

Title	Quantum field theory and statistical mechanics of bubble nucleation on surfaces
Sub Title	
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Abstract	<p>このプロジェクトでは、湾曲空間における相転移、気泡核生成、量子真空効果などの機構を研究しています。私たちが行った研究は、主に技術的なもので、非常に一般的な背景で相転移、より一般的には量子真空効果を定量的に記述することを可能にする特定の物理量（正確にはグリーン関数の同時計数限界の期待値）を計算する方法を開発することを目的としたものであった。このような方法は以前から存在したが、特殊なケースでの計算に限られていた。このような解析的な計算を行うことはもちろんですが、上記の物理量を効率的に計算し、その結果を具体的に応用するための数値的な実装の開発にも着手しています。現在開発している数値計算方法は、GPUによる計算機能を利用したもので、今年度中に継続したいと考えています。</p> <p>2021年4月から2022年3月までの間に、以下の論文が国際的な査読付き学術誌に投稿され、または掲載されました。</p> <p>A. Flachi, V. Vitagliano, "The Casimir effect for nonlinear sigma models and the Mermin–Wagner–Hohenberg–Coleman theorem", Journal of Physics A: Mathematical and Theoretical, Volume 54, Number 265401 (7 June 2021)</p> <p>A. Flachi, G. Fucci, "One-loop effective action of the CPn model at large mu beta", Physics Letters B, Volume 821 136627 (10 October 2021)</p> <p>A. Flachi, et al., "Bosons on a rotating ring with free boundary conditions", Journal of Physics A: Mathematical and Theoretical, Volume 54 405401 (13 September 2021)</p> <p>A. Flachi, "Quantum vacuum phenomena in various backgrounds", accepted for publication in the International Journal of Theoretical Physics (February 2022)</p> <p>A. Flachi, et al., "A general method to compute vacuum polarization effects in curved backgrounds", in preparation</p> <p>The target of this project is to study the mechanism of phase transitions, bubble nucleation, and quantum vacuum effects in curved space. The research we have carried out during the relevant academic year has been mostly technical and aimed at developing a method to compute certain physical quantities (precisely, the expectation value of the coincident limit of the Green function) that allows for a quantitative description of phase transitions and more generally quantum vacuum effects in a very general background. Such methods existed before, but were only confined to special case calculations. Aside for developing the analytical part of the calculations, we have begun developing a numerical implementation to be able to calculate in an efficient manner the above mentioned physical quantities and concretely use the results in applications. The numerical methods we are currently developing are based on GPU enhanced computing which we hope to continue throughout this year.</p> <p>During the period April 2021 to March 2022, the following papers have been submitted for publication or have appeared as published articles in international refereed journals:</p> <p>A. Flachi, V. Vitagliano, "The Casimir effect for nonlinear sigma models and the Mermin–Wagner–Hohenberg–Coleman theorem", Journal of Physics A: Mathematical and Theoretical, Volume 54, Number 265401 (7 June 2021)</p> <p>A. Flachi, G. Fucci, "One-loop effective action of the CPn model at large mu beta", Physics Letters B, Volume 821 136627 (10 October 2021)</p>

