Electric dipole moments of light nuclei

Nodoka Yamanaka
(iTHES Group, RIKEN)

In collaboration with
E. Hiyama (RIKEN), T. Yamada (Kanto Gakuin Univ.),
Y. Funaki (RIKEN)
CP violation of Standard model is not sufficient to explain matter/antimatter asymmetry ...

Prediction of Standard model: $10^{28} : 1$
Real observed data: $10^{10} : 1$

We need new source(s) of large CP violation beyond the standard model!

How to search?

Electric dipole moment: $\langle \vec{d} \rangle = \langle \psi | e \vec{r} | \psi \rangle$

EDM is CP-odd!
Why the nuclear EDM?

- **Nuclear EDM is sensitive to hadron level CP violation**
  
  (hadron level CP violation is generated by CP violating operator with gluons and quarks)

- **Standard model contribution is very small**: $\mathcal{O}(10^{-31})e\ cm$
  
  NY and E. Hiyama, JHEP 02 (2016) 067.

- **Nuclear EDM may enhance the CP violation through many-body effect**
  
  (Cluster, deformation make the parity violation easier)

  V. V. Flambaum, I. B. Khriplovich and O. P. Sushkov, Phys. Lett. B162, 213 (1985);

- **Nuclear EDM does not suffer from Schiff’s screening encountered in atomic EDM**
  
  (No electron to screen the nucleus)

- **Very accurate measurement of EDM is possible using storage rings**
  
  $\Rightarrow \mathcal{O}(10^{-29})e\ cm !$

- Nuclear EDM is a very good probe of BSM
EDM of charged particles using storage rings

Rotating particles in a storage ring feel very strong central effective electric field.

The spin precession of the charged particle can be measured if magnetic moment is kept collinear to the particle momentum. (strong electric field normal to the precession plane)

Measurements of the EDMs of muon, proton, deuteron, $^3$He are planned.

Prospective sensitivity:

$O(10^{-29})$ e cm!!

EDM of light nuclei is accurately measurable!
Sensitivity to new physics beyond standard model

If the EDM of light nuclei can be measured at $O(10^{-29})$e cm:

- **Supersymmetric model:**
  - Can probe 10 TeV scale SUSY breaking

- **Models with 4-quark interactions:**
  - Can probe PeV scale physics
    - (Left-right symmetric model, ...)

- **Models with Barr-Zee type diagrams:**
  - Can probe PeV scale physics
    - (Higgs doublet models, RPV SUSY, ...)

EDM is an attractive observable in the search for BSM physics!
Nuclear EDM from nucleon level CP violation

Energy scale

Atomic Nuclear Hadron QCD TeV

Paramagnetic Atom / Molecule EDM
Diamagnetic Atom EDM

N EDM

e-N int

N-N int (πNN int)

MQM

Schiff moment

 Observable available at experiment

Sizable dependence

Weak dependence

observable

Nuclear EDM from nucleon level CP violation

Paramagnetic Atom / Molecule EDM

Diamagnetic Atom EDM

Energy scale

Atomic

Nuclear

TeV

observable : Observable available at experiment

: Sizable dependence

: Weak dependence

Left-Right

Leptoquark

Composite models

SUSY

Extradimension

Standard Model

Nuclear EDM (or ion)

N EDM

N-N int (πNN int)

q EDM

q cEDM

q-q int

ggg

⇒ Many-body method!!

Two leading contributions to be evaluated:

1) Nucleon’s intrinsic EDM:

Contribution from the nucleon EDM

\[ D^{(\text{Nedm})} = \frac{1}{2} \sum_{i=1}^{A} \langle \psi | [(d_p + d_n) + (d_p - d_n) \tau_i^z] \sigma_i^z | \psi \rangle \]

\[ \Rightarrow \text{Spin expectation value (CP-even)} \]

2) Polarization of the nucleus:

