RITZ EFFECT, DOUBLE STARS AND PULSAR PSR 1957 + 20

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According to ballistic theory, an accelerated source at each subsequent moment imparts a slightly different speed to the light, and successive signals (or fronts of light waves) emitted at different speeds catch up with each other (reducing the wavelength), or diverge (increasing the wavelength), arriving at the receiver more or less often. From the transformation of the time intervals *dt* and the period *T*, we find for the change in the wavelength $\lambda = cT$, the frequency of light $f = 1/T$, - new intervals, wavelengths and frequencies, respectively,

$$dt' = dt\left(1+\frac{ra_r}{c^2}\right),\quad \lambda' = \lambda\left(1+\frac{ra_r}{c^2}\right),\quad f' = f\left(1+\frac{ra_r}{c^2}\right)^{-1}. \tag{1}$$

Effect (1), which complements the Doppler effect, will further be called the Ritz effect: Ritz derived formula (1) in 1908 [1]. At $V_r \ll c$, the total Doppler and Ritz transformation

$$dt' = \left(1+\frac{V_r}{c}+\frac{ra_r}{c^2}\right)dt,\quad \lambda' = \left(1+\frac{V_r}{c}+\frac{ra_r}{c^2}\right)\lambda. \tag{2}$$

If the Doppler effect $dt' = (1 + V_r/c)dt$ is easily recorded in the laboratory, then the Ritz effect (1) is more difficult to detect, due to the smallness of $ra_r/c^2 \ll 1$. But at distances r of the order of a light year, small accelerations $a_r \sim c^2/r \approx 9.5$ m/s^2 can change the apparent duration of the processes at times.

A change in the apparent duration *dt'* of processes according to the Ritz effect (which is the same illusion as a change in *dt'* according to the Doppler effect) also leads to a change in the recorded radiation power *W'*. Indeed, if the source radiated power *W* into the unit aperture of the photodetector during the time *dt*, then according to the law of conservation of energy *Wdt* perceived during the time *dt'*, the power $W' = Wdt/dt'$ would be recorded. Hence, taking into account (1),

$$W' = W\frac{dt}{dt'} = W\left(1+\frac{ra_r}{c^2}\right)^{-1}. \tag{3}$$

So, the radial acceleration of the source a_r leads to a change in the apparent brightness and power W' of the source, and fluctuations in a_r cause fluctuations in the apparent brightness of the source, for example, a star.

If effect (1) takes place, and the apparent motion of the stars is distorted, then, in addition to the noted distortion, there will be an additional shift of spectral lines according to law (1). The total change in the period and wavelength of the spectral line is given by formula (2). Thus, it is represented by the sum of the Doppler and Ritz effect shifts:

$$z = \frac{\Delta\lambda}{\lambda} = \frac{V_r}{c} + \frac{ra_r}{c^2}\,. \qquad (4)$$

Interpreting this displacement as purely Doppler, they will find the calculated value of the velocity

$$V_r' = c\frac{\Delta\lambda}{\lambda} = V_r + \frac{ra_r}{c}\,, \qquad (5)$$

which is different from the true V_r.

For radial velocity plots of stars moving in a circular orbit, the Ritz effect will lead to a change in the orbital phase of the star. If the true radial velocity of the star is given by the expression $V_r = -K\sin(2\pi t/P)$, then the acceleration $a_r = dV_r/dt = -(2\pi K/P)\cos(2\pi t/P)$, and the additional imaginary (apparent) velocity $V_r^* = ra_r/c$ or $V_r^* = la_r/c$ (in case of re-emission of light at a length l). From here we get that the design speed is given by the expression

$$V_r' = V_r + V_r^* = -K\sin\left(\frac{2\pi t}{P}\right) - \frac{2\pi lK}{Pc}\cos\left(\frac{2\pi t}{P}\right) = -K'\sin\left(\frac{2\pi t}{P} + \varphi\right), \qquad (6)$$

where the phase shift $\varphi = \arctan(2\pi l/Pc)$, and the calculated radial velocity amplitude

$$K' = K\sqrt{1+\left(\frac{2\pi l}{Pc}\right)^2}\,. \qquad (7)$$

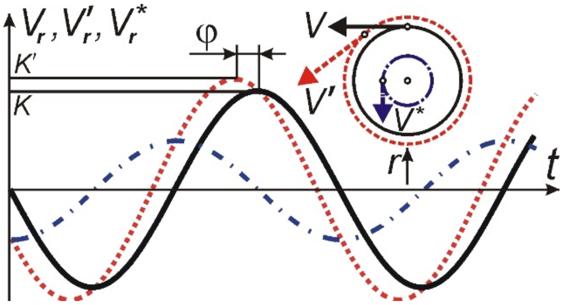

Fig. 1. Diagram of the distortion of the Doppler radial-velocity curve $V_r(t)$ (solid line) from the additional frequency shift according to the Ritz effect in the form of the imaginary radial-velocity curve $V_r^*(t)=la_r/c$ (dash-dotted line) and the corresponding orbits. The resulting spectral offset curve (dotted line) gives false Doppler velocity $V_r'(t)= V_r(t)+ V_r^*(t)$.

The phase shift of the radial velocity graph $V_r'(t)$ (Fig. 1) can be found in spectroscopic binaries that are simultaneously eclipsing binaries. Theoretically, an eclipse of a star with a circular orbit would be observed at the moment of its greatest distance in the phase of the radial velocity curve 0. If the curve is distorted by the Ritz effect, the eclipse will occur with a delay relative to phase 0 by a phase difference φ reaching π/2 (or in the orbital phase 0.25 - in astronomical notation) in the limiting case when the spectrum shift is mainly due to the Ritz effect. The discrepancies between the light curves and the radial velocity are actually discovered, for example, for the star υ Andromeda [2, 3]. The same effect was noted for the binary pulsar PSR 1957 + 20, in which the eclipse occurs in the orbital phase of 0.25 [4], which coincides with the limiting value of 0.25, at which the variations in the pulsar period are entirely due to the Ritz effect.

Also, the binary radio pulsar PSR 1957 + 20 revealed smooth fluctuations in optical brightness and color with an orbital period $P \approx 9.17$ hours [5], which can also be a consequence of the Ritz effect (3) and (1). This is evidenced by the shape of the light curve $W'(t)$, which corresponds in terms of the Ritz effect to the shape of the graph of radial accelerations $a_r(t)$ of a star moving in a circular orbit (as shown by the timing method), with distortions caused by the Ritz effect. Thus, a number of anomalies in space objects support the Ritz theory.

Literature:

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Installation date: 07/17/2016

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