SOCIETY OF PHYSICS STUDENTS
An organization of the American Institute of Physics

SPS Chapter Research Award Proposal

Project Proposal Title	Xenon beam to detect polluting particles
Name of School	Universidad Autonoma de Ciudad Juarez
SPS Chapter Number	3291
Total Amount Requested	$1,992.00

Abstract

Physical engineering students are motivated to create a particle pollutant detector with the help of a xenon light beam, using principles of physics, such as optics and fluid dynamics. Taking as the basis of this motivation the current situation of air quality in the city.

Proposal Statement

Overview of Proposed Project

What effects related to cognitive activity and scientific curiosity within the university and in the community will a particle detector produce with the help of a xenon lamp and an optical lens, and the great role that physics plays behind each part of the device?

- Motivation From elementary schools they teach us that taking care of the environment is important, science teachers teach us that scientists have an important role within the branch of physics, but they do not teach us the great role that we also carry within the field of environmental and the importance of creating new devices to save it and take care of the planet as well as being able to continue understanding the laws of nature.

Students need a process of demonstration through the visualization of this device that will be restored and innovative.

A visibilimeter can be of great help as follows:

i) Helps physics students at UACJ, especially in the optics and fluid dynamics part

ii) encourage the community to enjoy and help understand the greatness of multidisciplinary scientific field as well as the optical light beam play.

Brief description

This research project is based on the design, construction and implementation of a device (visibilimeter). Each technological part will carry within the device the importance of electricity, optics, since a concave optical lens will also be included to concentrate the light and this can detect the particles that pass inside the device.

Research goals of the project

1. Develop a functional prototype for various academic activities at the University. Autonomous of Ciudad Juárez.
2. Make research related to the components, electronic, optical and metal materials for the construction of the visibilimeter.

3. Implement a particle detector within the university's meteorology laboratory that will later be implemented in a web access system.

4. Generate dissemination, interest and scientific curiosity in Ciudad Juárez Community.

5. Motivate other engineering firms in the field of applied physics and participate in it.

- SPS connection

  To strengthen the objectives of the SPS, this project will also consist of the creation of a free access web page for anyone who wants to interact and acquire the data provided by the particle detector (visibilimeter) at any time.

Background for Proposed Project

Currently in many environmental laboratories it is common to have a mini meteorological station to know the weather conditions, but not all of them have a detector of polluting particles.
It would be in 1914, in recognition of his exact determination of atomic weights of a large number of chemical elements. He was a leading experimental scientist and even invented the adiabatic calorimeter and nephelometer, just to improve his research.
Therefore, these devices have a utility in physics labs to undergraduate students because they can be useful to demonstrate
this fact and the physical principles that govern the visibilimeter.
If the point measurement is assumed to be the same as the spatially averaged extinction coefficient (e in m-1) between the point and the visibility limit, the meteorological visual range (L, in meters) can be estimated from the coefficient of average extinction with the Koschmeider equation in addition to Using Snell's laws and optical principles:

$$L_V = \frac{3.9}{s_e}$$

This would be the only measurement equation, due to the fact that the visibilimeter is analogous and has information in it to know the data.
In addition, the speed at which the light beam travels and the distance with which it will be sufficient to see these particles is defined by :

$$t = \frac{1m}{3x10^8 m/s}$$

this would be the time it would take for light to travel through our device.

