Institut
Physique de
l'Univers
Aix*Marseille Université

Astro Group

High energy astrophysics

Astroparticles

Coordination:
Damien Dornic (CPPM), Emmanuel Nezri (LAM)

Astro Group

Main axes:

- *Gravitationnal waves*

- *High energy sky (multi wavelength, multi-messenger)*

- *Dark matter*

Groupe Astro

People in the list : 10 LAM, 5 CPT, 14 CPPM

«»	Email	Domaine	Nom	Réception	Sources	Abonné depuis	Mise à jour
☐	albert.bosma@lam.fr			normal (réception directe des messages)	subscribed	07 févr. 2020	07 févr. 2020
☐	aoife.bharucha@cpt.univ-mrs.fr			normal (réception directe des messages)	subscribed	20 févr. 2020	20 févr. 2020
☐	bertin@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	13 févr. 2020	13 févr. 2020
☐	busto@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	19 févr. 2020	19 févr. 2020
☐	cassol@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	07 févr. 2020	07 févr. 2020
☐	chris.marinoni@gmail.com			normal (réception directe des messages)	subscribed	09 avril 2020	09 avril 2020
☐	costant@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	13 févr. 2020	13 févr. 2020
☐	coyle@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	13 févr. 2020	13 févr. 2020
☐	delphine.porquet@lam.fr			normal (réception directe des messages)	subscribed	19 févr. 2020	19 févr. 2020
☐	dornic@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	13 févr. 2020	13 févr. 2020
☐	emmanuel.nezri@lam.fr			normal (réception directe des messages)	subscribed	11 févr. 2020	11 févr. 2020
☐	eric.kajfasz@univ-amu.fr			normal (réception directe des messages)	subscribed	07 févr. 2020	07 févr. 2020
☐	ernenwein@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	14 févr. 2020	14 févr. 2020
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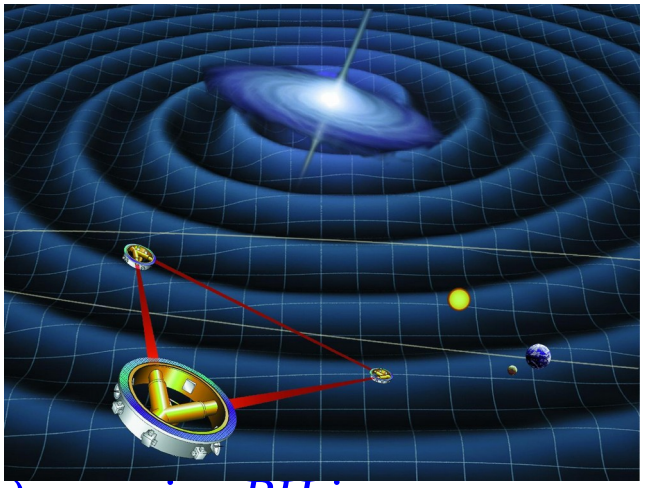
☐	guillaume.bonnet@lam.fr			normal (réception directe des messages)	subscribed	20 févr. 2020	20 févr. 2020
☐	hubaut@in2p3.fr			normal (réception directe des messages)	subscribed	07 févr. 2020	07 févr. 2020
☐	jean-gabriel.cuby@lam.fr			normal (réception directe des messages)	subscribed	19 févr. 2020	19 févr. 2020
☐	julien.bel@cpt.univ-mrs.fr			normal (réception directe des messages)	subscribed	09 avril 2020	09 avril 2020
☐	marceau.limousin@lam.fr			normal (réception directe des messages)	subscribed	19 févr. 2020	19 févr. 2020
☐	matthew.pieri@lam.fr			normal (réception directe des messages)	subscribed	06 févr. 2020	06 févr. 2020
☐	nicolas.grosso@lam.fr			normal (réception directe des messages)	subscribed	10 mars 2020	10 mars 2020
☐	pralavor@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	07 févr. 2020	07 févr. 2020
☐	roland.triay@cpt.univ-mrs.fr			normal (réception directe des messages)	subscribed	10 févr. 2020	10 févr. 2020
☐	secroun@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	13 févr. 2020	13 févr. 2020
☐	stephane.basa@lam.fr			normal (réception directe des messages)	subscribed	07 févr. 2020	07 févr. 2020
☐	stephane.blondin@lam.fr			normal (réception directe des messages)	subscribed	10 févr. 2020	10 févr. 2020
☐	stephanie.escoffier@univ-amu.fr			normal (réception directe des messages)	subscribed	13 févr. 2020	13 févr. 2020
☐	tao@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	20 févr. 2020	20 févr. 2020
☐	yassine@cppm.in2p3.fr			normal (réception directe des messages)	subscribed	13 févr. 2020	13 févr. 2020

