



# Cesium in Cryogenic Matrices: Towards a Measurement of the eEDM

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New CP violating particle  $\leftrightarrow$  electron EDM

$$\Delta E = d_e \vec{\sigma} \cdot \vec{\mathcal{E}}$$

Energy shift

eEDM

spin

Electric field



Statistical uncertainty

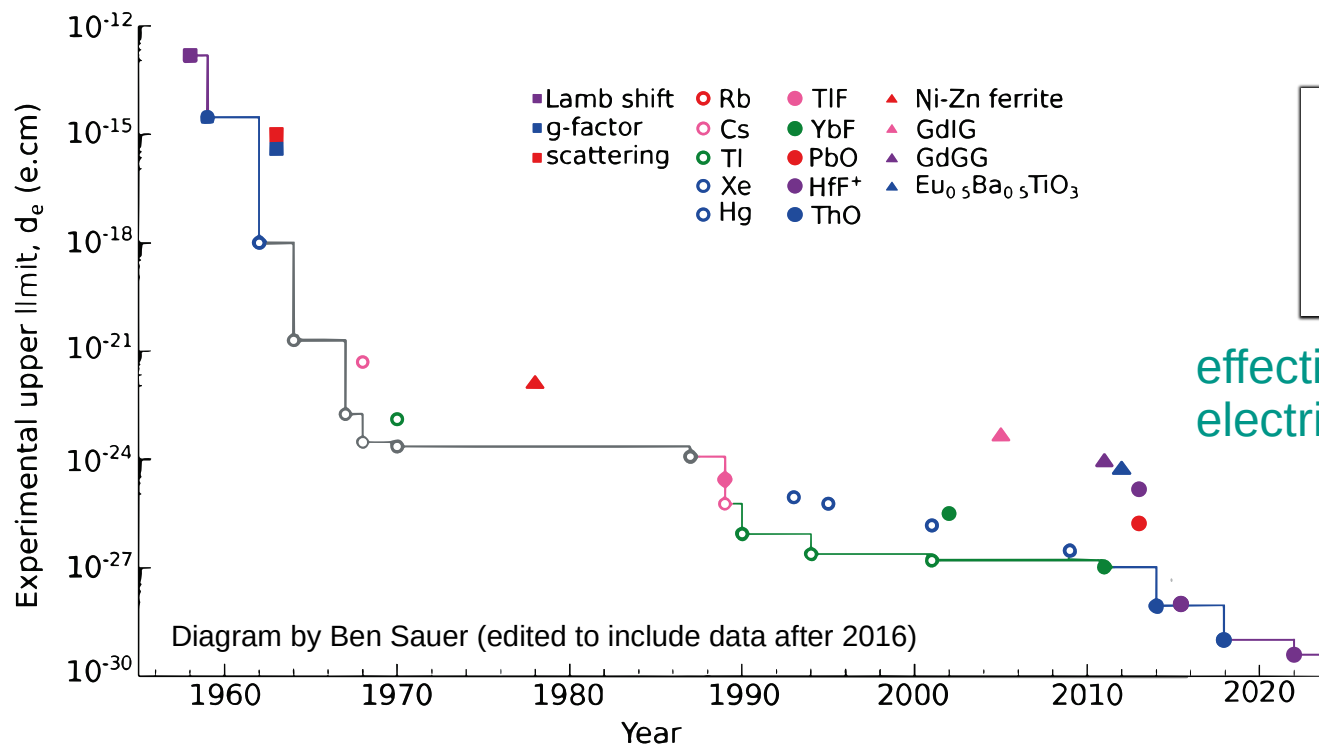
$$\Delta d_e \approx \frac{\hbar}{E_{\text{eff}} \sqrt{\tau t N}}$$

