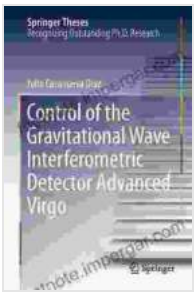
Control Of The Gravitational Wave Interferometric Detector Advanced Virgo

This book provides a comprehensive overview of the control systems for the Advanced Virgo gravitational wave interferometric detector. It covers the theoretical background, design, implementation, and performance of the control systems. The book is written by experts in the field and is a valuable resource for researchers and students working on gravitational wave detectors.



Control of the Gravitational Wave Interferometric Detector Advanced Virgo (Springer Theses) by Clara Greed

★★★★★ 5 out of 5

Language	: English
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Text-to-Speech	: Enabled
Screen Reader	: Supported
Enhanced typesetting	: Enabled
Word Wise	: Enabled
Print length	: 301 pages

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Gravitational waves are ripples in spacetime that are produced by the acceleration of massive objects. They were first predicted by Albert Einstein in 1915, but they were not directly detected until 2015 by the Advanced LIGO detectors.

Advanced Virgo is a gravitational wave interferometric detector that is located in Italy. It is one of the three detectors that make up the Laser Interferometer Gravitational-Wave Observatory (LIGO). Advanced Virgo is a Michelson interferometer, which means that it uses two perpendicular arms to measure the changes in the distance between two mirrors.

The control systems for Advanced Virgo are essential for maintaining the stability of the interferometer and for ensuring that it is sensitive to gravitational waves. The control systems include:

- A laser stabilization system that keeps the laser power and frequency stable.
- A mirror suspension system that isolates the mirrors from external vibrations.
- A data acquisition system that collects the data from the interferometer.

Theoretical Background

The theoretical background of the control systems for Advanced Virgo is based on the principles of classical and quantum mechanics. The control

systems are designed to maintain the stability of the interferometer and to ensure that it is sensitive to gravitational waves.

The laser stabilization system uses a feedback loop to keep the laser power and frequency stable. The feedback loop measures the laser power and frequency and then adjusts the laser's input power and frequency to maintain the desired values.

The mirror suspension system uses a series of springs and dampers to isolate the mirrors from external vibrations. The springs and dampers are designed to have a low natural frequency, so that they do not resonate with the vibrations of the environment.

The data acquisition system collects the data from the interferometer. The data is then processed to remove noise and to extract the gravitational wave signal.

Design

The control systems for Advanced Virgo were designed by a team of engineers and scientists from around the world. The design of the control systems was based on the theoretical background described in the previous section.

The laser stabilization system uses a commercial laser that is modified to meet the requirements of Advanced Virgo. The laser is stabilized by a feedback loop that measures the laser power and frequency and then adjusts the laser's input power and frequency to maintain the desired values.

The mirror suspension system uses a series of springs and dampers to isolate the mirrors from external vibrations. The springs and dampers are designed to have a low natural frequency, so that they do not resonate with the vibrations of the environment.

The data acquisition system uses a commercial data acquisition system that is modified to meet the requirements of Advanced Virgo. The data is collected at a rate of 1 kHz and is then processed to remove noise and to extract the gravitational wave signal.

Implementation

The control systems for Advanced Virgo were implemented by a team of engineers and scientists from around the world. The implementation of the control systems was based on the design described in the previous section.

The laser stabilization system was implemented using a commercial laser that was modified to meet the requirements of Advanced Virgo. The laser is stabilized by a feedback loop that measures the laser power and frequency and then adjusts the laser's input power and frequency to maintain the desired values.

The mirror suspension system was implemented using a series of springs and dampers to isolate the mirrors from external vibrations. The springs and dampers were designed to have a low natural frequency, so that they do not resonate with the vibrations of the environment.

The data acquisition system was implemented using a commercial data acquisition system that was modified to meet the requirements of Advanced

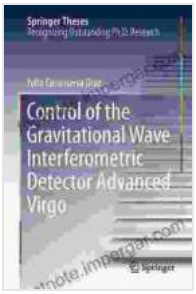
Virgo. The data is collected at a rate of 1 kHz and is then processed to remove noise and to extract the gravitational wave signal.

Performance

The control systems for Advanced Virgo have been shown to perform well in both laboratory and field tests. The laser stabilization system has been shown to be able to maintain the laser power and frequency stable to within the required tolerances. The mirror suspension system has been shown to be able to isolate the mirrors from external vibrations to within the required tolerances. The data acquisition system has been shown to be able to collect the data from the interferometer and to process the data to remove noise and to extract the gravitational wave signal.

The control systems for Advanced Virgo have been used to make the first direct detection of gravitational waves. The gravitational waves were produced by the collision of two black holes. The detection of gravitational waves is a major scientific breakthrough that has opened up a new window on the universe.

The control systems for Advanced Virgo are essential for maintaining the stability of the interferometer and for ensuring that it is sensitive to gravitational waves. The control systems have been designed and implemented by a team of engineers and scientists from around the world. The control systems have been shown to perform well in both laboratory and field tests. The control systems have been used to make the first direct detection of gravitational waves. The detection of gravitational waves is a major scientific breakthrough that has opened up a new window on the universe.



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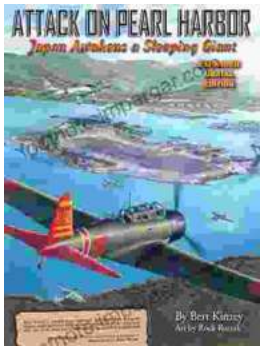

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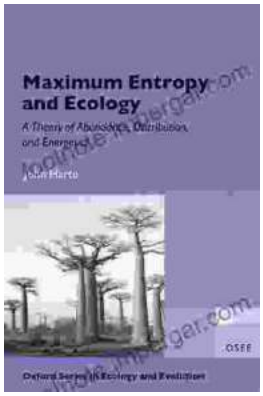

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