Gravitational waves



- *CPPM-LAM collab (D.Porquet, E. Kajfasz …)*
- *Prepare the scientific return of LISA*

- Massive BH physics (formation, evolution, microphysics), merging BH in binary system over a very wide mass range anywhere in the Universe

- Long observations of stellar mass BHs in complement of the ground interferometers (super angular resolution, early alerts)

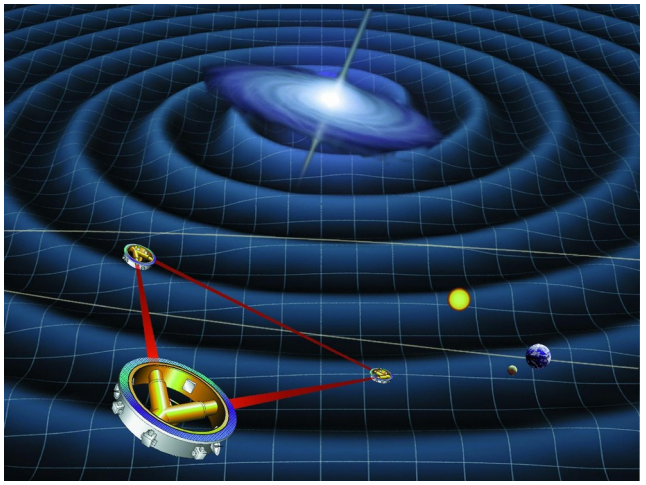
- multi-messenger studies (better localisation, more diversity…)

- Link with cosmology (BH population evolution, Hubble constant, stochastic GW signal, etc)

- *Synergy ground-space GW interferometers ?*

- *Link LISA with the CPT activities on gravitation ? Model discrimination ? ...*

Gravitational waves

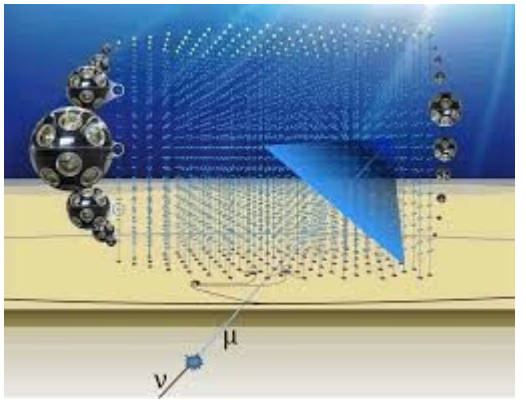


- *Half day meeting planned around spring 2021 (D.Porquet, E.Kajfasz. C.Marinoni, A.Perez)*

- *No project application in this field to the current IphU call. Technical work first, PhD in future*

- *IPhU contribution to CDD engineer @ CPPM to work on IR LEDs of LISA.*

High energy sky

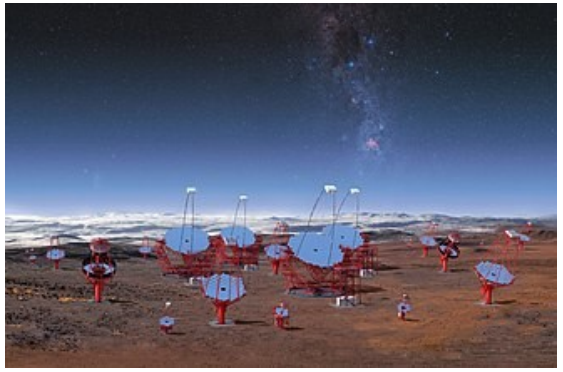


- *Enhanced the scientific return of the big experiments: CTA, KM3NeT and SVOM (+LSST)*

