Time Resolved Photometry in Two Pulsed Radio Source Fields

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A search for optical pulsations from two of the pulsating radio sources has been made, with negative results.

FOUR pulsed radio sources have so far been discovered[1]. All of them have short duration pulses and periods between 0·25 and 1·34 s.

Soon after the announcement of the discovery of the first source (*CP* 1919), Ryle and Bailey[2] suggested that this source could be identified with an 18^m blue star. In an attempt to confirm the identification, Duthie *et al.*[3] tried to observe optical pulsations of the source. Their detection technique is potentially capable of detecting light pulsations of $0{\cdot}1^m$ in a mode similar to the radio observations. The result was negative. A similar conclusion was reached by Bingham[4].

Bailey and Mackay[5] have searched the Palomar Sky Survey at the position of the source *CP* 0950; they could only find a very faint red object within the position error rectangle. *CP* 1919 has tentatively been identified with a faint blue object, so it seems likely that at least one of these identifications is incorrect.

The positions of the other two sources, *CP* 0834 and *CP* 1133, are considerably less certain[6]. Although the attempts to find optical pulsations of the source *CP* 1919 had negative results, we have tried to find within the position error rectangle objects with light variations in a mode similar to the observed radio pulsations.

Our detection technique is based on photographs of the fields taken with the 24 in. telescope of the Kapteyn Observatory. This telescope has been equipped at the Cassegrain focus with a camera attachment consisting of a large field lens and a 35 mm camera. The system becomes effectively a 24 in. $F/3{\cdot}3$ telescope, capable of photographing 18^m stars on Kodak 'Tri-*X*' film in 5 min. The unvignetted field is approximately 15′ of arc diameter. In order to obtain time resolved photometry over the entire field the camera was rocked at the published radio pulse frequency by a rotating eccentric wheel driven by a synchronous motor. As a result, "normal" star images are trailed; the objects which we searched for should have shown up as circular images. Several exposures were made to cover the entire position error rectangles.

No optical pulsations were detected. If there were stars within the position error rectangle brighter than seventeenth photographic magnitude and showing pulsations of the off–on type (with the on-portion shorter than 30 per cent of the period), they would have been found.

This means that either the optical counterparts of the radio sources must be fainter than seventeenth photographic magnitude, or that they do not show light pulsations of the same frequency as the radio objects, in which case they may have any brightness. The search for optical identifications in the cases of *CP* 1919 and *CP* 0950, however, indicates that the optical counterparts cannot be brighter than eighteenth and twentieth photographic magnitude, respectively.

Combined with the information that *CP* 0834 and *CP* 1133 are within a distance of 100 pc, we must conclude that their brightness does not exceed twelfth absolute photographic magnitude; probably they are considerably fainter.

The possible optical counterparts of *CP* 1919 and *CP* 0950 must be fainter than thirteenth and fifteenth absolute photographic magnitude, respectively. If the tentative identifications[2,5] with a blue and red star turn out to be correct, the optical counterparts fall in the class of the faintest known white dwarfs.

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Radial Oscillation Periods for Hamada–Salpeter Models of White Dwarfs

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Calculations of the oscillation periods for white dwarf models show that, until instability is reached, the period depends very little on the composition or the equation of state

RADIAL pulsations of white dwarfs may be responsible for the radio pulses discovered by Hewish *et al.*[1], and so quantitative computations of the oscillation periods have become important to observational astronomers. The calculations of Meltzer and Thorne[2] are based on the Harrison–Wheeler–Wakano equation of state, which describes cold matter continuously catalysed to the composition of lowest free energy. As these authors point out, nuclear thermodynamic equilibrium is unlikely to be reached in real white dwarfs; real white dwarfs are probably better described by the Hamada–Salpeter[3] models, which may be made of various elements such as helium, carbon and iron. The Hamada–Salpeter models also use an equation of state due to Salpeter[4], which takes into account various forces between the particles of the degenerate matter.