TRIUMF DND2020 || Summary: Radioactive AMO

JB's personalized takes on:

- **'Business as usual' that we avoided**
- **'Business as planned soon' that we incompletely covered**
- **Ettenauer: rad mol vital practicalities**
- **Berengut: BSM with nonlinear King plot extensions**

(Alejandro will summarize decays)

TRIUMF Rad AMO 'Business as usual'

TRINAT

- β-ν and spin correlations A_{recoil}, A_β

Mirror 'heavy neutron' ^{37}K:

Weak charged current Lorentz structure

- TRV in $\beta\nu\gamma$ decay
- TRV in isospin-hindered ^{45}K decay:

CSB, P even, T odd, nucleon-nucleon

Francium Atomic PNC

- Main goal:

Weak neutral current strength at momentum transfer $\sim$ 8 MeV

With accuracy comparable to Cs ($\sim$ 2 MeV)

- Optical exp. also extracts nuclear-spin dependent PV: interpretable phenomenologically as anapole moments

Others also in J. Dilling plenary:

- TITAN (mass, highly charged ions...)
- Collinear laser spectroscopy

^{74}Rb $\langle r^2 \rangle$ for V_{ud},
Fr hyperfine anomaly

- Laser-polarized beam:

TRV ^{8}Li R (Rikkyo U.)

to GRIFFIN soon ?

TRIUMF Rad AMO 'Business as planned'

- Francium fountain Electron EDM (J. Dilling plenary) TRIUMF LOI from LBL H. Gould 9.1x larger sensitivity, 25x smaller syst than Cs

- Rad Molecules (R. Berger, N. Hutzler plenaries) PNC, EDM's TRIUMF LOI from Garcia Ruiz, Dilling RaF laser-coolable

Stephan Ettenauer, CERN (WG talk) Practicalities of making molecules near g.s.

TRV: Nuclear MQM requires unpaired e^-. Molecules sensitive to octupole deformation-enhanced Schiff moments mentioned:

- ^{225}RaOH+, ^{225}RaOCH3+ (e.g. A. Jayich UCSB) Hutzler plenary; Cairncross other WG

- ^{223}Fr Ag DeMille (other WG): laser-cool both elements before stimulating combination to desired state, in situ in final EDM experiment region

  Preliminary work on Fr_2 with Gwinner Francium PNC group

BSM with nonlinear King plot extensions

Julian Berengut, U. New South Wales
arXiv 2005.06144. WG talk has guidelines:

- **SM sources of nonlinear King plots ("spurions" ☺) can be anticipated, parameterized, and estimated.**
- **An additional transition measurement is needed for each spurion:**

Number Isotopes - 1 $>$ # Transitions $>$ # Spurions

- **Ca: just enough info from 5 even stable isotopes and 3 narrow transitions possible, but adding HCI transitions as desirable needs more isotopes**
- **Yb also has 5 even stable isotopes, but is much harder to calculate and has more spurions of greater size. (The Counts PRL text makes it clear that the nonlinearity seen in Yb+ can be accounted for by SM nonlinearity.)**

More isotopes likely needed in the harder systems like Yb

Needed to expand AMO into these areas:

- **Rad molecules or ions for EDM's/PNC:**

Every molecule needs detailed spectroscopy (years).
Kia Boon Ng (WG): JILA is doing ThF^+ (g.s. is the physics state!)
after HfF^+: spectroscopy took years longer

- **If laser-cooled directly, requires schemes and demos**
- **Making radioactive molecules from two atoms of laser-cooled elements: full trapping schemes for each, dedicated facility**

These experiments need 'medium-energy scale' collaborations (ACME ThO 'dream team' of 3 faculty at 2-3 universities + N)

- **For mHz-accurate optical spectroscopy for nonlinear King plots (or cosmic fields), any element needs**
  multiple narrow lasers (commercial but $);
  ion trap techniques creative and exacting (Ozeri, Weizmann Inst), needing mostly people;
  atom trap techniques more involved but may be necessary