Texas A&M Evaluation Center
Strategic Priorities

- **Continuing ENSDF Mass Chain Evaluation (1 FTE)**

  First Strategic Priority according to the Mission Statement.

  All other priorities will be strictly subordinated to this purpose

- **Produce experimental nuclear data to aid data evaluation**

  Precision Internal Conversion Coefficients Measurements at Cyclotron Institute, Texas A&M University to give USDNP the best approach for ENSDF ICC-calculated values (concluding cases pending on conditions)

- **Experimental studies of Medical Isotopes**

  Invers kinematics methodology, Cyclotron Institute, Texas A&M University

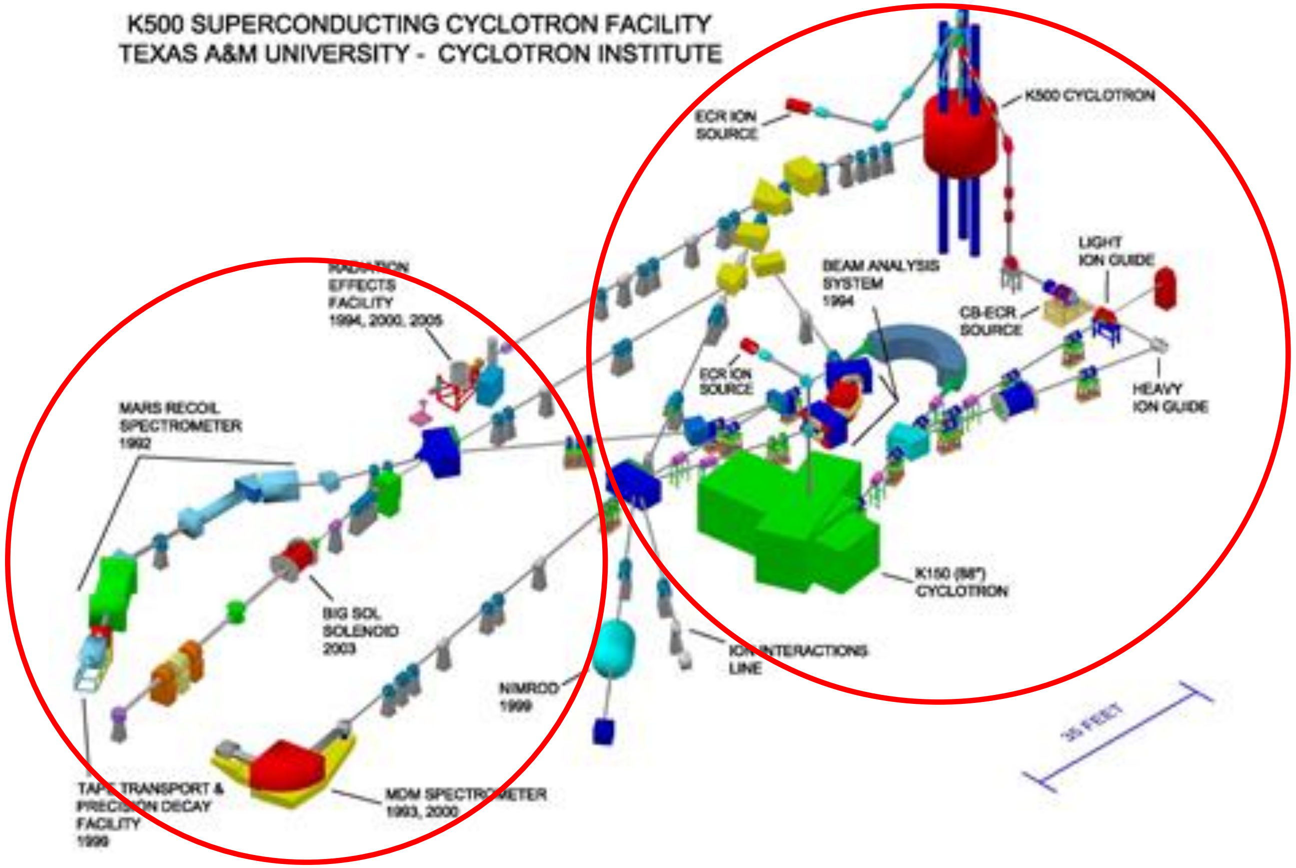
- **Reevaluation of data procedures for basic science and data evaluation**

