

3D BNS merger ejecta evolution up to second timescales

Dynamics, Element Distribution, and Light Curves

Luis Felipe Longo Micchi

Friedrich-Schiller Universität

4th Feb, 2026



European Research Council
Established by the European Commission

1 Introduction

Motivations
Past Works

2 Methods

3 Ejecta Dynamics

4 Elements Formation and Distribution

5 Light Curves

6 Conclusions and Future Work

1 Introduction

Motivations

Past Works

2 Methods

3 Ejecta Dynamics

4 Elements Formation and Distribution

5 Light Curves

6 Conclusions and Future Work

Importance of BNS ejecta

- A
- B

1 Introduction

Motivations

Past Works

2 Methods

3 Ejecta Dynamics

4 Elements Formation and Distribution

5 Light Curves

6 Conclusions and Future Work

What has been done?

- A
- B

1 Introduction

2 Methods

NR simulations

Post-Processing

3 Ejecta Dynamics

4 Elements Formation and Distribution

5 Light Curves

6 Conclusions and Future Work

1 Introduction

2 Methods

NR simulations

Post-Processing

3 Ejecta Dynamics

4 Elements Formation and Distribution

5 Light Curves

6 Conclusions and Future Work

- Original THC Simulations
- Athena++ extensions
 - Injection
 - Transition EOS
 - NR Set-up

1 Introduction

2 Methods

NR simulations

Post-Processing

3 Ejecta Dynamics

4 Elements Formation and Distribution

5 Light Curves

6 Conclusions and Future Work

Post-Processing

- KNEC code for light curves
- WinNet for nucleosynthesis

- 1 Introduction
- 2 Methods
- 3 Ejecta Dynamics**
- 4 Elements Formation and Distribution
- 5 Light Curves
- 6 Conclusions and Future Work

Homology parameter

- A
- B

Heating Rates Effects

- A
- B

Heating Rates Effects

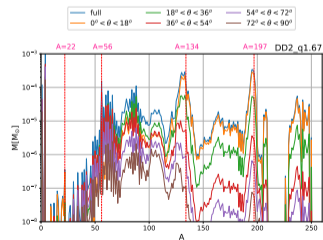
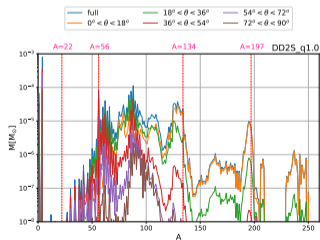
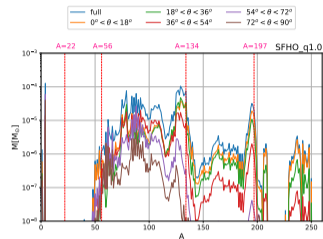
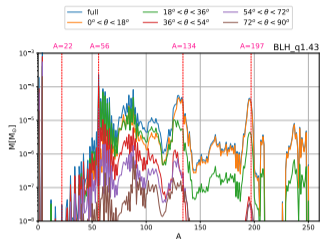
- A
- B

Fall-back Material

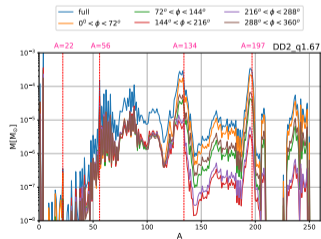
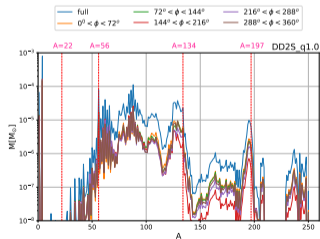
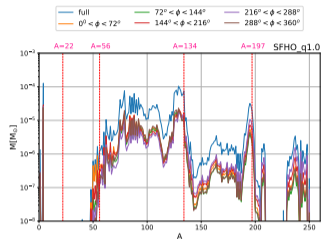
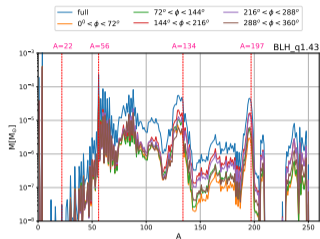
- A
- B