effective electric field

decoherence and  
measuring time

number of  
atoms/molecules

# Progress of eEDM sensitivity over time



Statistical uncertainty

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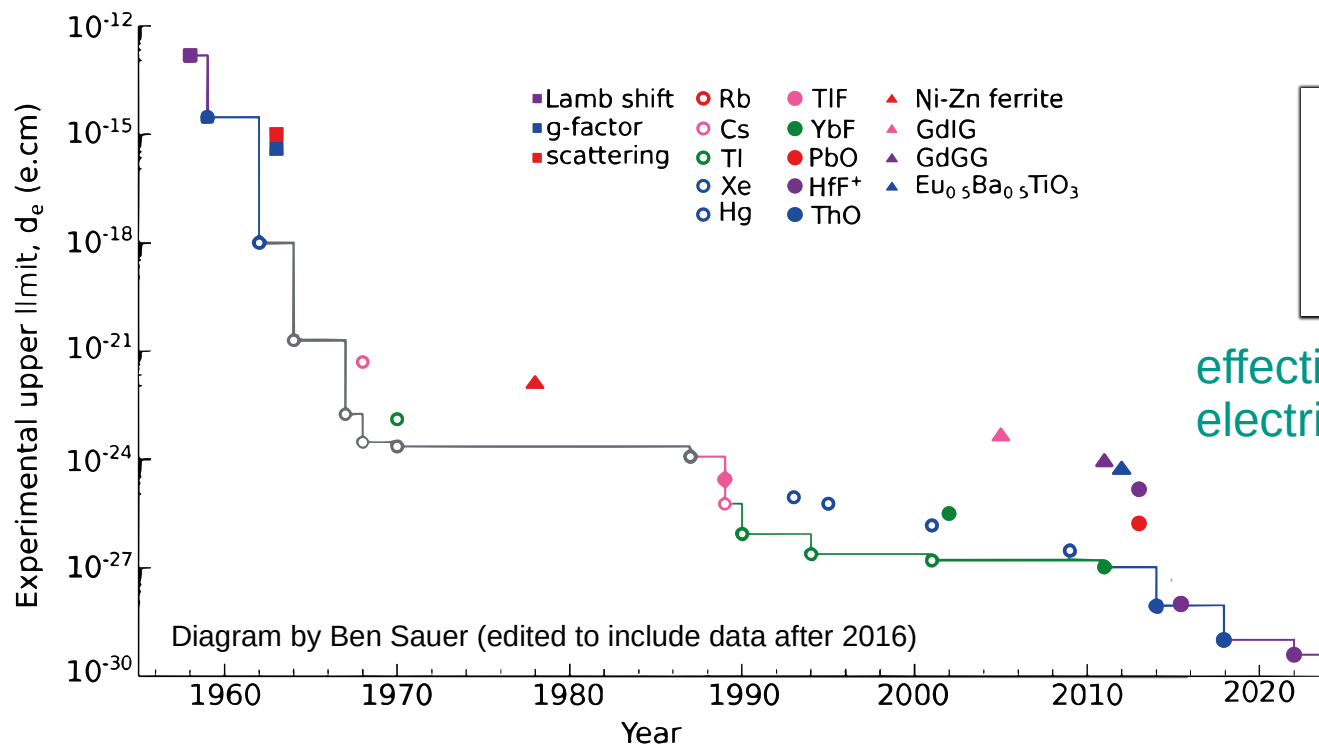
effective electric field

decoherence and measuring time

number of atoms, molecules

system	$E_{\text{eff}}$	$\tau$	$N$	sensitivity to $d_e$ for 24h of measurement
HfF <sup>+</sup>	23 GVcm <sup>-1</sup>	3000 ms	10 <sup>2</sup>	10 <sup>-29</sup> ecm

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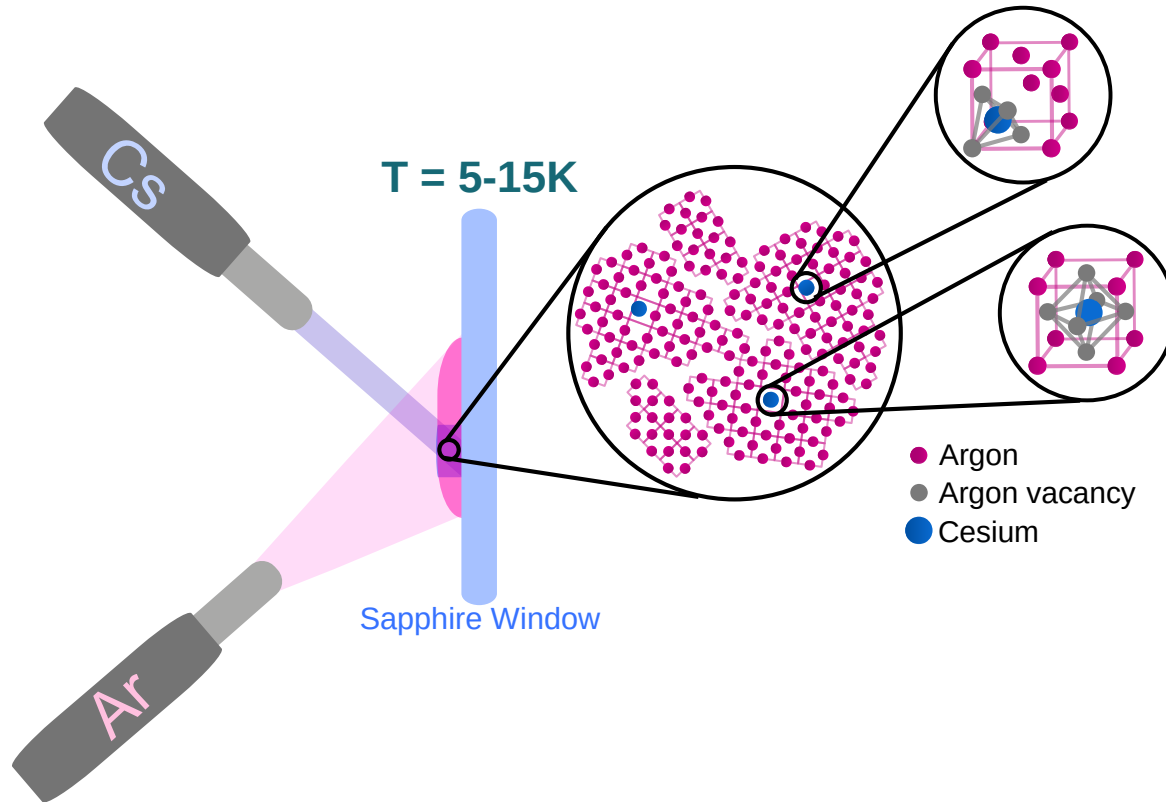
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How to probe many atoms at once?

