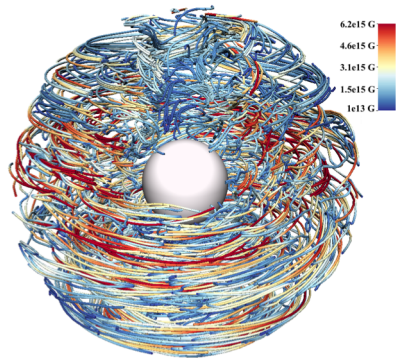
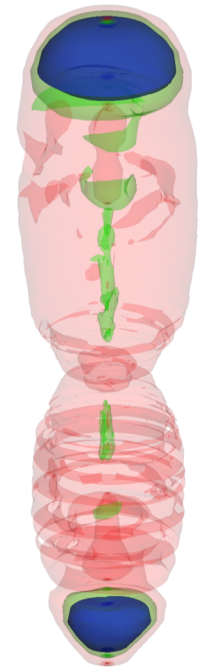


Progenitor, central engine, associated supernova/kilonova

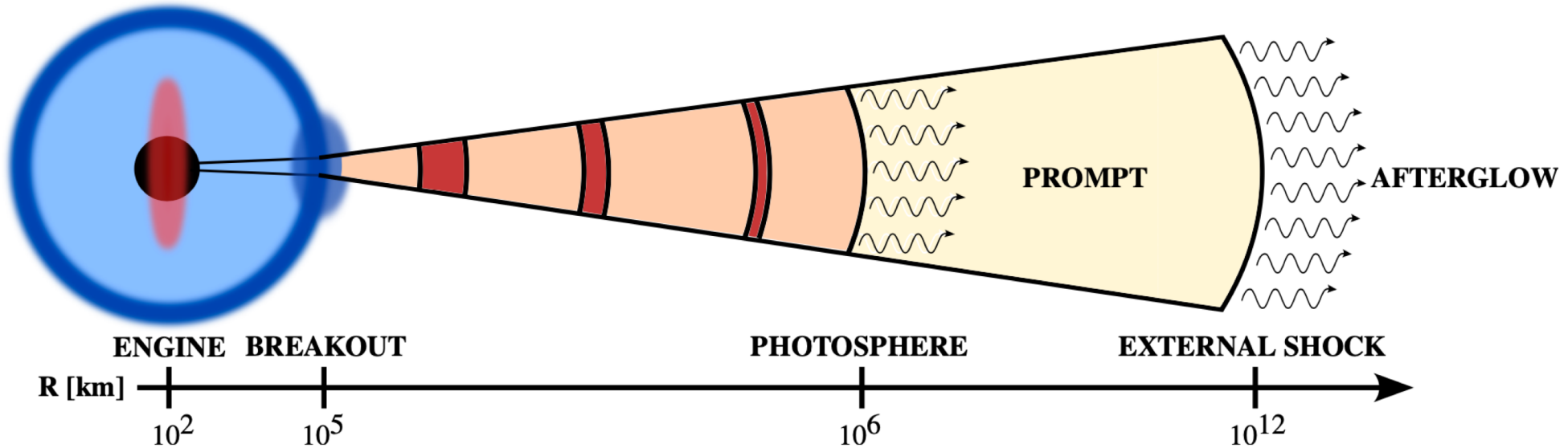


Jérôme Guilet
(CEA Saclay)



From central engine to electromagnetic emission: a long journey

Stellar collapse or
compact object merger ?



