IAUS291-1-0222 Electric current diagnostics in the magnetosphere of neutron stars using coronal seismology method

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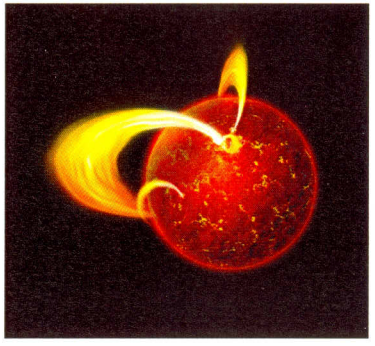

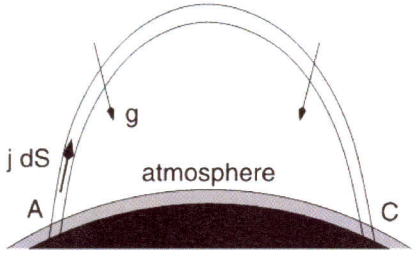

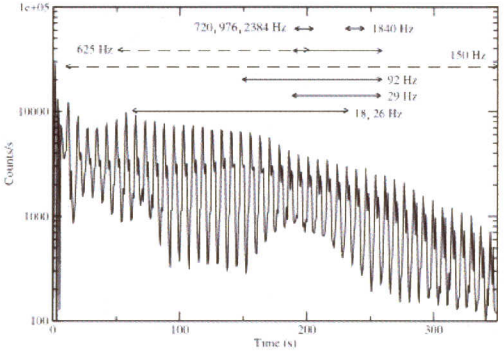

Diagnostics of magnetosphere of SGRs using high-frequency (20-2400 Hz) and high-Q ($Q \geq 10^5$) pulsations based on coronal seismology is proposed. Trapped fireball is represented as a set of current-carrying loops with its own eigen-frequencies

$$\nu = \left(2\pi\sqrt{LC}\right)^{-1}, Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

Example: SGR 1806-20 flare on Dec. 27, 2004

From loop geometry → inductance $L \approx 5\times10^{-3}$ Henry

From 'ringing tail' energy $LI^2/2$ → electric current $I \approx 3\times10^{19}$ A.

From current value $I \approx B_\varphi cr$ → $B \approx 10^{13}$ G $< B_q = 4.4\times10^{13}$ G

From current and loop cross-section area → $n \approx 10^{16}$ cm^{-3}

For ν = 625 Hz → capacitance $C = 1.3\times10^{-5}$ F and $Q = (R\sqrt{C/L})^{-1} \approx 8\times10$

(a) Self-excitation $I < I_{max}$

$$\frac{L}{c^2}\frac{\partial^2 \tilde{I}}{\partial t^2} + \alpha\left[I^2 - I_{\max}{}^2\right]\frac{\partial \tilde{I}}{\partial t} + \frac{\tilde{I}}{C} = 0$$

(b) Excitation due to parametric resonance

$$\frac{d^2 y}{dt^2} + v_0^2\left[1 + q\cos vt\right]y = 0,$$

Magnetospheres of SGR 0526-66, SGR 1806-20, and SGR 1900-14:

$I = 10^{18}$ - 3×10^{19} A, $B \approx 10^{12}$ - 10^{13} G $< B_q = 4.4\times10^{13}$ G, $n = 10^{15}$ - 2.5×10^{16} cm^{-3}