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Planck intermediate results: XLII. Large-scale Galactic magnetic fields

Adam R., Ade P., Alves M., Ashdown M., Aumont J., Baccigalupi C., Banday A., Barreiro R., Bartolo N., Battaner E., Benabed K., Benoit-Lévy A., Bernard J., Bersanelli M., Bielewicz P., Bonavera L., Bond J., Borrill J., Bouchet F., Boulanger F., Bucher M., Burigana C., Butler R., Calabrese E., Cardoso J., Catalano A., Chiang H., Christensen P., Colombo L., Combet C., Couchot F., Crill B., Curto A., Cuttaia F., Danese L., Davis R., De Bernardis P., De Rosa A., De Zotti G., Delabrouille J., Dickinson C., Diego J., Dolag K., Doré O., Ducout A., Dupac X., Elsner F., Enßlin T., Eriksen H., Ferrière K., Finelli F., Forni O., Frailis M., Fraisse A., Franceschi E., Galeotta S., Ganga K., Ghosh T., Giard M., Gjerløw E., González-Nuevo J., Górski K.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© ESO, 2016.Recent models for the large-scale Galactic magnetic fields in the literature have been largely constrained by synchrotron emission and Faraday rotation measures. We use three different but representative models to compare their predicted polarized synchrotron and dust emission with that measured by the Planck satellite. We first update these models to match the Planck synchrotron products using a common model for the cosmic-ray leptons. We discuss the impact on this analysis of the ongoing problems of component separation in the Planck microwave bands and of the uncertain cosmic-ray spectrum. In particular, the inferred degree of ordering in the magnetic fields is sensitive to these systematic uncertainties, and we further show the importance of considering the expected variations in the observables in addition to their mean morphology. We then compare the resulting simulated emission to the observed dust polarization and find that the dust predictions do not match the morphology in the Planck data but underpredict the dust polarization away from the plane. We modify one of the models to roughly match both observables at high latitudes by increasing the field ordering in the thin disc near the observer. Though this specific analysis is dependent on the component separation issues, we present the improved model as a proof of concept for how these studies can be advanced in future using complementary information from ongoing and planned observational projects.

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Keywords

ISM: general, ISM: magnetic fields, Polarization