- Link more the CPPM HE group and the LAM GECO (source characterization and modelisation, study of source population, multi-wavelength follow-ups, access to observing facilities…)

- *Time domain astronomy*

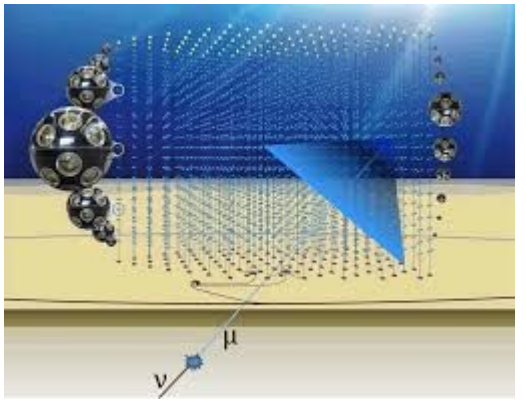
- Multi-wave length observations
- Understanding gamma-ray burst physics (Colibri)
- Studies of HE transient/variable sources (microquasars, blazars, ULX, TDE…)
- Support Theseus project



- *Multi-messenger astronomy*

- Finding the sources of HE neutrinos and the PeVatrons
- Understanding the link between VHE gamma, HE neutrino and UHECR
- Finding the HE part of the GWs, participate to the follow-up campaign of some interesting GW candidates
- Prepare the detection of the next galactic SN

High energy sky

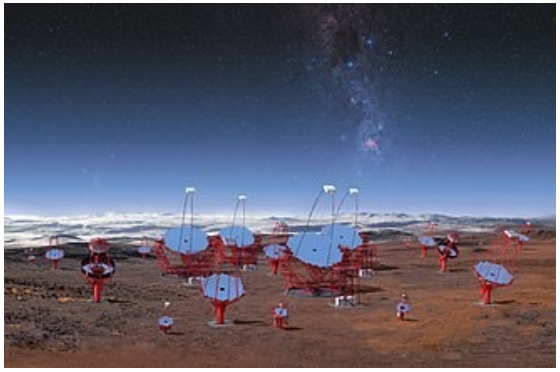


- Colibri: working LAM-CPPM collab, support to the construction

Need to define more collaborations between our 3 labs (CPPM/LAM, CPPM/CPT...)l

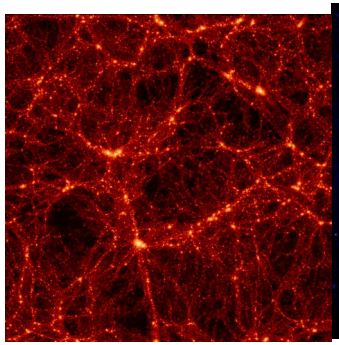
- CPT-CPPM : Link KM3NeT neutrino physics with CPT: sterile, NSI, physics beyond standard model … ? First contact between CPPM/CPT (Paschal/Alexandro-Christian) for neutrino decoherence, Lorentz invariance...

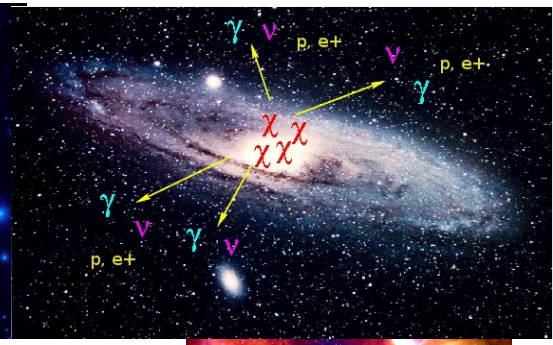
- CPPM-LAM: Supernovae physics ?