Contribution from the P, CP-odd nuclear force

\[ D^{(\text{pol})} = \frac{e}{2} \sum_{i=1}^{A} \langle \psi | (1 + \tau_i^z) z_i | \tilde{\psi} \rangle + (\text{c.c.}) \]

\[ \Rightarrow \text{EDM generated by the CP-even } \Leftrightarrow \text{CP-odd mixing} \]
Nuclear EDM from nucleon level CP violation

Two leading contributions to be evaluated:

1) Nucleon’s intrinsic EDM:

Contribution from the nucleon EDM

\[ D^{(\text{Nedm})} = \frac{1}{2} \sum_{i=1}^{A} \langle \psi | [(d_p + d_n) + (d_p - d_n)\tau_i^z]\sigma_i^z | \psi \rangle \]

⇒ Spin expectation value (CP-even)

2) Polarization of the nucleus:

Contribution from the P, CP-odd nuclear force

\[ D^{(\text{pol})} = \frac{e}{2} \sum_{i=1}^{A} \langle \psi | (1 + \tau_i^z)z_i | \bar{\psi} \rangle + (\text{c.c.}) \]

⇒ EDM generated by the CP-even ⇔ CP-odd mixing

May be enhanced by many-body effect!
Electric dipole operator requires CP mixing to have finite expectation value

Total hamiltonian:

$$H = \begin{pmatrix} H_{\text{realistic}} & H_{PT} \\ H_{PT} & H_{\text{realistic}} \end{pmatrix}$$

CP-odd N-N interactions mixes opposite parity states

Parity mixing $\Rightarrow$ Polarized ground state!
P, CP-odd nuclear force from one pion exchange

P, CP-odd nuclear force: we assume one-pion exchange process

\[
\pi \overset{\sim}{\rightarrow} \frac{1}{q^2 - m^2_\pi} \bar{N}N \bar{N}i\gamma_5 N
\]

P, CP-odd Hamiltonian (3-types):

\[
H_{PCT} = -\frac{g_{\pi NN}}{8\pi m_p} \left[ (\frac{g_{\pi NN}}{g_{\pi NN}}) \tau_a \cdot \tau_b + \frac{g_{\pi NN}}{g_{\pi NN}} (\tau_a \cdot \tau_b - 3\tau_a^z \tau_b^z) \right] (\bar{\sigma}_a - \bar{\sigma}_b) + \frac{g_{\pi NN}}{g_{\pi NN}} (\tau_a^z \bar{\sigma}_a - \tau_b^z \bar{\sigma}_b) \cdot \hat{\nabla}_a \frac{e^{-m_\pi r_{ab}}}{r_{ab}}
\]

4 important properties:
- Coherence in nuclear scalar density: enhanced in nucleon number
- One-pion exchange: suppress long distance contribution
- Spin dependent interaction: closed shell has no EDM
- Derivative: contribution from the surface

What is expected:
- Polarization effect grows in \(A\) for small nuclei
- May have additional enhancements with cluster, deformation, ...
**P, CP-odd nuclear force from one pion exchange**

P, CP-odd nuclear force: we assume one-pion exchange process

\[ \sim \frac{1}{q^2} \bar{N}N \bar{N} i \gamma_5 N \]

4 important properties:

- Coherence in nuclear scalar density: enhanced in nucleon number
- One-pion exchange: suppress long distance contribution
- Spin dependent interaction: closed shell has no EDM
- Derivative: contribution from the surface

What is expected:

- Polarization effect grows in \( A \) for small nuclei
- May have additional enhancements with cluster, deformation, ...

P, CP-odd Hamiltonian (3-types):

\[
H_{\pi\chi} = - \frac{g_{\pi NN}}{8\pi m_p} \left[ \frac{1}{2} \left( \frac{g^{(0)}_{\pi NN} \tau_a \cdot \tau_b + g^{(2)}_{\pi NN} (\tau_a \cdot \tau_b - 3\tau_a^z \tau_b^z)}{r_{ab}} \right) (\vec{\sigma}_a - \vec{\sigma}_b) + \frac{g^{(1)}_{\pi NN} (\tau_a^z \vec{\sigma}_a - \tau_b^z \vec{\sigma}_b)}{r_{ab}} \right] \cdot \bar{N} a e^{-m_{\pi} r_{ab}}
\]

