Searching for the Electric Dipole Moment of the Neutron

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1950 All theorists believed P.

1950 Purcell & Ramsey [PR. **78** 807]. Test needed for nucl.forcs.

1953 Beam Oak Ridge.

$d_n < 5 \times 10^{-20}$ e. cm.

1956 Lee & Yang suggest P failure in weak nucl. force.

Reference to our 1950 paper but summarize just our 1953 expt. I begin ^{60}Co expt with L.Roberts.

Oak Ridge delay. Wu&Ambler.

1957 Theorists assumed CP & T sym,
so $d_n = 0$.
But Ramsey and J.D Jackson, et. al. argued that T symmetry was an assumption to be tested and the search for an EDM was a good test.

1964 $d_n < 10^{-21}$ e cm Beam
Oak Ridge.

1964	Failure of CP in K^0_L so T
	sym fail if CPT conserved
1967	$d_n < 4x10^{-23}$ e cm. Beam Oak R
1973	Beam Grenoble $D_n < 4x10^{-24}$ e c
1984	$d_n < 3x10^{-25}$ e cm. Bottle expts.
	St Petersburg, Grenoble
1999	$d_n < 6.3x10^{-26}$ e cm St Peters, Gr
2006	$d_n < 3.0x10^{-26}$ e cm Grenoble [ge

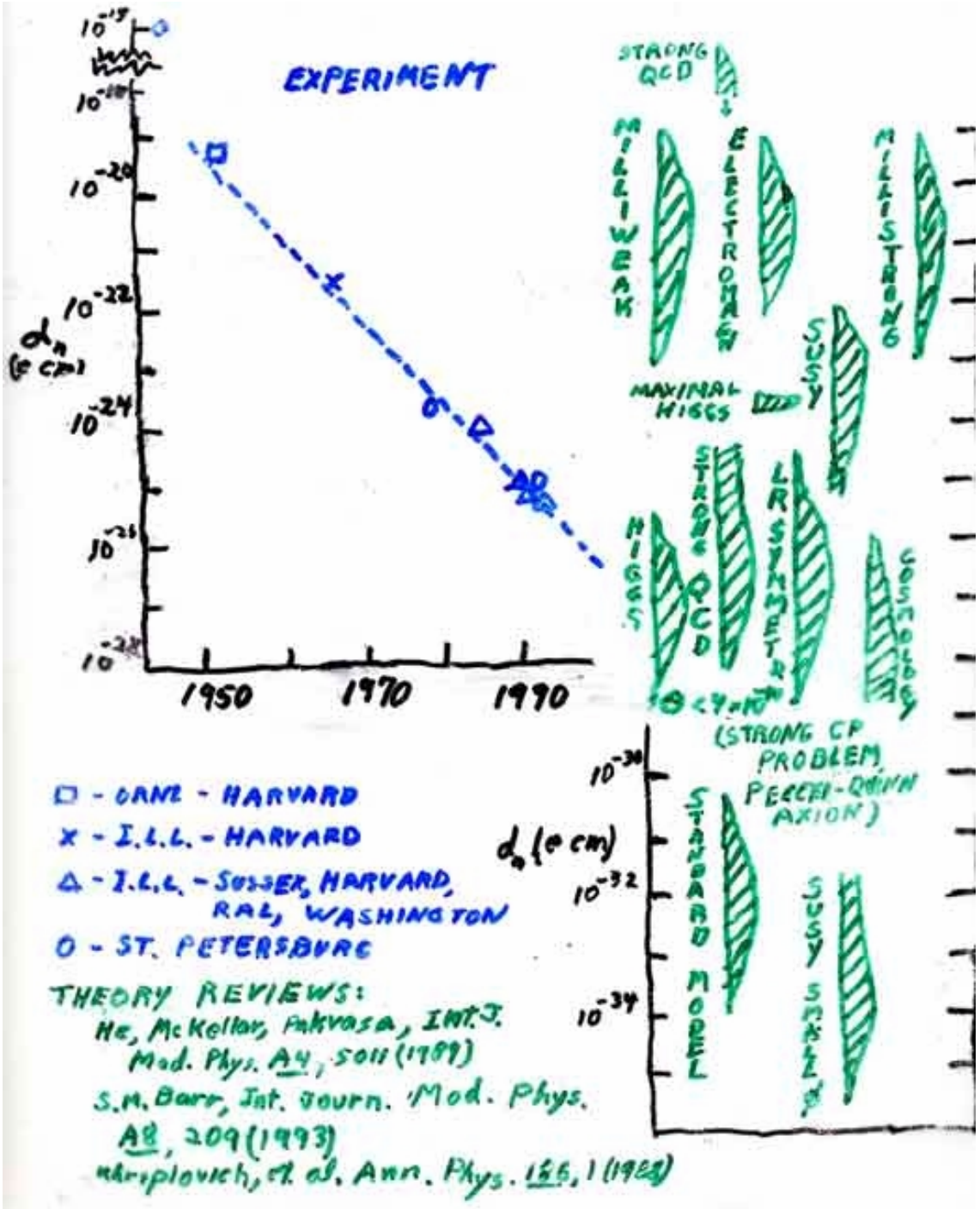
EXPERIMENT
10^{-18}
10^{-20}
10^{-22}
d_n (e cm)
10^{-24}
10^{-26}
1950
1970
1990
□ - ORNL - HARVARD
× - I.L.L. - HARVARD
△ - I.L.L. - SUSSEX, HARVARD, RAL, WASHINGTON
○ - ST. PETERSBURG
THEORY REVIEWS:
He, McKellar, Pakvasa, INT. J. Mod. Phys. A4, 5011 (1989)
S.M. Barr, Int. Journ. Mod. Phys. A8, 209 (1993)
Khriplovich, et al. Ann. Phys. 166, 1 (1985)
STRONG QCD
MILLIWEAK
ELECTROWEAK
MILLISTRONG
MAXIMAL HIGGS
SUSY
HIGGS
STRONG QCD
LR SYMMETRY
COSMOLOGY
$\theta < 10^{-9}$
(STRONG CP PROBLEM PECCEI-QUINN AXION)
10^{-30}
d_n (e cm)
10^{-32}
10^{-34}
STANDARD MODEL
SUSY SCALE

