

Chapter 20

Physics and Women: A Challenge Being Successfully Met in Cuba

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20.1 A Necessary Introduction

The history of physics in Cuba, like all the country's educational and scientific development, cannot be understood without taking into account its close relationship with the social changes that took place in Cuba during the five decades elapsed since 1959. This should include due consideration to the role played by women in this process, all the more since the link between science and gender is now generally regarded as a subject of growing special interest (Fernández Rius 2000).

It is quite a challenge for us even to outline the role of women in Cuban physics in the present context, however an overall view is attempted at the most relevant events related to the development of this science in the country.

While various approaches to the subject are possible, in any case it is not feasible to give in the few pages at our disposal a full and detailed enumeration of the many events and data deemed appropriate to the subject. Still, being proud of considering herself a part of the community of Cuban women physicists, the author feels it important to give some thought to various facts that emphasize the remarkable role played in the matter by the feminine gender. One must be aware that changes in individual subjectivity are slow to develop and that the relevant end results are long term, especially since we are dealing with ways of thinking deeply rooted through hundreds of years. It then becomes a great challenge for women to make themselves known within a predominantly masculine community with an androcentric cultural heritage, where certain values, behaviors and social barriers still prevail, in spite of the great efforts to revert them, made by the country, in the last five decades.

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The above challenges are even greater for Cuban women physicists as far as academic media are concerned, because of the dedication and time called for by work in the field of physics, and the great deal of time required by the roles ordinarily played by women in society, especially in the familial environment, and the related way of thinking among many male physicists. A female scholar in the area of gender and science in Cuba recalled:

A male friend, devoted to physics – a traditionally male science – told me once: ‘women cannot do well in scientific work because they cannot concentrate as we do, since they have one neuron in the computer and the rest in domestic affairs and children, they don’t have at their disposal the same time as we do to engage in work for hours and hours.’ (Fernández Rius 2000)

Similar barriers on women working in physics are reported around the world (Ivie et al. 2002). Basically, such barriers are related to the existing conflict between the long time required to take care of children and the equally long time required by physics work. Associated with this is the fact that the field of Physical Sciences is one of the least populated by women on a global level and Cuba is not an exception. For the same reasons, the achievements of women physicists are in direct relationship not only to their intelligence, but also to the intensity of the work they have to do to compensate for the more limited time they can dedicate to scientific work, as compared to that available to their male counterparts.

Still, while the number of women physicists in Cuba is considerably lower than that of men who have graduated in physics, like in the great majority of countries—or perhaps all of them, the presence of women physicists in academic and scientific leading positions in our country shows prominent singularities (Arias de Fuentes 2008).

In the absence of a case study to find out the causes responsible for the accession of Cuban women physicists to such positions, this author advances her opinion that it has been the result of the increased prestige, social and professional, acquired by women in Cuba since the revolutionary changes that took place in the country after 1959. It shows how important it is for the Government to have the will to promote women to academic functions. The insertion of Cuban women in the development process of the country both as a leading actor and as a beneficiary, should be evaluated as one of the most successful social developments that have taken place in Cuba in the last 50 years, derived from the fact that women have had ample possibility to access public life nationwide just as men have.

Nowadays male and female students are graduated as physicists at the University of Havana—the oldest one in the country, founded in 1728—at the University of Oriente in Santiago de Cuba, and at the Higher Institute for Applied Science and Technology. In this last one, physics professionals receive specialized training in nuclear and earth sciences. Some 50 physicists per year obtained their degrees from these three universities in the 1990s (Baracca et al. 2006). High school physics teachers were trained in other higher education institutions whose profile is essentially pedagogical.

20.2 Some Interesting Figures

As an interesting piece of information it shall be noted that early in 1959 women made up 55 % of the illiterate Cuban population and about 17 % of the country's work force, with household jobs being their main employment source,¹ while presently women make up 46 % of the active labor force of the nation in the civilian state sector, and 65.6 % of the country's professionals and technicians.²

In Cuba nowadays women make up 51.6 % of the research personnel³ and 60.4 % of the scientific research reserve of the country (González Bermúdez 2008) (i.e. young professionals with less than 2 years engagement in research work), which may be taken to predict an increase in the role played by women in this important sector of society. On the other hand, of the 3087 projects that compose the National, Branch, and Territorial Programs in the Science and Technology Innovation National System, 23 % are led by women (González Bermúdez 2008), which should be added to the recognized fact that the country is the second one in the region with the largest number of women incorporated to science (Padilla 2007). It should be noted, however, that while women represent 65 % of the university graduates in Cuba,⁴ their proportion is much less in physics—about 20 %.

