Semana de la Nanociencia y la Nanotecnología en Colombia 2013 (SNNC 2013)

UNIVERSIDAD
DE ANTIOQUIA
1803

CONTRIBUCIONES EN PÓSTER A NANODYF'2013 (Julio 17, Hall 2 piso Edificio de Extensión UdeA)	
Autor asistente	**Titulo de la contribucion**
Laura Toledo	Una experiencia de Divulgación y Promoción de la Nanotecnología en Argentina
Edwin alexander Robayo Chaparro	Nanociencia-Nanotecnología en Educación Media
Dilia Ingrid González Quecán	De las Galaxias a la Nanoescala
Edgar Rueda	Descubriendo la Nanotecnología
Angélica Maria Garzón Fontecha	Desarrollo de la Nanotecnología y Nanotoxicología en Bogotá D.C
Nancy Milena Valiente Triana	El nanomundo y los niños
Ana Elisa Casas	Posibilidades y desarrollos de la Nanotecnología en la Industria Textil
Paulo Noronha Lisboa-Filho	Nanotecnologia e Nanociência em Livros Didáticos de Ensino de Física na Escola Secundária: Discursos sobre a tecnologia e educação científica e tecnológica
Juan Carlos Martínez Orozco	¿Qué son y para qué sirven los transistores?
Marta Ramos	Heisenberg Uncertainty Principle in high school teaching
Maria de Jesus de Matos Gomes	Efeito de Tyndall em soluções coloidais de ouro
Irene Gómez Franco	Aprendizaje Significativo de la nanotecnología a través de Videojuegos y Simulaciones.
Faolain Chaparro Chaparro	Los cuentos en la infancia nano... una metodología pedagógica para todos.
Álvaro Luis Moralez Aramburo	Le darías a tu prometida un anillo cuántico

CONTRIBUCIONES ACEPTADAS COMO PÓSTER PARA NANOANTIOQUIA'2013 (Jueves 18 de julio, Hall 1 piso EIA-Sede Zuñiga)	
Autor asistente	**Titulo de la contribucion**
Adriana P. Herrera	Síntesis de nanopartículas de plata a partir de extracto de cilantro para aplicación antimicrobial
Adriana P. Herrera	Obtención de quitosano a partir de cáscaras de camarón para síntesis de nanomateriales para uso biomedicinal
Alejandro Puga Candelas	Monte Carlo simulation of the distribution of adsorbed paramagnetic particles induced by a an elliptical neutral substrate inside of the two dimensional suspension.
Alexander Cardona Rodríguez	Caracterización de nanopartículas de NdFeB para aplicaciones en farmacéutica

HEISENBERG UNCERTAINTY PRINCIPLE IN HIGH SCHOOL TEACHING

A. Pinto, L. Marques, M. M. D. Ramos*

Departamento\Centro de Física da Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal
* Autor a contactar: marta@fisica.uminho.pt.

Resumen

In Portuguese high school curricula concepts of quantum physics are taught in the discipline of physics in the 12th year of education. These concepts underlie the functioning of modern nano devices and nanotechnologies, but are difficult to understand by the students of this level of teaching, thus making it necessary the integration of new strategies to facilitate teaching-learning process.

In this we show the activities we developed to illustrate the Heisenberg uncertainty relations, based on a simple low cost experimental setup and a computer simulation program in Modellus to study the diffraction of light by a slit.

Acknowlegments: This work was supported by the project (PTDC/FIS/098943/2008) funded by the Portuguese Foundation for Science and Technology (FCT).

Palabras clave: Quantum physics, light driffraction, High school teaching

HEISENBERG'S UNCERTAINTY PRINCIPLE IN HIGH SCHOOL

Albino Rafael Pinto[1], Luís Marques[2] and Marta M. D. Ramos[2]

[1]Escola Secundária da Lixa, Felgueiras, 4615-653 Lixa, Portugal
[2]Department/Centre of Physics, University of Minho, Campus de Gualtar 4710-057 Braga, Portugal,
marta@fisica.uminho.pt

Universidade do Minho
Escola de Ciências

Centro de Física

INTRODUCTION

Most of the technological equipment that we use nowadays, functions based on phenomena explained by Quantum Physics concepts, which are taught at high school level. These concepts are difficult to understand for most of the students, being thus of utmost importance to develop new strategies that favour the teaching/learning process. Here we present a classroom strategy to introduce and explain the Heisenberg Uncertainty Principle by combining an experimental and computational approach. Using the software package Modellus 4.01 is possible to show and explain electron beam diffraction by a single-slit, while experimentally it is possible to observe the same physical phenomena with a light beam, being both strategies accessible to most of the teachers for using in the classroom.