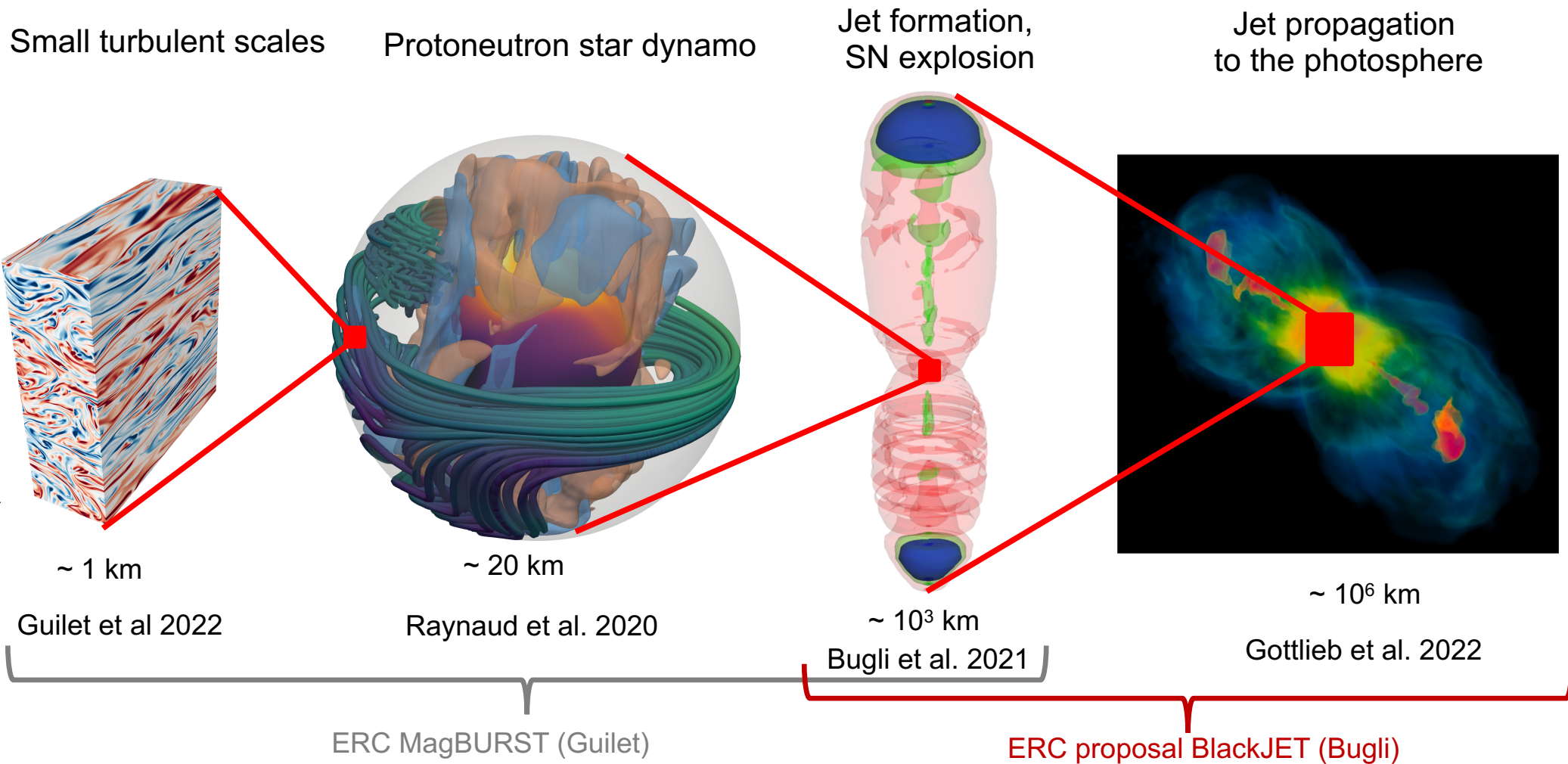
Magnetar or
accreting Black Hole ?

B field strength,
rotation, accretion rate,
energy budget

Jet properties ?

