



Image composed by Jörg P. Rachen for ISSI International Team 323, Bern 2014/15, <http://www.issibern.ch/teams/bayesianmodel/>

IMAGINE:

the Interstellar MAGnetic field INference Engine

Tess Jaffe for the IMAGINE Consortium

Co-PIs:

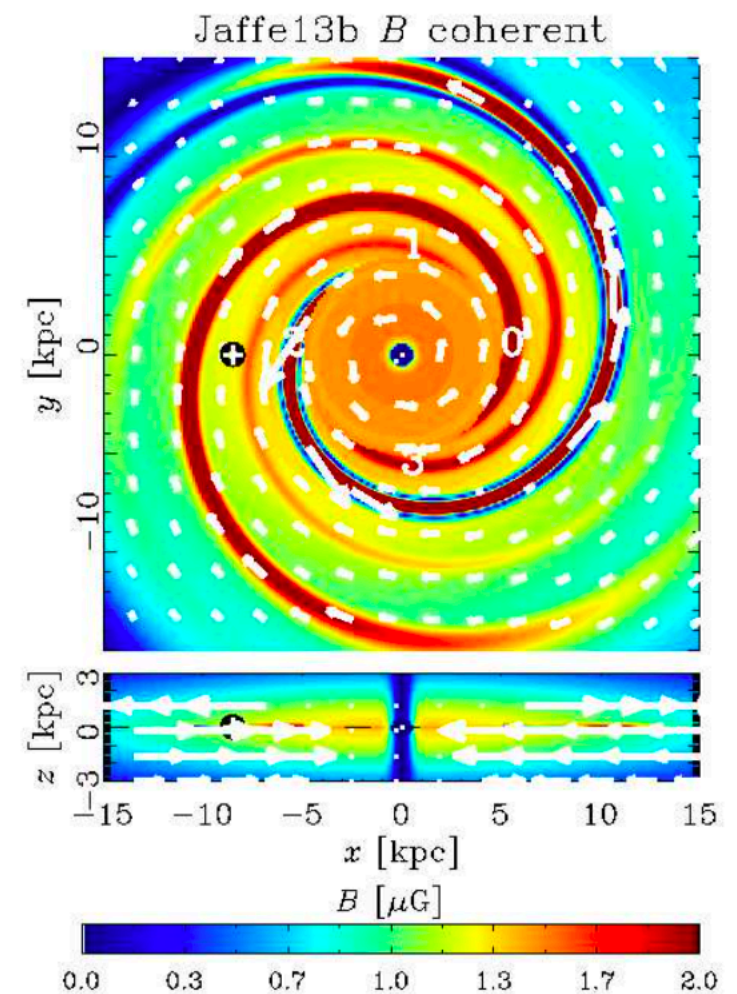
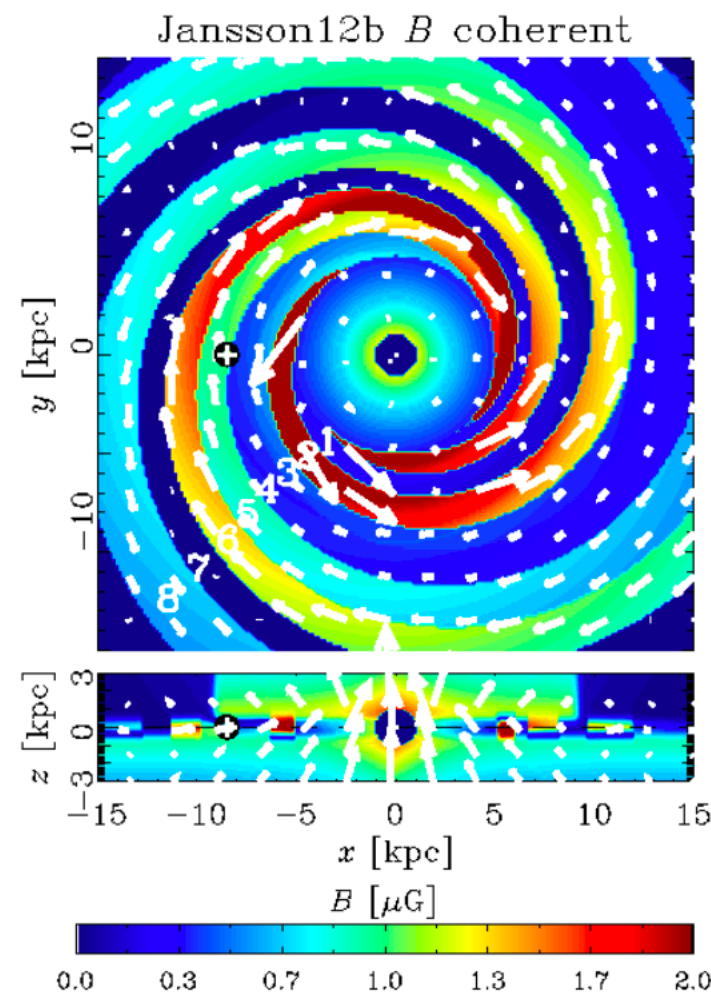
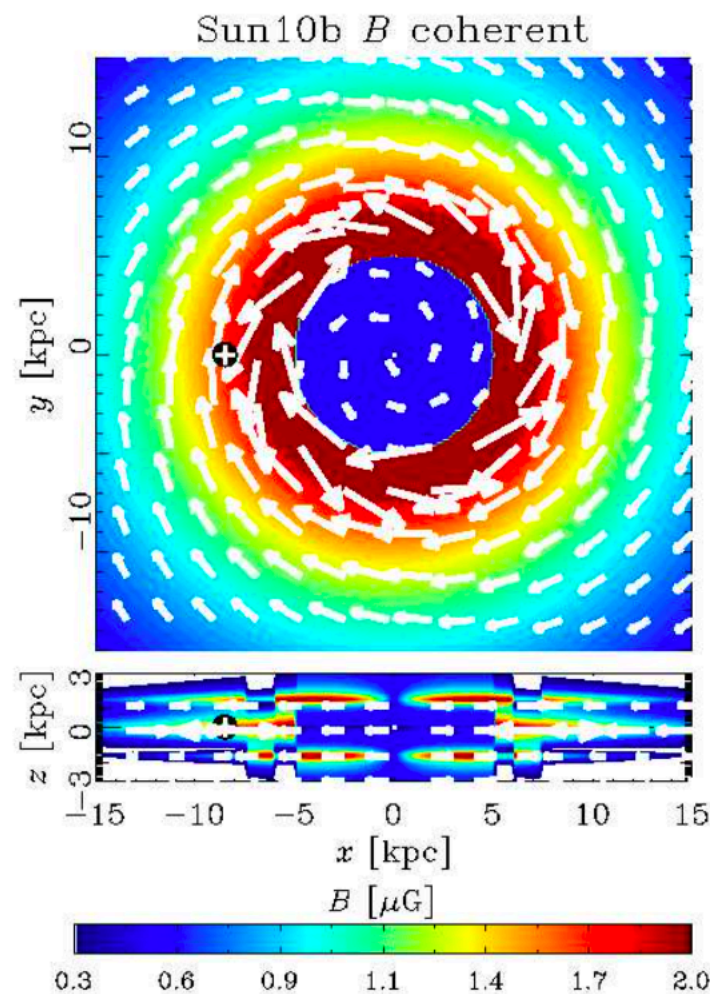
François Boulanger	(IAS, Paris)	<i>Planck</i> , polarized dust
Torsten Enßlin	(MPA, Munich)	Information Theory, CR and B-field theory
Marije Haverkorn	(Radboud U., Nijmegen)	Radio astronomy, B-fields, turbulence
Jörg Hörandel	(Radboud U., Nijmegen)	CR observations, radio emission
Tess Jaffe	(NASA/GSFC)	<i>Planck</i>, B-field modeling, simulation
Jens Jasche	(TUM, Munich)	IFT, Bayesian methods, theory
Jörg Rachen	(Radboud U., Nijmegen)	UHECRs, Bayesian methods
Anvar Shukurov	(Newcastle U)	Theory of CRs, B-fields, turbulence.

