



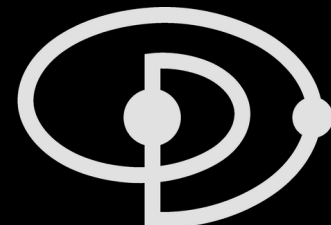
**FAST RADIO BURST  
GENERATION BY  
RELATIVISTIC  
MAGNETIZED SHOCKS  
IN MAGNETAR  
MAGNETOSPHERES**

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Supervisors: Vanthieghem Arno

Ciardi Andrea

LUX



Observatoire  
de Paris

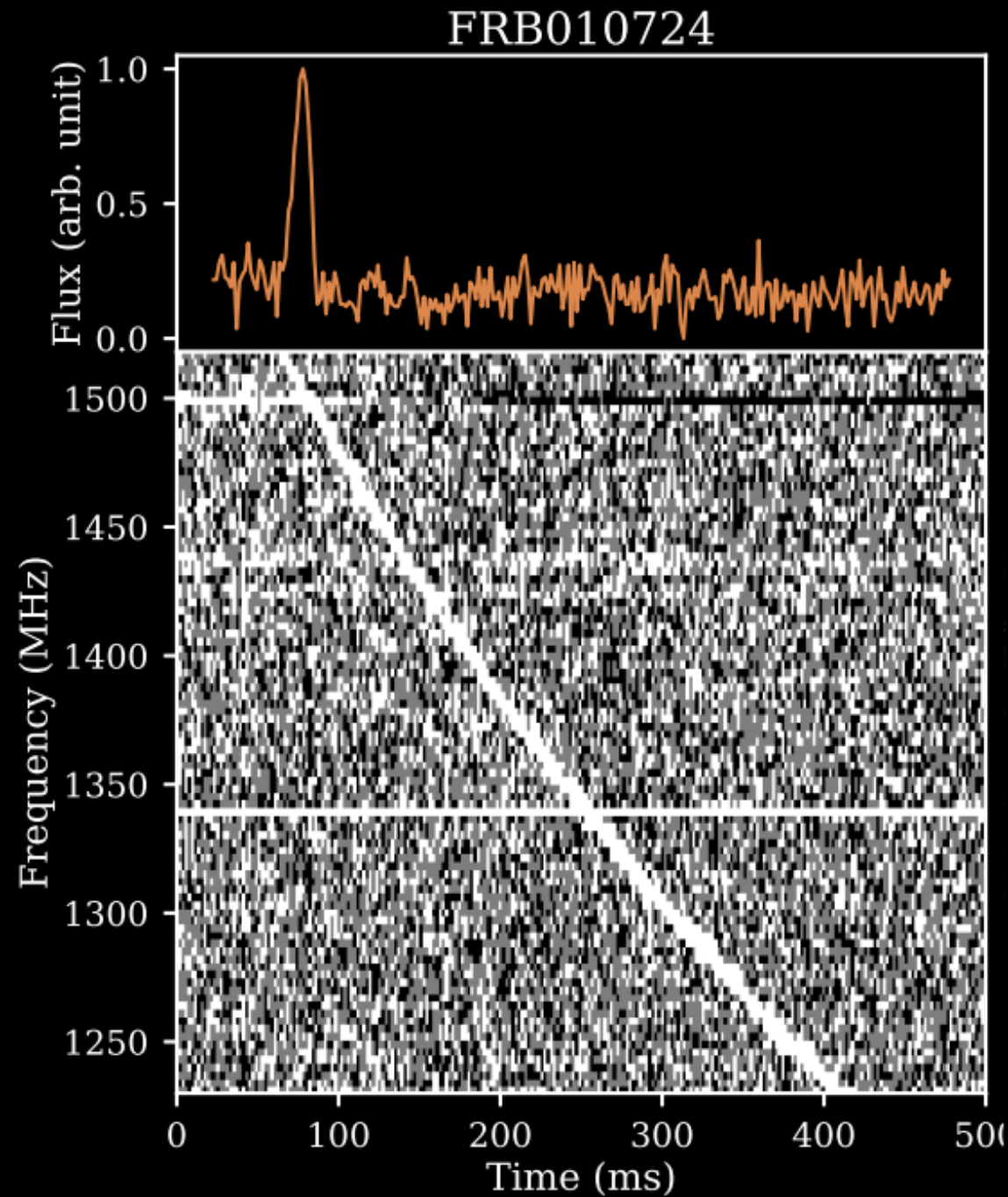
PSL



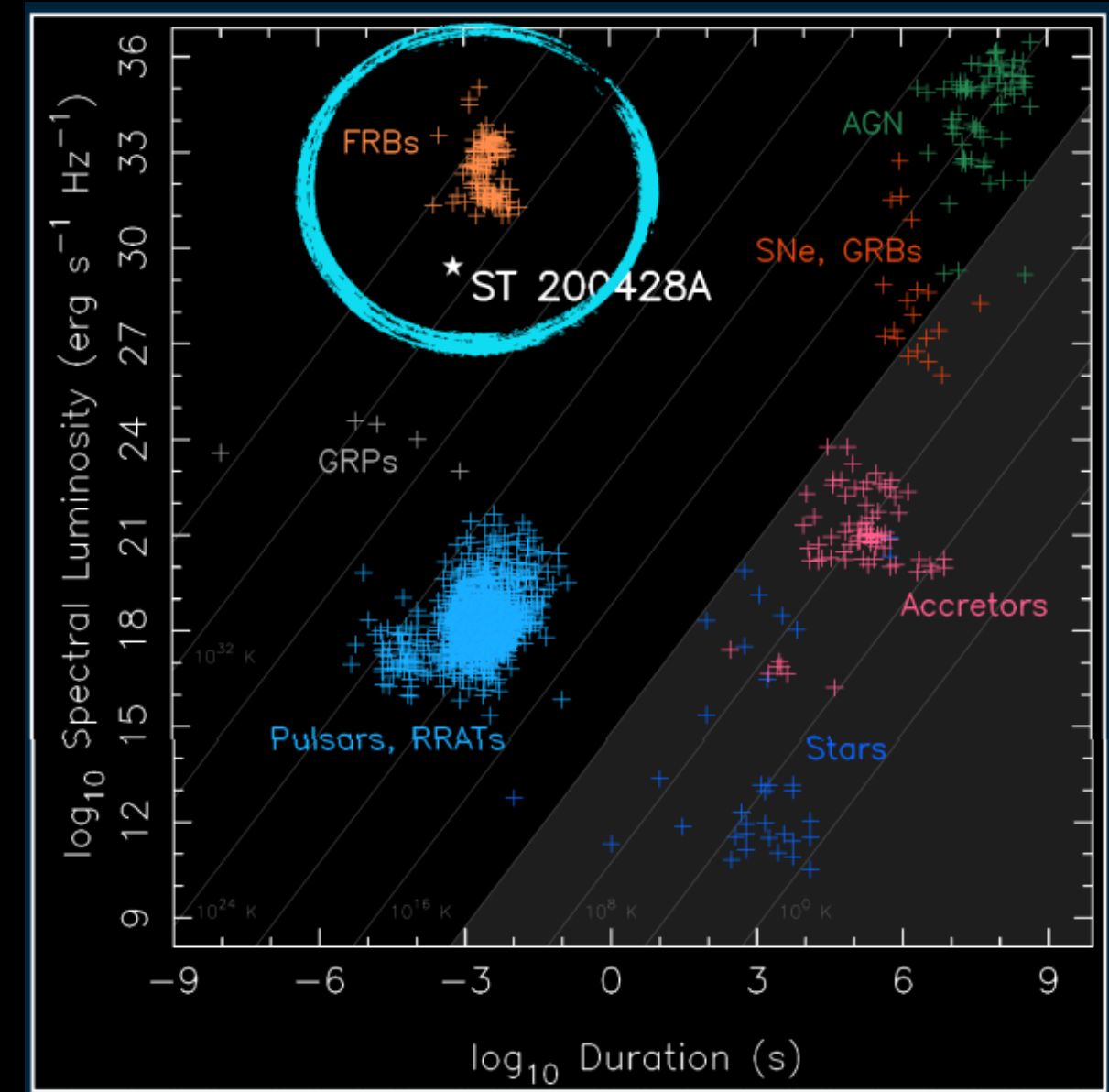
# FAST RADIO BURSTS

- **Bright flashes:**  
1 – 100 Jy
- **Short duration:**  
from  $\sim 10 \mu\text{s}$  to  $\sim 10 \text{ ms}$
- **Radio band (mostly linearly polarized):**  
0.1 to 8 GHz
- **Extragalactic**