Lorenz factor,
magnetisation,
collimation,
time variability

Ab initio numerical simulations: different spatial scales

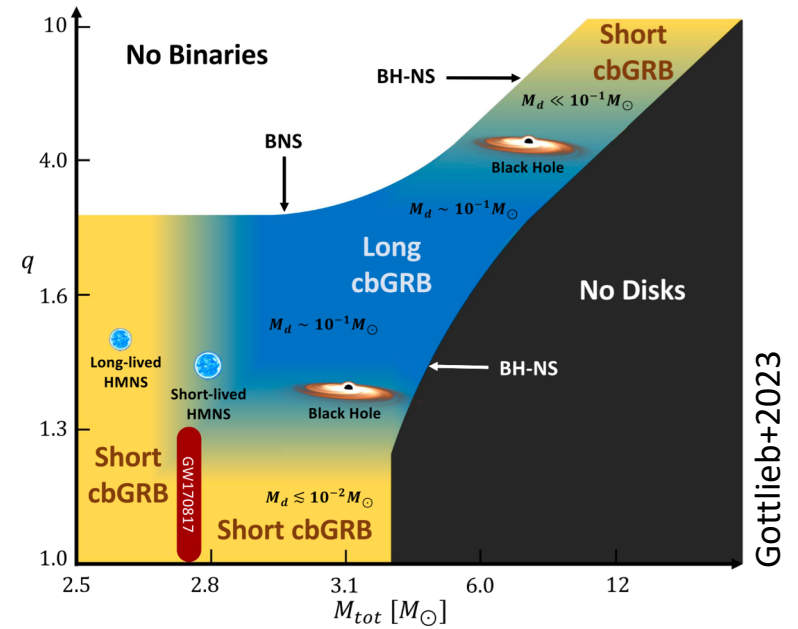
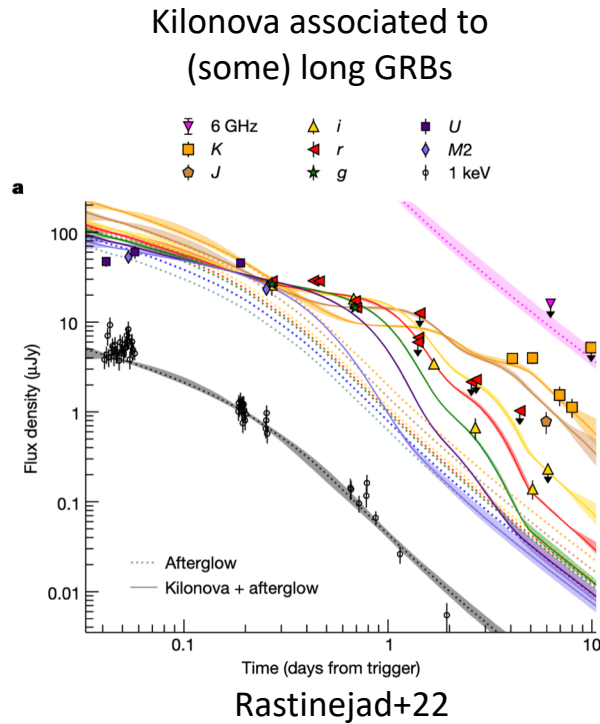


Collapsar or compact object merger ?

Long/soft GRB = collapsar ?

Short/hard GRB = compact object merger ?

=> recently challenged



Associated supernova or kilonova ?

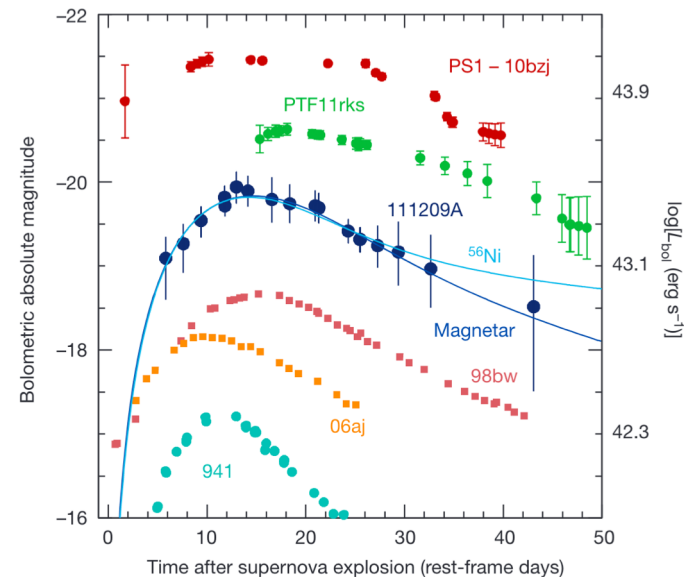
Supernovae associated to (ultra)long GRBs :

