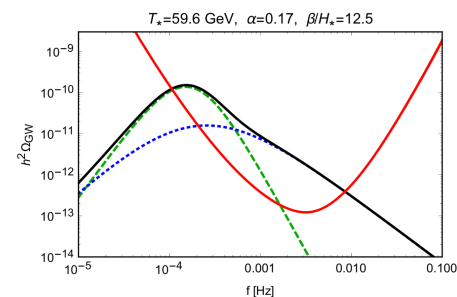
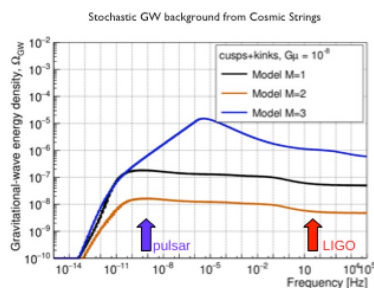
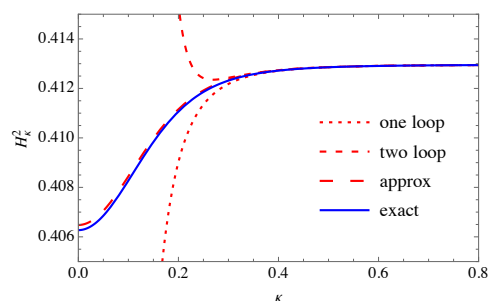
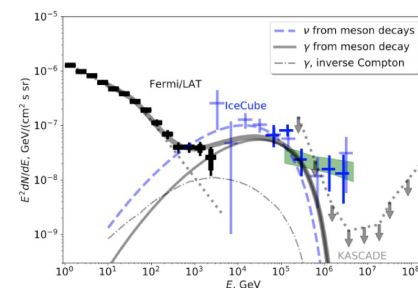
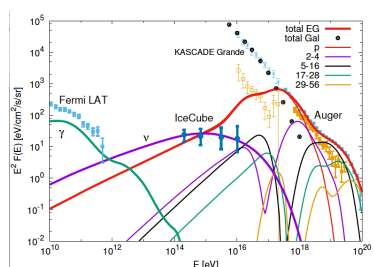
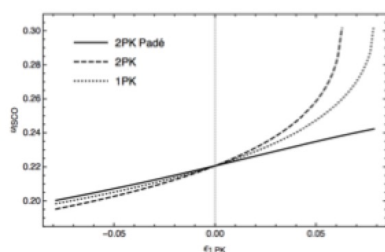


APC Theory Group



Dmitri Semikoz



Composition de l'équipe de recherche

- Responsable scientifique de l'équipe :
- Head of group Dmitri Semikoz, vice-head Eric Huguet

Liste des chercheurs de l'équipe :

• 11+3 permanents [Name, Status (Emeritus, PR, DR, MCF, CR, IR-Chercheur), (HDR)]

• CNRS

- | | |
|------------------|----|
| • Kiritsis Elias | DR |
| • Langlois David | DR |
| • Lemoine Martin | DR |
| • Luca Santoni | CR |
| • Semikoz Dmitri | DR |
| • Volpe Cristina | DR |

• University Paris 7

- | | |
|-------------------|-----------------|
| • Huguet Eric | MCF/ HDR |
| • Mourad Jihad | PR |
| • Neronov Andrii | PR |
| • Nitti Francesco | PR |
| • Serreau Julien | MCF/ HDR |
- **Daniel Steer** -> **ENS**

• Emeritus

- | | |
|----------------------|----|
| • Gazeau Jean-Piere | PR |
| • Lachièze-Rey Marc. | DR |
| • Renaud Jacque | PR |

Composition de l'équipe de recherche

0 postdocs [prénom, nom, indiquer sujet, origine financement, directeur, codirection, cotutelle, date de début, date de fin]

0 postdocs in last 2 years

- 3 doctorants [prénom, nom, indiquer sujet, origine financement, directeur, codirection, cotutelle, date de début, date de fin]

- | | | | |
|----------------------------|------------------------------|-----------|----------------------|
| • Pilar Ivanez-Ballesteros | Neutrinos | C.Volpe | Oct 2022 – Oct 2025 |
| • Fourquet Philippe | Quantum Field Theory | E.Huguet | Sep 2022 – June 2026 |
| • Boyer Théo | Cosmological magnetic fields | A.Neronov | Oct 2022 – Oct 2025 |

- This is absolute minimum over 20 years. // we had 4 postdocs and 11 PhD students at maximum

Activités de l'équipe de recherche

- Coopérations/collaborations principales avec l'extérieur (avec équipes locales, nationales, internationales)
- Associated scientists:
 - K.Noui (Orsay) 2 days/week
 - F. Vernizzi (Saclay) 2 day/week
 - D.Steer (ENS) 4 days/week
 - U.Reinosa (Polytechnique) 1 day/week
 - Julien Grain (IAS) 1 day/week
 - Brando Bellacini (Saclay)
 - Christos Charmousis (Orsay)
 - Blaise Gouteraux (Ecole Polytechnique)
 - Monica Guica (Saclay)
 - Herve Bergeron (Orsay)
 - Chiara Caprini (Geneva) 1 week/month

Activités de l'équipe de recherche

- Coopérations/collaborations principales avec l'extérieur (avec équipes locales, nationales, internationales)
- Visiteurs de longue durée (>3 mois) depuis 3 ans (sabbatiques, cofinancés, ...)

Prof. Julien Queva CNRS 6 month up to August 2024

Prof. Morgan Le Delliou (China) July 1 2024 to the end of October 2024.

