

SpiralMap: A Python library of the Milky Way's spiral arms

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Software

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Statement of need

Mapping the structure of the Galaxy has been an ongoing endeavour for several decades, thanks to which we have come to piece together the components it is made up of such as the discs/bulge/halo and so on ([Bland-Hawthorn & Gerhard, 2016](#)). Of particular interest is also the signature of non-axisymmetry in the disc, principally present in the form of the central Galactic bar, the warp, and various spiral like features fanning across a large portion of the disc. Over the years, various groups have surveyed the Galaxy across wavelengths (Radio to optical) and have deduced the rich variety of spiral structure present in the disc. While some of the papers in literature provide machine readable data to trace out the spiral arms in their model, often this can be a cumbersome exercise for a user simply interested in extracting the coordinates and/or overplotting the spiral arms on another plot of interest, such as while comparing the locations of the arms to features in the velocity field ([Khanna et al., 2023](#); [Poggio et al., 2024](#)).

With SpiralMap we present a library of the major spiral arm models (and maps) of the Galaxy. The package is written in Python, and allows the user to both extract the 2D trace and overplot the spiral arms in cartesian/polar coordinates in both Heliocentric (HC) and Galactocentric (GC) frames. A summary of the models currently included is provided in the Table below, where we have tried to include models from across the electromagnetic spectrum, and based on various tracers (gas/stars etc.). Other models can easily be included on request. In the near future, we anticipate the availability of 3D spiral arm traces for the Galaxy in literature which can also be included in SpiralMap.

Model	Description
Taylor_Cordes_1992	Model based on HII (Taylor & Cordes, 1993).
Drimmel_NIR_2000	Model based on Galactic plane emission in the NIR (R. Drimmel, 2000).
Levine_2006	Model based on HI (21 cm) (Levine et al., 2006).
Hou_Han_2014	Logarithmic spiral model based on HII/ GMC/methanol Maser observations (Hou & Han, 2014).
Reid_2019	Model based on parallax measurements of MASERS (Reid et al., 2019).
Poggio_2021	Map based on Upper Main sequence stars (Poggio et al., 2021).
Gaia_2022	Map based on OB stars (Gaia Collaboration et al., 2023).
Drimmel_Ceph_2024	Model based on Cepheid variables (Ronald Drimmel et al., 2024).

A few example plots that can be generated using the package are included below. For more details, we point to the following links: a) Documentation: [readthedocs](#), b) Demonstration: [Jupyter notebook](#), and c) [Github repository](#).

Drimmel_Ceph_2024(Sag-Car)

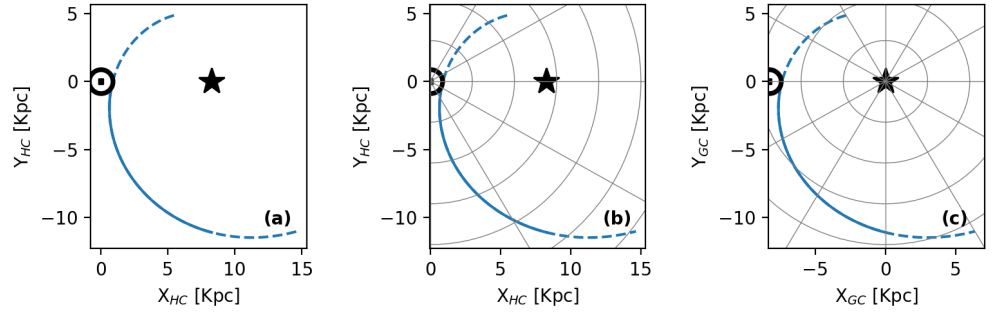


Figure 1: Cartesian projection of the Drimmel_Ceph_2024 model shown for a particular arm (Sag-Car). We show this arm in HC (a), HC with a polar grid in the background (b), and in GC frame with a polar grid in the background (c).

