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IPN develops sensors to explore nanoparticles in the atmosphere

- **With a mechanism that works by structuring laser light, it is possible to warn about the convenience of physical activity outdoors.**
- **Sensors could be placed in doctors' offices and hospitals to measure air quality and the concentration of pathogens**

Researchers at the Instituto Politécnico Nacional (IPN) have developed a mechanism that uses laser beams to study movement and determine the presence, absence, and concentration of organic particles in the atmosphere, including viruses, bacteria, and pollutants, which affect human health.

The research project, led by Dr. Carlos Torres Torres, is being conducted at the Escuela Superior de Ingeniería Mecánica y Eléctrica (Esime), Zacatenco Unit, with a focus on generating new technology that contributes to the well-being of the population at an affordable cost.

"One ultimate goal is to use the device created at IPN to monitor the atmosphere we breathe and make decisions based on that. The sensors can be placed in medical offices and healthcare centers to measure air quality and calculate the concentration of pathogens. Additionally, they allow for the identification of the expression of a molecule within a vaccine."

The doctor in Optical Sciences emphasized that biosensors have multiple applications. For example, they could be incorporated into smartwatches to provide alerts based on the concentration of pollutants, indicating whether it is advisable or not to engage in outdoor physical activity and the most suitable time for exercise.

The member of the National System of Researchers (SNI) Level II emphasized that studying changes in atmospheric dynamics allows us to understand the evolution of contaminants and pathogens present in the air we breathe.

"Pathogenic agents or contaminants are composed of nanoscale particles, whose displacement dynamics involve rotations similar to celestial bodies, so when they fall, they form a spiral-like geometric figure. Their movement is regulated by temperature

and the propagation of heat. They descend towards a cold location, just as we fall towards the force of gravity."

Based on this premise, supported by his team, the expert in experimental physics developed a prototype based on a highly sensitive model that took the theory of chaos as its basis. This is because the trajectory, precipitation, and movement of the particles under study are nonlinear and unstable.

It operates according to environmental conditions and features a photodiode that is sensitive to the incidence of pulsed light, which turns on and off based on the number of particles present in the atmosphere. "The samples are inspected using a signal emitted by a laser beam that turns on and off intermittently according to the programming of chaotic attractors (Lorenz equations). This provides a unique sensitivity in each measurement," explained the researcher.

"It's a cycle of information. When particles appear or disappear, the system is activated, and the information is sent from the photodiode to the computer, where we interpret the results. Depending on the pattern that is formed, we can determine the presence or absence of particles," added the node coordinator at Esime of the Nanoscience Network of the IPN.

The researcher, who is also an invited editor for the international journal Biosensors, pointed out that by adapting plasmonic nanoparticles to the system, it is possible to generate a signal to identify whether a virus is active or inactive. "The goal is to transform basic knowledge into applied science and make technological contributions based on that," he concluded.

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