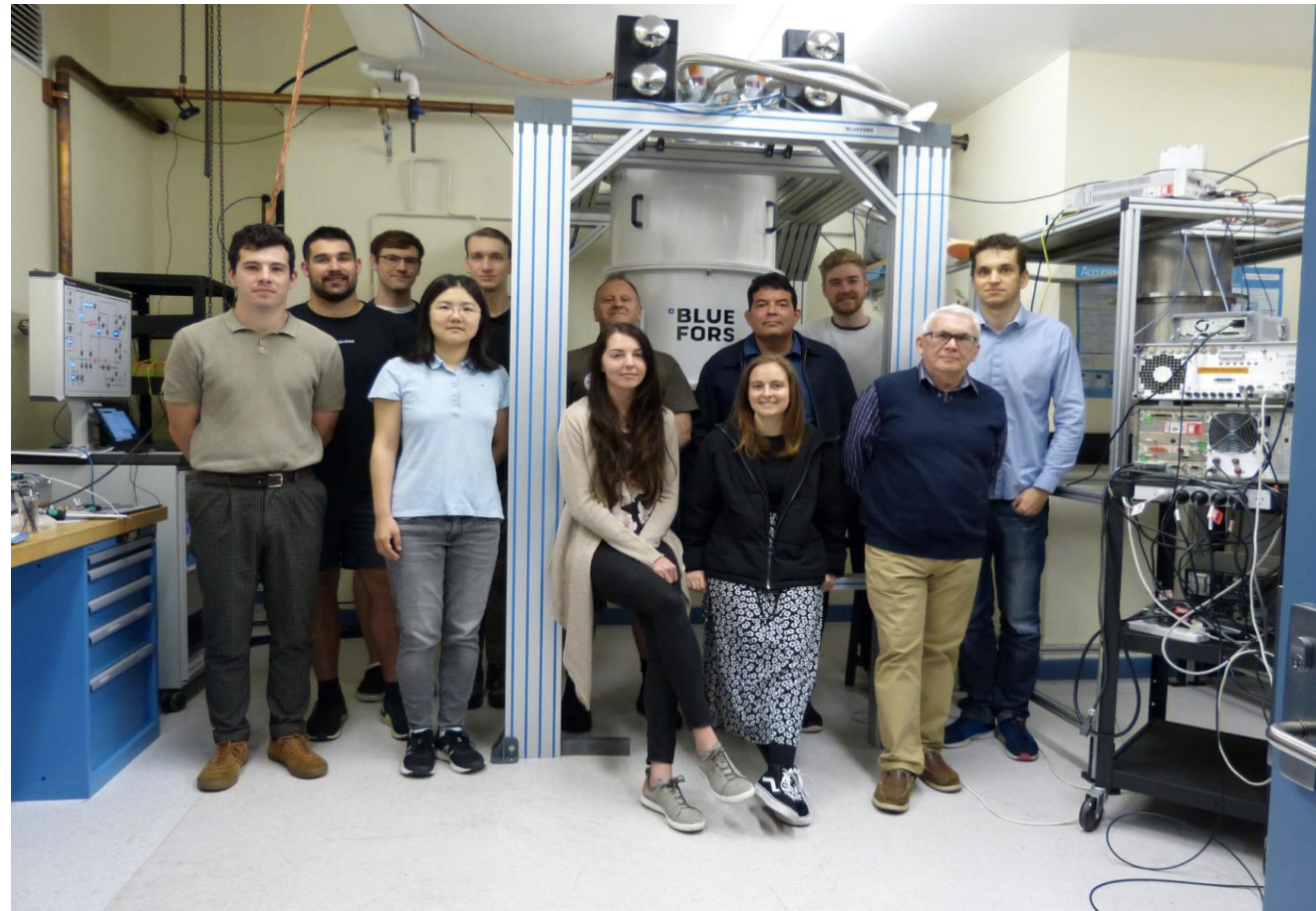


Searching for Scalar DM with mechanical resonators

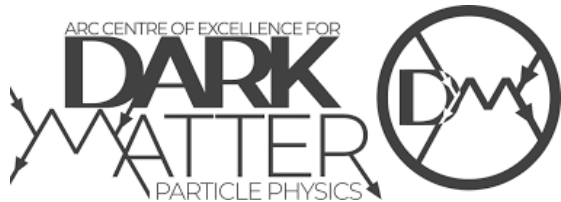


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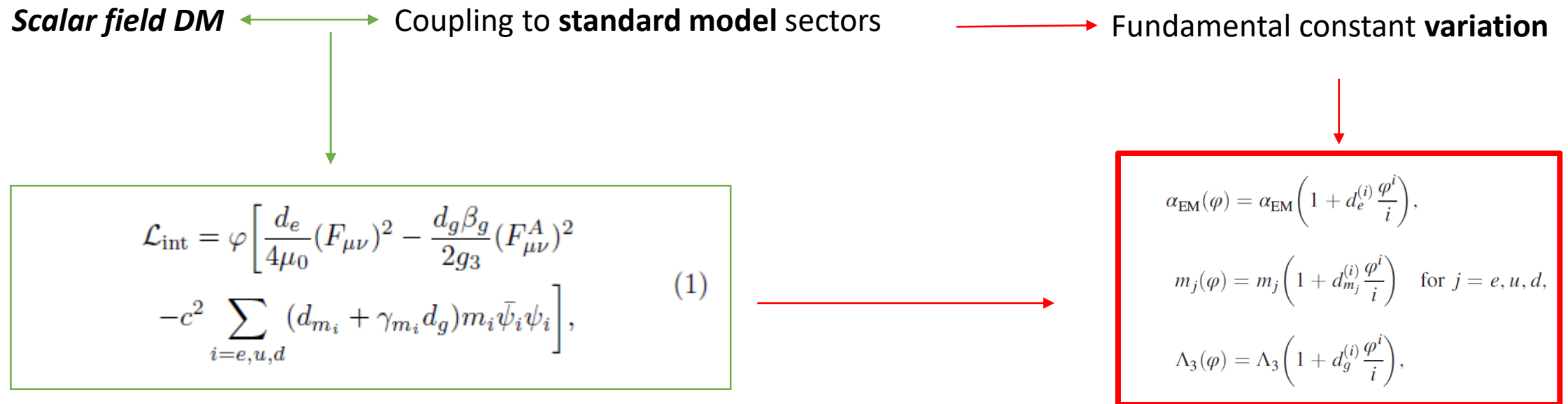
EQUIS



Scalar Dark Matter

The introduction of an **ultra light scalar** field **with non-trivial coupling** to the **standard model** that we identify as the majority component of the local **dark matter** density.

Coupling of such an ultralight scalar to the standard model causes the **fundamental constants** of nature to **oscillate** at the Compton wavelength corresponding to the scalar field's mass value



Damour, T., & Donoghue, J. F. (2010). Equivalence principle violations and couplings of a light dilaton. *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 82(8), 084033. <https://doi.org/10.1103/PhysRevD.82.084033>

Hees, A., Minazzoli, O., Savalle, E., Stadnik, Y. V., & Wolf, P. (2018). Violation of the equivalence principle from light scalar dark matter. *Physical Review D*, 98(6). <https://doi.org/10.1103/physrevd.98.064051>

