A quantum resolution of the author-ordering dichotomy

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[1] *The Donald Knuth Center for research into social engineering through TEX*
[2] *Upside down, floating over Paris, with a cockerel and a donkey for company*
[3] *The Village Vanguard, New York*
[4] *Cloud Nine*

We investigate and give a complete solution to the problem of precedence in scientific pubication, in a way that Don Knuth would surely approve of.

The starting point of this work is the well-known fundamental axiom of scientific publication, sometimes referred to as the "Gutenberg postulate":

Axiom 1 (Gutenberg)**.** *Due to the linear nature of written text, every scientific publication necessarily defines an unfair ordering of co-authors.*

("Unfair" is of course meant in the technical, measure-theoretic sense.)

In mathematics, the threshold for co-authorship is set fairly high. Indeed, it is unusual for a mathematician to be included as a co-author unless they have ruined at least one marriage and forgotten the names of a minimum of two of their children whilst working on the problem. Thus all co-authors on a mathematics paper will typically have made substantial contributions. The usual etiquette is therefore to list co-authors in alphabetical order. This convention serves two purposes. Firstly, it signals that no order of precedence of co-authors is implied. More importantly, it hides who was originally responsible for posing the research problem, which helps in the divorce proceedings.

In physics, the threshold for co-authorship is set substantially lower. Indeed, it is generally considered good practice for at least 30% of a paper's authors to have no idea why they are on the paper. (Most journals insist on this in their submission policy.) Common strategies for fulfilling this requirement include: (i) adding anyone who happened to be in the bar at the same time as the co-author responsible for uploading to the arXiv pre-print server; (ii) adding any colleague who pointed out that 2×3 is not 5; (iii) adding either Peter Shor and/or Ignacio Cirac as a co-author (depending on topic and journal). The usual etiquette is therefore to order co-authors according to a subjective evaluation of the magnitude of their contribution, factoring in who rewrote the paper to compress it into 4 pages, and who's the boss.

In theoretical computer science, the co-authorship threshold is effectively set somewhere in between that of mathematics and physics. "Effectively", becase standard practice is to run a complex Lisp AI algorithm, [1] which computes the co-author ordering that maximises the probability of STOC or FOCS acceptance. [2]

The above observations lead to our key lemma:

Lemma 2 (Quantum Information ordering dichotomy)**.** *The author ordering problem in quantum information theory has two stable solutions: (a) all quantum information theorists change their name to "!"; (b) all quantum information theorists appear on all quantum information papers. [3]*

Proof. Quantum information straddles all the three fields of mathematics, physics and computer science. A novel application of the Cook-Levin theorem to Axiom 1 shows that the ordering conventions of the three fields cannot be satisfied simultaneously. The dichotomy then follows from an extension of Nash's theorem. (See Ref. [4] for technical details.) □

Although we have given a fully rigorous proof of this Lemma, it is also worth noting that there is also ample empirical evidence to support it. In the interests of brevity, we merely point out here that: (a) credible sources inform us that Scott Aaronson's surname did not originally contain that many "a"s; (b) the reader is invited look at page 1 of a high-energy physics paper.

Our main theorem is a striking solution to the QI ordering dichotomy of Lemma 2:

Theorem 3. *Axiom 1 does not apply to quantum mechanics, thus Lemma 2 is not valid for publications that harness quantum effects.*

Proof. This follows from a simple application of Gödel's theorem, together with the Riemann hypothesis (whose straightforward proof we omit here for clarity) and the obvious use of modular forms over the monster group. □

LaTeX source code implementing a quantum algorithm for solving the author ordering problem is available from www.dr-qubit.org. It requires the `lcg` package to be installed, which is available from CTAN.

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[1] Nowadays, Haskell is also increasingly accepted.

[2] This is in fact the reason that publications in computer science appear all at once in annual conferences, instead of spread out over the course of the year in journals, as in other fields. The author-ordering problem is NEXP-complete, and current algorithms have a typical run-time of 6 months. The program is therefore run only twice per year from a cron script, immediately after each STOC and FOCS. It is run as a batch job which automatically inputs all draft papers it finds on the hard discs of researchers affiliated to approved computer science departments. This also accounts for the average quality of STOC and FOCS papers.

[3] Note that "!" is the first printable character in the ASCII collation sequence, other than ␣. The latter is ruled out by the invisibility axiom: no researcher wants to be. (Some authors cite Kitaev as a counterexample, due to his strong reluctance to write up and appear as author on results that anyone else would give their eye teeth to prove. The generally accepted view, however, is that the invisibility axiom implies non-existence of Kitaev.).

[4] Long version; to appear upon heat death of the universe.