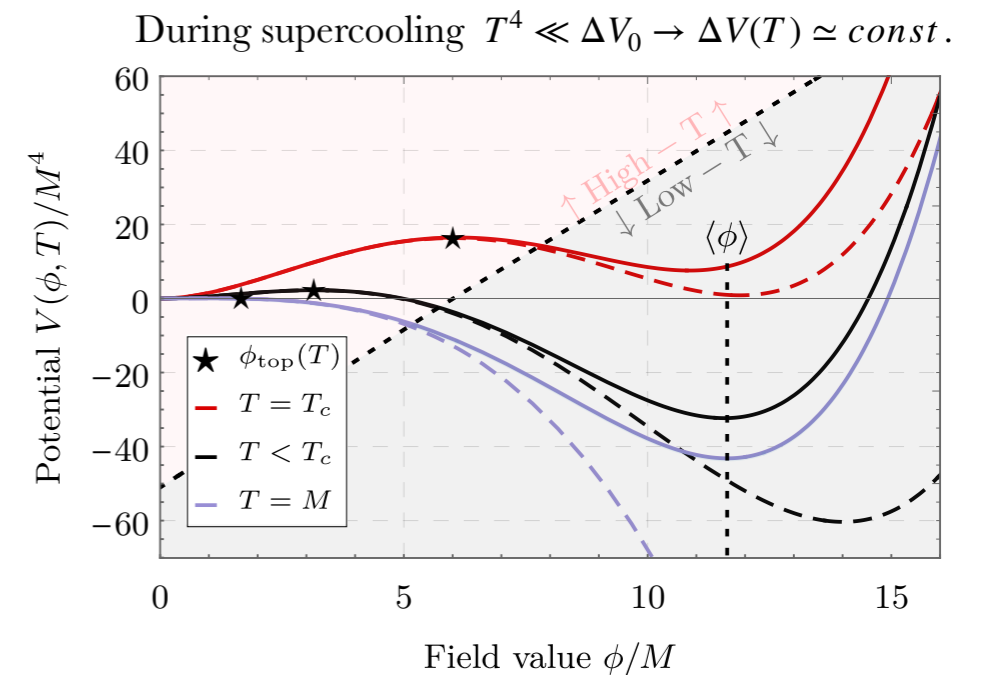
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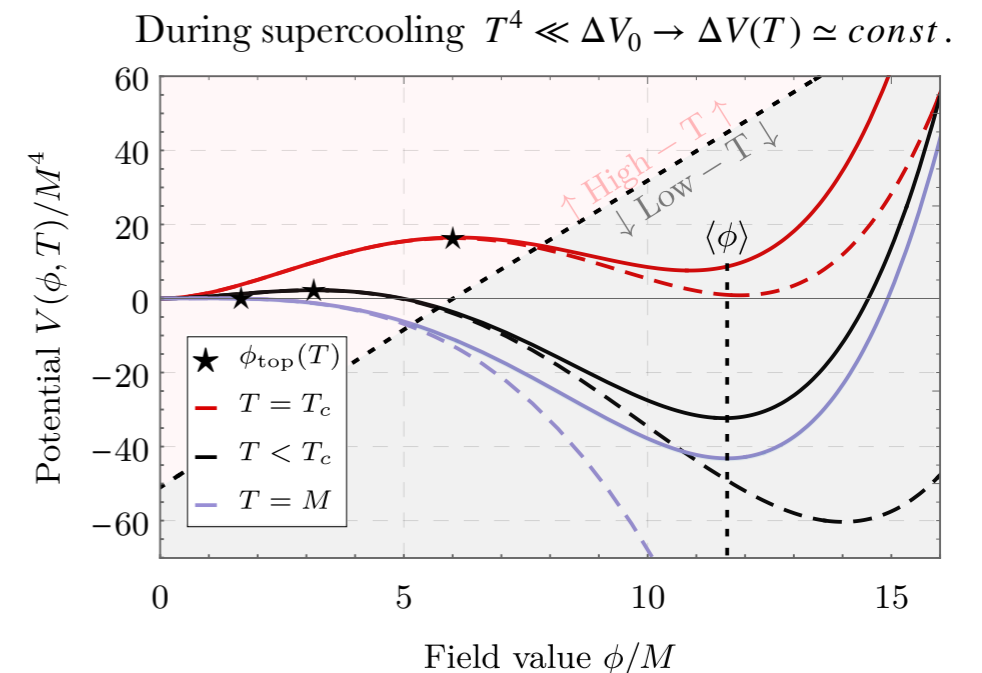
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Assume a generic high T potential

$$V(\phi, T) = \frac{1}{2}m^2(T)\phi^2 - \frac{\delta(T)}{3}\phi^3 \pm \frac{\lambda(T)}{4}\phi^4$$

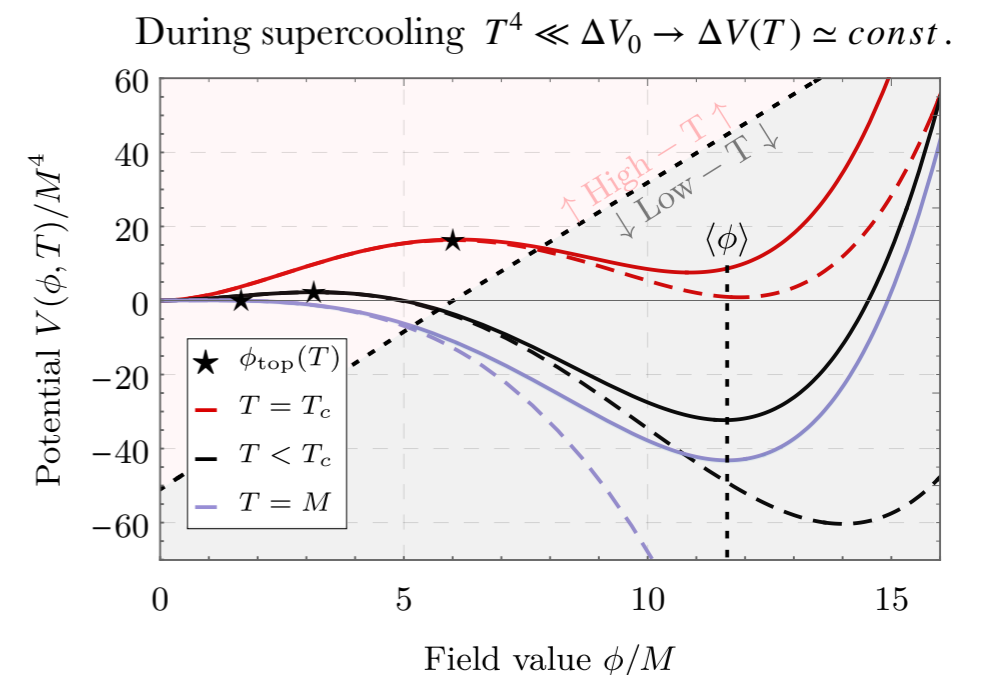
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Reparameterization

Single parameter problem

$$\tilde{V}(\varphi, T) = \frac{1}{2}\varphi^2 - \frac{\xi(T)}{3}\varphi^3 \pm \frac{1}{4}\varphi^4$$

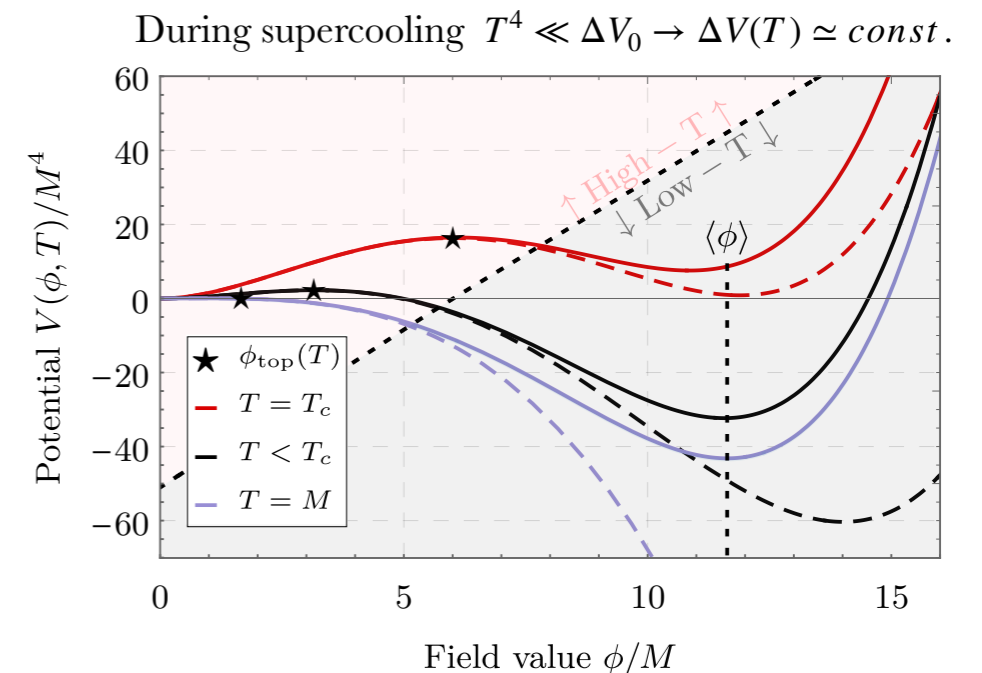
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Extremize the
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$$\frac{\Gamma(T_n)}{V} \simeq H(T_n)$$

The transition completes at T_n

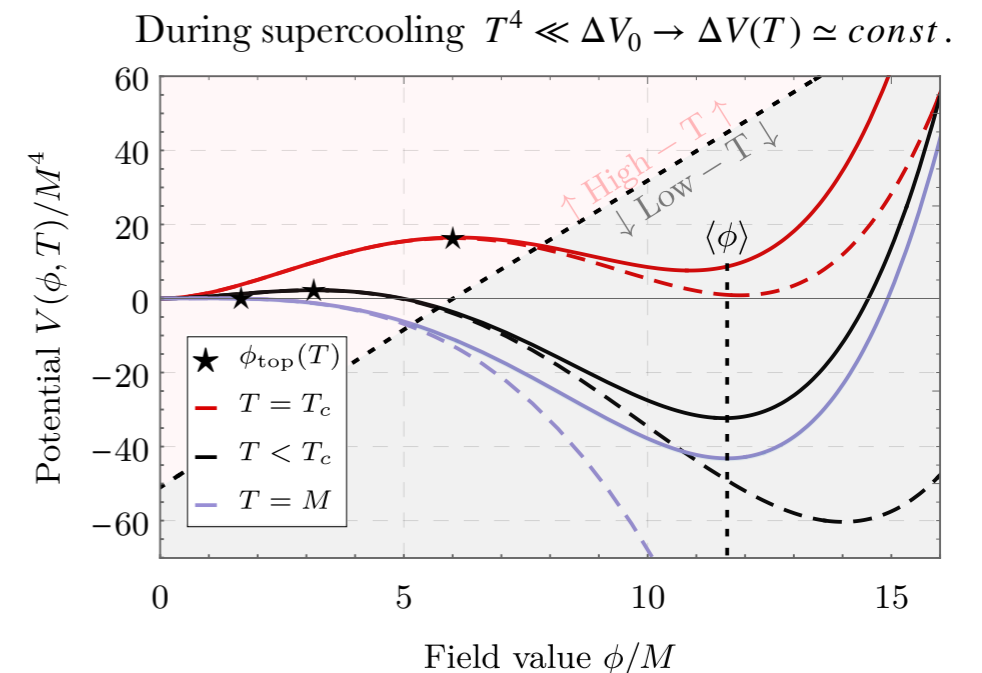
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Supercooling window in the theory parameter space

Extremize the nucleation condition

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The supercooling window in nearly conformal models

Hubble volume
occupied by ~ 1
bubble

$$\Gamma(T_n) \simeq H(T_n)^4 \rightarrow \frac{S_3}{T_n} \simeq 4 \log \frac{T_n}{H(T_n)}$$

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Bounce action Nucleation criterion

Hubble expansion

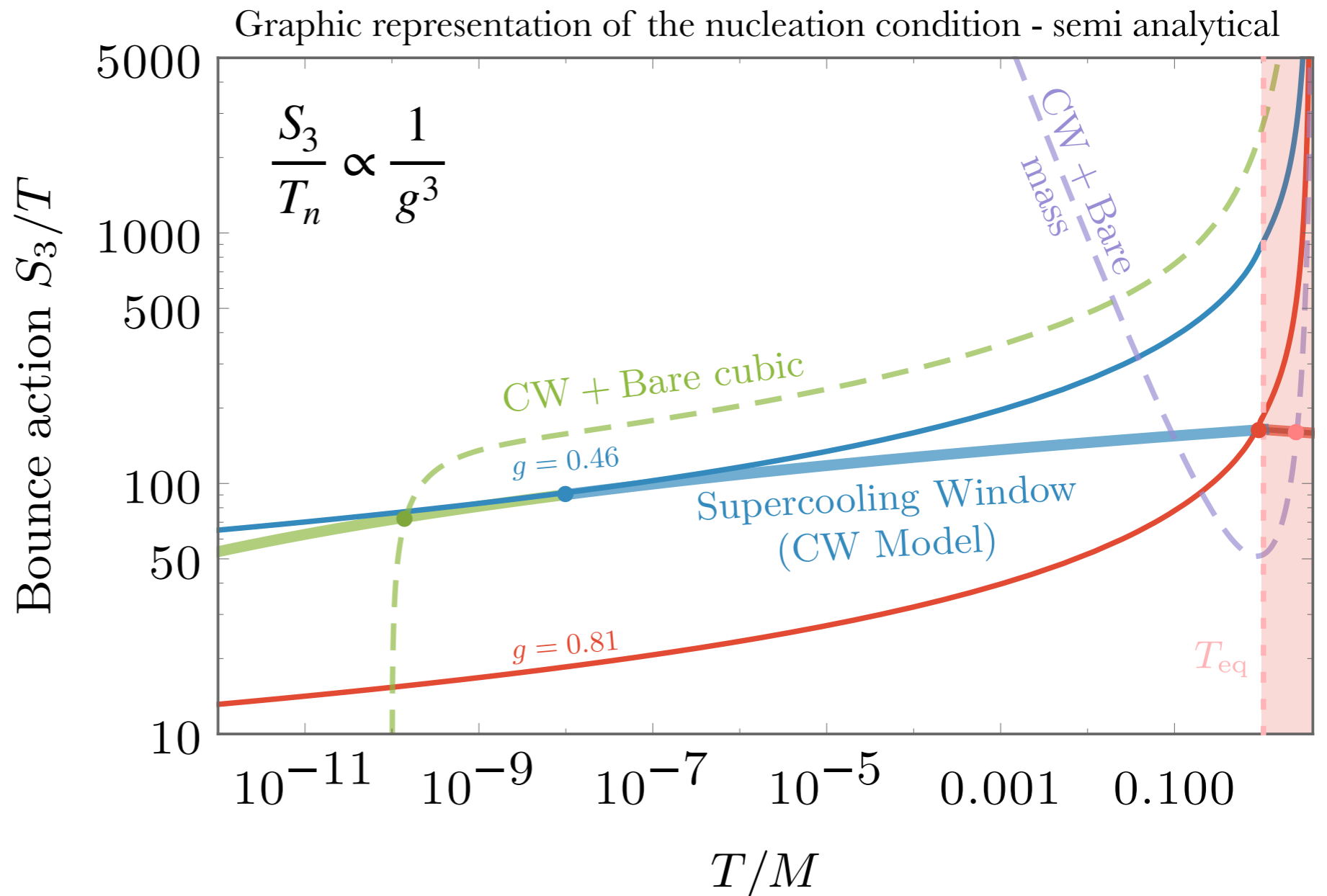
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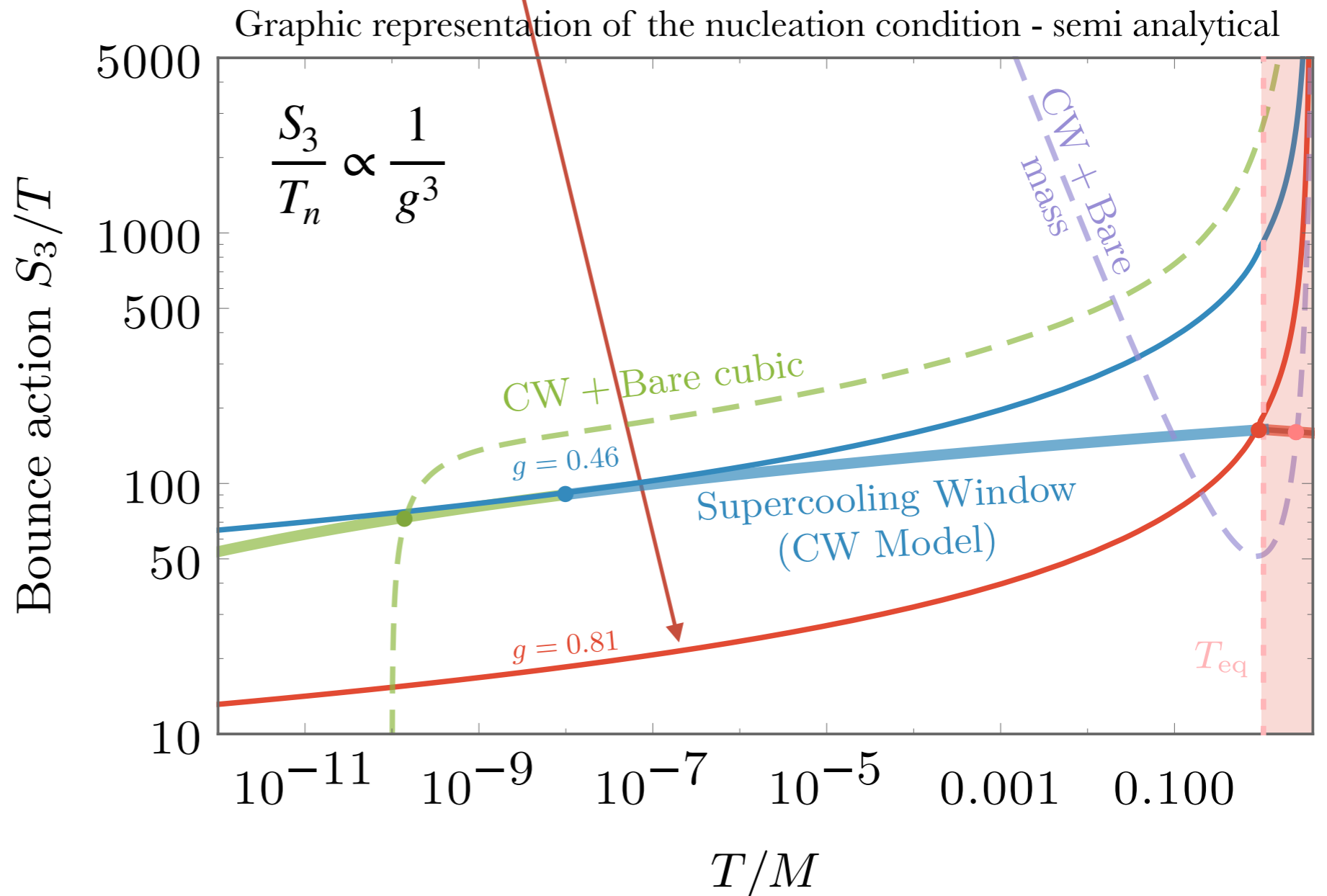