\( g_{\pi NN} \) isoscalar, \( g^{(0)}_{\pi NN} \) isotensor, \( g^{(1)}_{\pi NN} \) isovector
What we want to do

⇒ Nucleon level CPV is unknown and small: linear dependence

⇒ Linear coefficients depend on the nuclear structure

⇒ We want to find nuclei with large enhancement factors

⇒ We must calculate the nuclear structure with nucleon level CPV

Dependence of nuclear EDM on nucleon level CP violation must be written as:

\[ d_A = (a_\pi^{(0)} \bar{G}_\pi^{(0)} + a_\pi^{(1)} \bar{G}_\pi^{(1)} + a_\pi^{(2)} \bar{G}_\pi^{(2)}) \ e \ fm \]

Unknown CP violating nuclear couplings beyond the standard model

⇒ We want to evaluate red factors and find interesting nuclei!
A sophisticated method to calculate few-body system


Basis function:

$$\phi_{lm}(r) = \sum_n N_{nl} \sum_k C_{lm,k} e^{-\nu_n (r-D_{lm,k})^2}$$

Variational method

Successful in the benchmark calculation of $^4$He binding energy


It is applied in many subjects:
Nuclei, Hypernuclei, atoms, hadrons, astrophysics, ...

We expect accurate calculation of nuclear EDM!
**Ab initio tests ($^2$H, $^3$He)**

**Ab initio:**
Solve the full many-body Schroedinger equation with given hamiltonian.

<table>
<thead>
<tr>
<th>Group</th>
<th>Nuclear force</th>
<th>$a_0$</th>
<th>$a_1$</th>
<th>$a_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu &amp; Timmermans</td>
<td>Av18</td>
<td>0</td>
<td>1.43x10^{-2} e fm</td>
<td>0</td>
</tr>
<tr>
<td>Liu et al., PRC 70, 055501 (2004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEM (our work)</td>
<td>Av18</td>
<td>0</td>
<td>1.45x10^{-2} e fm</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>Nuclear force</th>
<th>$a_0$</th>
<th>$a_1$</th>
<th>$a_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faddeev</td>
<td>$N^2$LO chiral EFT</td>
<td>0.0079 e fm</td>
<td>0.0101 e fm</td>
<td>0.0169 e fm</td>
</tr>
<tr>
<td>Bsaisou et al., JHEP 1503 (2015) 104</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEM (our work)</td>
<td>Av18</td>
<td>0.0060 e fm</td>
<td>0.0108 e fm</td>
<td>0.0168 e fm</td>
</tr>
</tbody>
</table>

⇒ Consistent with previous works!
Cluster model: 

$^6$Li, $^9$Be EDM
Physics of nuclear EDM: light and heavy nuclei

Light nuclei

Heavy nuclei

Core
Physics of nuclear EDM: light and heavy nuclei

Light nuclei have cluster structure → Larger “surface” → May enhance CPV effect??
Setup of the cluster model

We treat $^6\text{Li}$ and $^9\text{Be}$ nuclei as 3-body systems of nucleons and $\alpha$ clusters ($^4\text{He}$ nucleus).

- **N-N interaction:**
  
  Av8’


- **N-$\alpha$ interaction:**
  
  Fitted to reproduce the $\alpha$-N scattering phase shift at low energy
  Pauli exclusion taken into account via OCM (0s excluded)


- **$\alpha$-$\alpha$ interaction:**
  
  Fitted to reproduce the $\alpha$-$\alpha$ scattering phase shift at low energy
  Pauli exclusion taken into account via OCM (0s, 1s, 0d excluded)

Orthogonality condition model (OCM)

Simple way to include the effect of antisymmetrization (Pauli exclusion) in cluster model

**N-α interaction:**

Repulsion of the 0s state:

\[
V_{Pauli} = \lim_{\lambda \to \infty} \sum_{f=0s} |\phi_f(r_{\alpha\alpha})\rangle \langle \phi_f(r'_{\alpha\alpha})| \lambda
\]

