

# **AST1501 - Introduction to Research**

**Jo Bovy**

# **Intro to academic writing**

# Overview

- Different kinds of academic writing
- Structure of a scientific paper
- Make content engaging
- Tools:
  - LaTeX
  - Overleaf

# **Different types of academic writing**

# Many different types of academic writing

- Papers
- Proposals
- Emails
- Conference abstracts
- Internal reports in collaborations, wiki pages, ...
- Documentation (code, data)
- ...



# **Structure of a scientific paper**

# Purpose of a paper

- Purpose of a paper is to report on a novel scientific investigation of a topic of interest
- Introduction: motivate and contextualize the problem:
  - discuss broader area and how the specific question you are investigating fits into this,
  - discuss prior and related work,
  - give overview of the paper structure
- Data/methods sections: Need to spell out the data and methods used in sufficient detail to allow for exact replication —> completeness trumps brevity
- Results section: discuss results and immediate implications
- Discussion section: broader implications, compare to previous work
- Conclusion: recap most important results, look a bit to the future
- Can make sense to split these basic sections up further

# The abstract

- For many people, the only part of your paper they will ever read!
- Generally ~250 words (~12 to 15 sentences)
- Mini-version of the paper: introduce/motivate (1-2 sentences), give method (2-3 sentences), results (3-4 sentences), implications (1-2 sentences)
- A&A uses an explicit template: (Context), Aims, Methods, Results, (Conclusions)
- Generally best not to cite anything unless absolutely necessary
- Mention results (including numbers) that you *really* want people to take away from your paper

# Writing style

- Write in a largely impersonal, yet engaging manner
- Avoid passive voice, mainly use present tense:
  - ~~In this paper, the relation between the mass and the velocity dispersion of a cluster is derived~~ —> In this paper, we derive the relation between the mass and the velocity dispersion of a cluster
  - ~~We cross-matched data from Gaia DR3 and Pan-Starrs DR2 and used it to create a deep Color-magnitude diagram~~ —> We cross-match data from Gaia DR3 and Pan-Starrs DR2 and use it to create a deep Color-magnitude diagram
- Astro references are AUTHOR (YEAR) [+variations], but cite impersonally
  - Generally prefer (AUTHOR YEAR) to AUTHOR (YEAR): ~~Aardvark (2019) and Armadillo et al. (2020) found that cluster masses can be derived from observed velocity dispersions~~ —> Previous work has shown that cluster masses can be derived from observed velocity dispersions (Aardvark 2019; Armadillo et al. 2020)
  - Always remember that you are citing a paper, not a person: ~~Aardvark was the first to show that cluster masses can be derived from observed velocity dispersions. She did this by starting from the general ...~~ —> Aardvark (2019) was the first to show that cluster masses can be derived from observed velocity dispersions. They did this by starting from the general ...

# Figures and figure captions

- Figures are often the most viewed parts of papers (e.g., journal clubs)
- So make them as self-explanatory as possible!
- Label things directly on the figure rather than explaining in the caption, use lines/arrows rather than legends when practical
- Caption should explain what the figure shows and everything that isn't immediately obvious about a figure. For results/implications figures, they should also mention the take-away message ("This figure clearly shows the trend between X and Y that is present in our data").
- Try to be as brief as possible! But again completeness trumps brevity.

# Other tips

- Everything in the reference list should be cited in the text
- Everything cited in the text should be in the reference list (incl. references in figures)
- Use footnotes sparingly and never for anything that a reader should read
- Avoid too much jargon and too many abbreviations, but do abbreviate long terms that you would otherwise use a lot (e.g., “Giant Molecular Cloud” —> “GMC”)
- Aim to be as consistent as possible in terms and math symbols used —> LaTeX macros to the rescue!

# Make content engaging

1. **What is the primary purpose of the study?**

2. **Who were the participants in the study?**

3. **What were the main findings of the study?**

4. **How was the data collected?**

5. **What were the limitations of the study?**

6. **What are the implications of the study's findings?**

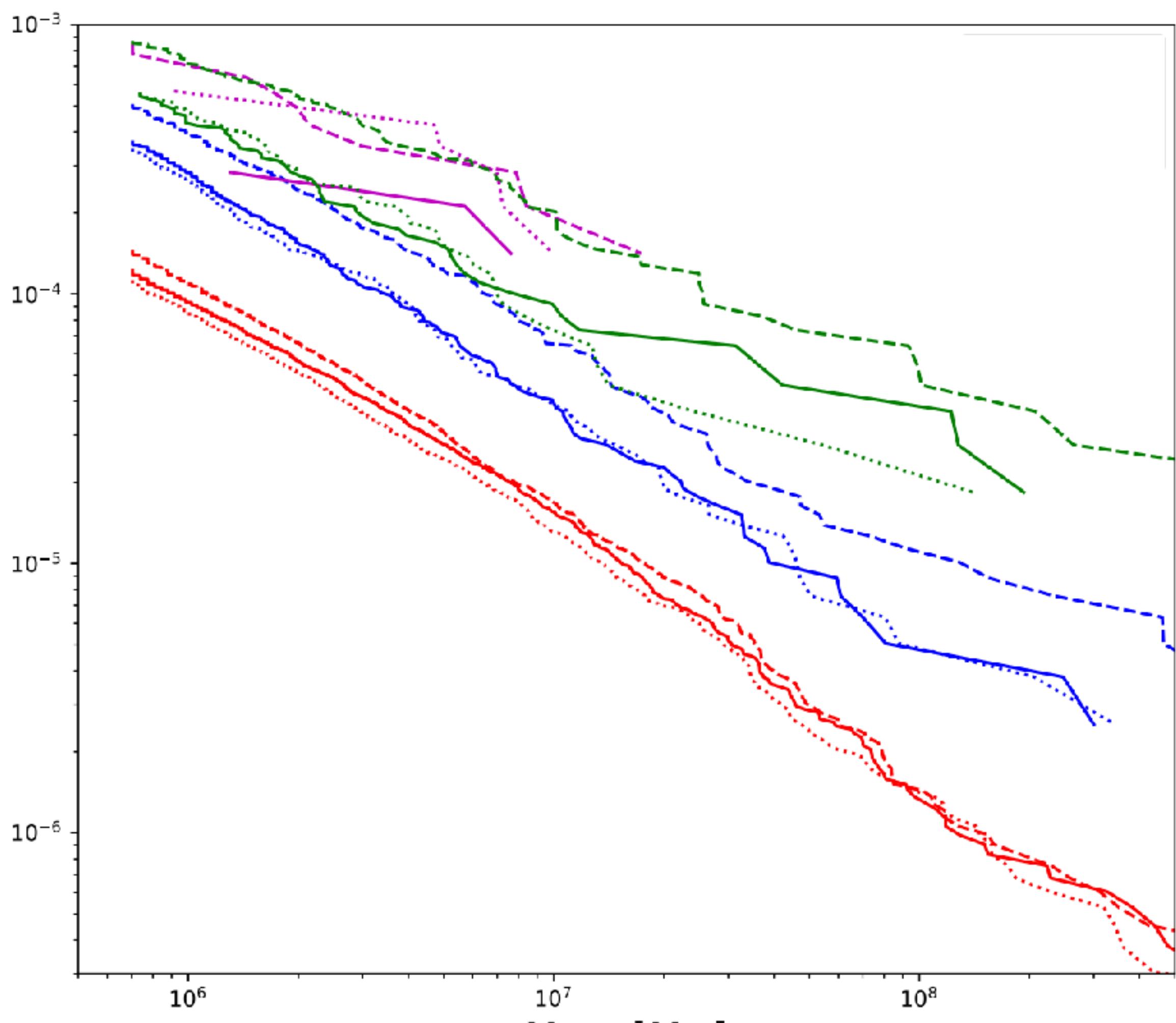
7. **What are the strengths of the study's methodology?**

