

# The relationship between X-ray and radio emission in the Vela pulsar

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**ABSTRACT:** We report the results of simultaneous observations of the Vela pulsar in X-rays and radio from the RXTE satellite and the Mount Pleasant Radio Observatory in Tasmania. We sought correlations amongst the Vela's X-ray and radio flux densities and radio arrival times on a pulse by pulse basis. We found significantly higher flux density in Vela's main X-ray peak during radio pulses that arrived early. This excess flux shifts to the other X-ray peak during radio pulses that arrive later. We suggest that the two X-ray peaks and various radio pulses are emitted from different magnetospheric altitudes and that the mechanism producing the radio pulses is intimately connected to the mechanism producing X-rays. Current models using resonant absorption in the outer magnetosphere as a cause of the radio emission, and less directly of the X-ray emission, are explored as a possible explanation for the correlation. Another puzzling effect occurs in a fraction of the observations; Vela emitted significantly more X-rays during radio pulses with high flux density than during those with low radio flux density. In other observations the effect is reversed. In both cases the probability that this effect is happening by chance is less than  $10^{-30}$ .