Possibilities of Radio Bursts from Extrasolar Planets

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Abstract

After the spectacular detection of the first planet by Mayor & Queloz, over 100 planet-like companions have been detected towards solar-type stars by using optical Doppler monitoring techniques (e.g., Butler et al. 1996) or photometric observations. These companions exhibit a variety of characteristics. Their values of *M*sin*i* are distributed between 0.5 and 7 M_J, suggesting that the actual masses of extrasolar planets reside within a range of giant planets. The most spectacular characteristic is they have very close orbits to main stars. A model I have constructed, based on solar flare, suggests that the flare caused by these planets may be detectable at radio wavelengths.

My model is based on the model used to explain solar radio bursts. A spot on the solar surface generates elongated magnetic tubes. Before reconnection, a plasma flow stresses magnetic tubes, and creates electric sheets within magnetic neutral zone. As magnetic reconnection proceeds, open coronal magnetic field reconnects to form closed loops. Then reconnection occurs and magnetic tubes are reformed. At that time much energy is released and radio burst occurs. The total energy release rate and the duration depend on the reconnection rate and magnetic configurations. Now there is no reconnection theory to describe the bursts of star with a planet exactly. I can only estimate the effect of planets' magnetic field qualitatively. Here I use Busse's law to calaculate a magnetic moment of the planets.

$$M = \rho_c^{1/2} \omega Rc^4$$

ρ_c = Fluid density in a core of a planet; ω = Angular velocity of a rotation of a planet; Rc = Core radius; M = Magnetic moment. Applying this law to Jupiter-like planets, we obtain 0.4 Gauss for 51 Peg companion planets, which is the same order of Jupiter. Considering the solar magnetic field at the farthest point of the magnetic tubes is around 1 Gauss, this magnetic field of the planets are expected to be large enough to be a trigger of radio bursts. Also it is expected that the magnetic fields of planets will interact with those of main stars sufficiently, pull the magnetic tube to form larger magnetic tubes of star. Thus we expect that the stars with a Jupiter-size planet of close orbit will emit the radio bursts more frequent with brighter radio flux than the case of stars without such nearly orbiting planet.

I have performed a survey observation of the stars 51 Peg, τ Bootis, ν And, and HD114762 at 8.6 GHz with the 10-m Mizusawa telescope and 11-m Tokai University telescope between September 1996, and February 1997. Though some signal had received in these observations, I could not distinguish them from artificial ones or terrestrial events since 3 σ of the signal-to-noise level of these observations is as high as 10 Jy. After that, Bastin et al.(2000) observed these three objects using 1.5 GHz of VLA with as low as 33 μJy, 13 μJy, 16 μJy for 51 Peg, τ Bootis, ν And. I want to observe this type of stars having planets with better SN ratio using large telescopes.