

Vereshchagin Gregory

Position: researcher
Period covered: 2017



I Scientific Work

The work focused on the following aspects:

- Photon-photon scattering and absorption of high energy photons in the Universe

Photon-photon scattering of gamma-rays on the cosmic microwave background has been studied using the low energy approximation of the total cross section by Zdziarski and Svensson. Here, the cosmic horizon due to photon-photon scattering is accurately determined using the exact cross section and we find that photon-photon scattering dominates over the pair production at energies smaller than 1.68 GeV and at redshifts larger than 180.

- Bose enhancement and Pauli blocking in the pair plasma (with I.A. Siutsou, A.G. Aksenov and N.O. Prokopenya)

Interactions in homogeneous electron-positron-photon plasma are studied numerically using the relativistic kinetic Boltzmann equation, with collision integrals given by QED. Efficient method for computations of reaction rates of two-particle interactions is developed. The results are compared with analytical approximations, showing excellent agreement.

- Thermal emission in the early afterglow of GRBs from their interaction with supernova ejecta (with R. Ruffini and Yu Wang)

The interaction between the GRB ejecta and a baryonic shell is considered in the context of the binary driven hypernova model of Gamma-Ray Bursts. The kinematic and observational properties of the shell after the interaction are derived. In particular, the temperature and the duration of the thermal emission are obtained. The model is then applied to GRB 090618 and the observed characteristics of the thermal component are reproduced.

- Inflationary measure in loop quantum cosmology (with S. Bedic)

Recently a contradiction between Liouville's theorem and attractor-like behavior in inflationary models has been analyzed by Remmen and Carroll. Motivated by their analysis we perform the study of inflationary measure in loop quantum cosmology. In addition, we analyze the stability of bouncing solutions using Lyapunov exponents.

II Conferences and educational activities

II a Conferences and Other External Scientific Work

- First ICRANet-Minsk workshop on high energy astrophysics, National Academy of Sciences of Belarus, Minsk, Belarus, April 26-28, 2017. Talk: “Cosmic horizon for GeV sources and photon-photon scattering”.
- XIII International Conference on Gravitation, Astrophysics and Cosmology and 15th Italian-Korean Symposium on Relativistic Astrophysics: A joint meeting, Ewha Womans University, Seoul, Korea, July 3 - 7, 2017. Talk “Cosmic horizon for GeV sources and photon-photon scattering”.

II b Work With Students

- David Melon Fursman (IRAP PhD): on generation of multiple shocks in GRB outflows
- Nikolai Prokopenya (NASB): reaction rates in relativistic plasma
- Susana Bedic (IRAP PhD): inflationary measure in loop quantum cosmology

II c Diploma thesis supervision

II d Other Teaching Duties

II e. Work With Postdocs

- Ivan Siutsou: on Bose enhancement and Pauli blocking in the pair plasma
- Wang Yu: on thermal emission in early afterglow from the GRB-SNR interaction

III. Service activities [*activities carried out in collaboration with ICRANet (e.g. teaching activities, conferences etc...) and outside ICRANet (teaching activities in your university etc...)*]

III a. Within ICRANet

- Member of the IRAP PhD Faculty
- coordination of cooperation with the Belarusian State University
- coordination of cooperation with the National Academy of Sciences of Belarus
- coordination of activities in ICRANet-Minsk center
- organizational work for Fifteenth Marcel Grossmann Meeting
- organizational work for Third Zeldovich Meeting
- organizational work for the 15th Italian-Korean symposium on relativistic astrophysics
- supervision of the ICRANet newsletter
- supervision of ICRANet press releases

III b. Outside ICRANet

- Co-PI of the scientific program “Relativistic astrophysical objects and phenomena” within the Belorussian state program “Convergence-2020”, subprogram “Microworld and Universe”.

IV. Other

This year the monograph "Relativistic Kinetic Theory With Applications in Astrophysics and Cosmology" written in co-authorship with Alexey Aksenov from ICAD, RAS, has been published by Cambridge University Press. It represents nearly 10 years of research work.

2017 List of Publication

1. G.V. Vereshchagin and A. G. Aksenov, "Relativistic Kinetic Theory With Applications in Astrophysics and Cosmology", Cambridge University Press, 2017.
2. R. Ruffini G. V. Vereshchagin Yu Wang, “Thermal emission in the early afterglow of GRBs from their interaction with supernova ejecta”, A&A 600 (2017) A131.
3. G.V. Vereshchagin, “Cosmic horizon for GeV sources and photon-photon scattering”, accepted for publication in Astrophysics and Space Science, 2018.
4. V.A. Belinski and G.V. Vereshchagin, “On the cosmological gravitational waves and cosmological distances”, submitted to Phys. Lett. B, 2017.
5. G.V. Vereshchagin and S. Bedic, “Inflationary measure in loop quantum cosmology”, in preparation.
6. N. O. Prokopenya, I. A. Siutsou, G. V. Vereshchagin, “Numerical scheme for treatment of Uehling-Uhlenbeck kinetic equation for two-particle interactions in electron-positron-photon plasma”, submitted to Journal of Computational Physics, 2017.