TEORETICAL CONCEPTS

To show the implications of Heisenberg's Uncertainty Principle, lets consider the electron beam diffraction by a single-slit with width Δx, where each electron has a linear momentum (p) . From figure 1 is possible to see that:

$$\text{tg}\ \theta = p_x/p_y \qquad (1)$$

And the condition to occur the first minimum is:

$$\text{sen}\ \theta = \lambda/\Delta x \qquad (2)$$

For small values of θ we can consider that sen θ ≈ θ and tg θ ≈ θ , and thus the previous equations can be written as:

$$p_y \times \theta = p_x \text{ and } \theta = \lambda/\Delta x$$

Electrons

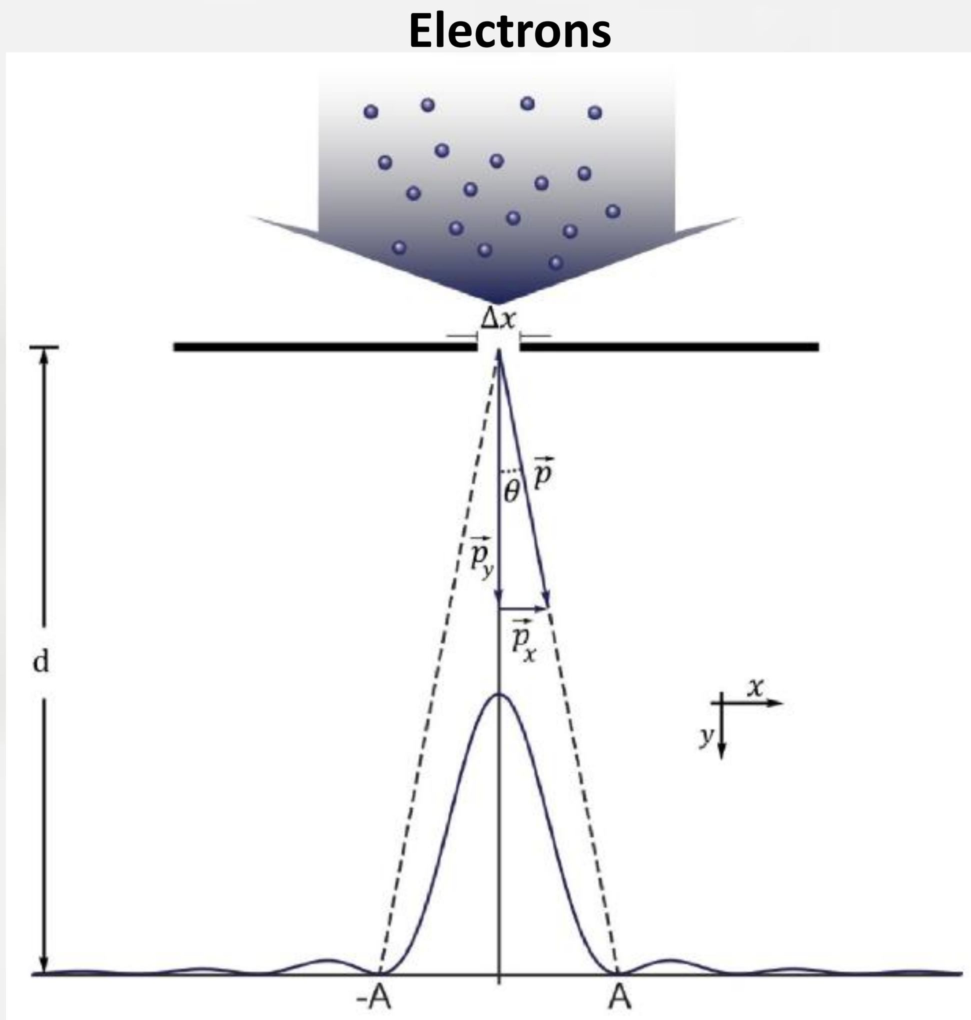


Figure 1

where:

$$p_x = p_y \times \lambda/\Delta x \qquad (3)$$

For those electrons that, after pass through the slit, reach the detector in the central region of maximum, are subject to an uncertainty in its momentum (Δp_x), which is given by $\Delta p_x \geq p_y \times \lambda/\Delta x$. Assuming equation of De Broglie ($\lambda = h/ p_y$):

$$\Delta p_x \times \Delta x \geq h \qquad (4)$$

Where Δx is, simultaneously, the slit width and the uncertainty on the x position of the electron when passes through it.

