of nonlocality. Fritz London pointed out in the 1930s that the motion of electrons in a superconducting ring depends on an external magnetic flux through the hole in the ring, where the electrons cannot go. He wrote in his 1937 paper, "The most stable state of a ring has no current, unless an external magnetic field is applied." Like Dirac, he said nothing about a nonlocal action of the magnetic field being surprising or unusual. Of course, London, like Dirac, was focusing on something else.

Ehrenberg and Siday were also focusing on something else—electron optics—when they found in 1949 that the motion of an electron can depend on the magnetic field in a region from which the electron is excluded. They chose not to mention that curious phenomenon in the abstract of their paper, although they did explicitly say elsewhere that it was "curious."

None of those earlier authors went on to conclude that such a phenomenon implies that the vector potential has to be seen as a real physical field in quantum mechanics. Only Aharonov and Bohm did that.

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Higher standards combat culture shock in medical physics

I can sympathize with Gregory Davis, who laments the new requirements for entering medical physics (PHYSICS TODAY, March 2010, page 10), but there is another side to the story. I suffered culture shock when I entered the field from "pure" physics 20 years ago. I went from a world where the language of advanced mathematics was understood to one where few people knew what a cosine was and many (not the physicists, but most of the other hospital staff) had to struggle to recall the Pythagorean theorem. Conversely, my new colleagues talked with ease about anatomy, medical instruments, and medical procedure, while I felt lost and inept. It took the better part of a decade for me to really feel that I was in command of my subject.

The new requirements are an attempt to reduce that transition shock and to better prepare new entrants to the field. They may not be a perfect fix, but at least they are a start. The fact is, medical physics is far more medical than physics, and it will continue to move in that direction. I can see a day when medical physics will be considered a medical specialty and not a physics specialty at all.

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As a board certified practicing medical physicist I was disappointed with Gregory Davis's remarks regarding the changing requirements to practice in my field. His assertion that the bar is being raised in order to limit practitioner numbers and thereby raise salaries for current practitioners is farfetched. The bar is being raised to bring the training of medical physicists in line with that of other practitioners represented by the American Board of Medical Specialties. Medical physicists are one of the few nonphysician groups represented.

When I finished a medical physics graduate program accredited by the Commission on Accreditation of Medical Physics Educational Programs in the early 1990s, I was considered a medical physicist, but I was in no position to function independently in a clinical environment. I was fortunate to work in a consulting group with a mentor who made the time and had the patience to properly train me while providing me with employment. The responsibilities of the clinical medical physicist in a therapy setting include ensuring the absolute calibration of a linear accelerator capable of delivering lethal amounts of radiation, consulting with radiation oncologists on the development of optimal treatment plans, and measuring the equipment's radiation characteristics for sophisticated computerized modeling to generate accurate representations of delivered dose. In a nutshell, medical physicists are solely responsible for the safe and optimal use of the equipment and the accurate and precise delivery of the prescribed amount of radiation to the patient. Davis's assertion that a physics degree is versatile is correct; however, it alone is not sufficient to prepare a person for clinical responsibilities.

As to Davis's claim that there is no evidence of threats to public safety, several newspaper articles by Walt Bogdanich that have appeared in the *New York Times* this year tell a different story about the consequences of medical physicists' errors.[1] In my opinion, the best way to minimize those errors is to standardize the education and training of medical physicists: Uniform graduate education, residency, and board-certification requirements will help ensure a candidate's competence for independent practice. Radiation oncologists, medical doctors who define the volume to be treated and prescribe the quantity of radiation to be delivered, are already expected to meet those requirements.

If I or a family member needed radiation therapy, I would want a board-certified medical physicist to review the treatment plans and calculations and to calibrate the equipment. The medical physicist is the sole individual in the clinic to attest to accurate and precise delivery of radiation treatments.

For more information see the position statement at the American Association of Physicists in Medicine website, http://www.aapm.org/publicgeneral/StatementBeforeCongress.asp.

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A fine point on topological insulators

Although I found the article "The Quantum Spin Hall Effect and Topological Insulators" by Xiao-Liang Qi and Shou-Cheng Zhang very interesting (PHYSICS TODAY, January 2010, page 33), I was disturbed to read on the second page that "cadmium telluride . . . has a similar lattice constant but much weaker spin–orbit coupling" than mercury telluride. The authors then attribute to this erroneous statement the *s*–*p* gap inversion of HgTe. Because of the rather topical nature of topological insulators, and to prevent propagation of the error, I believe it should be corrected. I also want to set the record straight concerning Steven Groves and his thesis adviser, William Paul, whose discovery of the inverted gap of α-tin,[1] also known as gray tin, is ignored by most workers in the field of topological insulators.

