



Call 2019

# MAQS

## Magnetic-Atom Quantum Simulator

*Mariusz Gajda (IFPAN) – theory, squeezing and metrology*

*T. Roscilde (ENSL) – theory, entanglement and spin physics*

*M. Lewenstein (ICFO) – theory, Bell inequalities*

*G. Modugno (LENS) – Experiments, Dy atoms and molecules*

*F. Ferlino, M. Baranov (IQOQI) - Exp/theory – lattices and mixtures*

*T. Pfau (Uni Stuttgart) – Experiments, Dy in lattices*

*B. Laburthe-Tolra (LPL) – Cr in lattices, **coordination***

[http://info.ifpan.edu.pl/ON-5/quantum\\_gases/index.php/magnetic-atom-quantum-simulators/](http://info.ifpan.edu.pl/ON-5/quantum_gases/index.php/magnetic-atom-quantum-simulators/)

<http://www-lpl.univ-paris13.fr/gqm/>



# PROJECT PROGRESS (highlights)



**CHALLENGE** – endowing **quantum simulators with long range interactions**



**SOLUTION** – **ultra-cold large-spin magnetic atoms in optical lattices**

The only truly macroscopic ( $>10^4$  spins) stable long-range interacting AMO system (as compared to Rydbergs and molecules)

4 experiments, 4 theory groups



**IMPLEMENTATION** –

First characterization of two-body correlations in a MAQS (collective measurements)

2 new experiments being built with ultra-short lattices (boosts energy scales)

A novel data-based approach to characterize entanglement



**HURDLES**

– COVID → less meetings – slow hiring and purchase

Weak interactions → sensitivity to magnetic noise

(→ short period lattices, larger spin (molecules), improved magnetic field control)



# IMPACT (RRI aspects)



**GENDER:** Only 1/7 Woman PI... However, our teams have hired a number of young female researchers: 6 at IFCO (including **one post-doc hired by Quantera**), 3 PhD at IQOQI, 1 Master at IFPAN.



**OPEN SCIENCE:** 15/62 papers published in **open-access** journals. One article in **Physics Today**. Announcements of ICFO papers on **Twitter**.



**SCIENCE EDUCATION:** M. Lewenstein **donated** the prize from his Medalla del Spanish Royal Physical Society (15.000 EU) for **Catalan education**; this is used to organize annual schools for teachers of physics.



**PUBLIC ENGAGEMENT:** - **Radio program** on the discovery of Pauli Crystals (in Polish). Disseminating quantum physics through art, and employing quantum physics for contemporary art: example **concert** at SONAR 2021 “Interpreting Quantum Randomness”. Participation at **Fête de la Science** (Bell Inequalities, using an IBM Q-computer)



# QUANTERA

ERA-NET Cofund in Quantum Technologies



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