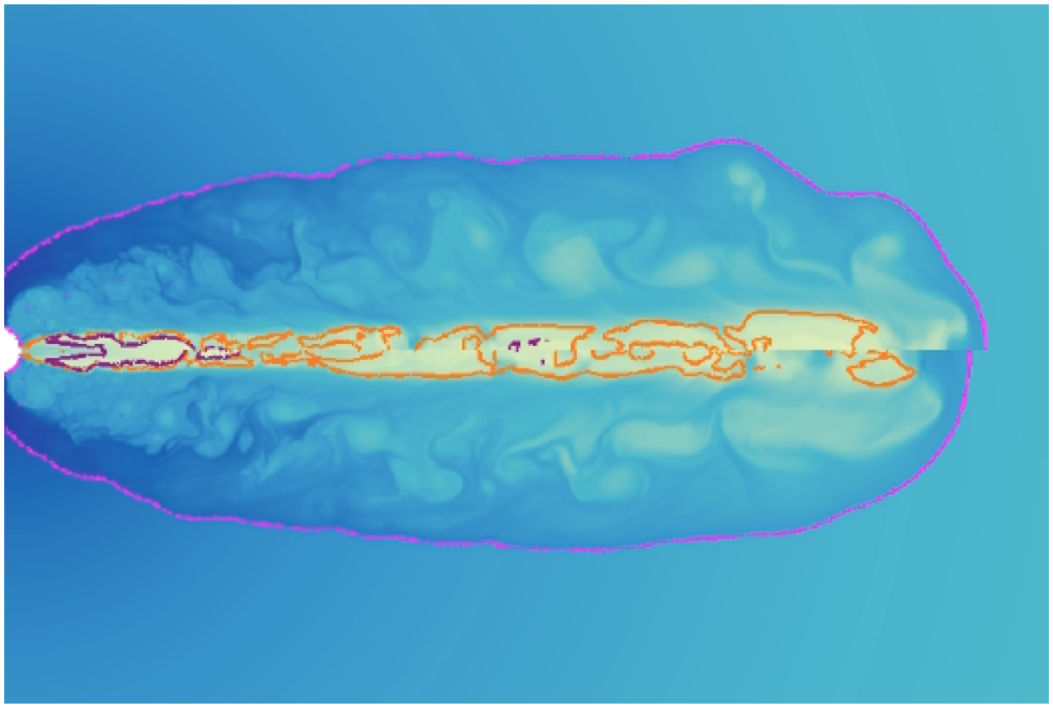
The prompt evolution of a SGRB jet through magnetized media



Diego López-Cámara (IA-UNAM)

+ Leonardo **Garcia-Garcia** (IA-UNAM), Davide **Lazzati (OSU)**

(García-Garcia et al. 2023)

SGRBs… (jets vs $\rho \uparrow\uparrow$)

$L_{iso} \sim 10^{49} - 10^{52}\ \mathrm{erg\ s^{-1}}$

(Ghirlanda et al. 2009, Berger 2013)

$\mathrm{v} \sim \mathrm{c}\ \ (\Gamma \gg 1)$

(Piran 1999, Ghirlanda et al. 2018)

$\theta_j \cong 5^\circ - 25^\circ$

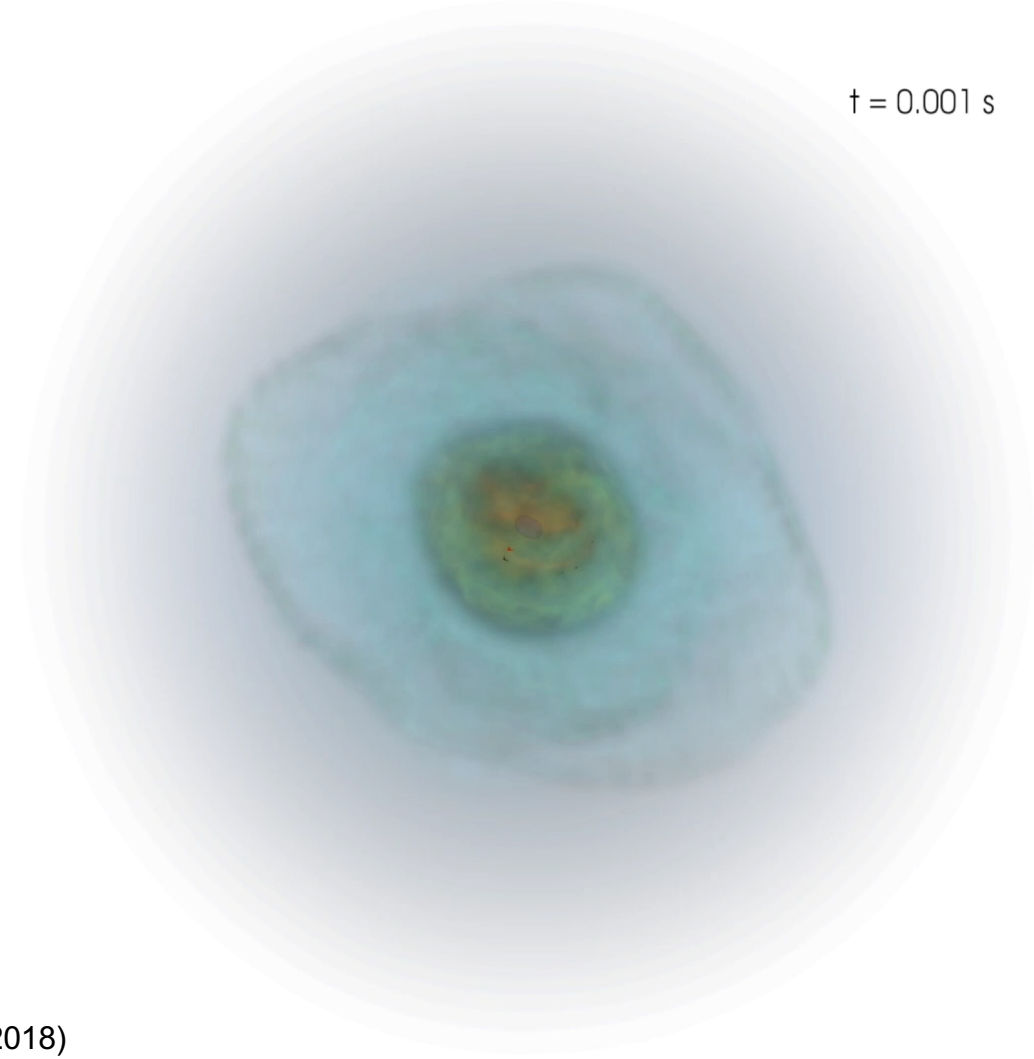
(Berger 2013, Fong et al. 2015)

