Axioms of Quantum Semiotic

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The sign relation

1. The quantum mechanical state vector is a *sign*.
2. A *sign* or *representamen* (R), according to Peirce, is a *first* standing in such a genuine triadic relation to a *second*, called its *object* (O), as to be capable of determining a *third*, called its *interpretant* (I), to assume the same triadic relation to its object in which it stands itself to the same object.(note 1)
3. The representamen R in a quantum semiotic sign relation *mediates* between the quantum mechanical object O and the interpretant I:
I-R-O
4. The interpretant I is a potential, actual, or general purely physical result of measurement.
5. The *sign links* (-), in the dyadic parts R-O and I-R of the sign relation are *interaction bonds* corresponding to the physical processes of *preparation* (the R-O link) and *registration* (the I-R link).
6. Each sign link is characterized by the Peircean categories as either 1: *potential*, 2: *actual*, or 3: *general*.
7. The category numbers, f and g, of the R-O link and the I-R link are restricted by the selection rule: $g \leq f$.
8. The *qualisign* 11 ($g = f = 1$) is the continuum of the *Hilbert space* $\boldsymbol{H}$. The *symbol* ($g = f = 3$) is *synthesized* from the lower signs by successive *actualizations* of *potential* links ($1 \rightarrow 2$) and *generalizations* of *actual* links ($2 \rightarrow 3$).
9. The six classes of signs (gf) are connected with Peirce's semiotic definitions and Dirac's bra-ket notation in the following way

(33)
symbol
$\langle q|p \rangle$

(13)
iconic legisign
$|p\rangle$

(23)
indexical legisign
$\langle\, |p\rangle$

(11)
qualisign
$\boldsymbol{H}$

(12)
iconic sign
$|\,\rangle$

(22)
indexical sinsign
$\langle\, |\,\rangle$

The measurement process

10. A *measurement* is a permanent *registration*. The physical setting of an interpretant (the I-R link) preceding the registration is an *irreversible* process.

11. Registration is a *dissipative* and *noisy* process.

12. For a dissipative admittance $Y(\omega)$ the quantum noise on the current, whose spectrum is given by the fluctuation- dissipation (FD) theorem (note 2) corresponds to a time-series of *discrete events*

$$f(t) = \sum_i \eta_i \delta(t - t_i) \ , \ \eta_i = \pm 1$$

13. For a dissipative device with mobility μ and relaxation time τ the average number of events up to time *t* following an event at time 0 at zero temperature according to the FD theorem is given by

$$N(t) = \frac{2\hbar\mu}{\pi} \int_0^\infty \frac{1 - \cos(ut/\tau)}{u(1+u^2)} du \approx \frac{2\hbar\mu}{\pi} \ln \frac{t}{\tau} \quad \text{for } t \gg \tau$$

14. The *collapse* or *reduction* of the state vector requires the setting of a dissipative sign link corresponding to the appropriate ray of $\boldsymbol{H}$ *before* the measurement. The projection on the ray is the first of the quantum events predicted by the FD theorem. (note 3)

15. The collapse of a state vector for more than one particle requires *prospective* coincidence counting.

16. The violation of Bell's inequalities and other *superclassical* correlations is due to a common context of detection of several particles represented by *preset coincidence counters*.

17. Quantum Mechanics is *strictly local* and all the so called "non-local" effects can be simulated in a purely classical and local scenario provided there is a common context for the registration of individuals. (note 4)

Notes:

1. *Collected Papers*, ed. Hartshorne & Weiss, *CP* 2.274.
2. H. B. Callen and T. A. Welton, *Phys. Rev.*, **83**, 34 (1951).
3. P. V. Christiansen, *The Semiotics of Quantum-Non- Locality*, IMFUFA text no. 93 (1985).
4. See my paper "Peircean local realism does not imply Bell's inequalities", Joensuu 1990.

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