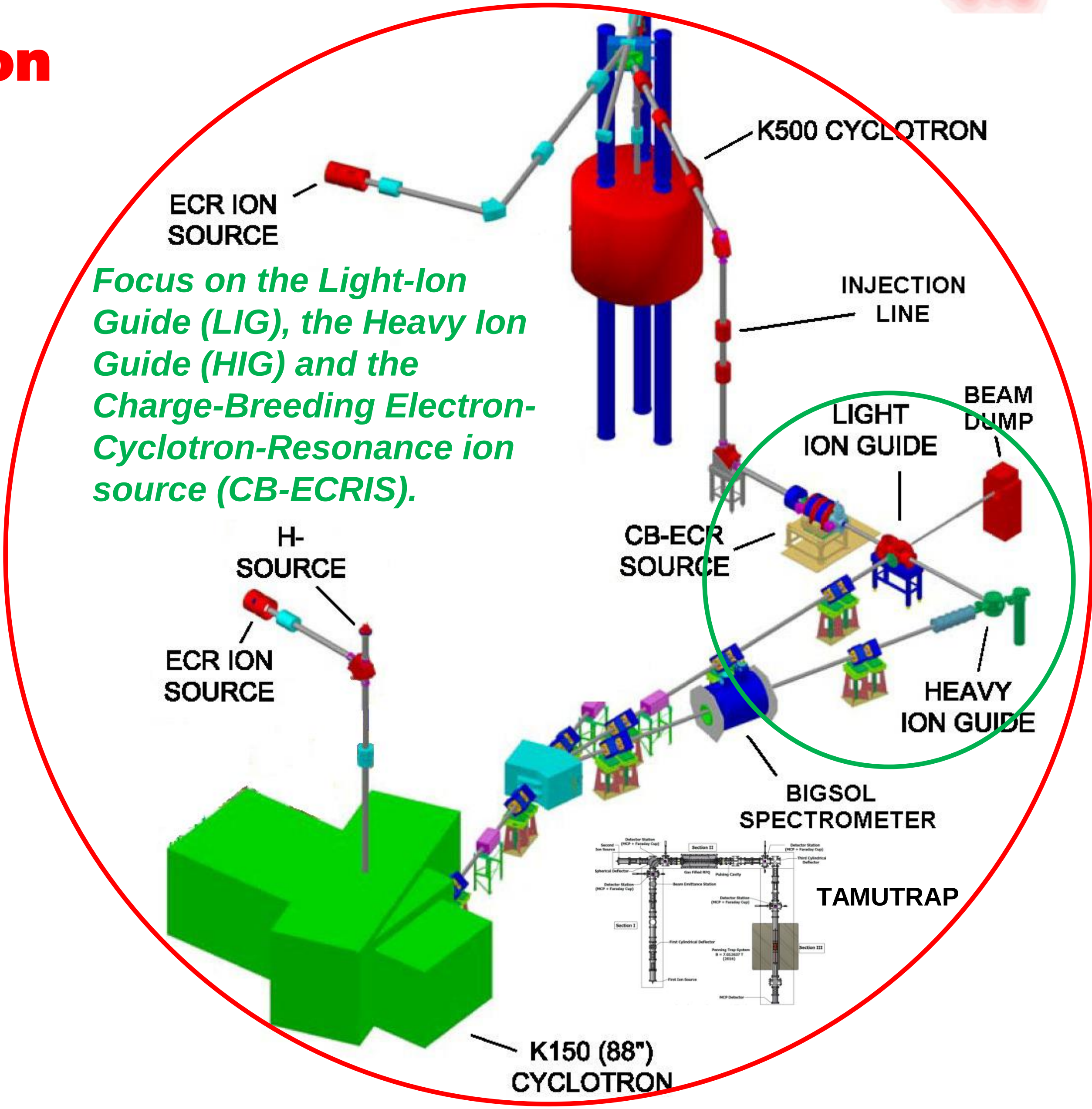
  Level scheme re-concept based on Repeatability, a newly revealed experimental data evidence

Cyclotron Institute
Texas A&M University

Texas A&M Evaluation Center:

Data Evaluation Station at Cyclotron Radioactive Ion Beam Facility to assist experiments and pre-evaluate data





Focus on the Light-Ion Guide (LIG), the Heavy Ion Guide (HIG) and the Charge-Breeding Electron-Cyclotron-Resonance ion source (CB-ECRIS).

