Pedro Miguel Etxenike

Cambridge, 1976. University of Cambridge.

Pedro Miguel Etxenike was born on 8 June 1950 in Isaba (Navarra) and received his university education at the University of Navarra, where he graduated with honours in physics in 1972. He received his PhD in 1976 from the University of Cambridge (England) for a thesis on the interaction of energetic particles with surfaces, and in 1977 from the University of Barcelona (Spain) for his work on spatial excitation patterns induced by swift ions in condensed matter.

After doing postdoctoral work at Oak Ridge National Laboratory (USA), Bohr Institute (Denmark), and Lund University (Sweden), and holding a faculty position at the University of Barcelona (Spain), he returned in 1980 to the Basque Country, where he served as a Minister of Education (1980-1983), as a Minister of Education and Culture (1983-84), and as Speaker for the Basque Government (1983-84). During this period (1980-1984), he launched a pioneering system for the development of science and technology, which has been largely influential over the past 15 years. Furthermore, the centres for research and development that he promoted are well known to have played a key role in the current basque technology network. He also promoted the so-called law for the use of the basque language.

In 1984 Etxenike left the Basque Goverment, and he spent the following two years as a Visiting Professor at the Cavendish Laboratory in Cambridge (England). In 1986 he joined the University of the Basque Country in San Sebastian, where he is now full professor of condensed matter physics.

Professor Etxenike has written nearly 200 papers in various research journals, many of them well-known to be of a very high level of originality. He has an unusually high number of

Vitoria-Gasteiz, 1980. Appointment as Minister of Education of the Basque Government

papers published in `Physical Review Letters', which is the most prestigious journal in physics in the world. His influential review article for the prestigious journal `Solid State Physics'[1] has soon become a standard reference in the field.

Though Etxenike has proved to be an authority in several distinct areas of scientific research, well-known fields of physics where he has made major contributions are particle-matter interactions, surface physics, and electron microscopy. His work has stimulated much theoretical and experimental work in these fields, as witnessed by the high frequency of citations for many of his scientific papers, and he has performed pioneering calculations of the electronic structure of surfaces.

During his period as a PhD student at the world-famous Cavendish Laboratory he solved several difficult problems with his supervisor J. B. Pendry, including work on loss mechanisms at surfaces, liquid helium, and on image states. He devised his famous equation for determining the energy loss of a charged particle moving near a surface[2], which has become a routine method of determining energy losses between particles and surfaces. He also developed a beautiful theory for the interaction of helium atoms with superfluid helium[3].

One of Etxenike's major contributions is certainly his elucidation of image-potential induced states at surfaces[4]. He devised a model that describes elegantly the density of

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1. P. M. Echenique, F. Flores, and R. H. Ritchie, *Dynamic screening of probes in bulk and surfaces*, Solid State Phys. **43**, 229 (1990).

2. P. M. Echenique and J. B. Pendry, *Absorption profile at surfaces*, J. Phys. C **8**, 2936 (1975).

3. P. M. Echenique and J. B. Pendry, *Reflectivity of liquid ^{4}He surfaces to ^{4}He atoms*, Phys. Rev. Lett. **37**, 561 (1976).

4. P. M. Echenique and J. B. Pendry, *The existence and detection of Rydberg states at surfaces*, J. Phys. C **11**, 2065 (1978).

Leioa, 1982.V.27 Ceremony of award Manuel de Irujo Doctor Honoris Causa by the University of the Basque Country

Donostia , 1996. Euskadi Prize for Research

Vitoria-Gasteiz, 1998. Basque of the Year Award 1998

states, the lifetimes, the binding energies, and the effective masses of electrons in such states. This work has had a profound influence on experimental work, after these states were eventually detected using the techniques of inverse photoemission and two-photon photoemission, and it has been of importance in developing our understanding of the scanning tunneling microscope. The class of surface states that Echenique predicted now form the mainstay of many research groups world wide.

Etxenike also made seminal contributions to the field of ion-matter interactions, emphasizing interactions with the bulk and with the surfaces of matter. He created a great deal of interest with his work on the wake potential of charged particles moving through solids, and the manner in which charged particles can drag a cloud of electrons as they move[5]. He devised the first rigorous nonlinear quantal theory of the electronic stopping power for slow ions[6], whose impact rivals that of some of the early legends such as Bohr and Bethe. This theory has played a critical role in understanding the origin of the oscillations that the electronic stopping power presents as the projectile charge is varied[7], and it has been proved to be of key importance in establishing a scenario for the interaction of highly charged ions with solids.