Members:

Andrew Fletcher , Philipp Girichides, Michael Kachelreiß, Christoph Pfrommer, Luis Rodrigues, Beatrice Ruiz Granados, Günter Sigl, Theo Steininger, Ajen van Vliet, Jiaxin Wang....

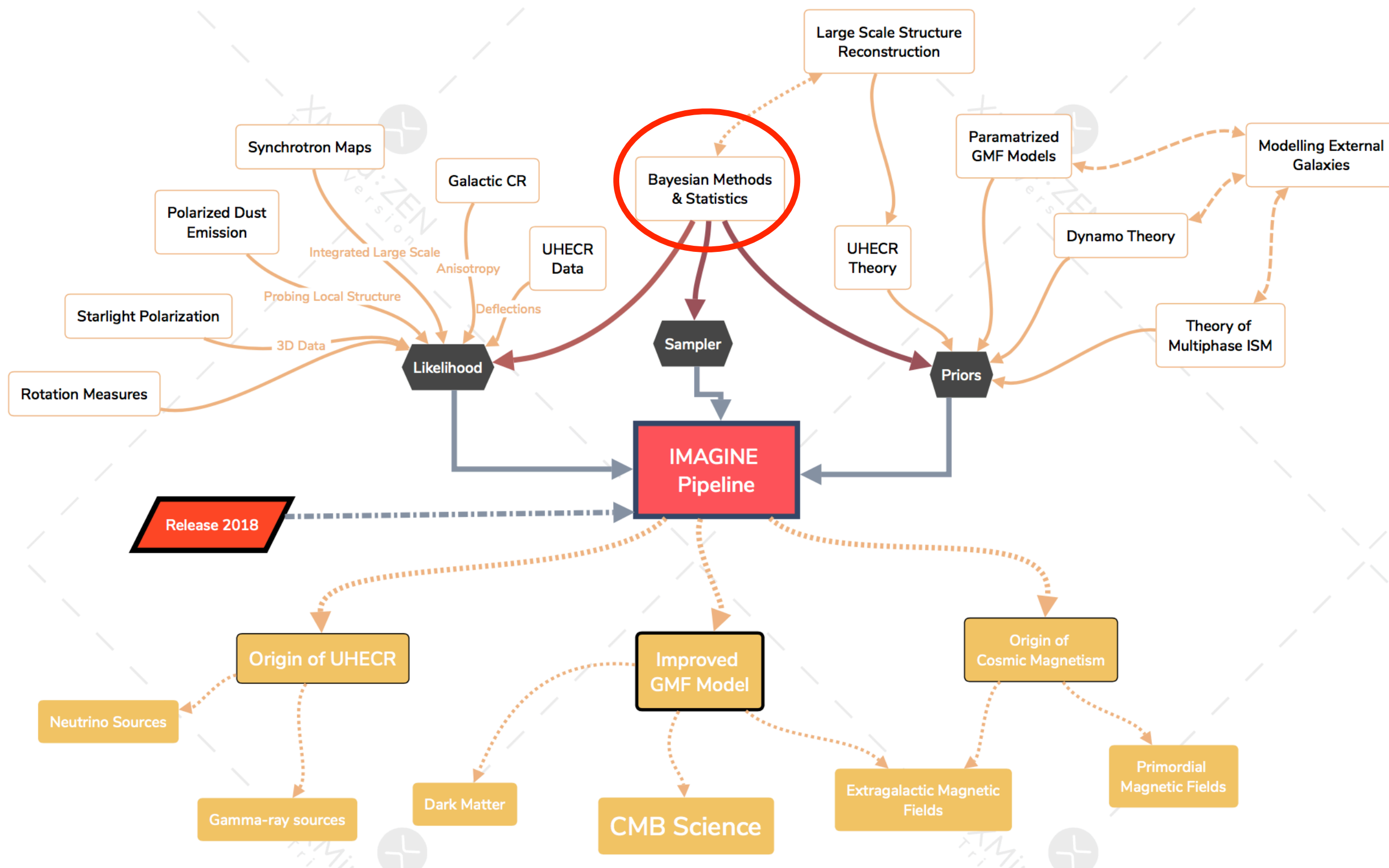
A few of the problems with the state of the art

- Three models below all roughly match the data.
- None is generated by dynamo physics.
- A Bayesian model comparison has not been done.
- And don't even ask about the treatment of the turbulence.