Prof. Foteini Oikonomou (NTNU, Norway) subbaticle Sept-Dec 2024

- 1-3 months visitors and 30+ short term visitors per year
- Prof. Eliezer Rabinovici, 1-30 September 2024. (le president du Conseil du CERN)
- Prof. M.Kachelriess (Trondheim U) Nov-Dec 2024

HCERES: Overall assessment of the team

The theory team has a high attractivity to postdocs, and an excellent publication record, with many major and acclaimed results, both in theoretical developments of quantum field theory, string theory and holography, and in cosmology, gravitation and astroparticle physics with close connections to experimental results. It suffered several departures which weakened the link with the cosmology and gravitation experimental teams. This changes the thematic balance of the team, and requires collective strategic thinking to ask for replacements.

HCERES: Strengths and possibilities linked to the context

The scientific production of the team is excellent, both in number (270 publications) and in quality, with key new and internationally recognised results in nearly all of the many research directions pursued. The significant fraction (25%) of publications in direct collaboration with local experimental groups both benefits from the wide diversity of experimental projects, and offers a significant added value to their experimental results and prospects.

The team enjoyed a very good attractiveness, with numerous international connections and visitors, as well as leadership in successful grant applications (1 ERC, 3 ANR) allowing to hire high standard international postdocs and PhD students from top level master programs.

HCERES: Weaknesses and risks linked to the context

Despite the recent hiring of a CNRS theoretician, the net incoming number of young permanent researchers is barely balanced, and does not compensate the leaving of more seasoned researchers, for other positions or for retirements.

This global tendency in the French theory community is further affected in the unit by the leave of one of the three youngest CNRS researchers and the long-term detachment of another.

The creation of a theoretical cosmology group at nearby ENS further challenges the natural regional and national leadership of the group in this area. The team presents its activities as a patchwork of many (very good) results and research lines, but with little or not obvious interconnections and common background.

To human resources managers, this may give the impression that satisfying one request for a permanent or postdoc position in one research direction is only satisfying a small fraction of the team, and is maybe dissatisfying the other fractions. The current project-based funding of postdocs presents a risk of draught should all project fundings simultaneously come to an end, which just happened. For a group with seven university positions out of eleven permanent members, the transfer of research excellence to academic training is not much apparent, except for the direction of Ph.D. theses, with good results.

HCERES: RECOMMENDATIONS TO THE TEAM

Keep the excellent visibility in conferences and publications,
with the very good current level of collaboration with experimental groups.

Strengthen the cohesion of the team by encouraging the formal
and informal links between its different research directions,
and watch for opportunities to increase them.

Use this cohesion for strategic thinking about the team future
and for defining clear realistic priorities for hiring requests.
In particular, the creation of a theoretical cosmology group
at nearby ENS needs to be taken into account in this strategy.

Turnique Recommandations:

Sans quitter la section 02, le groupe pourrait gagner en intégrant mieux la culture et les modalités de l'IN2P3, comme les “master projets”; même s'ils sont conçus au départ pour des projets expérimentaux, ils n'excluent en rien le financement de projets purement phénoménologiques ou théoriques, et leur donnent au contraire une visibilité au sein des activités de l'institut.

We opened 3 master projects

Tout en préservant la qualité des recherches, les candidatures réussies dans l'obtention de contrats (ANR, ERC) et la visibilité de chaque projet et de chacun, le groupe pourrait gagner en cohésion avec une réflexion sur les liens formels et informels existant déjà entre eux, comment mieux les mettre en valeur (par exemple dans une présentation du groupe) et les renforcer chaque fois que cela fait sens.

Même si cela est difficile, le groupe doit avoir une réflexion stratégique collective sur ses priorités en matière de délégation, qui sont soumises à l'avis de l'IN2P3, ainsi que pour le recrutement de CDD et pour les postes permanents

Grants

- We do not have grants at the moment
- Applied to several ANR (F.Nitti, D.Semikoz)
- Applied to ERC Synergy (A.Neronov)
- Plan to apply for ERC advanced

Projet #1 String theory and Holography

Scientist responsible for project : E.Kiritsis,F.Nitti

List of researchers in the project:

•2 permanent [Name, %ETPT in projet, (status)]

- Elias Kiritsis 100% (responsable)
- Francesco Nitti 50% (co-responsable)

•2 postdocs [Name, %ETPT in projet, (status)]

- Panagiotis Betzios 100% research
- Yuta Hamada 100% research

• 3 PhD students: [Name, %ETPT in projet, (status)]

- Valentin Nourry 50% research
- Edwan Préau 100% research
- Jani Kastikainen 100% research

•Important scientific results in project (2020-2021)

- Non-perturbative study of holographic field theories on de Sitter spacetime
- Models with the self-tuning of the cosmological constant and holographic relaxation mechanism
- Holographic RG flows on products of spheres
- Study of AdS vacuum decay by Coleman-de Luccia instantons
- Study of holographic F-theorems in flavored ABJM model
- Baryons in phenomenological holographic models for QCD (in progress)
- Computation of weak processes in dense strongly coupled media (like neutron stars) using semi-holography(in progress)

•Important publications (2020-2021)(3 max) :

- [Revisiting Coleman-de Luccia transitions in the AdS regime using holography](#), J.K. Ghosh ([ICTS, Bangalore](#) and [Independent U., Dhaka](#)), E. Kiritsis (APC), F. Nitti (APC) L. Witkowski (IAP), Feb 23, 2021, *JHEP09 (2021) 065*
- [Back-reaction in massless de Sitter QFTs: holography, gravitational DBI action and f\(R\) gravity](#) J.K. Ghosh([ICTS, Bangalore](#) and [Independent U., Dhaka](#)), E. Kiritsis (APC), F. Nitti (APC) L. Witkowski (IAP), May 18, 2020, *JCAP 07 (2020) 040*
- [The Self-Tuning of the Cosmological Constant and the Holographic Relaxion](#) Y. Hamada (APC), E. Kiritsis(APC), F. Nitti (APC) L. Witkowski (IAP), Jan 15, 2020 , *Fortsch.Phys. 69 (2021) 2, 2000098*