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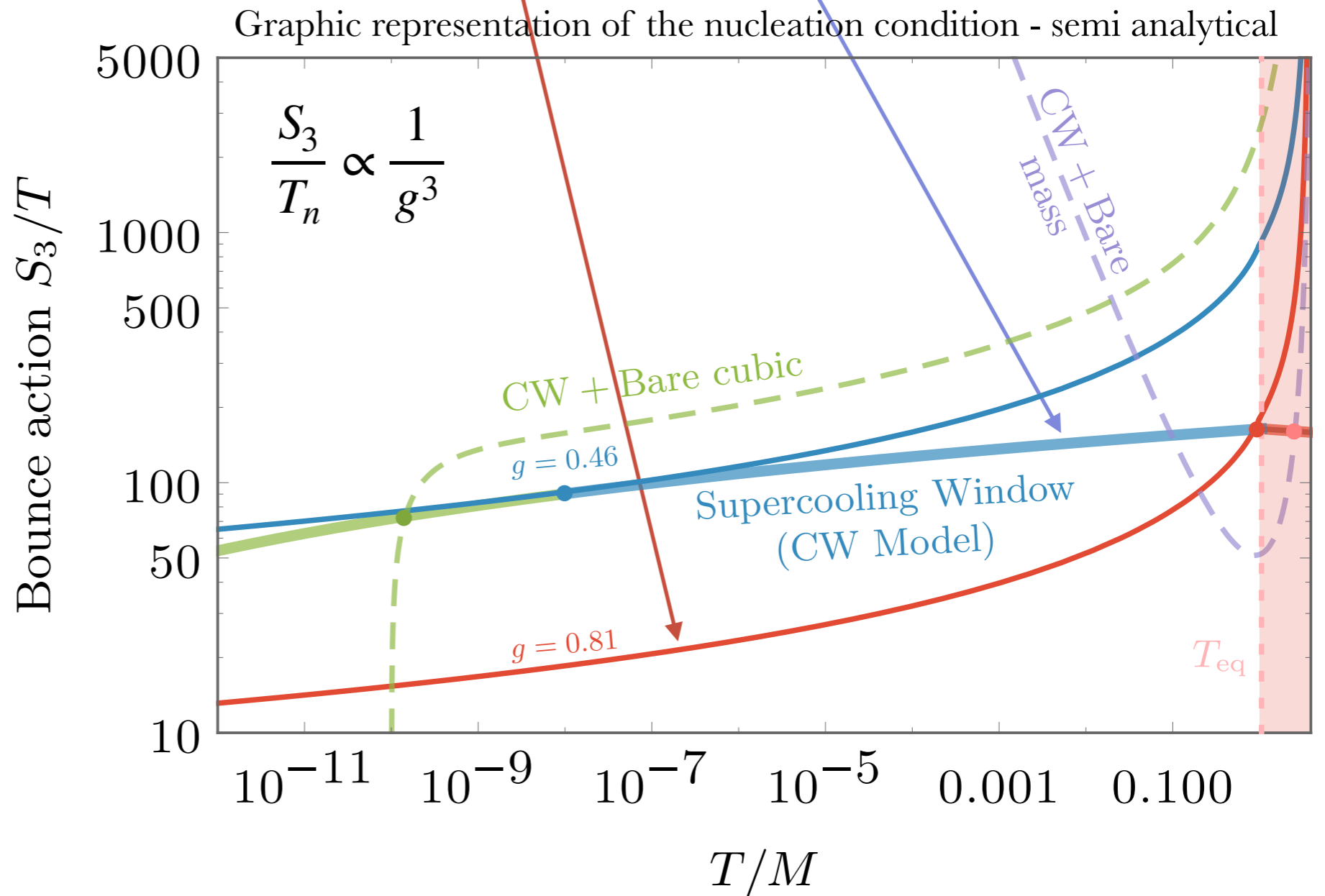


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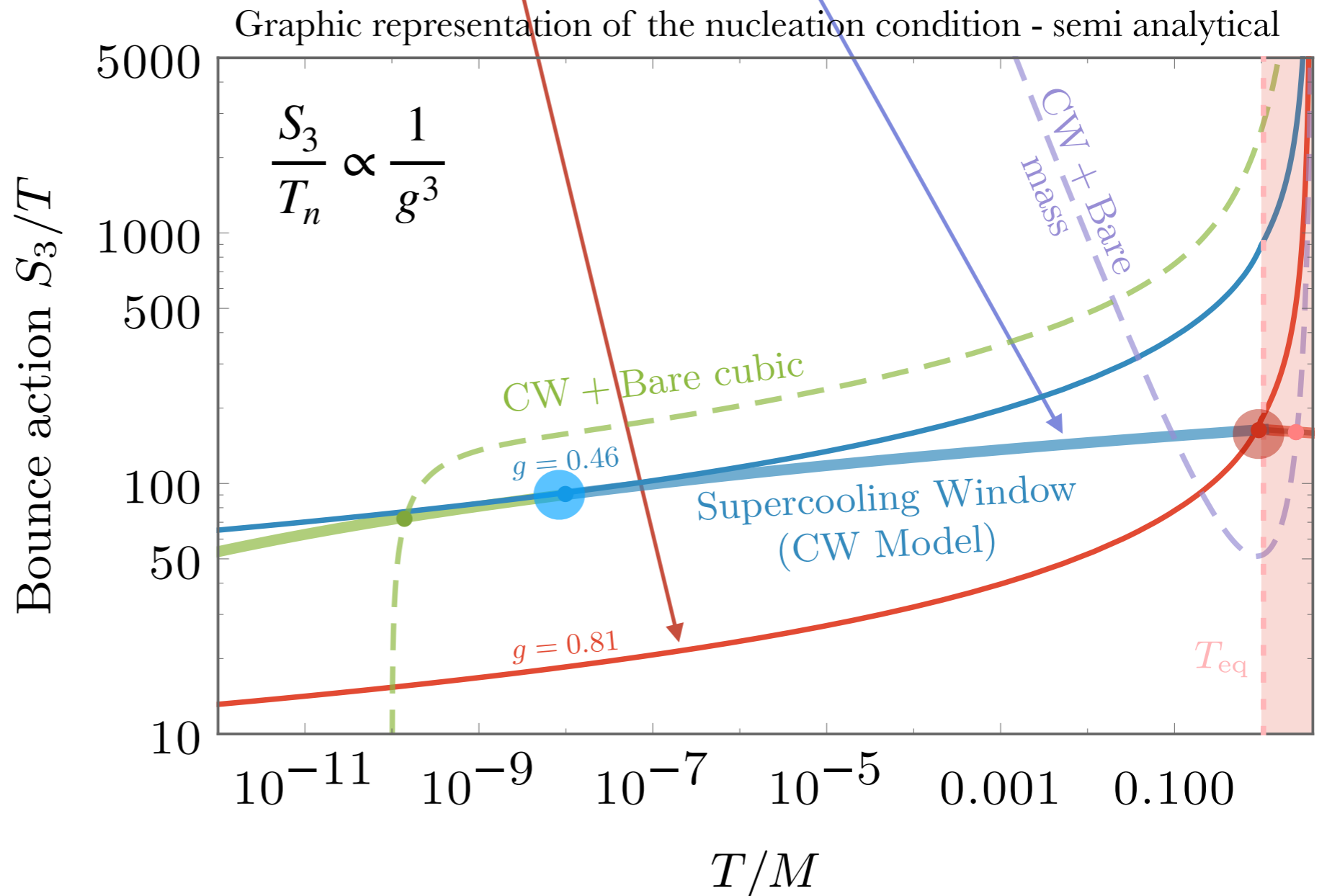


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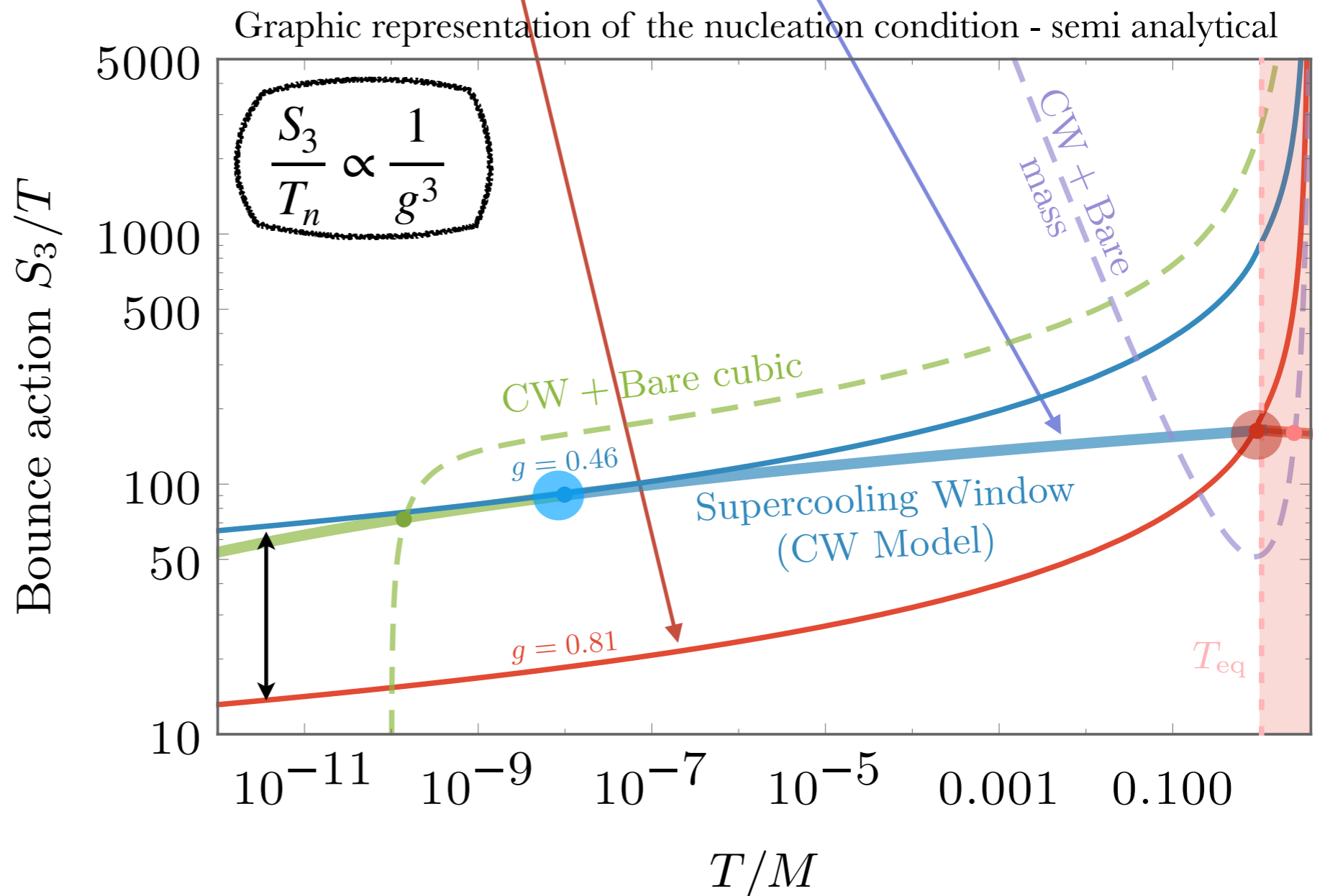
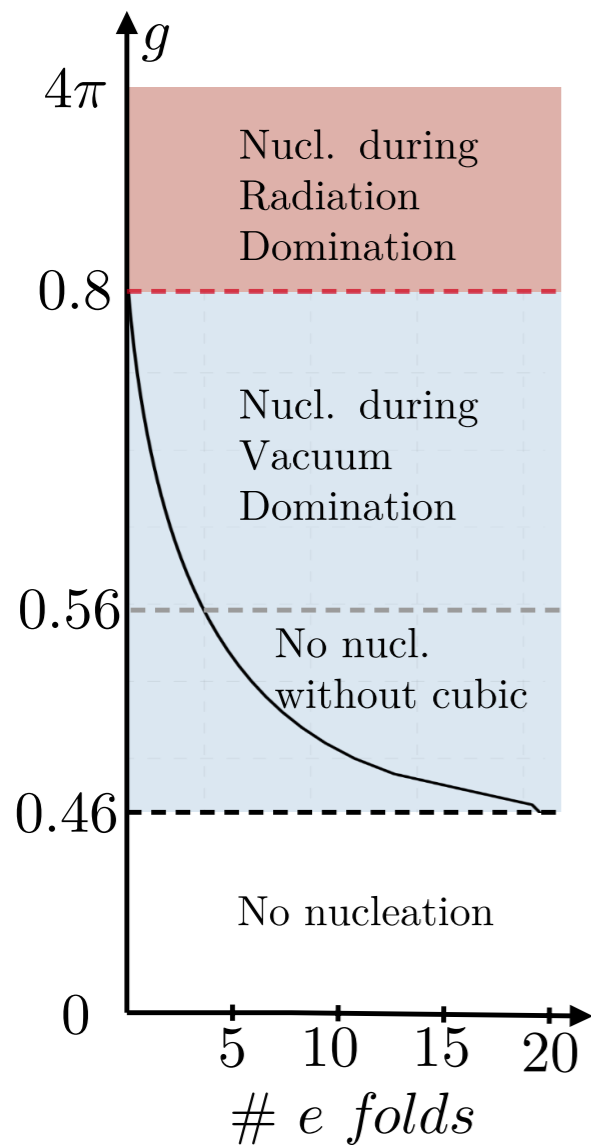