Figure 20.1 shows the percentage of women that have completed their physics degree courses in successive decades at the University of Havana, which is the main source of physicists in the country, from 1964 on. The first physics graduates in the

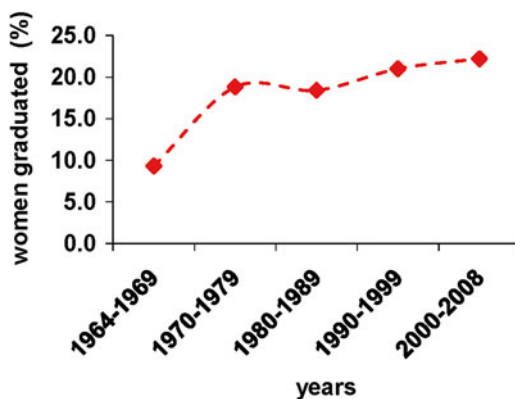


Fig. 20.1 Percentage per decade of women who have successfully finished physics degree courses taught at the University of Havana from 1964 to 2008

¹ See *Presencia de la mujer en la Salud Pública Cubana – Infomed*: http://bvs.sld.cu/revistas/spu/vol35_1_09/spu10109.htm. Accessed March 2014.

² See Aniversario 50 del Triunfo de la Revolución. *Mujeres Cubanas en Cifras* (2008): <http://www.mujeres.co.cu/50%20aniversario/textos/Mujeres%20cubanas%20en%20cifras%20%282008%29.html>. Accessed March 2014.

³ See footnote 2.

⁴ See footnote 2.

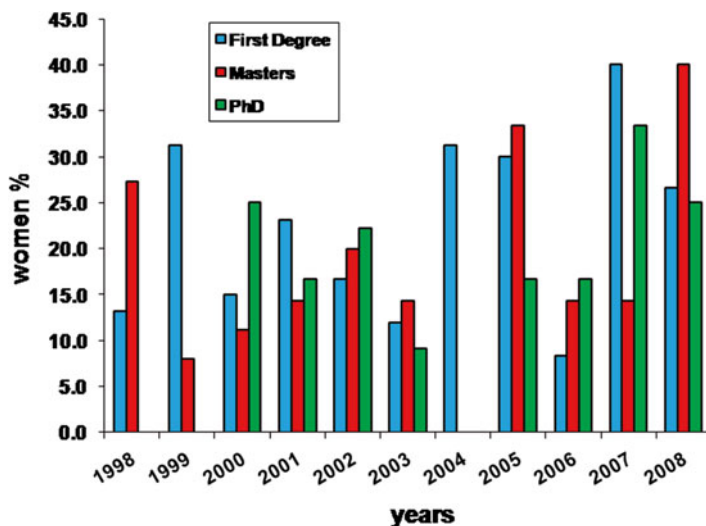


Fig. 20.2 Percentage of women graduated in all physics levels (1998–2008)

country finished their studies in 1964. It can be seen from the graph shown that the percentage of female graduates in physics has generally increased with time, having reached a maximum of 22.2 % in 2000–2008.

In Cuba, 72 % of the labor force in the Education sector is composed of women.⁵ They are 61 % of the teaching staff at the University of Havana as a whole (Fernández Rius 2000). Curiously enough, while that percentage goes down to only 27.3 % at the Faculty of Physics, up to 66 % of the executives (deans and vice-deans) were female at certain times. An important fact in the history of physics in Cuba is the nomination for the first time of a woman physicist as Dean of the Physics Faculty at the University of Havana.