•
5 papers in journals published

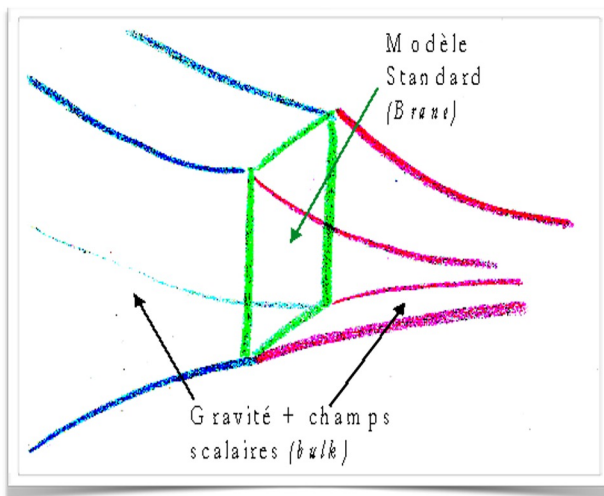
Projet #1 String theory and Holography

Holographie, constante cosmologique et gravité modifiée

Problème de la constante cosmologique:
pourquoi l'énergie de vide quantique du Modèle Standard TQC ne semble pas contribuer à la courbure de l'espace-temps ?

Universe Branaire holographique à 5d

C. Charmousis, E. Kiritsis, F. Nitti, JHEP 1709 (2017) 031



- Le modèle standard (localisé en 4d) interagit avec un *bulk* courbé à 5d;
- Mécanisme d'annulation automatique de la constante cosmologique à 4d (*self-tuning*);
- Modifications de la gravité à grande et/ou courte distance (duale: *gravité émergente*)

Projet #2 Quantum field theory

List of researchers in the project:

•5 permanents [Name, %ETPT in projet, (status)]

- E.Huguet 50%
- J.Mourad 50%
- J-P. Gaseau 100%
- J. Renaud 100%
- M.Lachieze-Rey 100%

•PhD Students

P. Fourquet

•Important scientific results in project (2022-2023)

- Covariant integral quantization of various classical systems.
- Restriction of Laplace operators on one-forms..
- Study of breaking of Supersymmetry: New vacua with broken supersymmetry with $(p+1)$ dimensionnal space-time Poincaré symmetry are found with supersymmetric and tachyon-free non-supersymmetric 10D string theories.

•Important publications (2022-2023)(3 max) :

Restriction of Laplace operators on one-forms : From R^{n+1} , R^{n+2} ambient spaces to embedded $(A)dS_n$ submanifolds.,
E. Huguet, J. Queva and J. Renaud, J. Math. Phys. 63, 07230 (2022).

On boundaries, charges and Fermi fields

Mourad, J. and Sagnotti, A., hep-th 2002.05372, Phys. Lett. B 804 (2020) 135368.

String (In)Stability Issues with Broken Supersymmetry

Mourad, J. and Sagnotti, A., hep-th 2107.04064, JHEP 2021 (2021)



Projet #3 QFT in curved spacetime and QCD

Scientist responsible for project : J. Serreau

List of researchers in the project:

•1 permanents [Prénom, Nom, %ETPT dans le projet, (responsabilité)]

Julien Serreau 50% (responsable)

•1 PhD student: [Prénom, Nom, sujet, %ETPT dans le projet, (responsabilité)]

Moreau Gabriel Champs quantiques en espace-temps courbe %100

•Important scientific results in project (2020-2021)

-nonperturbative QFT techniques to compute the effect of gravitationally enhanced quantum fluctuations during inflation.

-modified perturbative approach for the infrared regime of QCD. Calculation of the phase diagram of the quark-gluon plasma. Semi-analytical computation of dynamical breaking of chiral symmetry.

•Publications emblématiques de l'équipe dans revues à comité de lecture (2020-2021)(3 max) :

A novel background field approach to the confinement-deconfinement transition D. M. van Egmond, U. Reinosa (Ecole Polytechnique, CPHT), J. Serreau (APC, Paris), M. Tissier (Sorbonne Univ. LPTMC). SciPost (2021), to appear

The $1/N$ expansion for stochastic fields in de Sitter spacetime G. Moreau, J. Serreau (APC, Paris). PhysicalReview D 102 (2020) 125015

A window on infrared QCD with small parameters M. Pelaez (Republica Univ. Montevideo), U. Reinosa (Ecole Polytechnique, CPHT), J. Serreau (APC, Paris), M. Tissier (Sorbonne Univ. LPTMC). Reports on Progress in Physics(2021)

