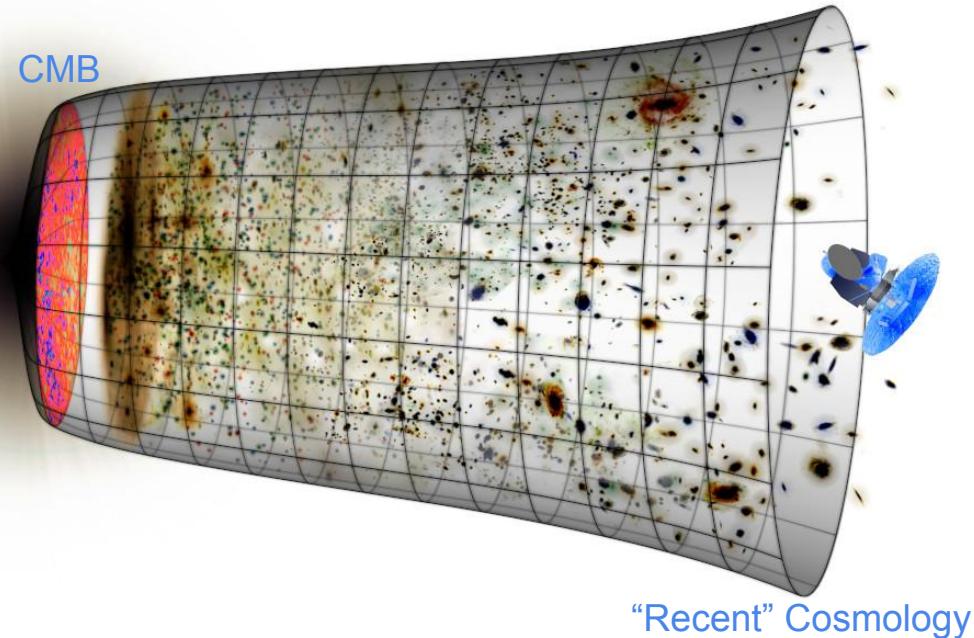


Cosmologie

APC



Composition de l'équipe de recherche

- Responsable scientifique de l'équipe : Ken Ganga; adjoint : Steve Torchinsky
- Budget annuel soutien équipe (hors budget projets) : 28.000€ (-5% ⇒ 26.600€)

Liste des chercheurs de l'équipe :

• X permanents [prénom, nom, qualité (émérite, PR, DR, MCF, CR, IR-chercheur), HDR]

- Eric Aubourg (Chercheur, HDR)
- Jim Bartlett (PR, HDR)
- Alexandre Boucaud (IR-chercheur; Also in IT)
- Martin Bucher (DR, HDR)
- Gabriel Chardin (DR, HDR)
- Michel Crézé (Émerite, HDR)
- Jacques Delabrouille (DR, HDR)
- Josquin Errard (CR)
- Ken Ganga (DR, HDR)
- Yannick Giraud-Héraud (Émerite, HDR)
- Jean-Christophe Hamilton (DR, HDR)
- Jean Kaplan (Émerite, HDR)
- Maxim Khlopov (Benevole)
- Sotiris Loucatos (Chercheur)
- Simona Mei (PR, HDR)
- Guillaume Patanchon (MCF, HDR)
- Michel Piat (PR, HDR)
- Cyrille Rosset (CR)
- Cecile Roucelle (MCF)
- Aurore Savoy-Navarro (Émerite, HDR)
- George Smoot (Émerite, HDR)
- Radek Stompor (DR, HDR)
- Steve Torchinsky (IR-chercheur)

How this group¹ operates in the CoViD era:

I have gotten strong indications that a significant fraction of the APC Cosmology Group are uncomfortable coming into the office at the moment. I also feel personally that we have a responsibility to work from home if that is possible/convenient. We decided early on (i.e., March/April 2020?) that we would accommodate work from home as much as possible. All of our group meetings are held online through Zoom.

Some discussion is done through Slack/Rocket.Chat. And email, of course.

¹ As distinct from the constituent “Projects”, which sometimes need people “in place”.