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Notes	
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研究課題 (日本語)						
Quantum field theory and statistical mechanics of bubble nucleation on surfaces						
研究課題 (英訳)						
Quantum field theory and statistical mechanics of bubble nucleation on surfaces						
1. 研究成果実績の概要						
<p>このプロジェクトでは、湾曲空間における相転移、気泡核生成、量子真空効果などの機構を研究しています。私たちが行った研究は、主に技術的なもので、非常に一般的な背景で相転移、より一般的には量子真空効果を定量的に記述することを可能にする特定の物理量(正確にはグリーン関数の同時計数限界の期待値)を計算する方法を開発することを目的としたものであった。このような方法は以前から存在したが、特殊なケースでの計算に限られていた。このような解析的な計算を行うことはもちろんですが、上記の物理量を効率的に計算し、その結果を具体的に应用するための数値的な実装の開発にも着手しています。現在開発している数値計算方法は、GPUによる計算機能を利用したもので、今年度中に継続したいと考えています。</p> <p>2021年4月から2022年3月までの間に、以下の論文が国際的な査読付き学術誌に投稿され、または掲載されました。</p> <p>A. Flachi, V. Vitagliano, "The Casimir effect for nonlinear sigma models and the Mermin-Wagner-Hohenberg-Coleman theorem", Journal of Physics A: Mathematical and Theoretical, Volume 54, Number 265401 (7 June 2021)</p> <p>A. Flachi, G. Fucci, "One-loop effective action of the CPn model at large mu beta", Physics Letters B, Volume 821 136627 (10 October 2021)</p> <p>A. Flachi, et al., "Bosons on a rotating ring with free boundary conditions", Journal of Physics A: Mathematical and Theoretical, Volume 54 405401 (13 September 2021)</p> <p>A. Flachi, "Quantum vacuum phenomena in various backgrounds", accepted for publication in the International Journal of Theoretical Physics (February 2022)</p> <p>A. Flachi, et al., "A general method to compute vacuum polarization effects in curved backgrounds", in preparation</p>						
2. 研究成果実績の概要 (英訳)						
<p>The target of this project is to study the mechanism of phase transitions, bubble nucleation, and quantum vacuum effects in curved space. The research we have carried out during the relevant academic year has been mostly technical and aimed at developing a method to compute certain physical quantities (precisely, the expectation value of the coincident limit of the Green function) that allows for a quantitative description of phase transitions and more generally quantum vacuum effects in a very general background. Such methods existed before, but were only confined to special case calculations. Aside for developing the analytical part of the calculations, we have begun developing a numerical implementation to be able to calculate in an efficient manner the above mentioned physical quantities and concretely use the results in applications. The numerical methods we are currently developing are based on GPU enhanced computing which we hope to continue throughout this year.</p> <p>During the period April 2021 to March 2022, the following papers have been submitted for publication or have appeared as published articles in international refereed journals:</p> <p>A. Flachi, V. Vitagliano, "The Casimir effect for nonlinear sigma models and the Mermin-Wagner-Hohenberg-Coleman theorem", Journal of Physics A: Mathematical and Theoretical, Volume 54, Number 265401 (7 June 2021)</p> <p>A. Flachi, G. Fucci, "One-loop effective action of the CPn model at large mu beta", Physics Letters B, Volume 821 136627 (10 October 2021)</p> <p>A. Flachi, et al., "Bosons on a rotating ring with free boundary conditions", Journal of Physics A: Mathematical and Theoretical, Volume 54 405401 (13 September 2021)</p> <p>A. Flachi, "Quantum vacuum phenomena in various backgrounds", accepted for publication in the International Journal of Theoretical Physics (February 2022)</p> <p>A. Flachi, et al., "A general method to compute vacuum polarization effects in curved backgrounds", in preparation</p>						
3. 本研究課題に関する発表						
発表者氏名 (著者・講演者)	発表課題名 (著書名・演題)	発表学術誌名 (著書発行所・講演学会)	学術誌発行年月 (著書発行年月・講演年月)			
フラキ アントニノ	Quantum vacuum phenomena in various backgrounds	International Journal of Theoretical Physics (accepted)	February 2022			

フラキ アントニノ	Bosons on a rotating ring with free boundary conditions	ournal of Physics A: Mathematical and Theoretical	13 September 2021
フラキ アントニノ	The Casimir effect for nonlinear sigma models and the Mermin-Wagner - Hohenberg - Coleman theorem	ournal of Physics A: Mathematical and Theoretical	7 June 2021
A. Flachi, G. Fucci	One-loop effective action of the CPn model at large mu beta	Physics Letters	(10 October 2021)