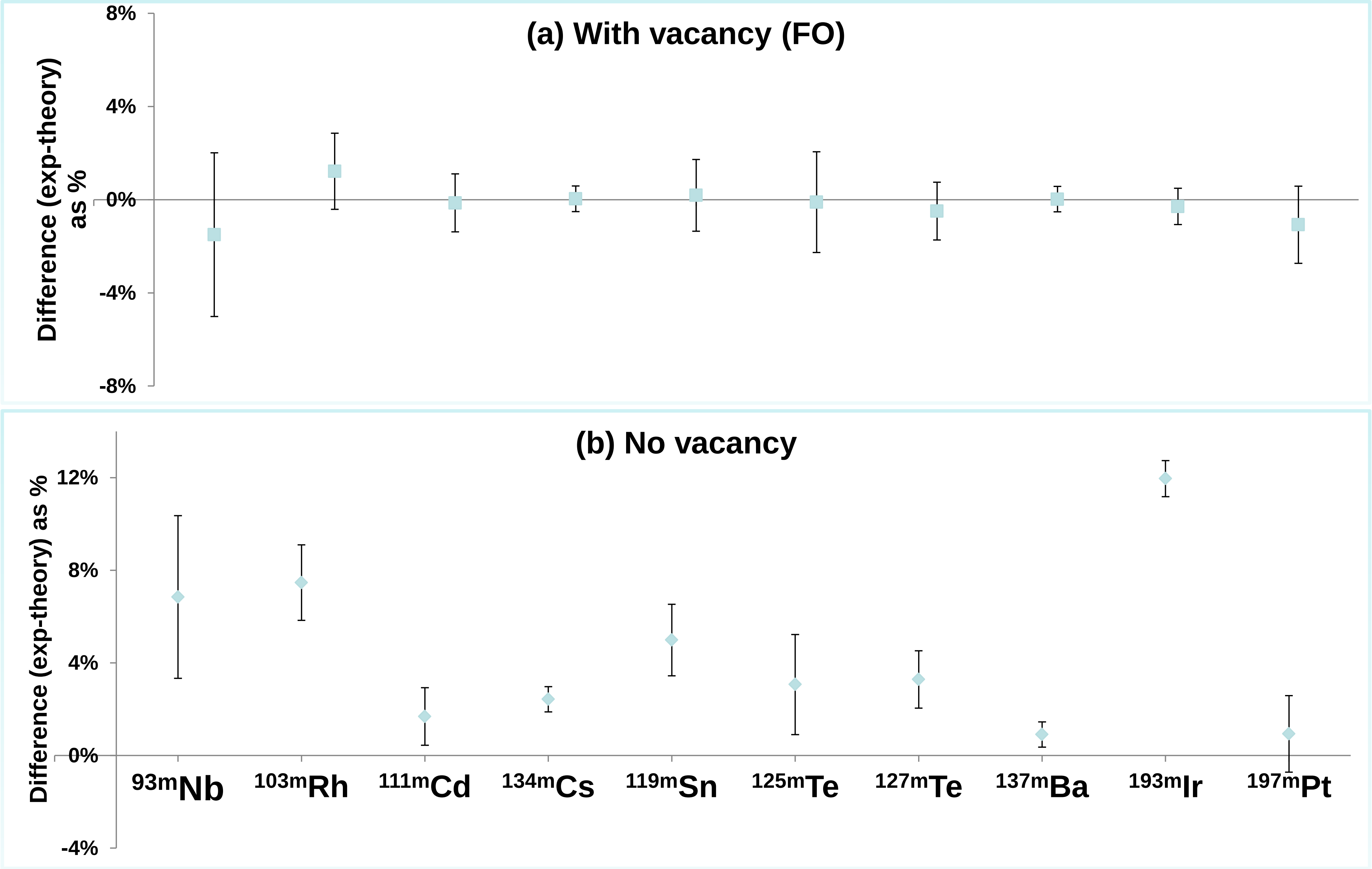
Texas A&M Evaluation Center

Expanded Involvement in Applied Measurements of Precision Internal Conversion Coefficients