- Hypernovae, broad-line type Ic
 - Superluminous supernovae
- => Long lasting central engine activity

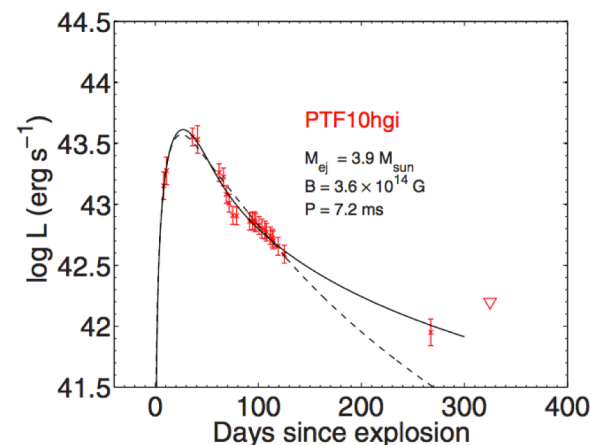
Superluminous supernovae light curves can be fitted by millisecond magnetar models

- strong dipole magnetic field: $B \sim 10^{14}\text{-}10^{15}$ G
- fast rotation: $P \sim 1\text{-}10$ ms

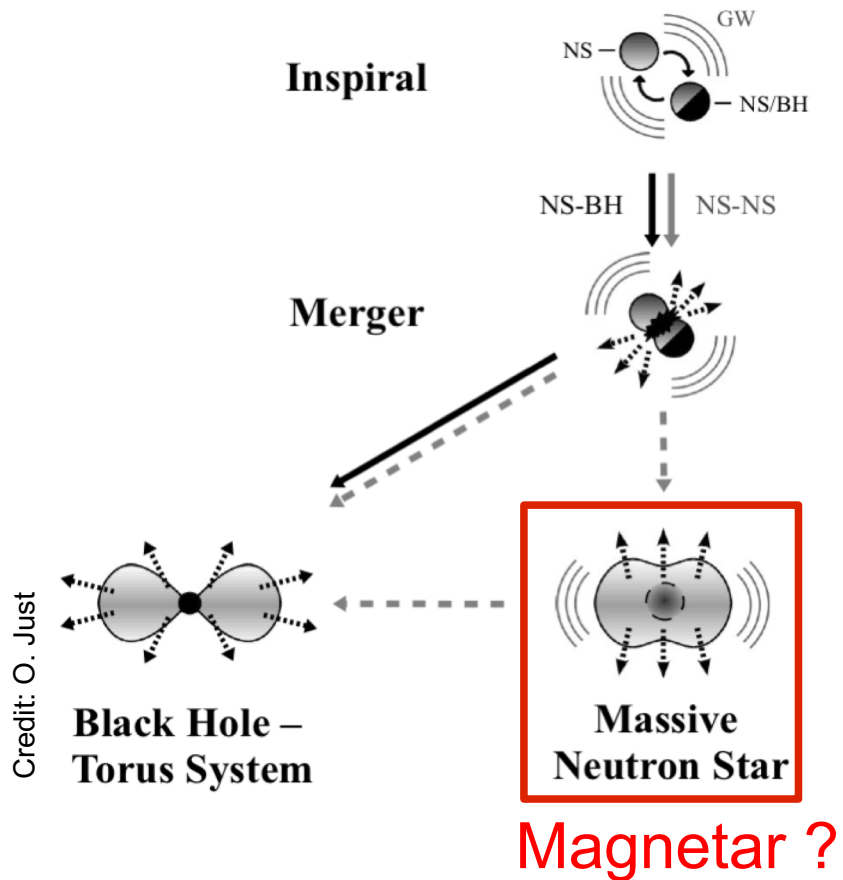
e.g. Kasen+10, Dessart+12, Nicholl+13, Inerrra+13



