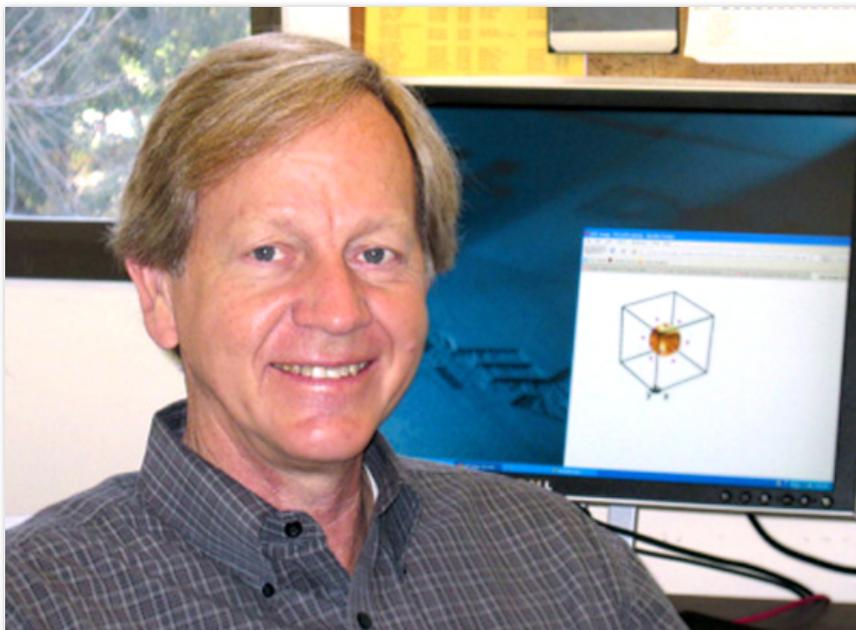




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“DIPLOMACY OF SCIENCE CAN BRING IRAN AND US CLOSER,” STATES PROF. PICKETT

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A distinguished American professor of physics, Prof. Warren E. Pickett visited Iran along with Anthony Leggett, a Nobel Prize winner. On his trip and meetings with Iranian authorities in charge of the country's education, he stated that the development of scientific activities between Iran and the US can deepen the two countries' political ties. The significance of Prof. Pickett's character in the American physics society interested us in holding an interview with him to delve deeper into his visit to Iran as well as his researches and works in the American scientific world which is as follows.

AVA Diplomatic's Exclusive Interview with Prof. Warren E. Pickett,

Distinguished Professor at the Department of Physics, University of California Davis (UC Davis)

Given that you have had many professional activities in the field of physics, what has been your most significant scientific achievement during these years?

Making such choices can be difficult. I have to mention two breakthroughs in different areas. (i) *High temperature superconductors*. For a few years after the discovery and study of the copper oxide high temperature superconductors at the end of 1986, various experiments seemed to indicate that these rather “strange metals” did not possess Fermi surfaces, which are surfaces in momentum space that separate filled electronic states from unfilled states; the Fermi surface is the most fundamental property of a metal. Our group did the quantum mechanical calculations, and compared in detail with the available data, to demonstrate that the optimally doped materials – the best superconductors – indeed

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did possess the Fermi surfaces, and that there was agreement with the calculated surfaces. This was published in the journal *Science* in 1992, together with a color figure of one of the Fermi surfaces on the cover of the issue. (ii) *Strongly correlated magnets*. Strongly correlated electronic materials that have open-shell atoms, yet are insulating (“Mott insulators”) rather than metallic, have been a central issue in materials physics for 5-6 decades. Around 2006 our group, part of a team of computational physicists supported by the DOE Computational Materials Science Network, applied a recently developed theory for simulating the dynamic correlations between electrons to the classic Mott insulator MnO (manganese oxide). Our experimental collaborators had shown just a couple of years earlier that MnO undergoes the “Mott insulator-to-metal transition” at the pressure of ~100 GPa (gigapascals), in common language this is one million atmospheres pressure. Our calculations reproduced this transition – a first in this field of research – and showed, furthermore, that the microscopic mechanism for setting the electrons free to conduct electricity is different than most theorists expected, being much more closely related to the change in magnetism of the electrons rather than to change in their kinetic energy.