Composition de l'équipe de recherche (bis)

Liste des chercheurs de l'équipe (continued):

•X post-doctorants [prénom, nom, indiquer projet, origine financement, date de début, date de fin]

- Ekaterina Antoshchenkova, interdisciplinaire modélisation production du fer, DIM-AMAP, colocalisé avec labo NIMBE, 12/2020, 12/2021
- Axel Guinot, Rubin, ANR AstroDeep, 2020, 2022
- Stephane Ilic, Euclid, PSL, 01/12/2019, 30/11/2021
- Clement Leloup, LiteBIRD
- Clement Stahl, Dirac-Milne, CNRS/IN2P3, 18 novembre 2019 au 17 novembre 2021

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

- Anton Afanasiev, High Redshift Clusters and Proto-Clusters, UP ED 127, Simona Mei, 01/10/2018, 30/09/2022
- Bastien Arcelin, Rubin, Ecole Doctorale, Eric Aubourg, fin en 2021
- Hamza El Bouhargani, Simons Observatory, Radek Stompor
- Baptiste Jost, Simons Observatory, Radek Stompor
- Raphael Kou, Euclid, Ecole Doctorale, Jim Bartlett, -, -, 10/2020, 2023
- Thomas Montandon, CMB and large scale non-Gaussianities, Labex, Guillaume Patanchon, Bartjan Van Tent, -, début : 10/2018, fin : 10/2021
- Louise Mousset, QUBIC, ED-560, Jean-Christophe Hamilton, Steve Torchinsky, -, 09/2018, 9/2021
- Guillaume Stankowiak, QUBIC, IN2P3/Labex, Michel Piat, Jean-Christophe Hamilton, -, 10/2018, 10/2021
- Wang Wang, LiteBIRD Preparation, IN2P3, Guillaume Patanchon, -, -, 12/2020–12/2023
- ZHANG, Zheng, "Le rôle de la polarisation dans les relevés à 21 cm" (HIRAX, REACH, SKA,...), DIM-ACAV, Martin Bucher, François Boulanger, 1/11/2000 - 1/11/2003

Are Covid Extensions to these posts possible?

Activités de l'équipe de recherche

• Coopérations/collaborations principales avec l'extérieur (avec équipes locales, nationales, internationales)

- IRL Berkeley - Centre P. Binetruy
- IRL Tokyo ILANCE
- QUBIC: Argentine (CNEA/CONICET), Italie (INFN Rome & Milan)

• Visiteurs de longue durée (>3 mois) depuis 3 ans (sabbatiques, cofinancés, ...)

- QUBIC (sur LIA ALFA-AC): M. Gamboa (Ar, PhD), C. Duca (Ar, Eng), E. Rasztoky (Ar, Eng)

• Participations à la communication, à la vulgarisation, à l'enseignement (pour les CNRS)

- Bucher : taught "Special Topics in Radio Astronomy" (2020) 4th year Honours course at UKZN, Durban, South Africa; Editorial Advisory Board of Quest Magazine (popular science magazine; 2020-2023)
- Chardin : Président du Concours CGenial (Fondation CGenial, Sciences à l'Ecole) (Collèges et Lycées); Membre du Comité Scientifique « Sciences et Citoyens »
- Errard: Coordinateur du cycle de conférences "Histoire du Cosmos" pour l'Université Ouverte
- Hamilton: Cosmologie à l'Université Ouverte (Université de Paris), Data Analysis in Particle Physics and Cosmology à l'école Centrale-Supélec (Saclay)
- Khlopov : Virtual Institute of Astroparticle physics
- Boucaud: Modélisation et machine learning (Université de Paris)

See also the PCCP...

• Responsabilités hors projets (laboratoire, université, sites, comités, ...)

- Bartlett: Membre CS UFR de Physique
- Bucher : Co-editor of "Essential Facts About Covid-19 for South African Learners" (commissioned by the Academy of Science of South Africa); Academy of Science of South Africa (2019)
- Chardin : membre du Haut Conseil TGIR; président du conseil de CTAO GmbH
- Ganga : European CMB Coordinators; Section 17 CoNRS (2016-pres.); IN2P3 Prospectives; CFM-Fondation; APPEC Science Advisory Committee; IAS & LPC HCERES Committees; Committee CDS Chaire d'Excellence (CPPM)
- Mei : Vice President CNU 34, member CUFR (to this year); CS DIM ACAV+. Coordinator of the Action de synergie cosmologie et structuration de l'Univers à l'Observatoire de Paris, coordination EUR EPU at UP; APC Deputy Director
- Hamilton: membre du CS APC, membre du CS du LIA ALFA-AC (France/Argentine)
- Patanchon : Porteur projet européen RISE, financement obtenu 1.2 M€ , Large scale B-mode polarization analysis; Directeur département SPACE USTH

