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New perspectives on quantum simulation with ultra-cold atoms

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Understanding the behavior of interacting electrons in solids or liquids is at the heart of modern quantum science and necessary for technological advances. However, the complexity of their interactions generally prevents us from coming up with an exact mathematical description of their behavior. Precisely engineered ultracold gases are emerging as a powerful tool for unraveling these challenging physical problems. In this talk, I will present recent ideas on using alkaline-earth atoms –currently the basis of the most precise atomic clock in the world– for the investigation of complex many-body phenomena and magnetism. I will also discuss a new research direction of using atomic clocks not only as precise time keepers but also as unique quantum laboratories for the investigation of new forms of matter with no known counterpart in nature.