Likewise, the spherical diopter is an equality that relates, under paraxial approximation, the distance to the origin of the object and that of the image with the refractive indices of the media

and the radius of curvature of the diopter according to, in the device we have a concave curvature , so that all the fired light is generated at a point and said focus point where the light waves can collide with the incoming air particles:

$$\frac{n'}{s'} \pm \frac{n}{s} = \frac{n' - n}{R}$$

Starting from Snell's law of refraction we can find the relationship between iˆ and rˆ_fr. If, in addition, we apply the paraxial approximation, we are left with:

$$n' sen(\tilde{\imath}) = n' sen(\hat{r}_{fr}) \Longrightarrow n'\hat{\imath} = n'\hat{r}_{fr}$$

Taking into account that, according to the DIN criterion, α is negative, and iˆ, rˆ_fr, β, γ are positive, we can write:

$$|\hat{\imath}| = |\alpha| + |\gamma| \Longrightarrow \hat{\imath} = -\alpha + \gamma$$

$$|\gamma| = |\hat{r}_{fr}| + |\beta| \Longrightarrow \gamma = \hat{r}_{fr} + \beta \Longrightarrow \hat{r}_{fr} = \gamma - \beta$$

After substituting this in Snell's law the following remains

$$n(\gamma - \alpha) = n`(\gamma - \beta) \Longrightarrow n`\beta - n'\alpha = (n' - n)\gamma$$

The rays that pass through the focus F, at a distance f from the vertex or origin O of the diptrium, exit parallel to the optical axis after refracting in it. In the first image we have a convex spherical diopter (R> 0) ⇒ f <0 (left side of the diopter). In the second image we have a concave spherical diopter (R <0) ⇒ f> 0 (right side of the diopter)

Expected Results

Once this project is executed, the following results are expected: It is expected that physical engineering students can interact and share knowledge with the scientific and university community.

A device capable of detecting the PM particles that will pass through it will be good for students, mainly with the physical and environmental ones. It is a result that we believe is very important to promote scientific culture in our city and university, that is why society values and promotes the development of physics and its applications. This type of project contributes to the development of physics because it motivates the future physicists.

From an academic point of view, this project will be a very useful didactic tool for the Optics Course, especially to understand Snell's laws.This is because any physics student can validate their theoretical knowledge with our experimental proposal, which we It will allow to validate the theoretical solutions with the experimental observations.

In addition to knowing more about fluid dynamics visually

Finally, as a result of the execution of this project, we hope that our scientific skills and that of the rest of our colleagues will improve, that we gain experience to be able to tackle the study of more challenging physics problems

Description of Proposed Research - Methods, Design, and Procedures

Review of the state of the art on the device

- Meetings will be held with fellow students on how to determine the design.
- Meetings will be held with fellow students on how to determine the specific design and installation
- Realization of theoretical calculation for experimental design.
- Buy all the necessary supplies.
- Build a prototype of the device. The above with the help of our infrastructure (workshops and laboratories).
- Device characterization and optimization, including physics parts and flow system
- Meet with advisors to receive comments and write and submit an interim report (May 1)
- Build the device, for the laboratory. Present and announce this project in our city.
- Check if the results match the expected findings, if not, solve the technical problems.
- Dissemination of the project.

Write and present the final report (December 1).