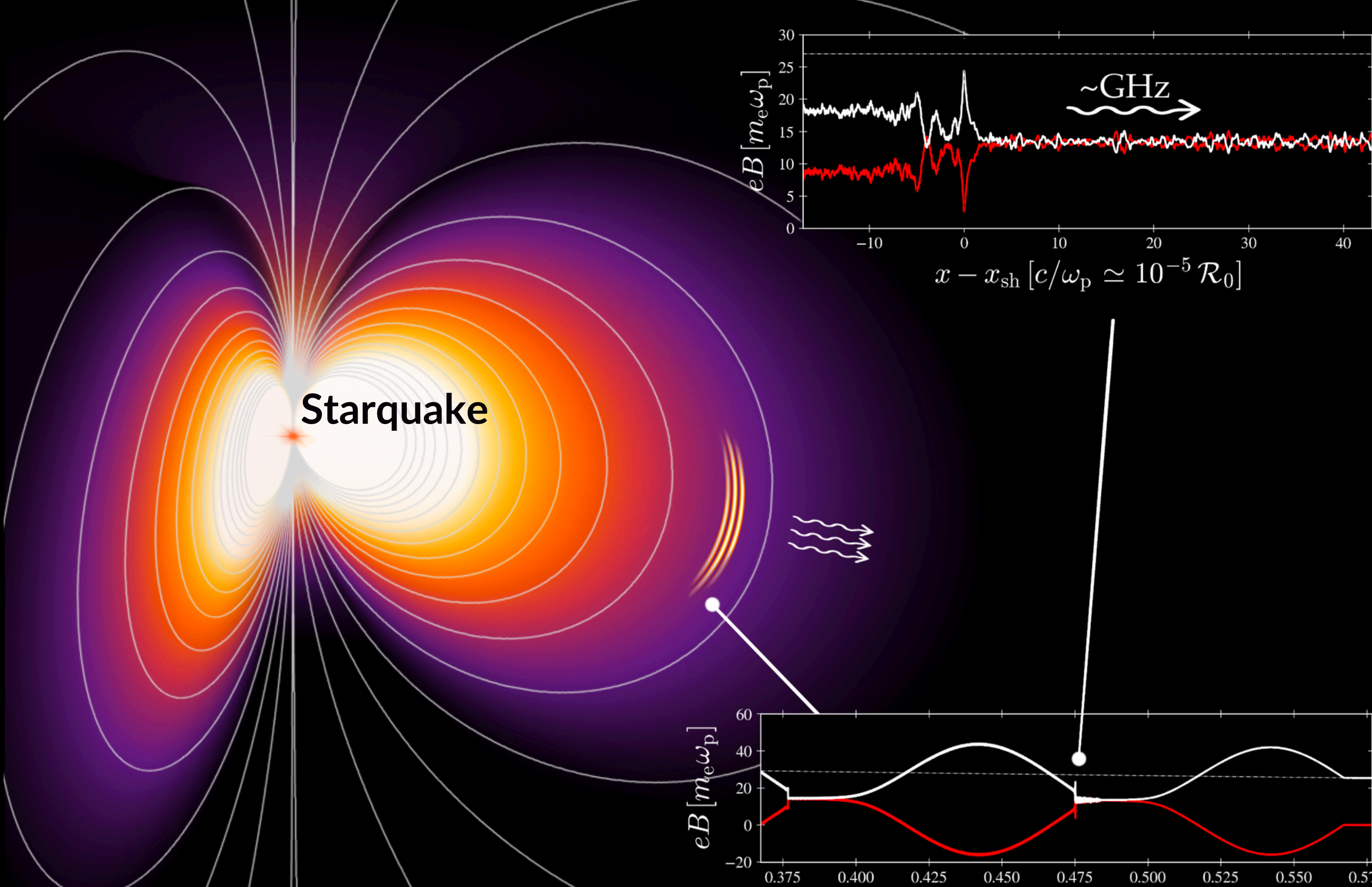
*What is their progenitor?*