• Organisations d'écoles, de workshops, conférences, ... (2019-2021)

- 06/2021 - ATLAS Space Mission
- GALSPEC21
- Alvio@80 (Crete)
- Towards Coordination of the European CMB Programme; 12-13 September 2019 (<https://indico.in2p3.fr/event/19414/>)
- Bayesian deep learning for Cosmology and Gravitational Waves, 4-6 March 2020, <https://indico.in2p3.fr/event/19458>

Implication dans les projets: Euclid

Responsable scientifique de labo du (master) projet : James G. Bartlett

Responsable technique de labo du (master) projet : Cécile Cavet

Liste des chercheurs de l'équipe impliqués dans le projet :

• Permanents [prénom, nom, %ETPT dans le projet, (responsabilité)]

- Éric Aubourg, 20%, scientifique réf. SDC-Dev
- James G. Bartlett, 50%, scientifique réf. du projet Euclid à l'APC et co-responsable SWG Galaxy Clusters
- Ken Ganga, 50%, responsable Master Projet Euclid@IN2P3 et scientifique réf. SDC-FR-Prod
- Simona Mei, 40%, scientifique réf. PF LE3 et PF EXT à l'APC
- Cyrille Rosset, 70%, scientifique réf PF SIM à l'APC
- Cécile Roucelle, 10%

• Post-doctorants

- Stéphane Ilic, 40%

• Doctorants

- Anton Afanasiev, 10%
- Raphaël Kou, 70%

Liste des ingénieurs et techniciens

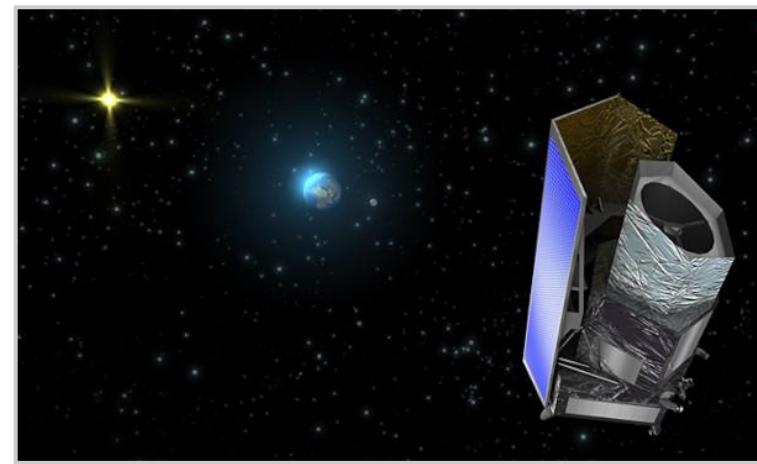
du laboratoire impliqués dans le projet :

• Y permanents

- Alexandre Boucaud, IR, 20%, contribution MER
- Cécile Cavet, IR, 60%, chef de projet Euclid@APC
- Jean-Marc Colley, IR, 40%, développement EXT stage 1, PA/QA
- Maude Le Jeune, IR, 0% (contribution en 2023)
- Martin Souchal, IE, 40%, responsable de la plateforme CODEEN (SDC-Dev)
- Sébastien Zappino, AI, 10%, support

• Y CDD [prénom, nom, %ETPT dans le projet, source de financement, date début, date fin]

- Antoine Boizard, 100%, CNES, 01/03/2017 - 31/08/2022 (5,5 ans), administration et support de la plateforme CODEEN
- Jennifer Pollack, 100%, CNES, 01/11/2020 – 31/10/2021 (renouvellement possible), développement LE3, SIM et EXT stage 2



Implication dans le projet LiteBIRD

Responsable scientifique de labo du (master) projet : Michel Piat

Responsable technique de labo du (master) projet : Laurent Grandsire

Liste des chercheurs de l'équipe impliqués dans le projet :