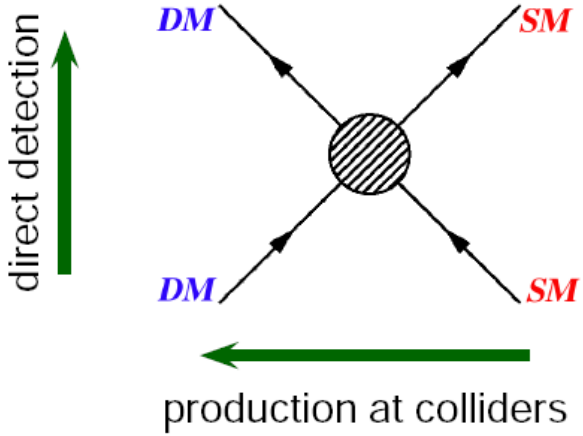
Dark matter

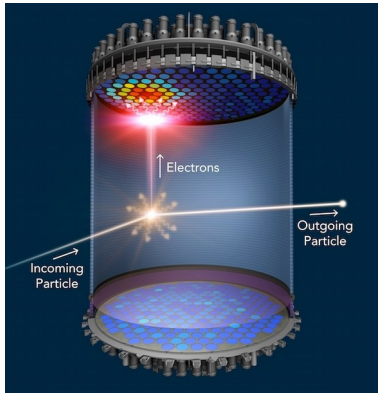
=> Understanding and Identification of DM

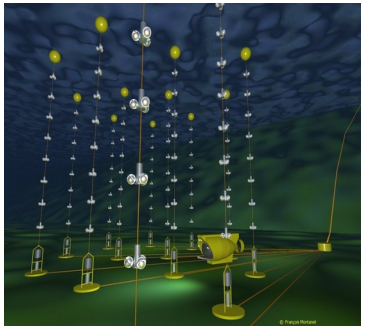


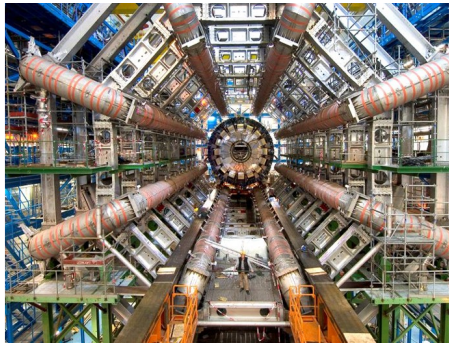


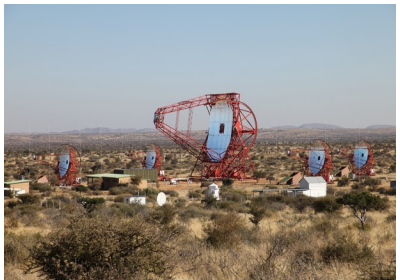
thermal freeze-out (early Univ.)
indirect detection (now)











Dark matter

Transgroup activity

PP : (non) particle candidates, BSM frameworks (WIMPs, Sterile neutrinos, ALPs, PBHs …), WIMP-nucleus cross sections from Lattice QCD

PP-Cosmo : relic density calculation, cross sections (tree/loop), hot universe scenario
(non) thermal ? freeze-in/out ?
Structure formation, minimal structure size, WDM, CDM, SIDM, FuzzyDM ?