$T_{90} < 2\ s$

(Kouveliotou et. al. 1993)

Progenitor: BNS merger

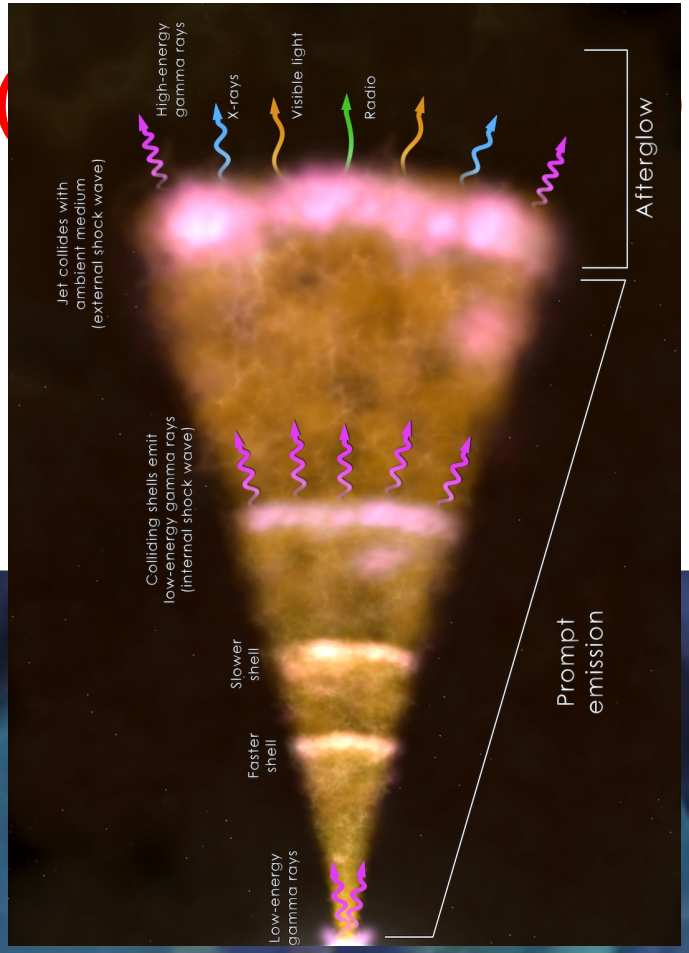
(Abbot et al. 2017; Lazzati et al. 2018, Mooley et al. 2018)



B_m effects? (Lazzati et al. 2021)

GRB170817A… (

Thanks Rosa and Ny Avo

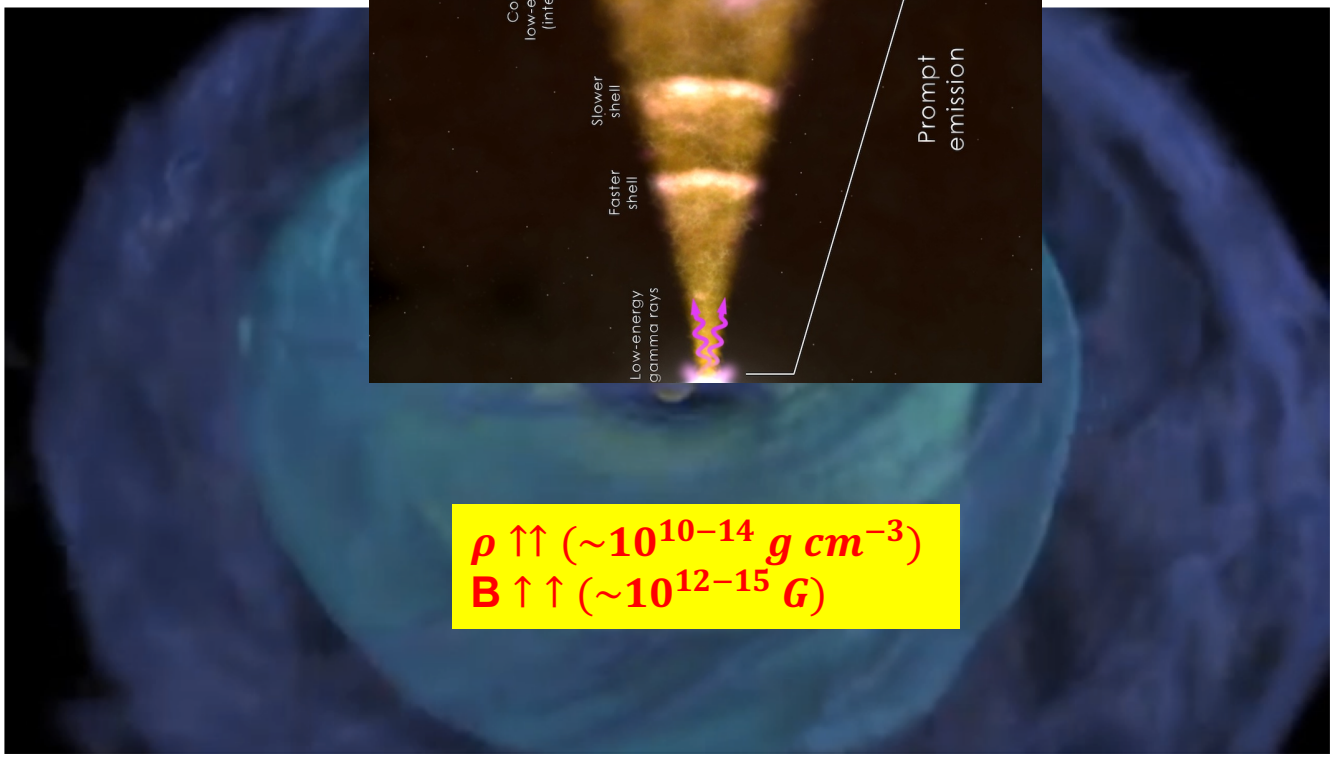


(Cavallo & Rees 1978)

BNS merger

+

SGRB
(off-axis)



(Ciolfi, et al. 2017)