Theme: Precision Measurements for USNDP

- **Texas A&M Center implied decisively by decade-long program of Internal Conversion Coefficient (ICC) Precision Measurements to guide USNDP for best approach of theoretical ENSDF database ICC values**

					Calculated α_K values:		
	Parent State	Multipolarity	Transition Energy (keV)	Measured α_K	No vacancy	"Frozen Orbitals"	SCF
1	^{93m}Nb	M4	30.760(5)	25600(900)	23960	25990	25440
2	^{103m}Rh	E3	39.752(6)	141.1(23)	131.3	139.4	137.2
3	^{111m}Cd	E3	150.825(15)	1.449(18)	1.425	1.451	1.446
4	^{119m}Sn	M4	65.660(10)	1621(25)	1544	1618	1603
5	^{125m}Te	M4	109.276(15)	185.0(40)	179.5	185.2	184.2
6	^{127m}Te	M4	88.23(7)	484(6)	468.6	486.4	483.1
7	^{134m}Cs	E3	127.502(3)	2.742(15)	2.677	2.741	2.73
8	^{137m}Ba	M4	661.659(3)	0.0915(5)	0.09068	0.0915	0.091
9	^{193m}Ir	M4	80.22(2)	103.0(8)	92.0	103.3	99.7
10	^{197m}Pt	M4	346.5(2)	4.23(7)	4.191	4.276	4.265
				χ^2:	**252**	**1.5**	**21.5**



(a) With vacancy (FO)
Difference (exp-theory) as %
8%
4%
0%
-4%
-8%
(b) No vacancy
Difference (exp-theory) as %
12%
8%
4%
0%
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93mNb
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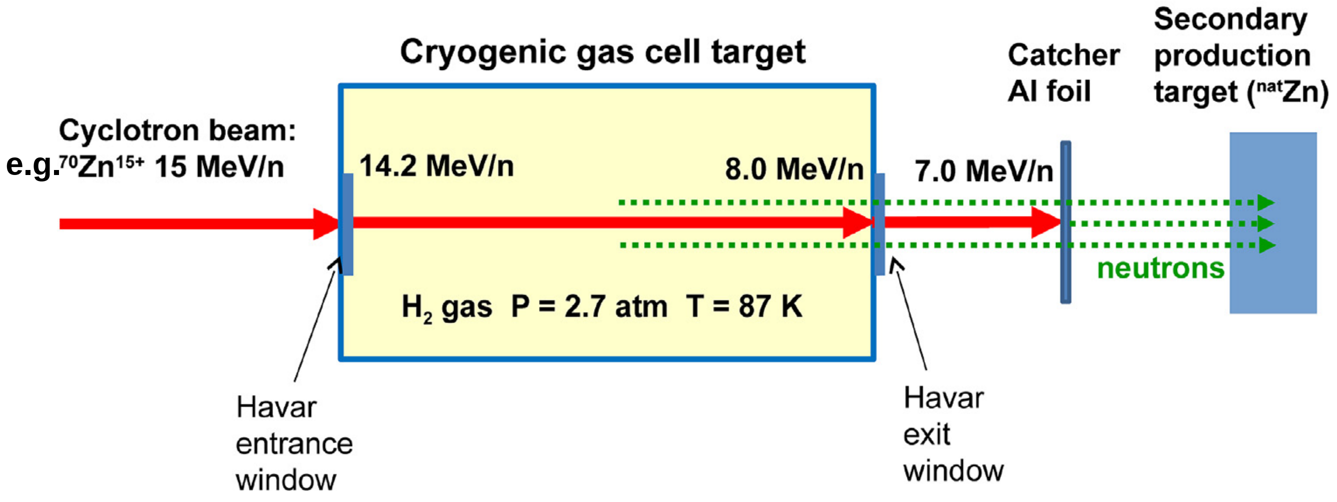
Texas A&M Evaluation Center

