

# The Mind-Blowing Truth Behind the Non Relativistic Qed Theory Of The Van Der Waals Dispersion Interaction

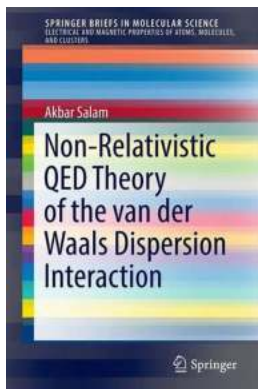
In the realm of quantum physics, there exists a fascinating phenomenon called the Van Der Waals dispersion interaction. This mind-boggling interaction lies at the heart of molecular and atomic interactions, shaping the world around us. Today, we delve into the deep secrets of the non-relativistic Qed theory behind this mesmerizing force.

## What is the Van Der Waals Dispersion Interaction?

Before understanding the theoretical framework behind it, let's first grasp the nature of the Van Der Waals dispersion interaction. At their core, these interactions are weak attractive forces between electrically neutral atoms or molecules. Despite their weakness when compared to other forces, such as covalent or ionic bonds, they play a significant role in various phenomena.

The Van Der Waals dispersion forces arise due to temporary fluctuations in electron distribution, creating electric dipoles in neighboring atoms or molecules. These temporary dipoles induce corresponding dipoles in the nearby entities, leading to an attractive force between them. In simple terms, when two particles are brought closer, their electron clouds interact, resulting in an attractive force.

**Non-Relativistic QED Theory of the van der Waals Dispersion Interaction (SpringerBriefs in**



## Molecular Science)

by Akbar Salam (1st ed. 2016 Edition, Kindle Edition)

★★★★★ 5 out of 5

Language : English

File size : 5717 KB

Text-to-Speech : Enabled

Screen Reader : Supported

Enhanced typesetting : Enabled

Print length : 177 pages



### Understanding Non-Relativistic Qed Theory

Now, let's take a closer look at the non-relativistic Qed theory that provides a mathematical framework to describe the Van Der Waals dispersion interaction. Qed, or quantum electrodynamics theory, is a fundamental theory in physics that provides a detailed understanding of electromagnetic phenomena.

However, to explain the Van Der Waals dispersion interaction, we consider the non-relativistic version of Qed theory. Non-relativistic Qed theory allows for simpler calculations and is applicable when the speeds involved are much smaller than the speed of light.

At its core, non-relativistic Qed theory describes the interaction between charged particles through exchange of virtual photons. In the context of Van Der Waals dispersion forces, these virtual photons mediate the interaction between the fluctuating electron clouds of individual atoms or molecules.

### Role of Virtual Photons in Van Der Waals Forces

According to non-relativistic Qed theory, the fluctuating electron cloud of an atom or molecule can emit virtual photons. These photons can be momentarily

absorbed by a neighboring entity, inducing a dipole moment in it. This process creates an attractive force between the two entities, resulting in the Van Der Waals dispersion interaction.

It is vital to note that these virtual photons, unlike real photons, do not possess a specific energy or momentum. Instead, they exist for extremely short durations, accounting for the fleeting nature of Van Der Waals forces.

## **Limitations and Applications**

While the non-relativistic Qed theory provides valuable insights into the Van Der Waals dispersion interaction, it does have certain limitations. Primarily, it assumes that the interacting entities are far apart, neglecting any short-range repulsive forces that may come into play when they get too close.

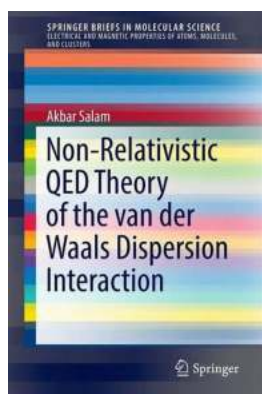
Nevertheless, the Van Der Waals dispersion interaction plays a crucial role in various phenomena, including the behavior of gases, the cohesion of liquids, and the stability of molecular crystals. Understanding and manipulating Van Der Waals forces is fundamental in fields like material science, chemistry, and biology, influencing drug development, surface interactions, and more.

## **In**

The non-relativistic Qed theory of the Van Der Waals dispersion interaction uncovers the underlying mechanics of this captivating force. Through the exchange of virtual photons, fluctuating electron clouds interact and induce attractive forces, shaping the intricate world of atoms and molecules.

As we deepen our understanding of the non-relativistic Qed theory, we open doors to new possibilities in various scientific disciplines. From designing advanced materials to manipulating surface interactions, the Van Der Waals

dispersion interaction leaves an indelible mark on our technological advancements.



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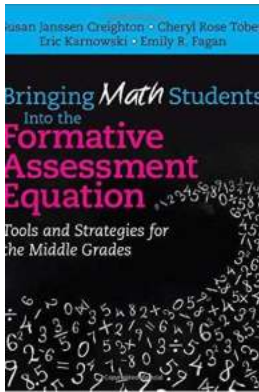


This book provides details of the calculation of the interaction between two neutral polarizable atoms or molecules using molecular quantum electrodynamics (QED). To better understand the origin of this force, it briefly outlines molecular QED theory, the well-known van der Waals dispersion potential first evaluated by Casimir and Polder, who accounted for retardation effects. It presents different calculation schemes for the evaluation of the dispersion potential and also discusses energy shifts involving electric quadrupole and octupole moments, along with discriminatory dispersion potentials. Further, it explores in detail non-additive dispersion interaction energies between three-bodies, as well as the effects of higher multipole moment correction terms, and provides results for specific geometries such as collinear and equilateral triangles. Lastly, it computes near and far-zone asymptotic limits for both pair and many-body potentials, with the former shown to agree with less rigorous semi-classical calculations.



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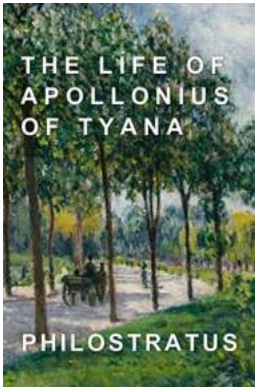
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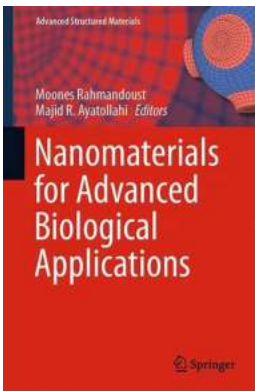
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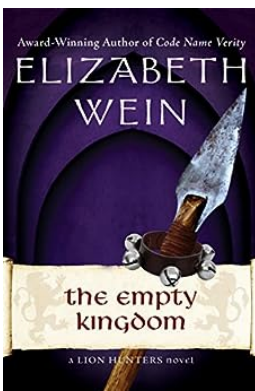
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