

Audience: students in International Baccalaureate Physics (Grade 11-12)

Instructional Goals:

1. Students will become familiar with the research done at NSCL, specifically using MoNA.
2. Students will process and analyze data taken in the calibration of the MoNA bar to determine relationships between the measured quantities and the position of the radioactive sample.
3. Students will use their processed data to predict the locations of the mystery samples and provide justification for their predictions.

This lesson meets the following aims of IB sciences (as given in the IB Physics guide):

1. provide opportunities for scientific study and creativity within a global context that will stimulate and challenge students
4. develop an ability to analyze, evaluate and synthesize scientific information
9. develop an appreciation of the possibilities and limitations associated with science and scientists
10. encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.

This lesson will also address the following assessment statements within the curriculum:

- 1.2.10 State uncertainties as absolute, fractional and percentage uncertainties.
- 1.2.11 Determine the uncertainties in results.
- 1.2.14 Determine the uncertainties in the gradient and intercepts of a straight line graph.
- 7.2.1 Describe the phenomenon of natural radioactive decay.
- 7.2.5 Explain why some nuclei are stable while others are unstable.

Part 1 – background information

In this part of the lesson, a PowerPoint presentation will be used to introduce the students to the experiment that produced the data they will be analyzing. This will include:

- A description of NSCL and its research in general.
- A description of the MoNA collaboration and equipment
- A description of cosmic rays and how MoNA detects them.
- The process we went through collecting data with the oscilloscopes.

Part 2 – data analysis

Students will be presented with the data collected by the Nucleons during PAN. The significances of the recorded quantities will be explained. Students will also be given the data from the two mystery source locations. They will be challenged to analyze the data and come up with a prediction as to where these sources were located. Predictions will need to be justified using:

- Calculations of standard deviations
- Graphs of data showing trends, with error bars included.
- Any calculations done with the mystery data and trends that led to their prediction.

Part 3 – conclusions

Along with their predictions, students will be asked to submit a conclusion, including the following points:

- An assessment of their level of confidence in their predictions – possibly given as a range.
- An analysis of the quality of the data.