A Ritzian Interpretation of Variable Stars

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Abstract. A revived version of de Sitter's 1913 "binary stars" argument against Ritz's Galilean relativity general electrodynamic theory provides a means of explaining of the mechanism underlying the *apparent* variability of variable stars, pulsars, and gamma-ray bursters. Numerical code to compute $c + v$ induced intensity peaks and *blueshift chirps* for spectroscopic binaries provides graphical displays for comparison with observed light curves and spectra for different classes of variable stars.

INTRODUCTION

In 1908 Walter Ritz formulated an emission theory of general electrodynamics [1] in which the velocity of a light source is added to the velocity of the light emitted by it, i.e., the the velocity of light is $c+v$. In 1913 Willem de Sitter urged abandonment of Ritz's theory because visual binary stars failed to show its predicted $c+v$ effects [2]. His argument was along the following lines.

The addition of the source velocity of a visible component of a binary star to the velocity of its light emitted in the direction of an observer would allow slower light $c - v$ from one side of the orbit (when the component was traveling away from the observer) to be overtaken by the faster light $c + v$ from one half orbit later (when the component was traveling toward the observer). At a sufficient distance this effect could cause the visible component to periodically seem to be at two different locations simultaneously and generally would lead to observational departures from Keplerian motion.

These effects were not observed and Ritz's ideas on electrodynamic theory were largely laid to rest. (Ritz died in 1909 at age 31 and wasn't around to defend or modify his theory.) What follows represents recent re-examinations of the matter.

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1) The author works for the U.S. Air Force which does not endorse the views expressed herein.

DERIVATION OF DE SITTER'S OVERTAKING DISTANCE EQUATION

The expression to compute the de Sitter overtaking distance is derived as follows. (Circular binary orbits are assumed.)

Let the time interval $t1$, required for the slower light (visible component receding) to reach the observer at distance L, be

$$t1 = \frac{L}{c - v}. \tag{1}$$

and time interval $t2$ which is the sum of the time for one half orbit T plus the time for the faster light (component approaching) to travel the same distance L:

$$t2 = T + \frac{L}{c + v}. \tag{2}$$

For $t1 = t2$ we have:

$$\frac{L}{c - v} = T + \frac{L}{c + v}. \tag{3}$$

Solving for L we get:

$$L = T\frac{c^2 - v^2}{2v}. \tag{4}$$

For $v << c$ we can use

$$L = T\frac{c^2}{2v}. \tag{5}$$

RECENT RECONSIDERATIONS

Contrary to de Sitter's claim and to other arguments advanced more recently, John Fox [3] found that visible binary stars do *not* offer evidence against the Ritz theory. He takes this stand on the basis of Tolman's extinction theorem [4], i.e., the absorption and re-radiation of electromagnetic radiation by electrical charges in dispersive media. (The re-radiated light travels at c with respect to the medium.) The Oswald-Oseen extinction theorem is another version of this idea. One extinction length (an exponential process) in the interstellar medium is estimated to be on the order of one light year.

In 1987 Vladimir Sekerin [5] showed that when we consider the distances (binary to observer) required for de Sitter's "whimsical" images to manifest themselves that the atmosphere limited angular resolution (one arc second) of our best ground based telescopes were insufficient for us to resolve them. (This was before the advent of the Hubble Space Telescope and the growing family of Very Large Telescopes.)

Sekerin hypothesized that de Sitter's binary star scenario might provide an alternate explanation for the light and apparent radial velocity time histories of periodically varying stars. Instead of seeing a visible component at two locations simultaneously (because the images can't be resolved) we would get periodic variations in its light intensity and spectral signature.

MODELING THE PROCESS

Computer generated CRT photographs, furnished by Sekerin's colleague, M.S. Serbulenko, show light curves and radial velocity curves computed in accordance with Sekerin's hypothesis. The curves are for a binary system with one visible component. Sekerin was pursuing a mechanism to explain the characteristics of Cepheids but there is a problem. For Cepheids, the peak (maximum brightness) of the light curve is nearly coincident with the peak (approaching) *apparent* radial velocity curve. In Sekerin's modeling the radial velocity peak lags the light curve brightness peak by 90 degrees.

