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# Axion Haloscope Calibration from Reciprocity

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Axion haloscopes intend to detect axions from the galactic halo. In the absence of detection, they constrain axion parameters like mass and coupling strength. Doing so requires a precise estimate of the expected axion signal power. The expected signal power in turn depends on the axion-induced electromagnetic field which, without detection, cannot be measured. Experiments thus depend heavily on simulations in order to constrain the axion parameter space. However, in the effort to push for higher axion masses, experiments become increasingly more complex and difficult, if not impossible, to fully simulate. It is therefore indispensable to verify the expected axion signal power in terms of measurable quantities allowing to calibrate more complex setups.

A lot of haloscopes have the ability to excite their system from the outside in order to estimate experimental parameters. In this scenario, the electromagnetic field is in principle measurable but generally different from the axion-induced field. The Lorentz reciprocity theorem, however, precisely relates these two scenarios.

In this talk, I will show how reciprocity yields an elegant expression for the axion signal power that for a set of well-motivated assumptions only depends on measurable electromagnetic fields and axion parameters. It applies to a wide variety of possible haloscopes and potentially provides a common description of formerly distinct setups. Furthermore, I will present possible ways to constrain the relevant electromagnetic fields, again applicable to a variety of setups.

**Primary author:** EGGE, Jacob (University of Hamburg)

**Presenter:** EGGE, Jacob (University of Hamburg)

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