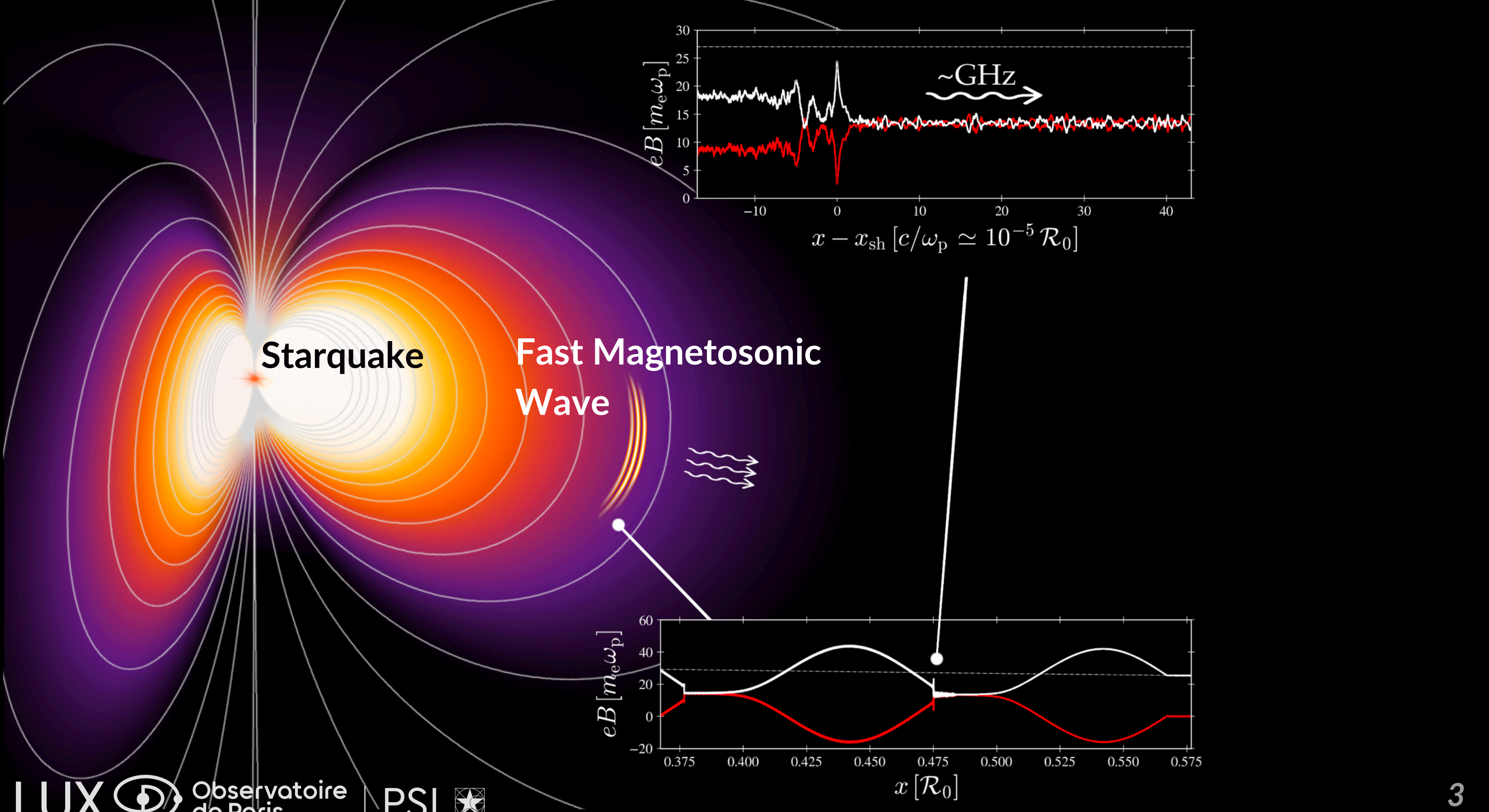


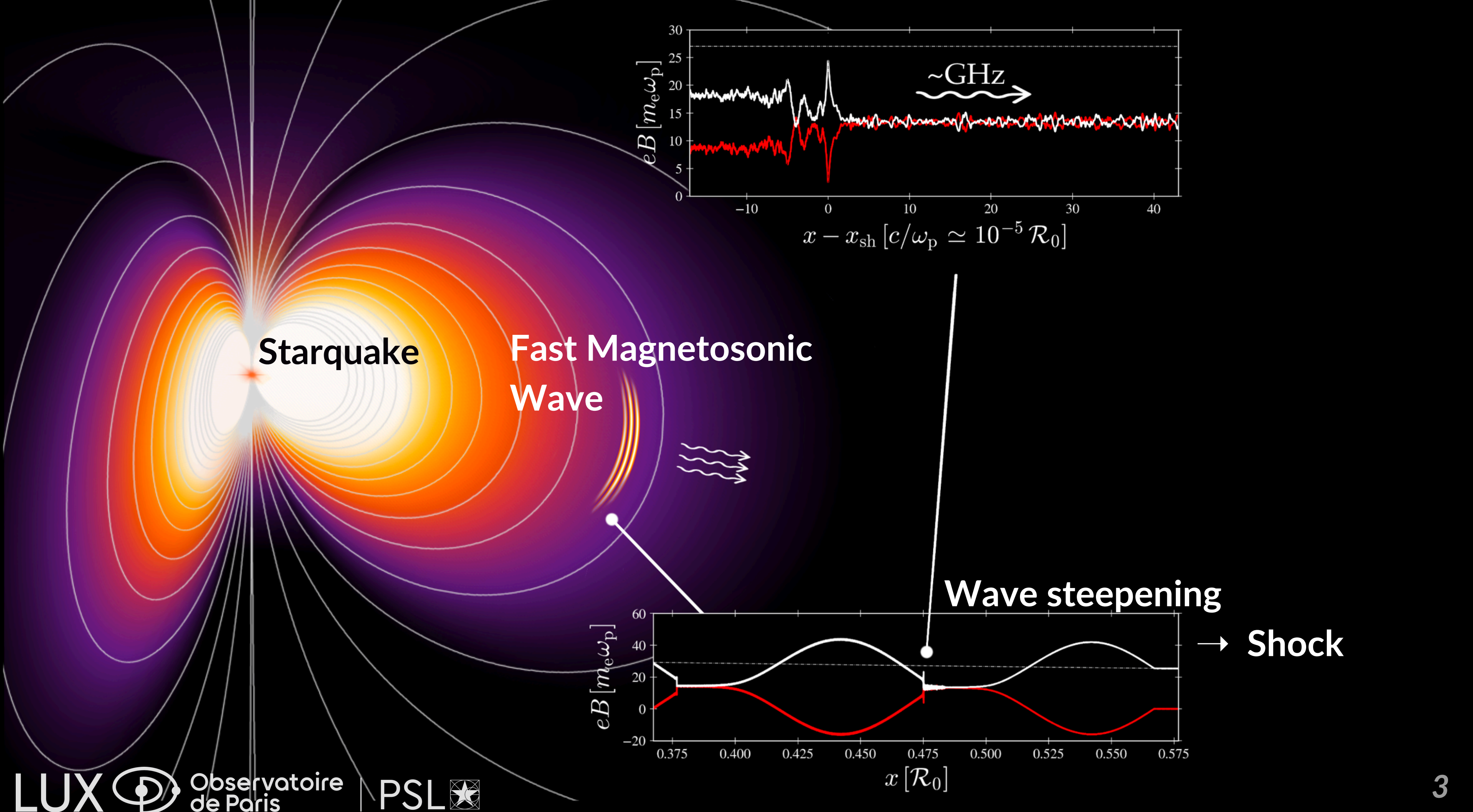
Lorimer et al. (2007)