• **Permanents [prénom, nom, %ETPT dans le projet, (responsabilité)]**

- Michel Piat, 20%
- Martin Bucher, 10%
- Josquin Errard, 50%, Performance Team co-lead
- Ken Ganga, 5%
- Jean-Christophe Hamilton, 5%
- Guillaume Patanchon, 50%, Systematic Working Group co-coordinator, Interim Governance Board member
- Radek Stompor, 40%, Coordination Team member, European Steering Committee member, Interim Governance Board member

• **Post-doctorants**

- Clément Leloup, 100%

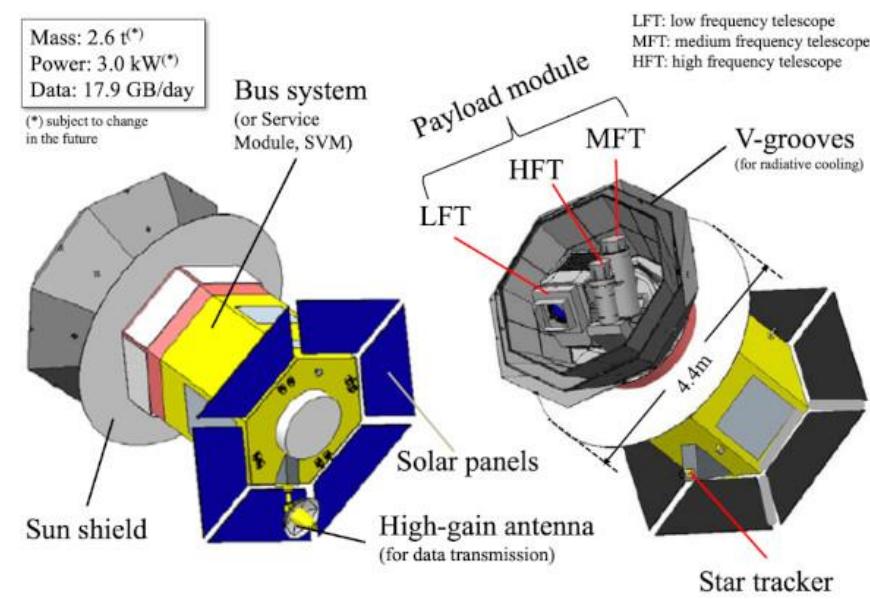
• **Doctorants**

- Wang Wang, préparation de l'analyse des données, 100%

Liste des ingénieurs et techniciens du laboratoire impliqués dans le projet :

• **Y permanents**

- Jean-Pierre Therneau, IR, 40%,
- Laurent Grandsire, IR, 30%
- Claude Chapron, 50%
- Maurice Karakac, 50%
- Stéphane Dheilly, 10%
- Damien Pailot, 20%
- Corinne Juffroy, 10%



Implication dans les projets: QUBIC

Responsable scientifique de labo du (master) projet : Jean-Christophe Hamilton

Responsable technique de labo du (master) projet : Michel Piat

Liste des chercheurs de l'équipe impliqués dans le projet :

• 6 Permanents

- Jean-Christophe Hamilton, 70%, (QUBIC Spokesperson)
- Michel Piat, 30%, (QUBIC Instrument Scientist)
- Steve Torchinsky, 70%, (QUBIC Calibration Scientist)
- Sotiris Loucatos, 50%, (Data Analysis)
- Jean Kaplan, 80%, (Data Analysis)
- Ken Ganga, 5%, (Data Analysis)

• 0 Post-doctorants

• 2 Doctorants

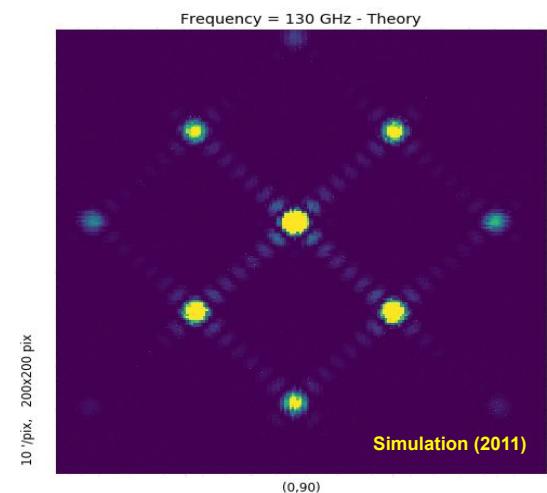
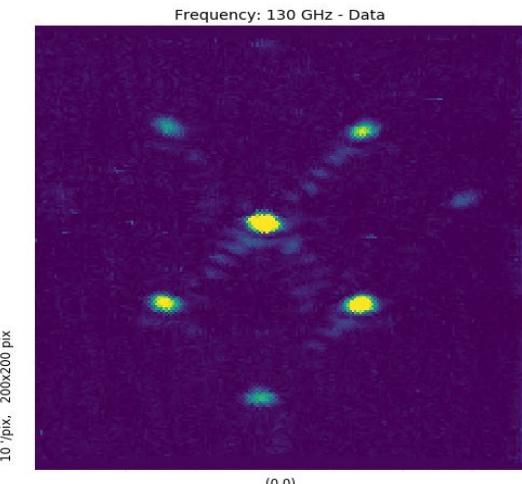
- Louise Mousset, QUBIC Data Analysis and Simulations, 100%, (Resp. Data Analysis Meetings)
- Guillaume Stankowiak, QUBIC Detection Chain, 100%

