

# 3D BNS merger ejecta evolution up to second timescales

## Dynamics, Element Distribution, and Light Curves

Luis Felipe Longo Micchi

Friedrich-Schiller Universität

4<sup>th</sup> 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

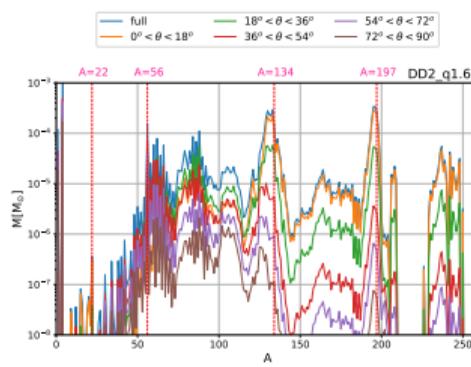
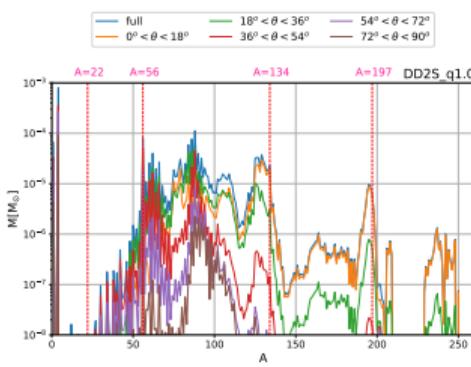
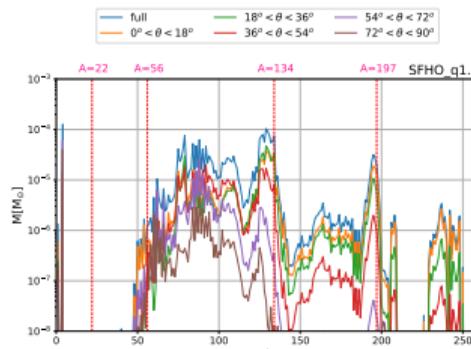
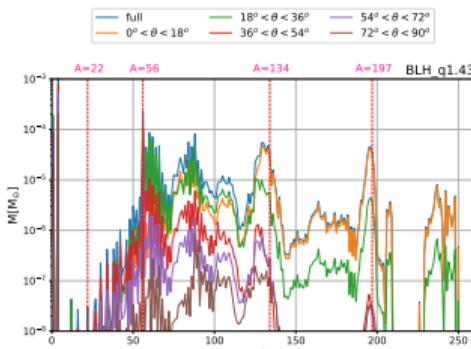
## 3 Ejecta Dynamics

## 4 Elements Formation and Distribution

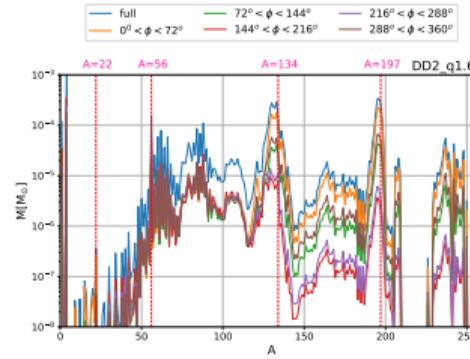
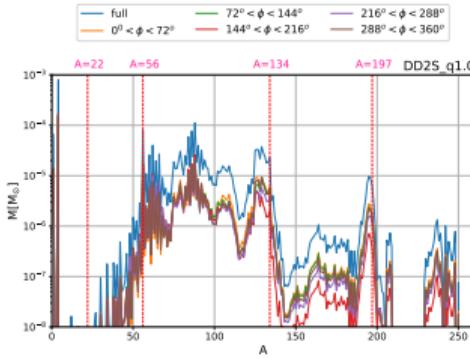
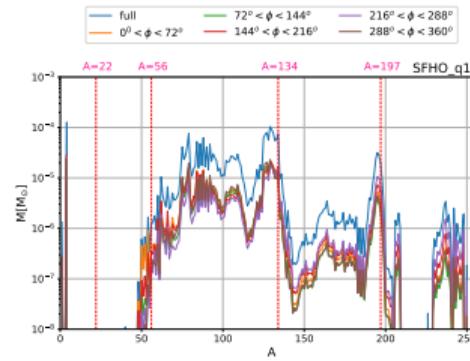
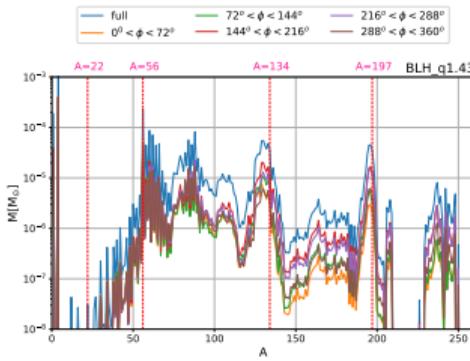
## 5 Light Curves

