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1 Introduction

A common experience is that time flows in only one direction. It is suggested in this note that there is a deep lying chiral asymmetry in the universe, which may be responsible for the flow of time: specifically the future null cones of spacetime events are are to be understood to have the opposite chirality to the past null cones. Concretely this is expressed in the language of twistor theory [1-11]. Twistors come in two mutually dual types, each inherently chiral, of opposite chirality. If twistors are used to describe future null cones, then dual twistors will be used to describe past null cones (or vice-versa).

2 Ghosts

Twistors typically form complex analytic spaces of either three or four complex dimensions, the former usually being a projective version of the latter. For the purposes of this note it will suffice to consider only the three-dimensional case.

A ghost is by definition a complex analytic variety of three complex dimensions, containing exactly two disjoint holomorphic compact Riemann spheres. It is suggested that in a non-flat vacuum asymptotically flat space-time, the null cone hypersurface twistor spaces of Penrose, for either a future, or past null cone, are ghosts. One of the holomorphic spheres of the ghost represents the vertex of the cone. The other represents the vertex of the null cone at infinity. The fact that that it is even conceivably possible to have such ghosts requires overcoming the Kodaira theorems that in perturbations of conformally flat spacetimes tend to provide an overabundance of holomorphic curves. The key lies in the famous null geodesic deviation equations of Sachs, which show, in particular, that in the presence of Weyl curvature, that there is decoherence of pencils of light rays along a null cone, vis a' vis the situation in conformally flat or conformally self-dual spacetime. In terms of the Cauchy-Riemann structure of null hypersurface twistor space, this decoherence is associated with the degeneration of the structure along the light rays of the cone. These features, which might be regarded as pathological from the point of view of flat or self-dual space-time, allow the twistor spaces for null hypersurfaces or real spacetimes to be depleted of their usual supply of holomorphic curves.

When the ghost space of a future null cone meets that of a past null cone, one finds on the overlap that there is a natural correspondence between the twistor curves of one hypersurface and the *dual* twistor curves of the other surface. This correspondence yields the chirality and the time asymmetry: twistor spaces are used for each future cone and dual twistor spaces for each past cone; we may then consistently term the future-pointing spaces ghosts and the past-pointing anti-ghosts.

The mathematical source for ghost and anti-ghost spaces is the genre of (open subvarieties of) Calabi-Yau manifolds. When ghosts and anti-ghosts meet, we have apparently the situation envisaged in the theory of mirror manifolds and the associated conjectures of Yau. Then the act of passing to a mirror corresponds to interchanging past and future. Slight discrepancies in the relative structures of these spaces relative to their mirrors account for the differnce between past and future.

The ideas sketched here are a natural consequence of the author's proposed unification of a triad of powerful theories: twistor theory, superstring theory and the theory of "dessins d'enfants" of Grothendieck, based on their common theme of quasi-conformal analysis. The realization of such a unification has been a long-standing objective of the author. The possibility of the unification discussed here results from an astounding numerical coincidence: that ten dimensions, the usual dimension of the arena of superstring theory, is the sum of four, the dimension of space-time and six, that of projective twistor space.

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