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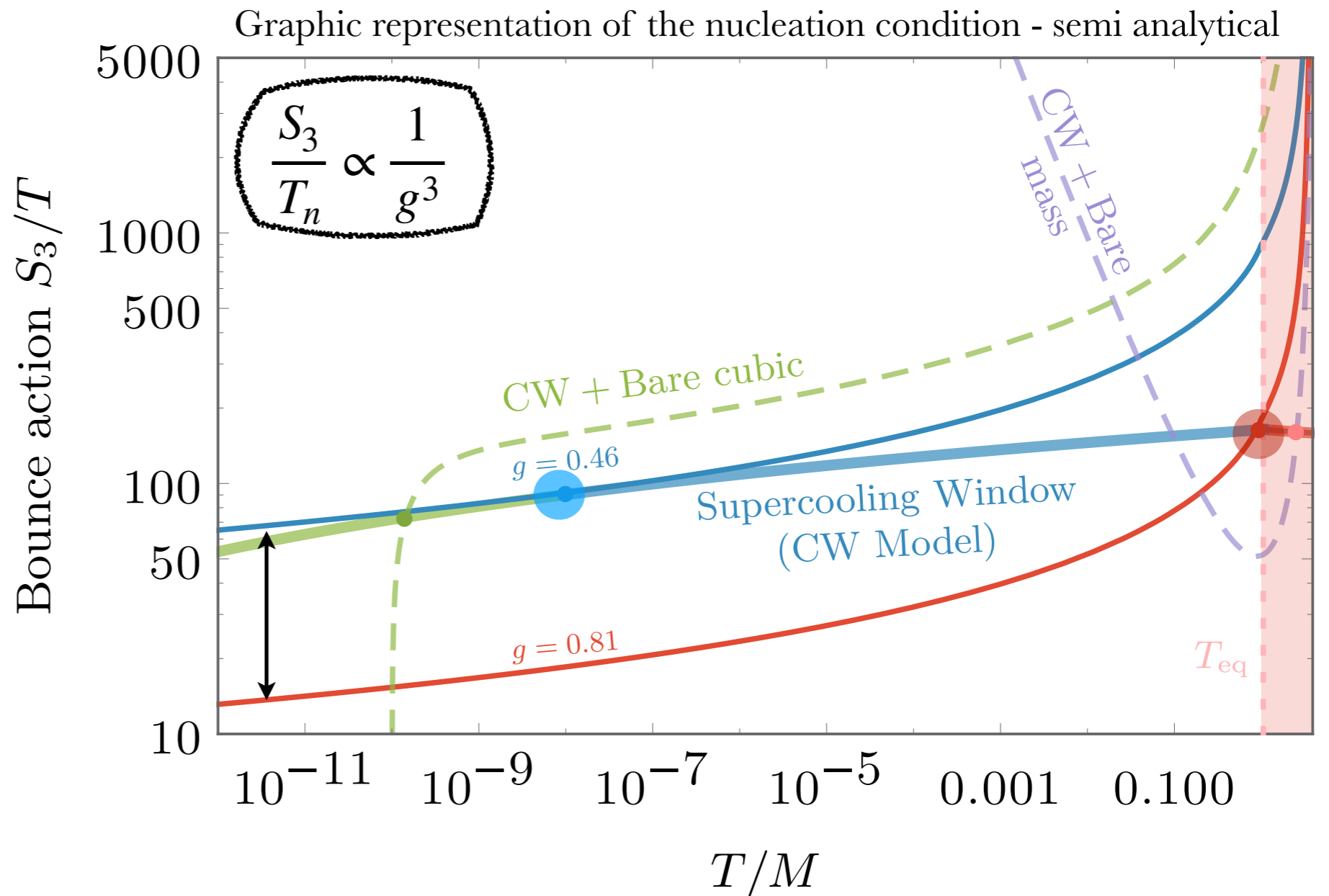
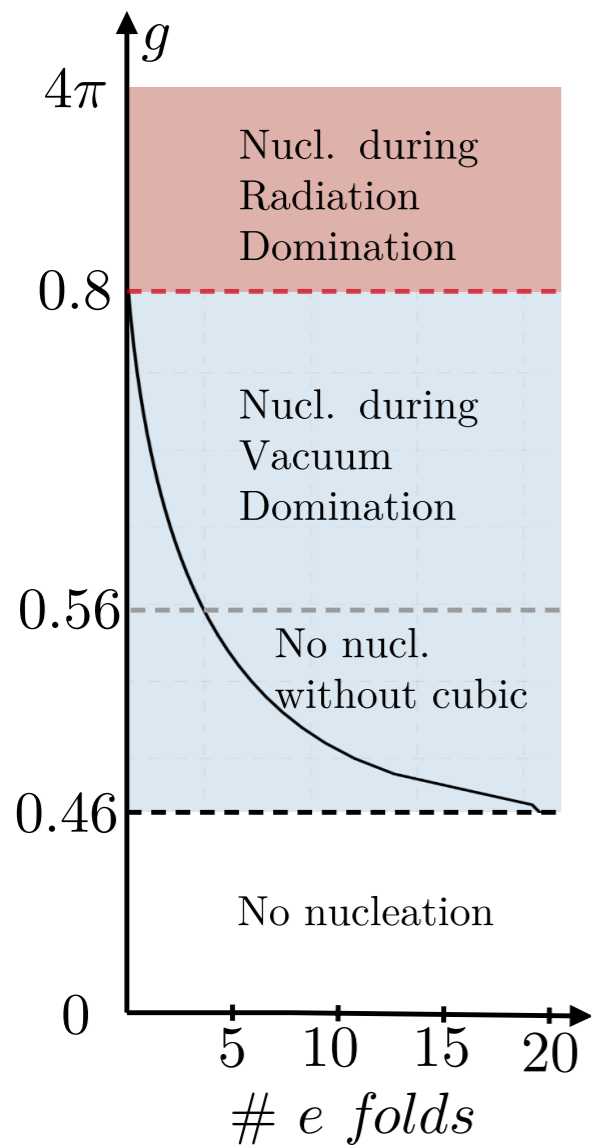


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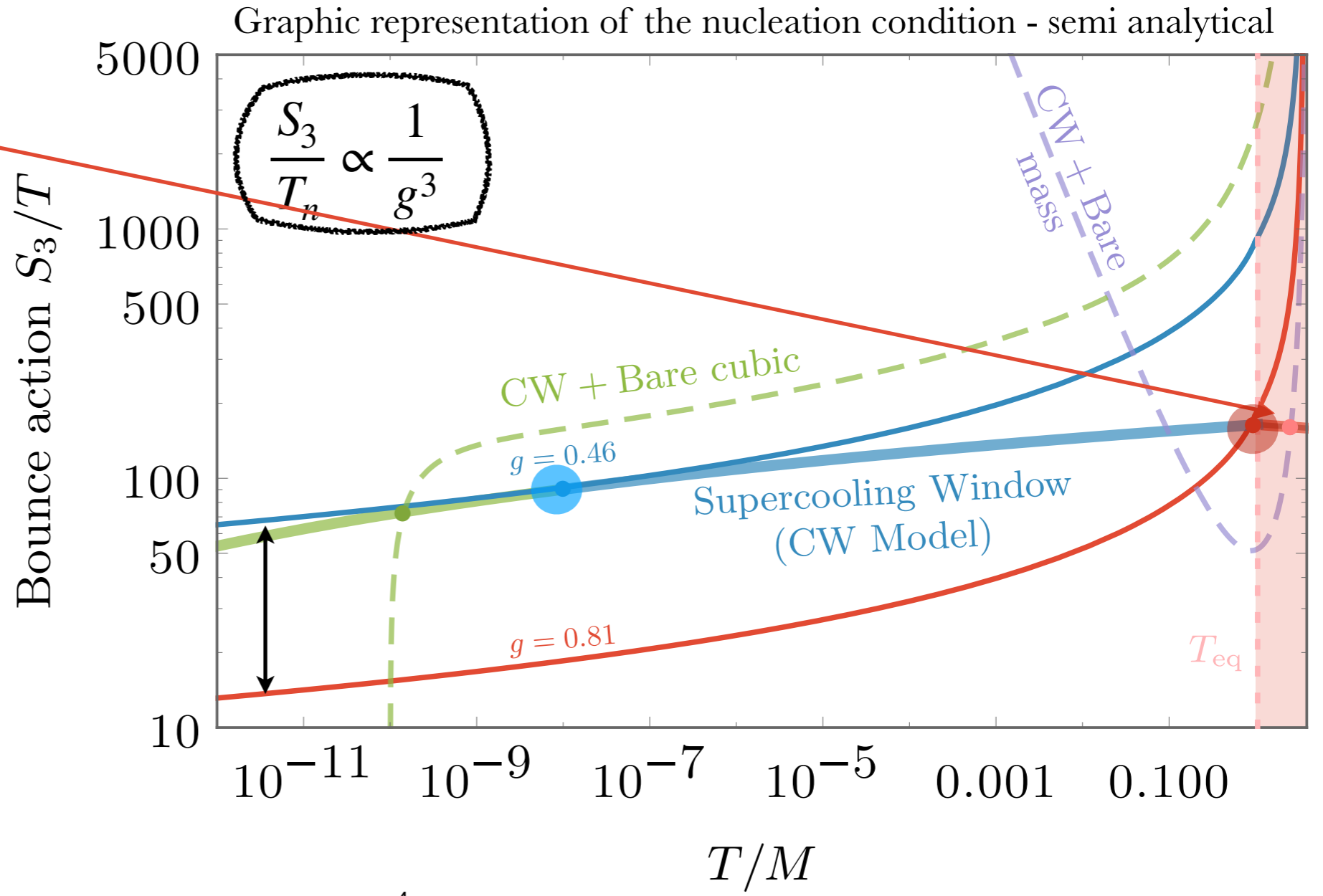
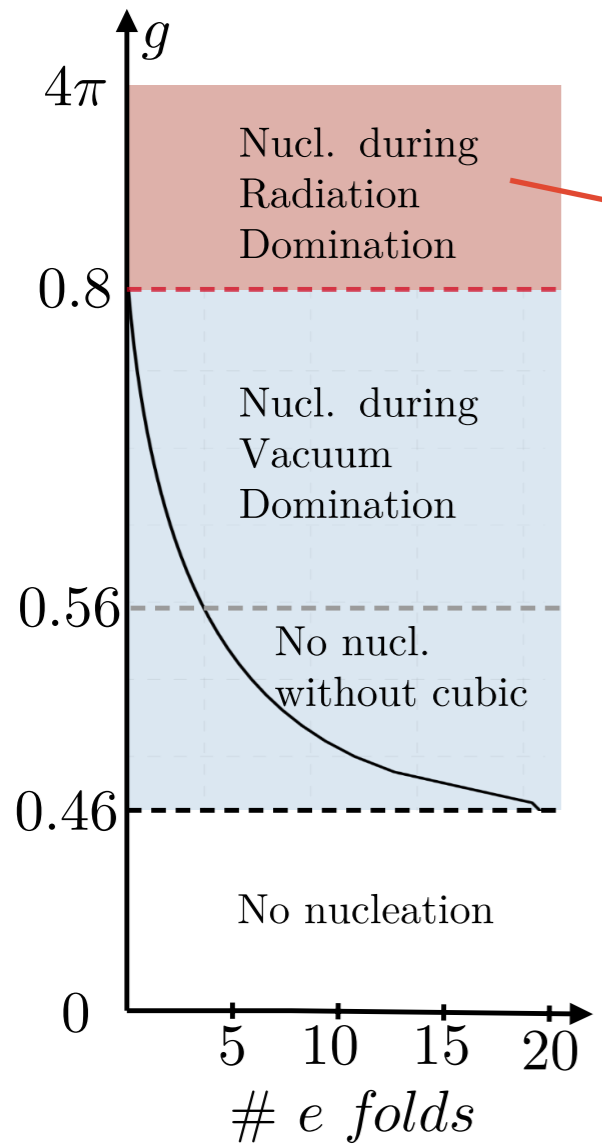