After his fruitful collaboration with leading researchers all over the world, Etxenike joined the University of the Basque Country and oriented his efforts to bring up a school of

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5. P. M. Echenique, R. H. Ritchie, and W. Brandt, *Spatial excitation patterns induced by swift ions in condensed matter*, Phys. Rev. B **20**, 2567 (1979).

6. P. M. Echenique, R. M. Nieminen, and R. H. Ritchie, *Density functional calculation of the stopping power of an electron gas for slow ions*, Solid State Commun. **37**, 779 (1981).

7. P. M. Echenique, R. M. Nieminen, J. C. Ashley, and R. H. Ritchie, *Nonlinear stopping power of an electron gas for slow ions*, Phys. Rev. A **33**, 897 (1986).

Oviedo, 1998.X.23. Prince of Asturias Award 1998

international prestige. With an enthusiastic group of graduate students and collaborators, he has succeeded in forming a team that is tremendously creative and productive and has become one of the most active theoretical groups in the field of condensed matter physics and radiation physics in the world. Nowadays several of his graduates have gone on to establish themselves as respected theorists in the field.

Over the last decade, the scientific work of Etxenike and his group has, to a large extent, determined the recent development in his area of research. The first complete linear theory of the stopping of alpha particles that accounts for charge transfer between these ions and the medium has been presented[8], with full inclusion of energy losses in such transfers. In the field of electron microscopy, Etxenike and his team have completely reformulated the theory of the energy loss of fast electrons passing through complex and inhomogeneous media, in the framework of a rigorous self-energy approach[9]. Seminal work has also been carried out in developing a quantal theory for the so-called Barkas effect in the stopping power of a solid for charged particles[10], thereby accounting for the experimentally observed differences between the ranges of protons and antiprotons moving with the same energy. This theory has contributed greatly to the physics of many-body interactions in the electron gas and has provided the scientific community with explicit expressions for the quadratic response, after the famous work carried out by Lindhard in the 50's for the linear response.

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8. A. Arnau, M. Peñalba, P. M. Echenique, F. Flores, and R. H. Ritchie, *Stopping for helium in aluminum*, Phys. Rev. Lett. **65**, 1024 (1990).

9. A. Rivacoba, N. Zabala, and P. M. Echenique, *Theory of energy loss in STEM of supported small particles*, Phys. Rev. Lett. **69**, 3362 (1992).

10. J. M. Pitarke, R. H. Ritchie, and P. M. Echenique, *Quadratic response theory of the energy loss of charged particles in an electron gas*, Phys. Rev. B **52**, 13883 (1995)

Bonn, 1998.12.03. Max-Planak Research Prize

Etxenike continues to be extraordinarily creative and productive, as can be seen by a glance at his list of publications and honours. In 1985 he was elected overseas Fellow at Churchill College, Cambridge (England), and in 1990 became Fellow of the American Physical Society, a rare honour for someone not living in the USA. In 1996 he was elected Scientific Member of the Bosmiche Physical Society at Cornell University, USA. Since 1996 he is a member of the so-called trilateral commission, one out of 335 distinguished individuals from the three regions -Europe, Japan, and North America- with a variety of leadership responsibilities. Recently, he has been elected universal basque of the year 1998; this prize, set up two years ago by the Basque Government and the Euskadiko Kutxa, is awarded to outstanding basque individuals who have done honour to the Basque Country all over the world.

Over the last few years he has been the recipient of several awards and prizes: The 'Xabier María de Munibe' in 1995, the 'Euskadi' for Research in 1996, the 'DuPont' for Science in 1996, the 'Prince of Viana' for Culture in 1997, the 'Grupo Correo' for Society in 1997, and the prestigious 'Prince of Asturias' for Scientific and Technical Research in 1998, which is granted to the individual, group or institution whose discoveries or research represent a highly significant contribution to the progress of humanity in the fields of Mathematics, Physics, Chemistry, Biology, Medicine, Earth and Space Sciences, as well as their related technical aspects and technologies.

In 1998 Etxenike was also the recipient of the Max Planck Research Prize, which is given by the Max Planck Society. This prize is bestowed on individual foreign and German researches who lead their field with regard to outstanding and internationally recognized scientific achievements. This award endows individuals with up to DM 250,000, thus enabling prize-winners to collaborate intensively and on a long-term basis with partners from around the world.

Professor Etxenike is now leading the newly established so-called Donostia International Physics Centre, with the aim of promoting international collaboration and providing a meeting point for scientists from all over the world.

Jose M. Pitarke