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ARE PROTARS SPINARS?

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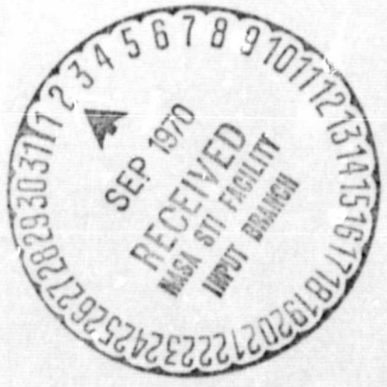

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It is suggested that primordial inhomogeneities in the "big-bang" universe resulted in massive spinning objects possessing magnetic fields (spinars) and that these objects produced copious amounts of cosmic-rays at a redshift of 70-100, resulting in an observable gamma-ray flux.

Morrison (1969) has recently suggested that quasi-stellar radio sources and pulsars are basically similar phenomena, being analogues in every respect except that of scale. He has characterized both types of objects as centrally condensed magnetized spinning masses whose luminous lifetime is governed by the rotational work done on charged particles by their moving magnetic fields. In the spirit of this hypothesis, Morrison (private communication) has suggested that the name "spinar" by applied to objects such as QSO's, pulsars, and possibly other highly condensed core objects such as may exist in the nuclei of Seyfert galaxies and active extragalactic radio sources.

The purpose of this letter is to point out a possible connection between the hypothesis of Morrison and those of Harrison (1970), Gunn

and Ostriker (1969), and myself (Stecker, 1969), which may be of future significance.

Harrison (1968) has argued that galaxies cannot condense out of an initially homogeneous big-bang universe. The existence of galaxies apparently requires the existence of inhomogeneities imprinted on the metric from a time

$$t^* = (G\hbar/2c^5)^{\frac{1}{2}} \simeq 4 \times 10^{-44} \text{ s} \qquad (1)$$

(Harrison, 1967).

Harrison (1970) therefore suggests that even during its earliest stages, the universe is structured with protogalactic configurations that are relatively dense and possess spins. He argues that these "spinning cores" may have accounted for the origin of present galactic magnetic fields. They would thus fit the Morrison definition of spinars.

Gunn and Ostriker (1969) have shown that such "spinars" may be capable of accelerating cosmic-ray protons to energies of the order of

$$E_{max} \sim \left[\frac{e^2}{Gm_p^2}\right]^{\frac{1}{3}} m_p \qquad (2)$$

or $\sim 10^{21}$ eV. The cosmic-rays themselves, if produced at high redshifts would be unobservable, but secondary γ-rays produced by interactions of these cosmic-rays would be observable out to redshifts of ~ 100.

Indeed, it now appears that such γ-rays, originating at a redshift ~ 70-100 may have already been observed by Vette et al. (1970). Such a suggestion of primordial cosmic-ray sources or "protars", based on the γ-ray evidence, has recently been made (Stecker, 1969).

If we tentatively identify protars to be the spinars of an early epoch in the history of the universe, we arrive at a qualitative outline of a cosmology consistent with and suggestive of primordial inhomogeneities. It is suggested here that such a picture deserves further study.

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