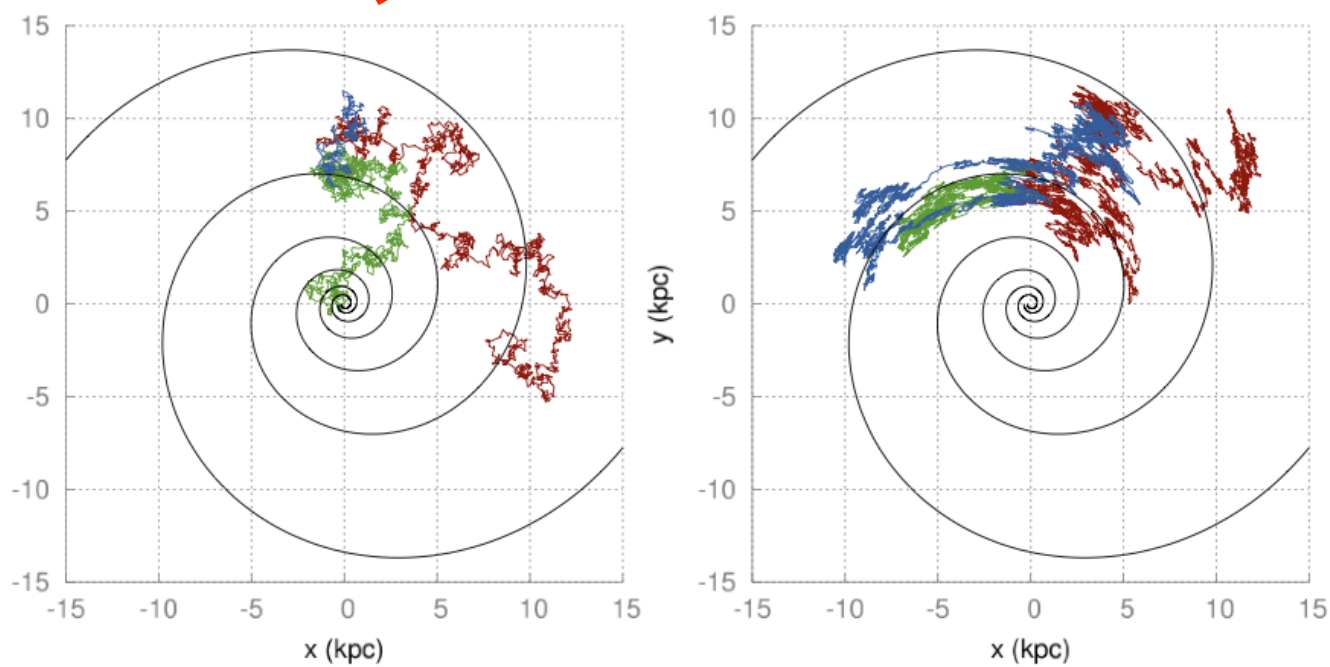
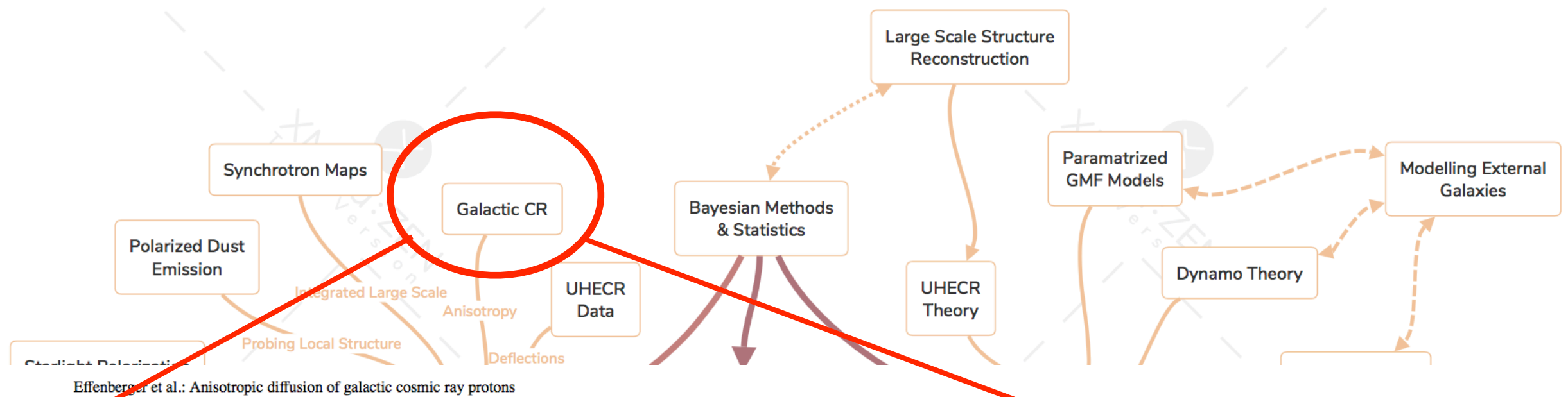


IMAGINE overview

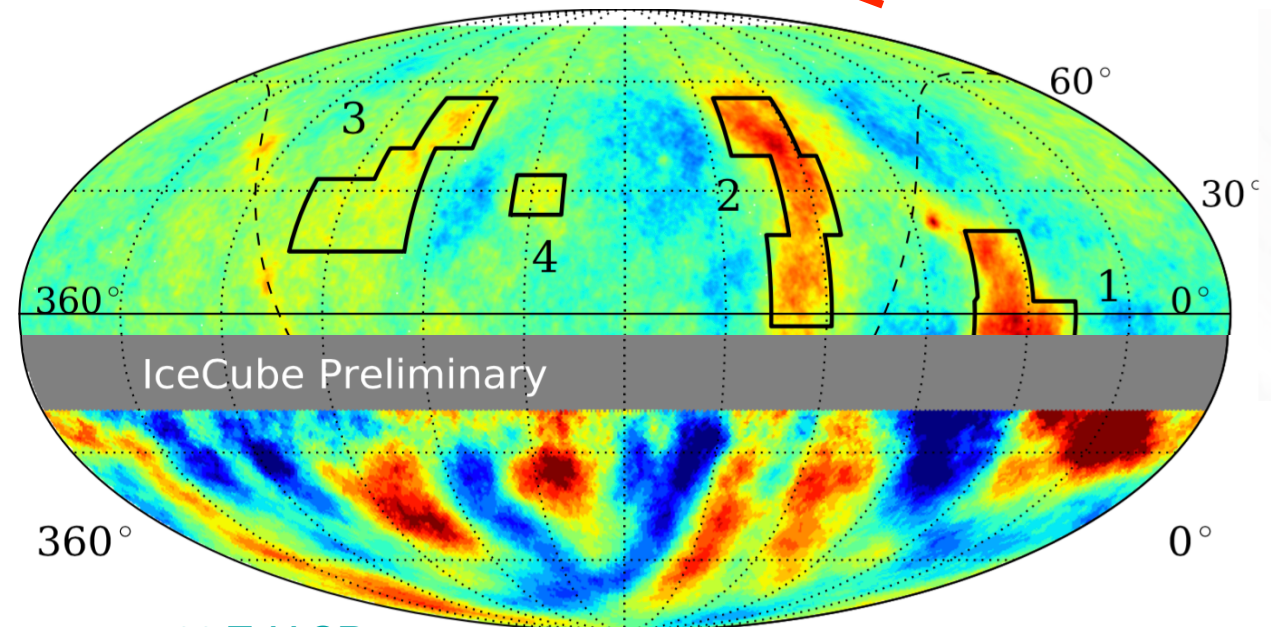
(Draft figure still being worked on)