Objective of this study…

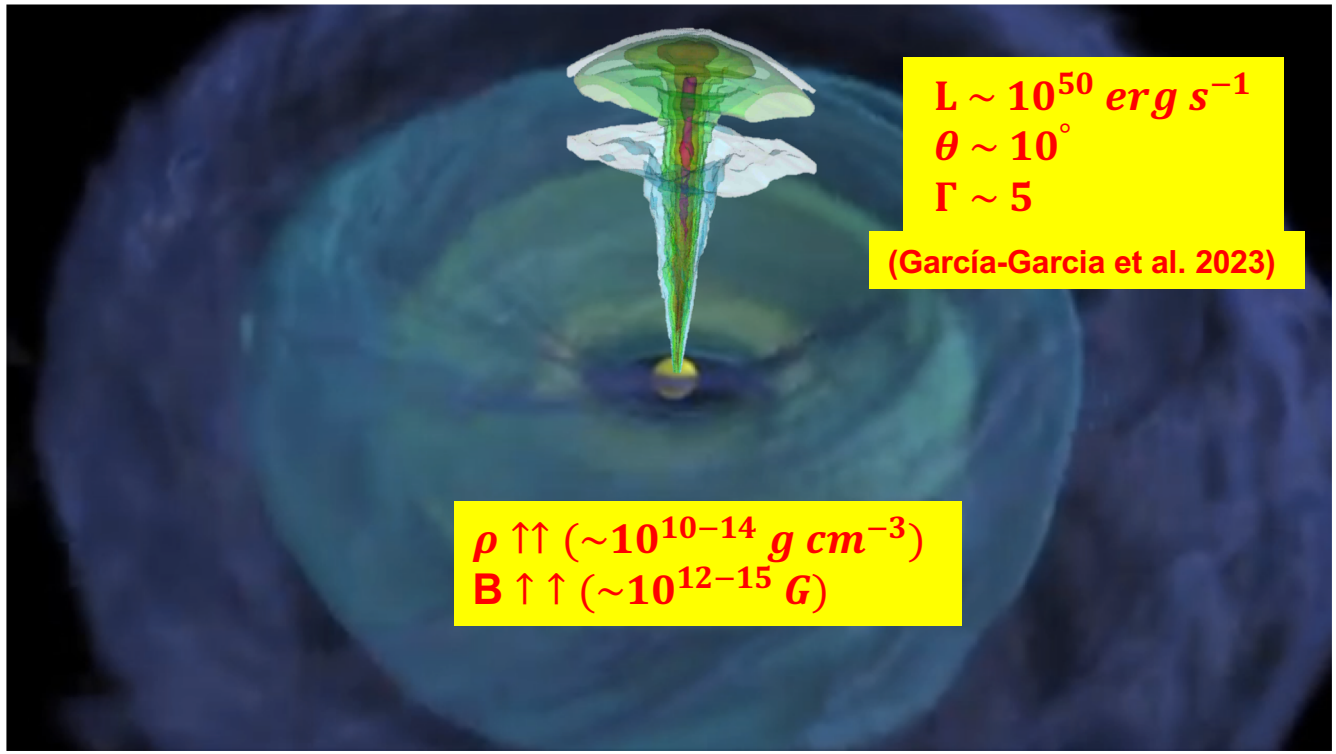
2D relativistic jet vs $\rho \uparrow\uparrow$ + B $\uparrow\uparrow$ media

… **PLUTO** RMHD code (Migone et al 2007)
(spherical coordinates)

BNS merger

+

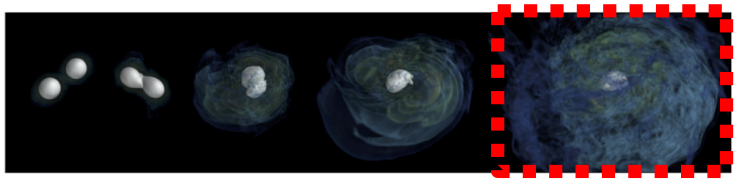
SGRB
(RHD jet)



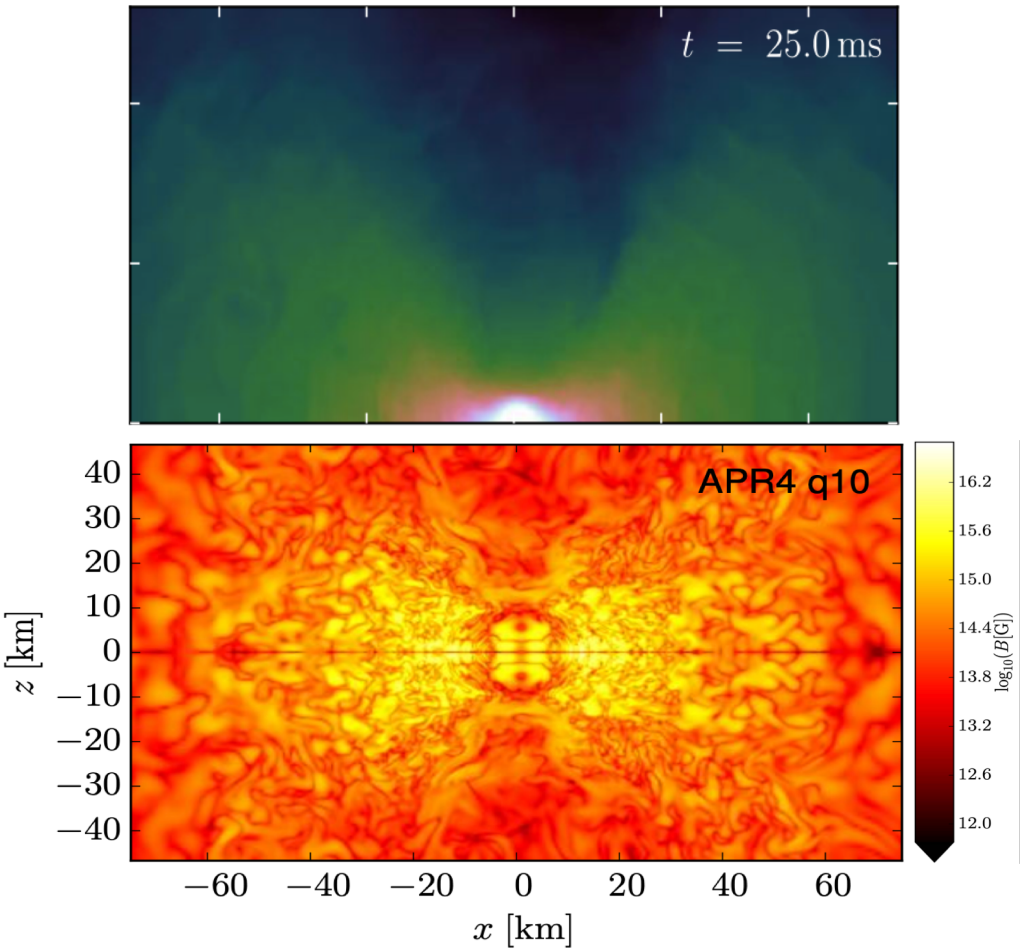
Setup… (ρ and B medium)