Frequency modes of **clocks** depend on fundamental constants

Compare modes of clocks of **differing architecture** to **constrain** fundamental constant variation \longrightarrow **Constrain scalar DM coupling**

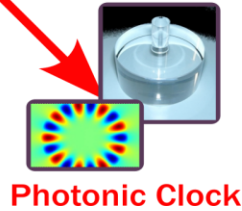
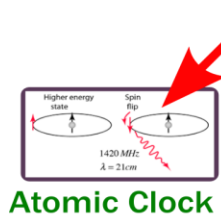
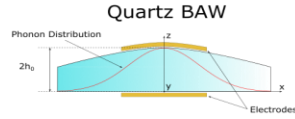
More work to be done !

Amplitude effect

HFGWs



Mechanical Resonator



$$\frac{\delta f_Q}{\delta f_{HM}}$$

$$\frac{\delta f_Q}{\delta f_{CSO}}$$

$$f_Q \propto m_e \alpha^2 \sqrt{\frac{m_e}{m_p}} \propto m_e \alpha^2 \sqrt{\frac{m_e}{\Lambda_{\text{QCD}}}} \quad (9)$$

The dependencies of both the CSO and Maser frequencies are given in Appendix A of Ref. [41],

$$f_{\text{CSO}} \propto m_e \alpha, \quad (10)$$

$$f_{\text{HM}} \propto m_e \alpha^4 \left(\frac{m_e}{m_p}\right) \propto m_e \alpha^4 \left(\frac{m_e}{\Lambda_{\text{QCD}}}\right). \quad (11)$$