7 papers in journals published + 1 conference proceedings

QFT in curved spacetime and QCD

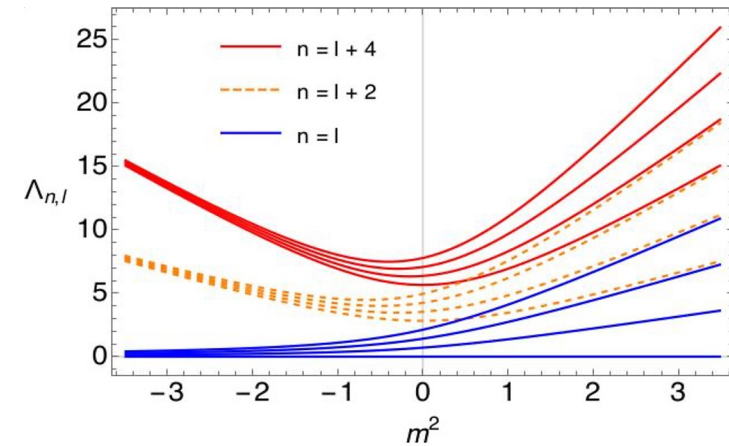
J. Serreau, G. Moreau

Quantum field theory in curved spacetime

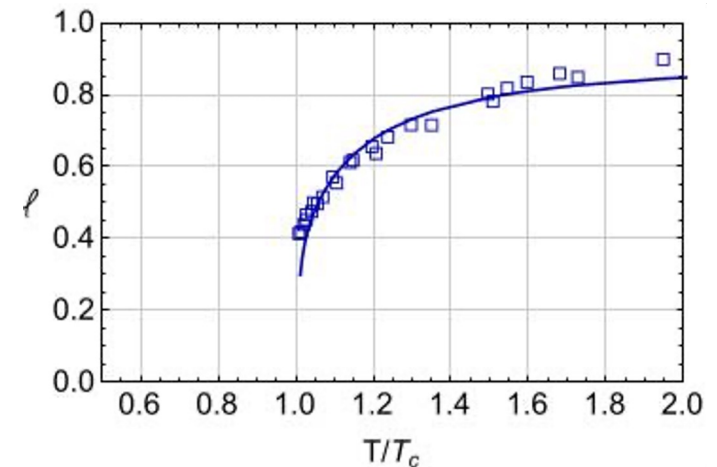
- development of nonperturbative QFT techniques to compute the effect of gravitationally enhanced quantum fluctuations during inflation
- analytical expressions of correlation lengths/times relevant for inflationary physics

Infrared regime of Quantum Chromodynamics

- analytical computation of the phase diagram of QCD with modified perturbative approach (massive extension of Landau gauge = Curci-Ferrari model)
- semi-analytical computation of dynamical breaking of chiral symmetry with the CF model



Exact eigenvalues of the Fokker-Planck operator in the large- N limit as a function of the self coupling [PRD 102 (2020) 125015]



The order parameter of the confinement-deconfinement transition in SU(3) Yang-Mills theory as a function of temperature (one-loop calculation vs. lattice results) [SciPost (2021), to appear]

Projet #4 Modified Gravity

Scientist responsible for project : D.Langlois

List of researchers in the project:

- **2 permanents+1 associé [Name, %ETPT in projet, (status)]**
 - David Langlois 100% (responsable)
 - Karim Noui 50% (associe)
 - Danièle Steer 10%
- **1 Doctorant: [Name, %ETPT in projet, (status)]**
 - Hugo Roussille 100%
- **Important scientific results in project (2020-2022)**
 - perturbations and quasi-normal modes of black holes in DHOST theories
 - tests of different modified gravity theories with GWs
- **Important publications (2020-2022)(3 max) :**

Black hole perturbations in modified gravity David Langlois(APC, Paris), Karim Noui(IDP, Tours and APC, Paris), Hugo Roussille(APC, Paris and IDP, Tours), Phys.Rev.D 104 (2021) 12, 124044

Asymptotics of linear differential systems and application to quasi-normal modes of nonrotating black holes David Langlois(APC, Paris), Karim Noui(IDP, Tours and APC, Paris), Hugo Roussille(APC, Paris and IDP, Tours), Phys.Rev.D 104 (2021) 12, 124043

Probing modified gravity theories and cosmology using gravitational-waves and associated electromagnetic counterparts S. Mastrogiovanni D. Steer, M. Barsuglia, Phys.Rev.D 102 (2020) 4, 044009



Projet #5 Equivalent formulations of General Relativity

E. Huguet

Scientist responsible for project : E. Huguet

List of researchers in the project:

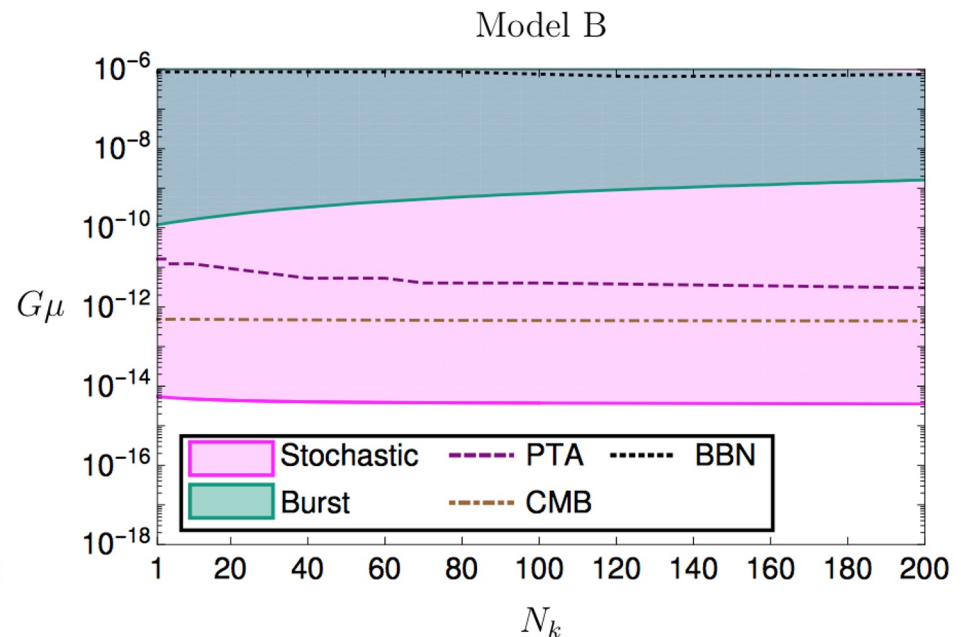
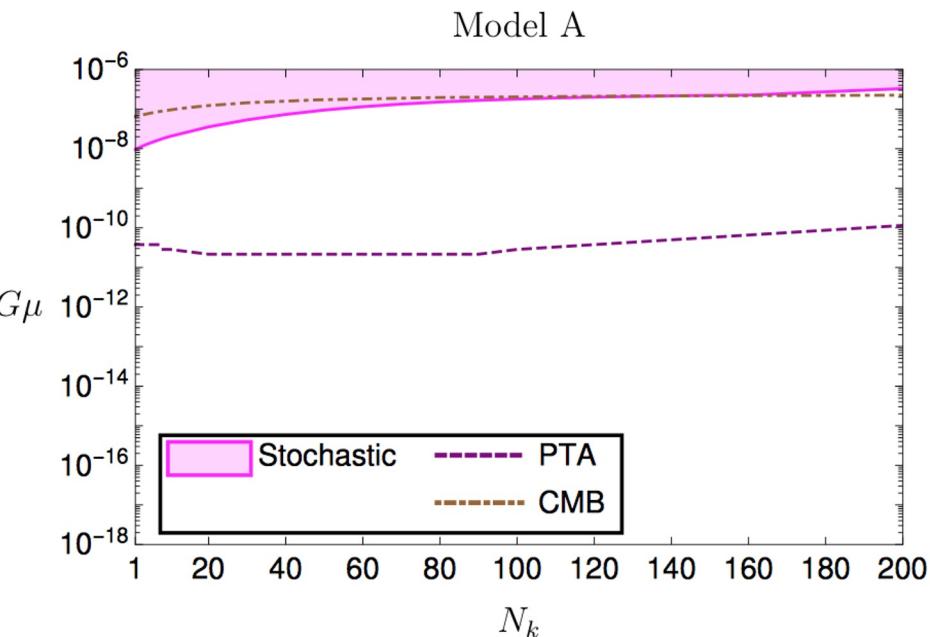
- **1 permanents [Name, %ETPT in projet, (status)]**
 - E. Huguet 50% (responsible)
- **Important scientific results in project (2022-2023)**
 - Reformulation of the Teleparallel Equivalent of General Relativity (TEGR) using a Cartan connection.
- **Important publications :**
- ``Teleparallel gravity as a gauge theory: coupling to matter with Cartan connection."
E.~Huguet, M.~Le~Dellou, M.~Fontanini and Z.- C.~Lin,, Phys. Rev. D {\bf 103}, 044061 (2021).
- ``Cartan approach to Teleparallel Equivalent to General Relativity: a review.",
E.~Huguet, M.~Le~Dellou and M.~Fontanini, Int. Jou. Geom. Meth. Math. Phys., 18 supp01, 21400041 (2021).

