

Henry W. Leung

Astronomy & Astrophysics Researcher at the University of Toronto
Toronto, Canada


 [henrysky.github.io](https://github.com/henrysky)


 henrysky.leung@utoronto.ca

 [henrysky](https://github.com/henrysky)

 [Henry Leung](#)

 Bilingual in English & Chinese

 Python & C

 Canadian & Hong Konger

Summary

I am a recent PhD graduate in astronomy & astrophysics from the University of Toronto. My research broadly focused on how to adopt and adapt **deep learning** methodology and **Foundation Model for science** to analyze big cross-domain cross-survey datasets to help us better understand the formation history and **dynamics of our MilkyWay Galaxy**. Most of my codes and models are well tested, well documented and open sourced to support open science.

EDUCATION

Ph.D. in Astronomy & Astrophysics , University of Toronto	2020-2024
Dissertation title: "Exploring the Milky Way with Deep Learning"	
Advisor: Prof. Jo Bovy	
M.Sc. in Astronomy & Astrophysics , University of Toronto	2019-2020
H.B.Sc. in Astronomy & Physics , University of Toronto	2014-2019

PUBLICATION OVERVIEW

I am an author on **14 refereed papers** that have **2570+** citations (h-index=11). Excluding 2 collaboration papers, there are **12 refereed papers** that have **760+** citations. Details of my ORCID (0000-0002-0036-2752) associated publications can be accessed on [Astrophysics Data System \(ADS\)](#).

MAJOR AWARDS & FELLOWSHIPS


Data Science Institute Doctoral Student Fellowship	2023-2027
University of Toronto	
CAD \$75,000	

SOFTWARE

Most of my research are open-sourced including codes for publications: <https://github.com/henrysky>. This includes a few software packages that are well tested and well documented, for example:

astroNN 

Deep Learning for Astronomers with Keras

Galaxy10 

A CIFAR10-like galaxy image dataset

milkyway_plot 

A handy package for plotting face-on and all-sky MilkyWay with Matplotlib and Bokeh

MyGaiaDB 

Setup local serverless Gaia/2MASS/ALLWISE/CATWISE databases and run query locally with python

I have also contributed to several open-source software packages, for example:

galpy

Galactic Dynamics in python

- Implemented DOP-853, an explicit Runge-Kutta method of order 8(5,3) numerical integer in Python and C
- Improved 2D animation rendering performance and implemented 3D animation using plotly.js

mw dust

Dust maps in the Milky Way

- Implemented necessary Hierarchical Equal Area isoLatitude Pixelation of a sphere (HEALPix) functionality in C
- Improved out-of-the box user experience on Linux/MaxOS/Windows by using Python instead of system packages

python-fsps

Python bindings to Flexible Stellar Population Synthesis (FSPS) Fortran code

- Fixed various compilation issues such that the code is usable on Windows

PUBLICATIONS

First/Second Author (8 papers, ordered by date):

[0 cites] 2024, [arXiv:2407.15703L](#) / [arXiv:2407.15703](#)

Estimating Probability Densities with Transformer and Denoising Diffusion

Henry W. Leung, Jo Bovy & Joshua S. Speagle

[14 cites] 2024, [MNRAS.527.1494L](#) / [arXiv:2308.10944](#)

Towards an astronomical foundation model for stars with a transformer-based model

Henry W. Leung & Jo Bovy

[18 cites] 2023, [MNRAS.522.4577L](#) / [arXiv:2302.05479](#)

A variational encoder-decoder approach to precise spectroscopic age estimation for large Galactic surveys

Henry W. Leung, Jo Bovy, J. Ted Mackereth & Andrea Miglio

[35 cites] 2023, [MNRAS.519..948L](#) / [arXiv:2204.12551](#)

A measurement of the distance to the Galactic centre using the kinematics of bar stars

Henry W. Leung, et al.

[157 cites] 2019, [MNRAS.490.4740B](#) / [arXiv:1905.11404](#)

Life in the fast lane: a direct view of the dynamics, formation, and evolution of the Milky Way's bar

Jo Bovy, **Henry W. Leung**, et al.

[134 cites] 2019, [MNRAS.489.2079L](#) / [arXiv:1902.08634](#)

Simultaneous calibration of spectro-photometric distances and the Gaia DR2 parallax zero-point offset with deep learning

Henry W. Leung & Jo Bovy

[171 cites] 2019, [MNRAS.483.3255L](#) / [arXiv:1808.04428](#)

Deep learning of multi-element abundances from high-resolution spectroscopic data

Henry W. Leung & Jo Bovy

[4 cites] 2017, [JAVSO..45...30P](#) / [arXiv:1611.03334](#)

Studies of the Long Secondary Periods in Pulsating Red Giants. II. Lower-Luminosity Stars

J. R. Percy & **Henry W. Leung**

Contributing Author (6 papers, ordered by date):

[6 cites] 2023, [MNRAS.526.1997P](#) / [arXiv:2306.09319](#)

Decoding the age-chemical structure of the Milky Way disc: an application of copulas and elicitable maps
Aarya A. Patil, Jo Bovy, Sebastian Jaimungal, Neige Frankel, **Henry W. Leung**, et al.

[44 cites] 2022, [ApJS..260...32W](#) / [arXiv:2108.08860](#)

Chemical Cartography with APOGEE: Mapping Disk Populations with a 2-process Model and Residual Abundances

David H. Weinberg, et al. (includes **Henry W. Leung**)

[727 cites] 2022, [ApJS..259...35A](#) / [arXiv:2112.02026](#)

The Seventeenth Data Release of the Sloan Digital Sky Surveys: Complete Release of MaNGA, MaStar, and APOGEE-2 Data

Abdurro'uf, et al. (Collaboration paper; includes **Henry W. Leung**)

[1085 cites] 2020, [ApJS..249....3A](#) / [arXiv:1912.02905](#)

The 16th Data Release of the Sloan Digital Sky Surveys: First Release from the APOGEE-2 Southern Survey and Full Release of eBOSS Spectra

Romina Ahumada, et al. (Collaboration paper; includes **Henry W. Leung**)

[11 cites] 2020, [MNRAS.494.2268W](#) / [arXiv:1910.01646](#)

Searching for solar siblings in APOGEE and Gaia DR2 with N-body simulations

Jeremy J. Webb, Natalie Price-Jones, Jo Bovy, Simon Portegies Zwart, Jason A. S. Hunt, J. Ted Mackereth, **Henry W. Leung**, et al.

[168 cites] 2019, [MNRAS.489..176M](#) / [arXiv:1901.04502](#)

Dynamical heating across the Milky Way disc using APOGEE and Gaia

J. Ted Mackereth, Jo Bovy, **Henry W. Leung**, et al.