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Ultra-stripped Supernovae And Their Role On The Formation of Double Neutron Star Binary Systems

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I hereby declare that this thesis was formulated by myself and that no sources or tools other than those cited were used.

Date _____ Signature _____

1. Gutachter: Dr. Ioannis Antoniadis
2. Gutachter: Prof. Dr. Norbert Langer

To my Loved Ones

τί δὴ τοῦτό ἐστι Πυθαγόρας ἐρωτώμενος,
ʽτὸ θεάσασθαιʼ εἶπε ʽτὸν οὐρανόνʼ

When Pythagoras was asked about the purpose
for which humans were created, he said,
"To look upon the heavens"

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Chapter 1

INTRODUCTION

A detailed coverage of the principles of stellar evolution is beyond the scope of this thesis. Moreover, for the interested reader, there are excellent textbooks (Kippenhahn et al. 2012; Clayton 1968) covering every aspect in the field of stellar astrophysics. Nevertheless, for the sake of completeness, a small introduction to several fundamental parameters, tailored to our needs, will be attempted in the next few paragraphs.

1.1 Helium stars

A brief explanation of what a helium star is

1.1.1 Formation of Helium stars

A small section explaining how helium stars are being formed

1.1.2 Evolution of single Helium stars

A small section explaining the evolution of single helium stars

Mixing mechanisms

convection, overshooting, thermohaline

Effects of rotation

Rotational mixing

Transportation of angular momentum

Eddington-Sweet circulation etc

Winds and mass loss

1.2 Evolution of binary systems

Few words about how most stars form in binary systems

1.2.1 Interaction and orbital parameters

Roche lobe overflow, cases A/B/C etc

1.2.2 Mass transfer

Few words about mass transfer in binary systems

1.2.3 Common envelope

Explain a little bit in more detail the basics of CE

1.2.4 Angular momentum transfer

Effects of angular momentum transfer

1.2.5 Gravitational waves

The very basics for GWs and their impact on binary mergers

1.3 Stellar transients

Couple of words for the different types of stellar transients and how can we observe them

1.3.1 Classification of Supernovae

Explain in details the difference between core collapse SNe and type Ia and different subdivision

1.3.2 Type Ib/c Supernovae

Explain in details this particular branch

1.3.3 X-ray binaries

HMXB, LMXB, UCXB

Chapter 2

METHODS

Explain shortly what MESA is.

2.1 Modules for Experiments in Stellar Astrophysics

Write 2-3 pages of the MESA basics and how it works (Newton iterations etc). Consider possible subsections

2.2 Physical assumptions

Mention which physical assumptions we used

2.2.1 Single stars

For single helium stars

2.2.2 Binary systems

For the binary systems

Chapter 3

RESULTS

Mension the mesa reader Python module for the extraction and analysis of MESA data

3.1 Single Helium stars

3.2 Neutron star + Helium star binaries

Chapter 4

CONCLUSIONS

Write the conclusions we arrived at for all cases and what are they implying for the formation of DNS binaries

Chapter 5

DISCUSSION

Write a page or two for your findings, future work etc

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