



University
of Victoria

Graduate Studies

PROGRAMME

The Final Oral Examination
for the Degree of

DOCTOR OF PHILOSOPHY
(Department of Physics and Astronomy)

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2008 University of Victoria
2003 Nankai University

MSc
BSc

“Force-free magnetospheres, Kerr-AdS
black holes and holography”

Friday, December 5, 2014
10:00 AM

David Turpin Building, room A144

Supervisory Committee:

Dr. Adam Ritz, Department of Physics and Astronomy, UVic
(Supervisor)

Dr. Werner Israel, Department of Physics and Astronomy, UVic
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Dr. Maxim Pospelov, Department of Physics and Astronomy, UVic
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Dr. James Dopp, Department of English, UVic

Abstract

In this thesis, we study the energy extraction from rotating black holes in anti-de Sitter (AdS) spacetime (Kerr-AdS black holes), via the Blandford-Znajek (BZ) process. The motivation is the anti-de Sitter/conformal field theory (AdS/CFT) correspondence which provides a duality between gravitational physics in asymptotically AdS spacetimes and lower dimensional boundary field theories. The BZ process operates via a force-free magnetosphere around black holes and the rotational energy of the black hole is extracted electromagnetically in the form of Poynting flux. The major part of the thesis is devoted to obtaining force-free solutions in the Kerr-AdS background, which generalize traditional BZ solutions in the asymptotically flat Kerr background. Given the solutions, we use the AdS/CFT to infer dual descriptions in terms of the boundary field theory, which hopefully will lead to a better understanding of the energy extraction for rotating black holes.

Presentations

1. Wang, X. "*Kerr-AdS black holes and force-free magnetospheres*" 15th Canadian Conference on General Relativity and Relativistic Astrophysics, Winnipeg, Manitoba, Canada. May 2014. (Oral)
2. Wang, X. "*Energy extraction from rotating black holes*" Seminar at Nankai University, Tianjin, China. Jun. 2012. (Oral)
3. Wang, X. "*Black hole firewalls*"; "*Thermal field theory regarding real-time correlators and AdS/CFT*" theory group journal club at University of Victoria, Victoria, British Columbia, Canada. Nov. 2013 & Apr. 2014. (Oral)

Publications

1. Ritz, A.; Wang, X.; "Kerr-AdS Black Holes and Force-Free Magnetospheres," *Phys.Rev.* **D89** **2014**, 106011; arXiv:1402.1452 [hep-th].
2. Wang, X.; "New analytic solutions to the force-free equations (in Kerr-AdS and NHEK backgrounds)," (to appear) **2014**.

