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Study of the generation of cosmological magnetic fields during primordial phase transitions in the early Universe

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For a few years now, lower bounds have been found for Intergalactic Magnetic Fields (IGMF). One of the most plausible explanations for their generation is during first order cosmological phase transitions (PT) such as the Electroweak phase transition (EWPT) or the QCD phase transition (QCDPT).

During these early phase transitions, bubbles of the new phase nucleate and expand inside the old phase until they percolate with each other. These collisions can generate gravitational waves and magnetic fields.

However, if Intergalactic Magnetic Fields were indeed produced during these events, the mechanism that generates them is still unclear for now.

First order PT can be described by restricted a set of 5 parameters .
The data provided by PTA last year coming from a 15 years survey put some new constraints on the Stochastic Gravitational Waves Background.

My goal is then to convert the constraints published by the different PTA collaborations into constraints in the PT parameter space, and, by extension, new constraints on the cosmological magnetic fields produced by first order PT.

To do that I use a model to compute the gravitational waves spectrum generated by first order PT as a function of the 5 key parameters. Then, I use the constraints from PTA on the stochastic gravitational waves background to reject or accept my parameters.

Under some hypothesis I can then convert these new constraints into constraints on the amplitude and the correlation length of the magnetic fields generated at first order PT.

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