

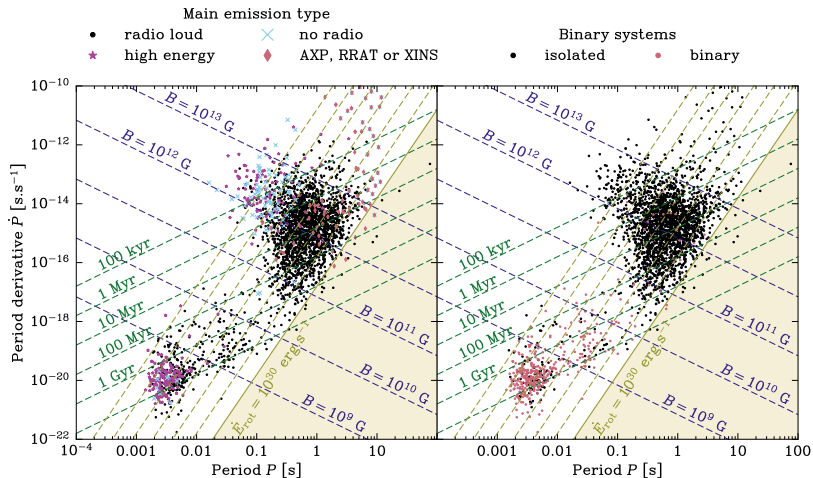
Simulation of the radiation of neutron star magnetospheres

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LUX

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Population of neutron stars



Magnetosphere of neutron stars

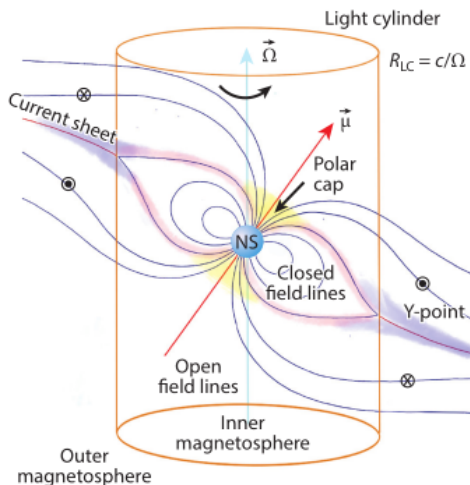
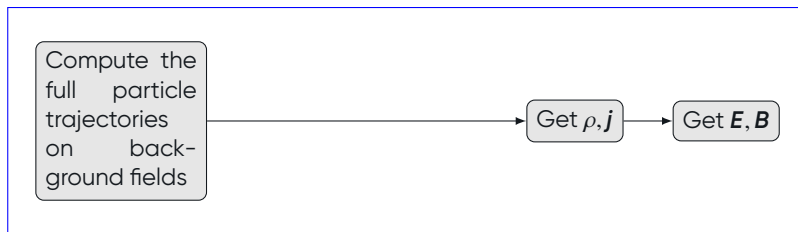


Figure 1: Magnetosphere with gaps. From [Philippov and Kramer, 2022].

Pulsar ARoMa: iteration scheme for stationary solutions

Pulsar Aroma [Mottez, 2024] computes self-consistent stationary solutions of electrospheres or magnetospheres.

repeat at each iteration until convergence

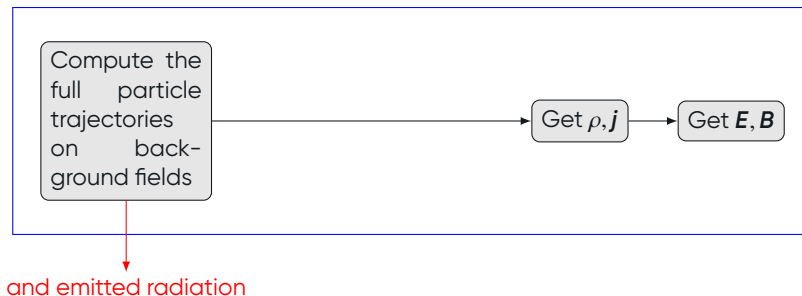


- f : distribution function of the particles
- ρ : charge density; $\mathbf{j}$: current density
- $\mathbf{E}$: electric field; $\mathbf{B}$: magnetic field

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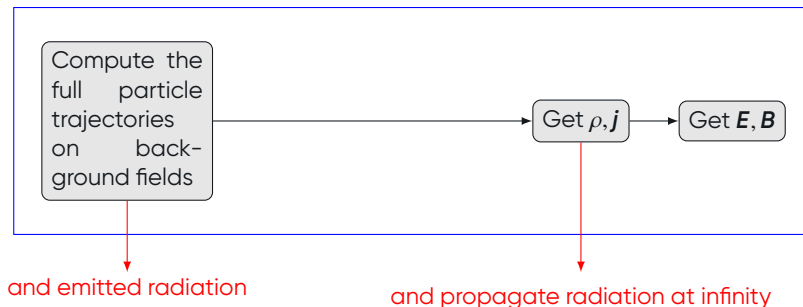