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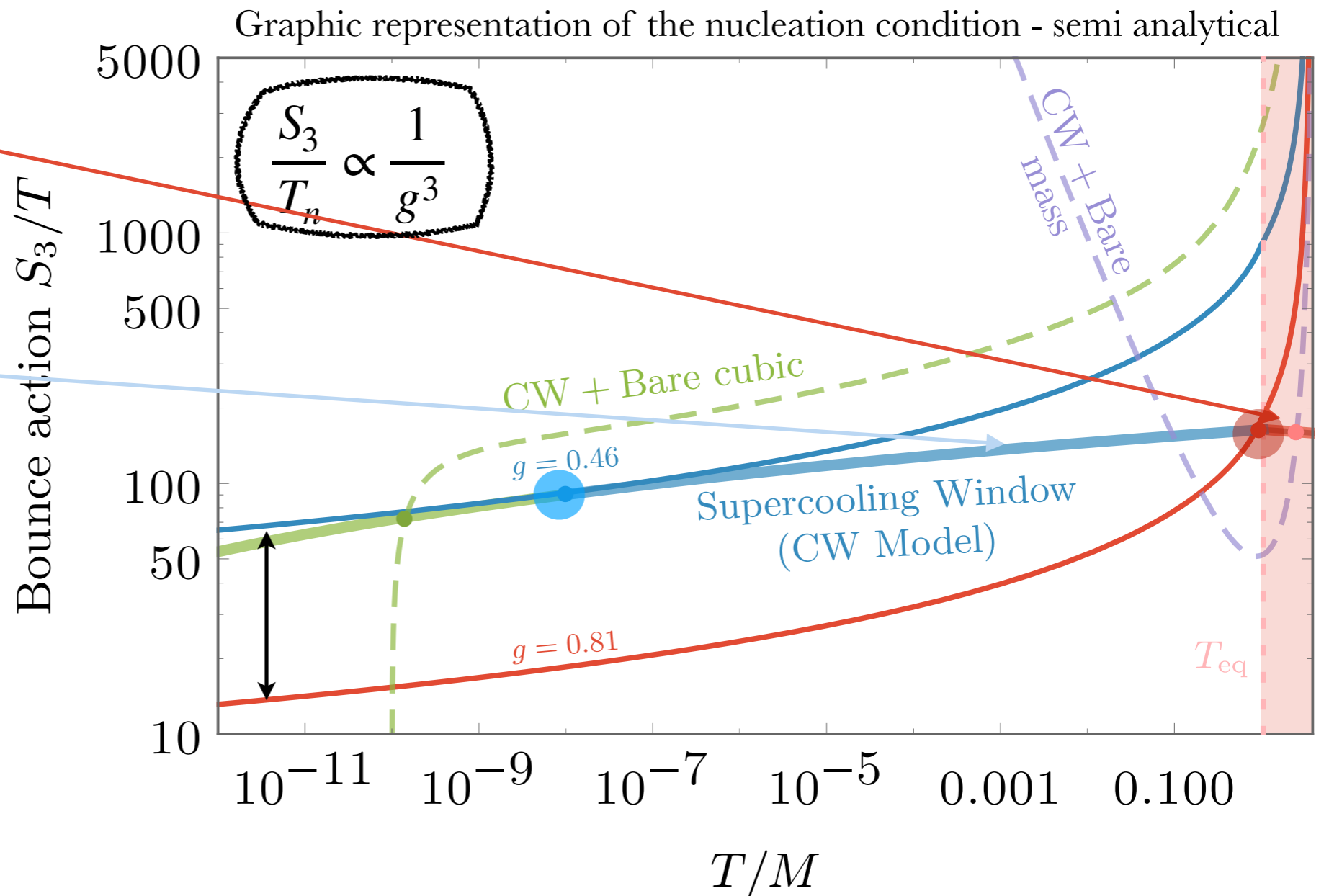
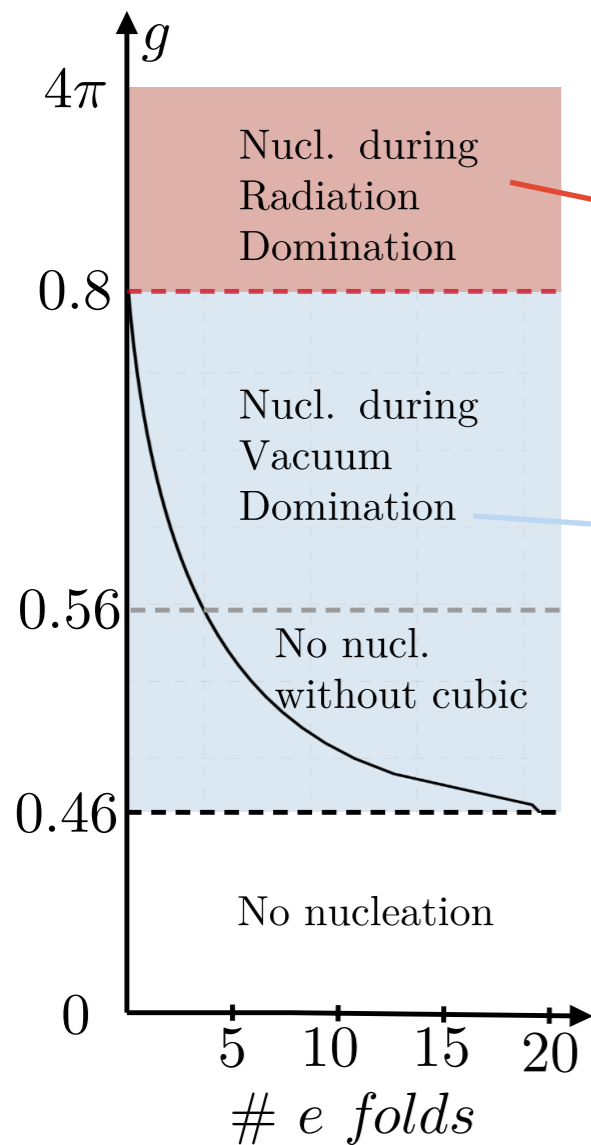


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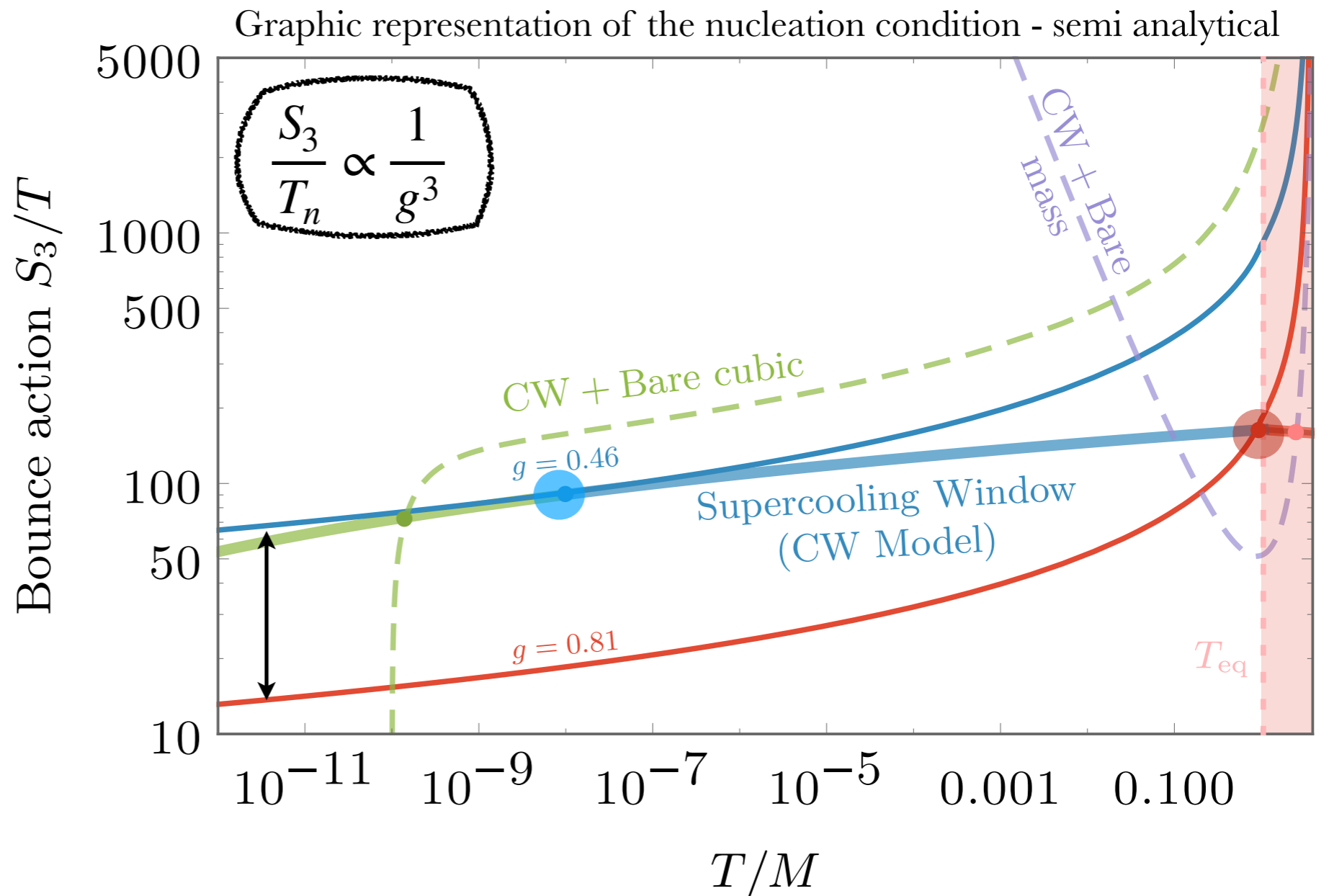
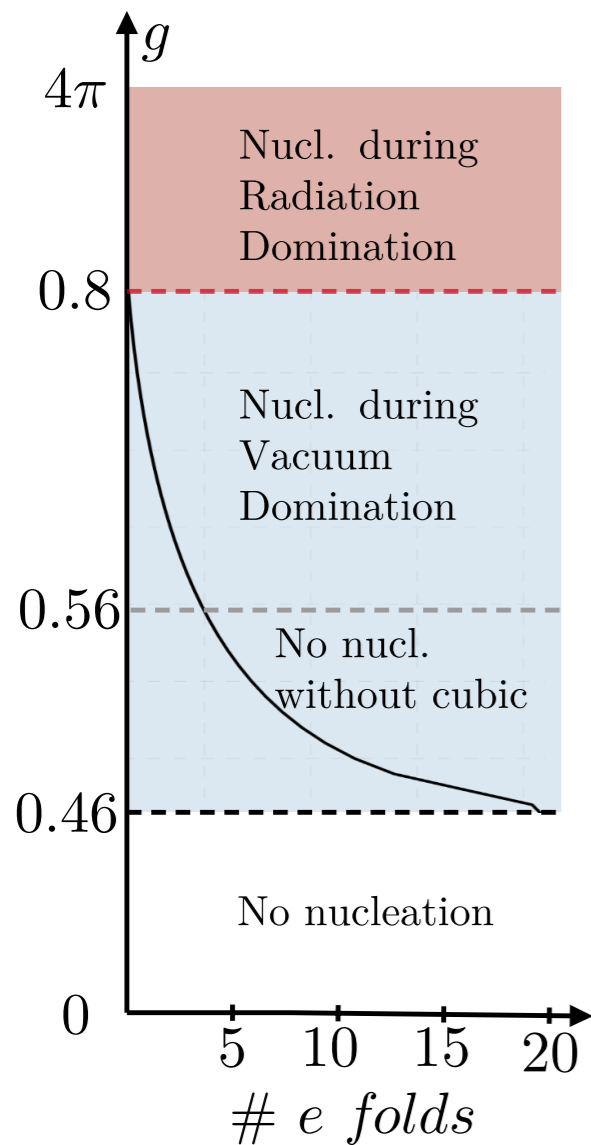


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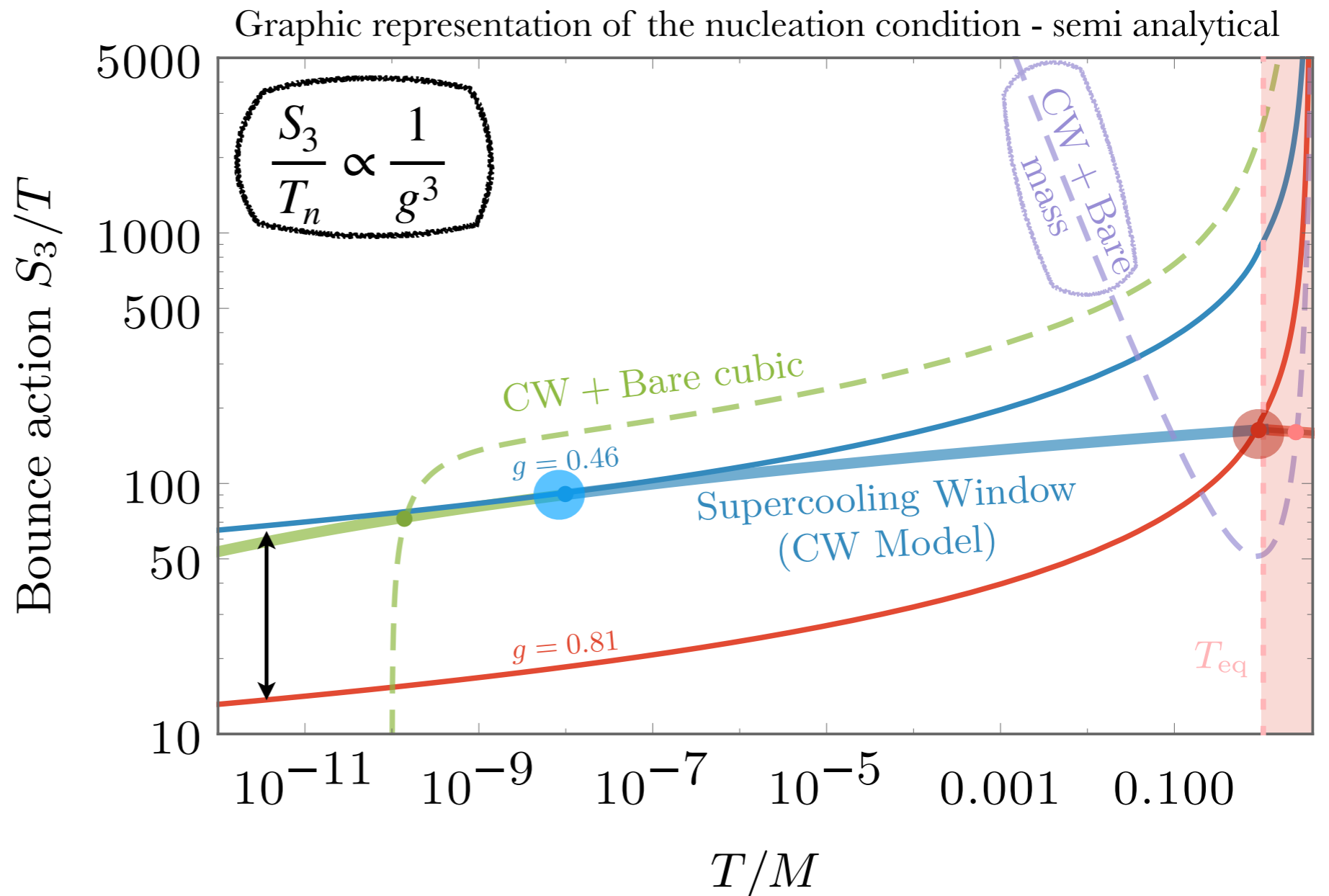
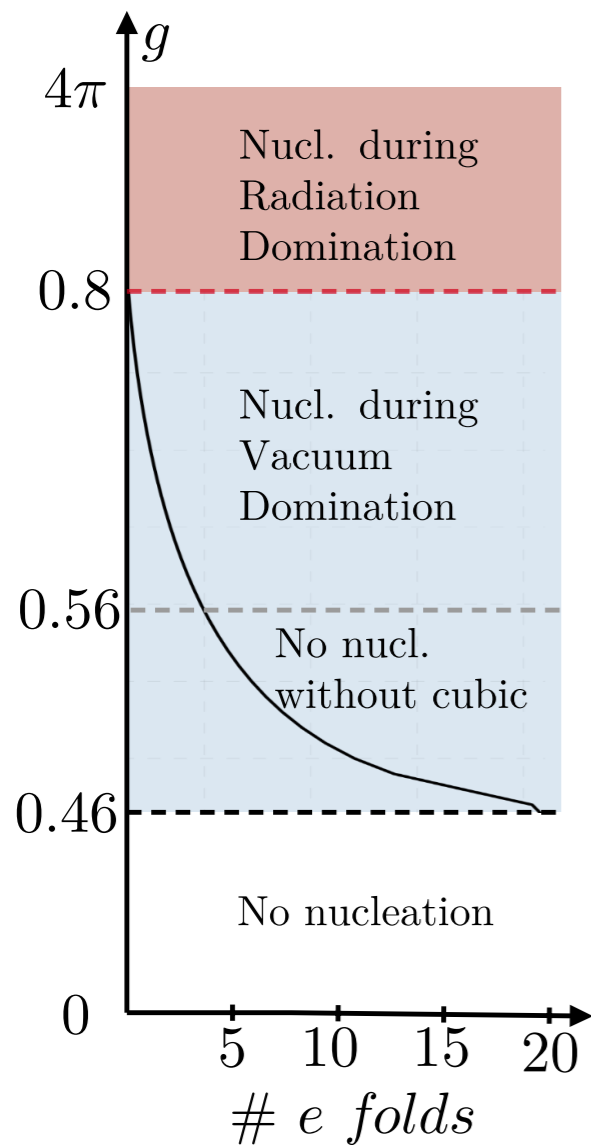


