Notes for Steve Adler's talk at the Larry Horwitz

92nd birthday conference, April 25, 2022

HISTORICAL

*Harari, Shupe 1979

*Horwitz & Biedenharn 1984

*Australia trip 1988: delta function potential, phase shift complex

rules out Peres test for QQM

Decided to write a book on QQM Oxford 1995

Anonymous reader: does QQM solve "measurement problem"

No –still linear

*!!!Larry Horwitz thoroughly read revised draft (and initial ones)

*No quaternion analog of canonical quantization led to idea of trace variational principle

δTrace[polynomial in operators] =0 using cyclic permutation under trace (antecedents Born & Jordan, Klein & co)

"Generalized Quantum Dynamics" later "Trace Dynamics"

1994 S.A. with Bhanot and Weckel: Jacobi identity

for generalized Poisson bracket

*Andrew Millard 1996: conservation of

$$\tilde{C} = \sum_B [q,p] - \sum_F \{q,p\}$$

recover QFT as thermodynamics

of averages in canonical ensemble

$< \tilde{C} >_{AV} = i_{eff}\hbar$ splits to $+i, -i$ sectors !!

*S.A. and Kempf 1998 $\tilde{C}$ is Noether charge

of global unitary invariance; need boson–fermion balance !!

*partition function uses Hamiltonian H: frame-dependent !!

*S.A. and Larry Horwitz –(I) Microcanonical ensemble derivation

of canonical ensemble

*Brownian motion corrections to averages

fluctuations important, connection to

GRWP, objective state vector reduction !!!

*S.A. and Larry Horwitz 1999 –(II) Completion of Lane Hughston

proof of Born Rule (projective Hilbert space)

simpler density matrix formulation

(alternative proof in GRP CSL paper)

*Problem connecting to Wightman axioms

Global unitary invariance - need "Global unitary fixing"

*S.A. and Larry Horwitz 2003– (III) detailed theory of global

unitary fixing in trace dynamics

*I decided to write a book 2004 CUP "Quantum Theory as an

Emergent Phenomenon"

*!!!Larry Horwitz read and critiqued entire mss

LINKS FROM BOOK TO RECENT WORK

*4 themes coming out of this book that motivated much of my recent work

(I) QFT an average, like thermodynamics.

Brownian fluctuations give objective state reduction

anti-Hermitian noise + normalization

+ no superluminal signaling implies CSL model,

Born Rule as a theorem

I wrote many papers (myself, with Bassi) on phenomenology and testing of CSL in many contexts

(II) Boson-fermion balance - weaker than SUSY. Attempts at SU(8) GUT with boson-fermion balance, with gauged spin 3/2.

Anomaly study for spin 3/2

(III) $+i, -i$ sectors Grav. Essay – could $-i$ sector be dark matter?

(IV) Frame dependence – need H (trace Hamitonian)

for canonical ensemble

frame dependence allowed, CMB picks a preferred frame

Including $g_{\mu\nu}$ metric in trace dynamics of massless

pre-quantum fields suggests $S(g_{\mu\nu})$ is Weyl scaling invariant

$S_{\text{dark energy}} \propto \int dV_{\text{inv}}/g_{00}^2$

Implications for:

Cosmology – new kinematics, Hubble tension?

Black holes – no event horizon, no apparent horizon: Leaky??

Lensing – correction to "lens equation"

Ongoing work

CONGRATULATIONS TO LARRY ON LONG,

VERY PRODUCTIVE CAREER