New numerical code was created to check Sekerin's hypothesis. The code models a binary system and remote observer. At selected positions in the orbit of one (or both) of the components, the distance from the component to the observer is "measured." The computed source-to-observer travel times, from these points, are added to the emission times to get arrival times, at the observer, which are then *scaled* in arrival time bins. The accumulating sums in these bins are displayed on a CRT time base. Doppler shifts for each "emission point" are used to create accompanying radial velocity curves. The new code also produced the 90 degree phase error.

Since the radial velocity curves in both computer models do not match observational data some other physical mechanism besides Doppler is needed in the modeling to bring the computed curves into some semblance of actual observations. The failure of this quest would constitute falsification of Sekerin's hypothesis.

Since Ritz's work mainly addressed electrodynamics, and light is electrodynamic in nature, we note that expressions for electrodynamic influences of charges on one another contain terms for positions, velocities, *and* accelerations. Heretofore accelerations had not been considered in either of our approaches.

If we consider a more or less circular binary star orbit with sinusoidally varying acceleration and velocity components (with respect to the remote observer), the acceleration effects are similar to Doppler shifts but lead them by 90 degrees. Thus, acceleration effects very nearly bring the Ritzian hypothesis into conformance with observational data.

The computer program was modified to use orbital accelerations, with respect to the observer, to produce the apparent radial velocity curves. (The light curve is the same regardless of whether Doppler or acceleration effects are used. The program will need to be modified to properly account for both effects.)

COMPARING NUMERICAL RESULTS TO OBSERVATIONS

For observer distances much less than the de Sitter overtaking distance the numerical code creates light and radial velocity curves which approximate those for simple Cepheid variables and similar objects. When both components are visible the program produces light and radial velocity curves for each component.

As the observer distance increases the Cepheid-like bumps evolve into sharp peaks which get higher and narrower as the de Sitter distance is approached.

For a binary star with both components visible we get a peak for each component. The double pulsed Crab pulsar may be considered as a candidate for a two component (fraternal twins) binary. A neutron star binary where the radii of the orbits are on the order of fourteen *Houstons* and their orbital speeds are on the order of $0.1c$ would suffice. There *are* intriguing spectral differences between the pulses.

If the Ritz hypothesis is valid, then we should expect to find lots of two-color, double pulsed, pulsars. AN Ursae Majoris, which is considered to be a possible slow pulsar [6] (period 1.914 hr), may be a candidate as a two-color pulsar. It is reported to have two different emitting sources.

At the de Sitter overtaking distance L, the sharp high peak splits into two peaks. (At L a telescope with sufficient resolving power would show two separate images pulsing in phase with one another with a smeared out faint bridge between them.) As the binary-to-observer distance increases beyond L the inter-peak time interval increases. The outer edges of the peaks become almost vertical and there is a saddle-like trough structure between the peaks. These peaks will flash alternately. At a binary-to-observer distance of $2L$ the computed light curve strongly resembles that of the Geminga Pulsar.

The $c + v$ effects produce arrival time modulation at the observer which further modifies the spectral content. The observed frequency modifications are in accordance with the relation $dt/d\tau$, where τ is the modulated arrival time.

APPLICATION OF THE HYPOTHESIS TO GAMMA-RAY BURSTERS

According to this Ritzian interpretation of variable stars, gamma-ray bursts could be caused by close encounters of stellar objects. The arrival time compressions that would accompany perihelion passages could produce blue shifted *observed* bursts of extremely high energies. (This means that the objects are not actually bursting, rather they just look that way from sufficient distances.) Short term elliptical orbits would produce repeating bursts such as the Geminga pulsar. Chance non-returning stellar encounters could produce non-repeating bursts.

In principle, any encounter of two stars could lead to perturbative accelerations which could produce a pulse or burst of light in the sense mentioned above.

Where a *capture* event takes place between two stars, we might expect to observe a series of pulses/bursts. The process may be accompanied by electromagnetic braking and perhaps inter-body electrical discharges. Both processes would produce changes in the settling down orbitals. The latter could produce radical energy changes in the orbits and abrupt changes in the observed light curves and spectra. When one of the participants happens to be a short period binary then an otherwise well behaved burst can take on a spiky or crenulated/serrated effect.

An unabridged version of this presentation, including graphics and the numerical code used, is available on the world wide web at:
`http://www.shadetreephysics.com`

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