What is the biggest challenge in the field of condensed matter physics?

Other fields of physics have had an identifiable “biggest challenge.” For high energy / particle physics, it was until recently “does the Higgs boson exist, and at what energy?” For astrophysicists and cosmologists, it is the evolution of the universe and the cosmological constant, and the implications. In the physics of condensed matter, the range of studies of materials, properties, and applications is extremely broad. Repeatedly it happens that there is tremendous excitement and activity in an area that didn’t exist five years earlier. New exciting discoveries, often with important industrial applications, occur often. Recent examples are: (i) graphene (single layer graphite made of carbon atoms), very active around 2005 and since then; (ii) topological insulators, insulators which show highly unusual, metallic surface behavior that may lead to important device applications, became very active by 2010 and remains so; (iii) ultra-cold atomic gases, which can be made to form ordered lattices by the appropriate positioning of laser light and which provides exciting new phases of this “ill-condensed” matter. A somewhat more general, longer lasting challenge recently and for the future is the design and synthesis of new functional materials, layer by layer and perhaps atom by atom — through experiment/theory synergy, thereby unraveling the “materials genome” through which materials that do not occur naturally can be designed, synthesized, characterized, and applied for society benefit.

You’re a member in a lot of scientific societies, including the American Physical Society. To what extent is this organization associated with other scientists and researchers around the world? How about with Iranian scientists?

Addressing the last question first: since the Iranian revolution in 1979, there has been little communication and connection between Iranian scientists and western scientists. The connections that did arise were from Iranian scientists attending international conferences, and from Iranian scientists obtaining their doctoral degree or doing postdoctoral work in the west (usually in the U.S.). That persisting state of isolation made it highly significant that three of us physicists were able to visit Iranian universities in February 2014 and meet with several groups: a few government ministers, Physics chairs and faculty, students, and some private citizens. There will be more discussion on that visit below. Back to the first question: a few U.S. scientific societies, certainly including the American Physical Society (APS) and the American Association for the Advancement of Science (AAAS), have offices that support and encourage interaction with scientists internationally. APS is active in this area through its *Forum for International Physics*, one of whose activities is to organize lectures at APS meetings on international connections between physicists, and other scientific groups as well. AAAS has its *Office of Science Diplomacy*, which specifically encourages and catalyzes scientist-to-scientist connections across international boundaries, below the “radar” of governmental interactions. The National Academy of Science has a long history of encouraging related interactions, going back at least to ~1960 when it facilitated reciprocal visits of physicists between the U.S. and USSR, during the height of the cold war. But for some time it has been challenging to promote ties to Iranian scientists.

Do scientific associations in America have plans to collaborate with Iranian researchers and scientists in physics?

I do not know of any specific such plans of scientific associations at this time. The U.S. and U.N. Sanctions Acts pertaining to Iran place restrictions in many cases and barriers in others, and organizations are particularly wary of activities that might become negative for the organization. Recognition of this is part of the reason that scientist-to-scientist interactions are leading the way towards more open connections. Only recently have I begun to hear of initiation of some activities at an official level. One very significant new development is the finalizing in July 2014 of a formal *Agreement of Cooperation* signed by the Chancellor of the University of California Davis (UC Davis) and the President of the Sharif University of Technology (Sharif). The intention of this document is to catalyze action from both sides to explore exchange visits and collaboration on topics of mutual interest. Common interests at this time include agriculture and environmental sustainability as well as the physical sciences.

Some international and even American communities have made efforts to curb and limit Iranian



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scientists. What is your view on this matter?