**α-α interaction:**

Repulsion of the 0s, 1s, 0d states.

\[
V_{Pauli} = \lim_{\lambda \to \infty} \sum_{f=0s,1s,0d} \lambda |\phi_f(r_{\alpha\alpha})\rangle \langle \phi_f(r'_{\alpha\alpha})|
\]

In our calculation, we have taken \( \lambda \sim 10^4 \) MeV

S. Saito, Prog. Theor. Phys. 41, 705 (1969);
Use Jacobi coordinates:

$R_{N\alpha}$

$\frac{3}{4} R_3$

$R_3$

$R_1$

$R_2$

Folding of CP-odd nuclear force in the center of mass frame

$\Rightarrow$ Exclude the center of mass motion
Integrate the CP-odd N-N interaction with the $^4$He nucleon density

$$\rho_\alpha(r) = Ae^{-\frac{r^2}{b}}$$

Spread: $b = (1.358 \text{ fm})^2$

Gaussian approximation of density:

Only isovector CP-odd nuclear force is relevant in N-α interaction

(Isoscalar and isotensor CP-odd nuclear forces cancel by folding)

$\Rightarrow$ Can reduce the calculation of p-shell nuclei
to few-body problem

Result: $^6$Li EDM

$^6$Li EDM is well described with $\alpha + d$

<table>
<thead>
<tr>
<th>Nuclear force</th>
<th>$&lt;\sigma&gt;$</th>
<th>$&lt;\sigma_T&gt;$</th>
<th>isoscalar ($a_0$)</th>
<th>isovector ($a_1$)</th>
<th>isotensor ($a_2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av8' + cluster model</td>
<td>0.86</td>
<td>—</td>
<td>—</td>
<td>0.022 e fm</td>
<td>—</td>
</tr>
</tbody>
</table>

- $^6$Li EDM is made of 2 comparable components:
  - Deuteron cluster polarization: slightly smaller than deuteron EDM
  - CP-odd $\alpha$-N interaction effect

Compare with deuteron EDM ($c_1 = 0.0145$ e fm):

$\Rightarrow ^6$Li enhances the CP-odd effect!
Result: $^9$Be EDM

![Diagram of $^9$Be with neutrons and alpha particles]

Binding energy: 1.57 MeV

<table>
<thead>
<tr>
<th>Nuclear force</th>
<th>$&lt;\sigma&gt;$</th>
<th>$&lt;\sigma_T&gt;$</th>
<th>isoscalar ($a_0$)</th>
<th>isovector ($a_1$)</th>
<th>isotensor ($a_2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster model</td>
<td>0.38</td>
<td>-0.38</td>
<td>—</td>
<td>0.014 e fm</td>
<td>—</td>
</tr>
</tbody>
</table>

- Sensitivity to isovector CP-odd nuclear force comparable to deuteron
- Polarization due to the CP-odd $\alpha$-N interaction

(No polarization from $\alpha$-$\alpha$ system)
Cluster model: $^{13}\text{C EDM}$
**Setup of the cluster model**

We treat the $^{13}$C nucleus as a 4-body system of nucleons and $\alpha$ clusters ($^4$He nucleus).


- **$\alpha$-$\alpha$ interaction:**
  - Folding of Schmid-Wildermuth $NN$ force (include Coulomb)
  - Pauli exclusion taken into account via OCM
    

- **N-$\alpha$ interaction:**
  - Fitted to reproduce the $\alpha$-N scattering phase shift at low energy
  - Pauli exclusion taken into account via OCM (0s excluded)
    

- **3-, 4-body interactions:**
  - Phenomenological 3-$\alpha$ force with angular momentum dependence
  - Phenomenological $\alpha\alpha N$ force to fit $^9$Be ground-state energy
  - Phenomenological 3$\alpha$-$N$ force to fit $^{13}$C ground-state energy
The low energy structure is well reproduced.

