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**Magnetic Characterization of Cardiac Alternans in Normal Conditions and in Brugada Syndrome**

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Sudden cardiac death is one of the leading causes of mortality worldwide, posing significant challenges for the development of novel diagnostic techniques. Recent advancements in quantum magnetometry [1] hold the promise to open new opportunities for noninvasive investigation of cardiac behavior during normal activation and pathological regimes. In this work, we develop a theoretical framework for the study of cardiac magnetic dynamics in a simple 1D geometry resembling a cardiac fiber [2,3]. Our approach integrates the state of the art of thermo-electric models of cardiac activity and Maxwell equations for the magnetic field, exploiting the potential of a simple, yet realistic, geometry. In this work, we study the onset and progression of cardiac alternans comparing novel magnetic-field based and standard indicators. In particular, we analyze the influence of the thermal state on the onset of both spatially concordant and spatially discordant alternans. Additionally, we examine the magnetic field signature of dysfunctional cardiac behaviors associated with channelopathies such as the Brugada syndrome.

[2] K. Arai et al 2022, Communication Physics, 5 (1) 200.

[2] A. Crispino et al., 2025, Physical Review E, 111 (1) L012401.

[3] M. Nicoletti et al., 2025, arXiv preprint arXiv:2502.08480.