Quantum Information Flux

by Sven Nilsen, 2020

In this paper I conjecture that the flux of quantum information is related to partial observations.

In discussions with Adam Nemecek, we talked about the measurement problem and how quantum propagation might be used as a model to tease out the correct behavior of quantum measurements. Quantum propagation is a technique of approximating the statistical probabilities of measurements, where complex probability amplitudes are summed by random basis vectors in the expanded product `$\psi\psi^*$` of `$\psi$`. Over time, these complex probability amplitudes converges to real probabilities.

I assume that at an instant, there is no way to extract more bits of information from an experiment than the bits that make up the experiment itself (see paper “Instant Quantum Partial Observations”).

$g \cdot f$	`g` is a partial observation of a semi quantum function `f`
$f : () \to \mathbb{B}^n$	`f` generates bits of information
$\lvert\exists_{pc}f\rvert \Longleftrightarrow \exists_p f$	`f` is semi quantum (all amplitudes of same length)
$\exists_{pc}f \Longleftrightarrow \psi$	The complex probabilistic path of `f` is the wave function
$g : \mathbb{B}^n \to \mathbb{B}^m$	$m < n$ `g` removes some information

$(x_0x_2^*, x_2x_3^*) : \mathbb{C} \times \mathbb{C}$	Sampling of propagated basis vectors
$g(0) = g(2) \quad g(1) = g(3) \quad g(0) < g(2)$	Constraints for an instant quantum measurement
$[0, 1, 2, 3] : ?\mathbb{N}$	Higher order non-deterministic natural numbers

This is because in the computational complexity class of such observations, the oracle “erases” the information about the semi quantum wave function, by taking every path with equal probability, such that the number of bits extracted, equals the number of bits from the output of the partial observation.

Furthermore, I assume that for measurements over time, it is not possible to extract more bits than the bits of partial observations times sum of instant moments (measured in Planck time units):

$d I \cdot dt = k \cdot \log_2(\lvert\exists g\rvert) \cdot t_p$ Where `k` is some constant

dI = Change of information (quantum information flux)
dt = Change in time
t_p = Planck time
$\exists g$ = Existential path of partial observation `g` (codomain predicate function)

Written in integral form, one can relate total quantum information with partial observations in the past:

$$I = \int dI\ dt = k \cdot t_p \cdot \sum i\ \{ \log_2(\lvert\exists g_i\rvert) \}$$