Galactic cosmic rays

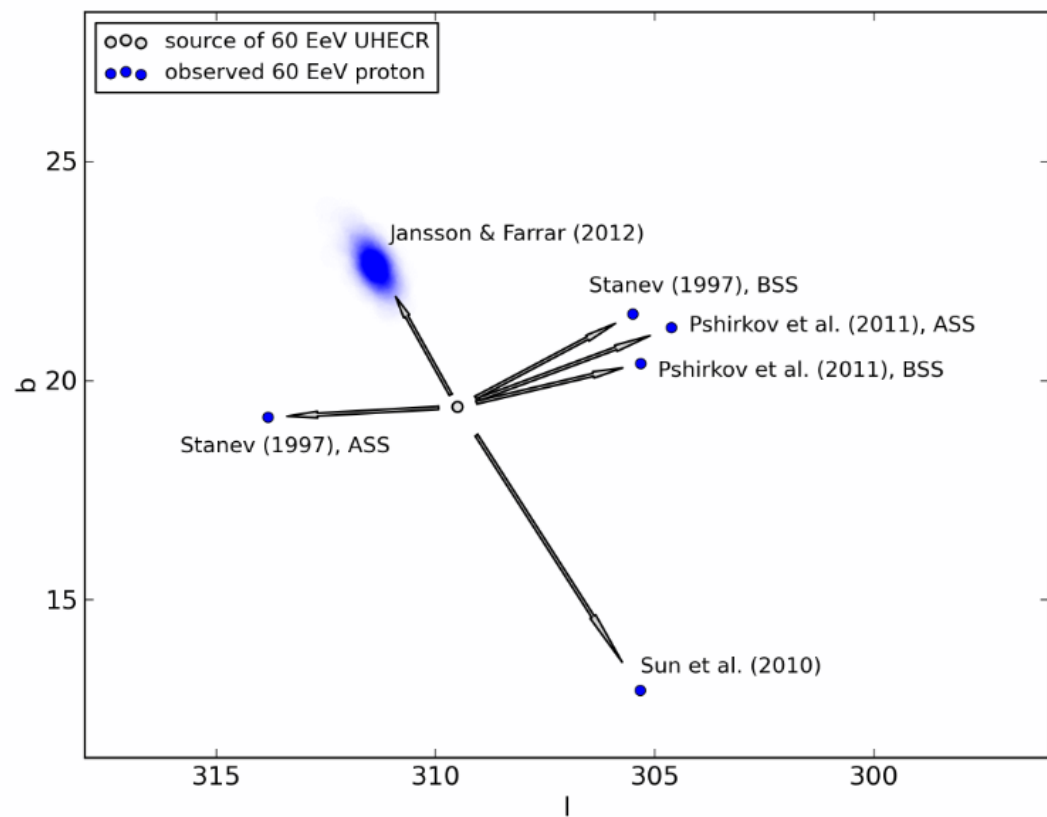
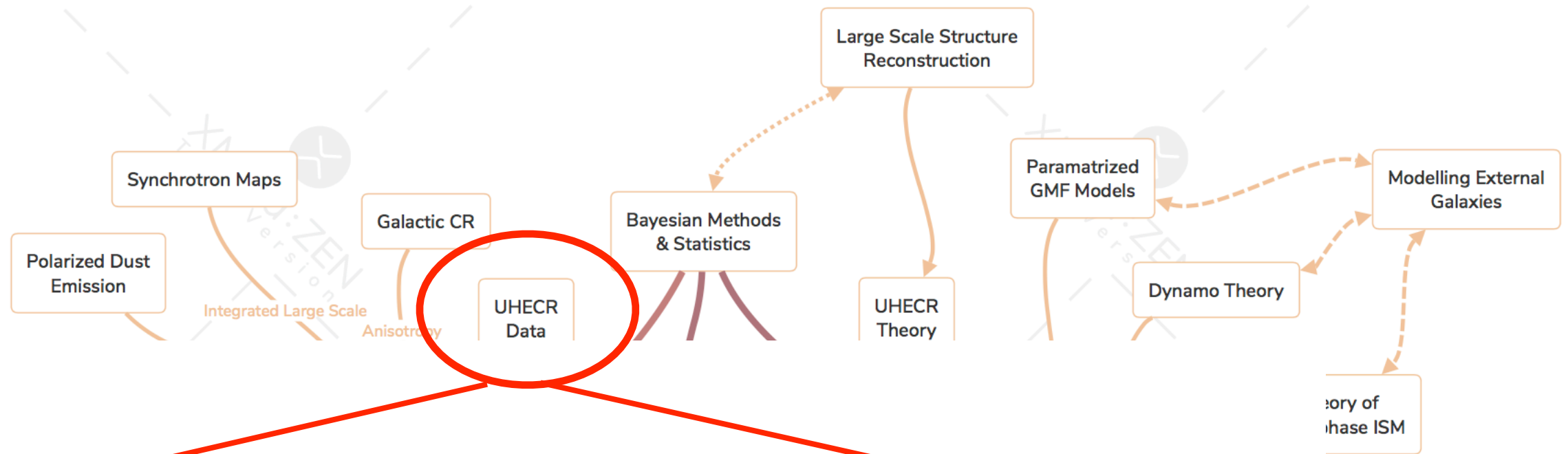


Effenberg et al. (2012)

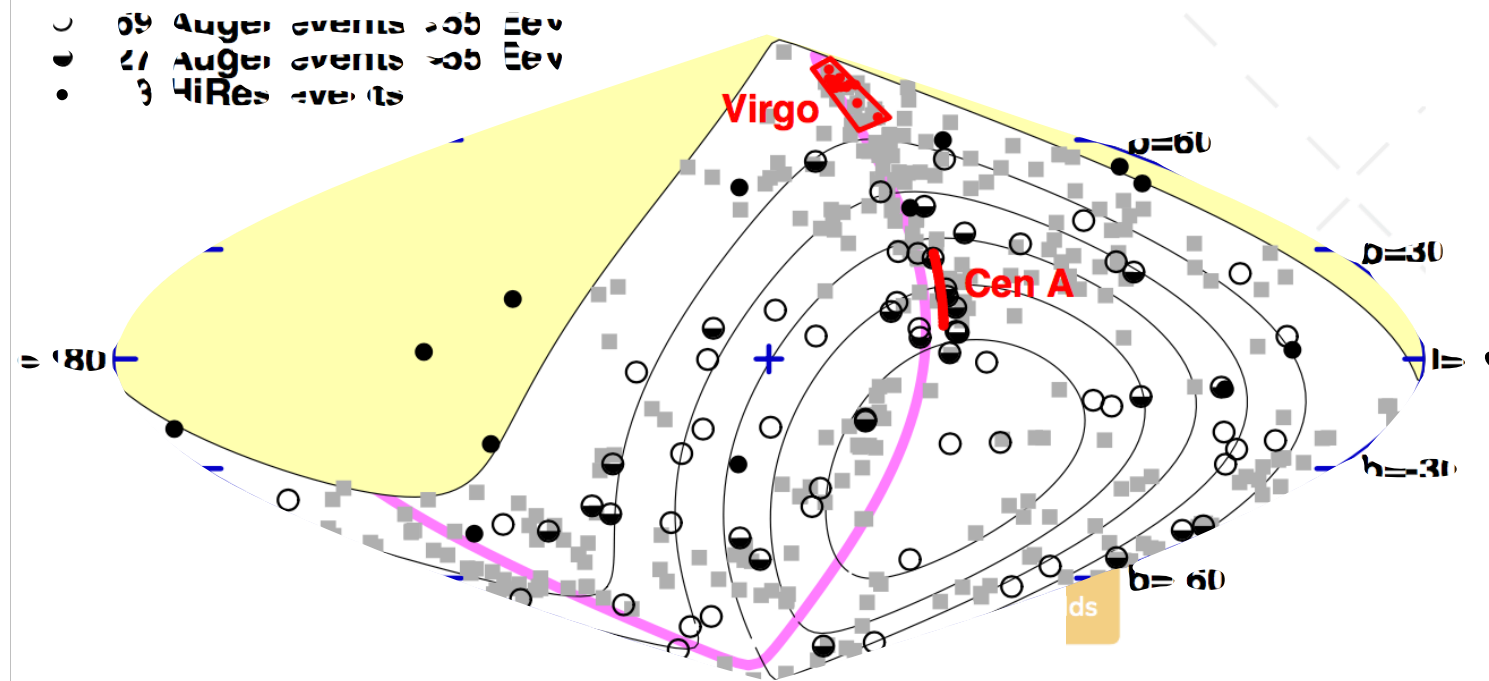


1-100 TeV CRs
Northern: **ARGO-YBJ** from Bartoli et al. (2013).
Southern: **IceCube** from Desiati et al. (2013)