## 6 Conclusions and Future Work

# Elements distribution's dependence on $\theta$

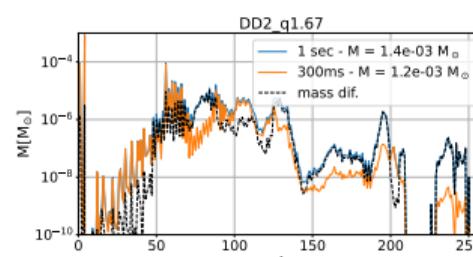
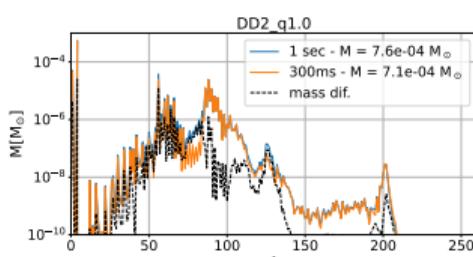
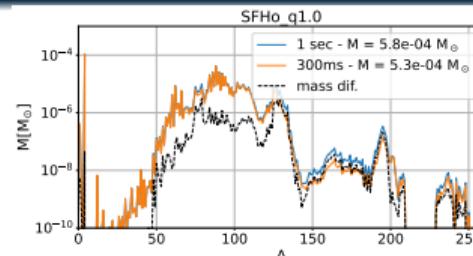
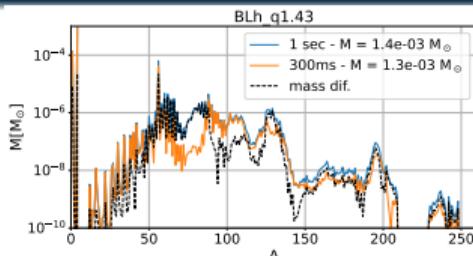