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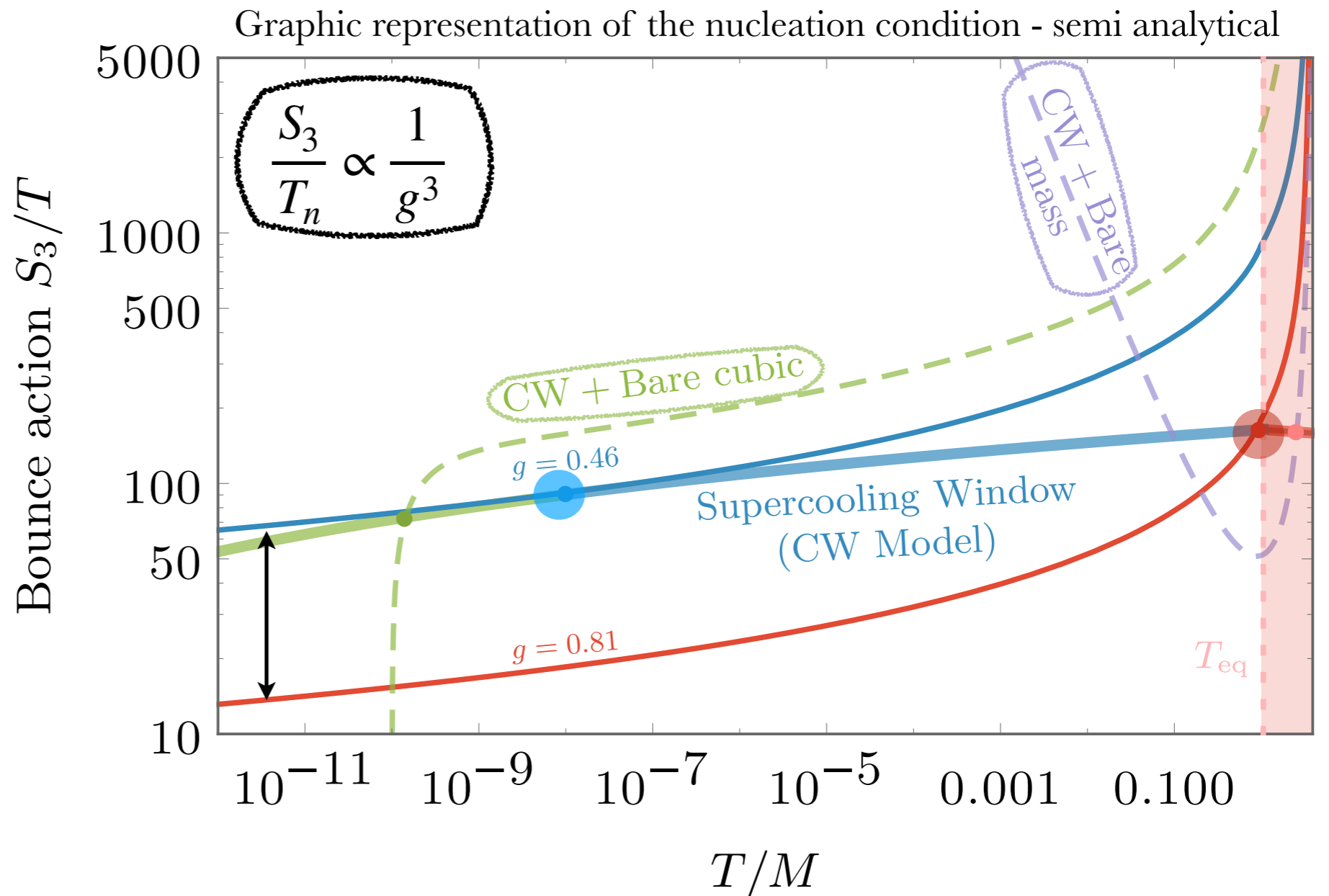
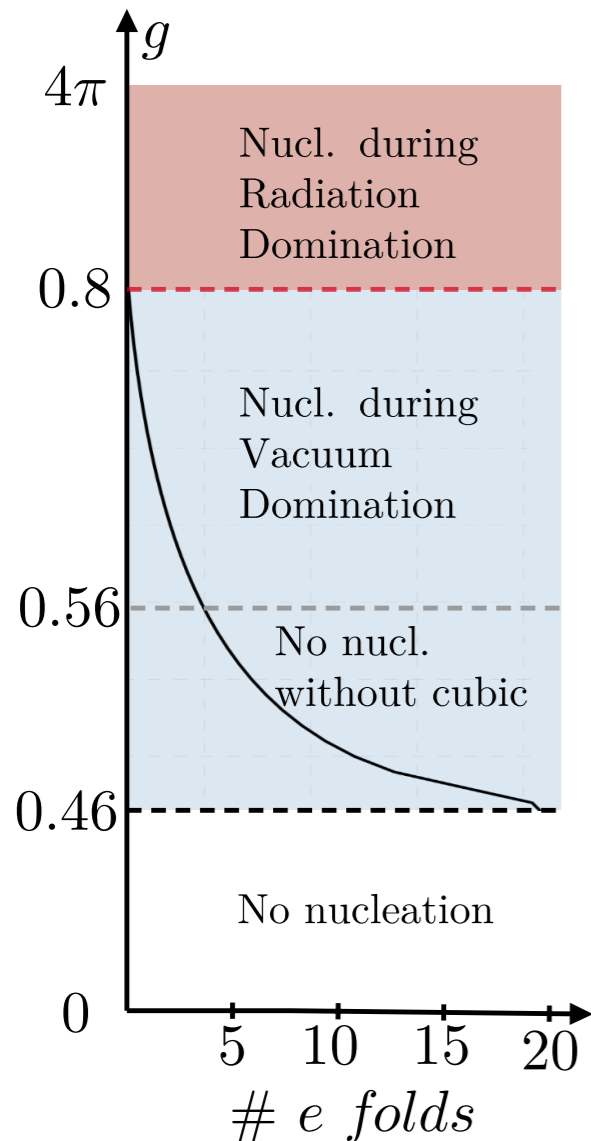


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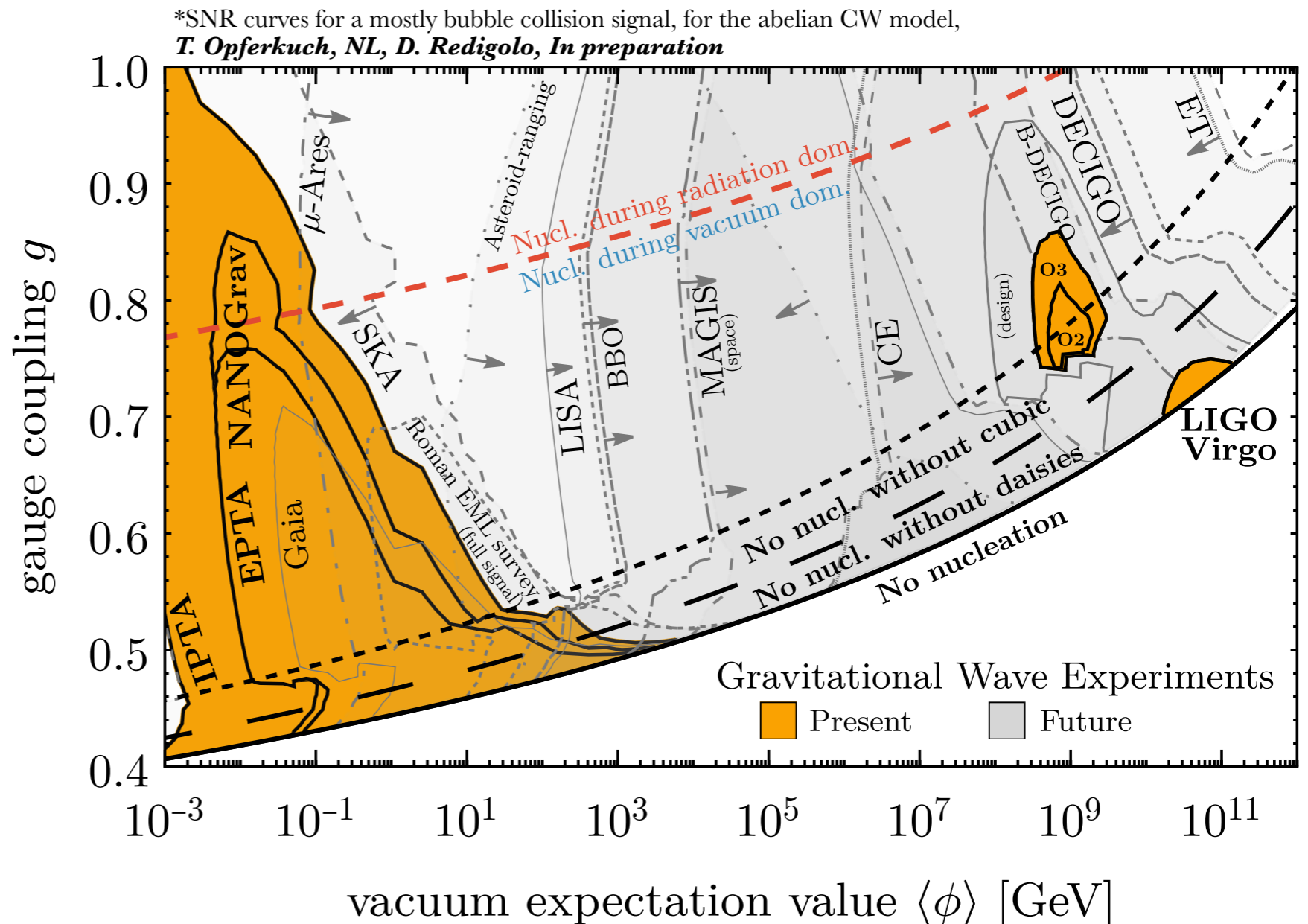
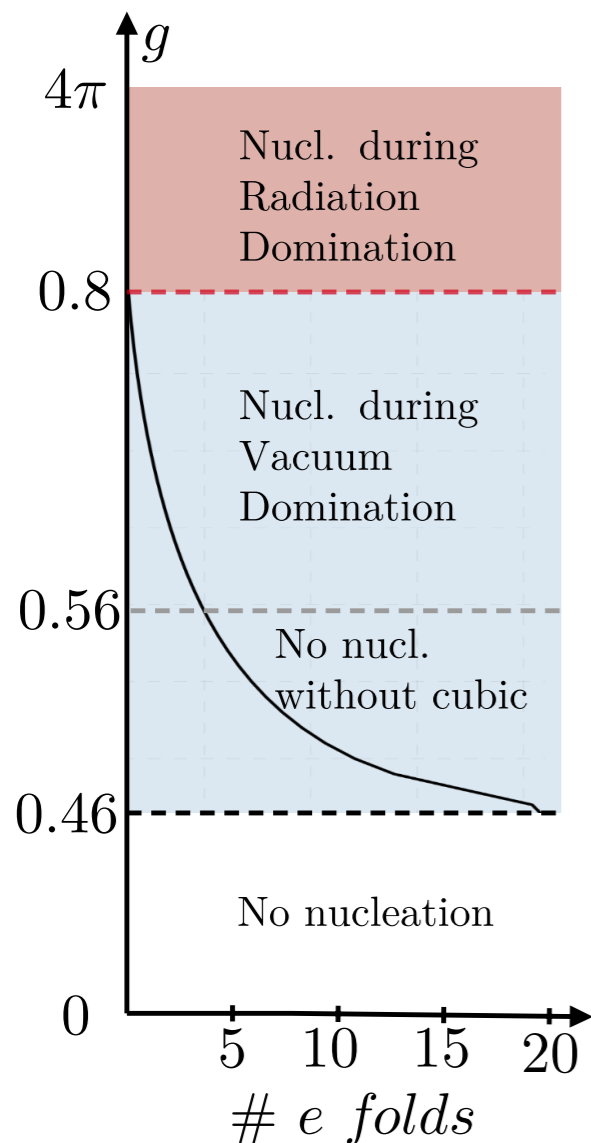
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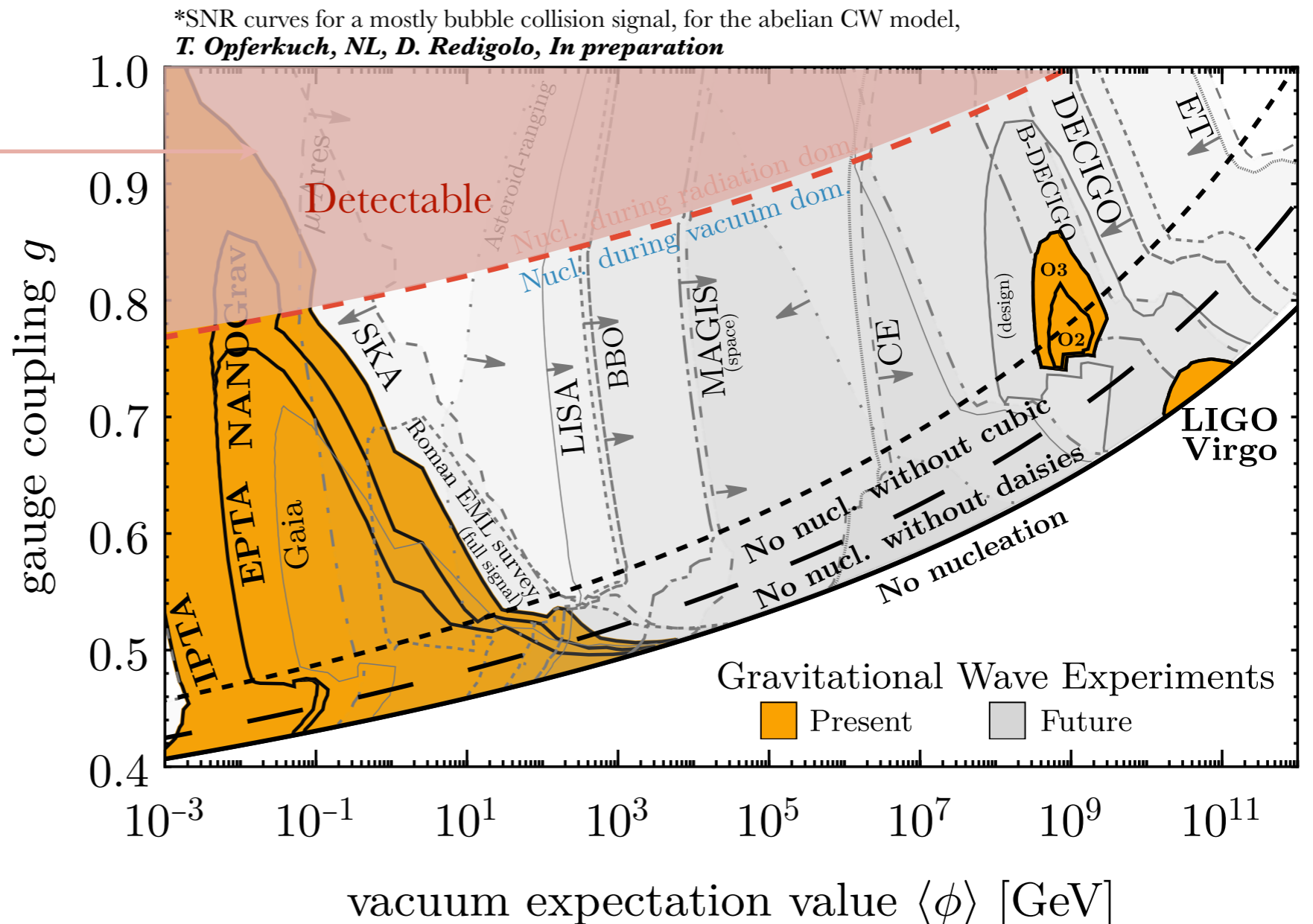
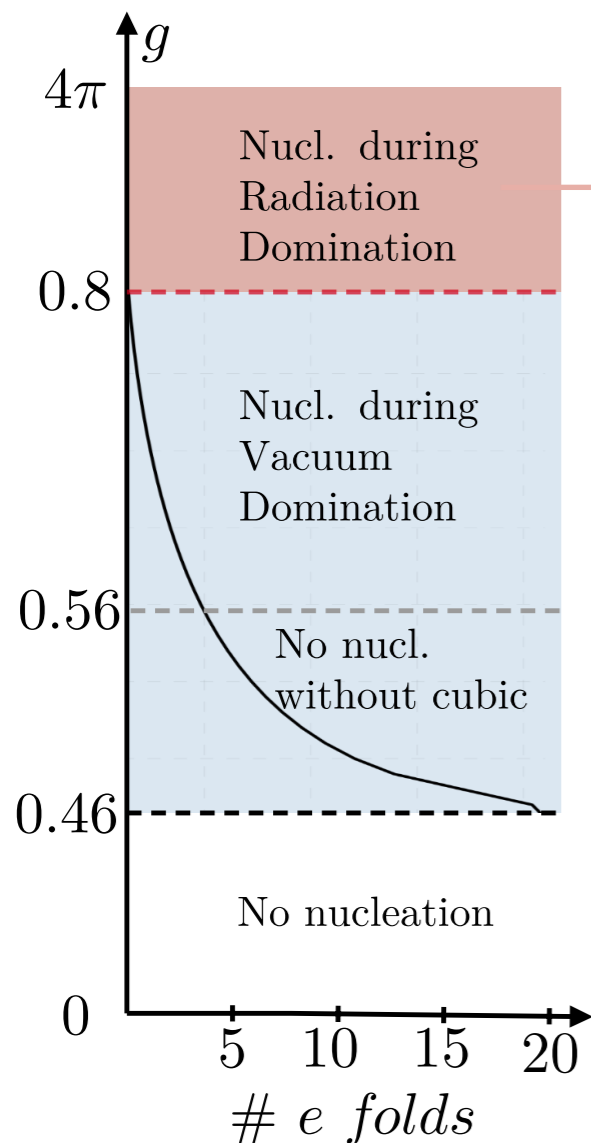
The supercooling window at weak coupling

