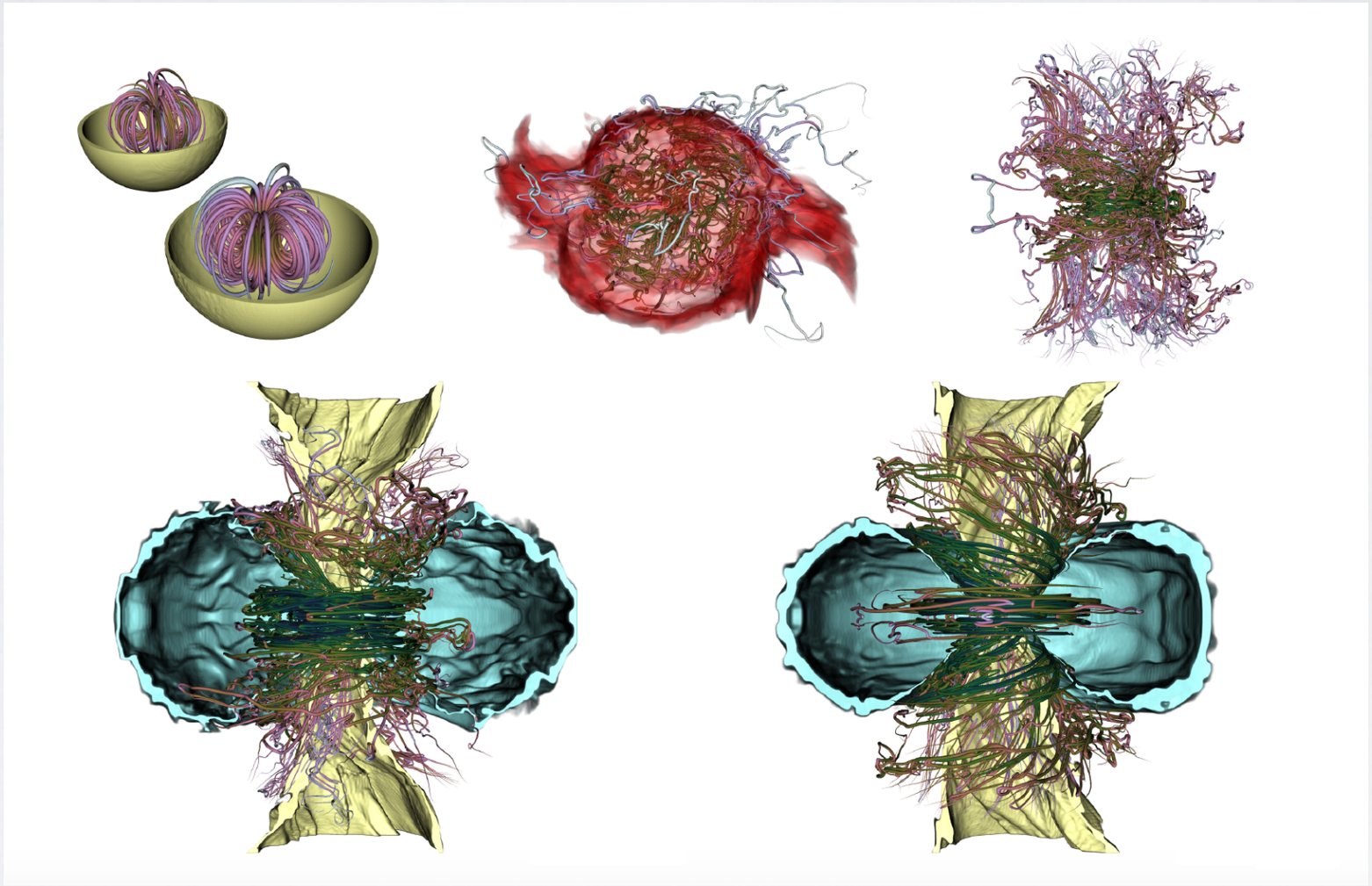
High-Mass Magnetized Binary Neutron Star Mergers And Short Gamma-Ray Bursts



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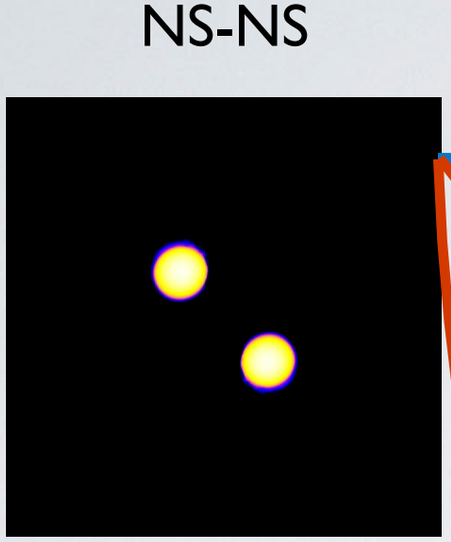
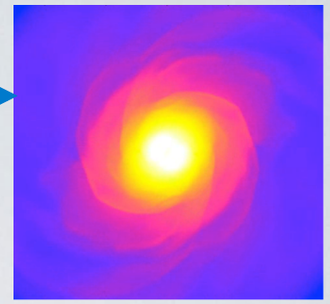
TIFPA
Trento Institute for Fundamental Physics and Applications

