GIORGIO DI RUSSO

CONTACTS

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PERSONAL DETAILS

I was born in Sora (FR, Italy) on 26/11/1994. Actually I live in Rome (RM, Italy).

EDUCATION

- I obtain the secondary school certificate from "E. Fermi" institute in Gaeta (LT, Italy) during the school year 2012/2013 with full mark (100/100).
- On 16/12/2016 I graduate in Physics (Bachelor's Degree) from the University of Rome "Tor Vergata" with the mark 102/110.

- Thesis: Rate equations approach to the Coulomb Blockade phenomenon in quantum transport and their limitations at low temperatures.
- Thesis Advisor: Gianluca Stefanucci
- Assistant supervisor: Enrico Perfetto

- On 25/10/2019 I graduate in Physics (Master Degree) from the University of Rome "Tor Vergata" full mark with honors (110/110 magna cum laude).

- Thesis: Probing String Theory bound states with lithe String states.
- Thesis Advisor: Massimo Bianchi.

- During the academic year 2019/2020 I acquired 24 credits in anthropo-psycho-pedagogical disciplines and didactic methodologies and technologies with full mark.
- From 02/11/2020 I am a PhD student in Physics at the University of Rome "Tor Vergata".

TEACHING EXPERIENCE

- From November 2019 I teach Mathematics and Physics (A020, A026, A026) at the higher education institute "Vittorio Gassmann" in Rome (RM).
- From September 2020 I teach Mathematics (A026) at the higher education institute "Giulio Cesare" in Cassino (FR)

SCIENTIFIC INTERESTS AND ACTIVITIES

In string theory, black holes (BH) can be represented as bound states of strings and branes. BRST-invariant vertex operators for massless states are well-known, while the identification of BRST-invariant vertex operators for very massive states, possibly with high spin, is rather laborious. A possible way out is to use the time-honored Del Giudice-Di Vecchia-Fubini (DDF) operators that produce BRST-invariant states by construction. Scattering amplitudes involving different number

of coherent states, tachyons and vectors, have been already analyzed in detail in bosonic string theory. So as a future project, it should be interesting to extend the DDF formalism to superstring theory as a tool to extract the whole spin dependence in the soft behavior.

The recent detection of gravitational waves (GW) from BHs collisions (LIGO and Virgo) has raised many new questions on the nature of gravity and how possible quantum gravity phenomena in BH physics may be tested from GWs. Motivated by the searches for α' effects in GWs beyond General Relativity, I studied in a Heterotic Sting Theory compactified on the 6-torus the tree-level scattering amplitude describing the merging of two $\frac{1}{2}-BPS$ BHs with the production of another $\frac{1}{2}-BPS$ BH plus a graviton. Choosing appropriate conditions on momenta and polarizations, the amplitude factorizes in a very simple form and shows automatically the graviton soft term. The soft limit generates the string corrections to the GW profile. As an outlook, it should be interesting to compute the same amplitude at one loop order because from it, one should be able to extract the post-minkowskian corrections the to the newtonian potential. The main advantage in using String Theory is that no sum is needed between diagrams at the same order in the Newton constant. It should be interesting also to generalize the case in which BHs are non-BPS.

Recently, it has been shown that the Weinberg's formula for soft graviton production is essentially a Fourier transformation of the formula for gravitational memory which provides an effective way to understand how the classical calculation arises as a limiting case of the quantum result. A triangle of exact equivalence relation between three classes of physics has been established: the precise ingredients of this triangle relation are Weinberg's soft graviton theorem, gravitational memory and Bondi–Metzner–Sachs (BMS) Super-translation. The universal properties go through the sub-leading order and sub-sub-leading order respectively in a low-energy expansion in arbitrary dimensions. With the triangle equivalence in mind, one would expect that any new discovery at one corner will hint at new physics at other corners which are intensively discussed recently.

Being a quantum theory of gravity, string theory has to give a coherent description of BHs. Some recent discussions about the information-loss paradox and how a BH radiates have led to an improved understanding of the constraints on the quantum state of a BH. Given that BHs evolve in a unitary manner, the same as for any other quantum state, it is by now clear that the once-standard Hawking model will have to undergo some rather dramatic modifications. the so-called fuzzball model can and should effectively play the role of a BH. The description of the BH interior as an empty spacetime has to be substantially revised. It has been argued that the BH interior can be described in terms of a bound state highly excited long closed strings. This interpretation opens up the door to some exciting possibilities. One can now ask, for instance, about the plight of an object falling into a BH and finally expect a rigorous answer or find out whether there is some observable effect of the inner-structure of the BH when two BHs collide.

RESEARCH EXPERIENCE

- During my master degree thesis I collaborated with Massimo Bianchi, Maurizio Firrotta in writing the article "DDF operators, open string coherent states and their scattering amplitudes" (arXiv:1902.07016, 2019).
- As original work, with the further collaboration of Andrea Addazi and Antonino Marcianò I computed the scattering amplitude involving the merging of two rotating black holes and the

creation of a third black hole and the emission of a gravitational wave in Heterotic String theory compactified on a 6-torus.
- I computed in rigorous way the scattering amplitude involving two vertices at mass level N in first Regge trajectory and two vector bosons in Bosonic String theory.
- I collaborated in writing the article “String Memories ... Lost and Regained” (arXiv:2008.02206)

PRESENTATIONS

In 08/04/2019 I discuss about Kerr Black Holes in General Relativity and in particular about geodesics in Kerr background, Penrose process and the stress energy tensor associated to the system during a workshop at the University "Tor Vergata" in Rome.

IT SKILLS

- Excellent knowledge of Microsoft operating system (10, 7 and specially XP).
- Excellent knowledge of Microsoft Office (Word Excel, PowerPoint, Outlook). Excellent knowledge of Latex and Beamer.
- Basic knowledge of AutoCAD.
- Excellent knowledge of Fortran95. Basic knowledge of C.
- Good knowledge of Wolfram Mathematica.

LANGUAGE SKILLS

- Very good knowledge of daily English. Excellent knowledge of scientific English.
- Scholastic knowledge of Spanish.