PhET Tips for Teachers

Rutherford Scattering

Rutherford Atom Screen

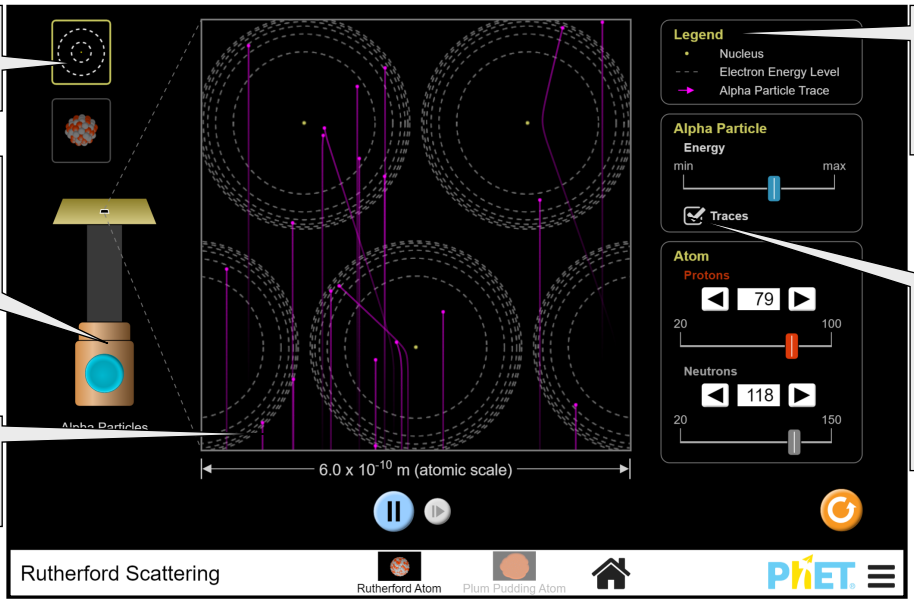
Atom view

Observe the behavior of alpha particles as they travel through a thin layer of atoms.

SELECT atomic or nuclear view.

TURN ON the alpha particle source.

VIEW alpha particle behavior.



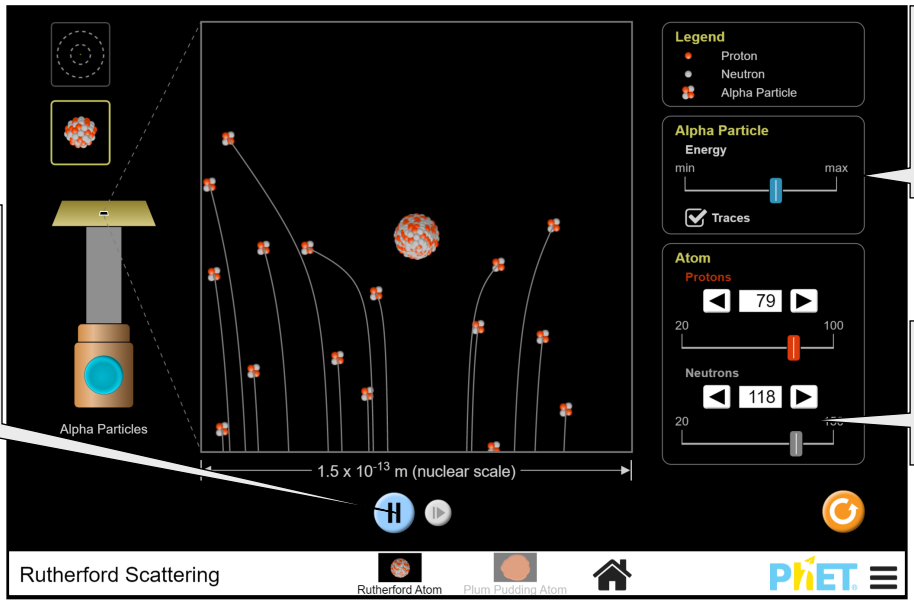
IDENTIFY key components of the model.

TURN ON traces to see alpha particle trajectories.

Nucleus view

Explore what causes an alpha particle to be deflected when it approaches the nucleus of an atom.

PAUSE the sim or use the step forward function to analyze alpha particle behavior.



INCREASE or decrease the energy of the alpha particles.

CHANGE the composition of the nucleus.