BNS MERGER OUTCOME



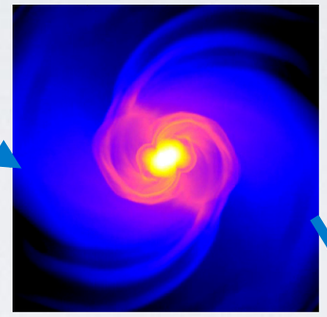
NS-NS

Low-Mass NS-NS



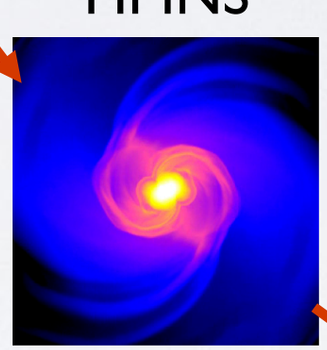
STABLE NS + Torus

SMNS



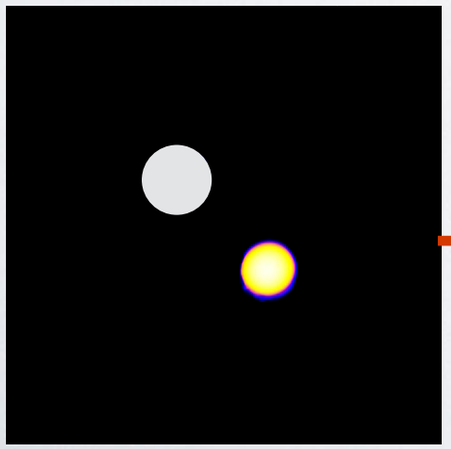
<~1 hour

HMNS

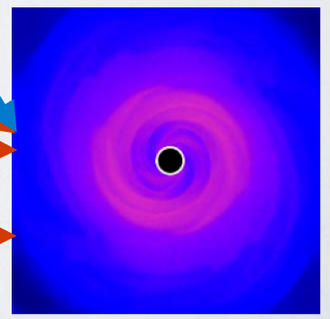


High-Mass NS-NS

<~1s



NS-BH

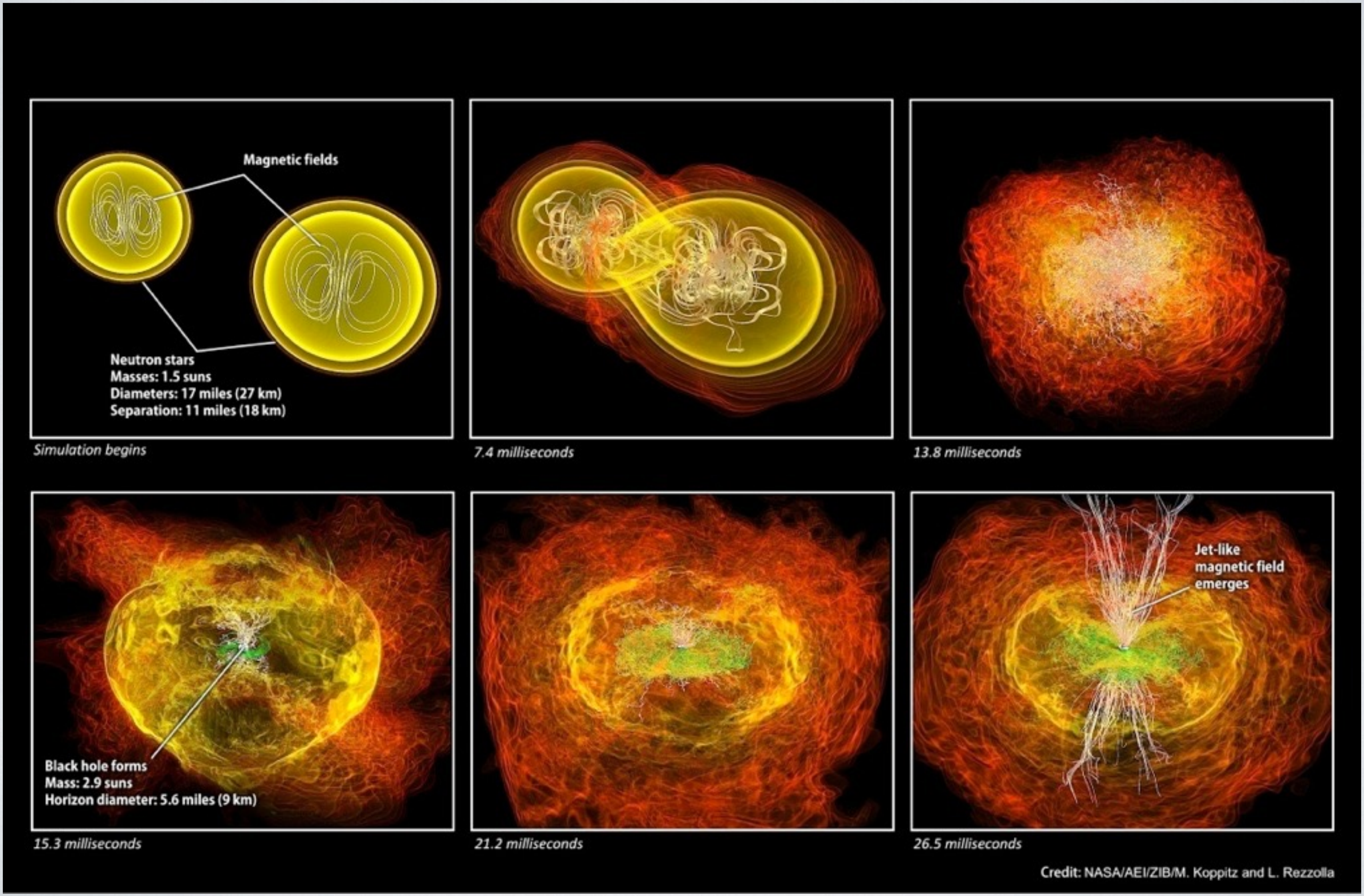


BH + TORUS