# $10^{18}$ Cs atoms embedded in Ar

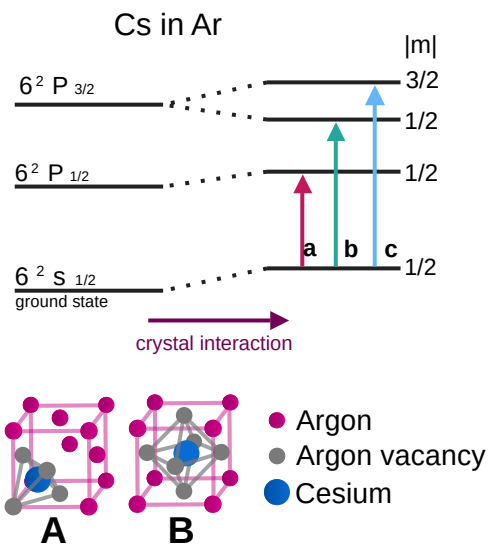
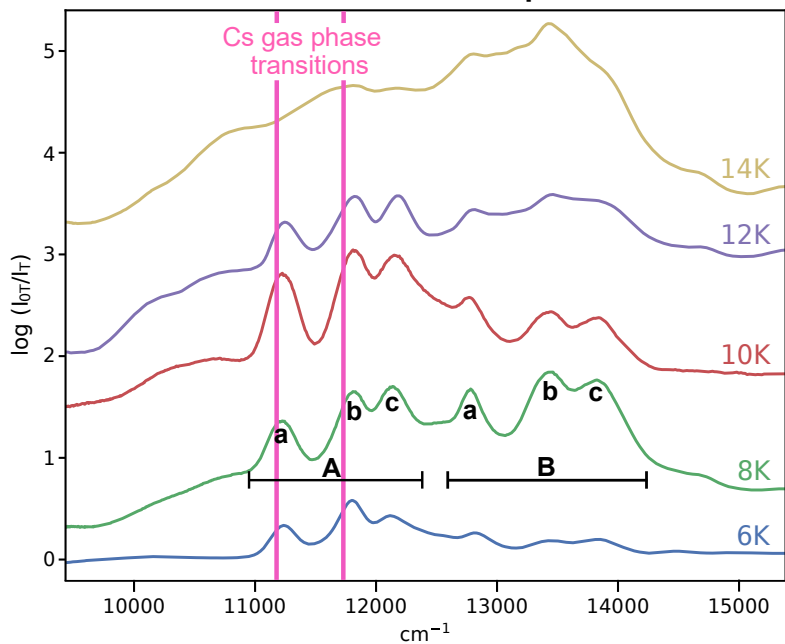
Cs: simple system (alkali atom) with very high sensitivity to eEDM

