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Concordance and challenges of the Dirac-Milne cosmology

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\documentclass[a4paper,oneside,12pt]{article}
\usepackage{geometry}
\geometry{top=25mm,bottom=25mm,left=25mm,right=25mm,nohead,nofoot,includeheadfoot}
\usepackage{graphicx}
\pagestyle{empty}
\begin{document}
\Large \bf Concordance and challenges of the Dirac-Milne cosmology\par}
\vspace{0.5cm}
\large \bf G. Chardin1, G. Manfredi2\par}
\vspace{0.2cm}
\footnotesize\itshape
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\par}
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The Dirac-Milne cosmology [1] features a symmetric matter-antimatter universe, which is the analog of the electron-hole system in a semiconductor, hence the reference to Dirac. In this universe, matter and antimatter decouple gravitationally at $z \approx 10^5$, avoiding annihilation at later epochs.

We recall the elements of concordance between our universe and the Dirac-Milne universe on the age, SN1a luminosity distance, nucleosynthesis, Hubble constant z-dependence and, very surprisingly, CMB angular scale.

We discuss the tensions on helium-3 production and BAO, as well as future tests of the Dirac-Milne cosmology, notably in structure formation [2-4].

Finally, following Price, we provide arguments that the Dirac-Milne universe and MOND (Modified Newtonian Dynamics) may be explained, {\it i.e.} by the vacuum polarisation as soon as negative mass components exist (as virtual particles) in the vacuum.

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\textbf{References}\par}
\footnotesize
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- [1] A. Benoit-Lévy and G. Chardin, *A&A* **537**, A78 (2012).
- [2] G. Chardin, G. Manfredi, *Hyperfine Interactions*, **239**: 45 (2018); arXiv:1807.11198
- [3] G. Manfredi, J.-L. Rouet, B. Miller, G. Chardin, *Phys. Rev. D* **98**, 023514 (2018).
- [4] G. Manfredi, J.-L. Rouet, B. Miller, G. Chardin, this conference.

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