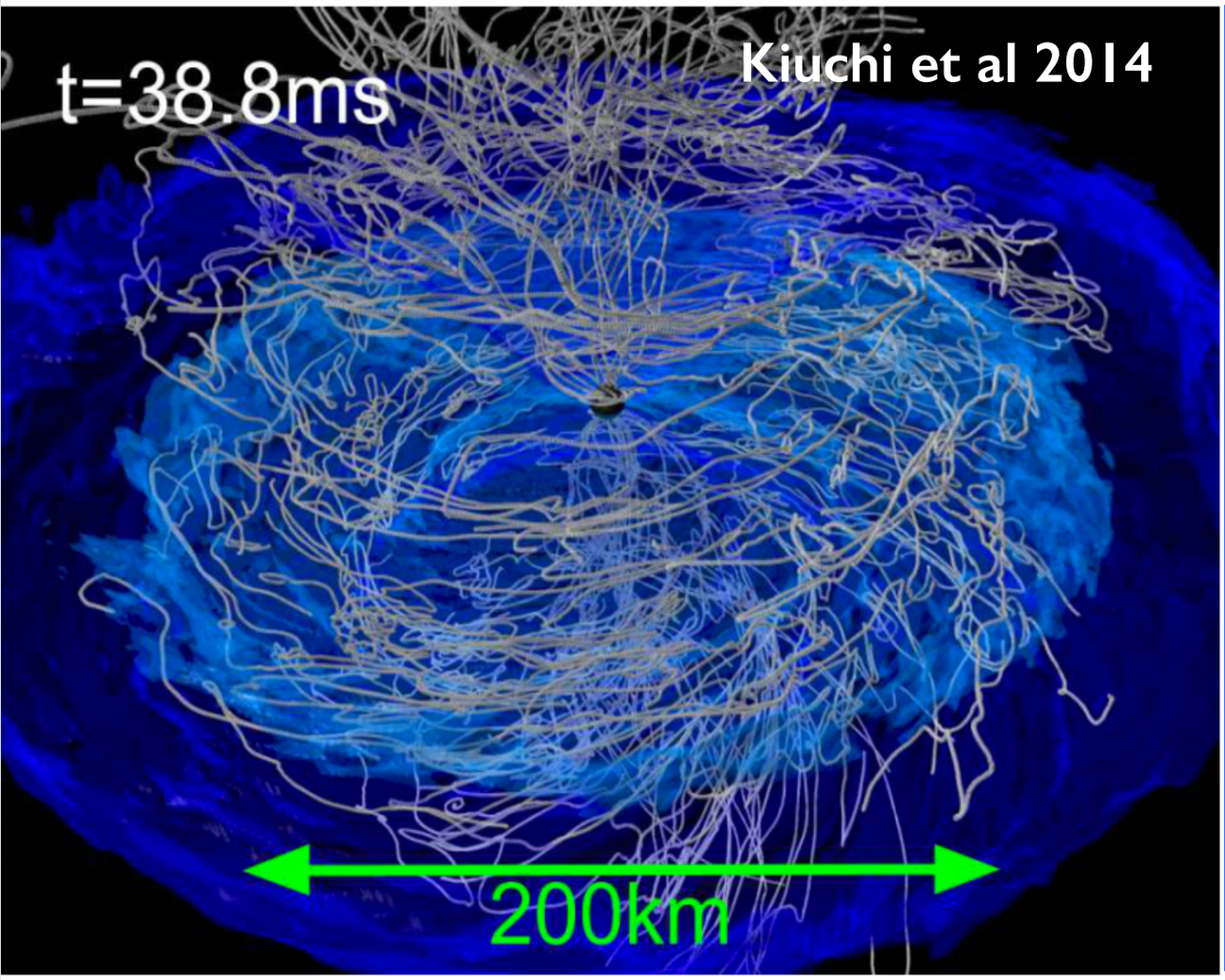
sim. & vis.: Wolfgang Kastaun

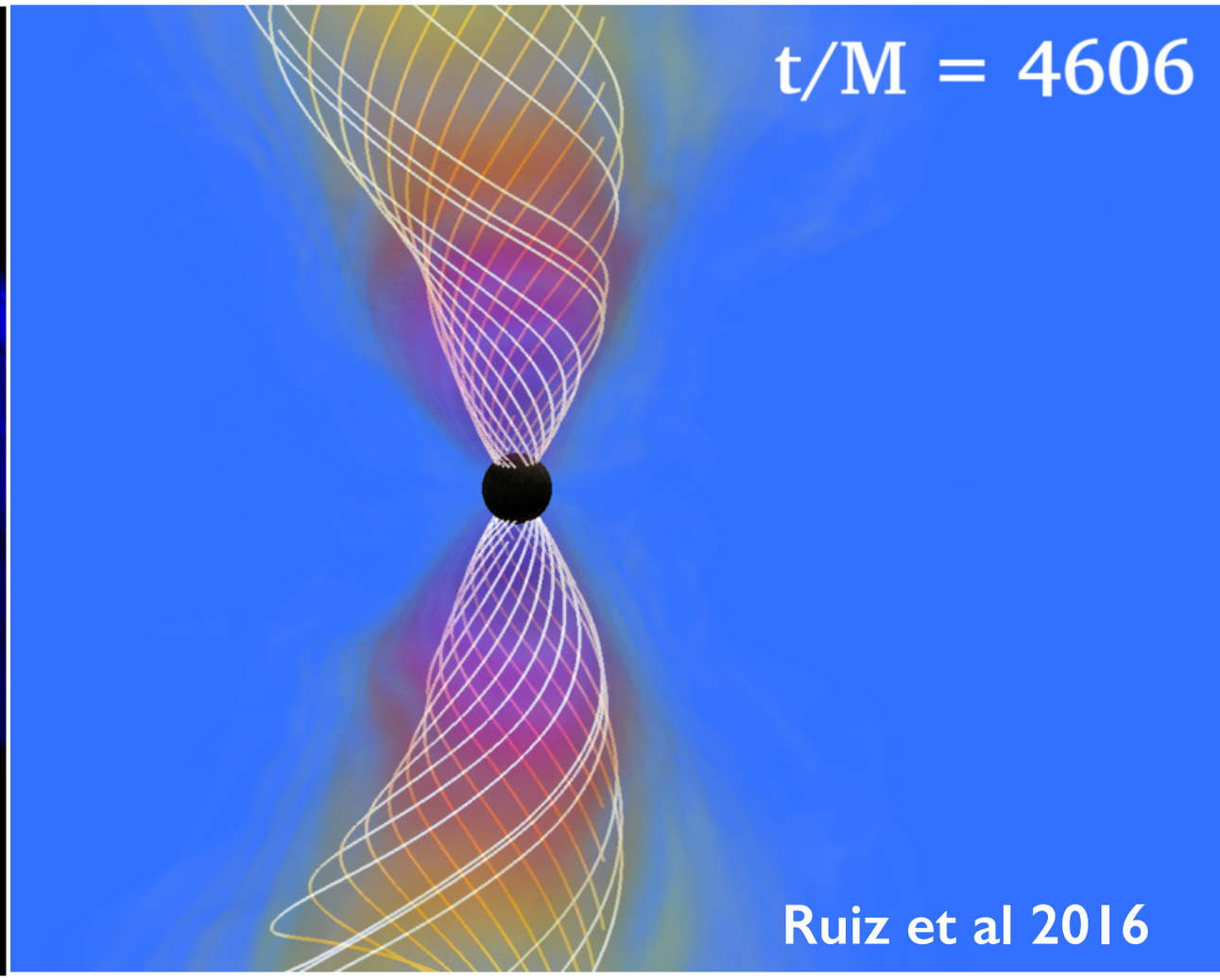
JETS FROM BNS MERGERS?

Rezzolla, **Giacomazzo**, Baiotti, Granot, Kouveliotou, Aloy 2011, ApJL 732, L6



Jet or no Jet?





Missing Link (Rezzolla et al 2011): showed formation of strongly collimated magnetic fields after collapse to BH.