I have been told (and reports have appeared in magazines and journals) of cases where scientific publishers are treating manuscripts from certain Iranian institutions differently, sometimes returning them without consideration. This choice is again due to (perceived) restrictions outlined – but not always clearly — in the Sanctions Acts. I have been assured by American Physical Society officials that such restrictions are not practiced of APS publications. One of my interests is to get such issues out into the open, to be recognized and actively discussed by the scientific community and its organizations. There are political realities to be considered, but individuals have some latitude that larger groups may not have.

To what extent can global scientific exchange between countries lead to a reduction in conflicts and disputes?

This is an important question, but one with no general answer; certainly many of us hope there could be more progressive outcome than simply communication and exchange visits on the personal level. Did the US-USSR exchanges of physicists in the 1960s influence the political stance of either country? I don't know of any evidence to support influence on political leaders. However, in 1971 China invited the U.S. ping-pong team, then in Japan, to visit China for sporting competition. Soon after, a Chinese team visited the U.S. on a reciprocal visit. In 1973, American government officials began making trips (initially secret) to China, and soon thereafter diplomatic relations between China and the U.S. began to be re-established. Some people believe this “ping-pong diplomacy” planted ideas in the minds of the two countries’ leaders. If so, then it is also possible that (sufficiently visible) “science diplomacy” between the U.S. and Iran might also cause leaders to consider new avenues toward cooperation.

In 2012 you traveled to Iran along with two other prominent physics scholars of America. Who did invite you to this trip?

My visit, with my wife and joined by Professor Paul Chu (University of Houston) and his wife, and Prof. Tony Leggett (UIUC), was during the first two weeks of February 2014. We were invited by Prof. Mohammad Akhavan (Physics, Sharif), whom we had known for several years from meeting at international conferences. It was also helpful for the visas, I imagine, that I (probably each of us) had a letter of invitation from the President of Sharif University. Prof. Akhavan had from our very first meeting in 2003 invited me to visit Iran, unfortunately it took a decade for the visit to materialize.

Was the idea of this journey only suggested by the Iranian scholars or were you planning for it too?

The idea, followed by detailed arrangements, was the brainchild of Prof. Akhavan who, as mentioned above, had had it in his plans for several years. The three of us physicists were kept fairly busy during the visit: (1) we attended the 4th National Conference on Advanced Superconductivity at Sharif, each giving one plenary talk and one research talk; (2) we each gave a public talk at one of the universities we visited [Sharif, Isfahan University of Technology, Sharif University]; (3) we accepted Adjunct Professor appointments in Physics at Sharif that will facilitate further communication and planning; (4) we were present at the inauguration of the new IRPAM program (International Research Collaboration on the Physics of Advanced Materials) at Sharif, and accepted appointments to its International Advisory Board. We also had time to make several visits to places of historical and cultural interest. I remain in frequent communication with Prof. Akhavan.

Which cities of Iran did you visit?

We visited Tehran, Isfahan, and Shiraz, meeting with Physics chairs and faculty, and sometimes students. We also were shown historical and cultural sites, some reflecting the centuries, even millennia, of Persian culture. There are too many to list; one surprise was a remarkably informative and delightful visit to the Carpet Museum, but there were several other excursions as well.

How much different did you find Iran from what is portrayed in the media?

In the U.S. we hear and read quite often about the governmental positions on the various contentious areas. However, we get little pithy information in the media about the people, or graphics of cities, places, or people, other than the occasional filmed uprisings against the U.S. Of course, bigger uprisings about internal affairs (elections) around ~2009 also got attention, but still not much on-the-street reporting was available (as far as I remember). I expected that scientific faculty and students would be happy and anxious to meet us, and that was indeed the case. Among my pleasant surprises were that (i) the ministers we met were so supportive of more communication between Iranian and western scientists, and (ii) that in every case where we met people without plan (at the bazaar, on the street, around tourist sites, near a school) the Iranians were delighted to meet Americans, to know that we could visit, and that



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we would take the time to visit their country. Every single one showed delight at having Americans visit and learn something about their country.