2 papers in journals published

Projet #6

Cosmology and GW

- D.Steer
- K.Leide (PhD)
- Constraints on cosmic strings using LIGO-Virgo O3 data.



Exclusion plots for 2 models of cosmic strings. y-axis = string tension $G\mu$; x-axis = number of kinks of strings

Phys.Rev.Lett. 126 (2021) 24, 241102

Projet #7 Gravity and Cosmology

Scientist responsible for project: L.Santoni

List of researchers in the project:

- **1 permanents [Name, %ETPT in projet, (status)]**
 - Luca Santoni 100% (responsible)
- **Important scientific results in project (2022-2023)**
 - Study of static response of rotating black holes in higher spacetime dimensions
 - Generalization of no-hair theorem for rotating black holes in scalar-tensor theories
 - Study of model of dissipative inflation
 - Analysis of the connection between nonzero density and spontaneous symmetry breaking in interacting scalar theories
- **Important publications (2022-2023)(3 max) :**
 - Maria J. Rodriguez, Luca Santoni, Adam R. Solomon, Luis Fernando Temoche, e-Print: 2304.03743 [hep-th]
 - Lodovico Capuano, Luca Santoni, Enrico Barausse, e-Print: 2304.12750 [gr-qc]
 - Paolo Creminelli, Soubhik Kumar, Bornha Salehian, Luca Santoni, e-Print: 2305.07695 [hep-th]
 - Alberto Nicolis, Alessandro Podo, Luca Santoni, e-Print: 2305.08896 [hep-th]

Dissipative Inflation via Scalar Production

with Paolo Creminelli, Soubhik Kumar and Bornha Salehian

The model. The inflaton ϕ couples to a complex scalar field χ charged under a (softly-broken) global U(1) symmetry:

$$S = \int d^4x \sqrt{-g} \left[\frac{1}{2} M_{\text{Pl}}^2 R - \frac{1}{2} (\partial\phi)^2 - V(\phi) - |\partial\chi|^2 + M^2 |\chi|^2 - i \frac{\partial_\mu \phi}{f} (\chi \partial^\mu \chi^* - \chi^* \partial^\mu \chi) - \frac{1}{2} m^2 (\chi^2 + \chi^{*2}) \right]$$

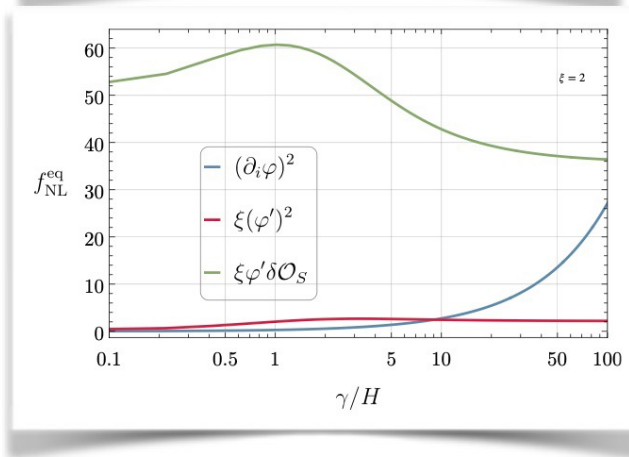
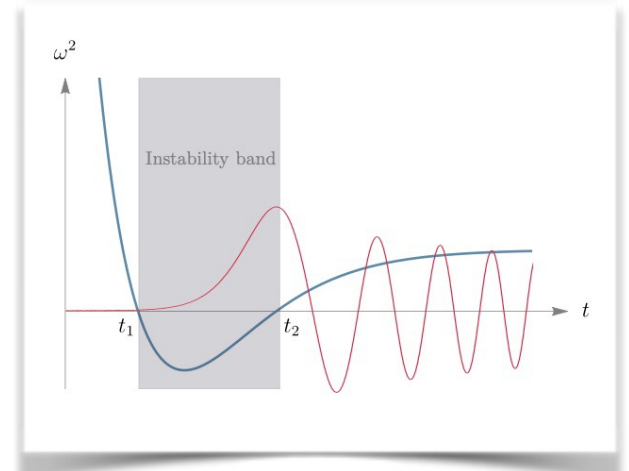
The coupling to ϕ is responsible for triggering an instability in the χ sector for a finite range of momenta. The copious production of χ modes extracts energy from the inflaton sector and induces an extra friction in the background and inflaton dynamics.

