Commentary: A physicist's perspective on COVID-19 FREE

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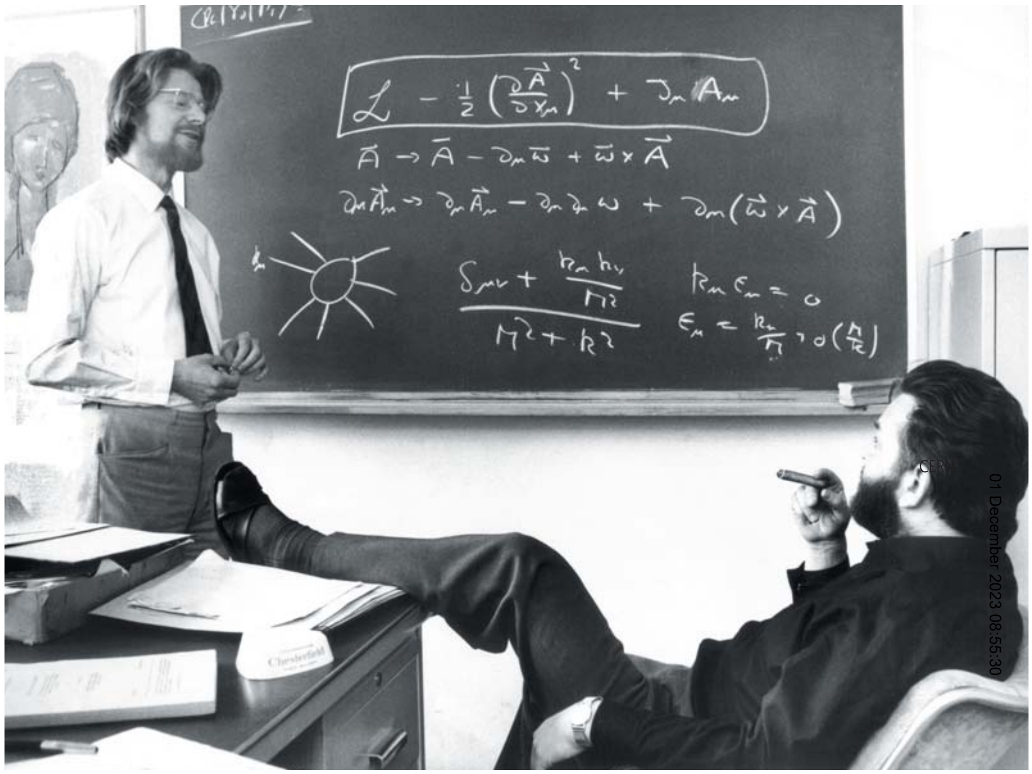
Commentary
A physicist's perspective on COVID-19

The COVID-19 pandemic has not only killed a large number of people—approximately 5.5 million worldwide at the time PHYSICS TODAY went to press in mid-January—it has also disrupted life in a fundamental, nonperturbative manner, forcing large-scale changes in human behavior from without.

The total effect of the pandemic is, of course, unknown at this point, since we are very much in the midst of it and the end is still at some unknown future. In fact, it is entirely possible, perhaps even likely, that the pathogen originally known as the 2019 novel coronavirus, SARS-CoV-2, will never leave the human host and will become endemic, just as other, not-so-novel coronaviruses that cause the common cold have done already.

COVID-19 predictions are pretty much like all large-scale nonlinear predictions, such as those for weather: It is possible to make not-so-useful, long-term qualitative predictions globally, and it is possible to make relatively accurate, very short-term quantitative predictions locally, but that is about it.



AT CERN IN 1973, John Bell (left), who was working there at the time, interacts with Martinus Veltman (right), who was then a professor at Utrecht University in the Netherlands. Since early 2020, COVID-19 has hindered physicists' ability to travel and discuss physics in person. (Courtesy of CERN.)

Early in 2020, I did some large-scale COVID-19 dynamics simulations with considerable help from my student Haining Pan. My simulations were lattice based with long-range coupling and hopping to represent disease transmission. What I quickly found out is that the simulation results depend *entirely* on the input parameters, none of which are known with any accuracy, and those parameters are almost randomly time dependent.

Many papers written by physicists reported similar simulations along with many predictions. Alas, it turns out that SARS-CoV-2 is too elusive a virus for any such simulations, by physicists or by others, to have any real predictive power except in the broadest terms—for example, for confirming that vaccination and testing are good.

It was difficult in the beginning of 2020 to anticipate the great COVID-19 calamity awaiting the world. In February of that year, I was apparently among the first people to have urged the leadership of the American Physical Society to cancel its upcoming March Meeting in Denver, which APS finally did at the last moment after considerable hesitancy.

The logistics of canceling a meeting of 10 000 people right before the event are not trivial. But given the crowd density in APS March Meetings, it is reasonable to assume that the 2020 event would have led to a few thousand COVID-19 cases *just* among the physicist attendees. Overall, it may have led to many tens of thousands, perhaps even hundreds of thousands, of cases, if not more. That estimate is based on research related to the now-infamous Boston Biogen superspreader conference in late February 2020. Within a month, roughly 100 people in Massachusetts who either went to the conference or were a household contact of someone who went tested positive. Genetic-code-based investigation estimated that the event led to 300 000 COVID-19 cases worldwide by the beginning of the following November. APS made the right call in canceling the meeting.