Figure 20.2 shows the percentage of women that obtained a *licenciatura*, MSc or PhD degree in physics in 1998–2008. Generally speaking, in this decade 20 % of the first level graduates (*licenciados*) were women, while the percentage of the MSc and PhD graduates was 16 % in both cases. This information refers to those who finished their corresponding studies in the country. On the other hand, we find out that of all those who obtained their MSc in physics after the initial and ephemeral existence of this degree in the 1970s (Baracca et al. 2006), 16 % were women, while of the total PhDs in physics defended in Cuba since it began in 1974, only 11 % went to women.

However, it should be noted that in spite of being such a minority, women were chosen as “best all around students” of many academic courses in physics at the University of Havana. In the last three, that condition was bestowed upon two women, one of whom was also elected the University’s best all around student. Among the physicists that have been awarded to date the “Carlos J. Finlay”

⁵ See footnote 2.

Order—the highest distinction awarded by the Cuban State to those professionals who have made important contributions to science and technology in the country—, 33 % are women. They have also quite a good representation in the yearly National Prizes awarded by the Cuban Academy of Sciences as exemplified by the fact that in three out of the seven dealing with physics subjects that were awarded in 2005, the leading author was a woman.

Generally speaking, the names of several women physicists regularly appear in the list of those who are awarded medals and national prizes for their scientific and educational work among them, the “José Tey” Medal awarded by the Council of State of the Cuban Republic the Distinction for Cuban Education, the Special Distinction of the Minister of Higher Education, the diplomas and medals awarded for participation in the preparatory tasks for the realization of the first Soviet-Cuban joint space flight, and the prizes for outstanding work awarded yearly by the National Science and Technology Forum, among others. All this, added to the fact that more than 35 % of the physicists who have been lately elected members of the Cuban Academy of Sciences are women, is a clear indication of national appreciation of the remarkable role played by women physicists in Cuba.

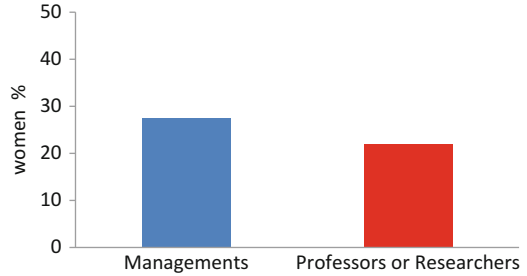
Two women physicists were nominated by Cuba for membership in the ICSU Regional Committee for Latin American and the Caribbean, and one of them was also elected by the International Council for Science (ICSU) as a member of its board of directors. A Cuban physicist was also elected member of the Academy of Sciences for the Developing World (TWAS), which brings together research workers of some 90 countries chosen through a highly competitive process, since less than 25 % of the nominees are finally promoted after taking into account their accumulated merits of their trajectory as professionals.⁶ Cuba has eight members in this organization three of whom are women. Two of the members are physicists, a man and a woman.

A Cuban woman physicist was elected a member of the Executive Council of the Third World Organization for Women in Science (TWOWS), where she held the position of vice president for Latin America and the Caribbean for the period 1999–2006. She was also the president of the Cuban Chapter of TWOWS, within the framework of the Commission for Woman Scientists of the Cuban Academy of Sciences, which every year awards a prize to those women who are the principal authors of works that have won an Academy prize. In 2010 two Cuban female scientists, one of them a physicist, were awarded the TWOWS-TWAS international prize for scientific excellence. All of these facts are indicative that also at an international level Cuban women physicists have played an important role.

Among the prizes instituted by the Latin American Association of Biology and Nuclear Medicine Societies (ALASBIMN) with a view to stimulate research and development of nuclear medicine and related areas, only one bears the name of a woman, the “Mercedes Borrón” prize for technicians. This award was established

⁶Cuba News Headlines; Cuban Daily News (21.11.2008); “Eligen a científica cubana miembro de academia internacional”: http://www.cubaheadlines.com/es/2008/11/21/14528/eligen_a_cientifica_cubana_miembro_de_academia_internacional.html. Accessed March 2014.

