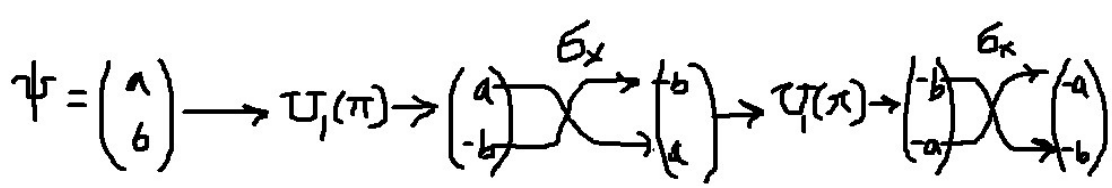
## An Open Problem

I realised that it might be possible to simulate a bispinor field at up to $n$ points using $2n$ qubits, by taking the components of one qubit (say $\psi_1 = \begin{pmatrix}\psi_{10}\\ \psi_{11}\end{pmatrix}$) as the first (e.g. electron) spinor, and the second (say $\psi_2 = \begin{pmatrix}\psi_{20}\\ \psi_{21}\end{pmatrix}$) for the other ( e.g. positron). As you can see, we can simulate the operation of the gamma matrices on the bispinor in the following way. The way in which to allow an operator of the form

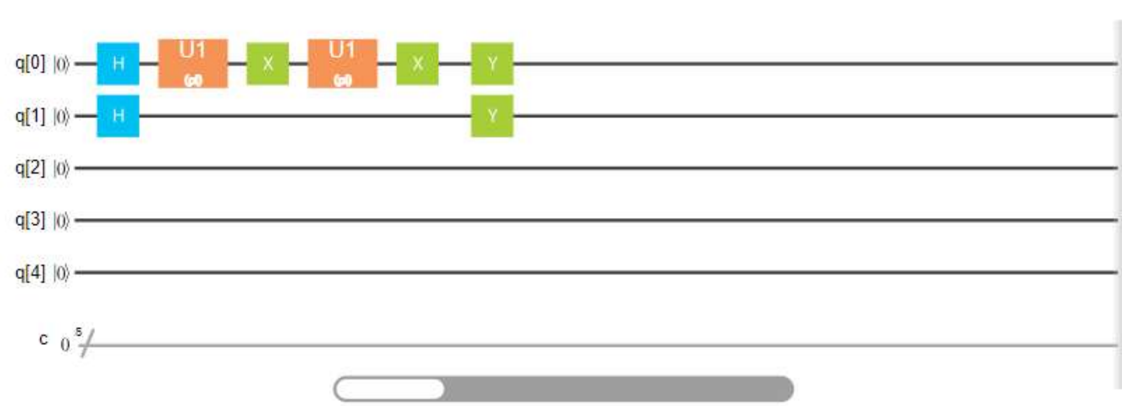
$$\begin{pmatrix} A & 0 \\ 0 & -A \end{pmatrix}$$

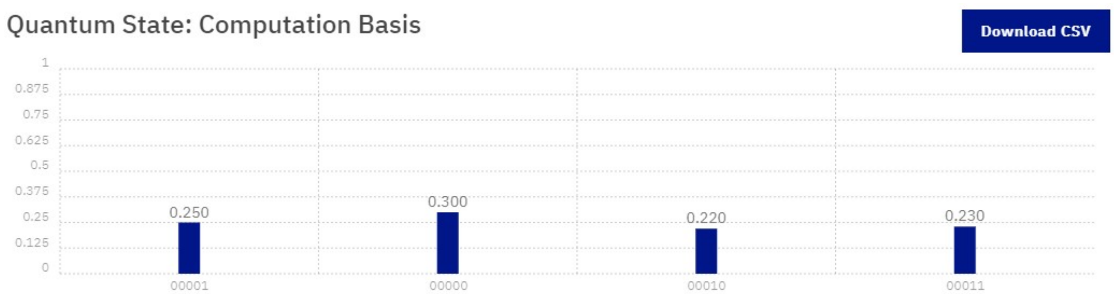
or a transpose of this, where $A$ is a 2×2 matrix, is to *flip* the signs of both components of the qubits and operate on that qubit with $A$.

The way to flip the sign could be:




So, for letting $\gamma_2$ operate, we do:






As you can see, the problem jumps out- the norm of each (sub-) spinor is ‘1’.

So, this leads us to the open problem:

Is there some way to entangle $q_i$ and some other qubits, so that $2n$ qubits can satisfy

$$\sum_{i=1}^{n} |\psi_i|^2 - |\psi_{i+n}|^2 = 1$$

so as to enable a discrete version of

$$\int \bar{\psi}\gamma_0\psi \; dV = 1$$

as is required?