Extragalactic CRs and UHECRs

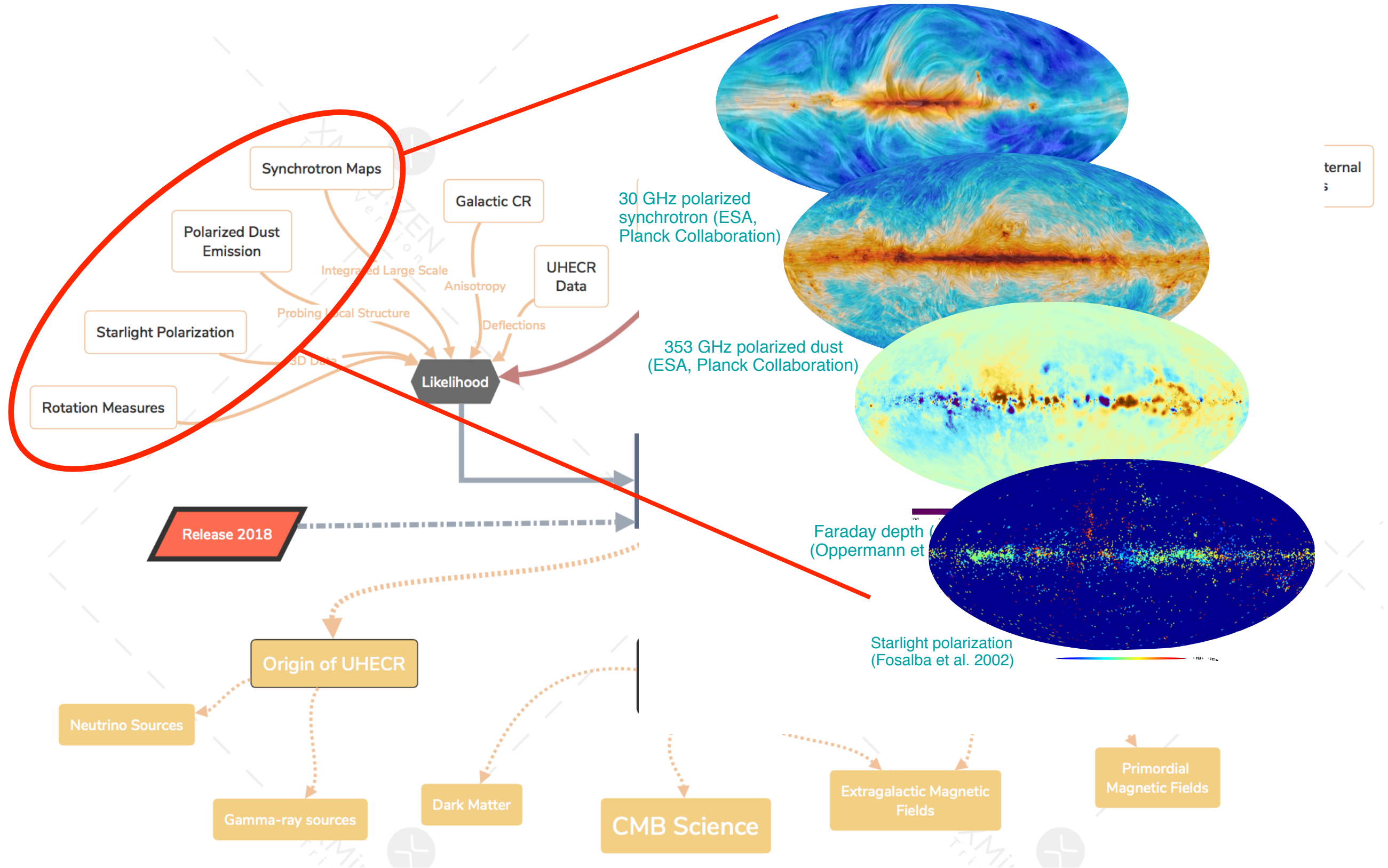


UHECR sources and B-field models
(Farrar et al., JCAP 01, 023, 2013)

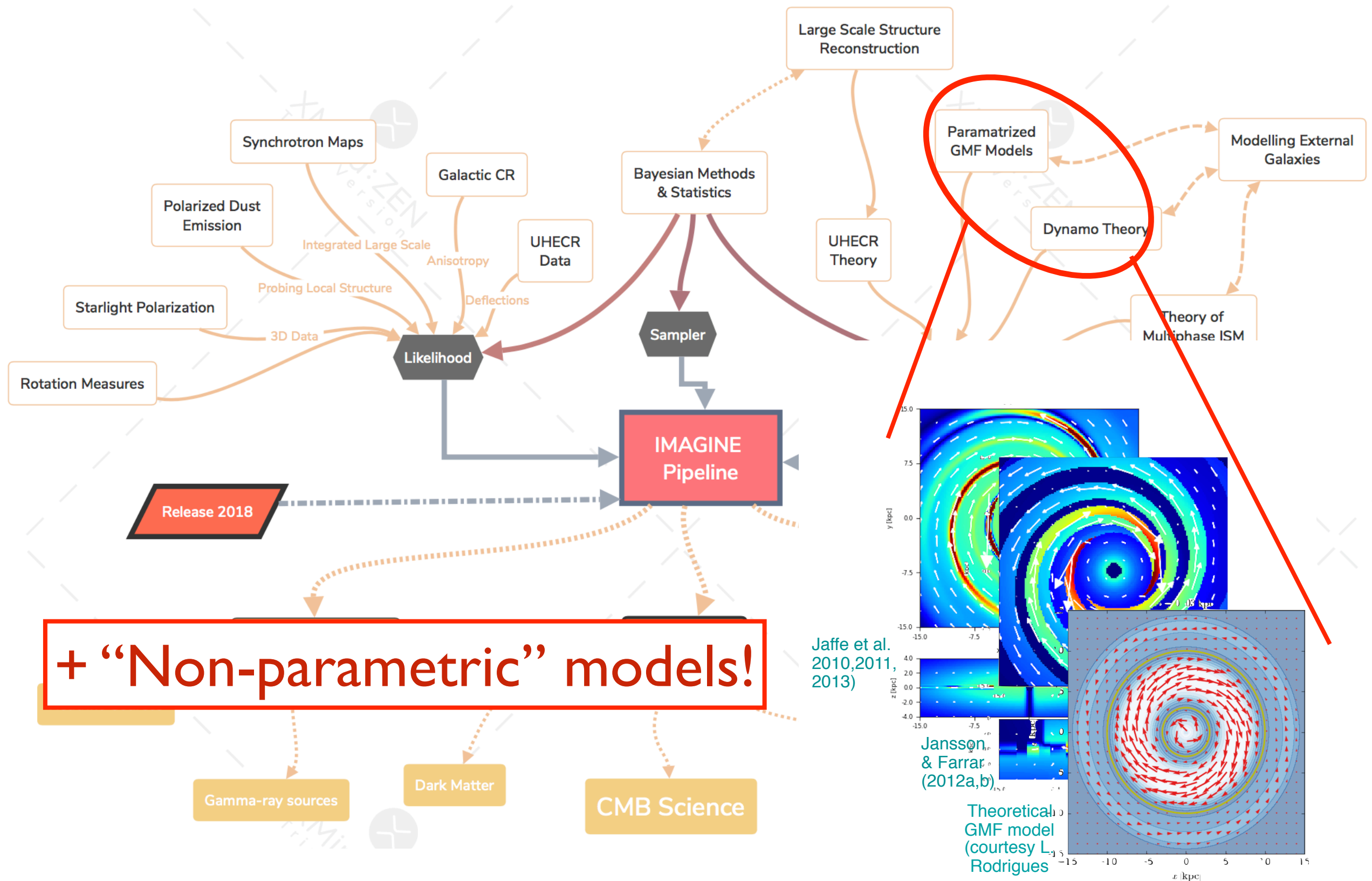


Auger events and possible sources
(Figure courtesy T. Stanev)