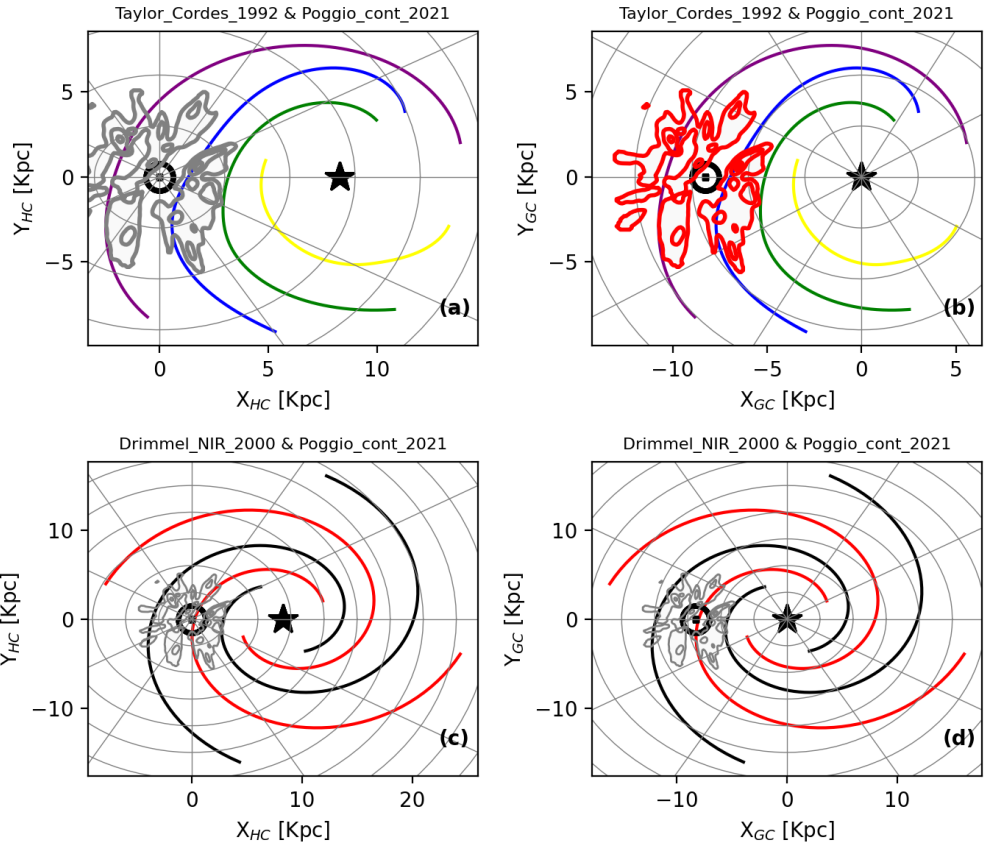


Figure 2: Cartesian projections of multiple models plotted together with a polar grid in the background. We show the Taylor_Cordes_1992 & Poggio_2021 models in HC (a) and GC (b) frames, and similarly, the Drimmel_NIR_2000 & Poggio_2021 models in HC (c) and GC (d) frames.

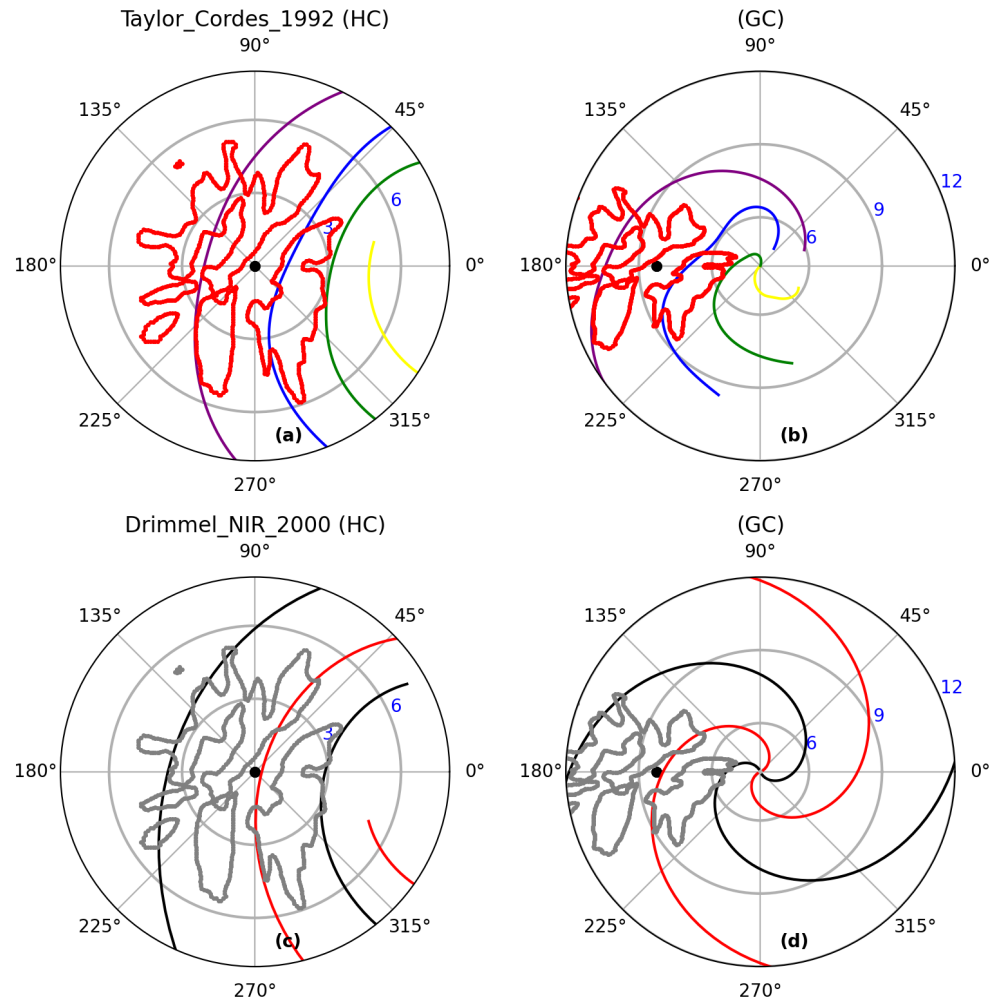


Figure 3: Polar projections of multiple models plotted together. We show the Taylor_Cordes_1992 & Poggio_2021 models in HC (a) and GC (b) frames, and similarly the tiple models plotted together with a polar grid in the background and similarly, the Drimmel_NIR_2000 & Poggio_2021 models in HC (c) and GC (d) frames.

Availability

The source code for SpiralMap is available on [GitHub](#), and the full documentation is hosted on [Read the docs](#).

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