8. **What are the potential biases in the study's results?**

9. **What are the study's conclusions based on?**

10. **What are the study's recommendations for future research?**

README



# MATTIAS LAZDA

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localize FRBs to their host galaxies. I joined CHIME/FRB in 2021 where I have since worked on commissioning two new radio telescopes. My undergraduate thesis lead to the development of the software pipeline that now enables the newly built telescopes to point at any particular point in the sky, a process known as beamforming.

Outside of school, I love to travel! I've included some of my favourite photos from my trips on my photos page.



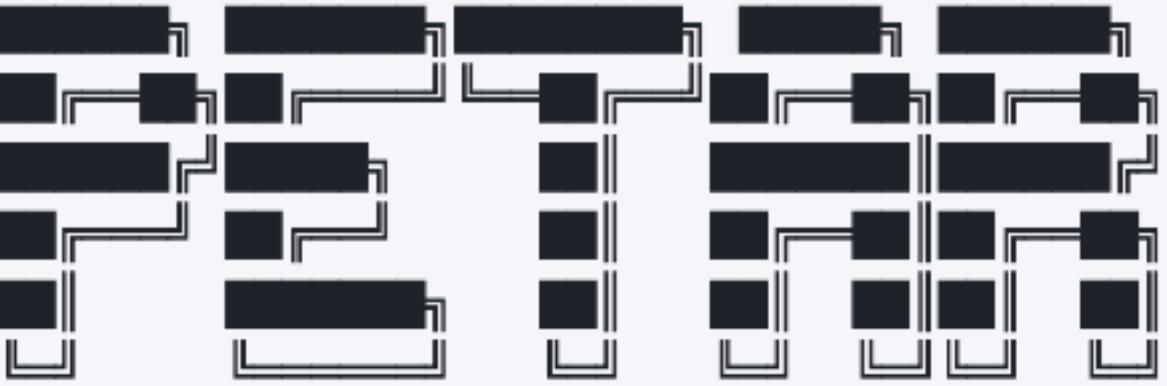
[MORE PHOTOS](#)

Current Institution: McGill University | Email: mattias.lazda@mail.mcgill.ca



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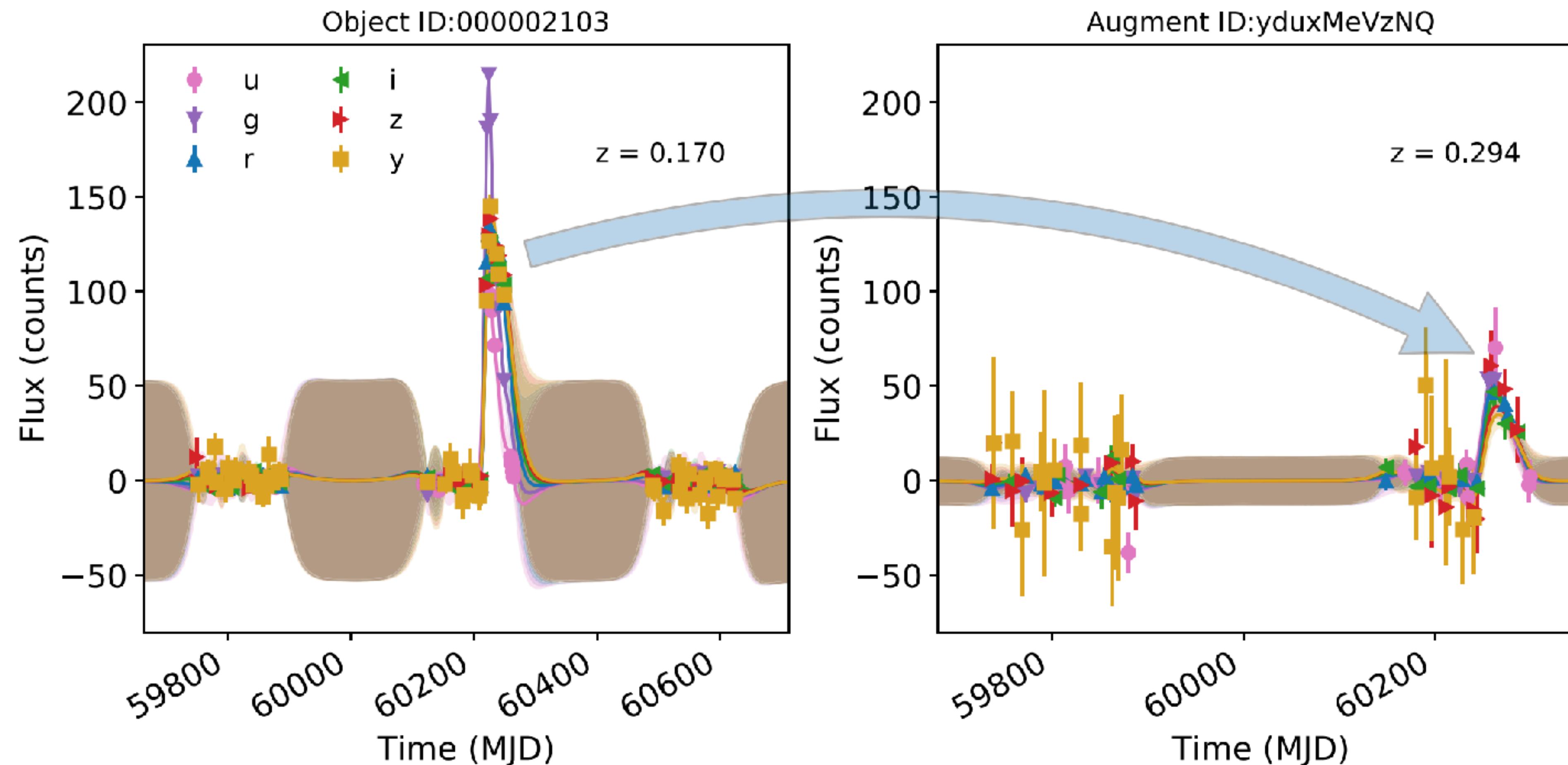
## ☰ README.md



PeTar is a N-body code designed to model collisional stellar systems, where multiplicity (binaries, triples ...) and close encounters are important for dynamical evolution. It combines three integration methods:

- The Barnes-Hut tree (Barnes & Hut 1986) is used to calculate long-range forces between particles, which are integrated with a second-order symplectic leap-frog integrator.
- The fourth-order Hermite integrator with block time steps (e.g., Aarseth 2003) is applied to integrate the orbits of stars and the centers-of-mass of multiple systems with short-range forces.
- The slow-down algorithmic regularization method (SDAR; Wang, Nitadori & Makino 2020) is used to integrate the multiple systems, such as hyperbolic encounters, binaries and hierarchical few-body systems.

