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Axion dark matter detection by laser spectroscopy of ultracold paramagnetic crystals

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Dark matter axions may induce transitions between Zeeman states in an atomic paramagnetic system as proposed by Sikivie.
The Axioma R&D experiment is looking for a possible approach to look at axion-driven atomic transitions to be detected by resonance- enhanced multi-photon ionization spectroscopy or through up conversion mechanism.
Two main lines are under evaluation :

1) Rare Earth Up-Conversion scheme in a crystal.
A detector is made by a rare earth doped crystals.
A ground state electron of the rare earth is promoted into a Zeeman excited level by the axion.
A tunable laser can subsequently transport the electron to an higher state from where a fluorescence signal can be produced and detected with high efficiency.

2) Solid Matrix Spectroscopy and Electron Evaporation
Guest Alcaline Atoms are embedded in a Neon, Methane or Para Hydrogen solid matrix. Valence electron level are splitted into Zeeman state of which only the lower one is populated. By axion interaction also the upper level can be populated: by using a properly tuned laser these electrons are brought to the Vacuum level of the Solid Matrix Conduction Band.
These free electrons can then be extracted into vacuum and afterward detected
by using an high efficiency micro channel plate.

Some preliminary results for both schemes will be presented.

(For the AXIOMA collaboration)

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