

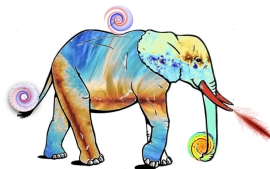
# The IMAGINE model library

## CRPropa Workshop, Bochum

Sebastian Hutschenreuter

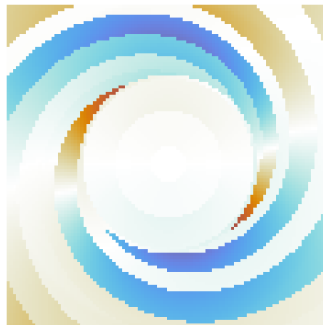
Vienna Observatory, University of Vienna

September 27, 2023





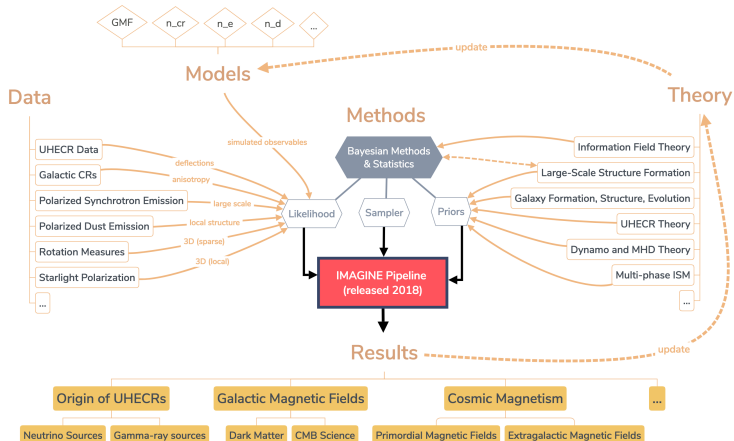
- 1 IMAGINE consortium
- 2 IMAGINE software
- 3 The model library
- 4 Explore connections to CRPropa?



JF12 model

What is the 3D configuration of the Galactic magnetic field?



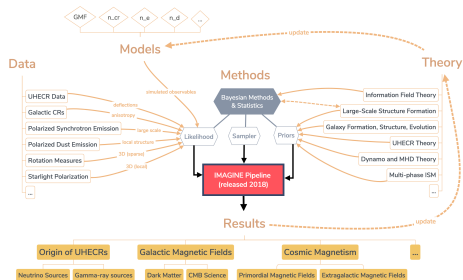


IMAGINE whitepaper ([1805.02496](#))

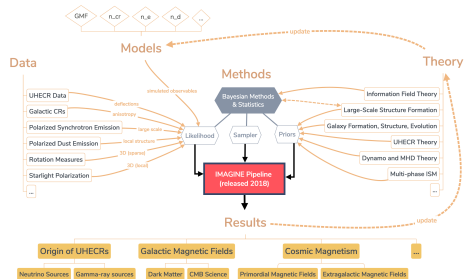




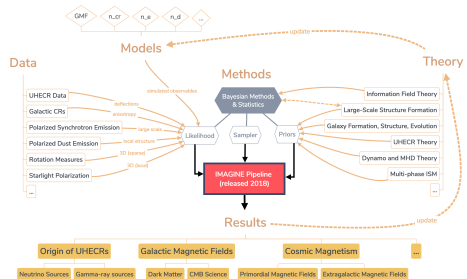
- Fully Bayesian inference framework based on nested sampling



- Fully Bayesian inference framework based on nested sampling
- Several possible engines (Multinest, dynesty, ultranest)

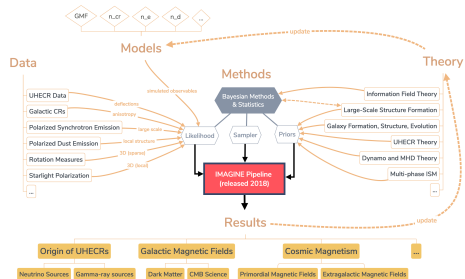


- Fully Bayesian inference framework based on nested sampling
- Several possible engines (Multinest, dynesty, ultranest)
- Physics simulators (RM / Synchrotron / Dust ...)

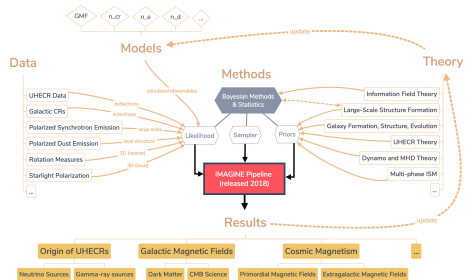




- Fully Bayesian inference framework based on nested sampling
- Several possible engines (Multinest, dynesty, ultranest)
- Physics simulators (RM / Synchrotron / Dust ...)
- Data structures (RM / Synchrotron /Dust...)