Liste des ingénieurs et techniciens du laboratoire impliqués dans le projet :

• 7 permanents

- Laurent Grandsire, IR, 70%, (QUBIC Project Manager)
- Claude Chapron, IR, 20%, (QUBIC Mechanical Architect)
- Fabrice Voisin, IR, 20%, (Micro-électronique: chaîne de détection)
- Jean-Pierre Therneau, IR, 10%, (Cryogénie)
- Damien Prêle, IR, 10%, (Micro-électronique: chaîne de détection)
- Maurice Karacak, IE, 30%, (Mécanique)
- Stéphane Dheilly, AI, 10%, (Mécanique: Atelier)

• 0 CDD [prénom, nom, %ETPT dans le projet, source de financement, date début, date fin]



Implication dans les projets: Rubin

Responsable scientifique de labo du (master) projet : Éric Aubourg

Responsable technique de labo du (master) projet : Françoise Virieux

Liste des chercheurs de l'équipe impliqués dans le projet :

• Permanents

- Éric Aubourg, 80%, PI ANR AstroDeep, System scientist camera controls
- Ken Ganga, 10%, AstroDeep, Synergy with Euclid and CMB
- Simona Mei, 30%, AstroDeep, Synergy with Euclid and photo-z
- Cécile Roucelle, 50%, AstroDeep

• Post-doctorants

- Axel Guinot, 100%, AstroDeep

• Doctorants

- Bastien Arcelin, 100%, Apprentissage machine et lentillage gravitationnel

Liste des ingénieurs et techniciens du laboratoire impliqués dans le projet :

• Y permanents

- Alexandre Boucaud, IR, 70%, AstroDeep + camera controls/filter exchanger
- Maude Le Jeune, IR, 5%, AstroDeep
- Françoise Virieux, IR, 95%, AstroDeep + camera controls/filter exchanger



Implication dans Simons Observatory/S4

Responsable scientifique de labo du (master) projet : Radek Stompor

Responsable technique de labo du (master) projet :

Liste des chercheurs de l'équipe impliqués dans le projet :

- **Permanents [prénom, nom, %ETPT dans le projet, (responsabilité)]**

- Radek Stompor, 40%, SO Membership Committee member,
S4 Junior Scientist Advancement Committee member
- Josquin Errard, 50%, SO Theory and Analysis member,
co-lead of the SO B-mode Working Group
- Jim Bartlett, 35%, SO Oversight Committee
- Ken Ganga, 25%, SO Talks Panel

- **Doctorants**

- Hamza El Bouhargani, 100%,
préparation de l'analyse des données
- Baptiste Jost, 100%
préparation de l'analyse des données



Production scientifique

- **Résultats scientifiques marquants de l'équipe (2018-2021) – 5 max**

- POLARBEAR The Astrophysical Journal, Volume 897, Issue 1, id.55, 23 pp. (2020) + Physical Review Letters, Volume 124, Issue 13, article id.131301 (2020).
- Confirmation of 16 clusters at $z > 1.5$ (Noirot et al. 2018)
- Spider CMB Balloon experiment 1st results (
<https://ui.adsabs.harvard.edu/abs/2021arXiv210313334S/abstract>)