Greiner+2015

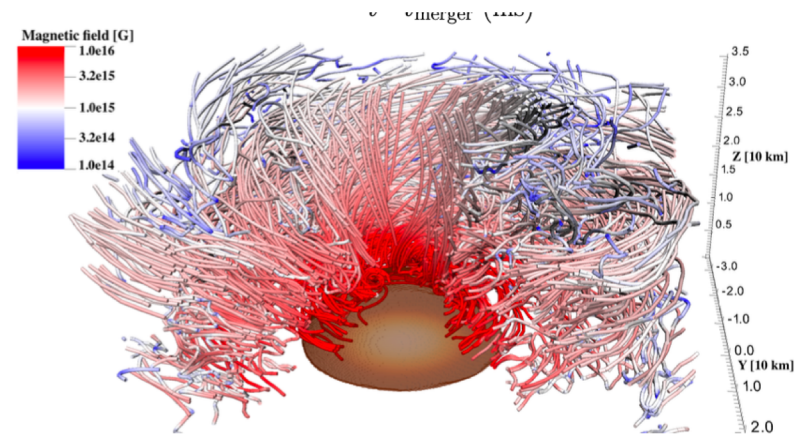


Central engine : ms magnetar or accreting Black Hole ?



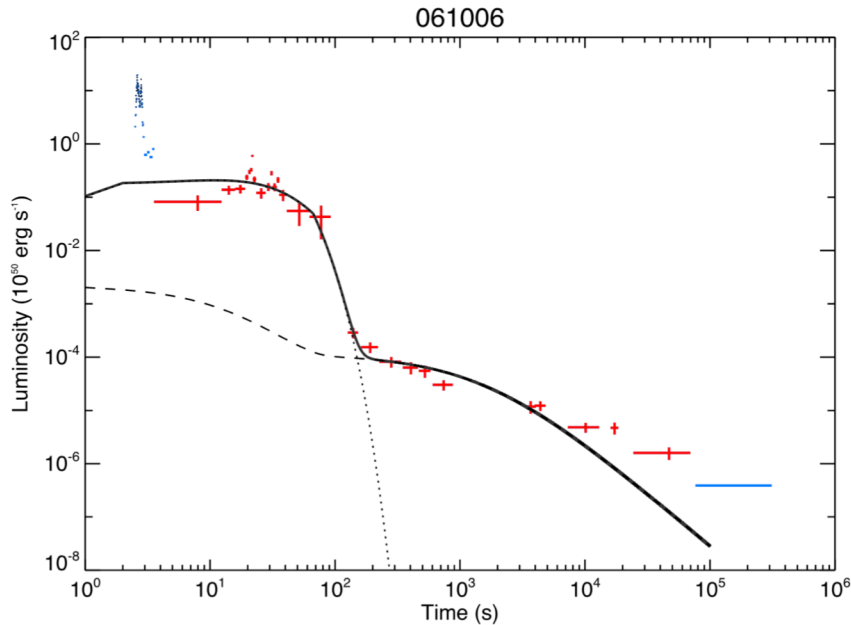
3 possibilities :

- direct collapse to a black hole
- hypermassive NS stabilized by rotation : delayed collapse
- stable neutron star



Kiuchi, Reoul-Salze+2023

X-ray plateaus: a sign of magnetar activity ?



