Universidade de São Paulo
Instituto de Física de São Carlos

XII Semana Integrada do Instituto de Física de São Carlos

Livro de Resumos

São Carlos
2022

Semana Integrada do Instituto de Física de São Carlos

SIFSC 12

Coordenadores

Prof. Dr. Osvaldo Novais de Oliveira Junior
Diretor do Instituto de Física de São Carlos – Universidade de São Paulo

Prof. Dr. Javier Alcides Ellena
Presidente da Comissão de Pós Graduação do Instituto de Física de São Carlos – Universidade de São Paulo

Profa. Dra. Tereza Cristina da Rocha Mendes
Presidente da Comissão de Graduação do Instituto de Física de São Carlos – Universidade de São Paulo

Comissão Organizadora

Adonai Hilario
Arthur Deponte Zutião
Elisa Goettems
Gabriel dos Santos Araujo Pinto
Henrique Castro Rodrigues
Jefter Santiago Mares
João Victor Pimenta
Julia Martins Simão
Letícia Martinelli
Lorany Vitoria dos Santos Barbosa
Lucas Rafael Oliveira Santos Eugênio
Natasha Mezzacappo
Paulina Ferreira
Vinícius Pereira Pinto
Willian dos Santos Ribela

Normalização e revisão – SBI/IFSC

Ana Mara Marques da Cunha Prado
Maria Cristina Cavarette Dziabas
Maria Neusa de Aguiar Azevedo
Sabrina di Salvo Mastrantonio

Ficha catalográfica elaborada pelo Serviço de Informação do IFSC

Semana Integrada do Instituto de Física de São Carlos
(12: 10 out. - 14 out. : 2022: São Carlos, SP.)
Livro de resumos da XII Semana Integrada do Instituto de Física de São Carlos/ Organizado por Adonai Hilario [et al.]. São Carlos: IFSC, 2022.
446 p.
Texto em português.
1. Física. I. Hilario, Adonai, org. II. Titulo

ISBN: 978-65-993449-5-4 CDD: 530

PG101

On the nature of the black hole information problem

BERGAMASCHI, Thiago; BERNARDES, Esmerindo de Souza

tbergamaschi@ifsc.usp.br

One of the most interesting predictions of general relativity is that a complete gravitational collapse leads to regions where not even light can escape. Although it is still unclear what theory would be adequate to describe the interior of this region, known as a black hole, one can use the framework of general relativity to study the dynamics of bodies in its surroundings, as well as a description of geometrical quantities measured by outside observers. This description is known as the laws of black hole mechanics, which are derived based on the geometrical properties of spacetime and Einstein's equation, and appeared to have a striking similarity with the laws of thermodynamics. Through semiclassical arguments, a deeper physical connection can be made, as the geometrical quantities related in the laws of black hole mechanics can be directly associated with those appearing in the laws of thermodynamics. (1) These developments, achieved by considerations from general relativity, thermodynamics, and quantum field theory, give rise to a problem concerning the preservation of information. (2) This problem appears as one considers particle creation effects at the horizon of a black hole, which results in the emission of radiation with perfect thermal spectrum. If this evaporation process is carried out, outside observers would only have access to the mass, angular momentum and charge of the black hole, as stated by the "no-hair"theorem. Therefore, information about the initial state of the black hole would be lost. The information problem is a question of whether information is truly lost, or if there is a more adequate theory to describe the process of black hole evaporation. We aim to analyse the assumptions that led to the information problem, while searching for connections with open questions regarding the dynamical origin of the entropy of a black hole and a quantum theory of gravity. As a first step, we study the mathematical framework and physical concepts required to depict black holes. Eventually, we will analyse the effects predicted by quantum field theory in curved spacetime, and study the connection with thermodynamics in order to reformulate the problem.

Palavras-chave: General relativity. Black hole thermodynamics. Information problem.

Agência de fomento: CAPES (88887.670913/2022-00)

Referências:

1 WALD, R. M. The thermodynamics of black holes. **Living Reviews in Relativity**, v. 4, n. 1, p. 6-1-6-44, Dec. 2001.

2 UNRUH, W. G.; WALD, R. M. Information loss. **Reports on Progress in Physics**, v. 80, n. 9, p. 092002-1-092002-8, Sept. 2017.