EXPERIMENTAL ACTIVITY

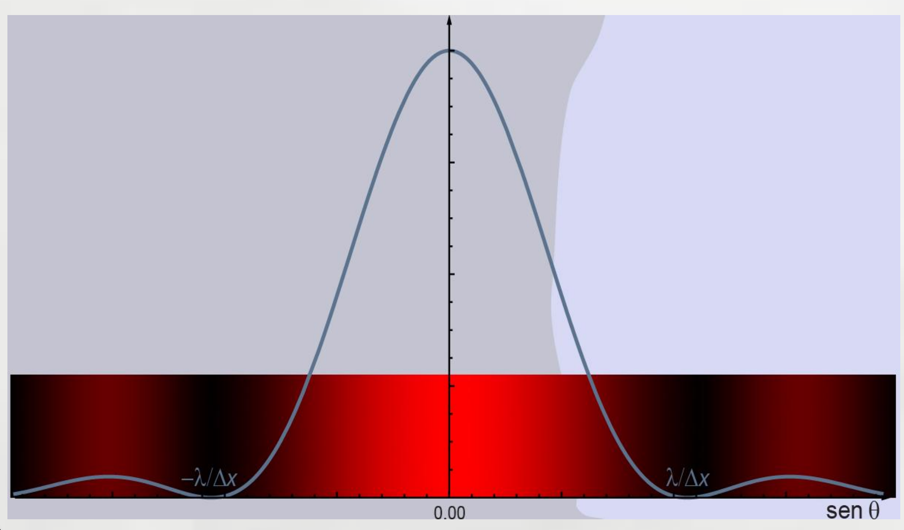
Material: A slit with proper width can be made using to two shaving blades attached to a black cardboard and a laser beam.

Proceeding: Focus the laser beam in slit, bending the cardboard to fit the slit width.

COMPUTATIONAL ACTIVITY

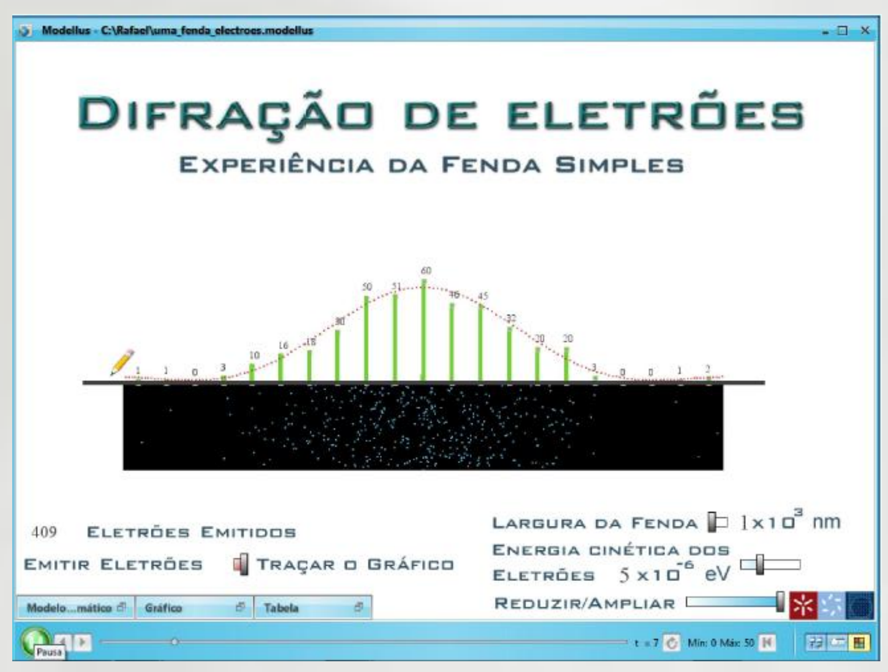
In the simulation, each dot represents an electron that passes thought one slit and is detected by a target (black rectangle). A bar graph that represents the amount of electrons that reaches the target is plotted. At each moment, the student can stop electron emission and plot a graph that best fit to results obtained. An interference pattern appears after some time.

RESULTS



The width of the central peak of the diffraction pattern increases with the decrease of the slit width, corresponding to an increase of the uncertainty Δx.

Decreasing the uncertainty in the position x leads to a narrow on central peak of the diffraction pattern . In this way $\Delta p_x \times \Delta x$ is always higher than *h*.



CONCLUSIONS

The activities proposed assists the teaching and learning process of Quantum Physics concepts, namely Heisenberg's Uncertainty Principle, as well as De Broglie's equation.

The materials used and the software package are accessible to teachers and can easy be implemented in the classroom.

The simplicity of the activities makes them suitable to be clearly explored in the classroom.

Acknowledgment
This work was supported by the project (PTDC/FIS/098943/2008) funded by the Portuguese Foundation for Science and Technology (FCT).