**Result: \(^{13}\text{C} \text{EDM} \)**

<table>
<thead>
<tr>
<th>Nuclear force</th>
<th>(\langle \sigma \rangle)</th>
<th>(\langle \sigma_T \rangle)</th>
<th>isoscalar ((a_0))</th>
<th>isovector ((a_1))</th>
<th>isotensor ((a_2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster model</td>
<td>-0.17</td>
<td>0.17</td>
<td>-</td>
<td>-0.0020 (e\ \text{fm})</td>
<td>-</td>
</tr>
</tbody>
</table>

- Intrinsic nucleon EDM effect \(-1/3 \, d_n\): consistent with simple shell model
  

- Smaller sensitivity than lighter nuclei

  Bad overlap with 1/2+ excited state?

  - Ground state is shell like, but 1/2+ is neutron halo like.
  - Bad core overlap between Ground and 1/2+ states.

- Opposite sign: orbital angular momentum and spin are antiparallel
Parity-odd transitions in $^{13}\text{C}$
Parity-odd transitions in $^{13}\text{C}$

$J_{12}\text{C} = 2$  \hspace{1cm} $L = 1$  \hspace{1cm} $S = 1/2$

$L \times S = 3/2$  \hspace{1cm} (Strong LS)

$J_{13}\text{C} = 1/2$
Parity-odd transitions in $^{13}\text{C}$

\[ \text{E(MeV)} \]

\[ 9 \quad 7 \quad 5 \]

$^{12}\text{C}(0^+)+n$ \quad $^{12}\text{C}(2^+)+n$ \quad $^{12}\text{C}(0^+)+n$ \quad $^{12}\text{C}(0^+)+n$ \quad $^{12}\text{C}(0^+)+n$

\[ J_{^{12}\text{C}} = 2 \quad L = 1 \quad S = 1/2 \]

$^{12}\text{C}$ \quad n

$L \times S = 3/2$  
(Strong LS )

$J_{^{13}\text{C}} = 1/2^-$

P = +1

EDM

P = −1

$1/2^+$

$1/2^-$
Parity-odd transitions in $^{13}\text{C}$

$J_{12\text{C}} = 2$ $L = 1$ $S = 1/2$

$L \times S = 3/2$ (Strong LS)

$J_{13\text{C}} = 1/2^{-1}$

$P = -1$

$J_{12\text{C}} = 0$ $L = 0$ $S = 1/2$

$P = +1$

$J_{13\text{C}} = 1/2^{+1}$

Bad overlap with $1/2^{-1}$
Parity-odd transitions in $^{13}\text{C}$

$^{12}\text{C}(0^+)+n$

$^{12}\text{C}(2^+)+n$

$J_{12C} = 2$

$L = 1$

$S = 1/2$

$L \times S = 3/2$

$(\text{Strong LS})$

$J_{13C} = 1/2^-$

Bad overlap with $1/2^-$
Parity-odd transitions in $^{13}$C

$^{13}$C, $^{12}$C, n

$^{12}$C$(0^+)+n\rightarrow ^{13}$C, $^{12}$C, n

$L \times S = 3/2$

(Strong LS)

$J_{13C} = 1/2^-$

$P = +1$

Good overlap with $1/2^-_1$, but far energetically

$J_{12C} = 2$

$P = -1$

$L = 2$

$S = 1/2$

$E$(MeV)

5

9

7

$^{12}$C$(0^+)+n$
Parity-odd transitions in $^{13}$C

$^{12}$C($0^+$)+n → $^{12}$C(0$^+$)+n

$J_{12C} = 2$  
$L = 1$  
$S = 1/2$

$L \times S = 3/2$  
(Strong LS)