$\rho_m \sim 10^{8-14}\ g\ cm^{-3}$

3D GRMHD NS-NS merger study



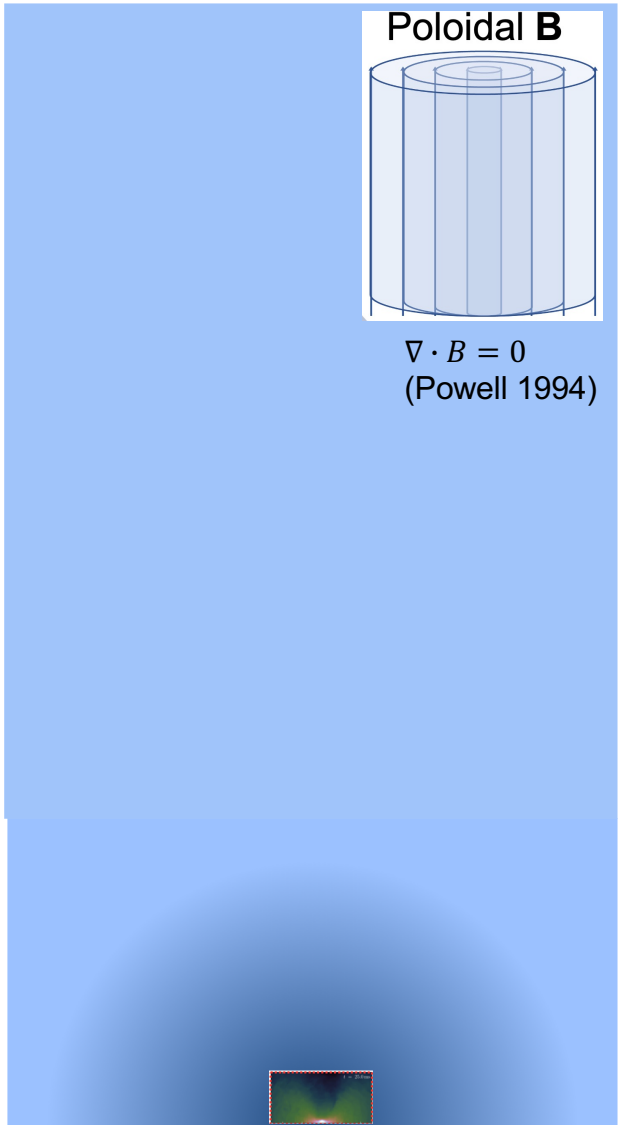
q=1
EoS = APR4
(Ciolfi et al. 2017)



$B_m \sim 10^{12-16}\ G$

Setup… (ρ and B big medium)

12,000 km



BIG domain!

$$\rho_m \propto R^{-3}$$

$$B_m \propto R^{-2}$$

$$(\beta = P_g/P_B = const)$$

Setup… (jet vs ρ and B big medium)

$\beta_m = P_g/P_B$

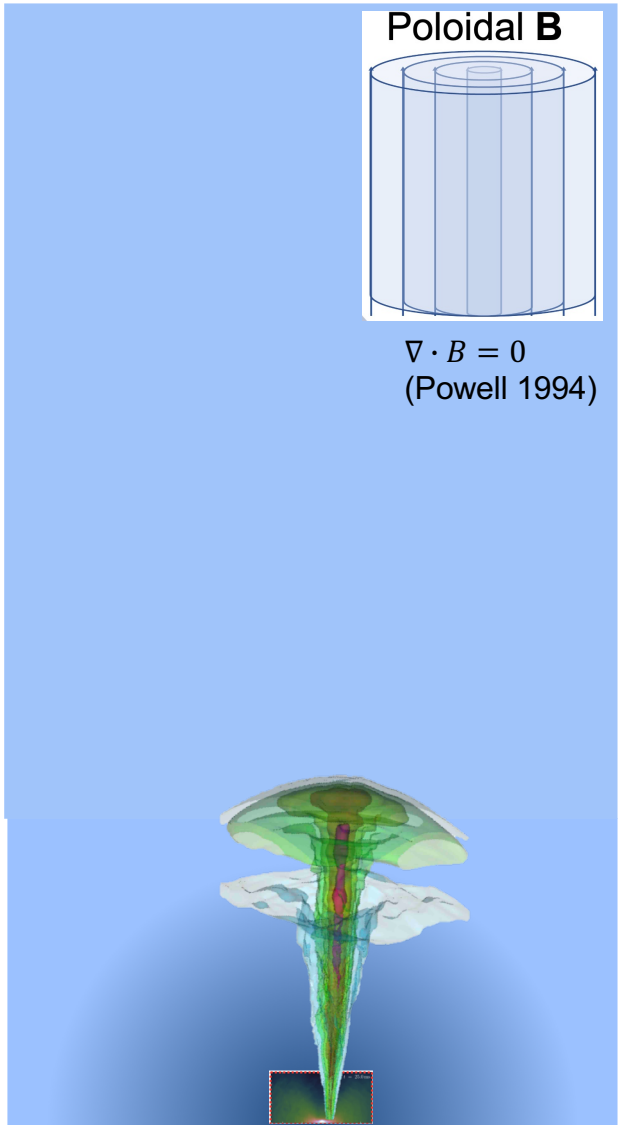
Jet!

$L_j = 10^{50}$ erg s^{-1}
$\theta_j = 10^{\circ}$
$\Gamma_{j,0} = 5$
$d_{co} = 200$ km

