EXTRAGALACTIC MAGNETIC FIELDS

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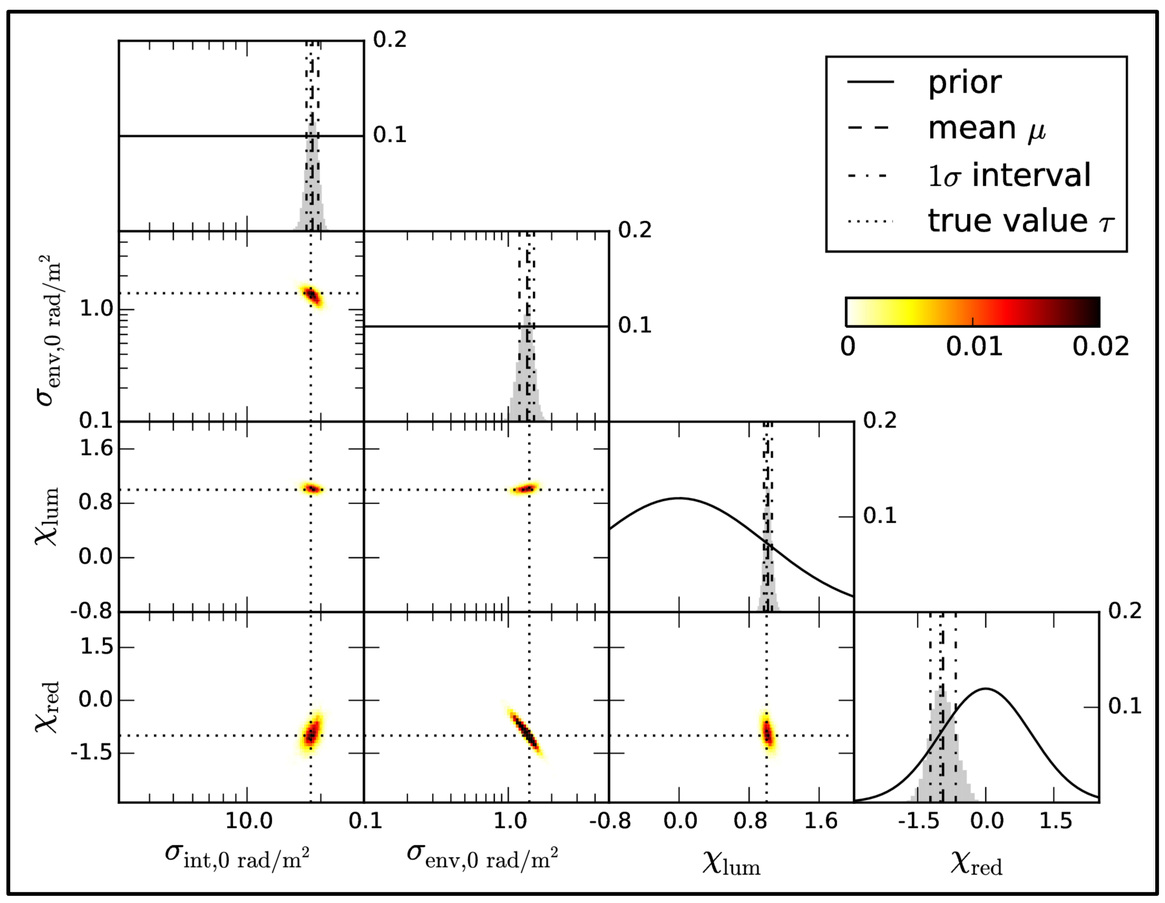
Introduction

To understand cosmic magnetism, a detailed knowledge of magnetic fields in the large-scale structure of the Universe is crucial. Magneto-ionic media between the source and the observer rotate the polarization angle of linearly polarized signals as a function of the Faraday depth,

$$\phi \propto \int B_{los} n_e \, dl.$$

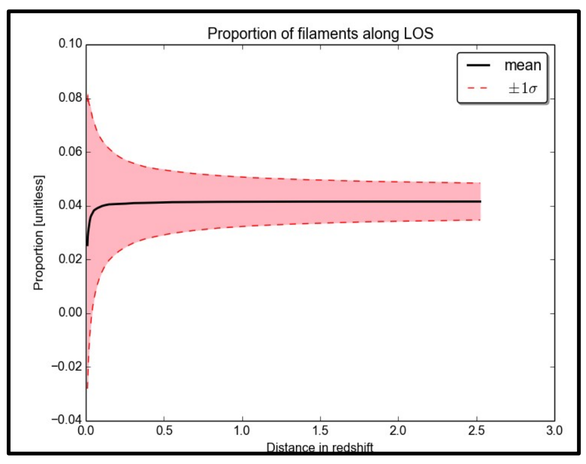
This effect is called Faraday rotation and represents a powerful tool to investigate large-scale magnetism (e.g., Govoni & Feretti 2004) . Faraday depths of extragalactic sources are sensitive to magnetization of the Milky Way, the emitting radio source, galaxy clusters, filaments, sheets, and voids. High-quality observations and sophisticated approaches are required to uncover the tiny signatures of large-scale magnetic fields (≤ 1-2 rad/m^2), typically buried by the Galactic term and the instrumental noise.



Methods & Results

Oppermann et al. (2015) separated the Galactic Faraday screen from the extragalactic term with an advanced statistical approach, by properly taking into account the noise. Recently, by assuming a zero-mean Gaussian extragalactic distribution, we developed a Bayesian algorithm to further statistically disentangle the contribution intrinsic to the emitting radio source, $\sigma^2_{\rm int,0}$, and the overall large-scale structure Faraday rotation, $\sigma^2_{\rm env,0}$, and their luminosity, $\chi_{\rm lum}$, and redshift dependence, $\chi_{\rm red}$. The Figure on the left shows

The posterior of these parameters obtained with a mock SKA - MID - Band 2 catalog. The algorithm is capable of constraining these parameters already with 3500 sources (see Vacca et al. 2016). To statistically discriminate the Faraday rotation from galaxy clusters, filaments, voids, and sheets, radio observations need to be combined with the knowledge of the cosmic web density field (Vacca et al. 2015). High-quality catalogs of sources in the local Universe (z ≤ 0.2) are desirable, since the fraction of line of sight through each large-scale environment tends to the cosmic mean for high-redshift sources (see panel to the right for filaments as an example).



Conclusions

In order to shed light on the origin and evolution of cosmic magnetism, we propose a new statistical approach to study magnetic fields on large-scales with the rotation measure grid data that will be obtained with the new generation of radio interferometers.

References

Govoni & Feretti 2004, IJMP D, 13, 1549; Oppermann et al. 2015, A&A, 575, A118; Vacca et al. 2016, A&A, 591, A13; Vacca et al. 2015, Advancing Astrophysics with the SKA (AASKA14), 114

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