From Gompertz+2014

Lightcurves can be fitted :

- Magnetar dipole spin-down
- Interaction with accreting matter
- Emission efficiency ?

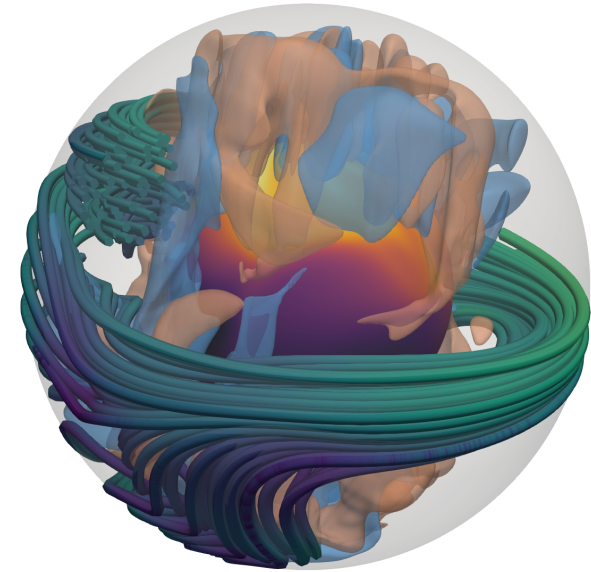
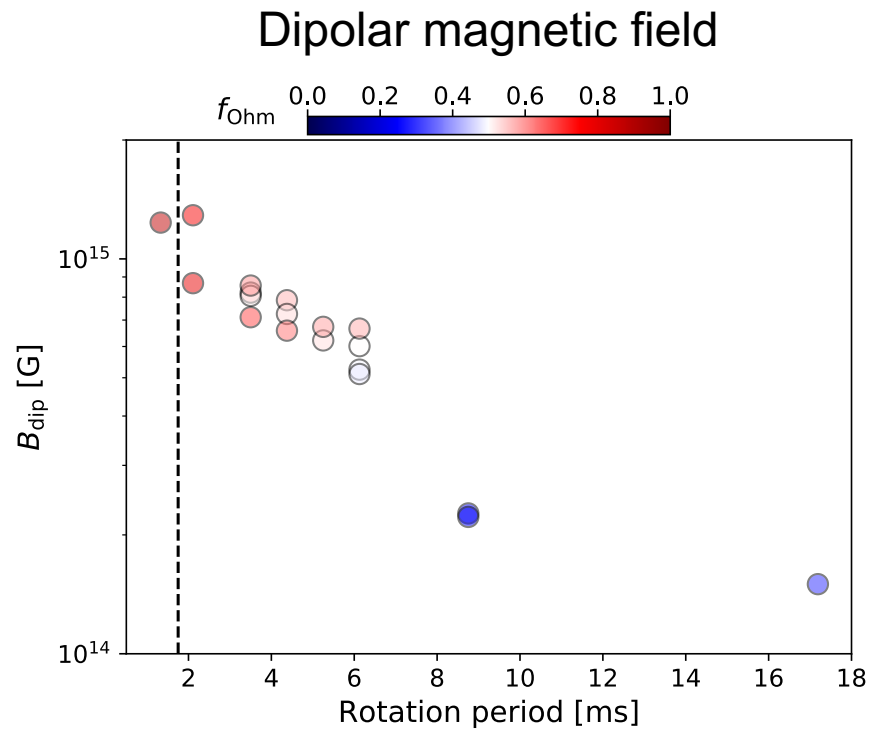
Deduce B field, rotation period

NB : Other interpretations can be possible

Zhang+2001, Fan&Xu2006, Metzger+2008,
Rowlinson+2010, 2013, Gompertz+2013,2014,
Lu+2015, Gao+2016