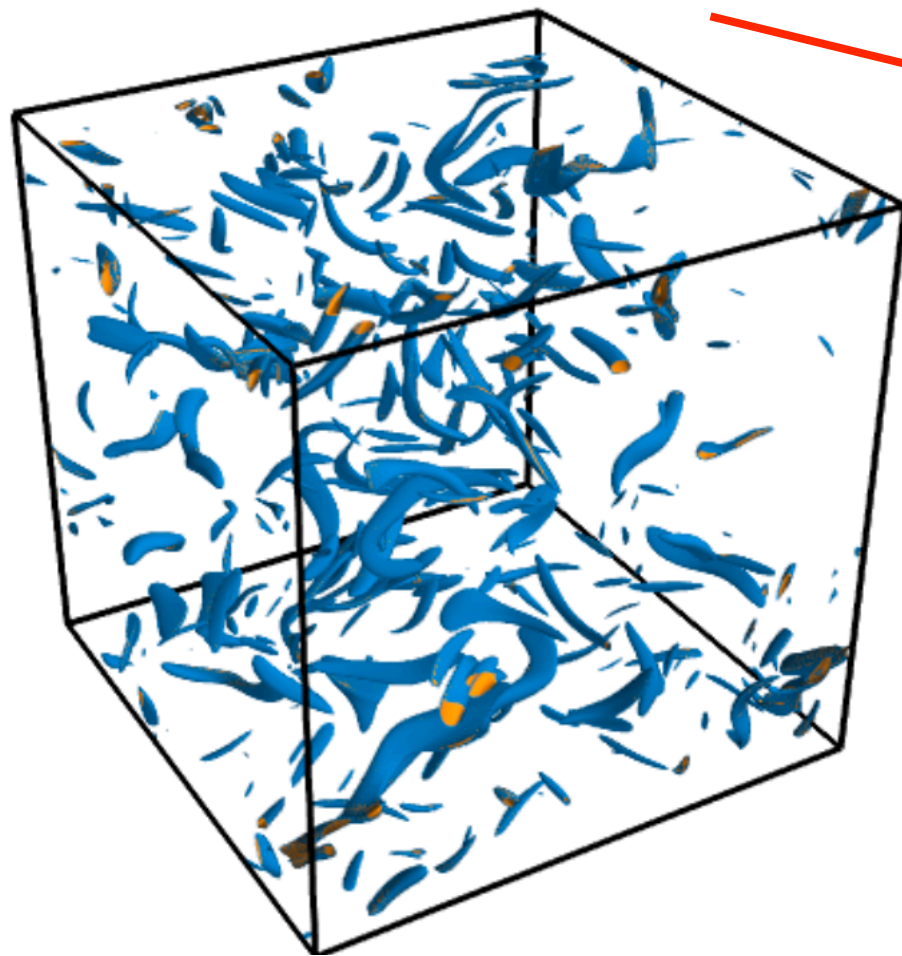
Polarized emission, RMs, starlight



Galactic magnetic field models

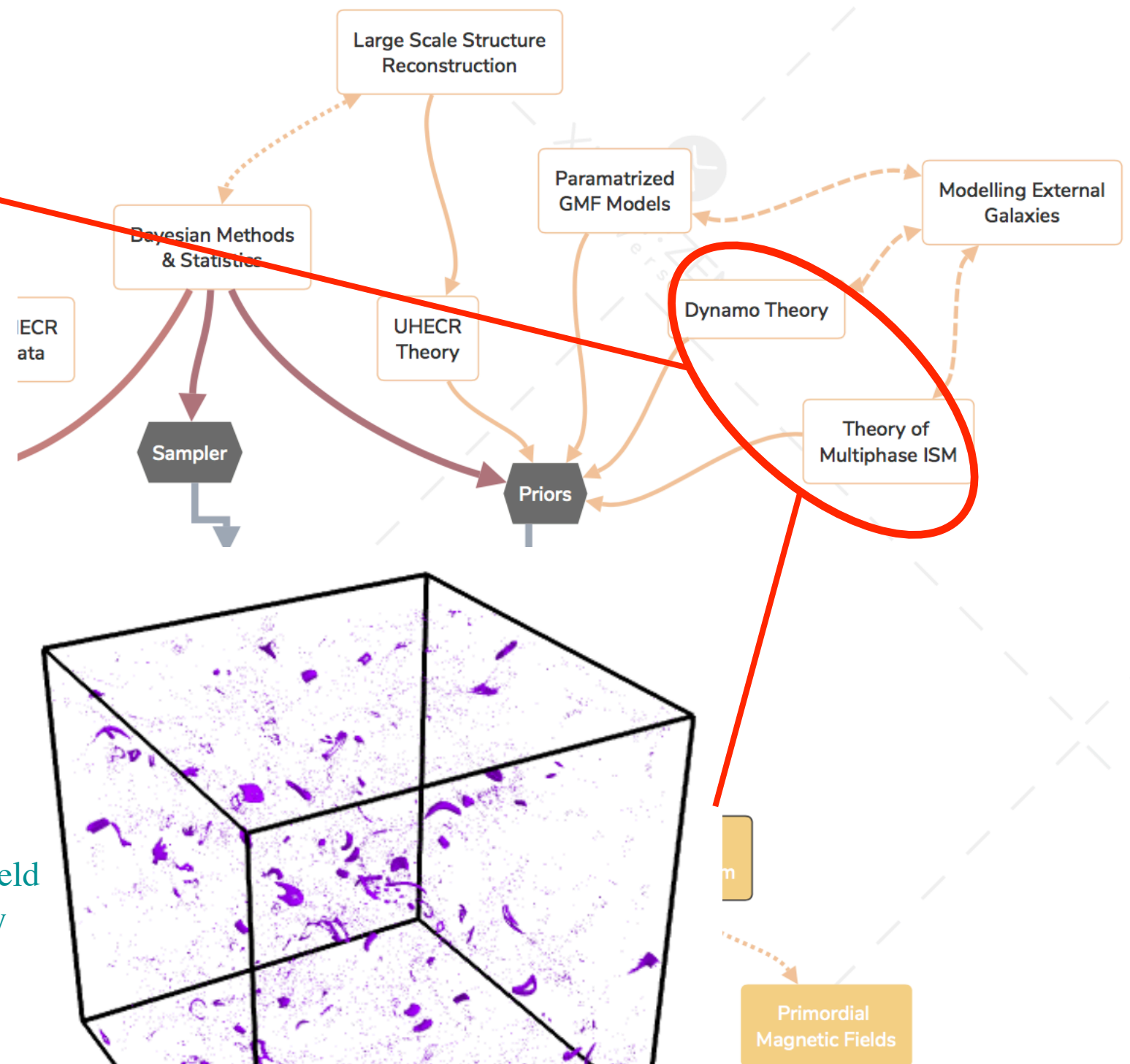
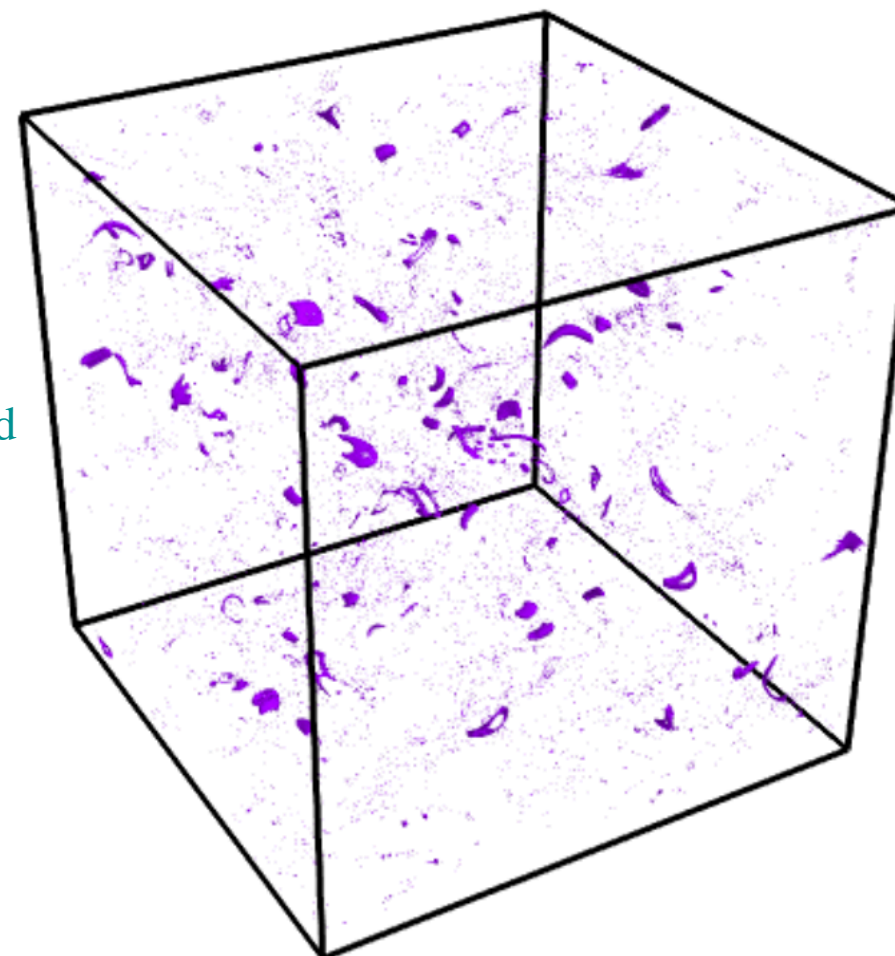