- **Thèses récentes soutenues dans l'équipe (2018-2021)**

- Calum Murray, preparing the euclid dark energy survey with clusters, 2020, Grenoble
- Clara Vergès, Recherche des ondes gravitationnelles primordiales avec la nouvelle génération des observatoires de polarisation du fond diffus cosmologique, 2020, Harvard
- Dominic Beck, Challenges in CMB Lensing Data Analysis and Scientific Exploitation of Current and Future CMB Polarization Experiments, 2019, Stanford
- Van Tuan Bui, A study of the large-scale structure of the universe with galaxy clusters : from Planck to Euclid, 2019
- Hoang Duc Thuong, Optimization of future projects for the measurement of Cosmic Microwave Background polarization, 12/2018, (retour USTH VN après un post-doc à Cornell)
- Carla Pieterse, "Comparison of Prime Focus and Offset-Gregorian Reflector Antennas for 21cm Intensity Mapping", Graduated Summa Cum Laude Jan 2021, Bucher with Dirk De Villiers, Dept. of Electrical Engineering, University of Stellenbosch and Kavilan Moodley, University of KwaZulu-Natal)

- **3 publications emblématiques de l'équipe dans revues à comité de lecture (2018-2021)**

- The LSST DESC DC2 Simulated Sky Survey, March 2021
- Hamilton et al. 2020, QUBIC I: Overview and Science Program
- Planck Collaboration 2020, Planck 2018 results. I. Overview and the cosmological legacy of Planck

- **3 publications récentes de conférence à forte contribution de l'équipe (2018-2021) :**

- Hazumi et al. 2020, LiteBIRD satellite: JAXA's new strategic L-class mission for all-sky surveys of cosmic microwave background polarization
- Carlstrom et al. 2019, CMB-S4 Decadal Survey APC White Paper

- **Passages aux conseils scientifiques de labo (3 ans)**

- 2020: Euclid+Rubin
- LiteBIRD

Evolution anticipée de l'équipe (3-5 ans)

- **Nouveaux projets en vue (inclus réponse aux appels ANR, Europe, appel d'offre locaux, ...)**

- Athena?
- CMB Stage 4?
- SKA?
- ATLAS Space Mission?

- **Evolution de la composition de l'équipe (départs/arrivées permanents, docs, post-docs, ...)**

- Gabriel Chardin deviendra émérite à la fin de l'année
- Yannick Giraud-Héraud est émérite, mais aura des difficultés à retourner à l'APC
- Jie Hu, a postdoc working in the mmLab, is now employed by the Observatory
- Simona Mei (et son équipe Illic; Afanasiev; Galaxy Formation/Evolution with Infrared-Radio imaging & spectroscopy) est arrivé
- 2 doctorants et 1 postdoctorant attendus en 2021 dans l'équipe Rubin/AstroDeep

- **Attente vis-à-vis de l'IN2P3**

- CNRS permanent (CRCN): Cosmologist for Euclid, a major space cosmology project and important priority for the IN2P3. For work on Large-Scale Structure, Bulk Flows, and Cross-Correlation science, with which there is strong complementarity with the LSST science case -- both of which we intend to exploit as the two observatories begin taking data 2023. The APC is deeply engaged, notably with the Reference Scientist for the French Euclid Data Center and a Cluster Science Working Group Coordinator. Despite this engagement, as well as the loss of a number of members of the group, this team has never benefited from a CRCN. This post is therefore, as it has been for a number of years, our first priority.
- CNRS CDD: Work on QUBIC and transition strategies for adapting to the era of Simons Observatory, *LiteBIRD* and CMB-S4. Development for future CMB missions is another priority for the APC Cosmology group, and its first priority for a CDD. The Group leads the QUBIC project, which can be considered as an essential precursor for ambitious future experiments targeting CMB polarisation B-Modes. Support on this project, at the time when the project is going to be established on the Argentinian site, would also be of great help for the IN2P3 as we transition to next-generation ground- and space-based CMB missions such as *LiteBIRD* and CMB Stage 4.

- **Autres..**

* I would note that **Cyrille Doux**, ranked 8 in this year's CRCN competition, would be perfect for our work on Euclid, for collaboration between Euclid and Rubin at the APC, and long-term doing further work with the CMB as well at the APC.