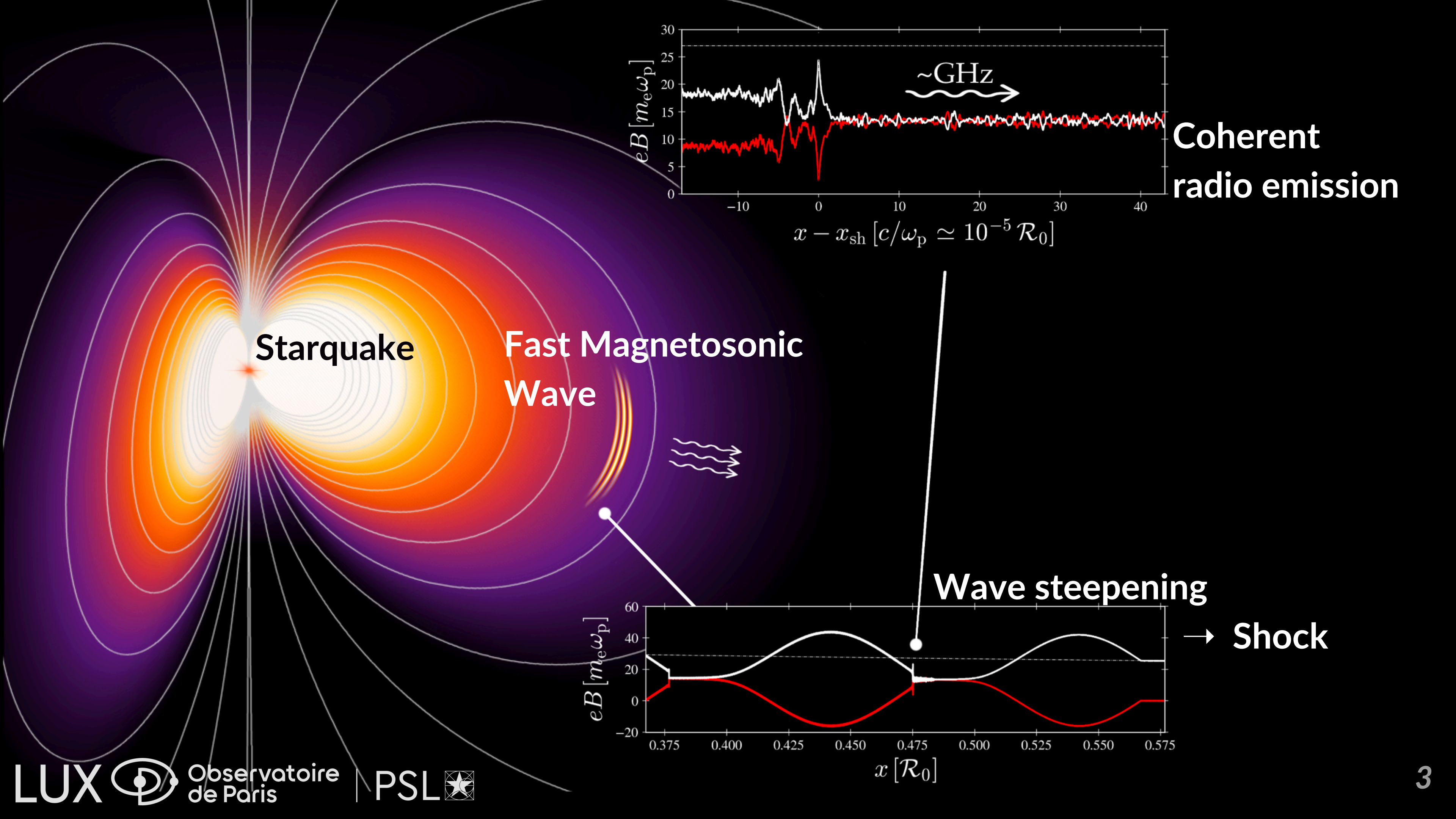


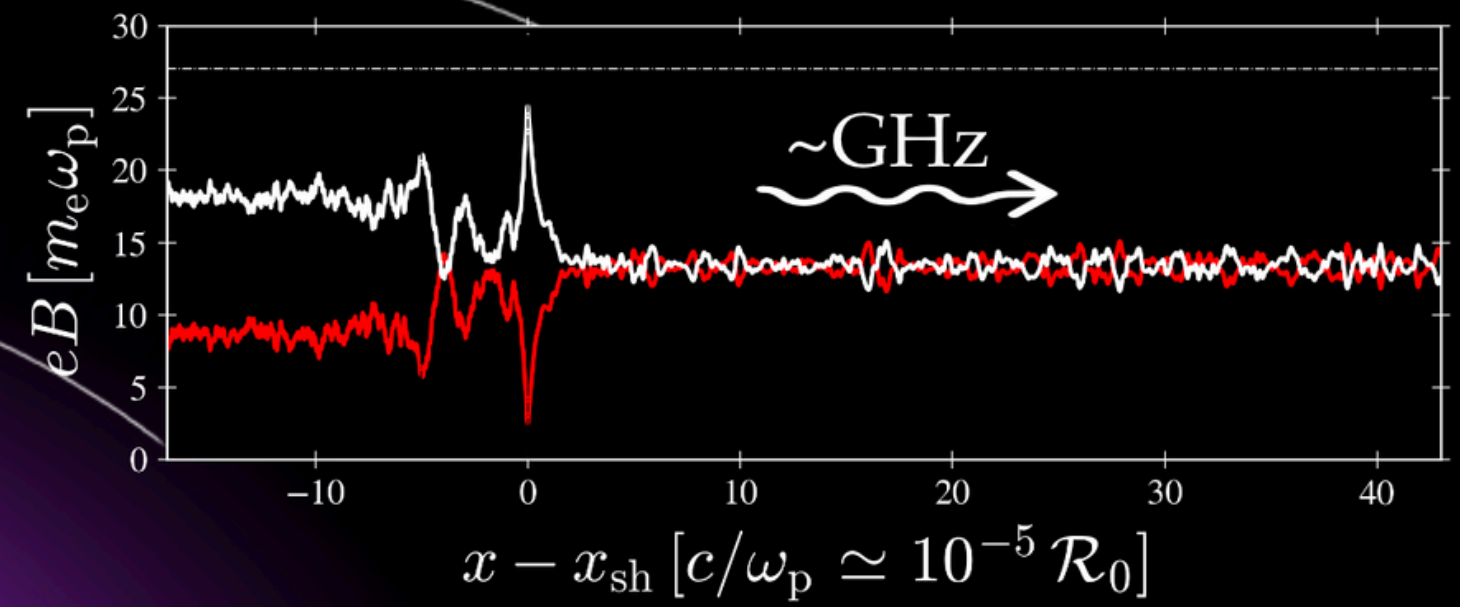