Kiuchi et al 2014: reported no ordered structure in the magnetic field.

Ruiz et al 2016: mildly relativistic collimated outflow

Effects of EOS, mass-ratio, and initial magnetic fields

Kawamura, Giacomazzo, Kastaun, Ciolfi, Endrizzi, Baiotti, Perna 2016, PRD 94, 064012

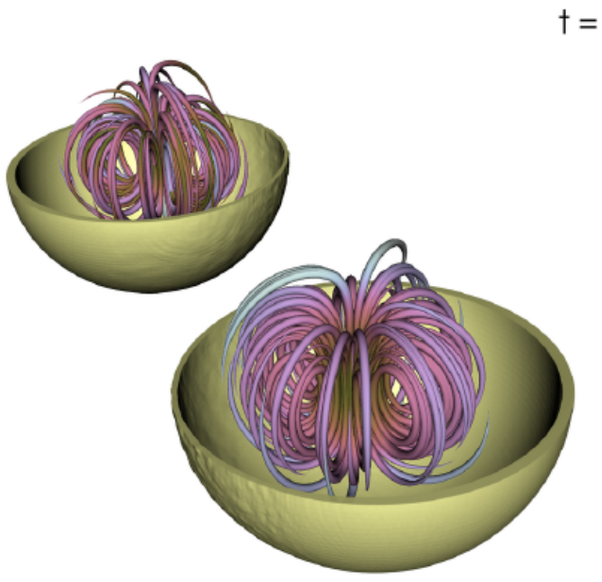
We performed a set of new GRMHD simulations:

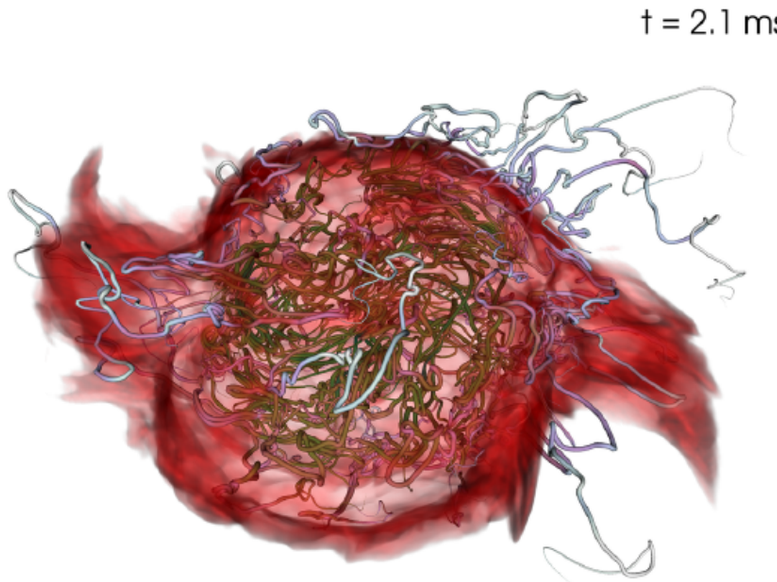
- Ideal-Fluid EOS:
  - Equal-Mass (1.5-1.5) with field alignment UU, UD, DD
  - Unequal-Mass (1.4-1.7)
- H4 EOS:
  - Equal-Mass (1.4-1.4)
  - Unequal-Mass (1.3-1.5)

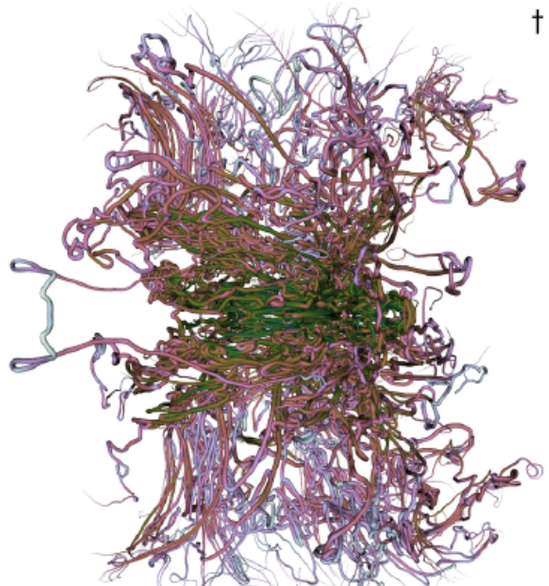
All models start with an initial magnetic field of ~10^{12} G (vs ~10^{15} G of Ruiz et al 2016).

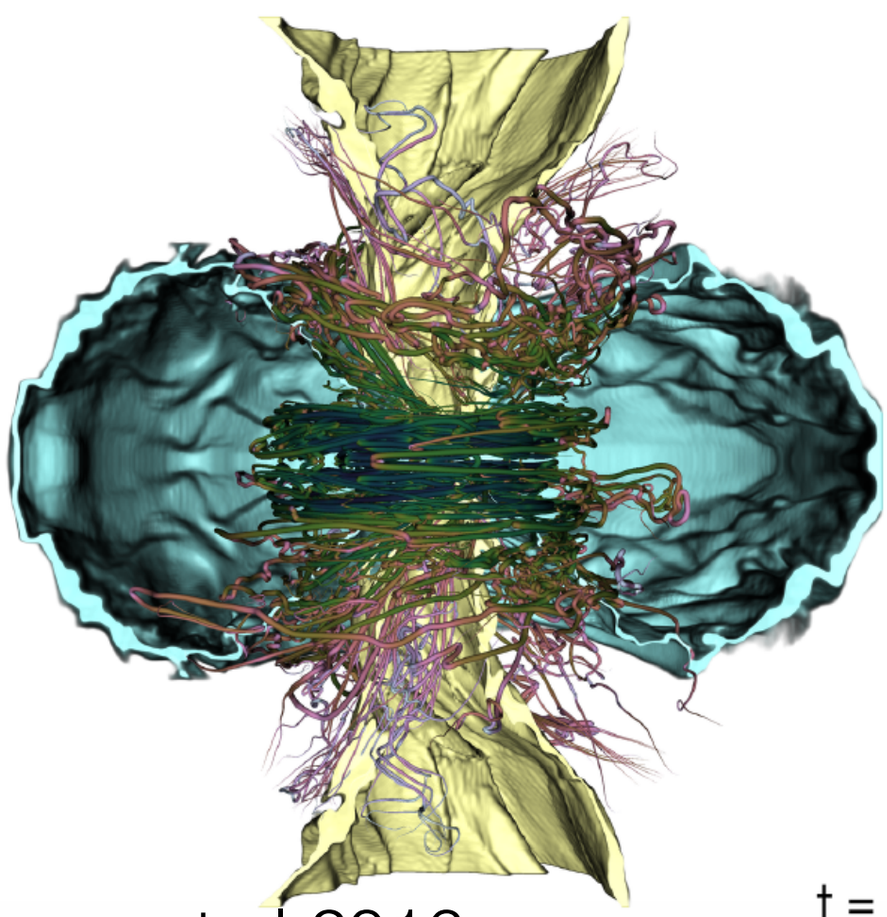
Unequal-mass models studied for the first time.

