# Henry W. Leung

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• henrysky

in Henry Leung

All Bilingual in English & Chinese

Python, C

Canadian

# RESEARCH INTERESTS

My research broadly focused on how to adopt and adapt deep learning methodology to analyze big cross-domain cross-survey datasets to help us better understand the formation history and dynamics of our MilkyWay Galaxy. I utilize a wide range of machine learning methods in my research from simple supervised models to self-supervised Transformers and diffusion models. I am interested in big questions like how would foundation models like "Large Astronomy Models" play a role in data-driven astronomy as well as how artificial intelligence would look like in astronomy in the future. Most of my codes and models are well tested, well documented and open sourced to support open science.

#### **EDUCATION**

**University of Toronto** In Progress PhD in Astronomy & Astrophysics 2020-2024 Thesis advisor: Prof. Jo Bovy

**University of Toronto** 

MSc in Astronomy & Astrophysics 2019-2020

Thesis advisor: Prof. Jo Bovy & Prof. Abigail Crites

**University of Toronto** 

HBSc in Astronomy & Physics 2014-2019

### PUBLICATION OVERVIEW

I am an author on 13 refereed papers that have 2280+ citations (h-index=11). Excluding 2 collaboration papers, there are 11 refereed papers that have 690+ citations. Details of my ORCID (ocrid) associated publications can be accessed on Astrophysics Data System (ADS).

# MAJOR AWARDS & FELLOWSHIPS

#### Data Science Institute Doctoral Student Fellowship

**University of Toronto** CAD \$75,000

2023-2027

#### **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 Tensorflow

# milkyway\_plot 🜎

A handy python package to do plotting on a face-on/edge-on/allsky map milkyway with matplotlib and bokeh

# Galaxy10 🜎

A CIFAR10-like galaxy image dataset

# MyGaiaDB 🜎

Setup local SQL serverless ESA 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

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

## mwdust 😯

Dust maps in the Milky Way

I have implemented necessary Hierarchical Equal Area isoLatitude Pixelation of a sphere (HEALPix) functionality in C for cross-platform compatibility as well as improved out-of-the box user experience

# python-fsps 🕠

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

I have fixed various compilation issues such that the code is usable on Windows.

#### **PUBLICATIONS**

# First/Second Author (ordered by date):

[11 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

[14 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

[26 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**, el al.

[145 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**, el al.

[127 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

[157 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 (ordered by date):

[3 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**, el al.

[39 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, el al. (includes **Henry W. Leung**)

[582 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, el al. (Collaboration paper; includes **Henry W. Leung**)

[1007 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, el 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**, el al.

[156 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, el al.