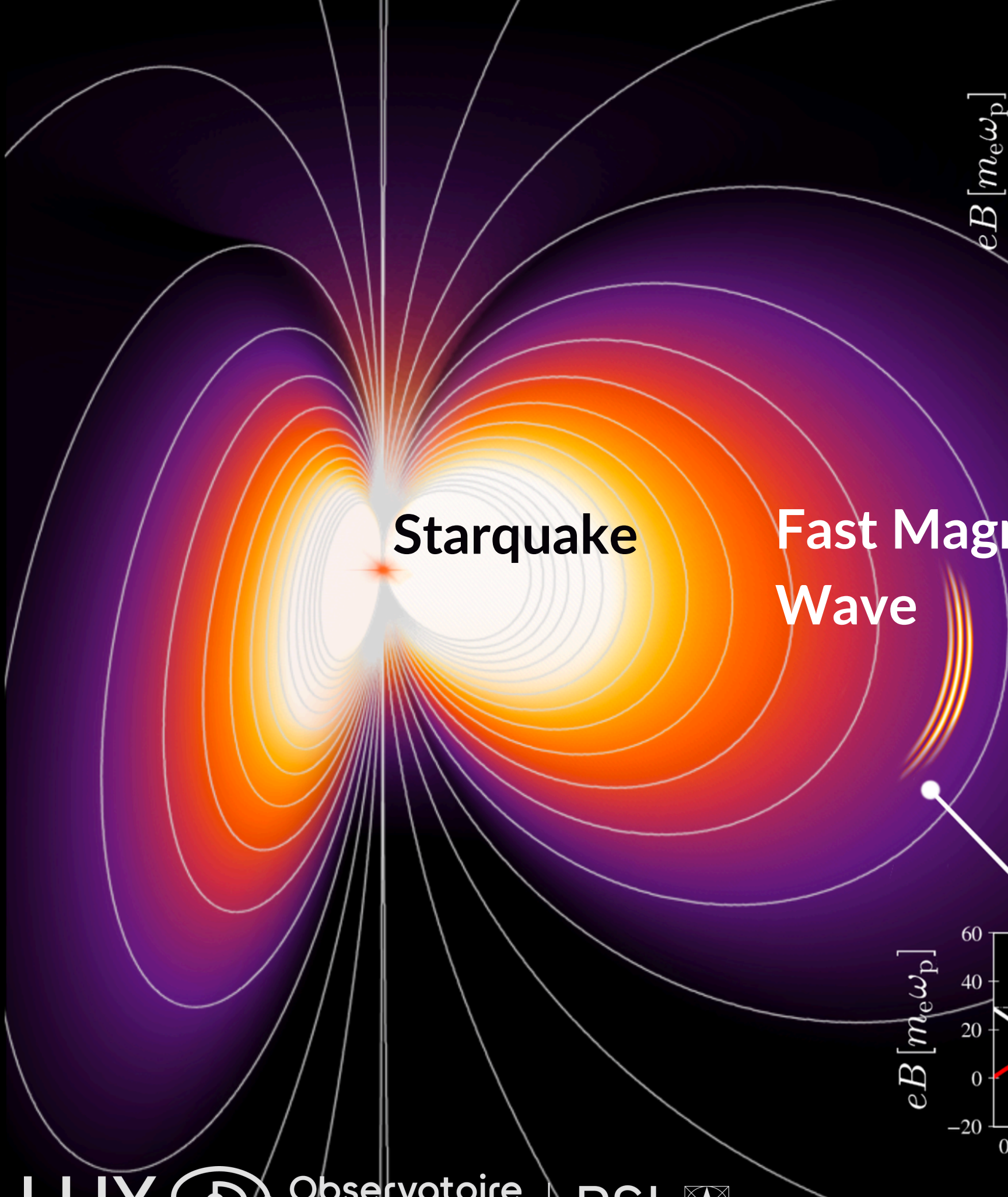
Bochenek et al. (2020)