Even before the appearance of the

Omicron variant in mid-November 2021, roughly 250 million COVID-19 cases had been reported to the World Health Organization. Random stochastic counting says that out of those 250 million cases, some 10 000 should have been physicists. But physicists are rational and generally careful people, so the actual number of infected physicists may have been much lower than that.

I write from the perspective of a highly active theoretical condensed-matter physicist who also happens to be the director of the University of Maryland's Condensed Matter Theory Center (CMTC), which consists of more than 30 young researchers. All CMTC members and all my colleagues in the University of Maryland physics department are fully vaccinated, and quite a few had received their booster shots by early November.

The physicists I know understand the science well and have taken responsible precautions throughout the pandemic. But infection and illness are just two aspects of the COVID-19 pandemic. The all-encompassing ramifications of COVID-19 extend way beyond the disease itself.

From my perspective, the most profound effects of COVID-19 on the physics community have been the absence of direct face-to-face discussions among physicists at the blackboard and of in-person conferences and workshops. I used to travel 150 000 to 500 000 kilometers per year before COVID-19, attending conferences all over the world, giving talks, and interacting with collaborators face to face. CMTC members and visitors used to go out to lunch or dinner together, often in groups of 10–15. The center used to host around 30–50 seminars per year, with the seminar speakers spending several days on campus.

All of that has vanished and may not come back for a long time. My last extended physics-related trip was to Aspen, Colorado, for a month in the summer of 2019, and the CMTC has hosted only one visitor during the past 20 months. The very thought of wearing a mask while traveling and then throughout a conference is sobering, and for me, foreboding. Traveling to do physics is supposed to be fun, not a chore. In-person interaction with other physicists at other institutions often led spontaneously to new ideas and new physics. I worry that it will be a long time before the culture of direct face-to-face interaction among physicists gets reestablished.

Of course, physics talks and conferences continue in virtual modes. Some of those meetings are excellent, and often the question sessions can go on for a long time, which is useful. My remotely delivered 2021 APS March Meeting talk on Majorana quasiparticles was followed by an almost hour-long discussion online. But such discussions can never replace the in-person interactions that dominated physics conferences and workshops. Among all COVID-19-related problems adversely affecting the physics community, I miss in-person interactions the most.

To view my writings on COVID-19 and its dynamics, see my blog at https://condensedmattertheorycenterblog.wordpress.com/blog/.

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LETTERS

Solar energy considerations

I would like to add several details to David Kramer's item "The cost of solar energy production has plunged, but it needs to fall further" in the June 2021 issue of PHYSICS TODAY (page 27).

First, while the monetary costs are important for investment decisions, they are less relevant in decisions regarding sustainability and decarbonization because they depend not only on where and with what energy source panels are made but also on financing, depreciation, taxes, and government subsidies. Costs should be accrued in energy units and compared with energy outputs in the same units. This ratio is typically referred to as energy return on energy invested (EROEI), which is a useful figure of merit for an energy source. Carbon saved over carbon invested would be another useful figure of merit.

I presume that the costs of solar photovoltaics (PV), particularly for the energy-intensive production of silicon crystals and aluminum frames, have not fallen in energy units as much as they have in dollars. I also presume that the EROEI for solar PV is still rather poor, and storage further reduces EROEI. In addition, one must consider the low duty factor (around 20% in my area) for solar energy.

Second, while solar PV is locally "clean," one must look at the whole production cycle—including mining of materials, fabrication (particularly of crystalline silicon and the aluminum frames), and transportation—and the energy involved and carbon produced in those processes. All these energy and carbon costs are up-front, and they are only recovered over some fraction of the life expectancy of the facility, which is about 25 years. The disposal process must be considered as well.

Third, I have found the transparency about the costs of solar PV to be abysmal, and I have found it nearly impossible to get detailed information about projects in my region. When public support, in the form of subsidies, tax advantages, or soft costs such as government reviews, goes to such projects, the public has a right to know about them. If the economics and the sustainability of the projects were as good as we are led to believe, I expect that this information would not be hidden behind corporate and government curtains.

David Kramer is right that the costs of solar PV need to fall further, but I would modify that to read as follows: The costs of solar PV measured in energy units need to fall a lot.

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David Kramer's report "The cost of solar energy production has plunged, but it needs to fall further" (PHYSICS TODAY, June 2021, page 27) gives an excellent overview of the present state of solar technology. One point, however, needs clarification. In evaluating cadmium telluride, the author correctly recognizes the toxic properties of cadmium, which is a carcinogen. He cites the claim that CdTe is virtually insoluble in water, but that dismisses the groundwater contamination risks posed if CdTe panels end up in a landfill.

In 2010–11, I worked at the now-defunct Amelio Solar in Ewing, New Jersey. Suspecting that the fluid that