Identical Particles Encyclopedia Article

Identical Particles

The following sections of this BookRags Literature Study Guide is offprint from Gale's For Students Series: Presenting Analysis, Context, and Criticism on Commonly Studied Works: Introduction, Author Biography, Plot Summary, Characters, Themes, Style, Historical Context, Critical Overview, Criticism and Critical Essays, Media Adaptations, Topics for Further Study, Compare & Contrast, What Do I Read Next?, For Further Study, and Sources.

(c)1998-2002; (c)2002 by Gale. Gale is an imprint of The Gale Group, Inc., a division of Thomson Learning, Inc. Gale and Design and Thomson Learning are trademarks used herein under license.

The following sections, if they exist, are offprint from Beacham's Encyclopedia of Popular Fiction: "Social Concerns", "Thematic Overview", "Techniques", "Literary Precedents", "Key Questions", "Related Titles", "Adaptations", "Related Web Sites". (c)1994-2005, by Walton Beacham.

The following sections, if they exist, are offprint from Beacham's Guide to Literature for Young Adults: "About the Author", "Overview", "Setting", "Literary Qualities", "Social Sensitivity", "Topics for Discussion", "Ideas for Reports and Papers". (c)1994-2005, by Walton Beacham.

All other sections in this Literature Study Guide are owned and copyrighted by BookRags, Inc.

Contents

Identical Particles Encyclopedia Article.....1

Contents.....2

Identical Particles.....3

Identical Particles

The concept of identical particles becomes important in the study of quantum **mechanics**. In a classical description from atomic physics--for instance, the one proposed by Ernest Rutherford--an **atom** resembles a miniature solar system. Protons and neutrons cluster together in the center like suns; electrons orbit around them like **planets**. In classical mechanics, each of the **subatomic particles** occupies a certain place in **space** and time, and (theoretically, at least) those places can be exactly defined. In **quantum mechanics**, however, the position of a given particle in space and time cannot be known exactly; it can only be predicted through probability. Under quantum mechanics, all particles of a given type become identical when they have the same probability of being in any particular space at any given time.

Quantum physicists divide all known particles into two basic types: **fermions**, which include all known particles of matter--quarks and leptons--and bosons, which include everything else: photons, gravitons, gluons, and others. There are some cases where collections of fermions can act like bosons because of their combined spin; the helium-4 **isotope** is an example. With respect to identical particles, bosons and fermions differ in a very important respect. According to the **Pauli exclusion principle**, no two fermions can occupy the same quantum state at the same time. According to Bose-Einstein statistics, however, any number of bosons can exist simultaneously in the same state. Under the system of investigation called wave mechanics, particles such as electrons behave in ways that can be predicted by a wave, a fermion must occupy a single point on the wave, but bosons can exist in quantity all along the wave form.

The theory of identical particles has had a great impact, not only on the study of **atomic structure**, but also in practical applications. The predicted behavior of fermions such as electrons has given rise to **electron** microscopy, new types of **lasers**, and solid-state **computers**.