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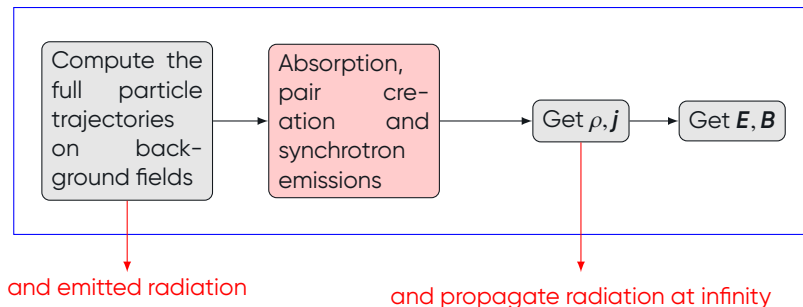


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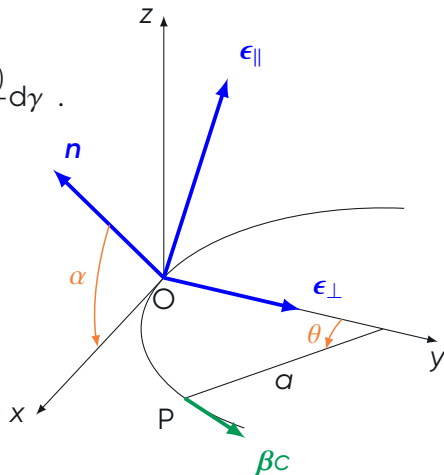


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Emission of curvature radiation

$$\mathcal{P}_\nu(\mathbf{r}) = \int_0^{+\infty} \frac{\sqrt{3}q^2\gamma}{cT} F(x) \frac{\partial N(\mathbf{r}, \gamma)}{\partial \gamma} d\gamma . \quad (1)$$

- $F(x) = x \int_x^{+\infty} K_{\frac{5}{3}}(\xi) d\xi$,
Westfold function
- $x = \frac{\nu}{\nu_c}$ with ν_c the critical frequency
- $T = \frac{2\pi a}{c}$, the period associated to the motion along the circle of radius a



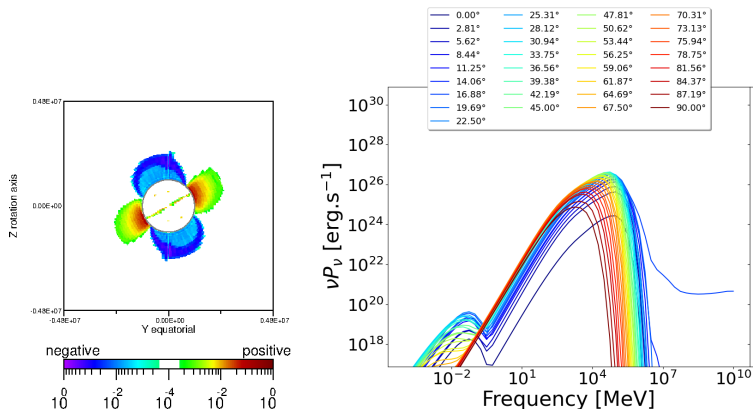


Figure 2: Charge density (left) and period averaged luminosity for multiple lines of sight (right). $B = 10^{11}$ G, $P = 5$ s, and $i = 30^\circ$.

Toy model of pair creations

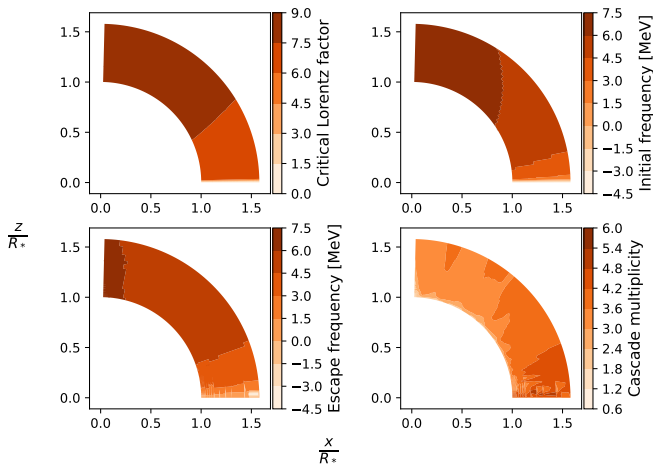


Figure 3: A toy model of $e^\pm$ pair creations ($\gamma + B \rightarrow e^\pm$) with realistic pair creation coefficients. Colorbars are log-scaled.

Conclusion

Implementation of the radiative transfer in pulsar ARoMa:

- emission from curvature radiation (classical and quantum regime)
- absorption from electron-positron pair creations.

Magnetospheres:

- electrospheres: gamma-ray transparent, faint but numerous → possible extended diffuse flux
- pulsars: toy model of pair creations.

References I



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Astronomy & Astrophysics, 684:A115.



Philippov, A. and Kramer, M. (2022).

Pulsar Magnetospheres and Their Radiation.

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