Turbulent ISM

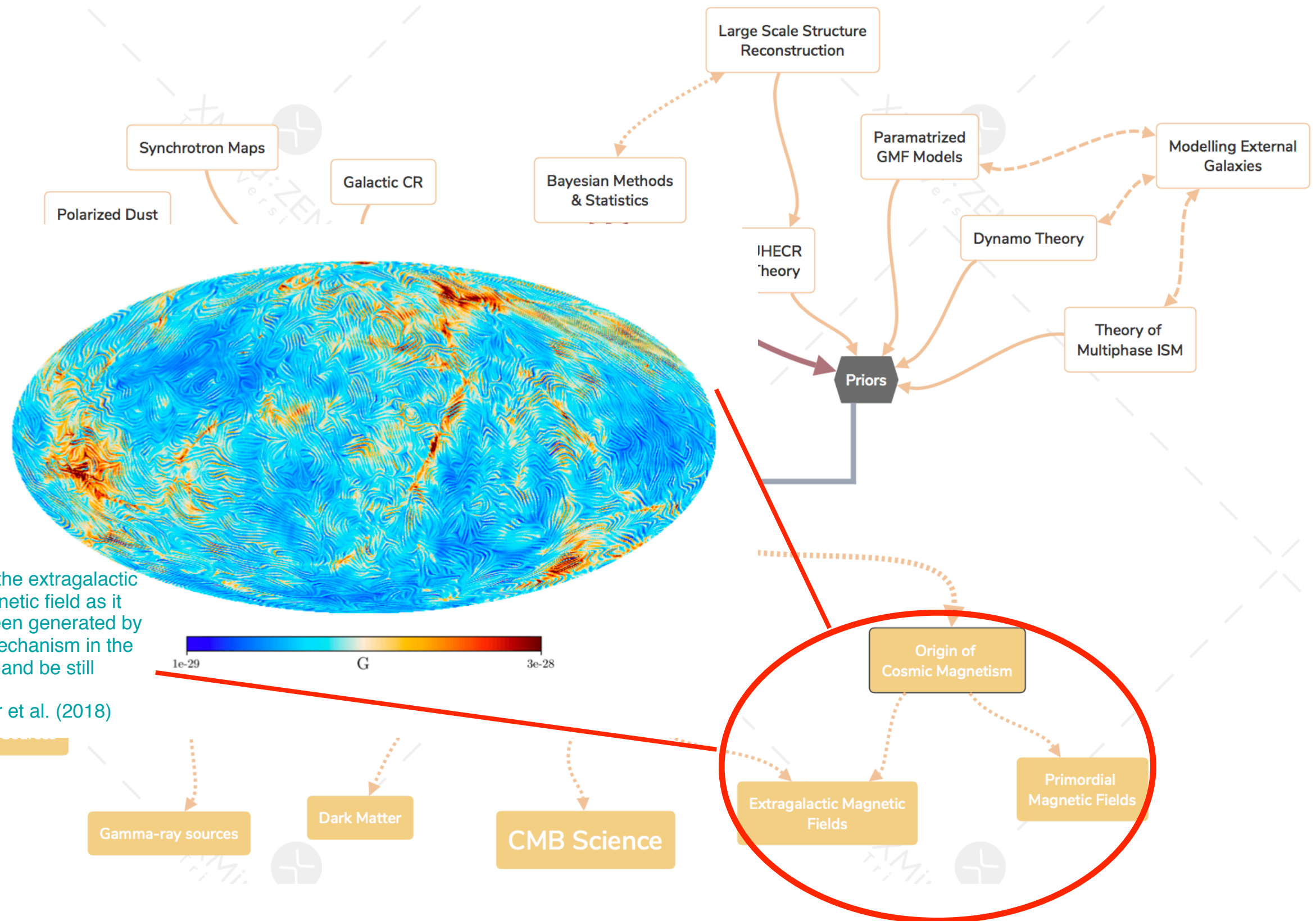


Isosurfaces of the strength of a random magnetic field B (left) and CR number density (right) produced by the fluctuation dynamo

(Seta et al. 2018)

