

# Calculation of Parity Non-conservation in Atomic Thallium

V. A. Dzuba, V. V. Flambaum

*University of New South Wales, Sydney,  
2052, Australia*

M. G. Kozlov, S. G. Porsev

*Petersburg Nuclear Physics Institute,  
188350, Gatchina, Russia*

## Magnetic Hyperfine Structure Constants for $^{205}\text{Tl}$ in MHz.

Method	$A_{6p_{1/2}}$	$A_{6p_{3/2}}$	$A_{7p_{1/2}}$	$A_{7p_{3/2}}$	$A_{7s}$
DF	17554	1302	1957	188	7824
CI	17883	-1	1956	343	11128
+ $\Sigma$ + Scr.	20481	-34	2134	323	11308
+RPA	21987	184	2283	191	12294
+Core Corr.	21493	79	2239	368	11873
+Val. Corr.	21557	-23	2253	351	11891
Exper.	21311	265	2155	309	12297

## E1 transition amplitudes in Tl (a.u.).

Transition	L-gauge	V-gauge	Experiment
$6p_{1/2} \rightarrow 7s$	1.77	1.72	1.82(5)
$6p_{3/2} \rightarrow 7s$	3.36	3.34	3.27(7)
$6p_{1/2} \rightarrow 6d_{3/2}$	2.31	2.32	2.30(9)
$6p_{3/2} \rightarrow 6d_{3/2}$	1.40	1.39	1.36(7)
$6p_{3/2} \rightarrow 6d_{5/2}$	4.08	4.09	
$7p_{1/2} \rightarrow 7s$	6.14	5.86	5.94(6)
$7p_{3/2} \rightarrow 7s$	8.28	7.93	7.90(8)

# E1<sub>pnc</sub> amplitude for 6p<sub>1/2</sub> → 6p<sub>3/2</sub> transition in Tl

Contribution	$\left( \times i e a_0 \frac{Q_W}{-N_{\text{nuc}}} \cdot 10^{-11} \right)$
CI with $\mathbf{H}_{\text{eff}}$ + RPA	-28.35
RPA <sub>sbt</sub> <sup>core</sup>	+1.16
RPA <sub>Σ</sub> <sup>core</sup>	+0.77
RPA <sub>scr</sub> <sup>core</sup>	-0.60
RPA <sub>sbt</sub> <sup>val</sup>	-0.25
RPA <sub>Σ</sub> <sup>val</sup>	
RPA <sub>scr</sub> <sup>val</sup>	+0.14
Norm (=0.991)	+0.24
Total	-26.9

**E1<sub>pnc</sub> amplitude for  
6p<sub>1/2</sub> → 6p<sub>3/2</sub> transition in Tl  
(× i e a<sub>0</sub>  $\frac{Q_W}{-N_{\text{nuc}}} \cdot 10^{-11}$ ).**

Novikov <i>et al</i> (1976)	-28.7 (20%)
Henley and Wilets (1976)	-36.6
Henley <i>et al</i> (1977)	-25.2
Neuffer and Commins (1977)	-36.0
Dzuba <i>et al</i> (1987)	-27.0 (3%)
Hartley <i>et al</i> (1990)	-26.2 (10%)
Hartley and Sandars (1990)	-31.6 (9%)
Liu <i>et al</i> (1996) <sup>1</sup>	-28.8 (6%)
This work (1997)	-26.9 (4%)

---

<sup>1</sup> unpublished

# Comparison with the experiment

## Theory

( Standard model value  $Q_W = -116.8$  assumed)

Novosibirsk      Dzuba *et al* (1987)      -15.1 (0.45)

Notre Dame<sup>1</sup>      Liu *et al* (1996)      -16.1 (1.0)

Gatchina      This work (1997)      -15.0 (0.6)

---

<sup>1</sup> unpublished

## Experiment

Oxford      Edwards *et al* (1995)      -15.68 (0.45)

Seattle      Vetter *et al* (1995)      -14.68 (0.17)