Global magnetic field signal of dark-photon dark matter

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based on arXiv:2106.00022 and forthcoming publication

with Michael A. Fedderke, Peter W. Graham, Derek F. Jackson Kimball

Patras Workshop

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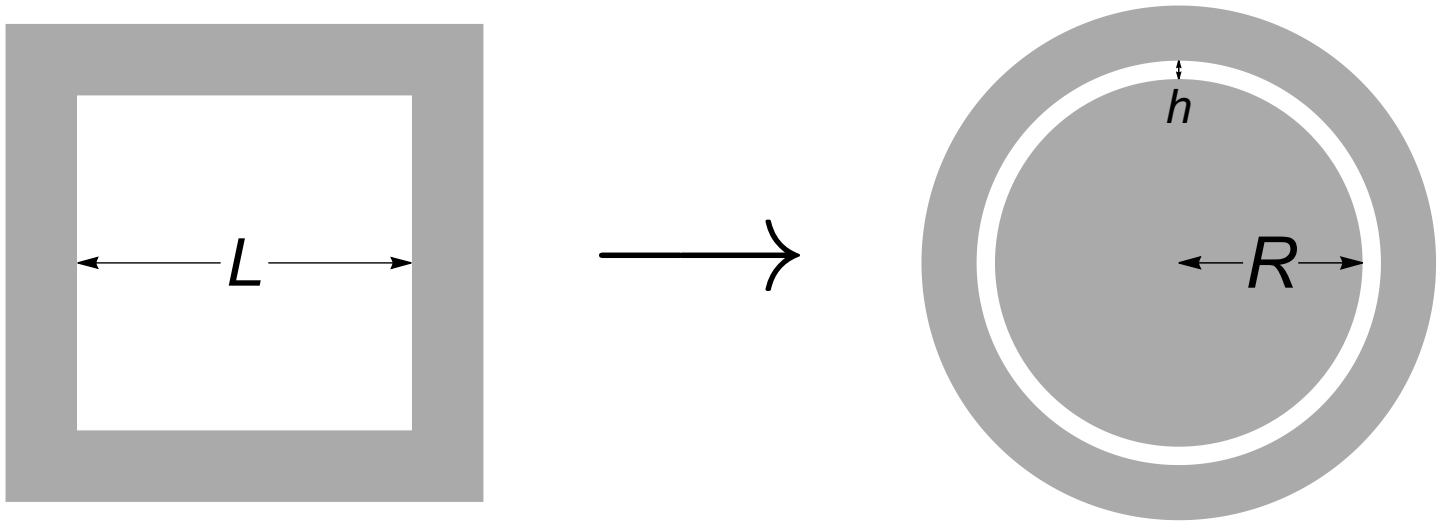
ADMX/DM Radio

