galpy by Jo Bovy

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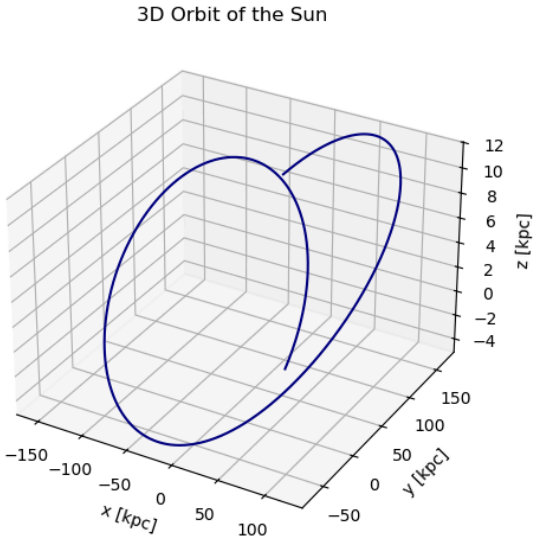
1. galpy was written to be a helpful python library for computations of galactic dynamics by computing orbits and the behaviors of stars and other interstellar objects inside galaxies.
2. I chose this library because I am an astronomy and physics double major so I figured knowledge of this package could be very useful to me in the future.
3. This package was released in 2014 and followed related codes like NEMO and orbit6 that also explore the dynamics of galaxies. It also has preceded similar packages such as gala and AGAMA. The version of galpy I used for this was the newest update for galpy version 1.10.2.
4. galpy is currently maintained by its primary author Jo Bovy as well as other contributors. It is possible to contribute to the project using github where you can submit any issues with the package.
5. galpy was very easy for me to install. In fact I started out trying to install gala but because it uses C++ to make its graphs I had lots of trouble trying to get it working but I was able to simply install galpy as it doesn't heavily use C++ as a base code. To install galpy I used the !pip install galpy command and that worked perfectly.
6. Yes galpy does install using the pip command.
7. Just pip install does not output the full source code for galpy but it is available on the github for galpy.
8. The only other code library I can find that uses and cites galpy is gala.
9. galpy is a python script so it works well in jupyter notebook as well as other coding platforms that support python well. It does not however work well as a commandline tool.
10. My examples using the code are in my Jupyter notebook
11. galpy does not produce its own figures nor does it directly use matplotlib but it does work well with matplotlib and you are able to produce figures more specific to galaxies.



12.
13. galpy is primarily a python library but uses some C integration methods.

14. galpy has a large collection of data you can pull from to create different graphs or do computations.
15. The main outputs of galpy are different data sets or parameters that describe orbital dynamics, stellar distributions, unit conversions, and more that can then be easily made into a graph using galpy specific graphing commands to visualize.
16. galpy does include unit tests designed to verify the code is doing what its supposed to be doing. These unit tests check that the core of the code works, they also can evaluate how well distribution functions match their expectations or that any numerical computations are done correctly. galpy also uses regression analysis to make sure new additions to the program don't affect the previous code as well as benchmarking to determine the performance of its computations.
17. Unit tests are the best way to be sure your code is producing a reliable result and by using the command pytest galpy/tests you can make sure that your code has produced an accurate and repeatable result.
18. galpy primarily depends on Numpy, Scipy and Matplotlib with the addition that certain advanced computations require the GNU Scientific library.
19. There is an in depth documentation on galpy which includes guides, references, and easy to use lines of code that have already been made so you can test the functions of the program.
20. There is a preferred citation provided by galpy which is,

Bovy, J. (2015), *The Astrophysical Journal Supplement Series, 216(2), 29*
DOI: 10.1088/0067-0049/216/2/29
21. Bovy, J. (n.d.). *Galpy/Galpy at main · Jobovy/Galpy*. GitHub. https://github.com/jobovy/galpy/tree/main/galpy

Welcome to Galpy's documentation. galpy documentation. (n.d.). https://docs.galpy.org/en/v1.10.2/index.html#quick-start-guide

22.Vitral, E., & Boldrini, P. (2022). Properties of globular clusters formed in dark matter mini-halos. *Astronomy & Astrophysics*, *667*. https://doi.org/10.1051/0004-6361/202244530

Hadden, S. (2024). Action-angle variables for axisymmetric potentials via Birkhoff normalization. *The Astrophysical Journal*, *972*(1), 64. https://doi.org/10.3847/1538-4357/ad6143

23. I was able to use my knowledge from the course for everything in this project.

24. I have had no prior experience using this package. I also worked mostly alone on this project though I collaborated with Jamie Vasquez-Rojas on a few details.