

Fundamental Symmetries Breakout Session

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Questions that arose in preparing my previous presentation

- Combining beta-decay projects into one section?
- Question marks on individual submissions:
 - Common problem was lack of description regarding the huge success of the previous five years. I think this is a problem with the template.
 - Please be clear about what you want to do in the next seven years.
 - SALER/BeEST
- Including particle theory?
- Quantum?
- How to understand and meet Canadian priorities?

Questions and discussions that I could remember from my previous presentation

- Homework for me: resources (likely appears in different section of the brief?)
- RadMol x1000 on Hg in next 7 yrs
- Encouraging small, high-impact projects to submit a killer brief, so that they will be prioritized over large projects.
- nEXO vs. LEGEND – I think this was resolved (no conflict)
- Dangerous to split closely linked projects, might cause dilution/confusion at the next level. (BeEST vs. SALER)
- PIONEER has V_{us} for CKM unitarity; encouraged them to submit a brief to CINP.



What are Canada's priorities?

June 7, 2025 – Ottawa, Ontario – Prime Minister's Office

PRIME MINISTER CARNEY ANNOUNCES CANADA'S G7 PRIORITIES AHEAD OF THE LEADERS' SUMMIT

Anchored in building stronger economies, Canada will seek agreements and co-ordinated action on three core missions:

- **Protecting our communities and the world**—strengthening peace and security, countering foreign interference and transnational crime, and improving joint responses to wildfires.
- **Building energy security and accelerating the digital transition**—fortifying critical mineral supply chains and using artificial intelligence and quantum to unleash economic growth.
- **Securing the partnerships of the future**—catalyzing enormous private investment to build stronger infrastructure, create higher-paying jobs, and open dynamic markets where businesses can compete and succeed.

Other discussions will include a just and lasting peace for Ukraine and other areas of conflict around the world, and a forward-looking agenda that engages partners beyond the G7, recognizing that our long-term security and prosperity will depend on building coalitions with reliable partners and common values.

Expanding our impact:

- “Artificial Intelligence”
- “Quantum”
- “Digital transition”
- “unleash economic growth”
- “responses to wildfires”

Other things we are good at:

- “Co-ordinated action”
- “Building coalitions with reliable partners”

Outline of the CINP brief

2020

- Intro
- Exec. Summary, Recommendations
- Physics case
- New facilities
- Human element, positive impacts
- Recommendations and budget

2025 v1 (OCSA, ISED, PMO, ...)

- Preparing society for the digital transition
 - AI
 - Quantum
- Unleashing economic growth
- Building international collaborations for fundamental science
- Science case
- Facilities
- Recommendations and budget

Outline of the CINP brief

2020

- Intro
- Exec. Summary, Recommendations
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2025 v2 (NSERC, CFI, ...)

- Pushing the frontiers of human knowledge
- Training HQP for the digital transition
 - AI
 - Quantum
- Prioritization of projects
- Recommendations and budget
- Science case
- Facilities

CINP brief recommendations

2020

- Nuclear theory
- Diverse physics program (name projects)
- More HQP
- ARIEL
- Grow the NP community

2025

- ?



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Backups

Places where I had question marks

Possible outline

Comparing 2020 to 2025

2020	2025 (?)
T/CP <ul style="list-style-type: none"> • TUCAN • RadMol • FrEDM 	T/CP <ul style="list-style-type: none"> • TUCAN • RadMol • EDM³ (also TRINAT)
Z0 <ul style="list-style-type: none"> • MOLLER • Fr • EIC 	Z0 <ul style="list-style-type: none"> • MOLLER • Fr • EIC
CPT <ul style="list-style-type: none"> • ALPHA/HAICU 	CPT <ul style="list-style-type: none"> • ALPHA/HAICU
Nuclear decay <ul style="list-style-type: none"> • 0+ -> 0+ (TITAN, GRIFFIN) • BL3 	“Vud” (“precision β -decay”?) <ul style="list-style-type: none"> • 0+ -> 0+ (GRIFFIN, TITAN) • Nab
β - ν correlations <ul style="list-style-type: none"> • TRINAT • Nab, NPDGamma, N3He 	<ul style="list-style-type: none"> • TRINAT • SALER • PENeLOPE <p style="text-align: right; color: red;">combine (?)</p>
ν <ul style="list-style-type: none"> • nEXO • BeEST 	ν <ul style="list-style-type: none"> • nEXO • BeEST • Detailed nucl. struct. ($0\nu\beta\beta$)

Contact: S. Malbrunot-Ettenauer

**UBC, TRIUMF, Toronto, Manitoba, Waterloo, McGill, Ottawa;
USA, UK, NL, Germany**

RadMol

Goal

- EDMs of octupole-deformed nuclei with trapped molecules (1e7 improvement over ^{199}Hg EDM)

Past five years

- Opportunities paper (2023)
- Preparation of laboratory
- Would profit from ARIEL

Next seven years

- Complete the laboratory
- Complete EDM experiment (?)

Beyond

- Going beyond EDM searches, e.g. nuclear anapole moments

Nab, PNab

Goal

- Measure A, B, a to determine $\lambda = g_A/g_V$. With τ_n , gives V_{ud} free of nuclear corrections. b accesses exotic couplings

Past five years

- Preparing the apparatus (?)

Next seven years

- 2027: a, b precision data set
- 2028-2032: PNab measurement of A, B

Beyond

- No plans beyond 2032

TRINAT

Goal

- V_{ud} , neutrino helicity, and T-violating decays using laser-trapped potassium isotopes and isomers.
Also charge radius measurement ?

Past five years

- Analog-antianalog isospin mixing in 47K β^- -decay
- Atomic shakeoff in β^+ decay (in prep.)
- ?

Next seven years

- Upgrade electrostatic spectrometer and complete improved β -v correlation measurements in 37K, 38mK, 38gK, and 47K.
- Charge radius of 38mK.

Beyond

- Any results breaking the standard model could drive further improvements.

Partially FunSym

Vud / Precision beta-decay

- Gamma spec & TITAN to improve precision on $0^+ \rightarrow 0^+$ F_t values (Vud), also octupole def. for RadMol
- How to disentangle SALER from BeEST?

Neutral weak currents

- EIC to perform precision measurement of $\sin^2\theta_W$ using PVDIS (NC)
 - Also: CLFV and charged-current DIS

Neutrinoless double beta decay

- Garrett et al. (“Detailed Nucl. Struct.”) measurement of matrix elements relevant to $0\nu\beta\beta$

Theory

- Only Holt & Navratil checked the FunSym box. Where do they belong?
- Barkanova & Aleksejevs are MOLLER collaborators
- Should some “particle” theory be included? (e.g. Ritz, Czarnecki, Morrissey, McKeen, ...)

Techniques

- What to do with “quantum”?