Earth



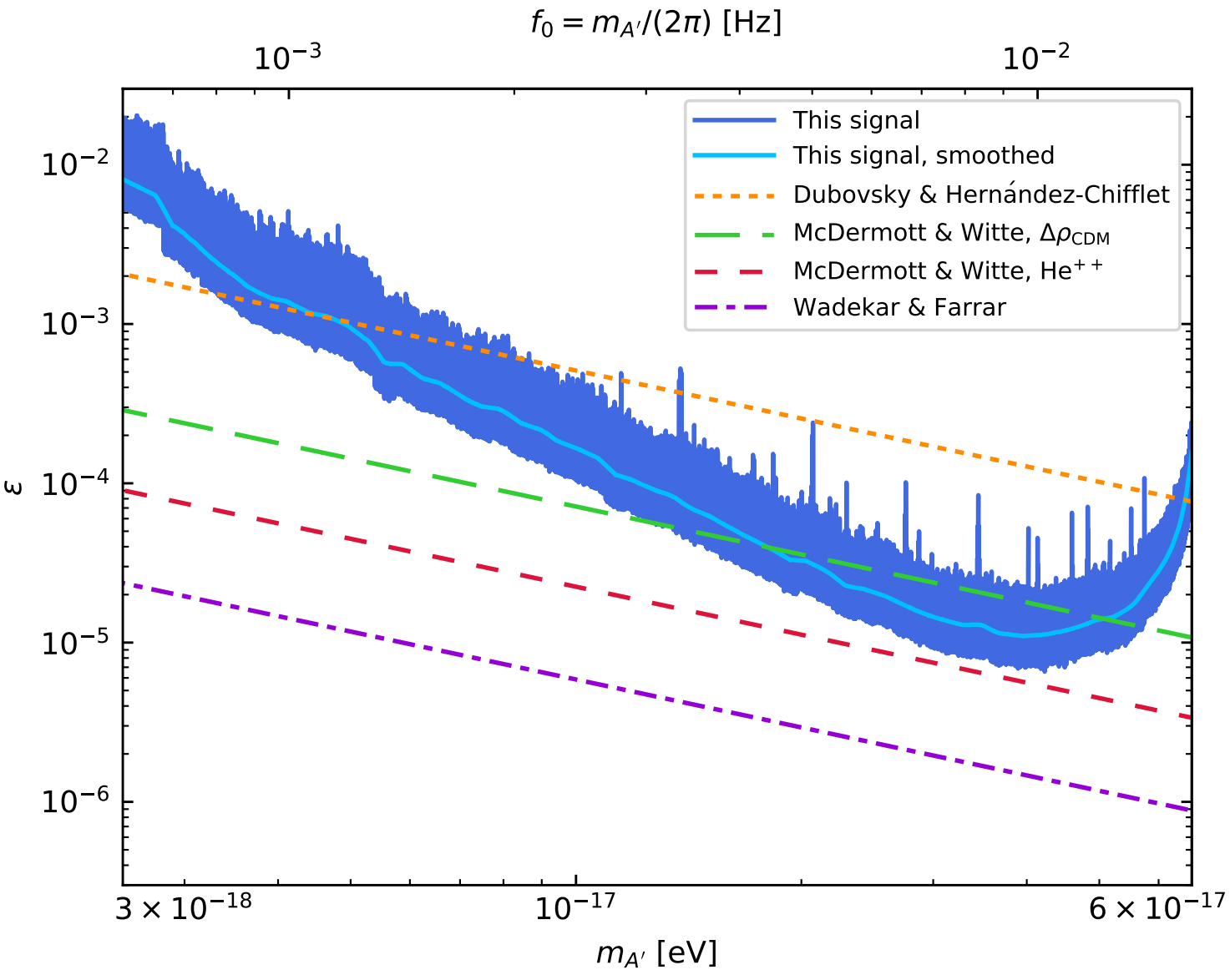
Suppressed by $m_{\mathrm{DM}} L$

Suppressed by $m_{\mathrm{DM}} R$!

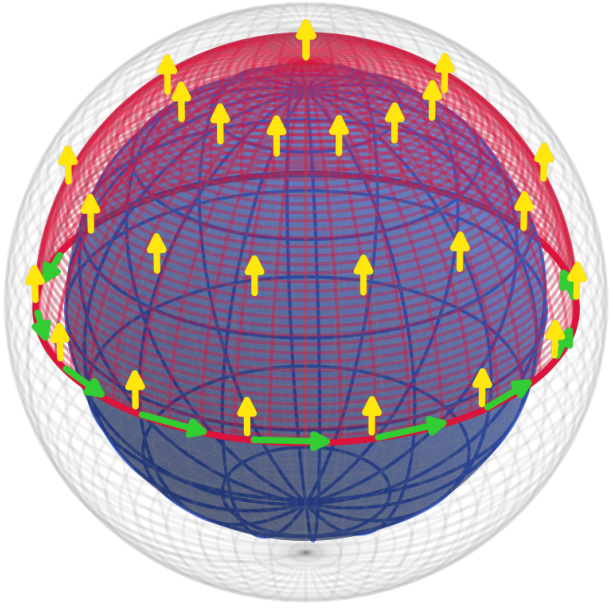
Signal Properties

- Observable magnetic field at Earth's surface
- Suppressed by $m_{\mathrm{DM}} R$ not $m_{\mathrm{DM}} h$
- Spatially coherent across globe with particular spatial pattern
- Sharply peaked in frequency with $Q \sim 10^6$
- Robust to details of conductivity profile near Earth

Analysis of SuperMAG Data



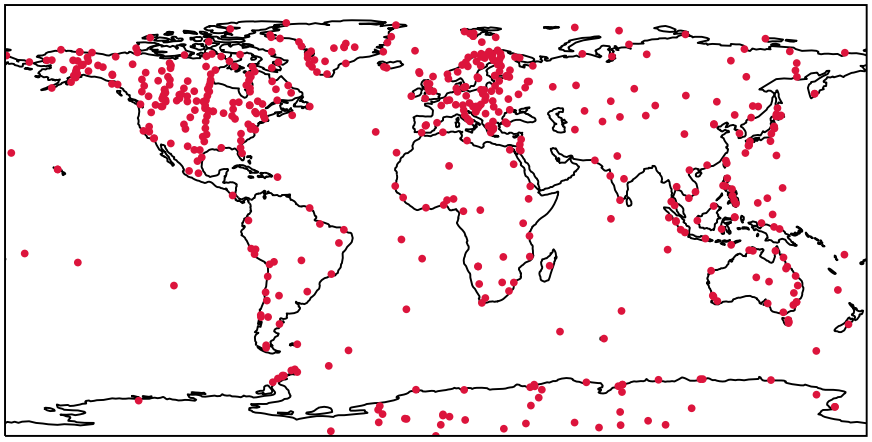
Ampère's Law Argument (for Earth)

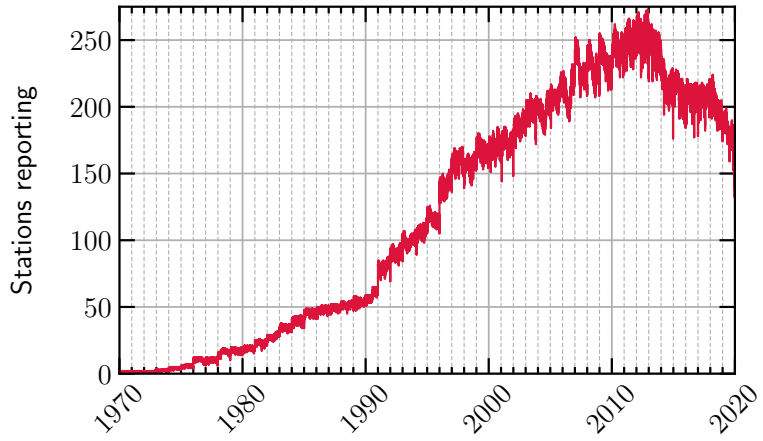


$$BR \sim \oint \boldsymbol{B} \cdot d\boldsymbol{\ell} = \iint \boldsymbol{J}_{\text{eff}} \cdot d\boldsymbol{A} \sim \varepsilon m_{A'}^2 R^2 A'$$

$$B \sim \varepsilon m_{A'}^2 R A' \sim \varepsilon m_{A'} R \sqrt{\rho_{\text{DM}}}$$

SuperMAG





- Collaboration of over 500 ground-based magnetometers
- Data collected over 50 years
- 1-minute time resolution
- Active stations highly variable and stations not uniformly distributed