- ① Introduction
- ② Methods
- ③ Ejecta Dynamics
- ④ Elements Formation and Distribution
- ⑤ Light Curves
- ⑥ Conclusions and Future Work

Elements distribution's dependence on θ

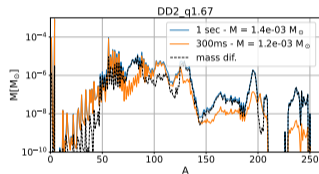
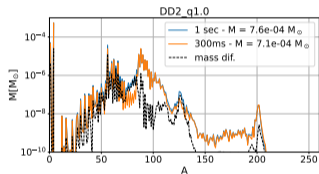
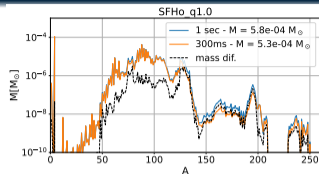
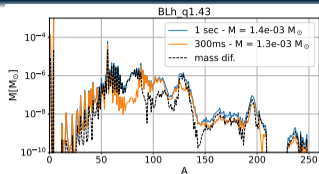


Elements distribution's dependence on ϕ

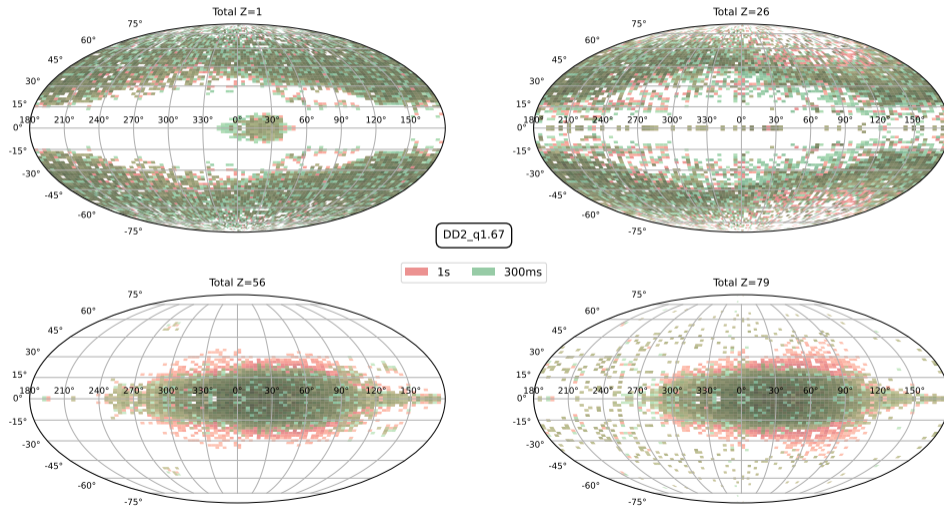


Sky Maps

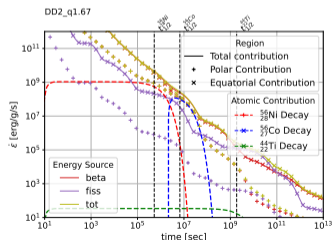
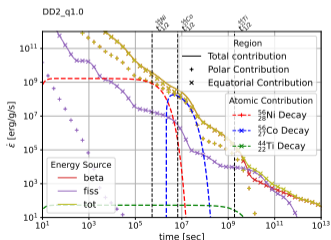
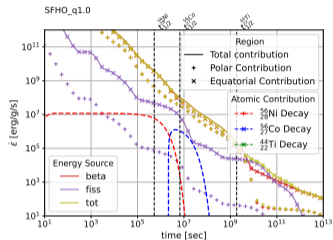
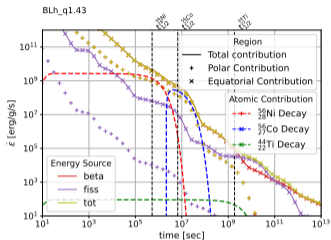
- Sky
- Maps



