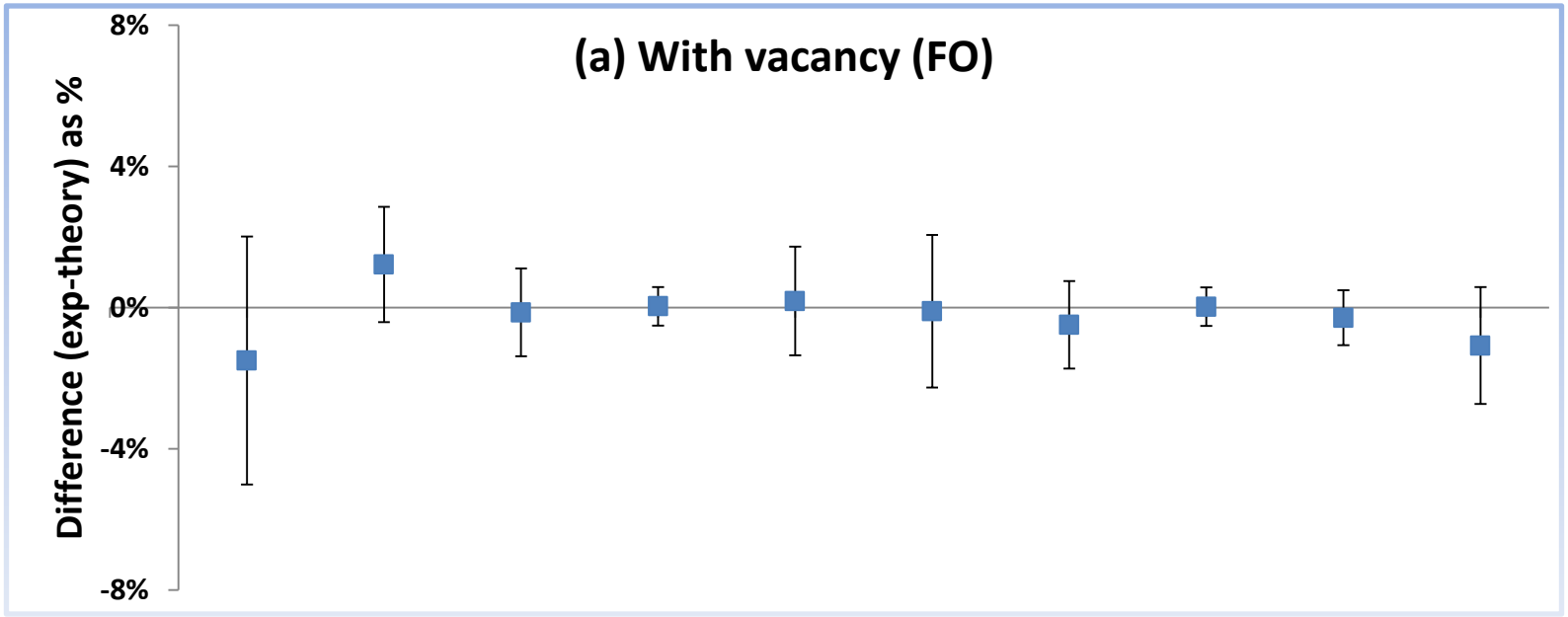
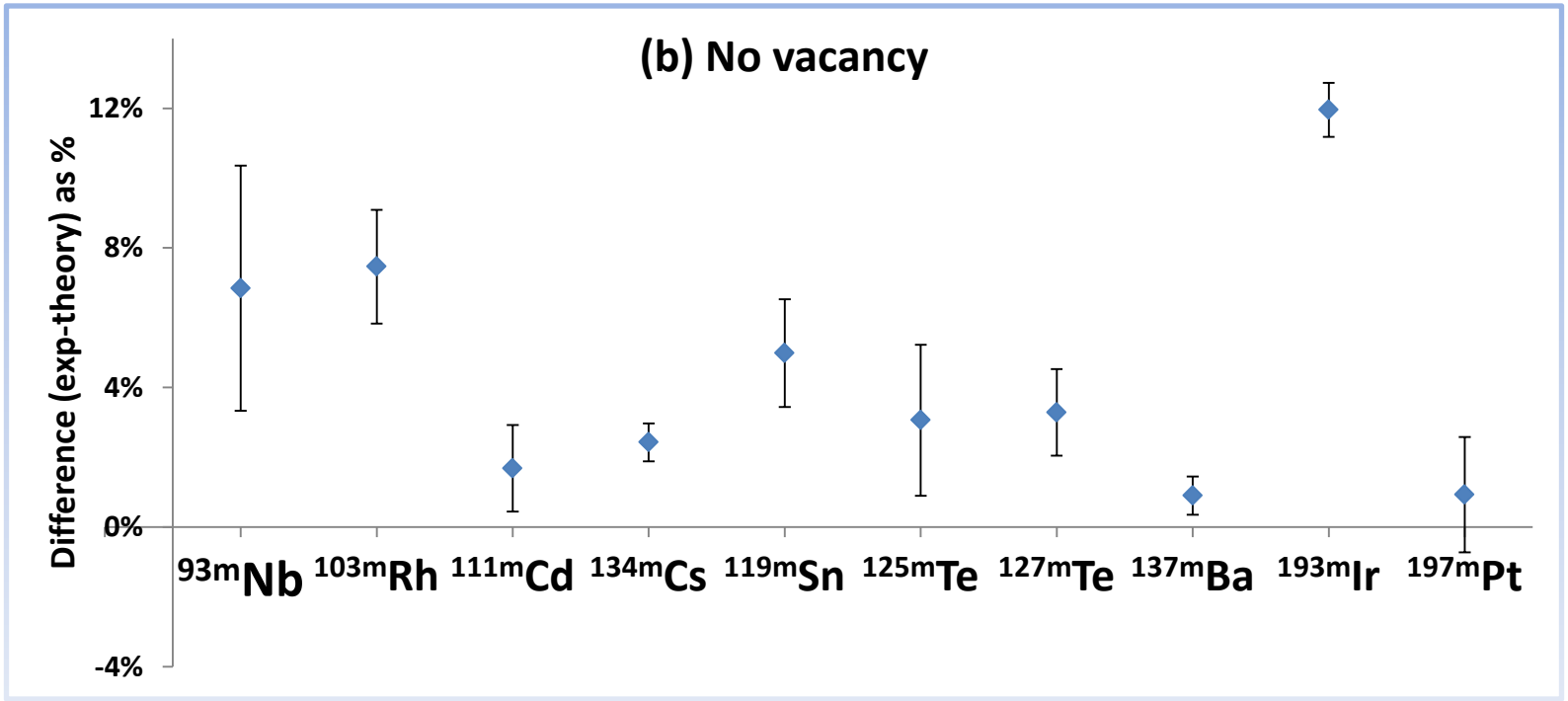
Texas A&M Evaluation Center
Precision Internal Conversion Coefficients Measurements Follow-up

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		Transition	Measured	No	"Frozen	SCF
	State	Multipolarity	Energy (keV)	α_K	vacancy	Orbitals"	
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%
-4%
93mNb
103mRh
111mCd
134mCs
119mSn
125mTe
127mTe
137mBa
193mIr
197mPt

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, (λ×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: σ_{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**

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

$^{198m}_{79}Au$, 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).