If $H \ll m \ll M \ll f$, dissipation takes place on parametrically small scales, allowing for an analytical description of the dynamics.

The model is the first *robust* explicit example of dissipative inflation which admits a local description.

By virtue of the central limit theorem and the large occupation on short scales, the statistics of the perturbations is naturally close to Gaussian.

The size of $f_{\text{NL}}^{\text{eq}}$ is always large provided that cosmological perturbations are sourced by χ ; the size is indeed at reach of current and upcoming non-Gaussianity searches.



Projet #8 Neutrino physics et astrophysics

Scientist responsible for the project : M.C.Volpe

List of researchers in the project:

• **1 permanent [Name, %ETPT in projet, (status)]**

- Maria Cristina Volpe 100% (responsible)

1 PhD student : [Name, %ETPT in projet, (status)]

- Pilar Ivanéz-Ballesteros, Master 2-PHE and ETH Zürich, “The diffuse supernova neutrino background and its potential”, PhD Thesis (2022-2025)

Important scientific results in project (2022-2023)

- We showed that if neutrinos can decay non-radiatively, this can challenge the interpretation of the upcoming diffuse supernova neutrino background (DSNB) observations by the Super-Kamiokande+Gd, DUNE, JUNO and Hyper-Kamiokande detectors.
- We provided a unique review on neutrinos from dense environments, in the panorama of the existing literature. The review covers a variety of MSW-like mechanisms discovered in the last fifteen years, the theoretical approaches employed and the importance of these studies for future observations of core-collapse supernovae, the DSNB and **kilonovae**.

Important publications (2022-2023)(3 max):

- P. Ivanéz-Ballesteros and M. C. Volpe, “[Neutrino nonradiative decay and the diffuse supernova neutrino background](#)”, *Phys.Rev.D* 107 (2023) 2, 023017, e-Print: [2209.12465](#).
- M. C. Volpe, «[Neutrinos from dense: flavor mechanisms, theoretical approaches, observations, new directions](#)», Review of Modern Physics, e-Print: [2301.11814](#) [hep-ph].
- P. Ivanéz-Ballesteros and M. C. Volpe, in preparation.

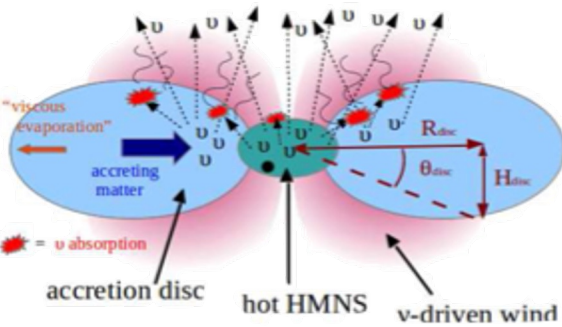
1 published article, 1 article in preparation, 1 (invited) Review Article submitted, 3 proceedings, 13 articles (JUNO Collaboration)

Neutrino physics and astrophysics

M.C.Volpe, P. Ivanez-Ballesteros



Supernovae



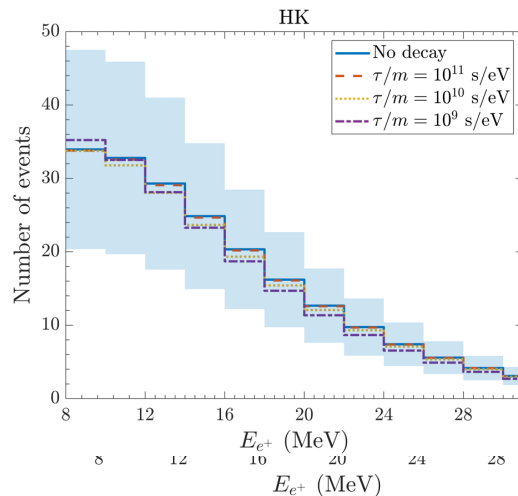
- Neutrinos modify their flavor while travelling.

In dense environments new flavor mechanisms are being uncovered.

- Flavor evolution can impact the neutron richness and nucleosynthesis of heavy elements - r-process - in core-collapse supernovae and binary neutron star merger remnants.

neutron star mergers

Diffuse supernova neutrino background and neutrino decay



Unique observational window for the lifetime-over-mass ratio, for neutrino decay.

Ivanez-Ballesteros and Volpe, PRD107 (2023).

Neutrinos from dense environments

The review covers a variety of MSW like mechanisms discovered in the last fifteen years, the theoretical approaches employed and the importance of these studies for future observations.

M. C. Volpe, Review of Modern Physics,
e-Print: [2301.11814](https://arxiv.org/abs/2301.11814) [hep-ph]

> Predictions for future observations of supernova neutrinos in neutrino detectors such as Super-Kamiokande, Hyper-K, JUNO, DUNE, ...