# Elements distribution's dependence on $\phi$

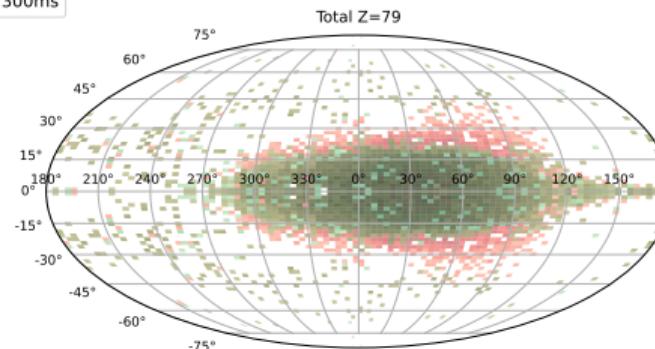
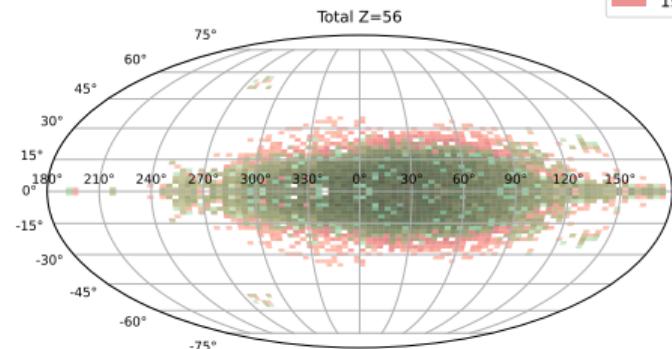
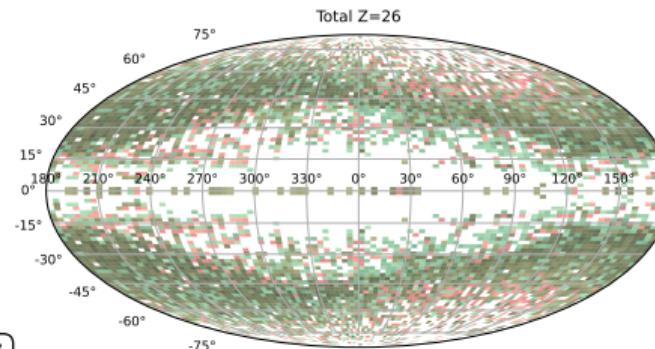
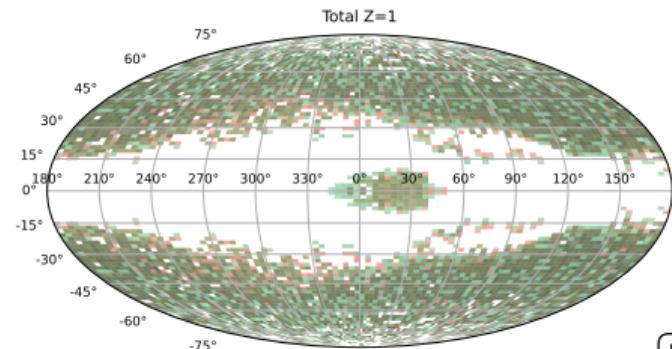


# Sky Maps

- Sky
- Maps



# Temporal Dependence

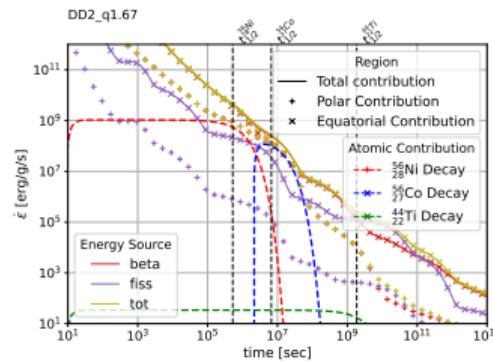
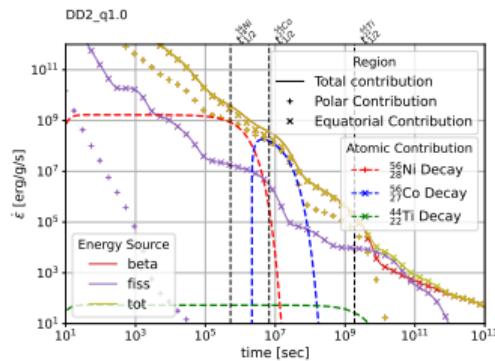
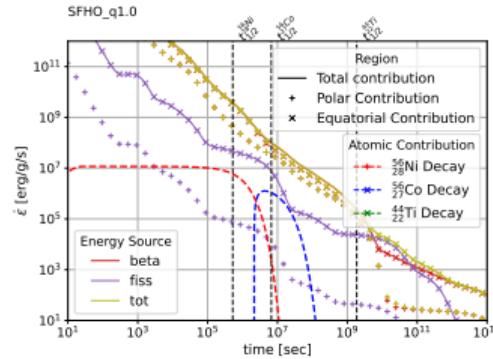
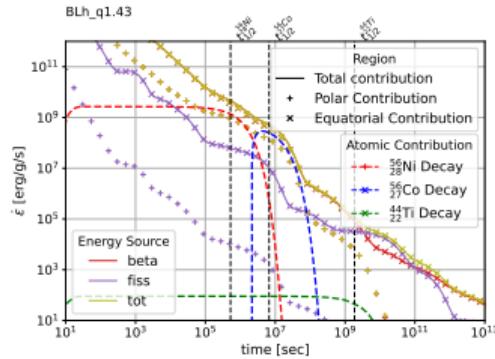


DD2\_q1.67

■ 1s ■ 300ms

A legend indicating two timescales: 1 second (red) and 300 milliseconds (green).