BACKUP

[+ Tous les documents jugés utiles pour la discussion]

Activity and plans of Scientific-Educational complex of

Virtual Institute of Astroparticle physics (VIA)

Accomplished by video-conferencing room, Forum, Library of records and presentations, VIA complex operates on website <http://viavca.in2p3.fr/site.html>

Created in 2006 as ASPERA pilot project, since 2009 it is incorporated in APC structure. Since 2018

there were more than 200000 visits of site from 153 countries (Google Analytics)



VIA transmissions of talks at 38 APC Colloquiums; Online seminars of APC Theory group; 101 VIA online lectures; Distant presentations of 42 speakers at 15 Conferences; Online XXII and XXIII Bled Workshops "What comes beyond the Standard models?" (2019,2020) Satellite Workshop "A.D.Sakharov's legacy in Cosmoparticle physics" dedicated to 100th Anniversary of A.D. Sakharov (2021) on VIA platform. Open Online Course "Cosmoparticle physics" by M.Khlopov, D.Semikoz, M.Bucher, Fully distant Open Online Exams

VIA future plans include: transmissions of APC colloquia and important seminar talks, support of presentations at distance at Conferences and Workshops, regular weekly VIA lectures from all over the world; Open Online Courses involving student's work on thesis on Forum with successive Open Online Exam with distant evaluation, ...

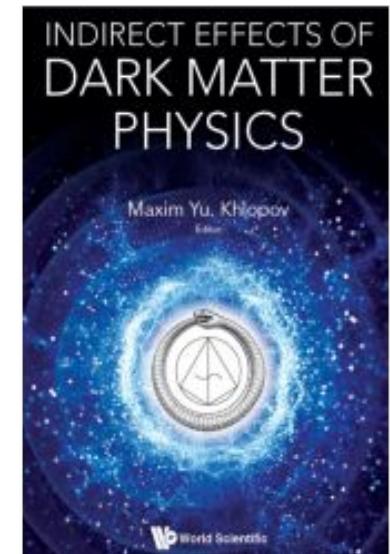
All these plans imply an urgent solution of the dramatic problem: since 2017 neither Director (M.Khlopov), nor Webmanager get any financial support for VIA activity.

M.Khlopov's scientific results and plans

2018-now: 52 papers, published in peer reviewed International journals, accomplishing APC theoretical studies in physics of dark matter, massive PBH formation, cosmological reflection of particle symmetry and multimessenger cosmological probes; Editor -in Chief of special issues "New trends in Cosmology and Astroparticle physics" of International Journal of Modern Physics D ; Guest editor of 9 special issues of Symmetry, Universe, Physics, Particles, Galaxies. Symmetry Best paper award 2021



now-2024: studies of physics of composite dark matter, cosmological consequences of Supergravity, formation of PBHs and Primordial massive BH binaries, Editor in Chief of special issue "New trends in high energy physics. Astroparticle physics and Cosmology" of International Journal of Modern Physics D, Book review "Indirect effects of dark matter physics" and monographies "Dark Atoms of Dark Worlds" and "Cosmoparticle physics" (2 edition) to be published by World Scientific.



QUBIC: the QU Bolometric Interferometer for Cosmology

Scientific Objectives & Collaboration:

- Primordial B-modes search $\sigma(r)=0.015$ (3 years)
- Improved constraints on dust properties (Spectro-Imaging)
- France-Argentina-Italy (+UK, Ireland)
 - At APC: Spokesperson, Instrument Scientist, Project Manager, Calibration Scientist
- Site: 5000m a.s.l. near Salta, Argentina

Design: (Done mostly at APC)

- 400 elements (first) Bolometric Interferometer
- 22 arcmin FWHM synthesized beam
- 150 and 220 GHz wide bands
- 1024 TES / band @ 300 mK with $NEP=4\times10^{-17} \text{ W.Hz}^{-\frac{1}{2}}$
- 128:1 SQUIDs + SiGe ASIC Multiplexing

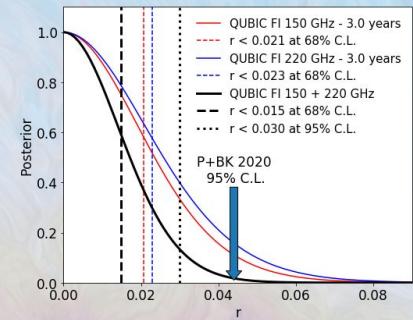
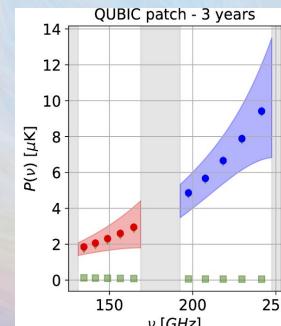
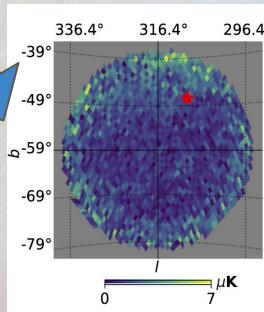
Activities:

- 2018: Technological demonstrator Integration at APC
- 2019: Calibration at APC: **Demonstration of BI**
- 2020: [CNRS Review \(Jan\)](#), [8 articles](#) in [JCAP special issue](#)
- 2021: **Shipment to Argentina: May 15th (IN2P3 funded)**

QUBIC Specificities & Forecasts:

• Spectral Imaging [[QUBIC I](#), [QUBIC II \(2021\)](#)]

- Wide-band measurements → up to 5 sub-bands maps !
- Increased constraints on foregrounds (esp. complex dust)



- Self-Calibration for instrumental systematics control

Pending funding (France):

- ERC-Adv (J.-Ch. Hamilton, Step 2)
- ANR (Step 2)

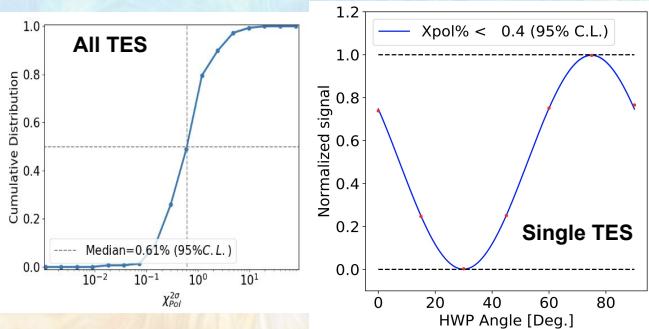
Funding Secured in Italy (INFN) and Argentina (CONICET/CNEA/MINCYT)

QUBIC Instrument phases	2022		2023		2024		2025		2026		2027...	
	Data Taking with TD	Upgrade to FI			Data Taking with FI				Upgrade to FI+			Data Taking with FI+
Scientific phases and objectives	Phase 1: QUBIC TD Science On-Sky demonstration of BI → First spectro-imaging results on bright Galactic regions		Phase 2: QUBIC FI Science $\sigma(r) = 0.015$ → Self-Calibration operational → Constraints on diffuse dust SED in the “clean” QUBIC field → SED of bright Galactic regions		Phase 3: QUBIC FI+ Science $\sigma(r) \sim 0.001$ → Sensitivity increase → Delensing from BI at LLAMA 12m antenna							

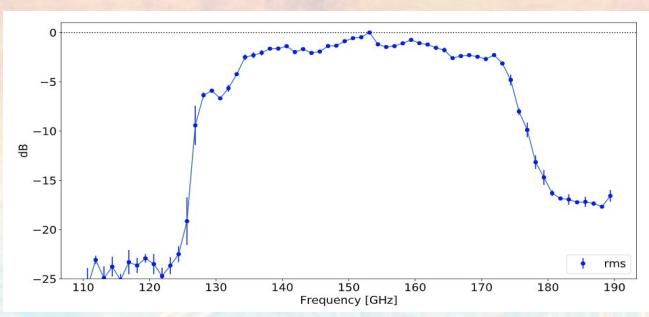


QUBIC Calibration Results (QUBIC III 2021):

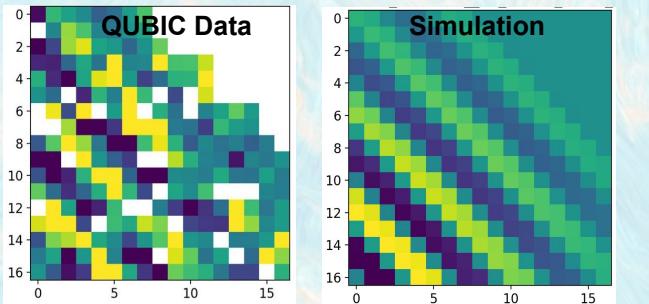
Cross-Pol: (~5x better than competitors)



Bandwidth



Interference Fringes



Spectral-Imaging demonstration with real data