Ar: noble gas. All naturally occurring isotopes do not possess nuclear spin

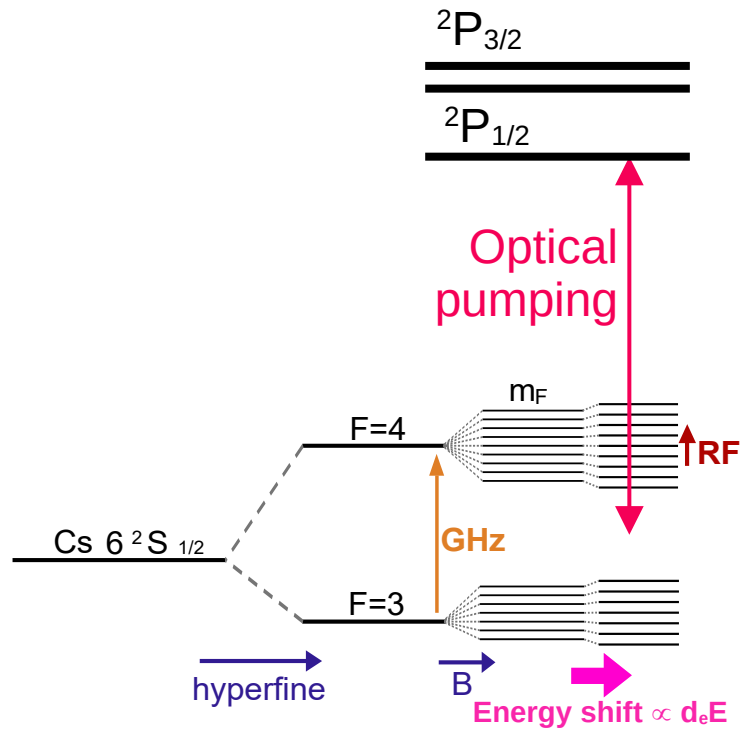


# Cesium in Argon

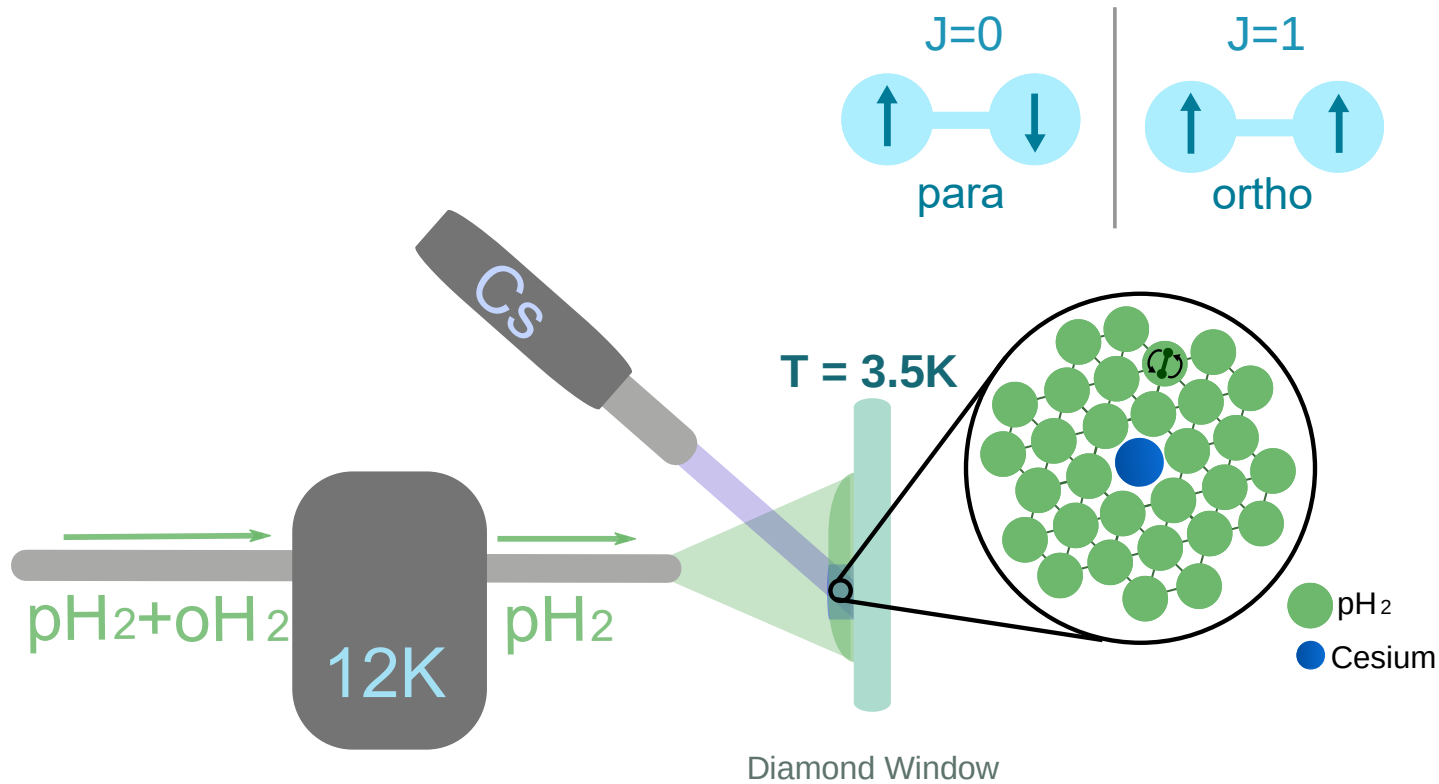
## Transmission Spectra



→ Phys. Rev. A 108, 042820



# Cesium in para-hydrogen







LAC / ISMO / LPL / CIMAP

- Team @

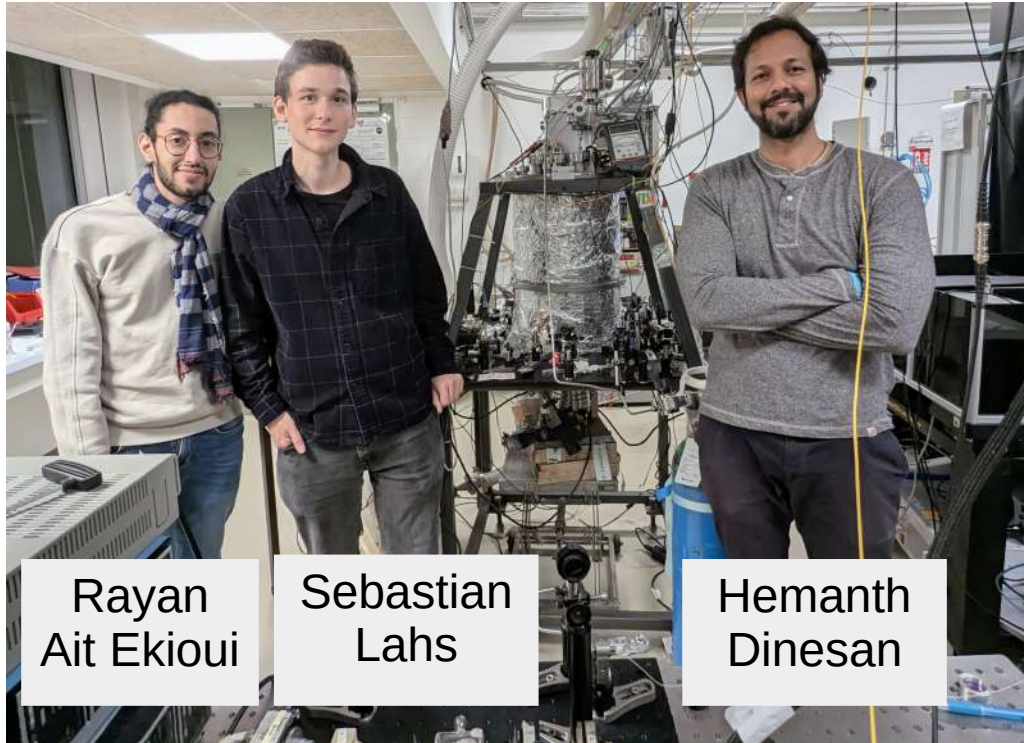


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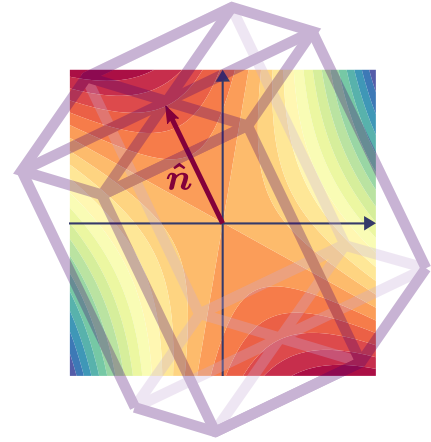
Claudine  
Crépin

Wutharath  
Chin





# Unique observables in inhomogeneous electric fields



**P odd**  $\Delta E \propto \frac{dQ}{P} \alpha_{t_m} (\mathcal{H} \cdot \hat{n}) (\mathcal{E} \times \mathcal{H}) \cdot \hat{n}$

**T odd**  $\Delta E \propto \frac{\mu Q}{T} \alpha_{t_m} (\mathcal{E} \cdot \hat{n}) (\mathcal{H} \times \mathcal{E}) \cdot \hat{n}$

**P&T odd**  $\Delta E \propto \frac{dQ}{PT} \alpha_{v_m} (\mathcal{E} \cdot \mathcal{H}) - (\mathcal{E} \cdot \hat{n}) (\mathcal{H} \cdot \hat{n})$

arXiv:2407.14694