# $^{56}\text{Ni}$ impact



## Ejecta masses

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

## Nickel masses

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

## 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

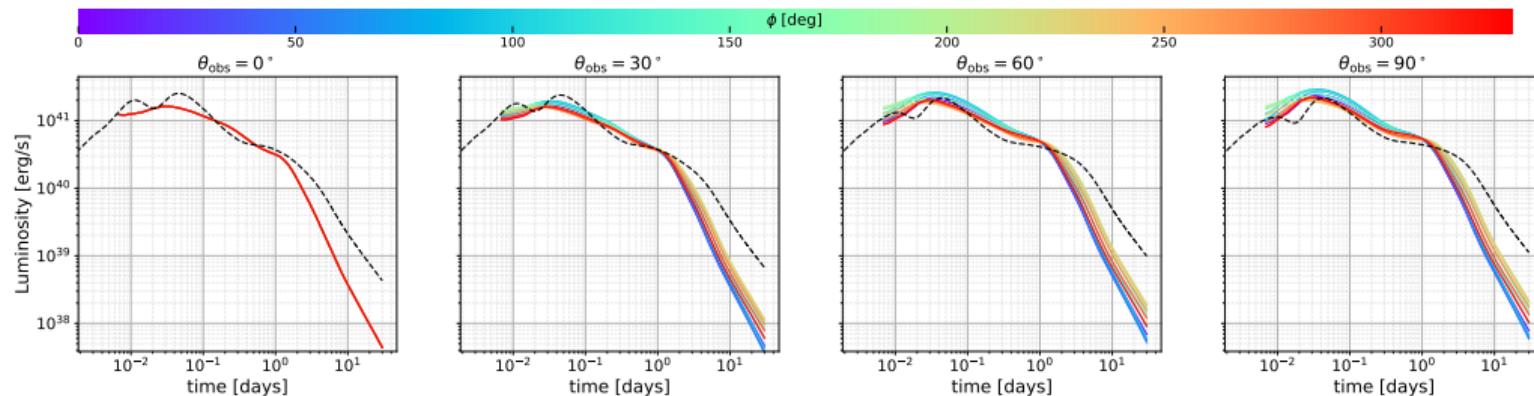


Figure 1: Discuss figure

# AB magnitudes at 40Mpc for BLh\_q1.43

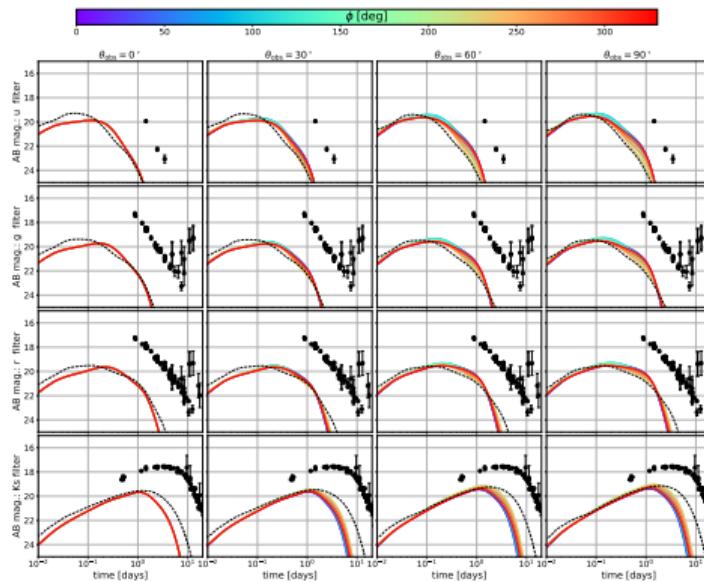


Figure 2: Discuss figure

## Future Work

- Comparison with 2D simulations
- Comparison with AT2017gfo data
- Extra  $\phi$ -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  $\phi$  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。