- The **thermal cubic** contribution **always** exists in theories with bosons, has been neglected in analytical approximations in past works, and **extends the supercooling window**



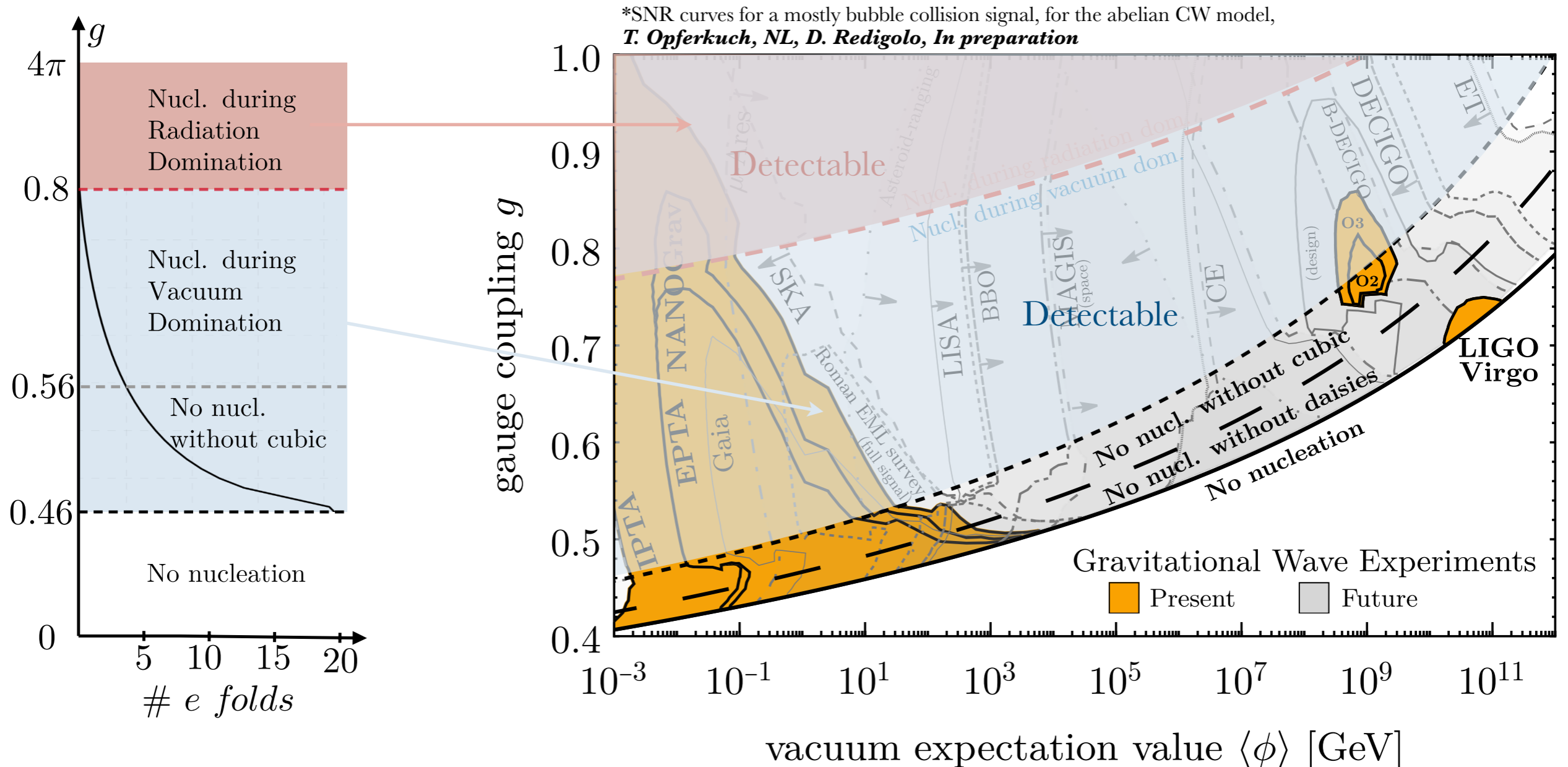
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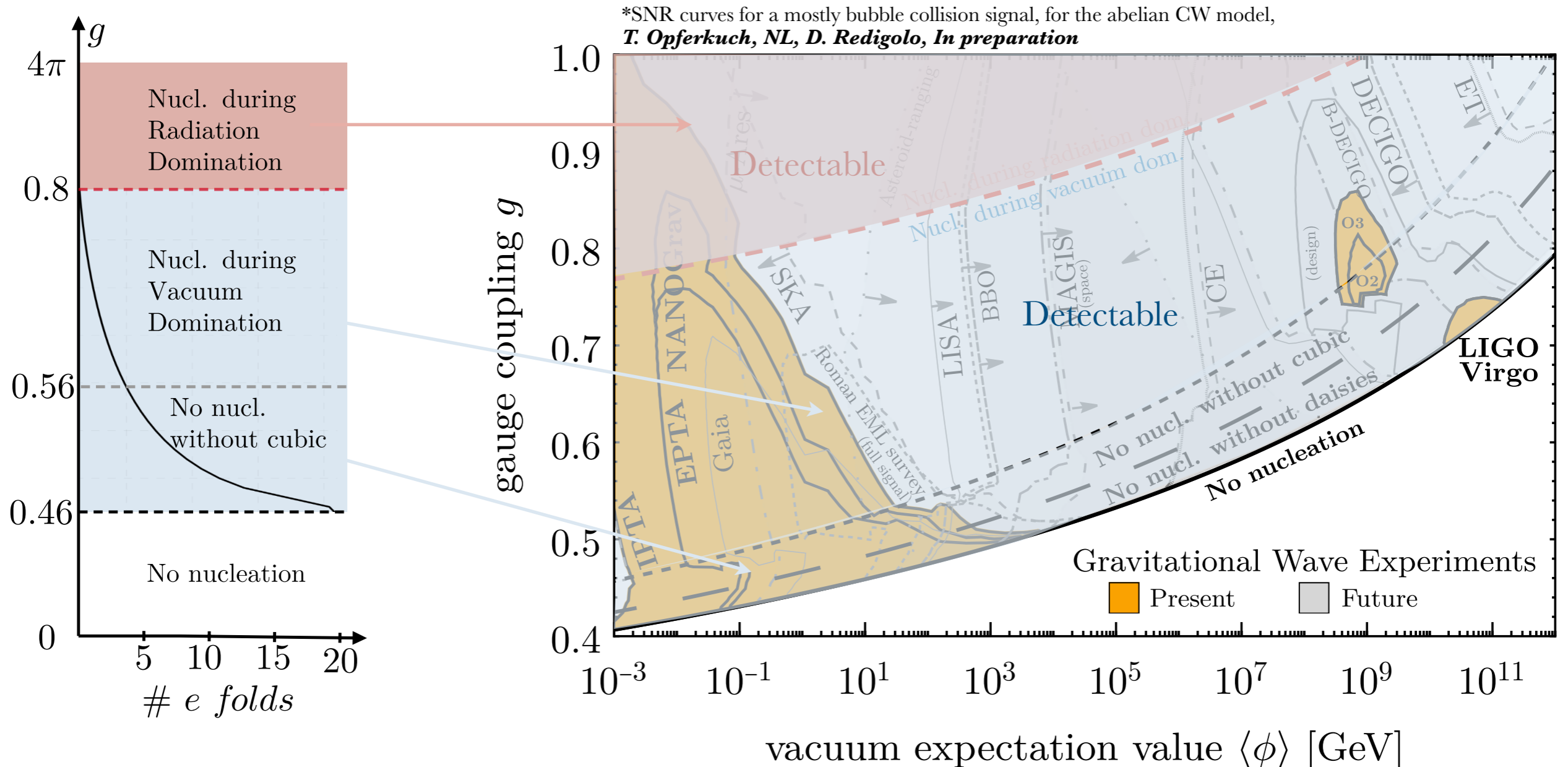
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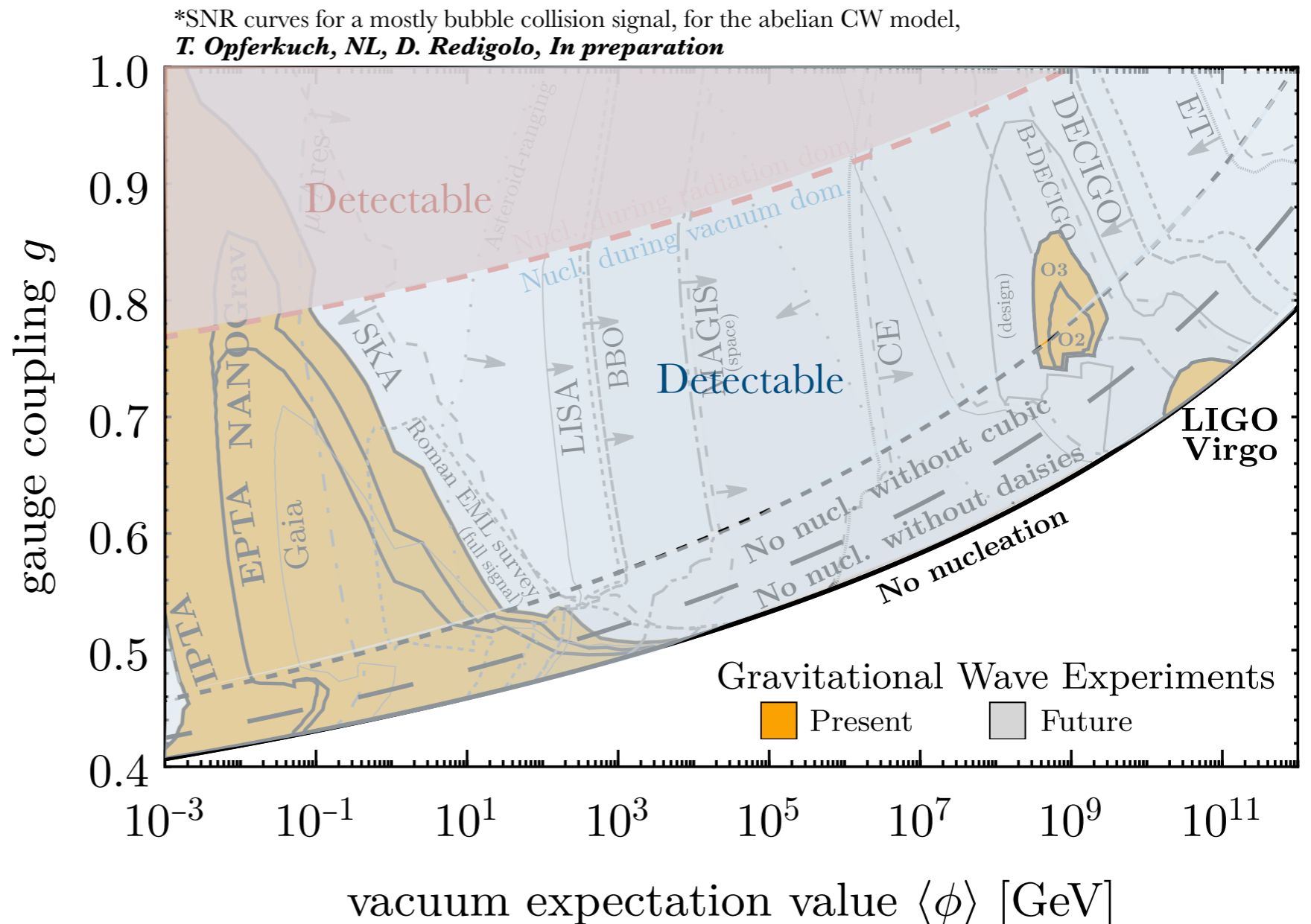
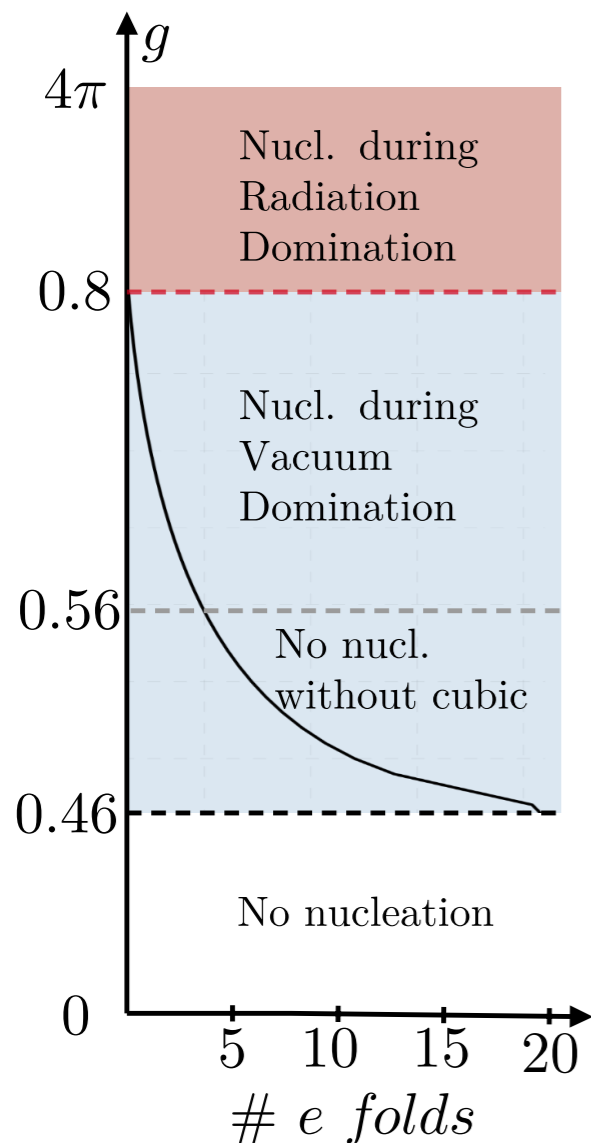