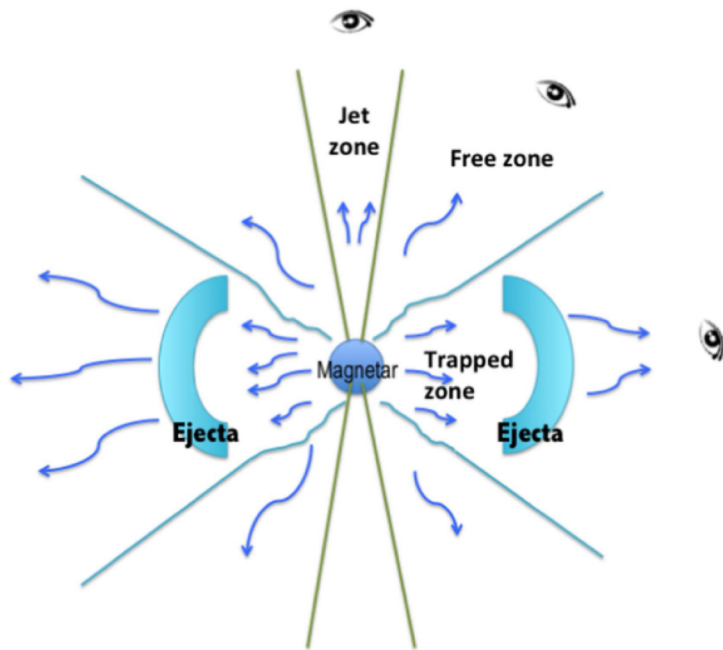
Comparison to protoneutron star dynamos ?

Convective dynamo simulations



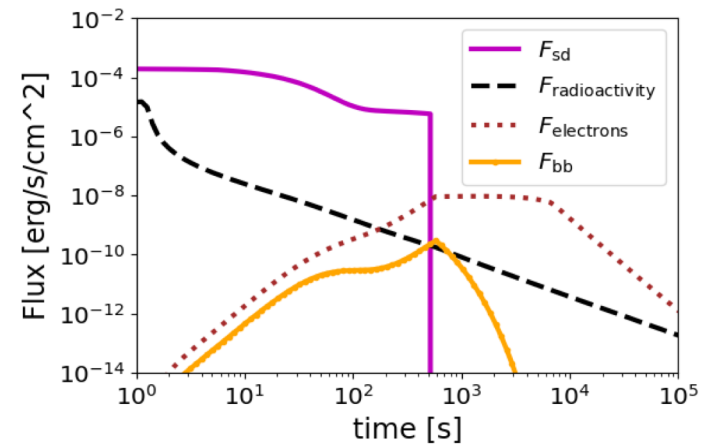
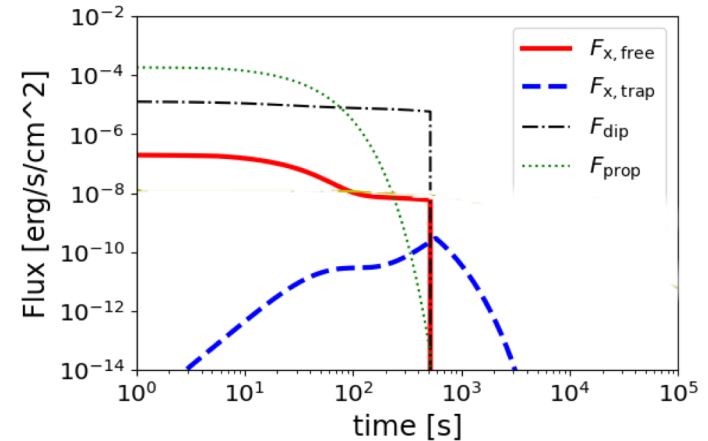
Raynaud et al 2020

Magnetar-driven X-ray electromagnetic counterpart of GW ?



PhD of Clara Plasse

Diego Gotz, Jérôme Guilet, Nicolas Leroy,
Alexis Reboul-Salze



GRBs: Guilet, Raynaud, Bugli

Thank you !