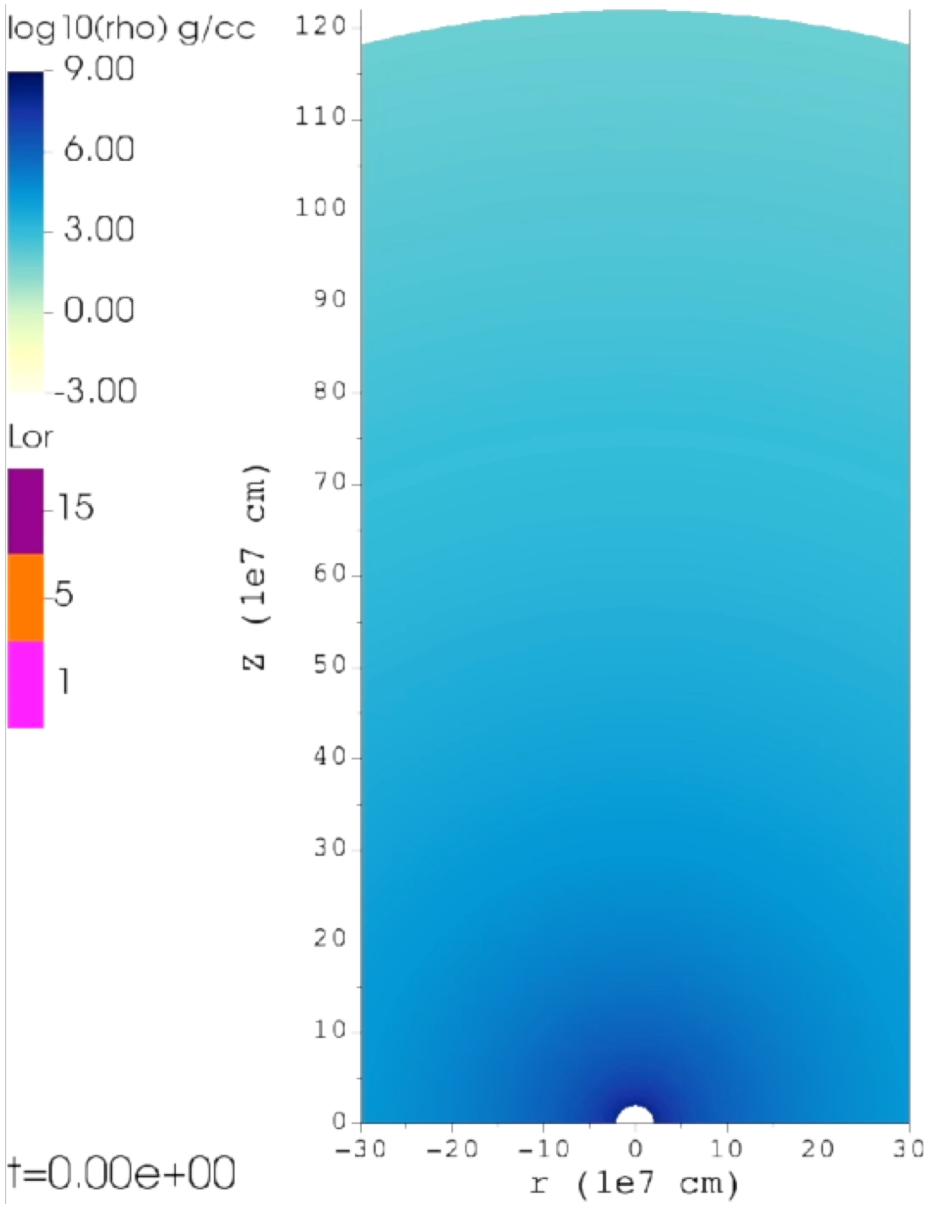
Name	β_m	Resolution
Control	∞	LR, MR, SR, HR
P0.1	0.1	SR
P0.5	0.5	SR
P1.0	1.0	SR
P5.0	5.0	SR
P20	10	SR
P25	25	SR
P50	50	SR
P75	75	SR
P100	100	SR
P500	500	SR
P1e4	10^4	SR

LR: $N_r = 6000$, $N_\theta = 600$
MR: $N_r = 8000$, $N_\theta = 800$
SR: $N_r = 10000$, $N_\theta = 1000$
HR: $N_r = 12000$, $N_\theta = 1200$