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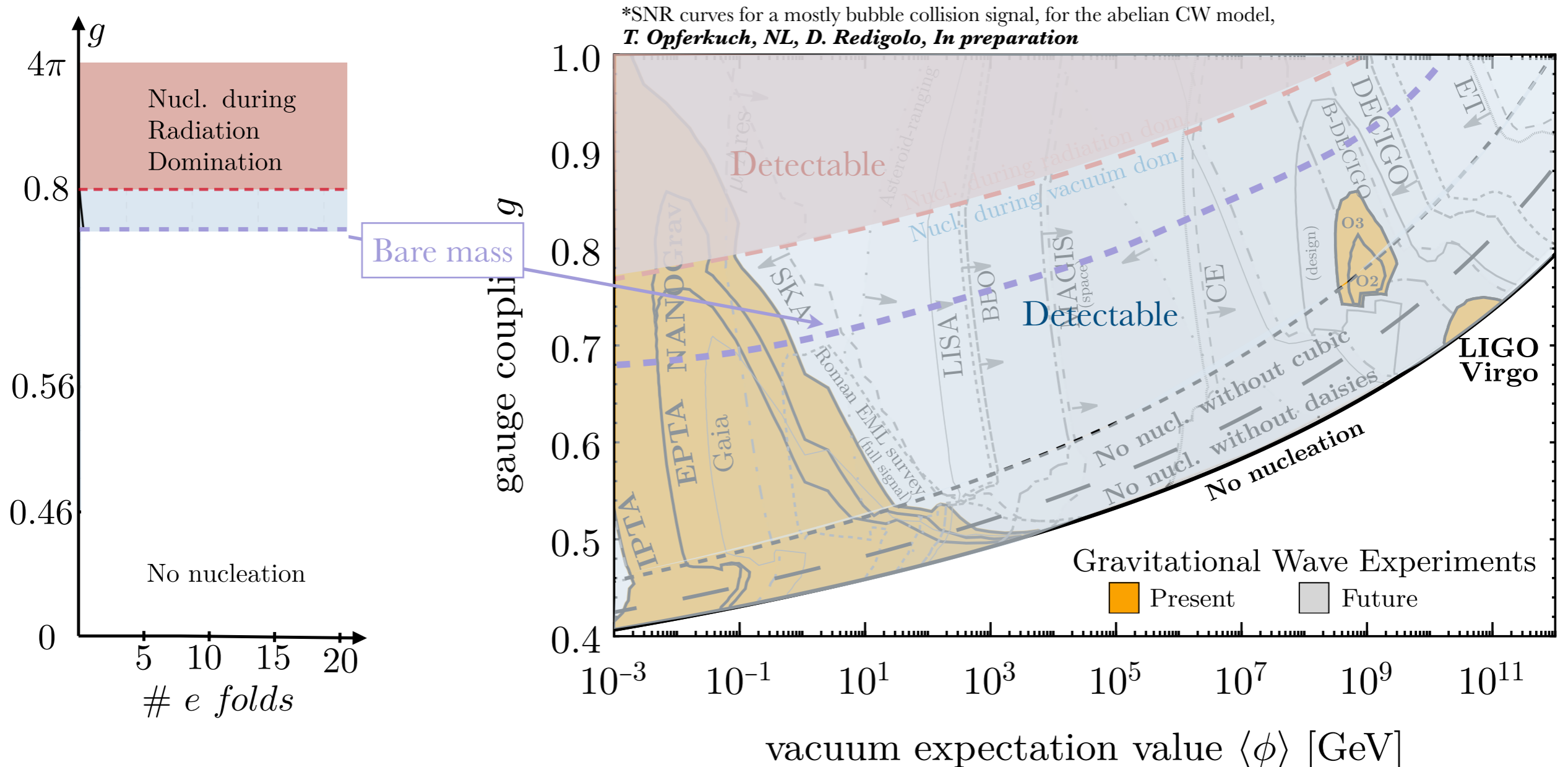
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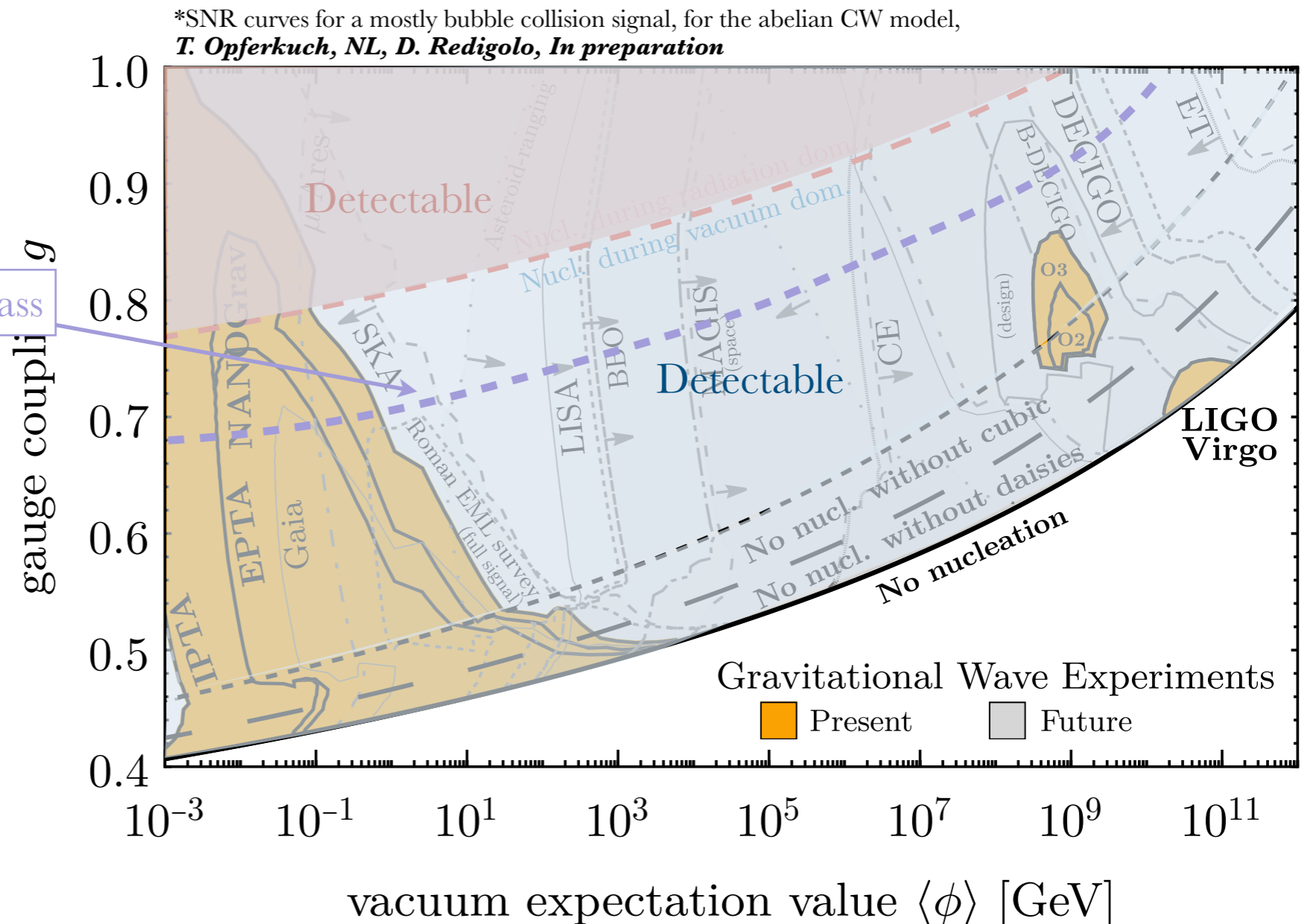
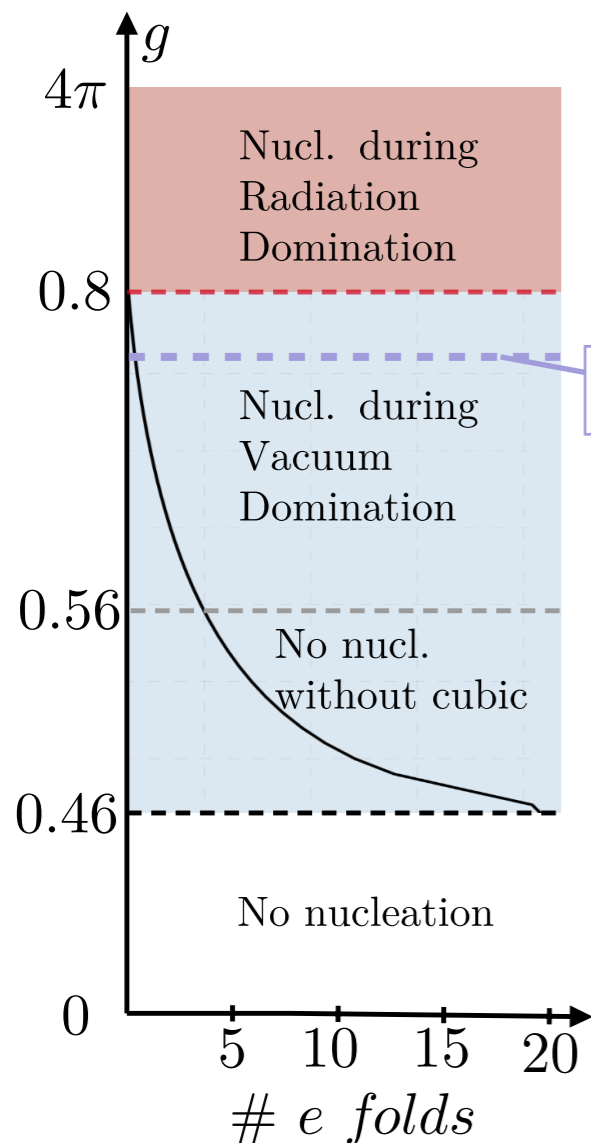
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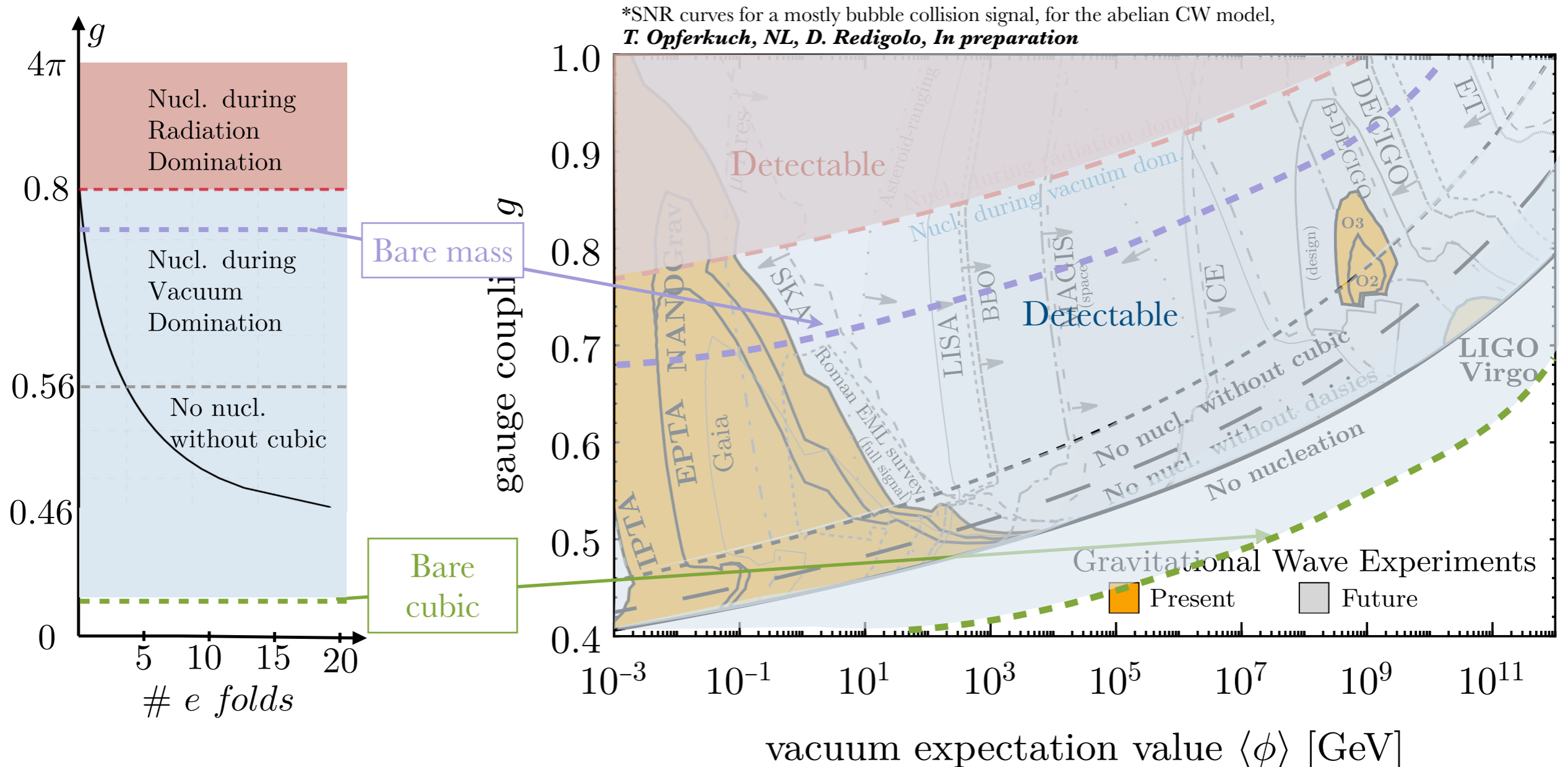
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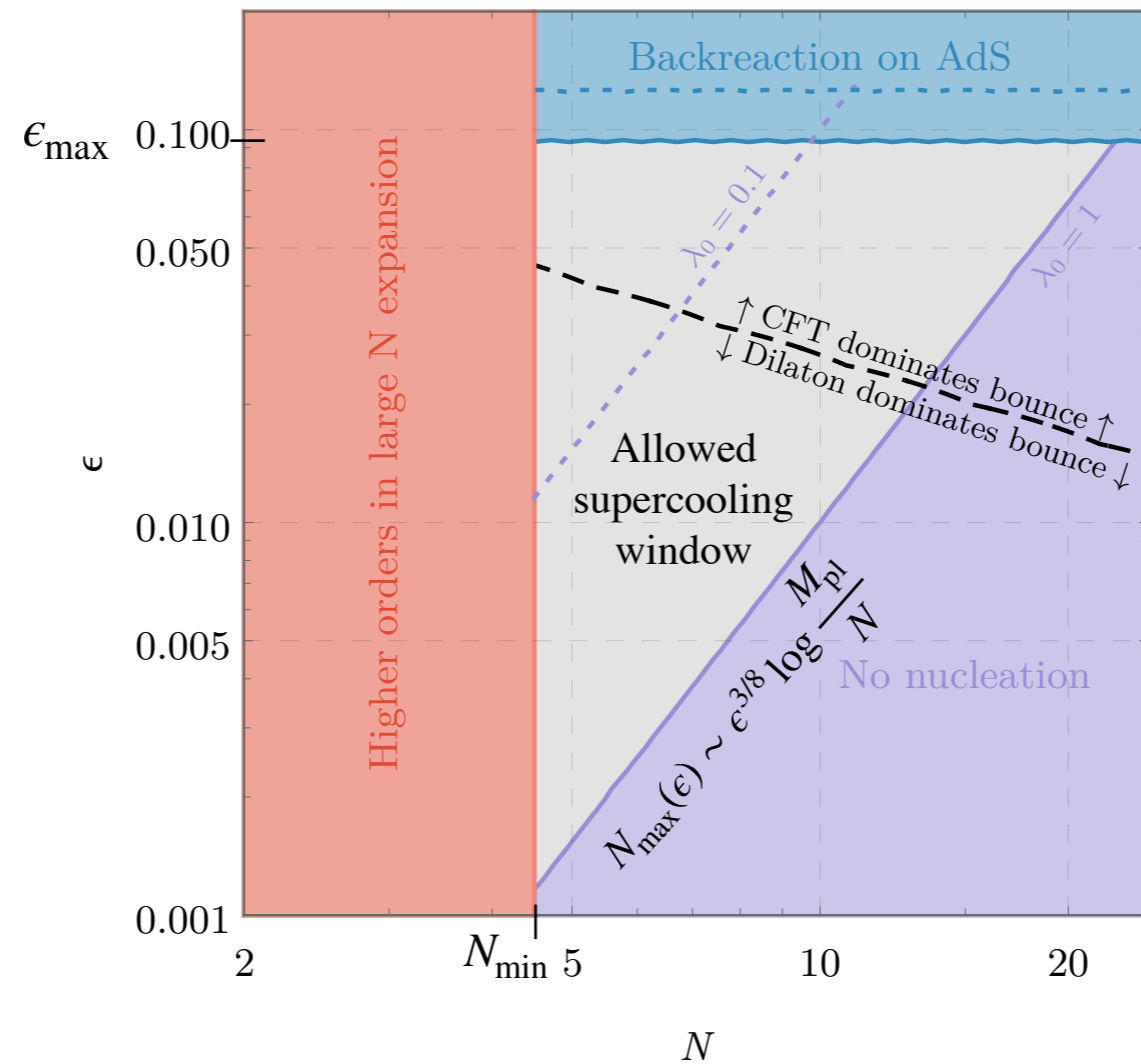