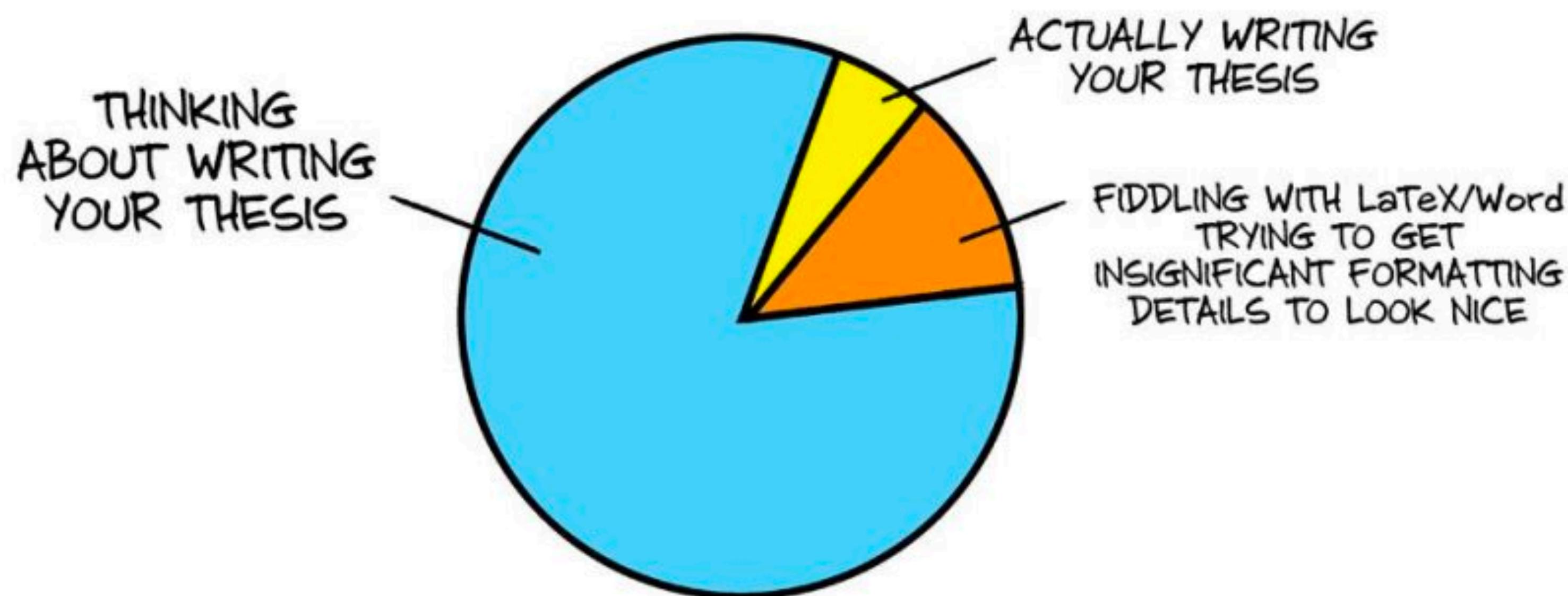
This readme provide a complete and short documentation to describe how to install and use the code. Please carefully read it first before asking questions to developers. More detail of the algorithms are described in Wang et al. (2020, arXiv: <https://arxiv.org/abs/2006.16560>). The detailed documentation for developers is under



# Tools

**LaTeX**

## WRITING YOUR THESIS:



# LaTeX

- You all indicated that you know LaTeX already, so we won't go through it in detail here
- LaTeX to me has two parts:
  - Full system for producing scientific papers, books, reports, proposals, your dissertation —> write all text in plain text file, compile, get output
  - Math engine used far more broadly (e.g., MathJax on the web [incl. Jupyter notebooks], plot labels in matplotlib, equations in presentations)
- People at UofT generally publish either in AAS journals or MNRAS (probably on its way out...) —> use their LaTeX templates
- Use macros for units, consistency of terms/symbols, comments

```
% Basic setup. Most papers should leave these options alone.  
\documentclass[fleqn,usenatbib]{mnras}  
  
% MNRAS is set in Times font. If you don't have this installed (most LaTeX  
% installations will be fine) or prefer the old Computer Modern fonts,  
comment  
% out the following line  
\usepackage{newtxtext,newtxmath}  
% Depending on your LaTeX fonts installation, you might get better results  
with one of these:  
%\usepackage{mathptmx}  
%\usepackage{txfonts}  
  
% Use vector fonts, so it zooms properly in on-screen viewing software  
% Don't change these lines unless you know what you are doing  
\usepackage[T1]{fontenc}
```

```
++  
45 %%%%%% AUTHORS - PLACE YOUR OWN PACKAGES HERE %%%%%%  
46  
47 % Only include extra packages if you really need them. Common packages are:  
48 \usepackage{graphicx}    % Including figure files  
49 \usepackage{amsmath}     % Advanced maths commands  
50 % \usepackage{amssymb}   % Extra maths symbols  
51 \usepackage{color}  
52 \usepackage{tikz}  
53 \usetikzlibrary{positioning}  
54 %\usepackage{needspace}  
55 % hypertex insanity  
56 \definecolor{linkcolor}{rgb}{0,0,0.25}  
57 \hypersetup{  
58 colorlinks=true,          % false: boxed links; true: colored links  
59 linkcolor=blue,           % color of internal links  
60 citecolor=blue,            % color of links to bibliography  
61 filecolor=blue,             % color of file links  
62 urlcolor=blue,              % color of external links  
63 draft=False,  
64 }
```

```
84 \newcommand{\henry}[1]{\color{red} Henry: #1}
85 \definecolor{darkgreen}{rgb}{0.0, 0.7, 0.0}
86 \newcommand{\jo}[1]{\color{darkgreen} Jo asks/comments: #1}
87 \definecolor{darkblue}{rgb}{0.0, 0., 0.7}
88 \newcommand{\sugfig}[1]{\color{darkblue} Suggested Figure: #1}
89
90
91 \newcommand{\gaia}{\emph{Gaia}}
92 \newcommand{\tess}{\emph{TESS}}
93 \newcommand{\kepler}{\emph{Kepler}}
94 \newcommand{\tmass}{\emph{2MASS}}
95
96 \renewcommand{\vec}[1]{\ensuremath{\mathbf{#1}}}
97 \newcommand{\teff}{\ensuremath{T_{\mathrm{eff}}}}
98 \newcommand{\logg}{\ensuremath{\log g}}
99 \newcommand{\xh}[1]{\ensuremath{[\mathrm{#1/H}]}}
100 \newcommand{\xfe}[1]{\ensuremath{[\mathrm{#1/Fe}]}}
101 \newcommand{\cn}{\ensuremath{[\mathrm{C/N}]}}
102 \newcommand{\alpham}{\ensuremath{[\alpha/\mathrm{M}]}}
103 \newcommand{\dex}{\ensuremath{\mathrm{dex}}}
104 \newcommand{\um}{\ensuremath{\mu \mathrm{m}}}
```

```
137 % Title of the paper, and the short title which is used in the headers.  
138 % Keep the title short and informative.  
139 \title[Towards an astronomical foundation model for stars]{Towards an  
astronomical foundation model for stars with a Transformer-based model}  
140  
141 % The list of authors, and the short list which is used in the headers.  
142 % If you need two or more lines of authors, add an extra line using  
% \newauthor  
143 \author[Leung \& Bovy]{  
144 Henry W. Leung\$^{\{1\}}$\thanks{E-mail: henrysky.leung@utoronto.ca} \&  
145 Jo Bovy\$^{\{1,2\}}$  
146 \newauthor  
147 \\  
148 % List of institutions  
149 \$^{\{1\}}$David A. Dunlap Department of Astronomy and Astrophysics, University  
of Toronto, 50 St. George Street, Toronto, Ontario, M5S 3H4, Canada\\  
150 \$^{\{2\}}$Dunlap Institute for Astronomy and Astrophysics, University of  
Toronto, 50 St. George Street, Toronto, Ontario, M5S 3H4, Canada  
151 }  
152 % These dates will be filled out by the publisher  
153 \date{Accepted XXX. Received YYYY; in original form ZZZ}  
154  
155 % Enter the current year, for the copyright statements etc.  
156 \pubyear{2023}  
157  
158 % Don't change these lines  
159 \begin{document}  
160 \label{firstpage}  
161 \pagerange{\pageref{firstpage}--\pageref{lastpage}}  
162 \maketitle
```