Did you have conversations / interactions with Iranian students and teachers on this trip?

We had arranged meetings with faculty, and once or twice with students. Scientific isolation, and difficulties in obtaining necessary laboratory equipment, were two of the topics that emerged in the conversations several times. We had several “5-minute” conversations with students and faculty, primarily before, during breaks, or after sessions at the conference or our public lectures. Very many people were anxious to have their pictures taken with us, and to obtain our autographs. More interactions would have been great, but we had a busy schedule at it was.

How would you assess the academic level of students in Iran?

I am not qualified to make general statements; I’ve seen no statistics, have not even talked in much detail with faculty who have acquaintance with western norms as well as with Iranian students. However, science education up to the BS level seems to be very good at several Iranian universities. My department (Physics, UC Davis) has accepted students into our graduate program, with perhaps four Iranians in residence at present (in our department, where a student is from is not a prominent item of discussion or notice; how they are performing and progressing is our focus). A year ago I discussed possible PhD research with an Iranian student, but she decided to work with another faculty member, and she has done very well so far. I have worked over the years with two Iranian postdoctoral fellows, both of whom obtained their PhD in the U.S. Outside of UC Davis: Stanford University authorities say that electrical engineering students from Sharif University are some of the best prepared worldwide for graduate school, at the bachelors degree level. One real problem for Iranian students, and therefore the Iranian system, is the lack of sufficient world-class research lab equipment at the graduate level in Iranian universities. Another contributing factor is the considerable isolation from the international scientific community; this aspect came through in discussions with both faculty and students. Many Iranian students cannot progress to modern graduate education and research because of barriers they face: limitations in local university programs and equipment, challenges in obtaining visas, qualifications that may be difficult to assess outside of Iran, and competition from the very best students from many other countries. Still, a significant number of Iranian students manage to enter graduate education and research programs outside Iran. Minister of Science, Research, and Technology Faraji-Dana (now former minister) championed promoting conditions within Iran that would attract more western-trained scientists back to careers in Iran, a direction that seems very much in the interest of Iran.

Your trip to Iran has been mentioned as science diplomacy in some media. Do you think this title is suitable for this trip?

Our visit to Iran was ostensibly to attend and make presentations at the conference at Sharif, and to initiate our advisory role to IRPAM, but we all understood that another intention of such visits is always to meet new people and try to open up more communication and understanding – and certainly in this case, to get an inside peek at Iran, which few people have been able to do recently. For similar reasons I had made a visit to a Malaysian university (University Putra Malaya) a year before. It was only after our return from Iran that I realized the terminology “science diplomacy” described our activities and purposes in Iran very well. It consists basically of scientist-to-scientist interactions, to clear up misperceptions, to increase knowledge of the other on each side, to build communication, and in appropriate cases to initiate and nurture collaboration. I use the description *science diplomacy* quite often now, when I lecture on my visit and experiences in Iran, and in various communications.

You were accompanied by your spouse on the journey. What was her opinion after paying a visit to Iran?

Jill had a great time in Iran. She, and the other wife that visited, were hosted very gracefully and energetically by the wife and (adult) children of Prof. Akhavan, not only in Tehran but in Isfahan and Shiraz as well. Jill is ready to return to Iran as soon as an opportunity arises. At just this time she is putting together an album of photographs from our first visit to Iran. She valued the opportunity to visit museums, historical sites, palaces, and mosques, and to learn about the ancient history and culture.

In the event of proposal for attending academic seminars or courses, how interested are you to travel to Iran again?

I certainly expect to visit Iran again. My priority at this time, though, is to encourage and enable others to visit, and to host visitors from Iran. Mohammad Akhavan (Physics, Sharif) and I (Physics, UC Davis) are working to obtain support for reciprocal visits of both faculty and students between the two universities. These visits might involve both a research workshop and seminars, to acquaint scientists from the other university of research activities, and an educational lecture series on specific topics where the expertise is



represented in the group of the attendees.

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