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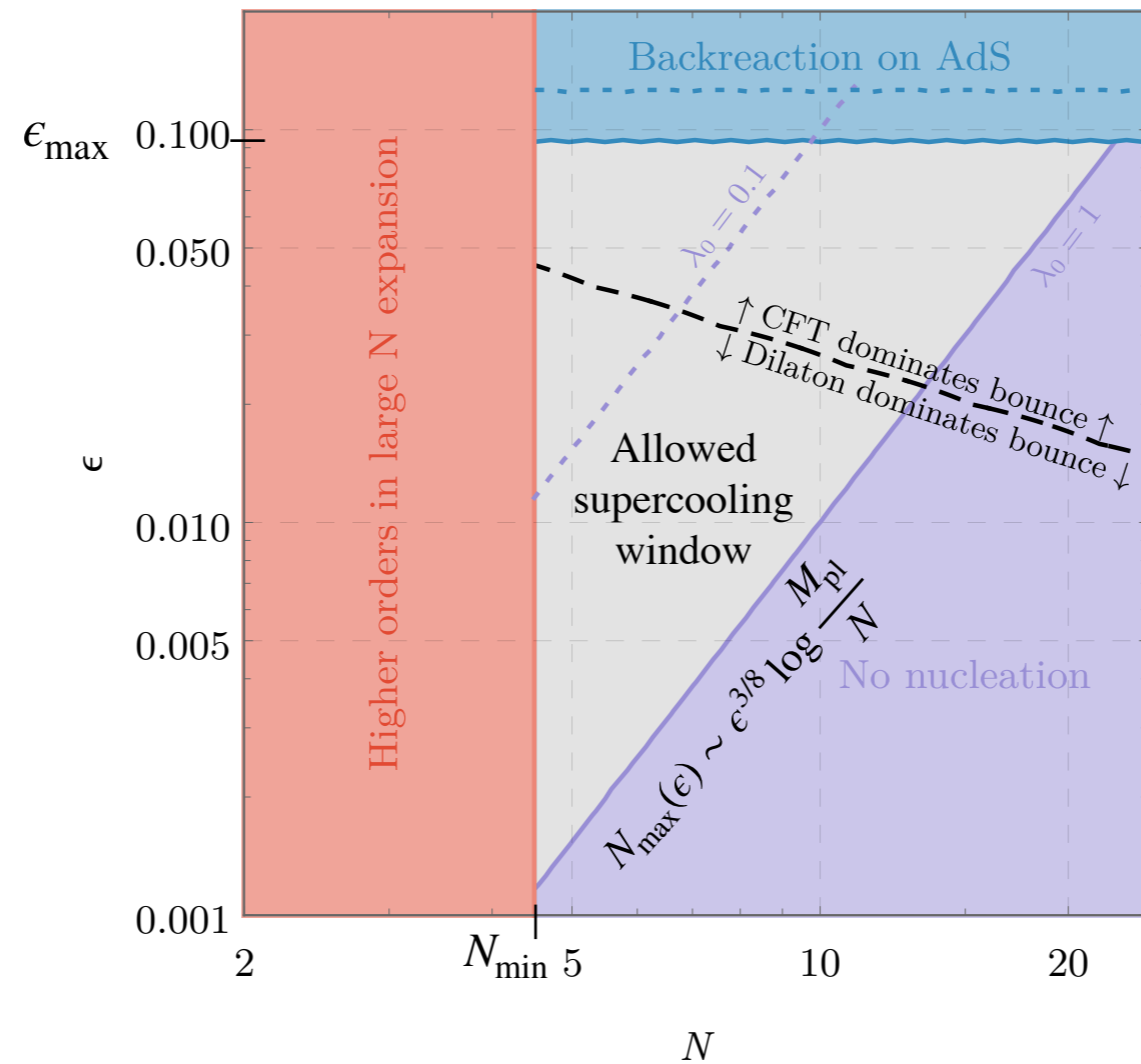


Strong coupling and beyond



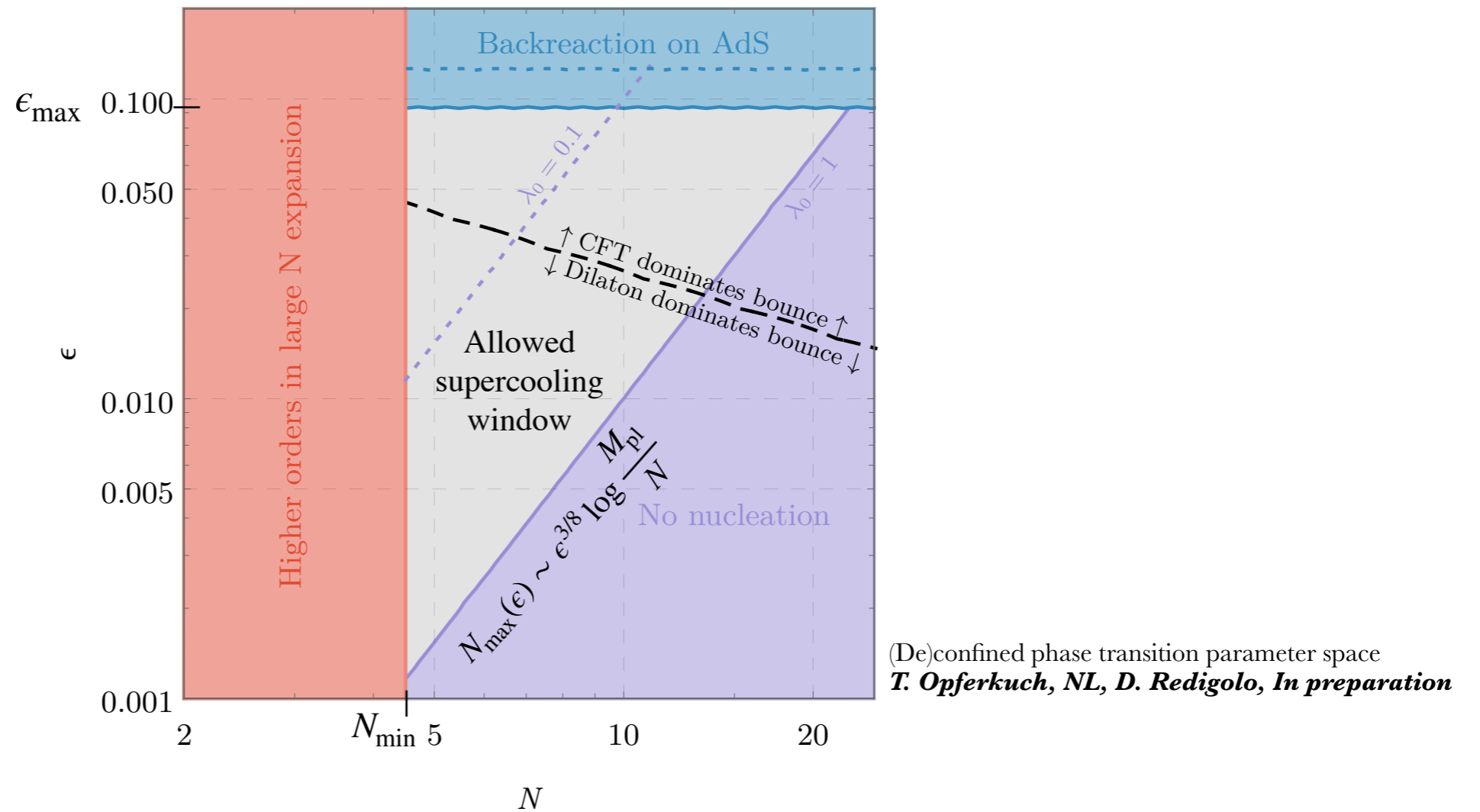
(De)confined phase transition parameter space
T. Opferkuch, NL, D. Redigolo, In preparation

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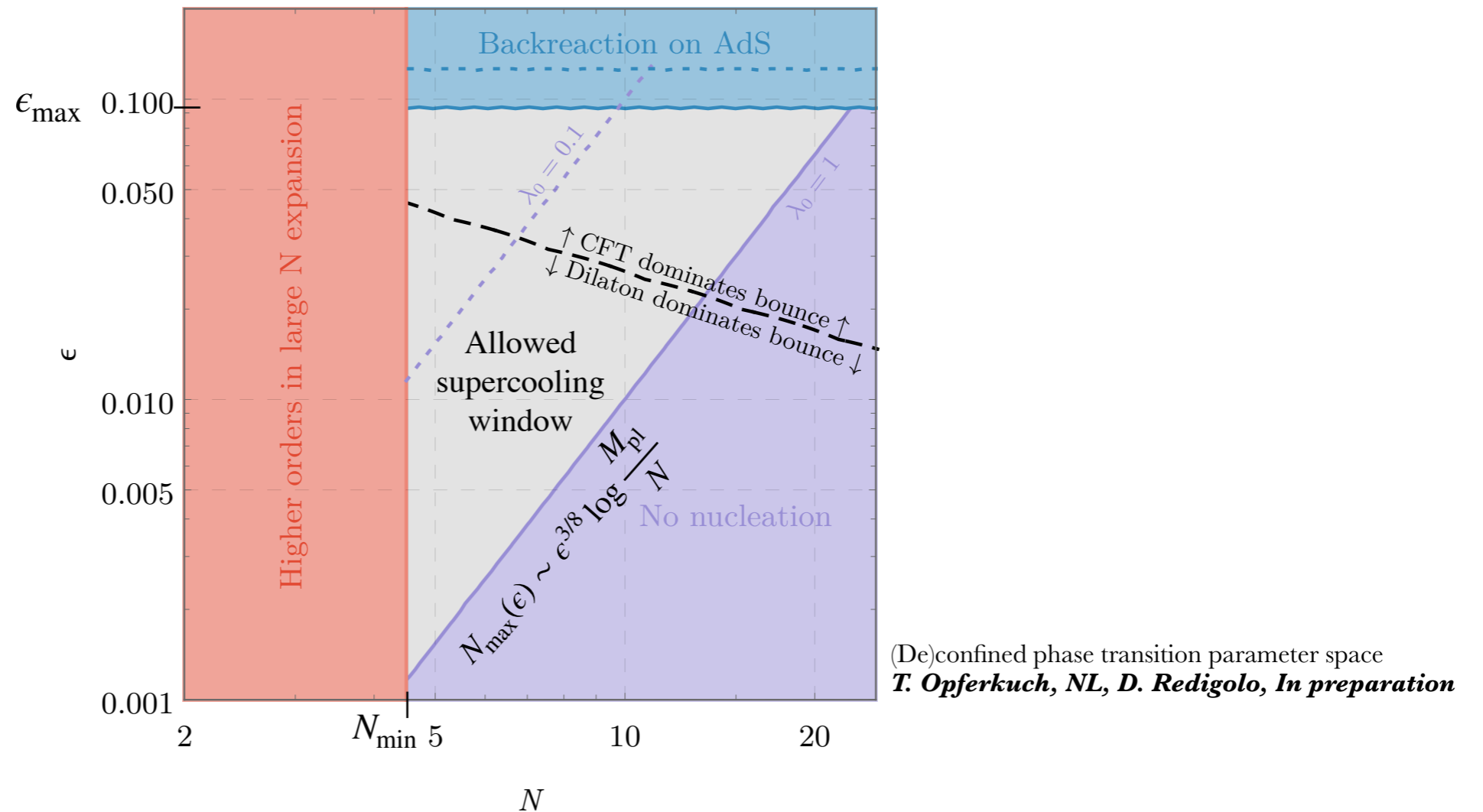
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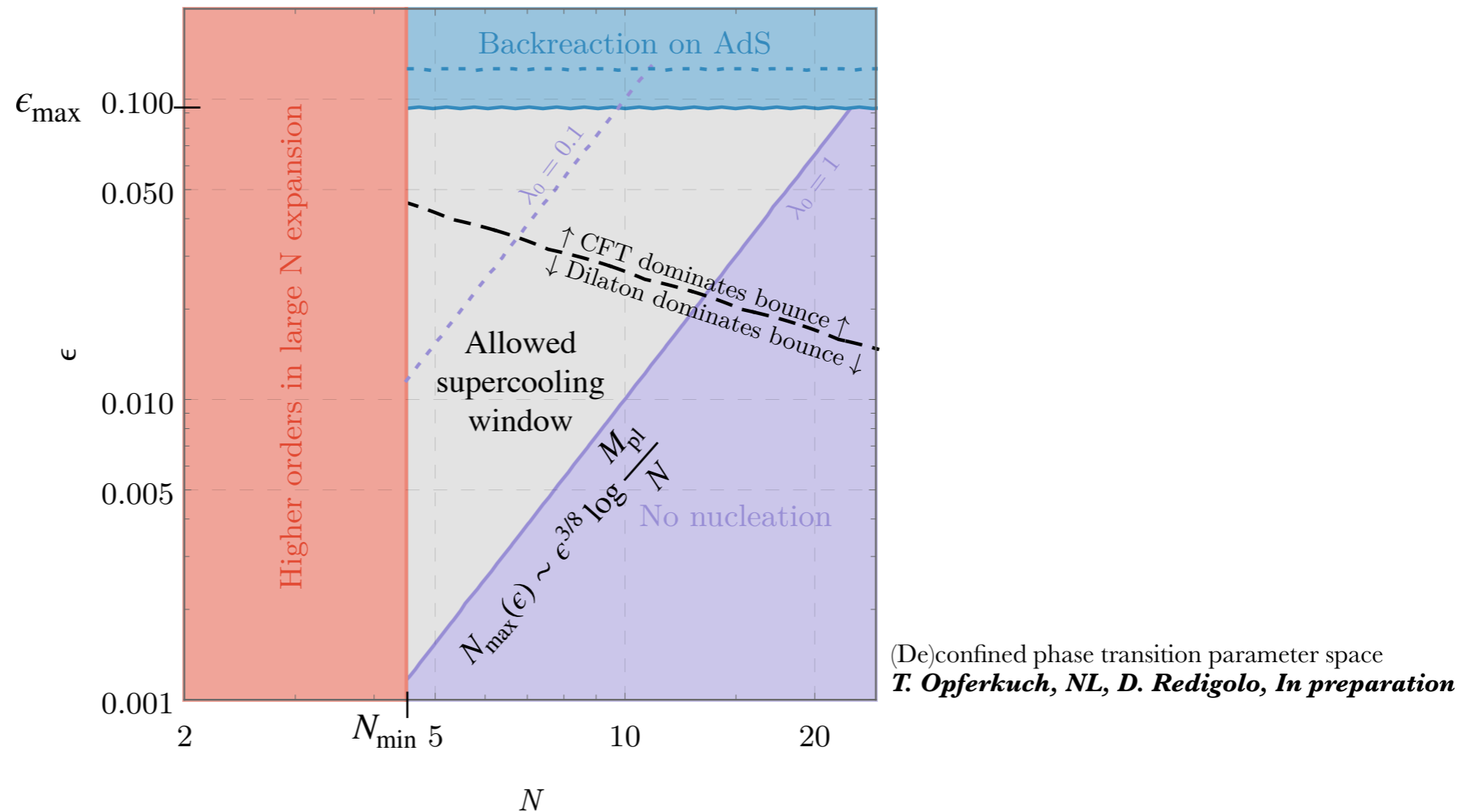
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