# **Towards an astronomical foundation model for stars with a Transformer-based model**

Henry W. Leung<sup>1</sup>★ & Jo Bovy<sup>1,2</sup>

<sup>1</sup>*David A. Dunlap Department of Astronomy and Astrophysics, University of Toronto, 50 St. George Street, Toronto, Ontario, M5S 3H4, Canada*

<sup>2</sup>*Dunlap Institute for Astronomy and Astrophysics, University of Toronto, 50 St. George Street, Toronto, Ontario, M5S 3H4, Canada*

Accepted XXX. Received YYY; in original form ZZZ

# Some useful LaTeX tools

- Detexify: hand-drawn symbol → LaTeX

The image consists of three separate screenshots arranged horizontally.

**Sephora Advertisement:** A vertical pink banner for Sephora with the text "JUST DROPPED" at the top. It features several beauty products: a dark nail polish bottle labeled "Gloss", a small dropper bottle, a white bottle labeled "function", and a clear bottle labeled "The Ordinary". At the bottom, it says "SEPHORA SHOP NOW".

**Detexify Website:** A screenshot of the Detexify website. At the top, there's a search bar with the text "Get started today." and a button "Get a quote". Below the search bar is the word "Detexify" with two tabs: "classify" (which is selected) and "symbols". In the center, there's a large input field containing a hand-drawn black arrow pointing downwards. To the right of the input field is a red "X" button. Below the input field, there's a section titled "Want a Mac app?" with text about the Mac app being stable enough and a link to a Vimeo video. There's also a note about restrictions regarding license purchases. At the bottom of this section, there's a "Buy Detexify for Mac" button and a "GUMROAD" logo.

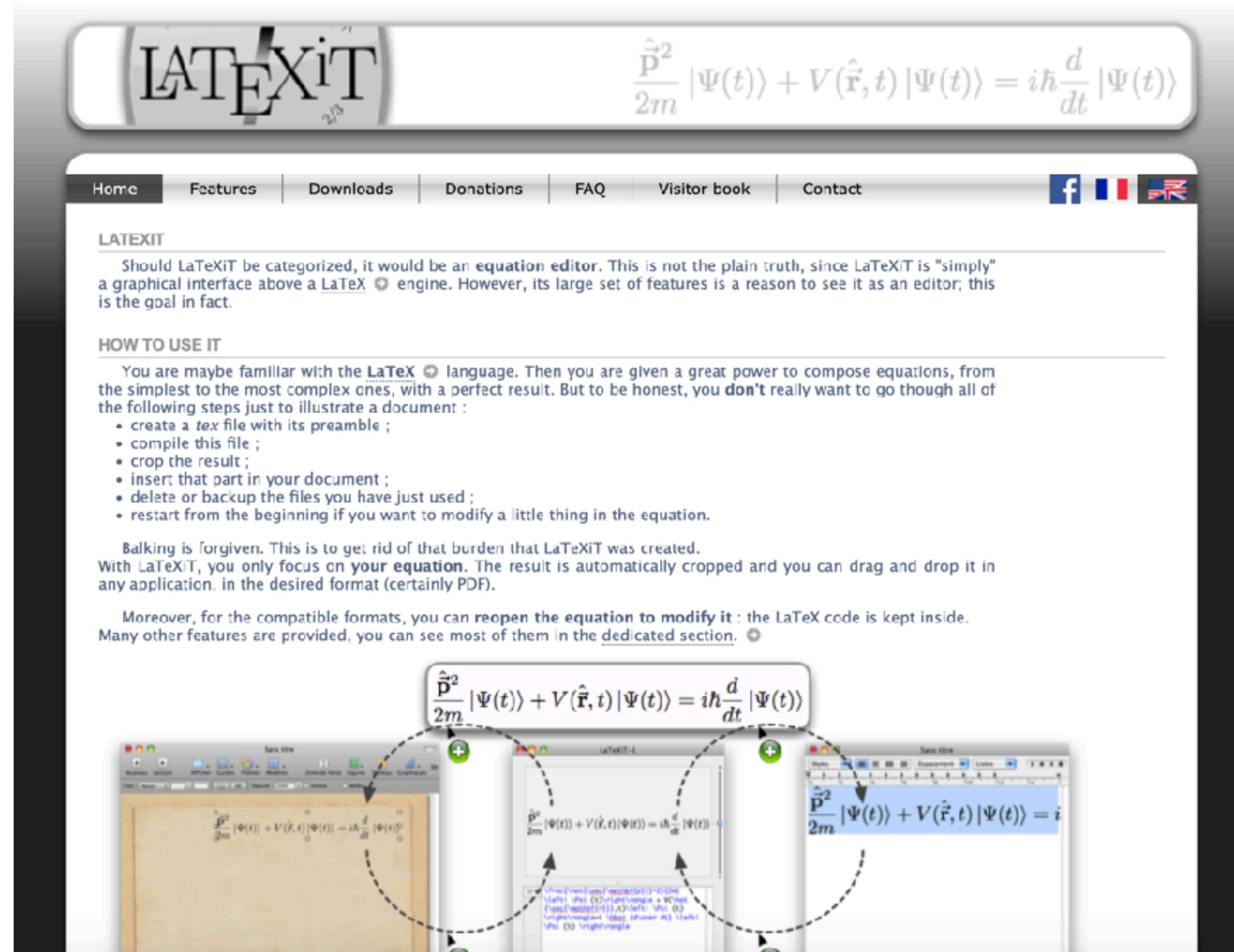
**TD Insurance Advertisement:** A screenshot of a TD Insurance advertisement featuring a woman with curly hair looking at her phone. To the right of the woman is a green call-to-action box with the text "See how much you could save on home or car coverage with TD Insurance." and a "Get a quote" button. Below the advertisement, there's a sidebar with a list of LaTeX symbols and their scores:

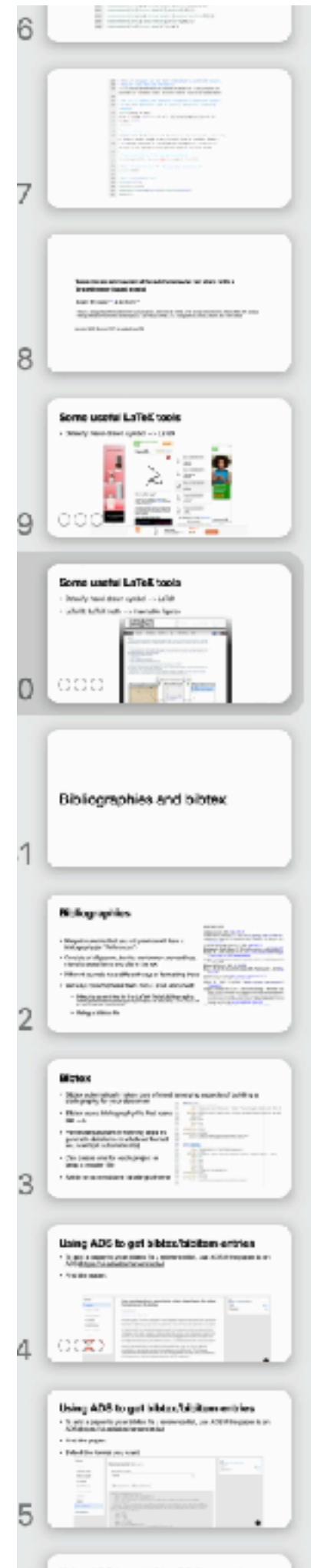
- $\approx\vee$  Score: 0.08443100140110471 \usepackage{ amssymb } \gtrsim mathmode
- $\approx\wedge$  Score: 0.12348029554028109 \usepackage{ amssymb } \gtrapprox mathmode
- $\geq\vee$  Score: 0.13753207485740243 \usepackage{ amssymb } \geq mathmode
- $\geq\wedge$  Score: 0.14061526630628612 \usepackage{ amssymb } \succsim mathmode
- $\geq\vee$  Score: 0.14814596849864098 \usepackage{ amssymb } \geqq mathmode

At the bottom of the sidebar, there's a link "The symbol is not in the list? Show more" and a "Did this help?" button. A small note at the very bottom says "Hosting Detexify costs money and if it helps you may".

# Some useful LaTeX tools

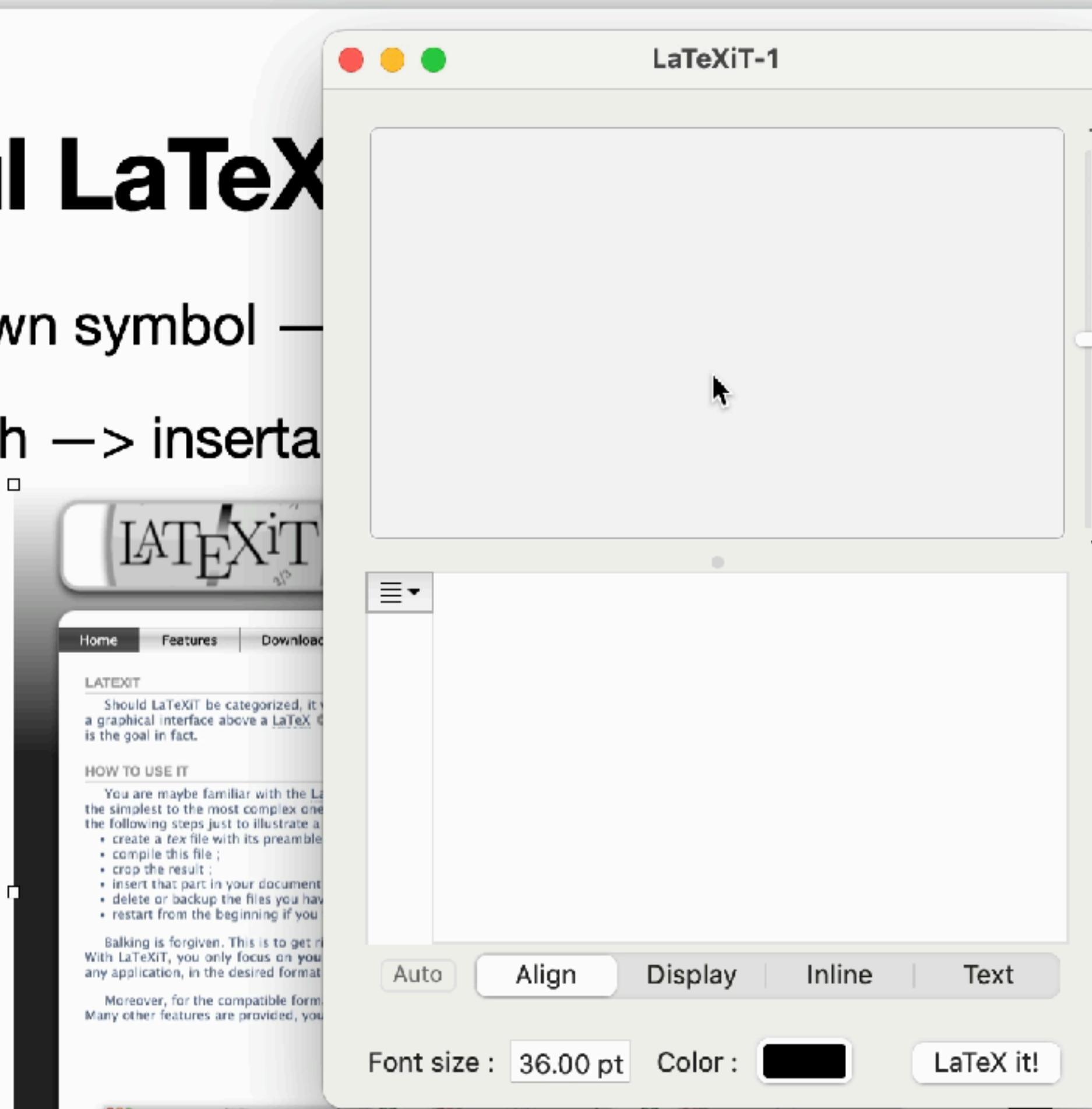
- Detexify: hand-drawn symbol → LaTeX
- LaTeXIt: LaTeX math → insertable figures





# Some useful LaTeX

- [Detexify: hand-drawn symbol → LaTeX](#)
- [LaTeXiT: LaTeX math → insertion](#)



# Some useful LaTeX tools

- Detexify: hand-drawn symbol → LaTeX
- LaTeXIt: LaTeX math → insertable figures
- AAS deluxetable: online tool from AAS: <https://authortools.aas.org/LATEX/make-latex.html>
- Astropy can also be useful in automatically generating tables