12,000 km



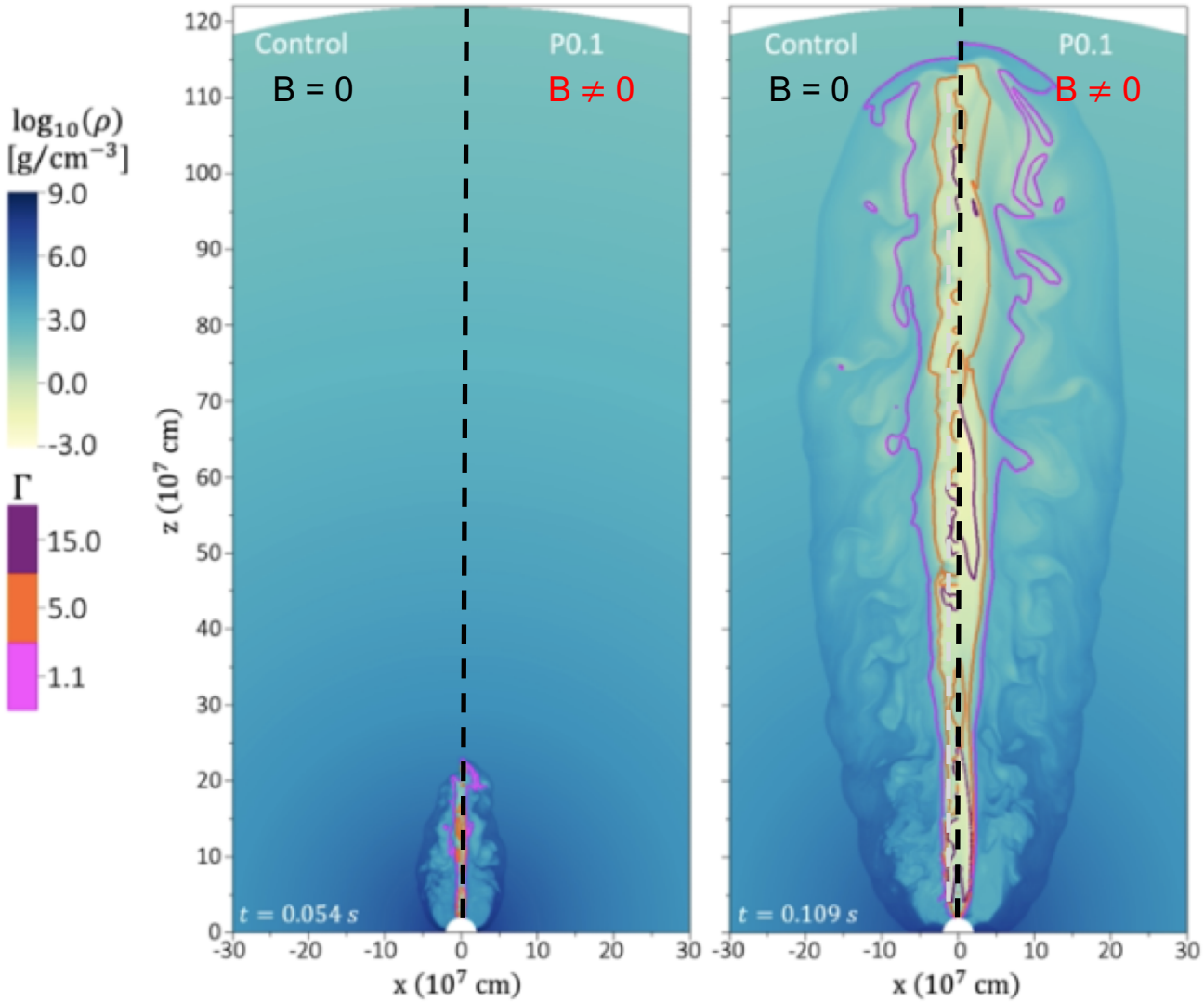
Jet in B medium…



$\beta_m = P_g/P_B = 0.1$

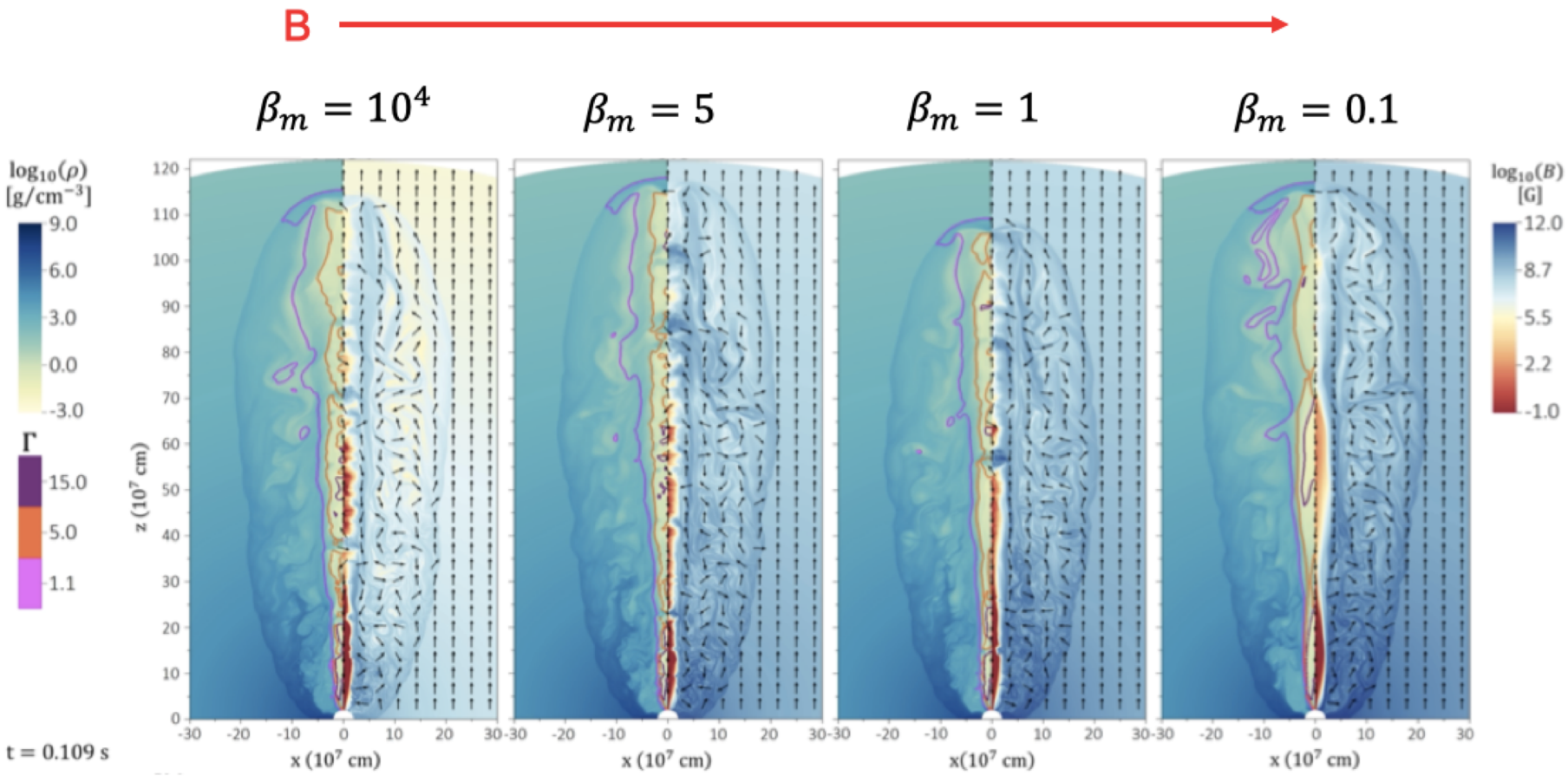
B vs no B…

$$\beta_m = P_g/P_B = 0.1$$

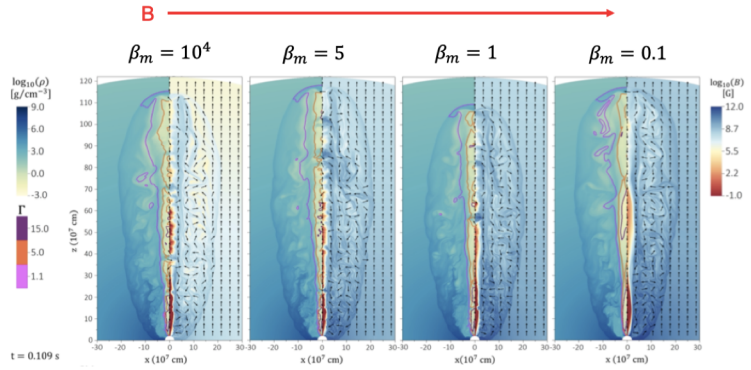


No clear difference… but with more models (and analysis)…

Different B… (effects in jet and cocoon)



Different B… (effects in jet and cocoon)