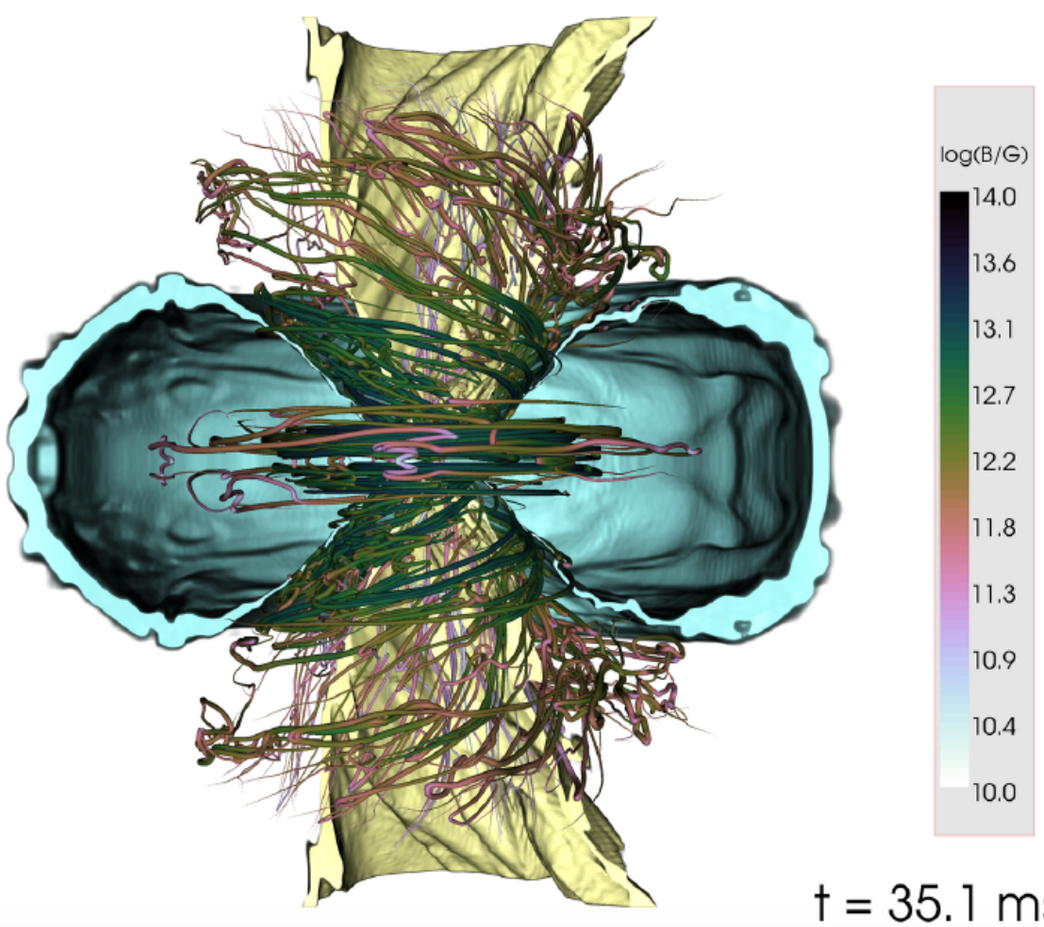
Typical Magnetic Field Structure Evolution







