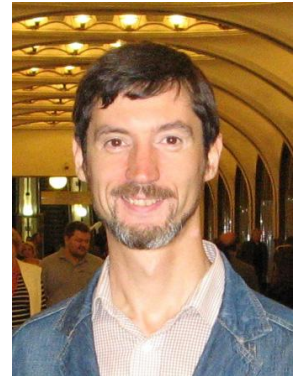


## Vereshchagin Gregory

Position: researcher  
Period covered: 2015



### I Scientific Work

The work focused on the following aspects:

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

Interactions in homogeneous electron-positron-photon plasma are studied numerically using the relativistic kinetic Boltzmann equation, with collision integrals including Bose enhancement and Pauli blocking corrections. The new method of computing collision integrals is developed.

- 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.

- Cosmic absorption of ultra high energy particles (with R. Ruffini and S.-S. Xue)

This work summarizes the limits on propagation of ultra high energy particles in the Universe, set up by their interactions with cosmic background of photons and neutrinos. By taking into account cosmic evolution of these backgrounds and considering appropriate interactions we derive the mean free path for ultra high energy photons, protons and neutrinos. For photons the relevant processes are the Breit-Wheeler process as well as the double pair production process. For protons the relevant reactions are the photopion production and the Bethe-Heitler process. We discuss the interplay between the energy

loss length and mean free path for the Bethe-Heitler process. Neutrino opacity is determined by its scattering off the cosmic background neutrino. We compute for the first time the high energy neutrino horizon as a function of its energy.

- Interaction of high energy photons with the background radiation in the Universe (with S. Tizchang, S. Batebi, R. Mohammadi, S.-S. Xue and R. Ruffini)

We study high energy cosmic ray in interaction with cosmic microwave background (CMB). We calculate optical depth due to Euler-Heisenberg photon-photon scattering at cosmological redshift. According to our result for CMB background and comparing with constrain obtained from Breit-Wheeler pair production, Euler-Heisenberg at energy less than TeV impose almost the same constrain as Breit-Wheeler on transparency of high energy cosmic photons. We also discuss implications of our results for two astrophysical data, Gamma Ray Burst and Blazar. We confirm theoretical bound in observation of high energy photons.

## **II Conferences and educational activities**

### *II a Conferences and Other External Scientific Work*

#### *II b Work With Students*

- S. Tizchang, S. Batebi: on interaction of high energy photons with the background radiation in the Universe

#### *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
- coordinating cooperation with the Belarusian State University
- coordinating cooperation with the National Academy of Sciences of Belarus

- co-chair (with J. Michael Burgess) of the parallel session GB4 “Photospheric Emission in GRBs” at the Fourteenth Marcel Grossmann Meeting (MG14).
- organizational work for MG14, as a member of the LOC
- organizational work for the 14th Italian-Korean Symposium on Relativistic Astrophysics, as a member of the organizing committee
- organizational work for the First Sandoval Vallarta Meeting on Relativistic Astrophysics
- editorial work as co-editor of the proceedings of the Zeldovich-100 Meeting
- editorial work as co-editor of the proceedings of the Second ICRANet César Lattes Meeting

### *III b. Outside ICRANet*

## **IV. Other**

### **2015 List of Publication**

1. G.V. Vereshchagin, "Relativistic Kinetic Theory with some Applications", in: *Cosmology and Gravitation: XV<sup>th</sup> Brazilian School of Cosmology and Gravitation*, eds. Mario Novello and Santiago E.Perez Bergliaffa, Cambridge Scientific Publishers, 2015, pp 1-40.
2. A. G. Aksenov, R. Ruffini, and G. V. Vereshchagin, “Radiative transfer in relativistic plasma outflows and comptonization of photons near the photosphere”, *Astronomy Reports*, Vol. 59, No. 6, (2015) pp. 418–424.
3. G. V. Vereshchagin, “Physics of Non-Dissipative Ultrarelativistic Photospheres”, in *Proceedings of the MG13 Meeting on General Relativity*, eds. Rosquist et al., WSPC (2015) pp. 708-728.
4. R. Ruffini, I.A. Siutsou and G.V. Vereshchagin, “Photon Thick and Photon Thin Relativistic Outflows and GRBs”, in *Proceedings of the MG13 Meeting on General Relativity*, eds. Rosquist et al., WSPC (2015) pp. 1748-1750.
5. A.G. Aksenov, R. Ruffini and G.V. Vereshchagin, “Radiative Transfer Near the Photosphere of Mildly and Ultrarelativistic Outflows”, in *Proceedings of the MG13 Meeting on General Relativity*, eds. Rosquist et al., WSPC (2015) pp. 1754-1756.
6. D. Bégué, I.A. Siutsou and G.V. Vereshchagin, “On the Decoupling of Photons from Relativistically Expanding Outflows”, in *Proceedings of the MG13 Meeting on General Relativity*, eds. Rosquist et al., WSPC (2015) pp. 1760-1761.
7. R. Ruffini, G. V. Vereshchagin and S.-S. Xue, “Cosmic absorption of ultra high energy particles”, submitted to *Astrophys. Space Sci.* (2015).

8. R. Ruffini G. V. Vereshchagin Yu Wang, “Thermal emission in the early afterglow of GRBs from their interaction with supernova ejecta”, submitted to *A&A* (2015).
9. I. A. Siutsou, A. G. Aksenov and G. V. Vereshchagin, “On Thermalization of Electron-Positron-Photon Plasma”, to appear in proceedings of the Second César Lattes Meeting, *AIP Conf. Proc.* (2015).
10. S. Tizchang, S. Batebi, G.V. Vereshchagin, R. Mohammadi, S.-S. Xue and R. Ruffini, “Interaction of high energy photons with the background radiation in the Universe”, in preparation (2015).