Golden mystery solved

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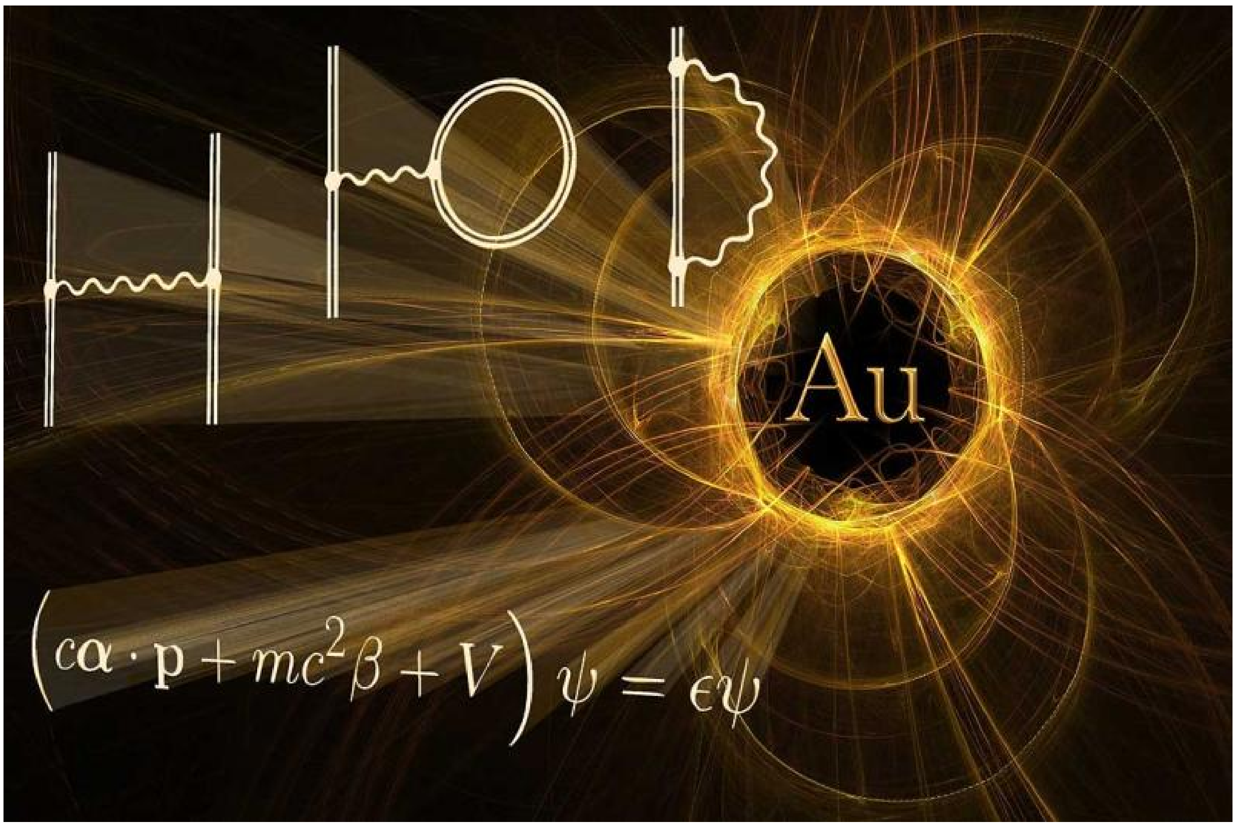

Unlocking the secrets of gold. Credit: Massey University

Gold is prized for its preciousness and as a conductor in electronics, but it is also important in scientific experimentation.

Ernest Rutherford utilised it when mapping the atom, in an experiment, which needed a thin metal foil made of gold. However, despite its usefulness in experimentation, scientists found gold would not always perform how they theorised it would at the atomic level.

Scientists do not like what they cannot explain, so debate grew amongst the communities best minds to explain this why gold is special, which until now remained unsolved even for the most basic atomic properties.

Acting Head of Institute of the New Zealand Institute for Advanced Study, Distinguished Professor Peter Schwerdtfeger, alongside international colleagues, solved the problem and uncovered more precise calculations for gold that will help scientists bridge the gap between theory and experiment.

"Precision in science is vital even in the most simple of experiments. For example, if you took a ball and rolled it down a slope, you could measure the gradient of the slope, the weight of the ball, wind conditions etcetera, and you could predict how fast the ball would reach the end of the slope. The more precise you made those calculations, the more likely you would find that your predictions about the speed of the ball would be closer to how fast it actually was.

"Gold is a little more mysterious and complex to measure because of its quantum nature, but even in basic experiments, such as removing and adding electrons, it remained inconsistent. Our calculations are important because more precise calculations are able to produce more reliable results," Professor Schwerdtfeger says.

The team was able to reduce the discrepancy between theory and experiment to just a few milli-electron-volts, which is a giant improvement over past results. They achieved this by using an approach, which other scientists have neglected, called Feynman's approach, which looks at the quantisation of the electromagnetic field - essentially looking at how light and matter interact.

This knowledge can be applied to further improve predictions in the research of not just gold, but other heavy elements, Professor Schwerdtfeger says.

This was a major effort over 10 years between three different groups of researchers. These include former Massey postdoctoral fellow Dr Anastasia Borschevsky from the Van Swinderen Institute for Particle Physics and Gravity, Dr Epharim Eliav and Dr Uzi Kaldor of Tel Aviv University, and Dr Lukas Pasteka of Massey University.

The article has appeared in the prestigious journal *Physical Review Letters* and selected as Editor's choice by the American Physical Society. It was also highlighted by American Physical Society.

More information: L. F. Pašteka et al. Relativistic Coupled Cluster Calculations with Variational Quantum Electrodynamics Resolve the Discrepancy between Experiment and Theory Concerning the Electron Affinity and Ionization Potential of Gold, *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.118.023002

Provided by Massey University

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