# **Bibliographies and bibtex**

# Bibliographies

- Many documents that you will produce will have a bibliography (or “References”)
- Consists of all papers, books, conference proceedings, miscellaneous items you cite in the text
- Different journals have different ways of formatting these
- Two ways to incorporate them into a LaTeX document:
  - Directly as entries in the LaTeX file’s bibliography:  
`\bibitem[\protect\citeauthor{Bovy}{2015}]{2015ApJS..216...29B}` Bovy J., 2015, ApJS, 216, 29. doi:10.1088/0067-0049/216/2/29
  - Using a bibtex file

## REFERENCES

- Abdurro’uf et al., 2022, [ApJS, 259, 35](#)  
Allam Tarek J., McEwen J. D., 2021, [arXiv e-prints, p. arXiv:2105.06178](#)  
Anderson L., Hogg D. W., Leistedt B., Price-Whelan A. M., Bovy J., 2018, [AJ, 156, 145](#)  
Andrae R., Rix H.-W., Chandra V., 2023, [ApJS, 267, 8](#)  
Bahdanau D., Cho K., Bengio Y., 2014, [arXiv e-prints, p. arXiv:1409.0473](#)  
Barbary K., 2016, extinction v0.3.0, doi:10.5281/zenodo.804967, <https://doi.org/10.5281/zenodo.804967>  
Bengio Y., Ducharme R., Vincent P., Janvin C., 2003, J. Mach. Learn. Res., 3, 1137–1155  
Blanton M. R., et al., 2017, [AJ, 154, 28](#)  
Bovy J., Rix H.-W., Green G. M., Schlafly E. F., Finkbeiner D. P., 2016, [ApJ, 818, 130](#)  
Bubeck S., et al., 2023, [arXiv e-prints, p. arXiv:2303.12712](#)  
Carrasco J. M., et al., 2021, [A&A, 652, A86](#)  
Chase H., 2022, LangChain, <https://github.com/hwchase17/langchain>  
Chopra S., Hadsell R., LeCun Y., 2005, in Proceedings - 2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR 2005. Proceedings - 2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR 2005. IEEE Computer Society, pp 539–546, doi:10.1109/CVPR.2005.202

# Bibtex

- Bibtex automatically takes care of most annoying aspects of building a bibliography for your document
- Bibtex use a bibliography file that looks like —>
- Processed as part of running latex to generate \bibitems in whatever format you want (all automatically)
- Can create one for each project or keep a master file
- Settle on a consistent labeling scheme

```
17951 @ARTICLE{Will08a,
17952   author = {{Will}, Clifford M.},
17953   title = "{Testing the General Relativistic ``No-Hair'' Theorems Using the Galactic Center Black Hol",
17954   journal = {\apjl},
17955   keywords = {black hole physics, Galaxy: center, relativity, Astrophysics, General Relativity and Quant
17956   | year = 2008,
17957   | month = feb,
17958   | volume = {674},
17959   | number = {1},
17960   | pages = {L25},
17961   | doi = {10.1086/528847},
17962   archivePrefix = {arXiv},
17963   | eprint = {0711.1677},
17964   primaryClass = {astro-ph},
17965   | adsurl = {https://ui.adsabs.harvard.edu/abs/2008ApJ...674L..25W},
17966   | adsnote = {Provided by the SAO/NASA Astrophysics Data System}
17967 }
17968
17969 @ARTICLE{Boehmer07a,
17970   author = {{B\{"o\}hmer}, C.\~G. and {Harko}, T.},
17971   title = "Can dark matter be a Bose Einstein condensate?",
17972   journal = {\jcap},
17973   keywords = {Astrophysics, General Relativity and Quantum Cosmology, High Energy Physics - Theory},
17974   | year = 2007,
17975   | month = jun,
17976   | volume = {2007},
17977   | number = {6},
17978   | eid = {025},
17979   | pages = {025},
17980   | doi = {10.1088/1475-7516/2007/06/025},
17981   archivePrefix = {arXiv},
17982   | eprint = {0705.4158},
17983   primaryClass = {astro-ph},
17984   | adsurl = {https://ui.adsabs.harvard.edu/abs/2007JCAP...06..025B},
17985   | adsnote = {Provided by the SAO/NASA Astrophysics Data System}
17986 }
```

# Using ADS to get bibtex/bibitem entries

- To add a paper to your bibtex file / reference list, use ADS if the paper is on ADS (<https://ui.adsabs.harvard.edu/>)
- Find the paper:

The screenshot shows the ADS abstract page for the paper "Core condensation in heavy halos: a two-stage theory for galaxy formation and clustering" by White, S. D. M. and Rees, M. J. The page includes a sidebar with options like View, Abstract, Citations, References, Co-Reads, Similar Papers, Volume Content, Graphics, Metrics, and Export Citation (which is circled in red). The main content area displays the title, authors, abstract, and full text sources (ADS and Publisher).

VIEW

Abstract

Citations (3439)

References (25)

Co-Reads

Similar Papers

Volume Content

Graphics

Metrics

Export Citation

FEEDBACK

Core condensation in heavy halos: a two-stage theory for galaxy formation and clustering.

Show affiliations

White, S. D. M. ; Rees, M. J.

A model of galaxy formation is developed in which dissipation plays a role along with purely gravitational processes. The gist of the model is that the distribution of the dominant mass component on all scales arises from purely gravitational clustering, while the observed sizes and luminosity functions of galaxies are determined by gas-dynamical dissipative processes. The model accounts for the large amount of nongaseous 'dark matter', apparently making up about 80% or more of the virial mass in clusters such as Coma and which may constitute massive halos around large galaxies. At work is a process of self-similar gravitational clustering in an expanding universe. The clustering builds up in hierarchical fashion; the smaller-scale virialized systems merge into an amorphous whole when they are incorporated in a larger bound cluster. Residual gas in the resulting potential wells cools and acquires sufficient concentration to self-gravitate, forming luminous galaxies up to a limiting size. This limit agrees adequately with the masses, luminosities, and radii of large galaxies. On certain specific assumptions, a luminosity function is derived that agrees reasonably well with observation.

FULL TEXT SOURCES

ADS

Publisher

# Using ADS to get bibtex/bibitem entries

- To add a paper to your bibtex file / reference list, use ADS if the paper is on ADS (<https://ui.adsabs.harvard.edu/>)
- Find the paper:
- Select the format you want:

The screenshot shows the ADS citation export interface. On the left, a sidebar lists various options: VIEW (Abstract, Citations (3439), References (25), Co-Reads, Similar Papers, Volume Content, Graphics, Metrics, Export Citation, FEEDBACK). The 'Export Citation' button is highlighted with a blue border. In the center, the main area displays 'Exporting record(s) 1 to 1 (total: 1)'. A 'Select Export Format' dropdown menu is open, showing 'BibTeX' as the selected option. Below it are two buttons: 'Download to File' and 'Copy to Clipboard'. A large text box contains the following BibTeX code:  
```@ARTICLE{1978MNRAS.183..341W,  
author = {{White}, S.~D.~M. and {Rees}, M.~J.},  
title = "{Core condensation in heavy halos: a two-stage theory for galaxy formation and clustering.}",  
journal = {\mnras},  
keywords = {Astronomical Models, Galactic Clusters, Galactic Evolution, Galactic Nuclei, Gravitational Effects, Halos, Critical Mass, Dark Matter, Dynamic Models, Interstellar Gas, Luminosity, Many Body Problem, Red Shift, Astrophysics, Formation:Galaxies},  
year = 1978,  
month = may,  
volume = {183},  
pages = {341-358},  
doi = {10.1093/mnras/183.3.341},  
adsurl = {https://ui.adsabs.harvard.edu/abs/1978MNRAS.183..341W},  
}```  
On the right, a panel titled 'FULL TEXT SOURCES' shows links for 'ADS' and 'Publisher' with corresponding icons.

# Using ADS to get bibtex/bibitem entries

- To add a paper to your bibtex file / reference list, use ADS if the paper is on ADS (<https://ui.adsabs.harvard.edu/>)
- Find the paper:
- Select the format you want:

The screenshot shows the ADS citation export interface. On the left, a sidebar lists options like Abstract, Citations (3439), References (25), Co-Reads, Similar Papers, Volume Content, Graphics, Metrics, and Export Citation (which is highlighted in blue). The main area displays "Exporting record(s) 1 to 1 (total: 1)". It includes a "Select Export Format" dropdown set to "AASTeX", and buttons for "Download to File" and "Copy to Clipboard". Below this is a code snippet: 

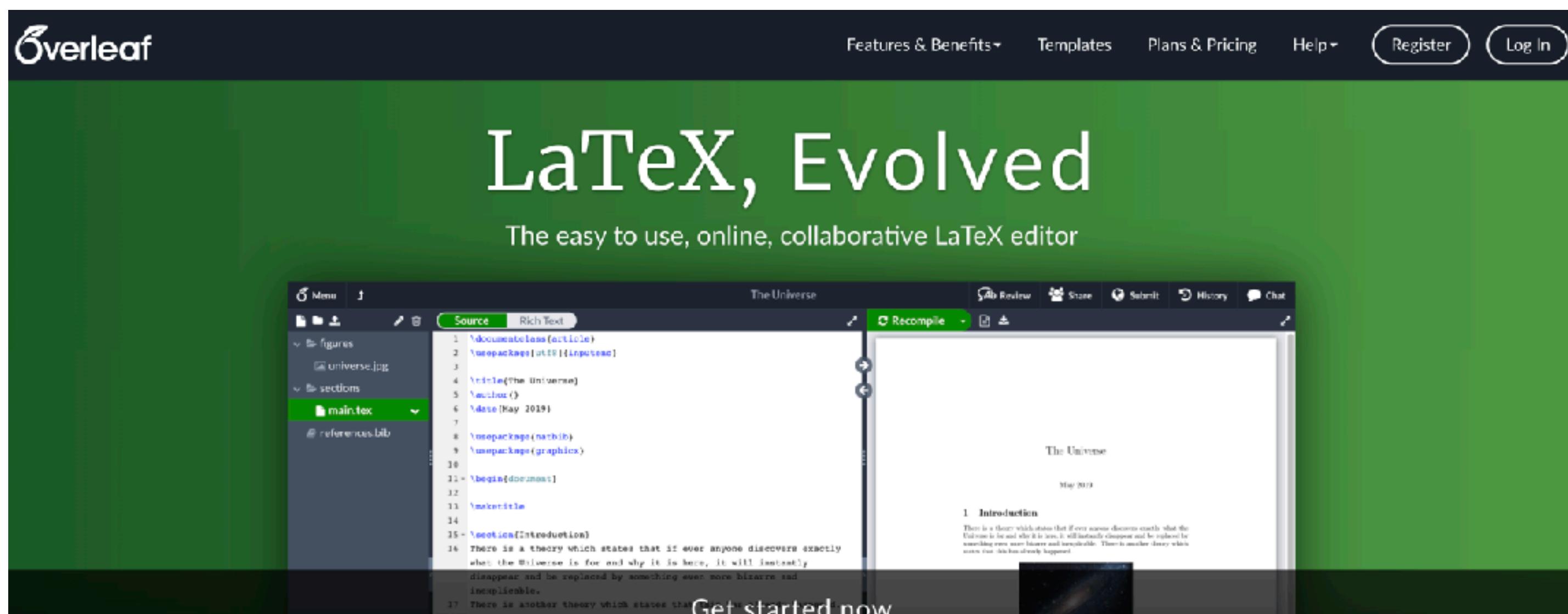
```
\bibitem[White \& Rees(1978)]{1978MNRAS.183..341W} White, S.~D.~M. \& Rees, M.~J. 1978, \mnras, 183, 341.  
doi:10.1093/mnras/183.3.341
```

. On the right, a "FULL TEXT SOURCES" section shows links for ADS and Publisher.

# Overleaf

# Overleaf

- Most paper/proposal writing these days happens on [overleaf.com](https://overleaf.com)
- Advantages:
  - No need to install LaTeX and packages yourself
  - Straightforward real-time collaboration
  - Contains templates for many journals



Filters: All / Templates / Examples / Articles

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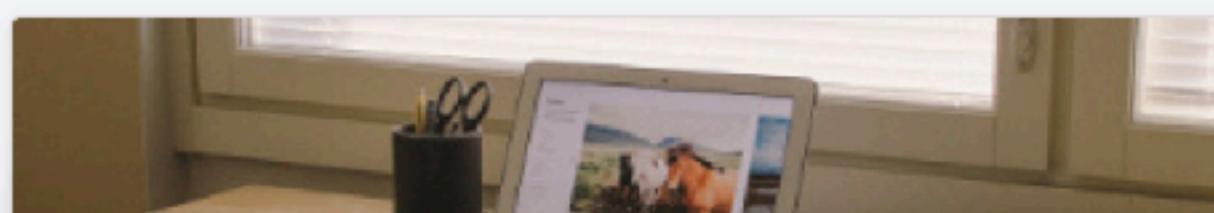
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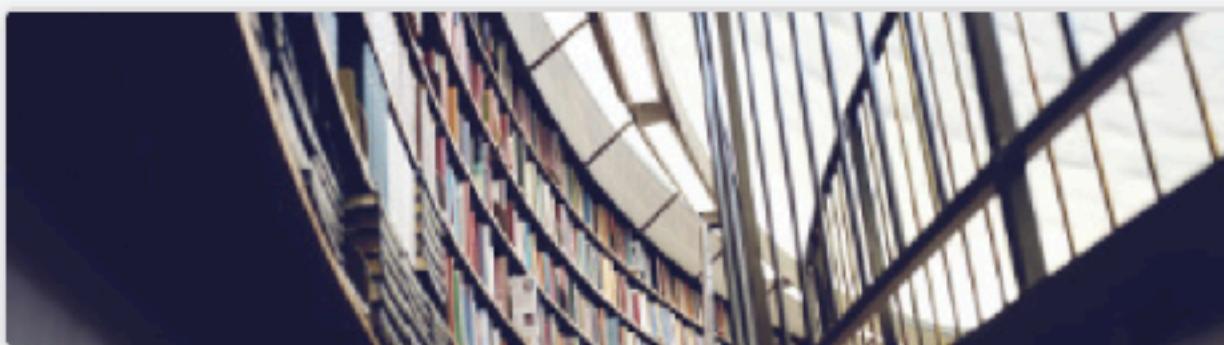
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Academic Journal



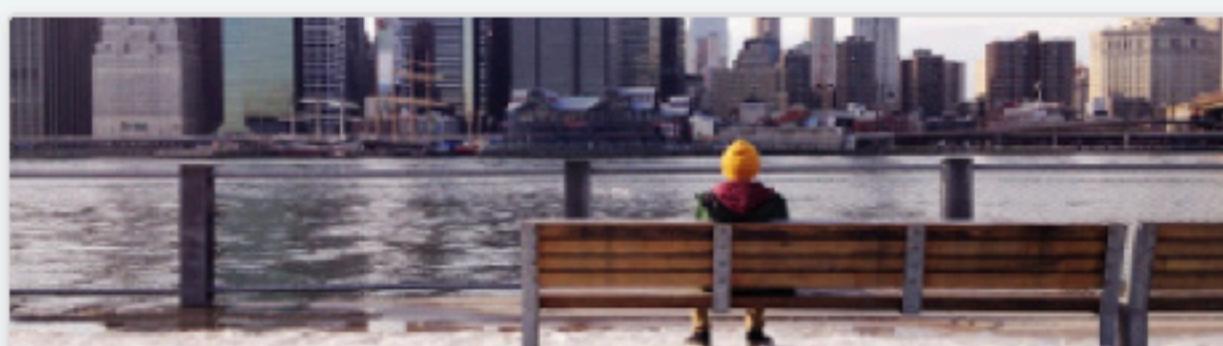
Bibliography



Book



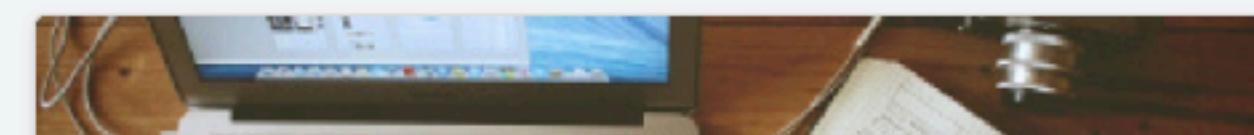
Calendar



Résumé / CV



Formal Letter



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## AASTeX Template for submissions to AAS Journals (ApJ-AJ-ApJS-ApJL-PSJ-RNAAS) Official

The American Astronomical Society (AAS) has developed a markup package to assist authors in preparing manuscripts intended for submission to all the AAS-affiliated journals. The journals are the Astrophysical Journal (ApJ), the Astronomical Journal (AJ), ApJ Supplements (ApJS), Letters (ApJL), The Planetary Science Journal (PSJ), and Research Notes of the American Astronomical society (RNAAS). The latest LaTeX classfile is AASTeX v6.3.1 and it can be obtained here. The sample631.tex template uses this classfile to illustrate some ...

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## PASP (Publications of the Astronomical Society of the Pacific) AASTeX Template

This template contains details on how to prepare and submit your articles for publication in The Publications of the Astronomical Society of the Pacific. It is a modified version of the sample631.tex template from The American Astronomical Society (AAS) markup package. The latest LaTeX classfile is AASTeX v6.3.1 and it can be obtained here. The PASPsample631.tex template uses this classfile. Once your manuscript is complete, please visit this page to submit your manuscript: [https://mc04.manuscriptcentral...](https://mc04.manuscriptcentral.com)