TABLE 1. Upper 90% Confidence Levels on Principal T Non-conserving Interaction Parameters.

The Parameters Are Defined in Khriplovich [Nucl. Phys. A449, 750 (1986) and Ann. Phys.186, 1 (1988)]. This Table Is Based in Part on Tables Prepared by Fortson and Barr. [Corrected 06-17-06 From C.L. Baker, et al Phys. Rev. Lett. (2006)].

System --> **Property (Units)**	**n**	**^{199}Hg**	**TlF**	**^{205}Tl**
d (x 10^{-26} e cm)	<3.0	<0.063	{d_p<16,000}	<23,000
		Hadronic Parameters:		
Q_S (x 10^{-11} e fm^3)		<1.6	<100	<23,000
η (x 10^{-6})		<1,200	<20,000	
η_q (x 10^{-6})	<13	<2.5		
$\bar{\theta}_{QCD}$ (x 10^{-6})	<1.3	<9.4	<60	<4,000
$\varepsilon_{q,susy}$ <1.3	<0.0014	<0.005	<0.08	
$\varepsilon_{e,susy}$			<0.012	<0.5
		Semileptonic Parameters:		
C_T(x 10^{-6})	<0.005	<0.5		
C_S (x 10^{-6})	<0.23	<20	<0.3	<20
		Leptonic Parameter:		
d_e		<4.4	<40	<0.3
System -->	**n**	**^{199}Hg**	**TlF**	**^{205}Tl**

FUTURE

Russian Experiments

Reactor n's in liquid ^{4}He at Grenoble

Spallation n's in liquid ^{4}He at Los Alamos

Other Experiments