IF1: Quantum Sensors

Instrumentation Frontier White Paper Meeting
2/18/22

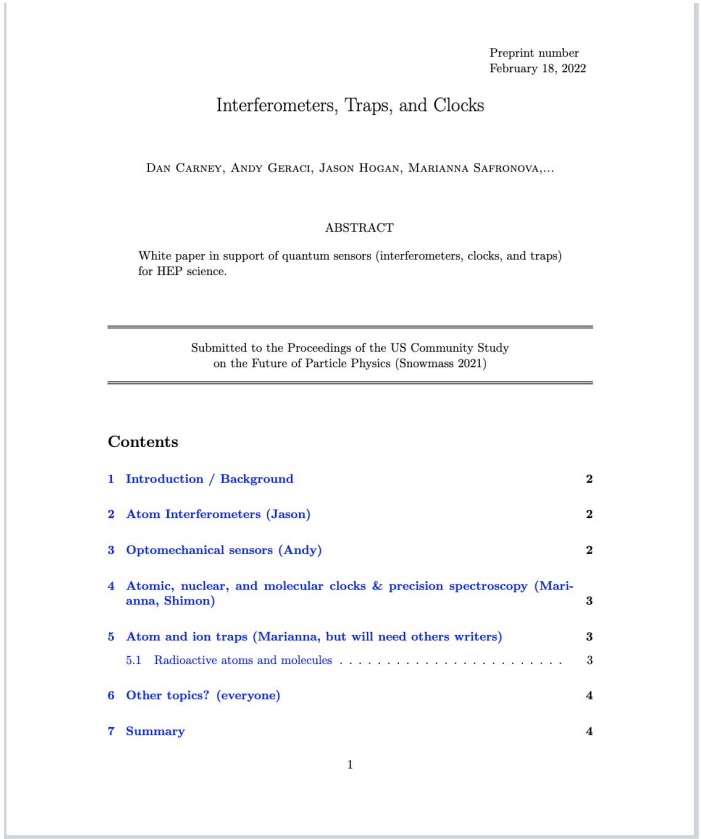
Tom Cecil, Kent Irwin, Matt Pyle, and Reina Maruyama

IF01 Community White Papers

- Received 74 LOIs tagged with IF01
- Grouped LOIs into 4 groups
  - Superconducting Sensors
  - Quantum Calorimeters
  - AMO: Spins, NMR, and Defects
  - Interferometers, Clocks, and Traps
- Each community white paper will be guided by a writing committee
  - All are invited and encouraged to contribute

Interferometers, Clocks, and Traps

- Convenor: Tom Cecil
- Writing committee: Dan Carney, Andy Geraci, Jason Hogan, and Maria Safronova
- Held public information session on Feb 1st to gauge interest and encourage engagement
- Draft whiter paper on overleaf
  - In between outline and first draft
  - writing is on-going



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February 18, 2022

Interferometers, Traps, and Clocks

Dan Carney, Andy Geraci, Jason Hogan, Marianna Safronova,...

ABSTRACT

White paper in support of quantum sensors (interferometers, clocks, and traps) for HEP science.

Submitted to the Proceedings of the US Community Study on the Future of Particle Physics (Snowmass 2021)

Contents

AMO: Spins, NMR, and Defects

- Convenor: Reina Maruyama
- Writing committee: Derek Kimball, Shimon Kolkowitz, and Surjeet Rajendran
- Held public information session on Feb 1st to gauge interest and encourage engagement
- Draft whiter paper on overleaf
  - In between outline and first draft
  - writing is on-going

Submitted to the Proceedings of the US Community Study
on the Future of Particle Physics (Snowmass 2021)

Quantum sensors for high precision measurements of spin-dependent interactions

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ABSTRACT

White paper in support of quantum sensors (Spins, NMR, and Defects) for HEP science.

[DK: Test]
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[SR: Test]
[AS: Test]

1 Introduction

There are disparate profound mysteries in fundamental physics, ranging from the nature of dark matter and dark energy to the origin of the matter-antimatter asymmetry of the universe, and, in turn, a plethora of theoretical proposals to explain these mysteries. Consequently, it is advantageous in this era to cast a wide net in the search for new physics. A powerful, versatile, and relatively low-cost approach is to use the tools of atomic, molecular, and optical (AMO) physics to search for spin-dependent interactions of novel origin, which are predicted by a wide variety of theories of beyond-the-standard-model physics. Experimental AMO techniques for precision measurement of such spin-dependent interactions have substantially advanced over recent decades, in no small part because they share a common foundation with the robust program of research on spin-based quantum sensors for measurement of magnetic fields, magnetic resonance phenomena, and related phenomena. Furthermore, control and measurement of atomic spins is at the heart of quantum information science (QIS) and quantum computing schemes. Thus development of spin-based quantum sensors offers a significant opportunity for cross-fertilization between fundamental and applied research.

Quantum Calorimeters

- Convenor: Matt Pyle
- Status
  - Writing committee in place
  - Meeting next week to develop paper outline, writing plans

Superconducting sensors

- Convenor: Kent Irwin
- Status
  - Work on-going