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(AAS JOURNALS DATA EDITORS)

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ABSTRACT

This example manuscript is intended to serve as a tutorial and template for authors to use when writing their own AAS Journal articles. The manuscript includes a history of AASTeX and includes figure and table examples to illustrate these features. Information on features not explicitly mentioned in the article can be viewed in the manuscript comments or more extensive online documentation. Authors are welcome replace the text, tables, figures, and bibliography with their own and submit the resulting manuscript to the AAS Journals peer review system. The first lesson in the tutorial is to remind authors that the AAS Journals, the Astrophysical Journal (ApJ), the Astrophysical Journal Letters (ApJL), the Astronomical Journal (AJ), and the Planetary Science Journal (PSJ) all have a 250 word limit for the abstract<sup>5</sup>. If you exceed this length the Editorial office will ask you to shorten it. This abstract has 161 words.

Keywords: Classical Novae (251) — Ultraviolet astronomy(1736) — History of astronomy(1868) — Interdisciplinary astronomy(804)

1. INTRODUCTION

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File outline

- Introduction
- Manuscript styles
- Floats
  - Tables
    - Splitting a t...
  - Figures
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aastex631.cls  
orcid-ID.png  
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File outline

- Introduction
- Manuscript styles
- Floats
- Tables
  - Splitting a table
  - Figures
  - Enhanced graphics
- Software and third party tools
- Appendix information
- Gold Open Access
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- Introduction
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- Floats
  - Tables
    - Splitting a t...
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- Software and third ...
- Appendix information
- Gold Open Access
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File outline

- Introduction
- Manuscript styles
- Floats
  - Tables
    - Splitting a t...
  - Figures
  - Enhanced graph...
- Software and third ...
- Appendix information
- Gold Open Access
- Author publication ...
- Rotating tables
- Using Chinese, Japa...

Keywords: Classical Novae (251) — Ultraviolet astronomy(1736) — History of astronomy(1868) — Interdisciplinary astronomy(804)

1. INTRODUCTION

LaTeX<sup>1</sup> is a document markup language that is particularly well suited for the publication of mathematical and scientific articles (Lamport 1994). LaTeX was written in 1985 by Leslie Lamport who based it on the TeX typesetting language which itself was created by Donald E. Knuth in 1978. In 1988 a suite of LaTeX macros were developed to investigate electronic submission and publication of AAS Journal articles (Hanisch & Biemesderfer 1989). Shortly afterwards, Chris Biemesderfer merged these macros and more into a LaTeX 2.08 style file called AASTeX. These early AASTeX versions introduced many common commands and practices that authors take for granted today. Substantial revisions were made by Lee Brotzman and Pierre Landau when the package was updated to v4.0. AASTeX v5.0, written in 1995 by Arthur Ogawa, upgraded to LaTeX 2e which uses the document class in lieu of a style file. Other improvements to version 5 included hypertext support, landscape deluxetables and improved figure support to facilitate electronic submission. AASTeX v5.2 was released in 2005 and introduced additional graphics support plus new mark

```
1 %% Beginning of file
2 %%
3 %% Modified by aastex631.cls
4 %%
5 %% This is
6 %% AASTeX
7 %%
8 %% AASTeX
9 %% (Copyright)
10 %%
11 %% AASTeX
12 %% Latexsy
13 %% Oct 202
14 %% AASTeX
15 %% already
16 %% For exa
17 %% TexLive
18 %% In part
19 %% https://
20 %%
21 %% The fir
22 %% command
23 %% documen
24 %% The com
25 %% typeset, one-column, single-spaced document. It is the default and thus
26 %% does not need to be explicitly stated.
27 %%
28 %% using aastex version 6.3
29 \documentclass[linenumber]{aastex631}
30 %%
31 %% The default is a single spaced, 10 point font, single spaced article.
32 %% There are 5 other style options available via an optional argument. They
33 %% can be invoked like this:
34 %%
35 %% \documentclass[arguments]{aastex631}
```