$\overline{B_i}$

$\uparrow B_m \Rightarrow \overline{B_j} \approx$

$(\overline{\beta_c} = \beta_m^{0.7})$

$\uparrow B_m \Rightarrow \overline{B_c} \uparrow\uparrow$

B_m

$\log_{10} \bar{\beta}$

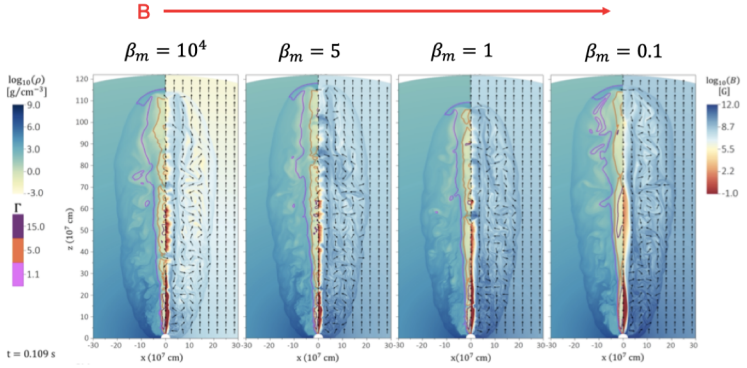
$(\overline{\beta_i} = \overline{P_g/P_{B,i}})$

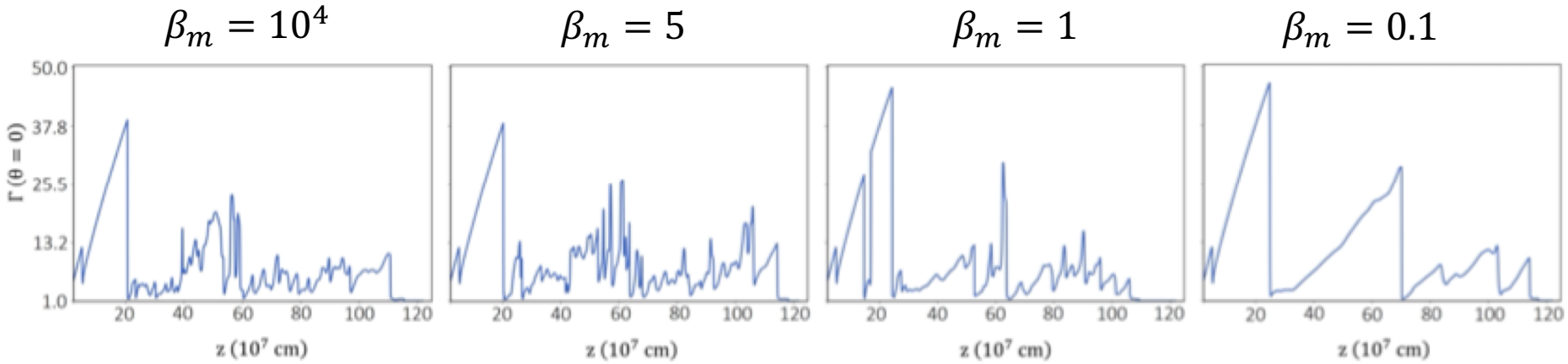
$\bar{\beta}_J$

$\bar{\beta}_c$

$-\log_{10} \beta_m$ $\left(1/\beta_m = P_B/P_g\right)$

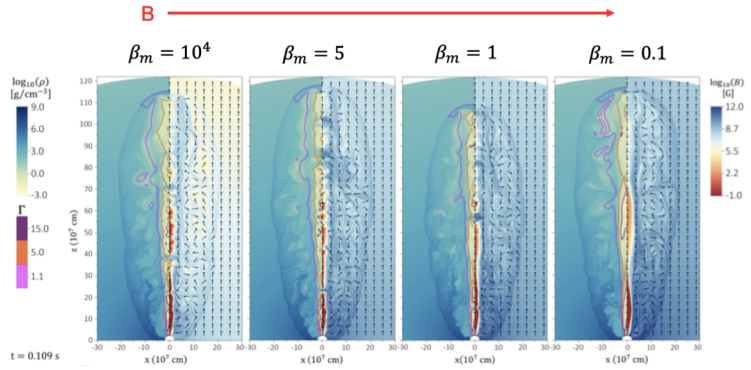
Different B… (effects in shocks)