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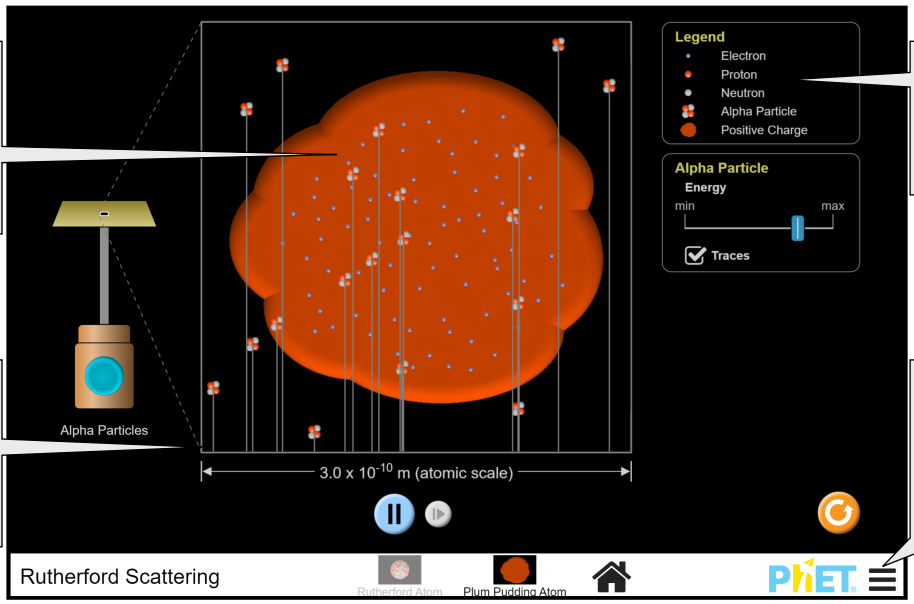
Plum Pudding Screen

Explore the expected behavior of alpha particles based on the Plum Pudding model of an atom, which suggested that an atom was composed of substance with a diffuse positive charge embedded with negatively charged electrons.

VIEW alpha particle behavior predicted by Rutherford.

COMPARE the scale of the views shown in each screen.



IDENTIFY parts of the Plum Pudding model.

CHANGE the background color of the sim for projection.

Model Simplifications

- The default number of protons and neutrons is set to match the most common isotope of gold.
- On the Rutherford Atom screen, the nucleus view shows only a small fraction of the area of the atom. The number of alpha particle deflections is greater than what is observed experimentally.
- The atom view on the Rutherford Atom screen is designed to help students see that most alpha particles pass through the thin layer of atoms without being deflected. However, the number of alpha particles that deflect in the simulation is greater than what is observed experimentally.
- On the Plum Pudding screen, the diffuse positive charge is shown as an amorphous red blob. The red color was used to indicate the positive charge. Electrons are distributed evenly throughout the atom, causing most parts of the atom to have no charge. Therefore, no alpha particle deflection is observed. For computational simplicity, we chose not to show deflections due to the small inhomogeneity of charge distribution.
- Alpha particles are modeled as two protons and two neutrons on both the Rutherford Atom and Plum Pudding screens for consistency, despite the fact that protons and neutrons are not part of the Plum Pudding model of the atom.

Suggestions for Use

Sample Challenge Prompts

- Identify factors that change the deflection of alpha particles. Explain why these factors impact alpha particle deflection.
- Describe the behavior of alpha particles in the Plum Pudding atom screen. Why would you expect to see alpha particles behave this way?

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- Describe two important outcomes of Rutherford's experiment and explain how this data was used to develop a new atomic model.
- Calculate the ratio of deflection angles for alpha particles that approach at different angles and check that it matches the Rutherford scattering formula.

Customization Options

Query parameters allow for customization of the simulation, and can be added by appending a '`?`' to the sim URL, and separating each query parameter with a '`&`'. The general URL pattern is:
`…html?queryParameter1&queryParameter2&queryParameter3`

For example, in Rutherford Scattering, if you want to change the screen order (`screens=2,1`), with the 2nd screen open by default (`initialScreen=2`) use:
https://phet.colorado.edu/sims/html/rutherford-scattering/latest/rutherford-scattering_all.html?screens=2,1&initialScreen=2

To run this in Spanish (`locale=es`), the URL would become:
https://phet.colorado.edu/sims/html/rutherford-scattering/latest/rutherford-scattering_all.html?locale=es&screens=2,1&initialScreen=2

Query Parameter and Description	Example Links

`screens` - specifies which screens are included in the sim and their order. Each screen should be separated by a comma. For more information, visit the Help Center.	`screens=1`
	
	`screens=2,1`

`initialScreen` - opens the sim directly to the specified screen, bypassing the home screen.	`initialScreen=1` `initialScreen=2`
`locale` - specify the language of the simulation using ISO 639-1 codes. Available locales can be found on the simulation page on the Translations tab. Note: this only works if the simulation URL ends in "_all.html".	`locale=es` (Spanish) `locale=fr` (French)
`colorProfile` - changes simulation colors for easier projection.	`colorProfile=projector`
`allowLinks` - when `false`, disables links that take students to an external URL. Default is `true`.	`allowLinks=false`

See all published activities for Rutherford Scattering here.
For more tips on using PhET sims with your students, see Tips for Using PhET.