Fig. 20.3 Percentage of women female physicists holding posts as managers, professors or researchers referred to the total number of physicists in universities and scientific centers with a large number of physicists



and so named by ALASBIMN in honor of a distinguished Cuban physicist that passed away in 2002. She worked in the same area and had been awarded prizes by the Association. The “Sofia Kovalevskaya” international prize, sponsored by the organization of the same name, with the purpose of stimulating an increasing presence of women in the science and technology sectors of developing nations, has been awarded, since 2003, to 15 Cuban women scientists, 6 of whom were physicists. The Russian Cosmonautics Federation awarded another Cuban woman physicist the “Valentina Tereshkova” medal for her outstanding participation in the preparation of the scientific experiments which were performed during the joint Soviet-Cuban space flight.

Figure 20.3 shows the percentage of women physicists holding managerial posts as well of those who are involved in teaching and research work in the country’s four universities that employ the largest number of physicists, and in two research centers with a sizable number of these professionals (Arias de Fuentes et al. 2009).

Interestingly enough, the percentage of women physicists who are scientific managers is larger than that of women physicists who do teaching and/or research. This can be taken as an indication of the academic and scientific leadership reached by women physicists in the country, and emphasizes the progress made by women in Cuba and the increase in their social prestige as far as national academic activities are concerned (Arias de Fuentes 2008). While still a minority, women physicists presently hold or have held in the past important managerial posts in the country’s scientific institutions, such as:

- Director of Sciences at the Ministry of Science, Technology and Environment (CITMA). National Representative of the Ibero American Program of Science and Technology for Development (CYTED).
- President of the Commission of Women Scientists of the Cuban Academy of Sciences.
- Scientific Advisor at the Ministry of Science, Technology and Environment (CITMA).
- Director of the Managing Center for the Programs of the Ministry of Science, Technology and Environment (CITMA).
- Rector of the Higher Institute for Applied Science and Technology, one of the three universities in the country where it is possible to study for a career in physics.

- Advisor of the Rector of the University of Havana, the largest and most important university in the country.
- Director of the Integrated Directorship for Projects of the Agency for Nuclear Energy and Advanced Technologies.
- Vice rector of the “José A. Echeverría” Higher Polytechnic Institute (ISPJAE), one of the country’s four higher education centers whose academic personnel includes the largest number of physicists.
- Vice director for Research of the Physics Faculty, University of Havana.
- Dean and vice dean of the Faculty of Physics of the University of Havana, whose academic personnel includes the highest number of physicists in the country. [Present]
- Vice director of the Institute for Materials Science and Technology (IMRE), University of Havana, one of the centers of the country with the largest number of physicists.
- Member of the managing group that founded the Cuban Physics Society.
- President and vice president of the Cuban Physics Society.
- Editor of the journal *Revista Cubana de Física*.
- Director of the Institute for Research and Projects for the Mining-Metallurgical Industry (CIPIMM), the leading center for technological research related to mining in Cuba.
- Vice director of the Institute for Cybernetics, Mathematics and Physics (ICIMAF), one of the scientific centers with the largest number of physicists in the country.
- Head of the Physics Department of the Institute for Cybernetics, Mathematics and Physics (ICIMAF).
- Director of the Institute for Geophysics and Astronomy (IGA).
- Director and vice director of the Research Center for Microelectronics (CIME) (Arias de Fuentes 2001).

20.3 The First Women to Graduate as Physicists

The Law for the Reform of Higher Education in Cuba was enacted on January 10, 1962, the 33rd anniversary of the assassination by government henchmen of Julio Antonio Mella, who led the first movement for a general reform at the University of Havana. New degree courses, faculties and research centers were established.⁷ Specialized Schools (the Physics School among them) with their associated departments, were created within the Faculty of Sciences to replace the former independent chairs dedicated to special areas of mathematics, physics, chemistry, and natural sciences (Pérez Rojas et al. 1976). An independent (5-year) degree course in physics was inaugurated in this context, since up to then the nearest thing to it in the country were two 4-year degree courses entitled “physical-mathematical

⁷Informe al Claustro Universitario convocado en conmemoración del 280 aniversario de la fundación de la Universidad de la Habana. 2008. Teatro Astral, Ciudad de la Habana.

sciences” and “physical-chemical sciences”, both taught only at the University of Havana and essentially dedicated to the training of high-school teachers. The Physics School became the Faculty of Physics of the same university in 1984.