Plan for Carrying Out Proposed Project

• Personal. Three members of SPS will participate in the investigation of activities:
Jaquelin, Abigail and Julio are the ones who take responsibility for the project, designing and executing the project activities. In addition, in January-2021 two more Physics students and one environmental student
The engineering that supports electronics and instrumentation will be integrated.
The entire team will be under the supervision of Dr. Adrian Vazques.
Finally, it has the support of the staff in charge of laboratories and workshops of the UACJ.
• Experience. Abigail, Jaquelin and Julio have a necessary background
of courses such as General Physics, Classical Mechanics and Instrumentation that are
useful for achieving success in the proposed project.
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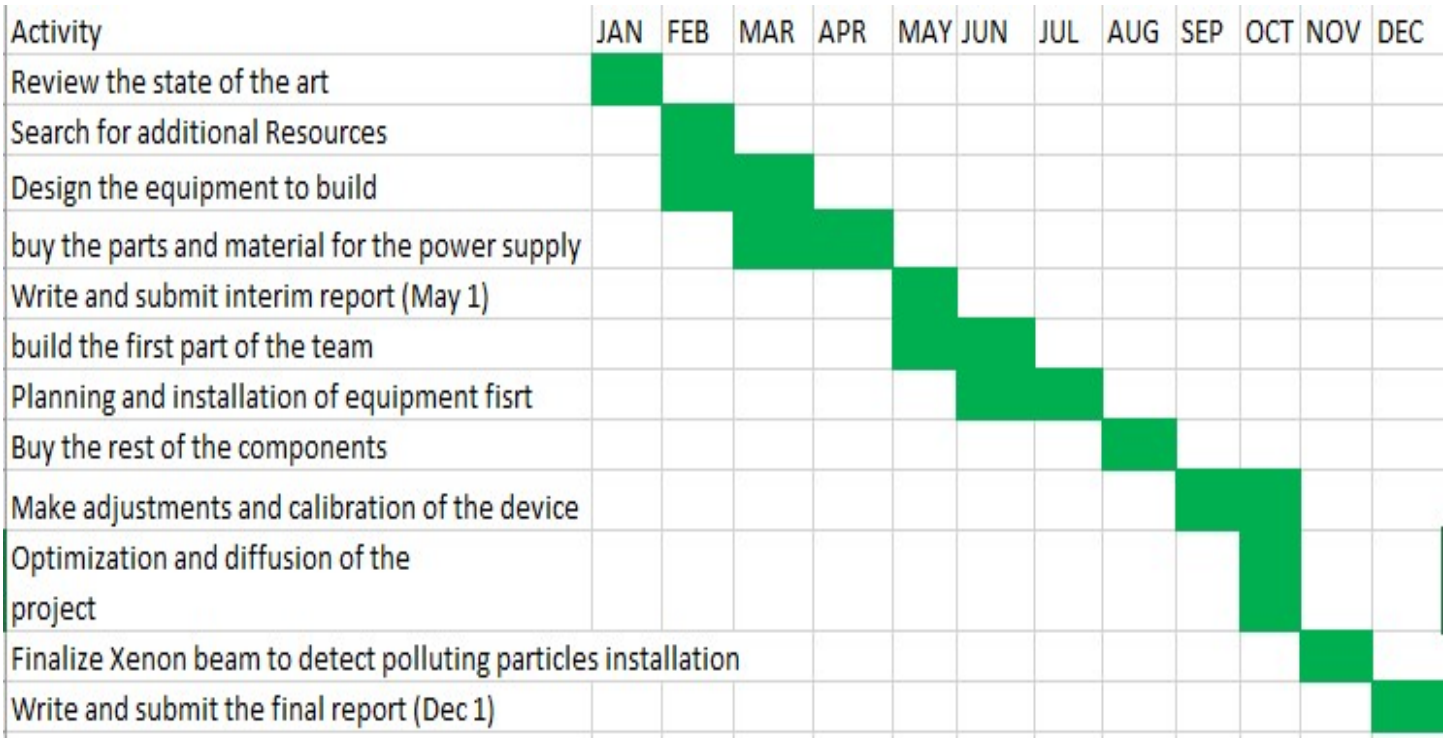
• Research space. The work of this research will be carried out in Physics
Laboratories of the UACJ and in their respective workshops. The final stage of this
The project will be carried out in the UACJ laboratory

Project Timeline



Budget Justification

Project funding is necessary for the acquisition of materials for the
construction of eddy pendulum, for example, we require sensor, xenon light camera, electronic components, etc.
At our university, we have well-equipped laboratories and workshops. In addition, we have the academic support of several professors from our faculty. Furthermore, we are
We are currently looking for more support so that our project can be in the museum of our city, but first we must count on your financial support.
We are sure that investing in our project will bring many benefits to our society, particularly to Ciudad Juárez, on the border with Texas. This project will allow us to have educational didactic tools for optics and fluid mechanics
Finally, we can develop skills that are necessary in a xxi century scientist. We appreciate your support

Bibliography

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