The spin–orbit (SO) splitting at the top of the valence band of HgTe is actually slightly smaller than that of CdTe (800 meV versus 880 meV).[2] I presume that what gave rise to the error is the fact that the 6*p* SO splitting of atomic Hg is indeed larger than that of 5*p* in Cd; the authors probably surmised that the SO splitting at the top of the valence bands of HgTe should also be larger than that of CdTe. That would be correct if the materials had inversion symmetry, but they do not. Consequently, there is an admixture of outermost *d* core electrons with the *p* valence electrons, which lowers the SO splitting of the compound.[3] That effect is, of course, much stronger for HgTe than for CdTe. The reason for the gap inversion in α-Sn, and for that in HgTe, seems to be the relativistic mass–velocity correction of the 6*s* electrons of Hg near the core, which drives their masses up and thus their kinetic energies down.[4]

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Qi and Zhang reply: The letter by Manuel Cardona raises two issues regarding our PHYSICS TODAY article. The first one concerns the microscopic origin of the band inversion in mercury telluride. It arises both from the spin–orbit splitting of the *p* orbitals and from the lowering of the *s* orbital by the so-called Darwin term, which also arises from the relativistic Dirac equation. Because of the article's space limitations, we discussed only the first mechanism. Regardless of the microscopic origin of the band inversion, the general conclusion of topological edge states in HgTe is unchanged.

The second issue Cardona raises concerns the similar phenomenon in α-tin, which has been discussed extensively in the theory literature about topological insulators.[1] Unfortunately no experiments seeking this phenomenon in α-tin have been carried out to our knowledge.

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Wooing sea turtles back to China

I agree with most of the observations in the article "Physics in China," by Charles Day (PHYSICS TODAY, March 2010, page 33), but I would like to provide some supplementary information and share my experience.

Fundamental changes in science are taking place in China. The changes come partly from China's growing economy and increased government support and partly from the return of Chinese physicists educated overseas.

The current trend for those young Chinese physicists, possibly including me, is to return to their home country. Those who study abroad and then return to China are called *haigui*. *Hai* means sea; *gui* means returning and sounds the same as the Chinese word for turtle. People therefore call a returning Chinese scientist *haigui*, or sea turtle. Right now the world economy is in such a condition that governments and universities in many countries are seeing budget cuts and an oversupply of graduate students, so the job situation for Chinese physicists abroad is not good. Most of them have been stuck in postdoc positions for years. Those well-trained scientists could be a force in China's future development.

To provide some incentives for haiguis, the Chinese government started the so-called Hundred Talent program in 1994. It aimed to attract 100 Chinese scientists back to China by the year 2000. Because of its success, the program was continued, and by 2004 more than 700 haiguis had returned.

The incentives for return are good. The Chinese Academy of Sciences' Institute of Physics provides as much as CNY 570 000 (approximately $84 000) as a housing allowance and gives research grants up to CNY 2 million. The institute also offers postdocs an annual salary of CNY 180 000. The average salary in Beijing is about CNY 48 000 per year; the Hundred Talents amount would allow new postdoctoral fellows like me to enjoy a higher standard of living in Beijing than in Boston.

The Hundred Talent program has attracted mostly postdocs, as faculty salaries at Chinese universities are still much lower than at their overseas counterparts. To aim the program at a higher level of expertise, the Chinese government launched a much more ambitious plan, the Thousand Talent program, in 2009. Its goal over 5 to 10 years is to attract back from foreign countries 1000 Chinese scientists currently working in academia or as industry experts. The offer includes a tax-free CNY 1 million bonus in addition to the generous salary and research grants.

Still, many factors make Chinese physicists reluctant to be sea turtles. One big concern is the complicated bureaucracy involved in working in China. Chinese scientists who are accustomed to working in overseas environments may find the lack of personal connection with the top officials in Chinese universities unfavorable to them and may fear that it will negatively affect promotions and grant applications. In addition, housing prices in China are at an all-time high, so even with the financial incentives of the new programs, household budgets can be very tight. To make ends meet, returning scientists may be distracted from their research by having to find additional sources of income.

The current performance-evaluation mechanism in China is also a concern for many haiguis; emphasis is placed on quantity rather than quality. Many institutions have financial reward systems based on publications and journal impact factors, so researchers often write multiple papers on the same topic. Some even publish fake experimental results. For example, in December 2009 the International Union of Crystallography had to retract numerous papers because the more than 70 crystal structures they described had been fabricated by Chinese researchers. Also, generally only a publication's first and corresponding authors receive the financial reward, which tends to discourage collaboration. Other problems include the lack of international journal subscriptions in Chinese libraries and the difficulty or even lack of information exchange; as is well known, in China one cannot access internet sites such as Google, Wikipedia, YouTube, and the networking site Facebook.

Working in physics in China presents both challenges and opportunities. Let us hope the story of Chinese sea turtles will end up being a happy one.

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