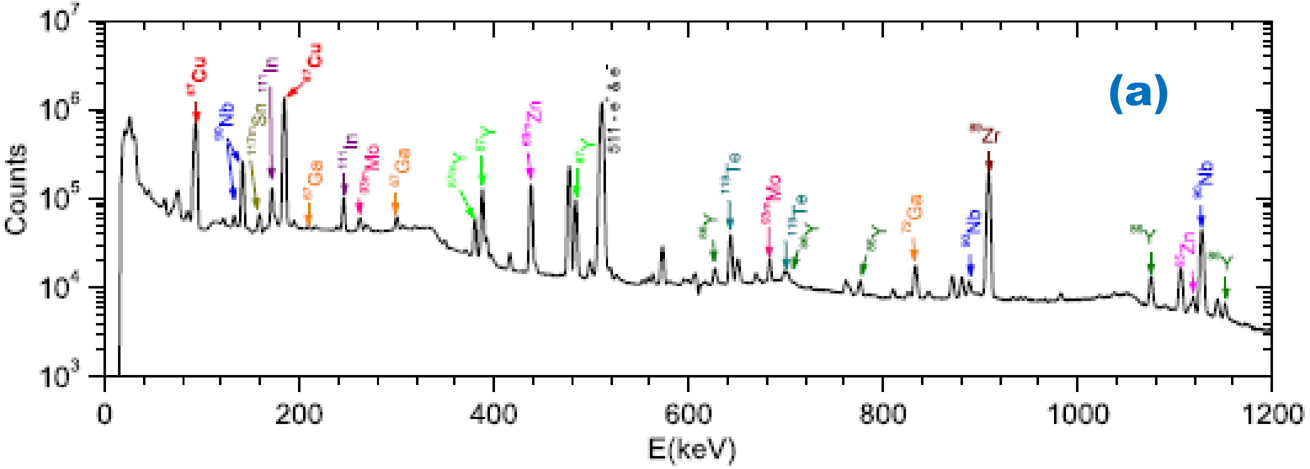
Expanded Involvement in Applied Measurements for Medical Isotopes Production by Inverse Kinematics

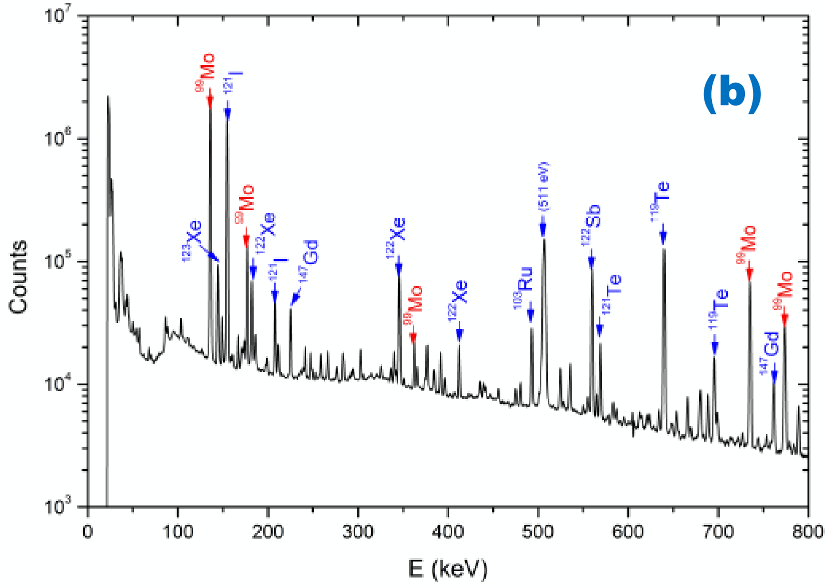
Theme: Research for Medical Isotopes Production by Inverse Kinematics

- **Innovative method for the production of important medical radioisotopes based on the nuclear reaction in inverse kinematics, by:**
  - **Directing a heavy ion beam of appropriate energy on a light target (e.g., H, d, He) and**
  - **Collecting the isotope of interest on an appropriate catcher after the target.**



