

A10.1 Each branch is a separate, isolated universe.

We will show that if the state vector has more than one branch, **each branch evolves in time just as if the other branches were not there**. Thus the branches are totally isolated from each other so they effectively correspond to separate universes. There can be no information passed from one branch (version of reality) to another.

We use a spin $\frac{1}{2}$ Stern-Gerlach experiment ([A6.1](#)) to illustrate. After the magnet but before detection, at time 0, the state of the system consisting of the spin $\frac{1}{2}$ particle, the detectors on the + and - paths, and the observer is

$$\begin{aligned}
 |\Psi, 0\rangle &= a(1)|+\rangle|D+, no\rangle|D-, no\rangle|Obs \text{ sees } no, no\rangle + \\
 &\quad a(2)|-\rangle|D+, no\rangle|D-, no\rangle|Obs \text{ sees } no, no\rangle \\
 &= a(1)|\text{version 1 of reality}\rangle + \\
 &\quad a(2)|\text{version 2 of reality}\rangle
 \end{aligned} \tag{1}$$

where $a(1)$ and $a(2)$ are coefficients. The linear time translation operator, $U(t)$, then takes the system to time t . The property of linearity implies

$$\begin{aligned}
 |\Psi, t\rangle &= U(t)|\Psi, 0\rangle = a(1)U(t)[|\text{version 1 of reality}\rangle] + \\
 &\quad a(2)U(t)[|\text{version 2 of reality}\rangle]
 \end{aligned} \tag{2}$$

But each linear operator on the RHS acts only on the contents of the square bracket in front of it. That means $U(t)[|\text{version 1 of reality}\rangle]$ is independent of $a(1)$ and $a(2)$ (and $|\text{version 2 of reality}\rangle$). Hence one can calculate $U(t)[|\text{version 1 of reality}\rangle]$ when $a(1)=1$, $a(2)=0$ and one will get *the same answer* when $a(2)$ is different from 0. But when $a(2)=0$, there is surely no interaction at all between the two branches (because the second branch is not there!).

The conclusion is that each branch is totally isolated from all other branches; each branch evolves in time as if the other branch were not there. So for example, if a photon is given off by a detector in version 2, that photon can never be perceived by the version of the observer in version 1 of reality. No signal or information can be passed between the two versions. Each branch effectively constitutes a separate, isolated universe.