Astro-cosmo: Dark matter distribution features
https://arxiv.org/abs/2004.06008, https://arxiv.org/abs/2005.03955

Halo profiles, clumpiness, environnement,
Cosmological N-body simulations, LSS, Lensing ...
dynamical studies, analytical models, galaxy formation,
Link with baryonic physics
Phase space distribution

Astro-PP-Cosmo: Dark matter detection
https://arxiv.org/abs/1906.11674, https://arxiv.org/abs/2005.03955

Direct detection
Indirect detection (multi wavelength, multi messenger)
Accelerators
Signals/exclusions in experiments

Dark matter
Transgroup actvity

Active collaborations :

- LAM, CPT (and LUPM)
OCEVU project “Lattice QCD enlightens DM”

https://arxiv.org/abs/2005.03955

+ new direct detection group in CPPM
(DarkSide (and MadMax) experiment)
P.Pralavorio, F.Hubaut

- LAM,CPPM :

Dark matter and neutrino telescopes

DM capture by the Sun:
(co-supervised OEVU PhD, A.Nunez-Castineyra)

https://arxiv.org/abs/1906.11674

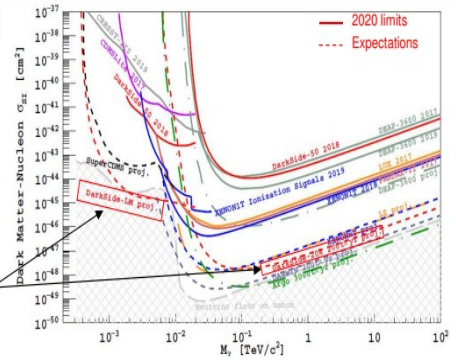
https://arxiv.org/abs/2004.06008

Neutrino and gamma (CTA)
signal from halos, GC …

Direct search for WIMP dark matter

Proposal for a new 4-year project btw experimentalists and theorists across 3 IPHU science working groups gathering **4 labs**. Request: **25 k€** over the 4 years and **one PhD grant** starting 2021

Goal : Prepare at best the search for WIMP dark matter with the first data of DarkSide-20k expt [Gran Sasso, It.] in 2024. This expt will explore the most favored region of phase space for masses between 1 GeV and 100 TeV



IPhU science working group(s) involved:
Astroparticle and HE Universe ☒ Galaxies and Cosmology ☒ Particle Physics ☒
Quantum Field Theory and Quantum Gravity ☐

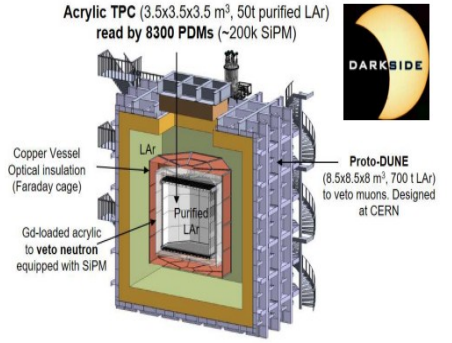
Project title: Direct search for WIMP dark matter

Project time frame:
Start date: 01/01/2021 duration (months): 48

Project coordination:
Coordinator's name: Pascal Pralavorio
Lab/team: CPPM/Matière Noire email: pralavor@cppm.in2p3.fr tel: 04 91 82 72 69

List of other teams involved:
Lab/team: CPPM/Matière Noire Team project leader: Fabrice Hubaut
Lab/team: LAM/GECO Team project leader: Emmanuel Nezri
Lab/team: CPT/PP Team project leader: Laurent Lellouch

Lavalle



Submitted 18-Dec 2020

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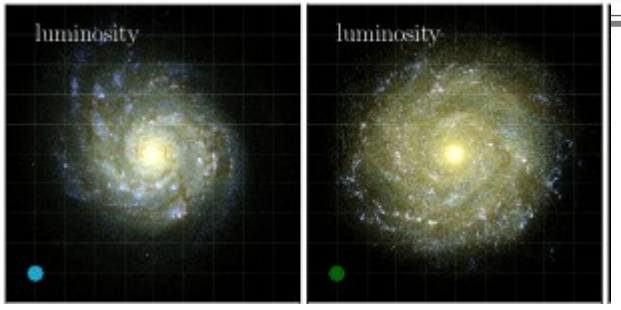

→ 2 half day meeting per year on DM to increase exchanges and collaborations.
BSM aspects from CPT , complementarity with LHC ...

Thanks