Projet #9 Cosmic rays

Scientist responsible for project : D.Semikoz

List of researchers in the project:

- **2 permanents [Name, %ETPT in projet, (status)]**
 - Dmitri Semikoz 30% (responsible)
 - Martin Lemoine 30% (co-responsible)
 - Andrei Neronov 10% (co-responsible)
- **Important scientific results in project (2021-2023)**
 - Cosmic ray spectrum in outer galaxy was studied with Tibet data
 - New model of cosmic ray propagation in Galaxy was developed

- **Important publications (2020-2021)(3 max) :**

Pion decay model of the Tibet ASgamma PeV gamma-ray signal

[S. Koldobsky](#) (Moscow Phys. Eng. Inst.), [A.Neronov](#) (APC, Paris), [D.V. Semikoz](#) (APC, Paris & Moscow Phys. Eng. Inst.). . Published in **Phys Rev D 104 (2021) 4, 043010**

Signatures of anisotropic diffusion around PeVatrons in 100~TeV gamma-ray data

[G.Giacinti](#), [T.Abounnasr](#), [A.Neronov](#) and [D.Semikoz](#), Phys. Rev. D 106 (2022) no.12, 123029
[arXiv:2203.11052 [astro-ph.HE]].

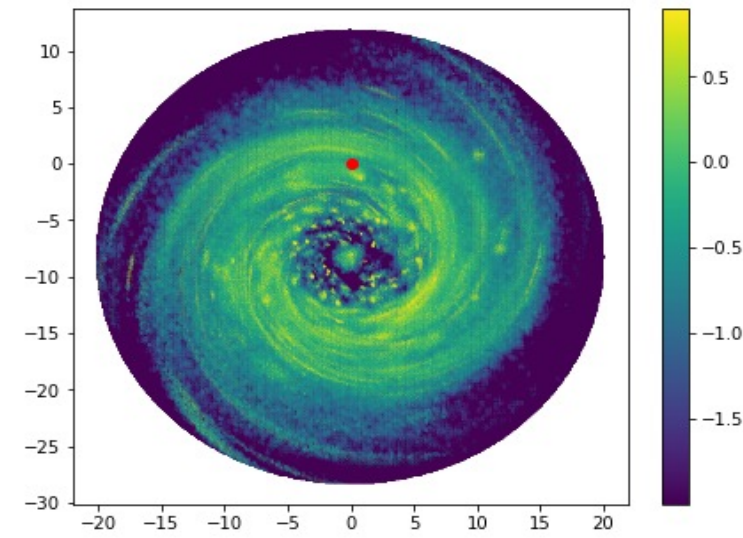
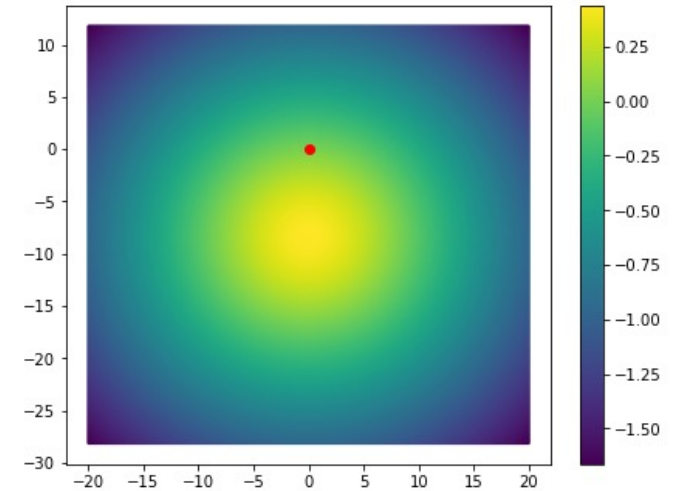
Model of Cosmic Ray Propagation in the Milky Way at the Knee

[G.Giacinti](#) (Shanghai U.) and [D.Semikoz](#) (APC, Paris), [arXiv:2305.10251 [astro-ph.HE]].

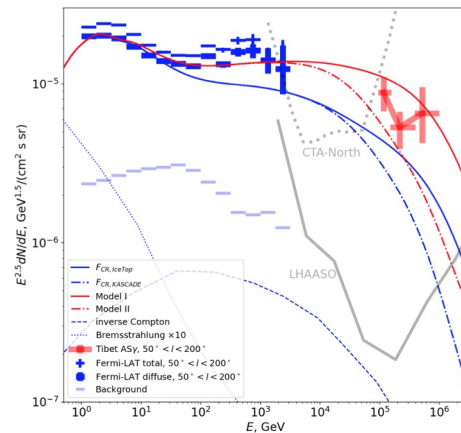
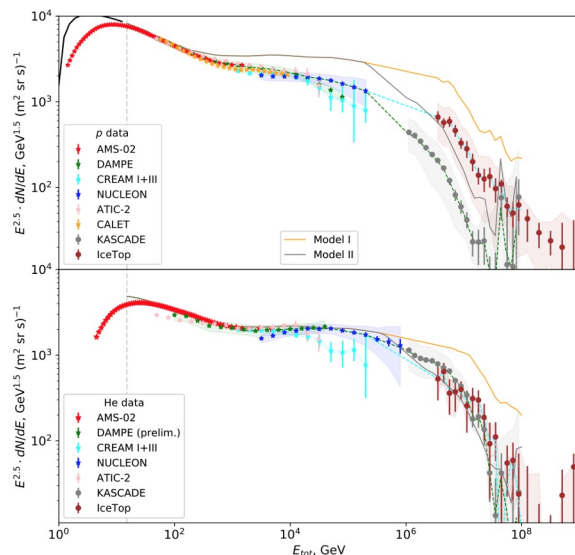
Cosmic rays

We are organizing writing new code for anisotropic cosmic ray diffusion at CR knee with 10 scientists from 5 countries involved

First results very promising to explain gamma-ray data at $E > 1$ TeV



G.Giacinti & D.Semikoz, arXiv:2305.10251



Phys Rev D 104 (2021) 4, 043010

Multimessenger physics with high energy gamma-rays and neutrinos

Scientist responsible for project : A.Neronov

List of researchers in the project:

- **2 permanents [Name, %ETPT in projet, (status)]**
 - Andrei Neronov 35% (responsible)
 - Dmitri Semikoz 20% (co-responsible)
- **1 Doctorants [Name, %ETPT in projet, (status)]**
 - T.Boyer, 100% cosmological magnetic fields and gamma-ray astronomy
- **Important scientific results in project (2021-2023)**
 - We found 5 sigma signal from Seyfert galaxies in IceCube 10 years data: first class of sources in neutrinos
 - We put constraint from GRB 221009A on cosmological magnetic field. This is first constraint on cosmological magnetic field from GRB
- **Important publications (2021-2023)(3 max):**

Neutrino signal from Seyfert galaxies

A.~Neronov, D.~Savchenko and D.~V.~Semikoz, [arXiv:2306.09018 [astro-ph.HE]].