- **Case Studies** (at this stage beyond the proof-of-principle):
  - ^{67}Cu ($T_{1/2}$ = 62 h) via the reaction of ^{70}Zn beam of 15 MeV/nucleon with a cryogenic hydrogen gas target
  - ^{99}Mo ($T_{1/2}$ = 66 h) via the reaction of ^{100}Mo of 12 MeV/nucleon with a cryogenic ^{4}He cryogenic gas target
  - Secondary neutrons from the primary reaction were used to irradiate a secondary target for further radioisotope production (to be further developed)
  - At K500 Cyclotron & MARS spectrometer of Texas A&M Cyclotron Institute





  - Radioactive isotopes identified by γ-ray spectroscopy:
    - (a) ^{67}Cu run
    - (b) ^{99}Mo run

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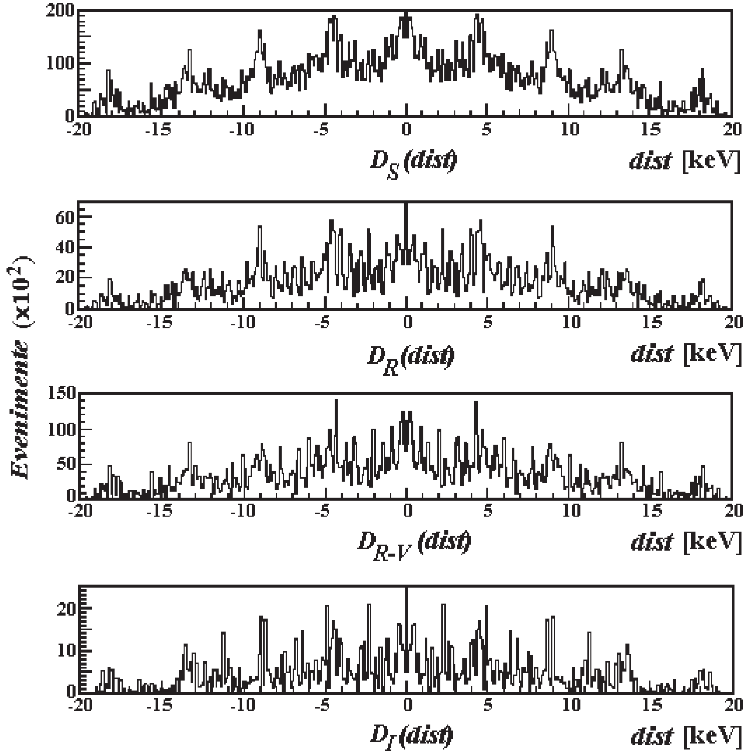
New Initiatives & Directions

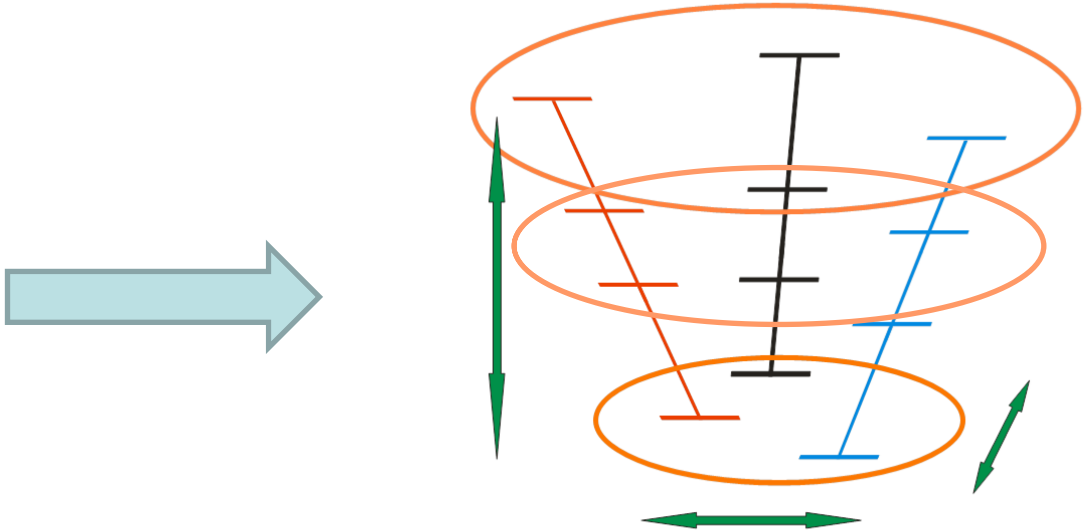
Theme: Data Evaluation for Basic Physics

