Time to fix science prizes

Shivaji Sondhi and Steven Kivelson

Science prizes should better reflect how modern science is carried out, argue **Shivaji Sondhi** and **Steven Kivelson**.

Scientists do science for its own sake, but, being human, also respond to external incentives. Typically, the external incentive they care most about is recognition.

Prizes are a part of the landscape of incentives and ideally they meet the need for recognition while also serving to draw attention to truly important developments in science. The Nobel Prizes in Physics, Chemistry and Medicine were instituted in 1901 and remain the most prestigious, although there are now many other significant prizes. As far as physics goes, the timing of the Nobel was perfect. Physics was just about to undergo multiple revolutions and the ranks of the early awardees are awe-inspiring. But the Nobels are starting to show their age. Under the Statutes of the Nobel Foundation, no prize can be shared by more than three individuals. While in 1901 this was quite enough to recognize important developments in science, today this is no longer the case — the landscape of frontier research has changed. We feel that the Nobel Prizes and most others awarded to scientists today are at best inaccurate snapshots of how breakthroughs come about and at worst produce perverse incentives for scientists to spend time rewriting history instead of moving on with the true business of science.

As we are physicists, our view is shaped by our own field. Take, for example, the 2013 Nobel Prize in Physics, awarded to Peter Higgs and François Englert for the discovery of the Higgs boson. There is a reasonable case that the actual theoretical discovery of the Higgs particle began with the work of Philip Anderson and was followed up, independently, by the pair of Robert Brout and François Englert, Peter Higgs, and the trio of Thomas Kibble, Gerald Guralnik and Carl Hagen. (And this is not counting the somewhat later, but also independent, work by Alexander Migdal and Alexander Polyakov in the Soviet Union.) Were it not for the rule of three, it would have been entirely just to have recognized the living subset of these contributors. The situation is perhaps even worse for experimental discoveries that involve hundreds of scientists, like that of the Higgs boson at CERN. Under current rules, any prize for the experimental work would have to go to just the leaders of this intensely collaborative effort.

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Admittedly, even in recent times, it has not always been impossible to recognize an important development within the parameters of the Nobel Prize in a way that does not seem contrived. For instance, the 1988 Nobel Prize in Physics to Robert Laughlin for the theory of the fractional quantum Hall effect recognized a singular contribution to the field that came, pretty much, out of the blue. But this is increasingly rare and requires a certain Procrustean definition of what is the primary discovery and a bias in favour of discoveries that do fit the (Procrustean) bed. Not only do an increasingly large fraction of research papers have multiple authors, it is not unusual for multiple groups to contribute at almost the same time and the follow up on a new discovery is so rapid that the edifice of facts a short while later tends to dominate what were available at the start.

The rate at which new knowledge is generated — including even ideas that involve drastic changes in perspectives — has accelerated enormously with time, in large part due to the rapid, effortless and broad information exchange that is now part of daily life. This means that important developments increasingly rely on advances from many sources. To take one example, there has been an enormous amount of progress in understanding the properties of the high-temperature superconductors that were discovered in 1986 and for which Georg Bednorz and Alexander Müller received a Nobel in 1987. Most notably it was demonstrated by a combination of ingenious experimentation and theoretical insight that these are '*d*-wave' superconductors, a distinct new state of matter that had previously been considered too fragile to be observable. However, the involvement of half a dozen or more key people has kept it from being even in the running for Nobel recognition.

To improve matters we propose a paradigm shift in the prize business: prize-granting entities should begin by identifying a major development and then determine the key individuals who contributed to it. Ideally everyone identified in this fashion would share in the prize. Of course, this does not remove the need for judgement — not all authors on papers actually do equal amounts of work and the distinction between passive and active participation in any discovery will continue to be a contested area. But it would move the focus to establishing the boundaries that are intrinsic — those related to the science itself. A second possibility is to award prizes explicitly for lifetime/cumulative accomplishments, which would again rationally single out individuals who have consistently been at the frontiers of their subjects for long periods.

For most prize-granting entities, this shift would not be hard to make — they just have to decide to make it. Indeed, the Breakthrough Prizes have already taken steps in both directions that we recommend. The Nobel Foundation, though, appears constrained by its statutes. It is not clear to us whether there is any possibility of modifying these. However, nothing prevents the Swedish Academy from raising funds for companion prizes for which the number of recipients would not be artificially constrained. ❐

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