**Coherent  
radio emission**

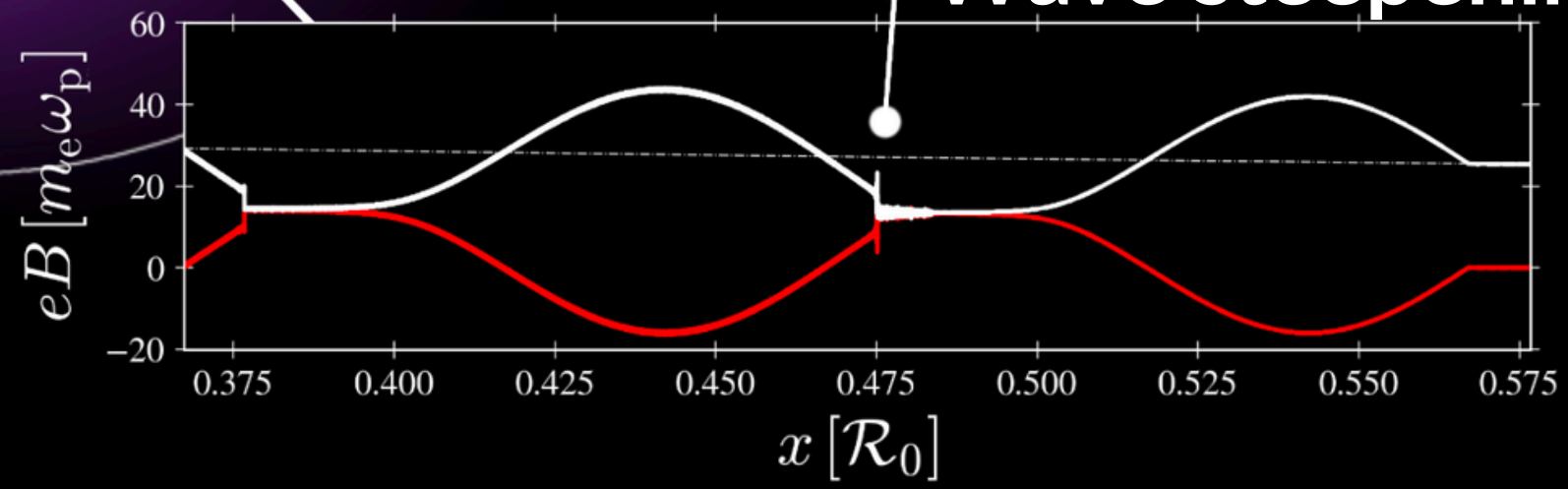
**Fast Magnetosonic  
Wave**

**PhD : Nonlinear waves  
in strongly magnetized environments?  
Theory & simulations**



**An open-source code for high-energy  
astrophysics**

**Wave steepening**



**Shock**

# Evolution of a nonlinear wavepacket of fast magnetosonic waves

Strongly magnetized  
pair plasma

$$\sigma_0 \sim 10^4 \gg 1$$

$$N_{\text{cells}} = 10^6$$

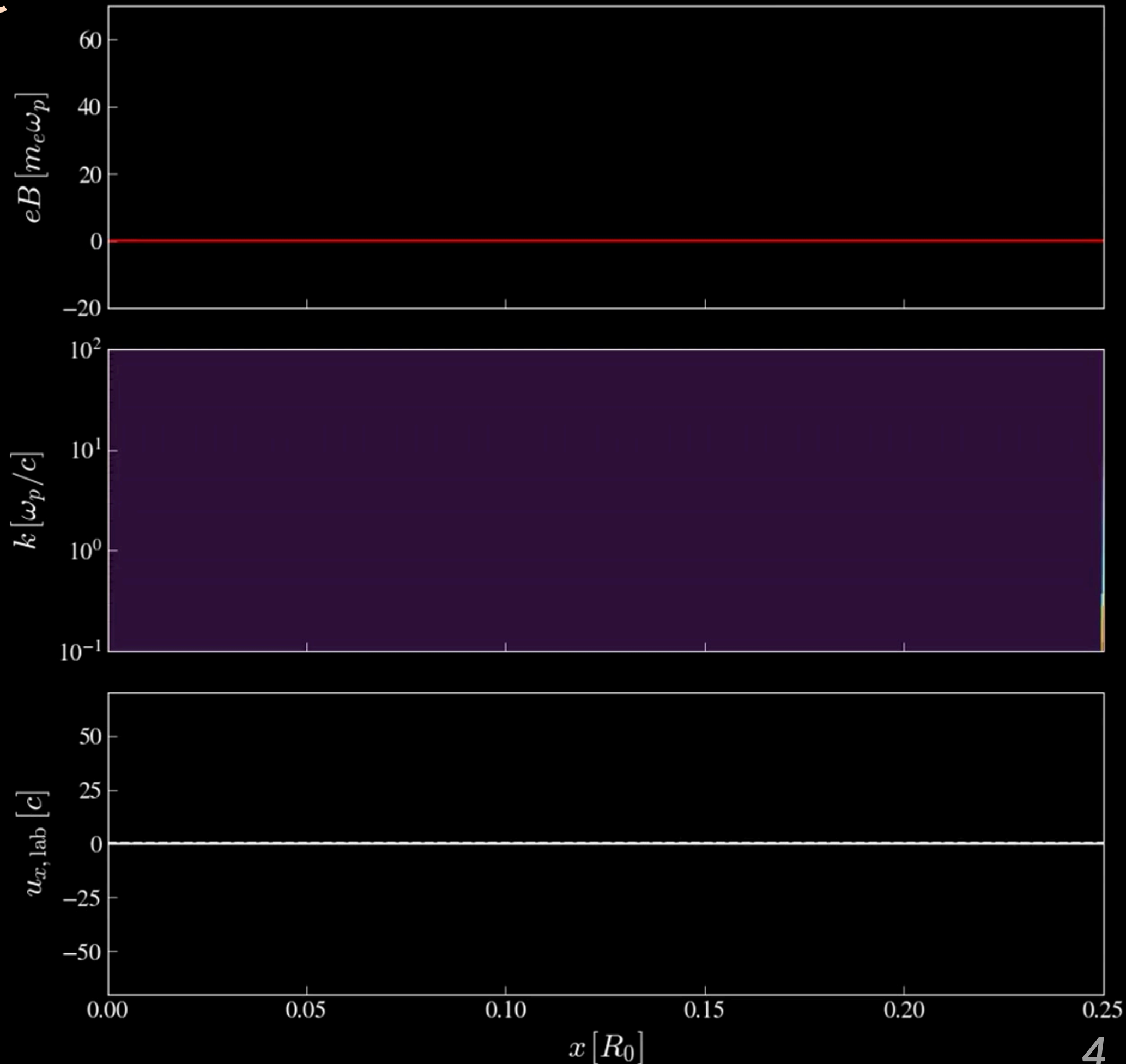