The first four *licenciados* in physics graduated in 1964. It should be noted that right from the beginning there was an important female presence, since two of the new graduates were women (50 %), one of whom is presently a senior professor of the Faculty of Physics of the University of Havana. In 1965 there were, again, four graduates, one of them a woman (25 %). In 1966 new graduates reinforced the staff of the Physics School of the University of Havana. Six of these were physics graduates from universities in the former Soviet Union (Pérez Rojas et al. 1976), two women among them (33.3 %).

20.4 The Presence of Women Physicists at Some Important Moments for Physics in Cuba

Women physicists were prominent in various events that took place in the 1960s and 1970s and had an important bearing on the subsequent development of physics in Cuba. Not only did they actively participate in relevant research groups, but in many cases women physicists were the principal authors of the first results obtained in the period, such as:

- The first semiconductor alloy diodes obtained in 1967, a milestone that marked the birth of solid-state physics research in the country (Baracca et al. 2006).
- The creation of the planar technology laboratory of the University of Havana (colloquially referred to at the time as “the little house”) and all the results associated to the research work done in it.
- The manufacture at laboratory level, in 1969, of the first transistors and integrated circuits (Arias de Fuentes 1993, 2001; Arias de Fuentes and Martínez Morell 1997).
- The development of light emitting diodes (LEDs) in the 1970s.
- The first research papers on semiconductor physics published in indexed journals.

It is worthy of mention that in the period 1970–1975 a woman physicist served as vice director for research at the then Physics School of the University of Havana, while other women physicists served as heads of educational laboratories and departments. A woman physicist was in charge of the design, setting up and organization of the first educational laboratories of the Physics School of the same university.

Among other significant moments for the development of Physics in Cuba in which women physicists had outstanding participation, the following can be mentioned:

- First laboratory made solar cells (Arias de Fuentes 2001)
- Creation and development of the Research Center for Microelectronics at the “José Antonio Echeverría” Higher Polytechnic Institute (ISPJAE) (Arias de Fuentes 2001).
- Foundation of the Institute for Nuclear Physics, which included five women physicists
- Foundations at the Cuban Academy of Sciences of the Institute for Fundamental Technical Research (ININTEF), which later was expanded into the Institute for Cybernetics, Mathematics and Physics (ICIMAF), with a female presence in its group for theoretical physics. A woman physicist served as the vice director of ICIMAF for 9 years
- Foundation in 1985 of the Institute for Materials and Reagents for Electronics (IMRE) (Arias de Fuentes 1993, 2001; Arias de Fuentes and Martínez Morell 1997), now called Institute for Materials Science and Technology. Women physicists have served as vice directors.
- Design and development of the first integrated circuits to order (ASIC) (Arias de Fuentes 2001).
- Epitaxial growth while orbiting around the Earth, included in the Cuban experiments made in outer space during the Soviet-Cuban Space Flight in September 1980
- LED technology transferred to Cuban semiconductor device industry during the 1980s.
- Development of photovoltaic solar cells.

One of the promoters and organizers of the Cuban Physics Society in 1979 was a woman physicist, who was later elected its executive secretary for two successive periods and its vice president afterward. Later on a woman was elected president of the society. There is a female presence in its current executive committee. The editor of the *Cuban Journal of Physics* was also, for a long time, a woman.

Finally, it should be pointed out that, with the wholehearted support of the Cuban Physics Society, a Chair for Women Studies was created at the University of Havana, as well as a Working Group of Women Physicists at the Ministry for Science, Technology and Environment (CITMA). Since its inauguration, in 2002, this working group has actively participated in international gatherings of women physicists (Alvarez et al. 2002, 2005; Arias de Fuentes 2009; Vigil 2009), and has promoted the participation of women in all sorts of scientific activities, like conferences, round tables and panels. In particular, female scientific workers belonging to the ICIMAF have promoted debates on the place of women in physics and mathematics, while their colleagues at the Institute of Meteorology have systematically organized similar gatherings of women meteorologists.

By way of resumé it can be said that, in spite of the fact that women physicists make up only a small part of the Cuban physicists community, they have played an important role in the development of physics in the country, and have enjoyed a strong presence in academic and scientific leading posts that made them outstanding

in comparison with the situation in other places abroad where the role of women in the area is still quite limited.

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