Temporal Dependence



$^{56}_{28}\text{Ni}$ impact



Ejecta masses

Model	$M_{\text{ej}} [M_{\odot}]$
BLh_q1.43	8.37×10^{-3}
SFHo_q1.0	4.58×10^{-3}
DD2_q1.0	4.63×10^{-3}
DD2_q1.67	1.38×10^{-2}

Nickel masses

Model	$^{56}_{28}\text{Ni}$ $M_{\text{ej}} [M_{\odot}]$
BLh_q1.43	4.60×10^{-4}
SFHo_q1.0	1.10×10^{-6}
DD2_q1.0	1.59×10^{-4}
DD2_q1.67	3.10×10^{-4}

- ① Introduction
- ② Methods
- ③ Ejecta Dynamics
- ④ Elements Formation and Distribution
- ⑤ Light Curves**
- ⑥ Conclusions and Future Work

Bolometric Light Curves for BLh_q1.43

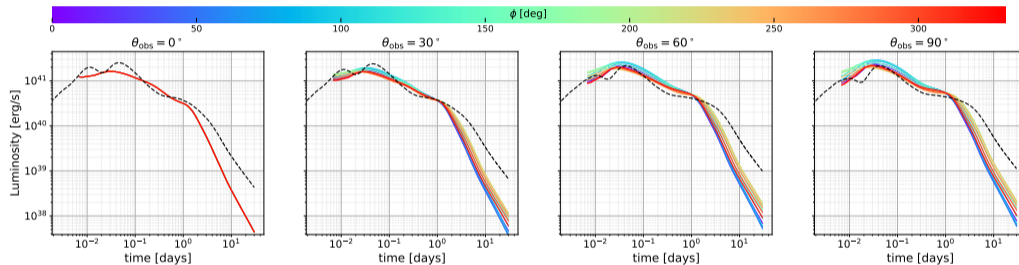


Figure 1: Discuss figure

AB magnitudes at 40Mpc for BLh_q1.43

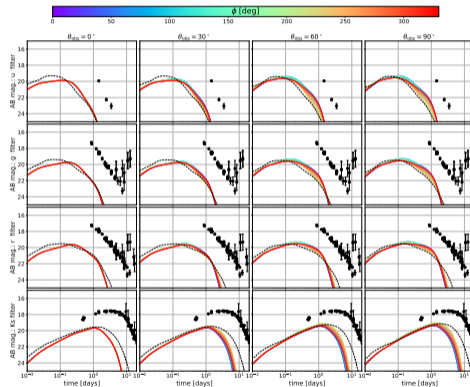


Figure 2: Discuss figure

Future Work

- Comparison with 2D simulations
- Comparison with AT2017gfo data
- Extra ϕ -dependence does not bridge the gap

- ① Introduction
- ② Methods
- ③ Ejecta Dynamics
- ④ Elements Formation and Distribution
- ⑤ Light Curves
- ⑥ Conclusions and Future Work**

Conclusions and Future Work

Conclusion

- New set-up for long term ejecta: Athena++, Transition EOS, KNEC, WinNet
- $\dot{\epsilon}$ is responsible for expansion of lanthanides curtain
- $^{56}_{28}\text{Ni}$ decay route is the main source of $\dot{\epsilon}$ at $t \sim 7\text{sec}$
- Larger effects of $^{56}_{28}\text{Ni}$ at $\theta > 45^\circ$ regions
- Extra ϕ dependence does not bridge the gapes on the KN's light curves

Future Work

- Extend the study for larger times
- Study interaction of ISM
- Inclusion of B-fields

Thanks for your attention!
ご清聴ありがとうございました。