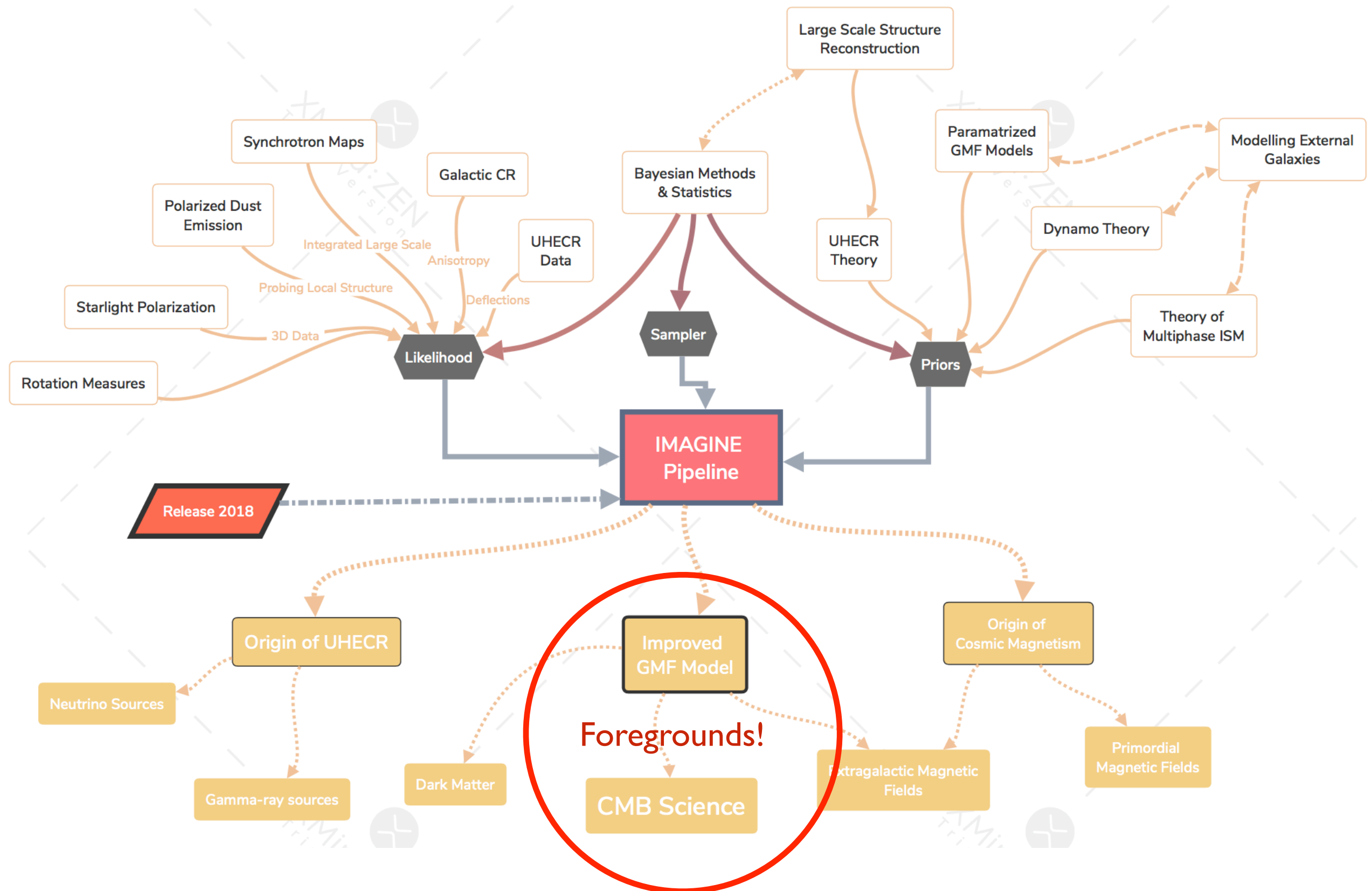


Extragalactic magnetic fields



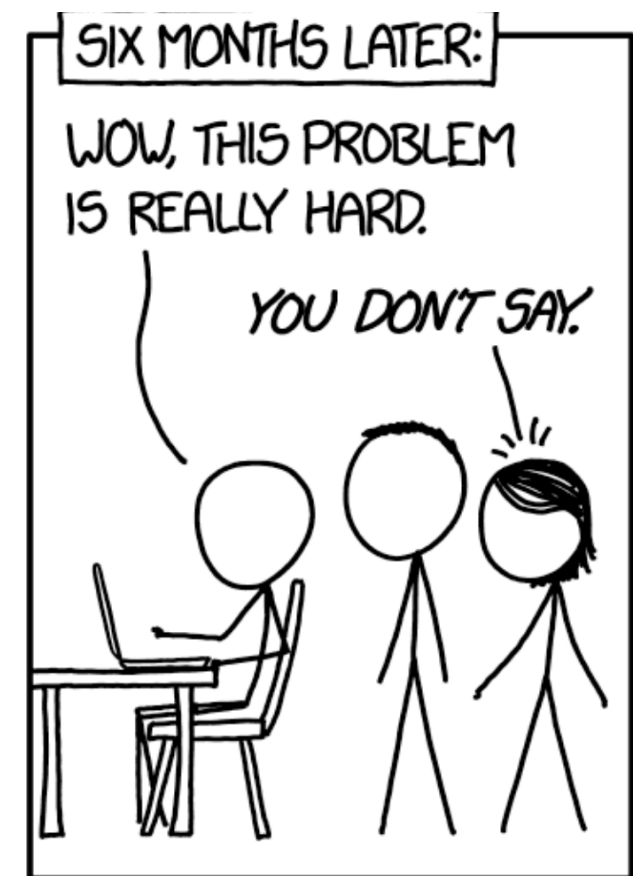
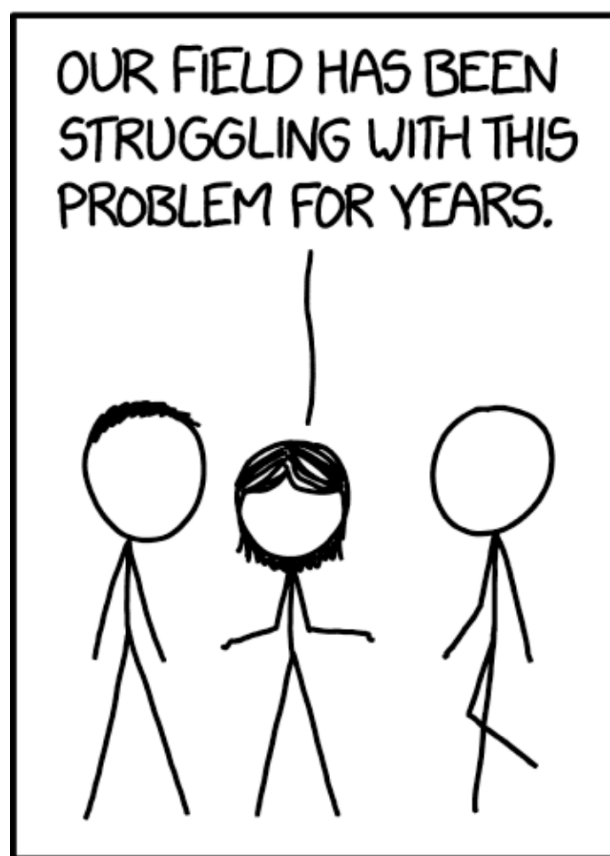
All sky map of the extragalactic primordial magnetic field as it should have been generated by the Harrison mechanism in the Early Universe and be still present today.
Hutschenreuter et al. (2018)

CMB foregrounds!



What IMAGINE can do for the CMB

- What microwave observations give to IMAGINE is clear. But the reverse is obviously more important for this group!
- Need more realistic simulations of astrophysical foregrounds in order to design your experiment and test your component separation methods. We need
 - ▶ Non-Gaussian and correlated turbulent components of B , n_{CR} , n_d . E.g., based on MHD for synchrotron.
 - ▶ Proper 3D integration to probe the effects of variations both within the beam and along the LOS.
 - ▶ Include in simulated systematics (e.g., intensity leakage into polarization?) in the presence of these correlated non-G components (i.e., Planck shows dust total I correlated at small scales with magnetic field direction).



Randall Munroe, XKCD (<https://xkcd.com/1831/>)