
Stellar progenitors of the Gravitational Waves chorus with detailed population synthesis

A Data Management Plan created using DMPonline.be

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Project abstract:

This project will investigate the properties of gravitational waves' progenitors by modeling systems of a compact object orbiting another, less evolved, star: this phase is expected to precede a double compact object configuration. I will use the detailed code for binary evolution, Modules for Experiments in Stellar Astrophysics (MESA), and population synthesis techniques to predict merging rates and detectability by next generation's GW detectors.

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FWO DMP (Flemish Standard DMP)

1. Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

Stellar models	Generate new data	Digital	Simulation data from public software MESA	ASCII, binary	Several TB
Analysis results	Generate new data	Digital	Saving the results of models analysis and population synthesis	ASCII, tabular format	Several GB
Code/algorithms	Generate new data	Digital	Self written/developed for visualization / analysis / publication	.ipynb, .f90, others	< 1GB
Publication files	Generate new data	Digital		TeX files, .pdf	< 1 GB
Astronomical data from surveys	Reuse existing data	Digital	Data of single degenerate binaries from several surveys	FITS, ASCII, tabular format	< 10 GB
Gravitational waves data from LVK catalogue	Reuse existing data	Digital	Data (posterior samples of parameters) of gravitational wave signals from LIGO-Virgo-KAGRA collaboration	ASCII, .hd5f	Several GB

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

Archival and newly collected astronomical data from different telescopes are publicly available in their respective online archives. We will decide timely which survey to focus on.

Archival and newly collected gravitational waves data from the LVK collaboration are publicly available in the website: <https://gwosc.org/eventapi/html/GWTC/>

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, ...)? If so, please comment per dataset or data type where appropriate.

- No

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements/ research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.

- No

Use of existing public software tools, such as MESA, used in this project require correct acknowledgment of citations in scientific publications:

<http://mesa.sourceforge.net/bestpractices.html#citing-mesa>

Use of archival astronomical data need to be acknowledged in journal publications according to specific data policy requirements, which are survey / collaboration-specific.

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- No

2. Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g., in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded).

All software and code written by the PI as part of this project to create new data and processes existing data will include ReadMe files on BitBucket and/or Github and will be documented inline within the code using, for example, docstrings in Python code.

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- Yes

In WP2 a standard format for metadata in astronomical data is used to search for existing data. This standard data format is FITS files, which contain headers containing all necessary meta data details, such as data dimensions, the quality flags for the data, etc. In WP3 and WP1, created data consisting of databases of model output will have a ReadMe file and a description of the different parameters in the file headers, as is the standard for when using the MESA code.

Namely, produced ASCII tables have explanatory title and comments, including content of the table, units of measurements, etc. For ASCII files that will be associated to a publication and made available through the Zenodo database system, a README file will be provided.

Python codes will have documentation in the file itself, like explanatory comments in code, procedure to use/run them etc. Publication files (TEX/PDF) generally include date of submission, acceptance and publication.

3. Data storage & back-up during the research project

Where will the data be stored?

All data will be stored locally on both personal devices and networked storage hosted by the Institute of Astronomy of KU Leuven's server system.

How will the data be backed up?

The Institute of Astronomy research unit at KU Leuven has an automatic periodic backup (both daily and off-site) on the network server of raw and processed data according to KU Leuven and in-house security standards: all data are secured with access restrictions on file-system level. The backup and recovery procedures are handled by the in-house IT system administration team.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely. If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

The Institute of Astronomy research unit at KU Leuven currently manages a server system with a total storage capacity exceeding 500TB, which is more than enough space to host this project. In the unlikely event of more storage being needed, this expense can be made by the research group's working budget.

How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

All types of data stored on the Institute of Astronomy's network servers and its backup follow the KU Leuven and in-house security standards: all data are secured and password protected with access restrictions on file-system level.

What are the expected costs for data storage and backup during the research project? How will these costs be covered?

All (potential) data storage costs are covered by the research unit's working budget, such that the cost to be covered by this FWO project is expected to be zero.

4. Data preservation after the end of the research project

Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).

All data will be retained for the expected 5 year period, on the Institute of Astronomy's file system, after the end of the project. These include original results, such as processed data, data base of models, publications, and all software written as part of this FWO project.

The data coming directly from observations are stored on servers hosted by the respective observatories and downloaded to personal devices for processing.

Where will these data be archived (stored and curated for the long-term)?

All data stored on the Institute of Astronomy's file server are stored long-term (both locally and off-site). Code and software (including metadata) will be archived longterm on Bitbucket (<https://bitbucket.org/product/>) and/or Github (<https://github.com>).

Moreover, the PI plans to keep the data stored on a personal device for a period of minimally 10 years after the end of the project.

What are the expected costs for data preservation during the expected retention period? How will these costs be covered?

Costs for backup and storage of all data on the Institute of Astronomy's file servers are covered by the research unit's working budget. Data associated to journal publications are stored by external partners and thus without additional cost.

5. Data sharing and reuse

Will the data (or part of the data) be made available for reuse after/during the project? In the comment section please explain per dataset or data type which data will be made available.

- Yes, in an Open Access repository
- Yes, in a restricted access repository (after approval, institutional access only, ...)

A description of the full scientific analysis, tools and deliverables will be published through peer reviewed journals, which are available through the respective publisher websites, the open-access arXiv journal-repository website (<https://arxiv.org>), and the KU Leuven Lirias repository (<https://www.kuleuven.be/english/research/scholcomm/lirias>), and the open-access source code repositories Bitbucket (<https://bitbucket.org/product/>) and GitHub (<https://github.com>), when applicable.

If access is restricted, please specify who will be able to access the data and under what conditions.

No restrictions.

Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain in the comment section per dataset or data type where appropriate.

- No

Where will the data be made available? If already known, please provide a repository per dataset or data type.

A description of the full scientific analysis, tools and deliverables will be published through peer reviewed journals, which are available through the respective publisher websites, the open-access arXiv journal-repository website (<https://arxiv.org>), and the KU Leuven Lirias repository (<https://www.kuleuven.be/english/research/scholcomm/lirias>), and the open-access source code repositories Bitbucket (<https://bitbucket.org/product/>) and GitHub (<https://github.com>), when applicable.

When will the data be made available?

Upon publication of the research results.

Which data usage licenses are you going to provide? If none, please explain why.

N/A

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- Yes

Not yet available.

What are the expected costs for data sharing? How will these costs be covered?

No costs are expected for data sharing.

6. Responsibilities

Who will manage data documentation and metadata during the research project?

The project PI will be responsible.

Who will manage data storage and backup during the research project?

The project PI, with assistance from the project coordinator, software developer and system administration of the Institute of Astronomy will be responsible.

Who will manage data preservation and sharing?

The project PI, with assistance from the project coordinator, software developer and system administration of the Institute of Astronomy will be responsible.

Who will update and implement this DMP?

The PI bears the end responsibility for updating and implementing this DMP.