Authors

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Abstractions

Last authors

Lithium and beryllium are the first metals encountered in the periodic table, but these light elements do not bond to one another — at least, not under ambient conditions. On **page 445**, renowned theoretical physicist Neil Ashcroft and Nobel-prize-winning chemist Roald Hoffmann, both at Cornell University in Ithaca, New York, report using computational methods to demonstrate that an alloy of these two metals, with unusual quantum behaviour, could be created at high pressures. They spoke to *Nature* about how bridging disciplines opens new frontiers.

Does chemistry have a role in quantum physics?

NA: The periodic table was created from an understanding of how elements react at ambient pressure. Now we need a greater understanding of how the chemistry, as well as quantum physics, of elements in combination changes under pressure.

RH: For me, this was a chance to convince physicists that chemists also understand bonding.

What initial findings led to this paper?

NA: No one thought a light alkali metal could ever be a superconductor until, in 1997, my group found that lithium could be at extremely low temperatures. Then we found that by putting lithium under high pressure, the superconducting temperature could be quite high. More recently, we wondered why beryllium, lithium's neighbour, is not a better superconductor. We decided to see whether forming a beryllium–lithium alloy improved its chances. Our computations suggest some of the alloys are stable at higher pressures, and they may even be good superconductors.

How might the alloy be useful?

RH: Unfortunately, it is not inherently useful — but then, neither was $E = mc^2$ at first. The world has a way of making new ideas useful. We gain insight into the nature of chemical bonds when we are able to make new compounds — in this case using pressure.

This paper was the work of one student and three professors. How did each of you contribute?

RH: We didn't know what structural combinations were possible between lithium and beryllium, so graduate student Ji Feng explored structures based on known chemical and physical rules while our colleague Richard Hennig searched random combinations for specific characteristics. Neil and I provided physical and chemical explanations for the findings — particularly the unusual two-dimensional electronic structures that emerged when modelled alloys were being squeezed in three dimensions. In the end, it was Ji that came up with the theoretical quantum mechanical model used in the paper to explain these structures.

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