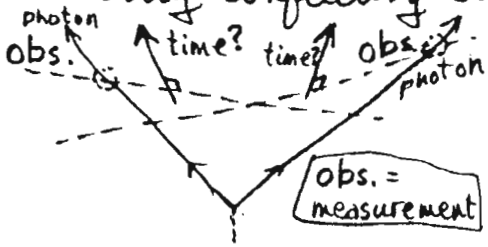
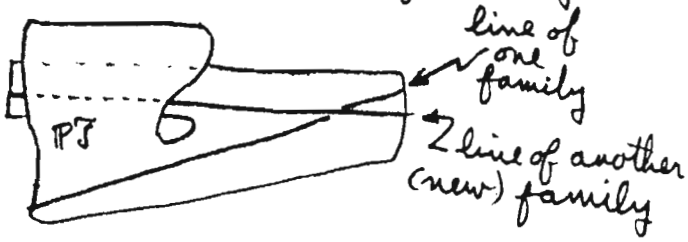
Twistors and State-Vector Reduction

One of the most puzzling features of the procedure of the "reduction of the state vector" in quantum theory is that there seems to be no particular "moment" at which it happens. Yet, in the real world of our experience, such discontinuous changes in the quantum-mechanical description of the world have to be considered to take place, generally, between two measurements. One might have thought that any such violently discontinuous change in the state of the world — if it were a real effect — ought to be more noticable, as to when it actually takes place! Also, since the Schrödinger equation is such a nice smooth analytic thing, it seems odd that Nature should choose to execute such violent discontinuous jumps from time to time. Perhaps most baffling is the non-local and seeming relativity-conflicting behaviour in E.P.R.-type (Clauser-Aspect) experiments. Spacelike-separated measurements take place. There is a conflict between the apparent time-ordering of the "reductions" due to these two measurements. "When" do these reductions "actually" take place?



It is conceivable that a twistor-type viewpoint could provide some sort of resolution of this puzzle. Suppose that reduction is a gravitational effect (cf. R.P., TN19) and that the space-time is described twistorially. Of course we need to have solved the problem of representing general space-times, not merely anti-self-dual ones, for this to work (beyond the googly!) and it may well be that space-time points are not simply "lines" in twistor space. But for the sake of descriptiveness (only), let's take lines. Now suppose that, with some measurement, the twistor space $\mathbb{PT}$ becomes sufficiently "curved" that the original family of holomorphic lines, representing space-time points, peters out — and we must switch to a new family of such lines in order to keep going. Somehow the geometry of space-time seems to jump — yet in the "actuality" of the twistor space there is no jump — just a (necessary) shift in viewpoint. Anyway, it's a thought!



~ Roger Penrose