

# From Abelian And Non Abelian Quantum Hall States To Exact Models Of Critical

The study of Quantum Hall states has revolutionized our understanding of condensed matter physics. Originally discovered in two-dimensional electron gas systems subjected to a strong magnetic field, Quantum Hall states are unique phenomena that exhibit fractional quantum numbers, robust topological properties, and fascinating edge states. These states have opened up new avenues for exploring emergent phenomena and have paved the way for the exploration of exotic states of matter.

## Abelian Quantum Hall States

Abelian Quantum Hall states, also known as Laughlin states, were the first class of Quantum Hall states to be discovered. They are characterized by their fractionalized charges, which are anyonic in nature. These states arise due to strong electron-electron interactions in a two-dimensional system and are described by effective fractional statistics. The fractional charge of these states is given by the famous formula discovered by Robert B. Laughlin -  $e/m^*$ , where  $e$  is the elementary charge and  $m$  is an odd integer.

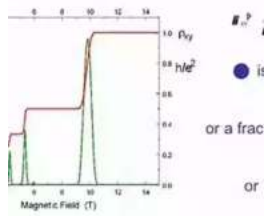
The fractional statistics of these states leads to phenomena such as the fractional quantum Hall effect, where the Hall conductance exhibits quantized plateaus at fractional multiples of the elementary conductance quantum. This effect has been experimentally observed in various systems, providing strong evidence for the existence of fractionalized excitations in these states.

**Mapping of Parent Hamiltonians: From Abelian and non-Abelian Quantum Hall States to Exact**

### Hall effect

Longitudinal resistivity - no dissipation, bulk mostly along the edges of the sample

Hall resistivity



## Models of Critical Spin Chains (Springer Tracts in Modern Physics Book 244)

by Martin Greiter (2011th Edition, Kindle Edition)

★★★★☆ 4.4 out of 5

Language : English

File size : 58028 KB

Text-to-Speech : Enabled

Enhanced typesetting : Enabled

Print length : 390 pages

Screen Reader : Supported

Paperback : 24 pages

Item Weight : 4 ounces

Dimensions : 8.27 x 0.06 x 11.69 inches



### Non-Abelian Quantum Hall States and Their Significance

Non-Abelian Quantum Hall states are an extension of the Abelian Quantum Hall states and represent even more exotic phases of matter. These states are characterized by non-Abelian anyons, which possess non-trivial braiding statistics. These anyons have the remarkable property that their fusion rules are topologically protected, giving rise to the potential for fault-tolerant quantum computation.

The discovery of non-Abelian states has had a profound impact on the field of topological quantum computation. These states provide a promising avenue for building fault-tolerant quantum computers as they are highly resistant to errors caused by decoherence. The braiding of anyons in these states can be used as a universal set of quantum gates, making them ideal building blocks for quantum computation.

## **Exact Models of Criticality and Their Connection to Quantum Hall States**

Exact models of criticality have also emerged as an important area of research in condensed matter physics. These models describe critical points in phase transitions, where the system undergoes a dramatic change in its properties. The discovery of the connection between Quantum Hall states and exact models of criticality has opened up new ways of understanding the behavior of strongly correlated systems and has provided insights into the nature of emergent phenomena.

By mapping Quantum Hall states to exact models of criticality, researchers have gained a deeper understanding of the underlying physics behind these states. This mapping allows for the calculation of various critical exponents and scaling dimensions, shedding light on the universality of these states. It also provides a bridge between the fields of quantum Hall physics and conformal field theory, further enhancing our theoretical toolbox for studying these systems.

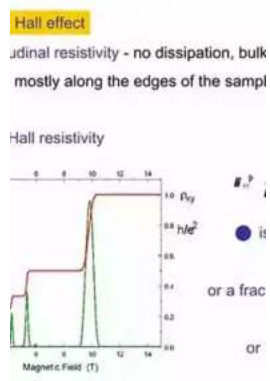
## **The Future of Quantum Hall Physics**

The study of Quantum Hall states has only scratched the surface of the fascinating phenomena that can arise in condensed matter systems. Researchers are currently exploring new directions and investigating exotic states that exhibit even more intriguing properties. These include states with non-Abelian anyons that possess non-Abelian statistics, topologically protected quantum states, and even potential applications in quantum computing.