$J_{13C} = 1/2^-$

$P = +1$

⇒ Bad overlap of the core suppresses the EDM!
<table>
<thead>
<tr>
<th>EDM</th>
<th>isoscalar ($a_0$)</th>
<th>isovector ($a_1$)</th>
<th>isotensor ($a_2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{129}$Xe atom</td>
<td>$1.0 \times 10^{-7} \text{ e fm}$</td>
<td>$3.0 \times 10^{-8} \text{ e fm}$</td>
<td>$7.6 \times 10^{-8} \text{ e fm}$</td>
</tr>
<tr>
<td>N. Yoshinaga et al., talk of this conference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dzuba et al., PR A 80, 032120 (2009)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{199}$Hg atom</td>
<td>$4.7 \times 10^{-6} \text{ e fm}$</td>
<td>$-1.8 \times 10^{-6} \text{ e fm}$</td>
<td>$7.5 \times 10^{-6} \text{ e fm}$</td>
</tr>
<tr>
<td>Ban et al., PRC 82, 015501 (2010)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dzuba et al., PRA 80, 032120 (2009)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{225}$Ra atom</td>
<td>$0.00088 \text{ e fm}$</td>
<td>$-0.0052 \text{ e fm}$</td>
<td>$0.0035 \text{ e fm}$</td>
</tr>
<tr>
<td>Dobaczewski et al., PRL 94, 232502 (2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dzuba et al., PRA 80, 032120 (2009)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutron</td>
<td>$0.01 \text{ e fm}$</td>
<td>$-$</td>
<td>$-0.01 \text{ e fm}$</td>
</tr>
<tr>
<td>Crewther et al., PLB 88, 123 (1979)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mereghetti et al., PLB 696, 97 (2011)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deuteron</td>
<td>$-$</td>
<td>$0.0145 \text{ e fm}$</td>
<td>$-$</td>
</tr>
<tr>
<td>Liu et al., PRC 70, 055501 (2004)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY and EH, PRC 91, 054005 (2015)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^3$He nucleus</td>
<td>$0.0060 \text{ e fm}$</td>
<td>$0.0108 \text{ e fm}$</td>
<td>$0.0168 \text{ e fm}$</td>
</tr>
<tr>
<td>Bsaisou et al., JHEP 1503 (2015) 104</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY and EH, PRC 91, 054005 (2015)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^6$Li nucleus</td>
<td>$-$</td>
<td>$0.022 \text{ e fm}$</td>
<td>$-$</td>
</tr>
<tr>
<td>NY and EH, PRC 91, 054005 (2015)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^9$Be nucleus</td>
<td>$-$</td>
<td>$0.014 \text{ e fm}$</td>
<td>$-$</td>
</tr>
<tr>
<td>NY and EH, PRC 91, 054005 (2015)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{13}$C nucleus</td>
<td>$-$</td>
<td>$-0.0020 \text{ e fm}$</td>
<td>$-$</td>
</tr>
<tr>
<td>NY et al., arXiv:1603.03136 [nucl-th]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Future prospects
Exchange current contributions?

Exchange current effect to nuclear EDMs is not large for the deuteron, \(^3\)He


Green function Montecarlo calculation:

Exchange current effect to magnetic moment is not small for some nuclei (\(^9\)Li, \(^9\)C)

Large effect to EDM for larger nuclei?

Light nuclei sensitive to CP violation: what’s next?

\[ \text{\bf 7Li:} \]

- Have \( \alpha + 3N \) cluster structure
  - Can be treated as 4-body system
- Closest \( ^3\text{He} + \alpha \) continuum threshold at 2.5 MeV
  - Large overlap with closest continuum?
- \( g-2 = +1.256 \)

\[ \text{\bf 19F:} \]

- Coupled channel \( ^{15}\text{N} + \alpha - ^{16}\text{O} + ^3\text{H} \) cluster structure
- \( 1/2^+ - 1/2^- \) energy splitting:
  - Only 110 keV!
- \( g-2 = +0.629 \)
Summary:

- We have studied the EDM of light nuclei using the Gaussian Expansion Method.
- Large EDM for $^6\text{Li}$: suggest enhancement of EDM due to cluster structure.
- Small EDM for $^{13}\text{C}$ EDM: may be understood by the small overlap between the cores of $1/2^-$ and $1/2^+$ states.
- Our results are a very good guide to search for nuclei with large enhancement factors.

Future subjects:

- Exchange current contribution?
- Further study of EDM of light nuclei: $\rightarrow$ EDM of $^{19}\text{F}$ and $^7\text{Li}$?
- We are waiting for experiments!
End