Detecting spin-2 dark matter with gravitational wave interferometers

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Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION,
YOUTH AND SPORTS

Outline

❄ Ultra-light (fuzzy) dark matter ❄

❄ Continuous Gravitational Waves ❄

❄ The signal for interferometers ❄

✺ Results and outlook ✺

Find all the details in arXiv:2012.13997 [astro-ph.CO]

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The spin-2 M_{ij} field is the one we will work with

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The spin-2 field is special:

$$S_{\rm int}[g, M_{ij}, \Psi] := -\frac{\alpha}{2M_{\rm P}} \int {\rm d}^4x \sqrt{-g} M_{ij} T^{ij}_{\Psi}$$

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This looks like a continuous gravitational wave

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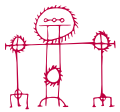

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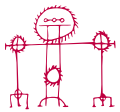

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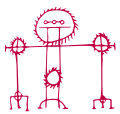

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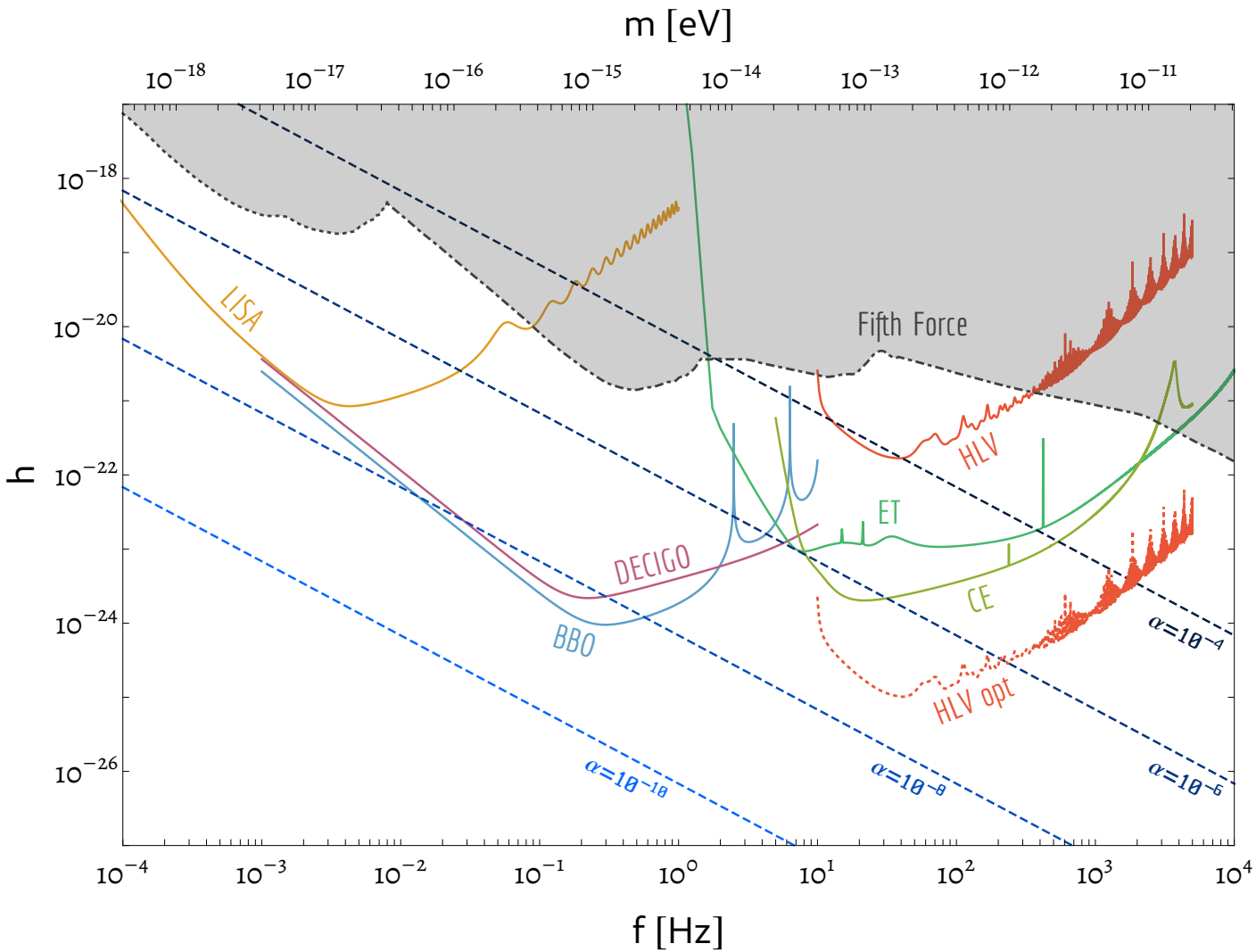
The overall magnitude scales as $1/m$ thanks to α