$$\text{ppc} = 60$$

Modes  $N = 2$   $\Delta\phi = \omega_2 - \omega_1 = \pi$

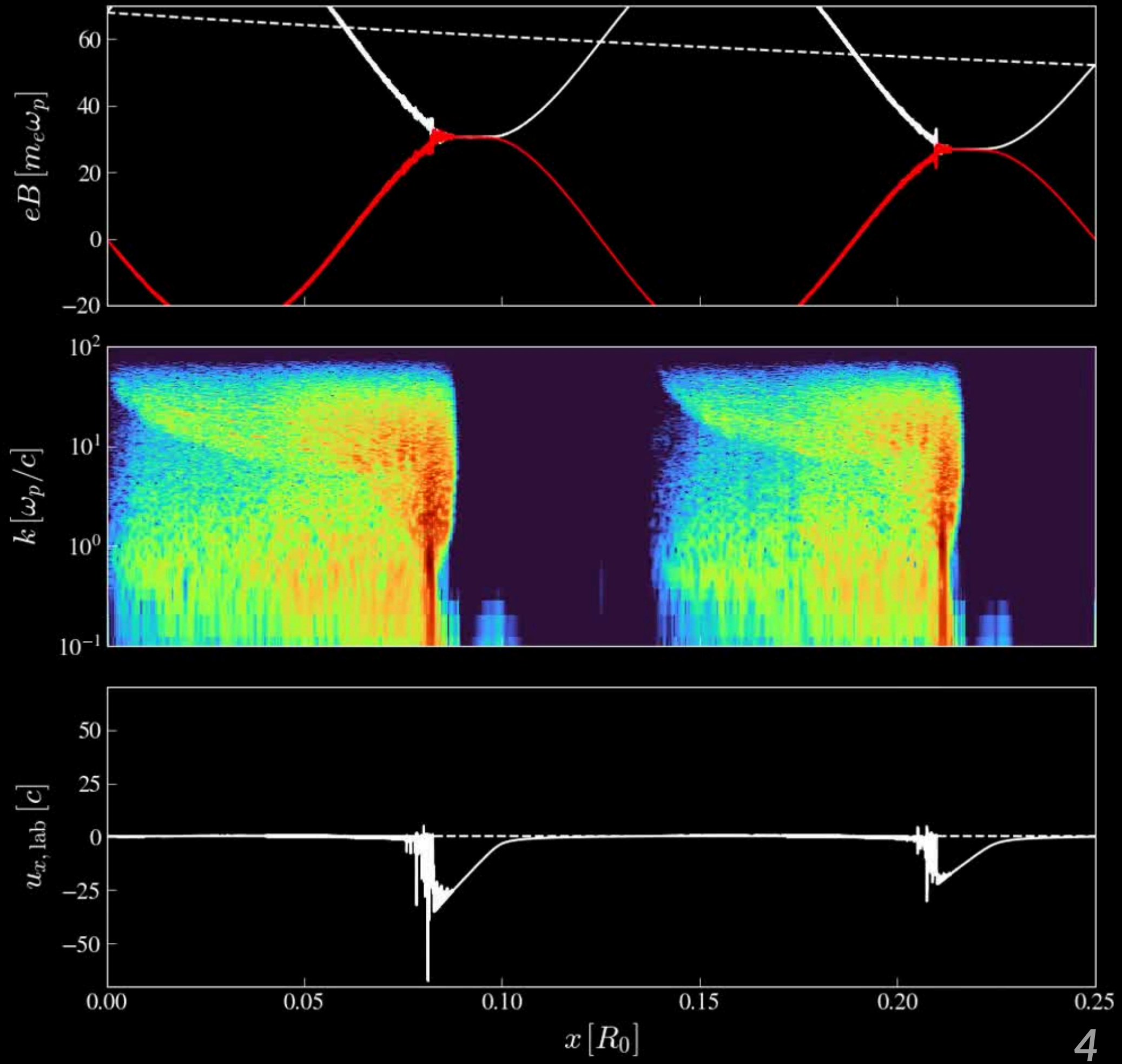
Wave 1  $\frac{\delta B_1}{B_0} = 0.30$   $\frac{\lambda_1}{R_0} = 0.125$

Wave 2  $\frac{\delta B_2}{B_0} = 0.03$   $\frac{\lambda_2}{R_0} = 0.25$

Step: 0 |  $t = 0.00 R_0/c$



Step: 56 |  $t = 0.29 R_0/c$



## Next steps:

- Realistic wave injection ( $N \gg 1$ )  
power-law, Gaussian spectra,  
background noise
- Radiative cooling effects