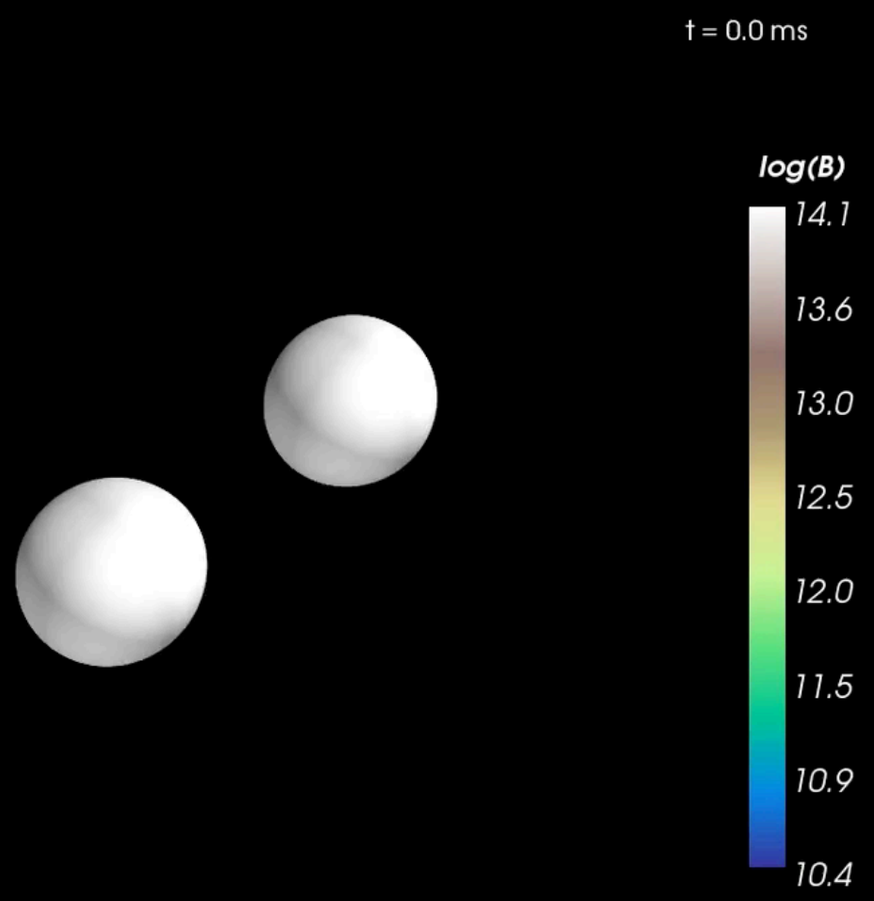




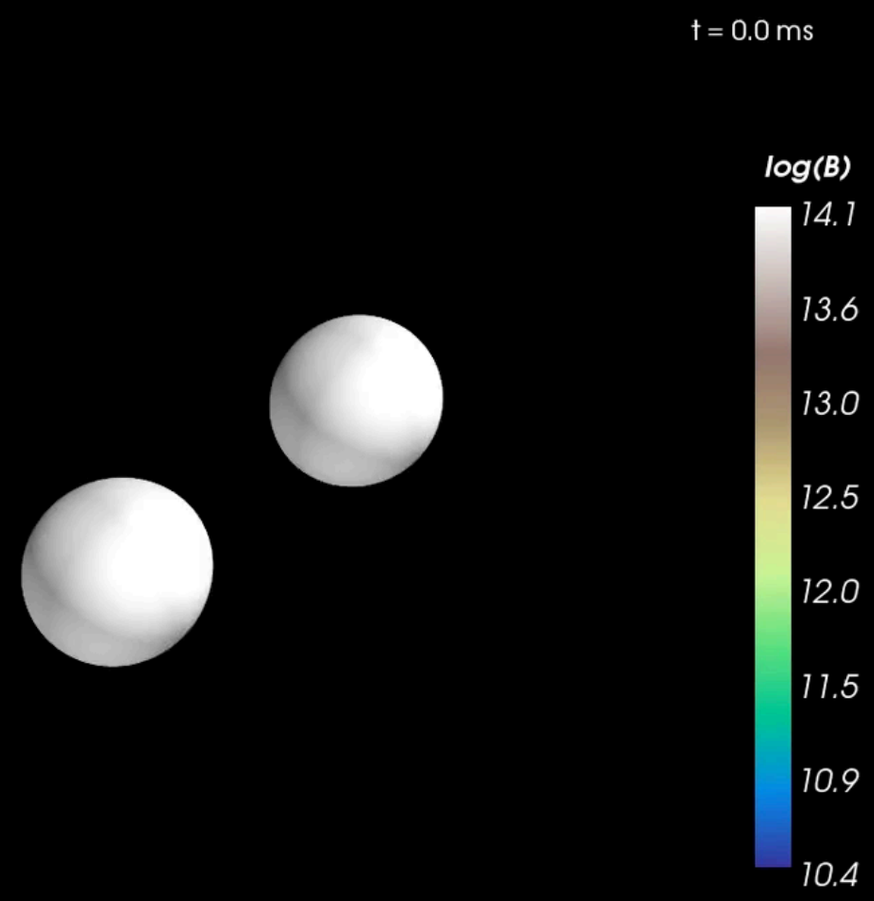
Kawamura et al 2016

UU vs UD (Ideal Fluid Equal Mass)

