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

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Angefertigt von

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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,*
*῾τὸ θεάσασθαι᾿ εἶπε ῾τὸν οὐρανόν᾿*

*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

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# 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 (cite Kippenhahn, Clayton) 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

# 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

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# Chapter 3

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# 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

DRAFT

# Chapter 4

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# CONCLUSIONS

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

# DISCUSSION

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