- **Reevaluation of data procedures for basic science and data evaluation**

  Level scheme re-concept based on Repeatability, a newly revealed experimental evidence



Regular $E_{\gamma i}$-$E_{\gamma j}$ Distributions *D(dist)*
(high spin data)



3D Correlations in the Level Scheme

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Precision Internal Conversion Coefficients Measurements Follow-up

Theme: Precision Measurements for USNDP

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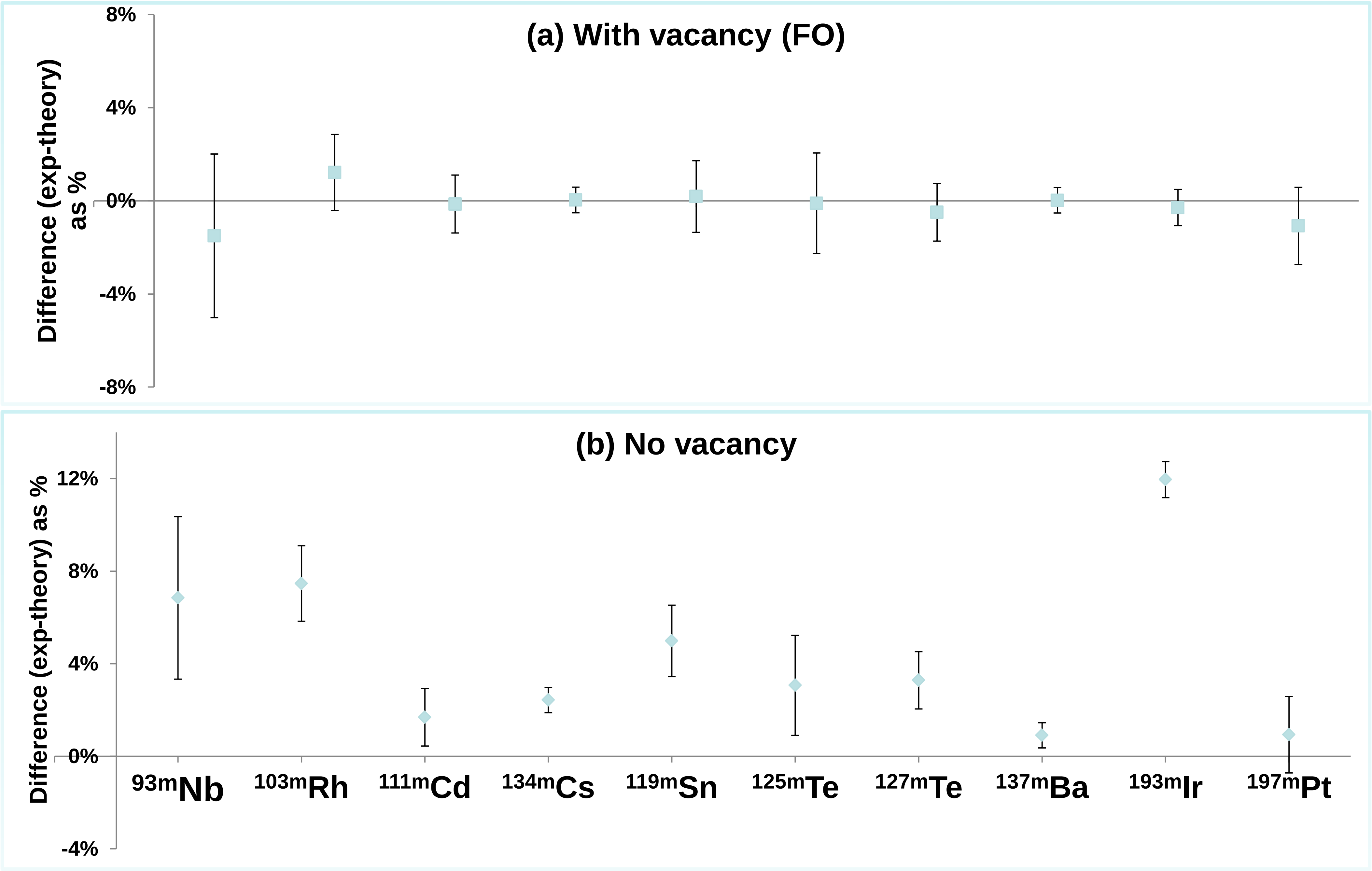
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Texas A&M Evaluation Center
Precision Internal Conversion Coefficients Measurements Follow-up