Constraint on intergalactic magnetic field from Fermi/LAT observations of the "pair echo" of GRB 221009A

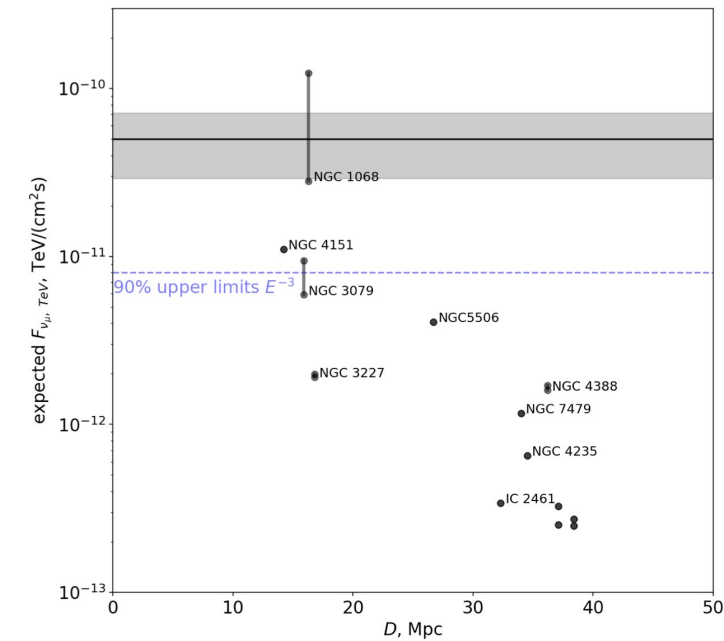
I.Vovk, A.Korochkin, A.Neronov and D.Semikoz, [arXiv:2306.07672 [astro-ph.HE]].

New limit on high Galactic latitude PeV γ -ray flux from Tibet ASy

A. Neronov (APC, Paris), D.V. Semikoz (APC, Paris & Moscow Phys. Eng. Inst.), Ye.Vovk (Tokyo U.) . Jul 14, 2021 10 pp. Published in *Astron.Astrophys.* 653 (2021) L4

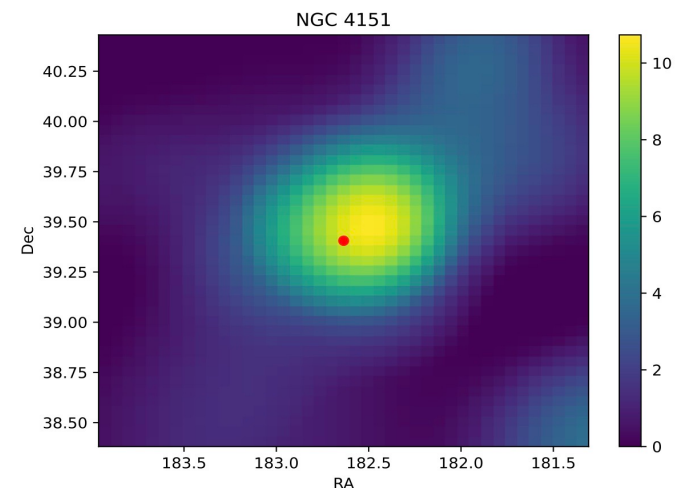
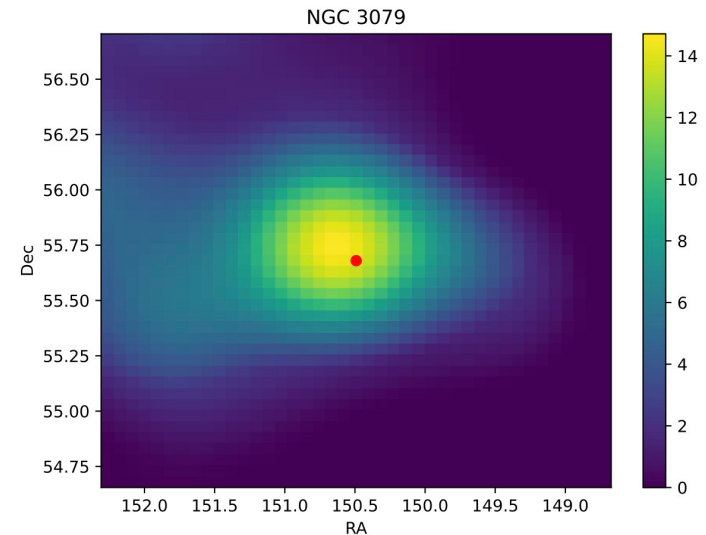
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A.Neronov, D.Savchenko D.Semikoz (APC, Paris)



NGC 3079 and NGC 4151 are only Sources except NGC 1068 should be visible In 10 years of IceCube. BOTH are detected above 3 sigma.

Probability that both are by chance is $3e-7$



Conclusion

- APC Theory team is strong in many theoretical directions and has expertise in all essential directions of APC research including cosmology, gravity, field theory, neutrinos and astroparticle physics
- We need in young permanent researchers, both from University and from CNRS side
- Hopefully, number of postdocs and students will increase after absolute minimum over 20 years of 3 PhD students today
- Theory group **URGENTLY** need visitor space, may be it is good to have one on the level of lab?