- Fully Bayesian inference framework based on nested sampling
- Several possible engines (Multinest, dynesty, ultranest)
- Physics simulators (RM / Synchrotron / Dust ...)
- Data structures (RM / Synchrotron /Dust...)
- Hammurabi interface



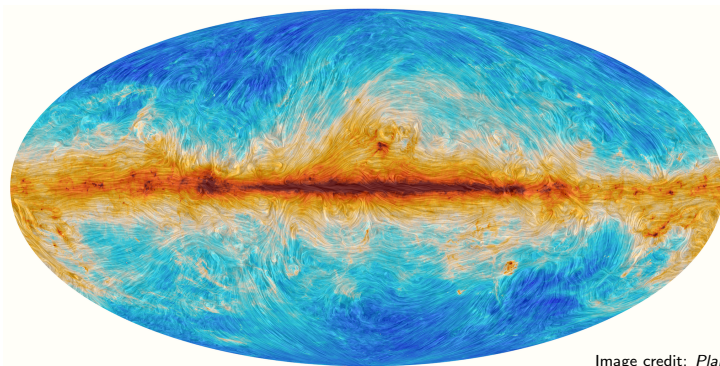


Image credit: *Planck*

Dust polarisation, cosmology

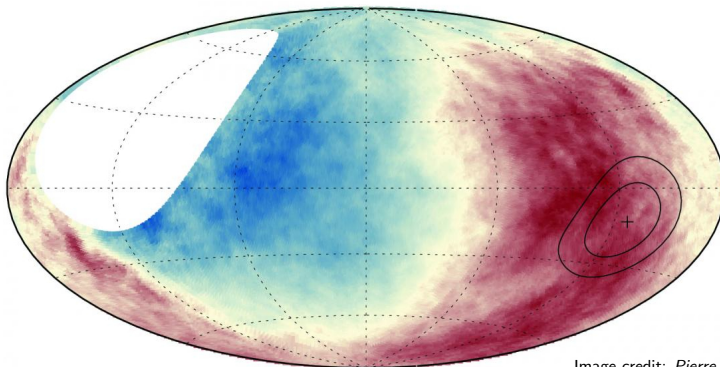


Image credit: *Pierre Auger*

CR propagation

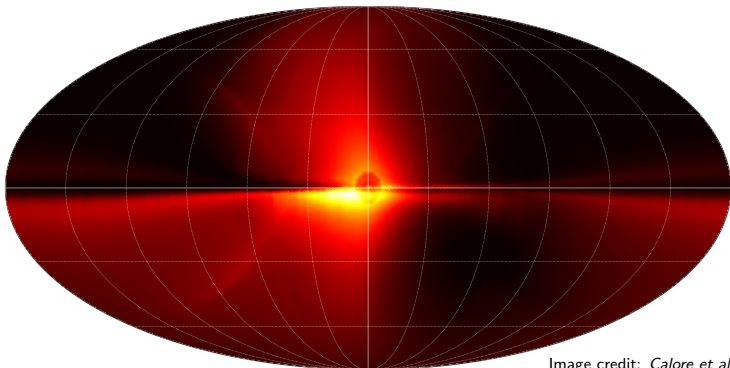


Image credit: Calore et al. (2021)

## Search for Axions

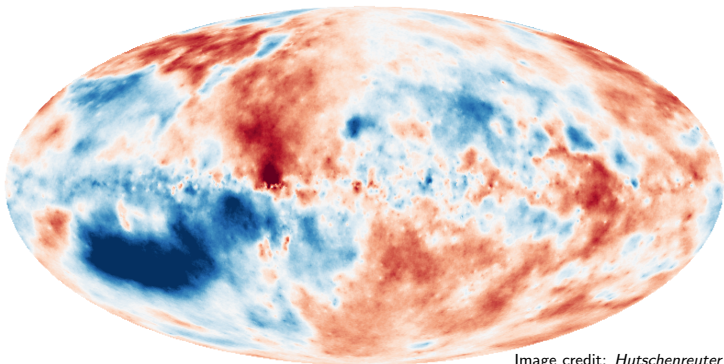
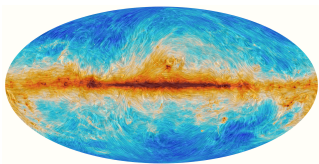
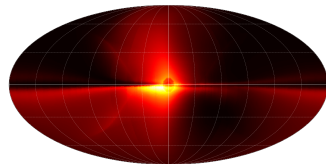


Image credit: *Hutschenreuter et al. (2023)*

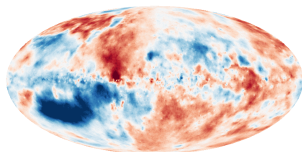
Faraday rotation



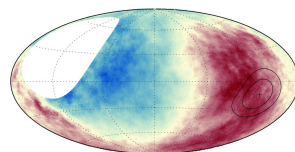
Dust



Axions



Faraday



CR

- Many applications
- Possible mutual benefits
- → Modularize the IMAGINE software



Available at <https://github.com/IMAGINE-Consortium/imagine-models>





Available at <https://github.com/IMAGINE-Consortium/imagine-models>

Features:

- 18 Galactic Magnetic field models ([LIST](#))
- several thermal electron models



Available at <https://github.com/IMAGINE-Consortium/Imagine-Models>

Features:

- 18 Galactic Magnetic field models ([LIST](#))
- several thermal electron models
- core implemented in C++, with bindings to python



Available at <https://github.com/IMAGINE-Consortium/ imagine-models>

Features:

- 18 Galactic Magnetic field models ([LIST](#))
- several thermal electron models
- core implemented in C++, with bindings to python
- unified interface for all models



Available at <https://github.com/IMAGINE-Consortium/imagine-models>

Features:

- 18 Galactic Magnetic field models ([LIST](#))
- several thermal electron models
- core implemented in C++, with bindings to python
- unified interface for all models
- Also support for turbulent fields (FFTW based, optional)
- autodifferentiation (usable for ML, VI, optional)



DEMO



- More models



- More models
- More random field generators



- More models
- More random field generators
- More testing





- More models
- More random field generators
- More testing
- Interfaces to other frameworks, e.g.
  - Nifty
  - Dragon
  - Hammurabi
  - CRPropa



- Software repository ([link](#))
- IMAGINE homepage ([link](#))
- IMAGINE whitepaper ([link](#))

# Thank you for your attention!