- Covered the interval 93<A<197 of nuclear chart and concluded that the "frozen orbitals" hole calculations are best describing the results.
- However the calculation methodology is an approximate description of reality with no obvious reason, other than the empirical evidence, that it is universally valid.
- *Game changer:* the last studied case, ^{93m}Nb, was done with a Si(Li) detector that was painstakingly efficiency calibrated and it is now fit to explore for ICC measurements in the underrepresented region A<100.
- There are but two measurements close to A~200 limit and one can use the HPGe detector for more measurements in this region (and higher)

  - Conclusion: it is still possible to improve the ICC test by extending the A range

  - Possible candidates: ^{58m}Co, ^{198m}Au

${}_{27}^{58m}Co$

${}_{27}^{58m}Co$, Δ_K=4.7%, α_K(exp)=1860(100) (ENSDF), %unc=5.4% ; 2030(90) (2002RA45)

24.9-keV M4, single IT γ , $T_{1/2}$=9.1 h,

α_K(FO)=1840, α_K(NH)=1754

^{58}Co g.s. ε, $T_{1/2}$=70.9 d, $(\lambda\times I_{Kx})$(g.s./m.s.)= 0.51(3)%

ONLY Si(Li) detector

ENSDF list of reactions:

a) There are many reactions used for *prompt* studies:

With γ measured: (α,nγ), (p,γ), (p,nγ), (n,2nγ), (d,nγ);

Only particles: (p,n), (p,d), (d,t), (d,n), (d,α), (^{3}He,d), (α,d)

that generally did not observed the 24.9γ, nor give relevant cross sections.

b) Most promising ^{58}Co IT decay dataset were considered:

1. ^{58}Ni(n,p)^{58}Co in n flux Φ=10^{14} n/cm^{2}s (1971Pl02)

- "spectroscopically pure" NiO activated for 24 h;
- ^{58m}Co was separated from NiO with anion-resin (Dowex-2, X-10, 200-400 mesh);
- Ni was washed out with 7N HCl solution => separation factor ~10^5
- The elude was dried and dissolved in *aqua destillata* from which it was electroplated on Pt foil
- 99.9% enriched (from 68%) ^{58}Ni (metal, oxide) is available from Isoflex, Trace

Texas A&M Nuclear Science Center reactor activation estimation

- NSC fast neutron: Φ(integrated) ~ 5.1x10^{10} n/cm^{2}s (…)
- EXFOR V0002009: $\sigma_{aver}(n,p,E_n)$=1.1-14 MeV=478 mb (should be divided in between m.s. and g.s…)
- 2 mg of ^{58}Ni activated for 1 h give about 1 μCi of ^{58}Co

$_{79}^{198m}Au$

$_{79}^{198m}Au$, Δ_K=5.0%, *α_K(exp)= , %unc= ;*

115.2 -keV M4, multiple IT γ , $T_{1/2}$=2.3 d,

α_K(FO)=185, α_K(NH)=176

***^{198m}Au* IT vs. g.s.**

811.715	**(12-)**	**2.272 d 16**	**IT**
0.0	**2-**	**2.6941 d 2**	**ß-: 100 %**

ONLY HPGe detector

ENSDF list of reactions to populate the IT state:

^{200}Hg(d,α) (1972Cu06), ^{197}Au(d,p) (1968Bo30,1973Pa08), ^{198}Hg(n,p) (1973Pa08),

^{196}Pt(α,pn)(1975Ma30),^{198}Pt(d,2n) (1975Ma30),

^{197}Au(n,γ) (1990Pi08).