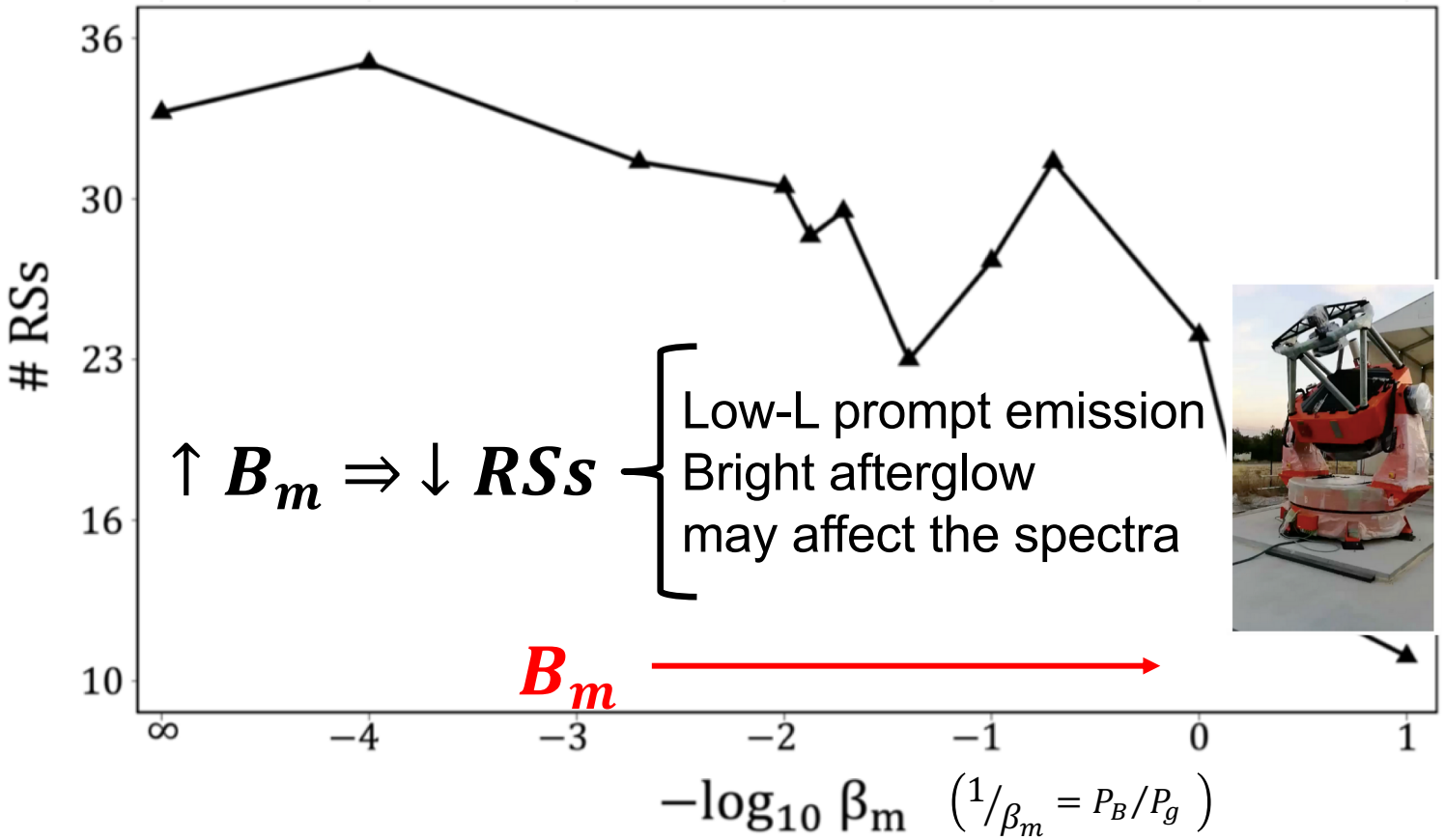




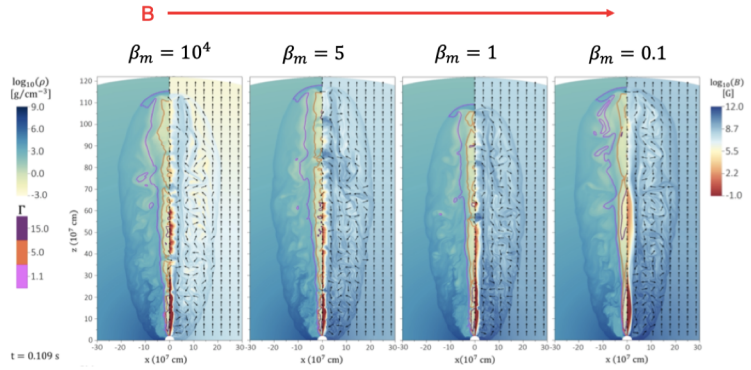
$$B_m \propto RSs\ ?...$$

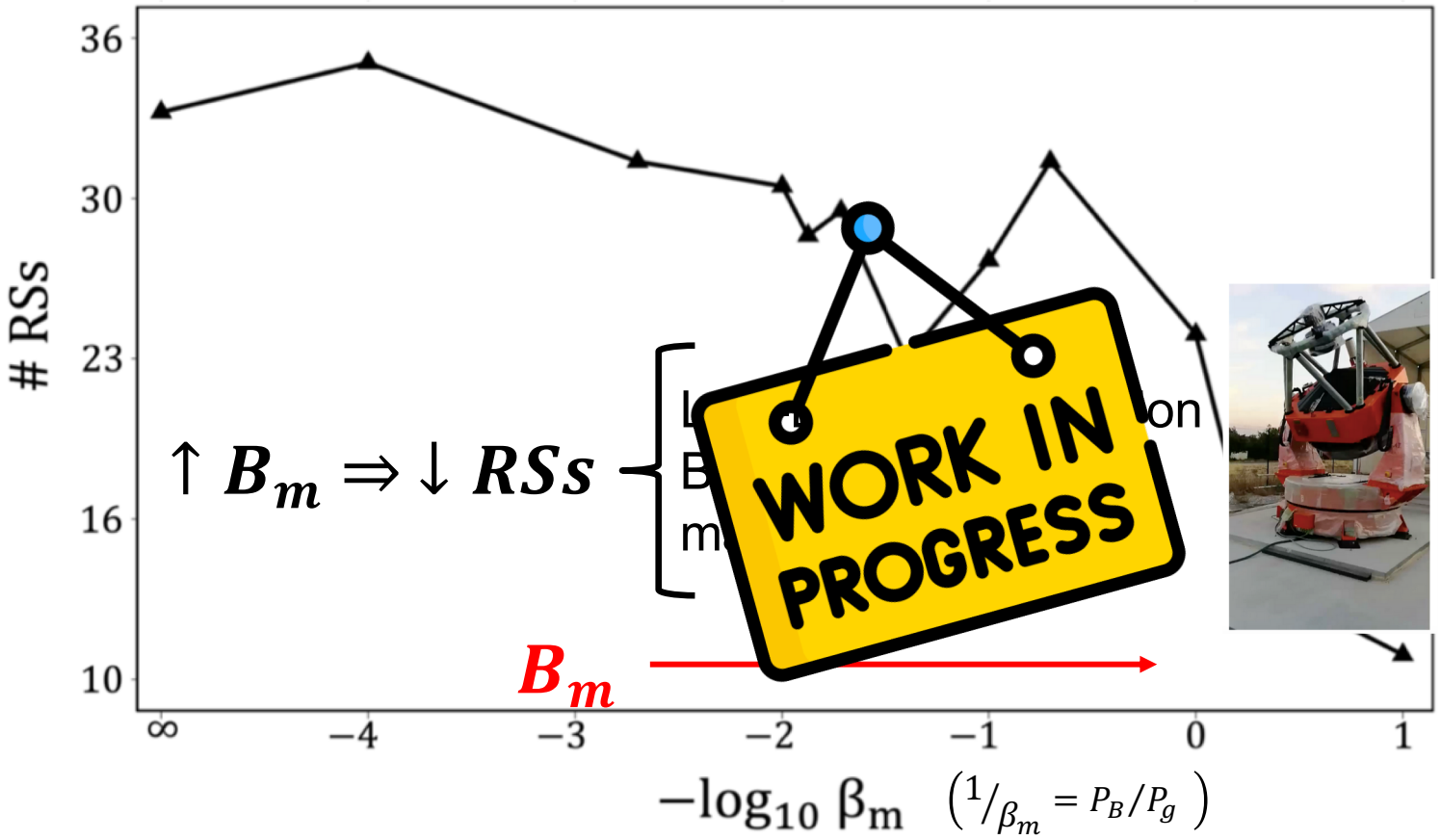
Different B… (effects in shocks)





Different B… (effects in shocks)





Conclusions…

2D relativistic jet vs ρ ↑↑ + B ↑ ↑ media

↑ B_m ⇒ $\overline{B_c}$ ↑ (cocoon magnetization)

↑ B_m ⇒ ↓ RSs (suppression of RSs) ⇒ low-L prompt + bright afterglow

v_{Jh} and the induced $\overline{B_j}$ are ~ independent from B_m

Future numerical studies with a larger domain are necessary to obtain LCs and spectra in order to better understand the role of B_m