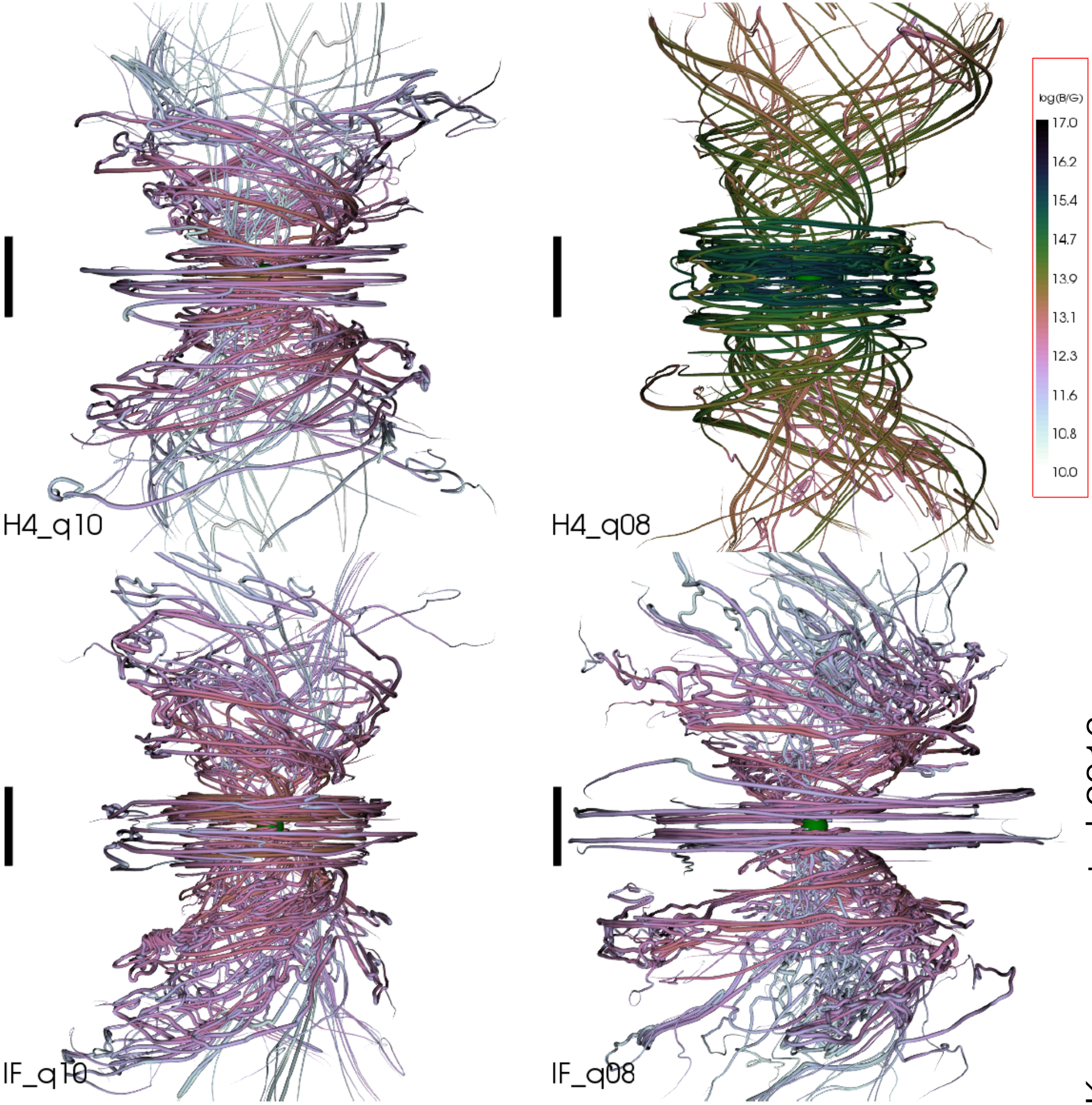
Up–Up



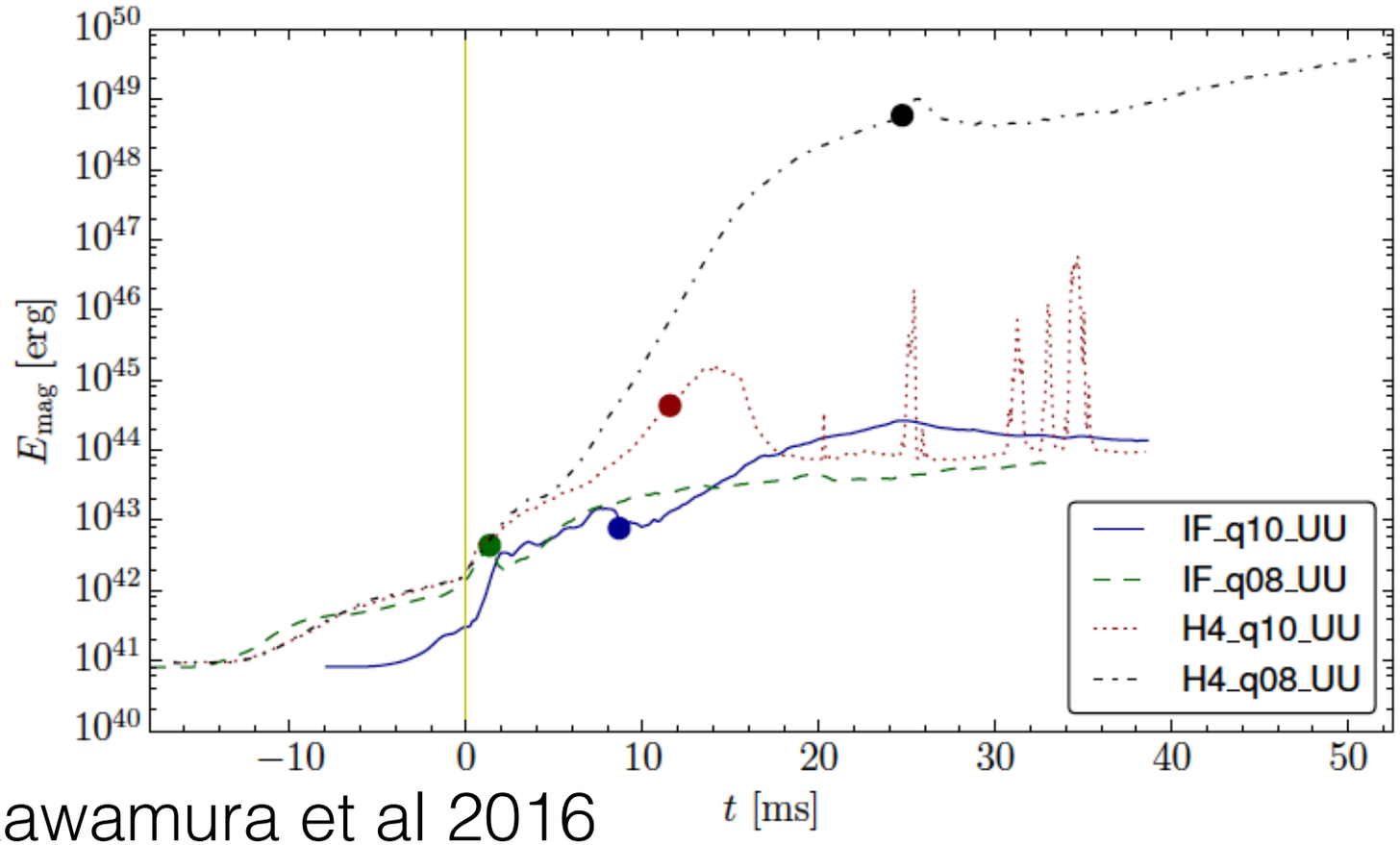
Up–Down



Role of EOS and Mass Ratio



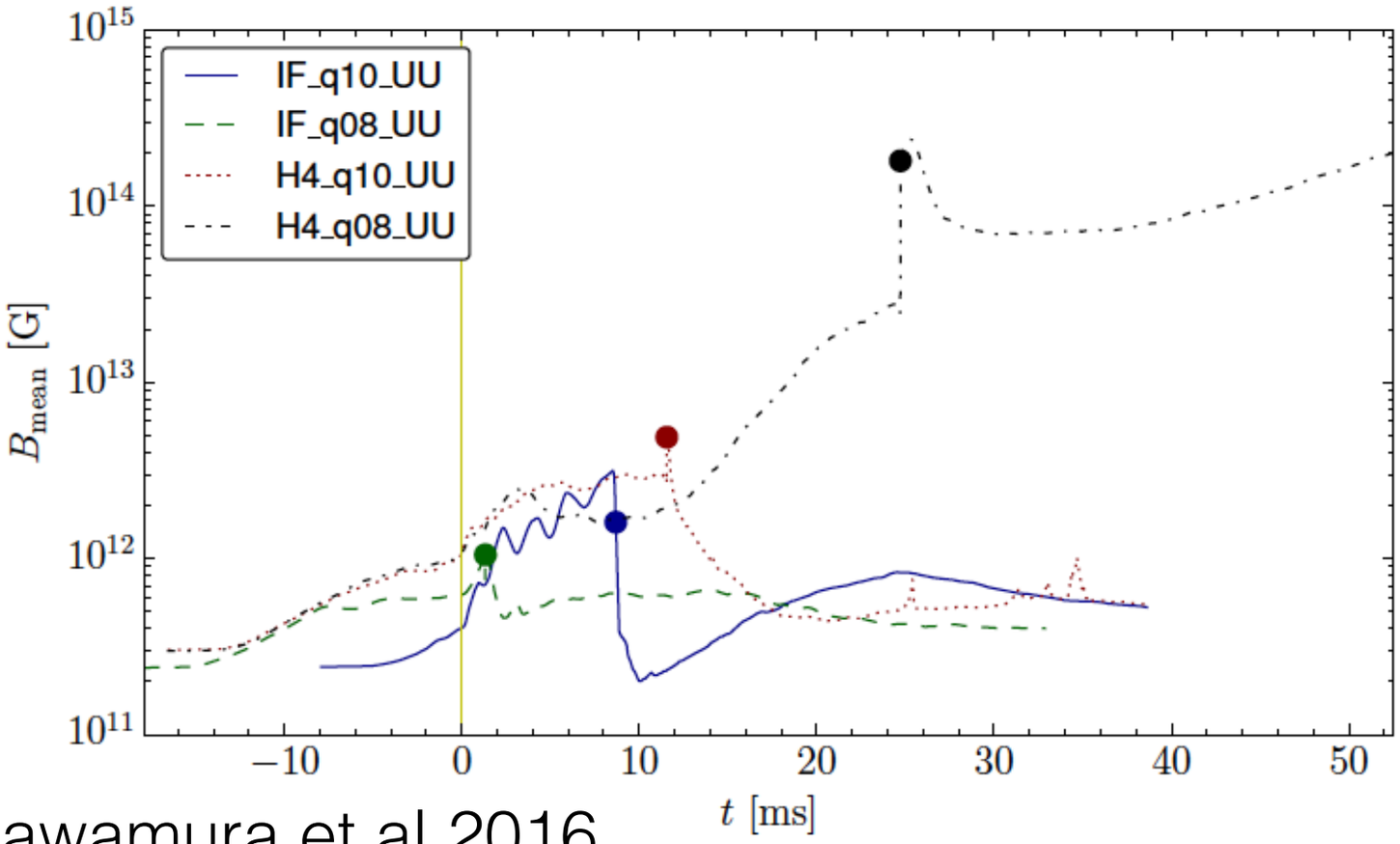
Kawamura et al 2016



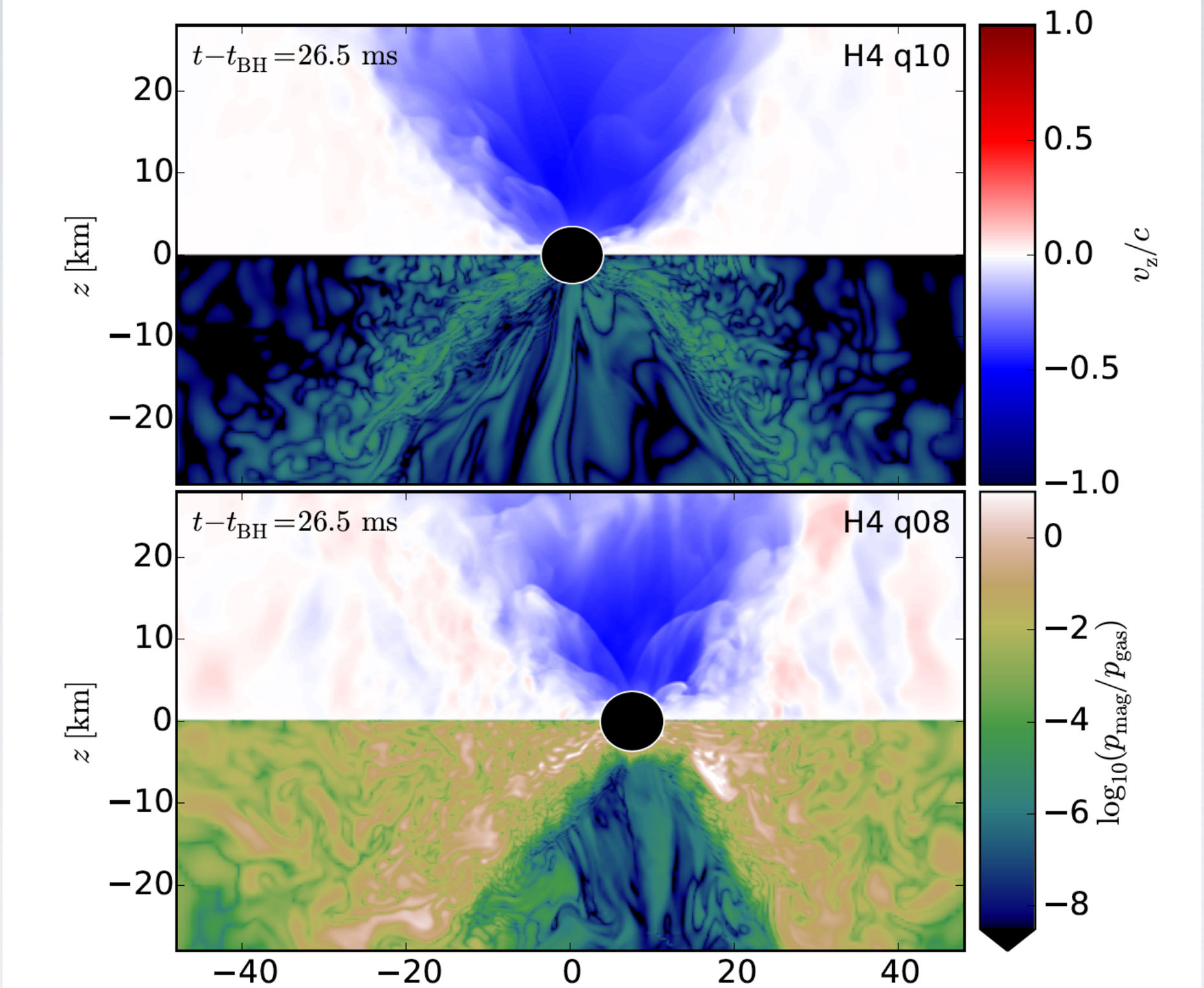
Kawamura et al 2016

H4_q08 has the longest-living HMNS and show largest magnetic field amplification.

Large magnetic fields survives also after BH collapse.
Possible to resolve MRI in this case.



Kawamura et al 2016



Kawamura et al 2016

No Jet observed, but it may change with longer evolutions and (much) higher resolutions.

CONCLUSIONS

- Performed GRMHD simulations of BNS systems
- Collimated magnetic field structure seems to be universal (independent of EOS and mass ratio)
- Magnetic fields can be strongly amplified in the post-merger phase
- No jet observed (no magnetically dominated region)
- Higher resolution simulations may help resolve Kelvin-Helmholtz and MRI instabilities and produce magnetically dominated funnel