As our understanding of Quantum Hall states continues to deepen, it is likely that we will make further breakthroughs in our understanding of emergent phenomena and condensed matter physics. The field holds great promise for the development of new materials with unique properties and the exploration of novel quantum

states that may revolutionize technology. The possibilities are endless, and the journey to unravel the mysteries of Quantum Hall physics is just beginning.

Keywords: Abelian Quantum Hall States, Non-Abelian Quantum Hall States, Fractional Quantum Hall Effect, Anyons, Topological Quantum Computation, Exact Models of Criticality, Emergent Phenomena, Conformal Field Theory, Quantum Computing, Condensed Matter Physics



## Mapping of Parent Hamiltonians: From Abelian and non-Abelian Quantum Hall States to Exact Models of Critical Spin Chains (Springer Tracts in Modern Physics Book 244)

by Martin Greiter (2011th Edition, Kindle Edition)

★★★★☆ 4.4 out of 5

- Language : English
- File size : 58028 KB
- Text-to-Speech : Enabled
- Enhanced typesetting : Enabled
- Print length : 390 pages
- Screen Reader : Supported
- Paperback : 24 pages
- Item Weight : 4 ounces
- Dimensions : 8.27 x 0.06 x 11.69 inches



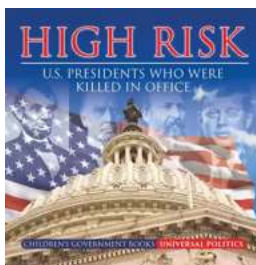
This monograph introduces an exact model for a critical spin chain with arbitrary spin  $S$ , which includes the Haldane--Shastry model as the special case  $S=1/2$ . While spinons in the Haldane-Shastry model obey abelian half-fermi statistics, the spinons in the general model introduced here obey non-abelian statistics. This manifests itself through topological choices for the fractional momentum spacings. The general model is derived by mapping exact models of quantized

Hall states onto spin chains. The book begins with pedagogical review of all the relevant models including the non-abelian statistics in the Pfaffian Hall state, and is understandable to every student with a graduate course in quantum mechanics.



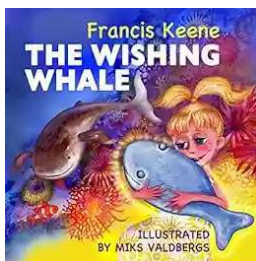
## **Kathy Santo Dog Sense Kathy Santo - Unlocking the secrets of dog behavior**

Are you a dog lover who wants to better understand your furry friend's behavior? Look no further! Kathy Santo, a highly respected dog trainer and...



## **10 Presidents Who Were Killed In Office - Shocking Truth Revealed!**

Throughout history, the role of a president has been filled with power, ambition, and danger. While they carry the weight of the nation on their shoulders, presidents also...



## **Unveiling a World of Magic: Beautifully Illustrated Bedtime Stories for Beginner Readers with Fantasy Animals and Rhyming**

Bedtime stories have always held a sense of wonder and magic for young children. They transport them to far-off lands, introducing them to captivating...



## The Blind Parables: An Anthology Of Poems

For centuries, poetry has been a medium for expressing emotions, thoughts, and experiences. It transcends the boundaries of language and connects with people...



## Rival Conceptions Of Freedom In Modern Iran

The Struggle for Freedom in Iran Iran, a country with a rich history and culture, has experienced various political, social, and cultural changes...



## Advances In Their Chemistry And Biological Aspects

In recent years, significant advances have been made in understanding the chemistry and biological aspects of a certain species. Scientists and...



## Getting Into Mini Reefs For The Marine Aquarium

Are you interested in enhancing the beauty of your marine aquarium with mesmerizing minireefs? Mini reefs are a fantastic addition to any aquarium setup, offering a...



## Exploring the Intriguing Connection Between History, Religion, and the Chinese Martial Arts

When one thinks of Chinese martial arts, popular images of intense training, powerful strikes, and legendary fighters often come to mind. However, beneath the...