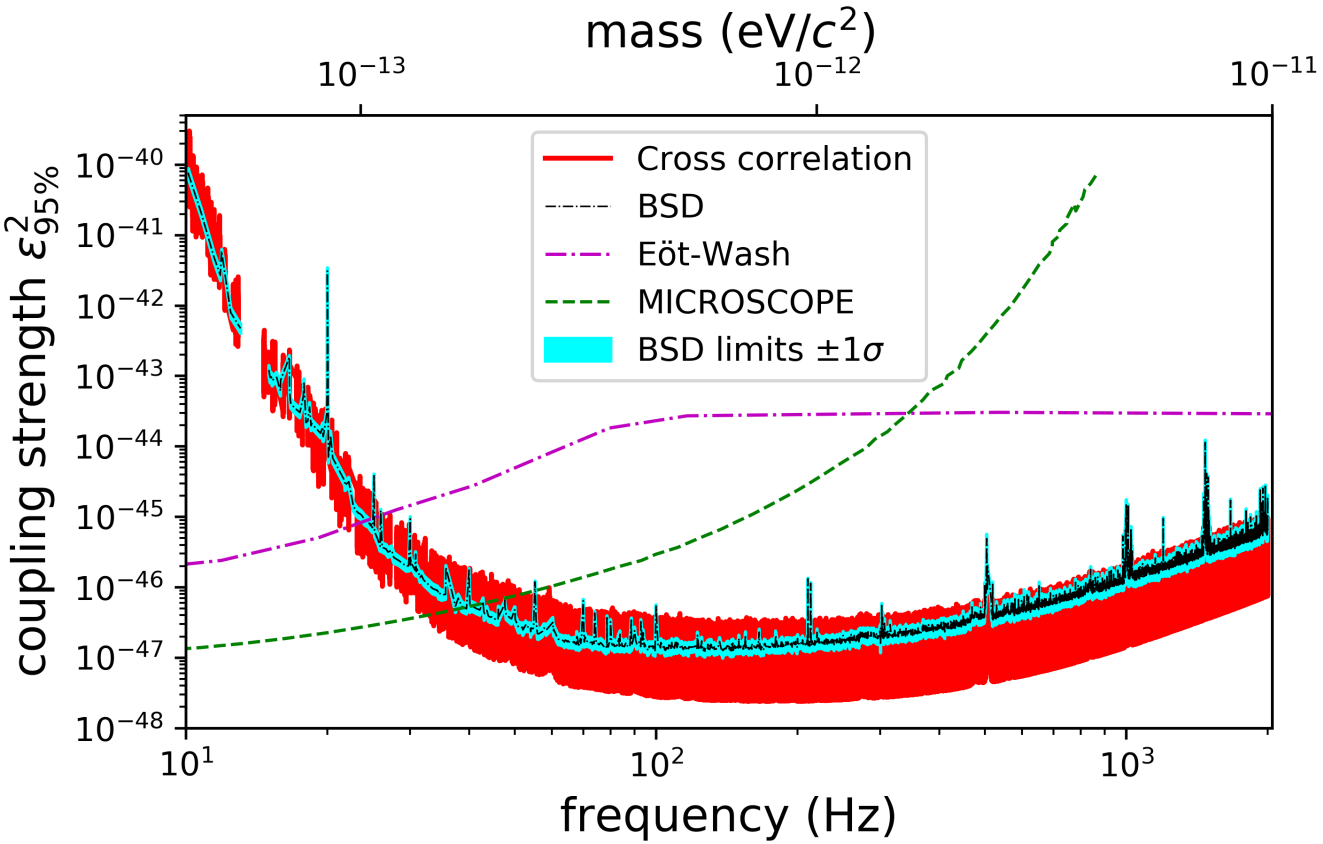
C.f. the $1/m^2$ for spin-0 and spin-1 (without fifth forces)

Results


m [eV]
10^{-18}
10^{-17}
10^{-16}
10^{-15}
10^{-14}
10^{-13}
10^{-12}
10^{-11}
h
10^{-18}
10^{-20}
10^{-22}
10^{-24}
10^{-26}
LISA
Fifth Force
HLV
ET
DECIGO
CE
BBO
HLV opt
$\alpha=10^{-4}$
$\alpha=10^{-6}$
$\alpha=10^{-8}$
$\alpha=10^{-10}$
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
f [Hz]

In real life: spin-1 fifth force

$$\mathcal{L}_{\text{int}} = \varepsilon e J^\mu A_\mu$$



for spin-2: work in progress!

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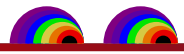

Armaleo, López Nacir, FU arXiv:2012.13997 [astro-ph.CO] — JCAP (2021)

...and work in progress (with Armaleo, D'Antonio, Depasse, López-Nacir, Miller, Piccinni, Palomba, Rella)