Seebeck effect in superconducting materials

Thomas KEITA
M1-Master of Fundamental Physics

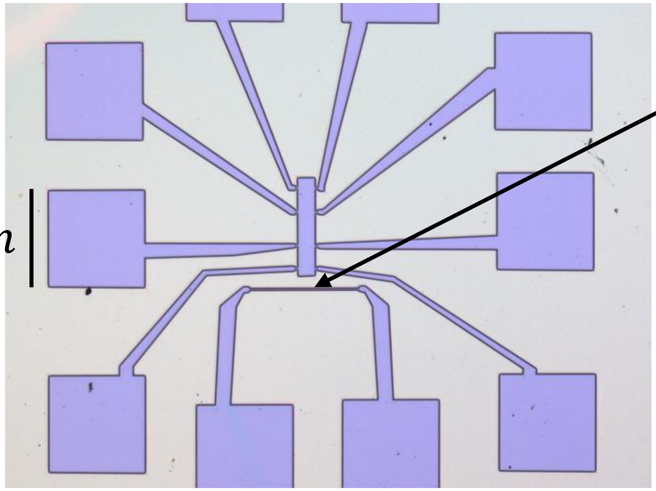
Astroparticle solid state detectors

IJCLab Irène Joliot-Curie
Laboratoire de Physique des 2 Infinis

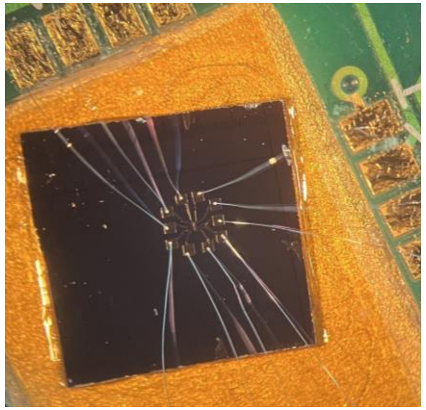
A2C Astroparticles, Astrophysics & Cosmology

Heating line

$300 \mu m$

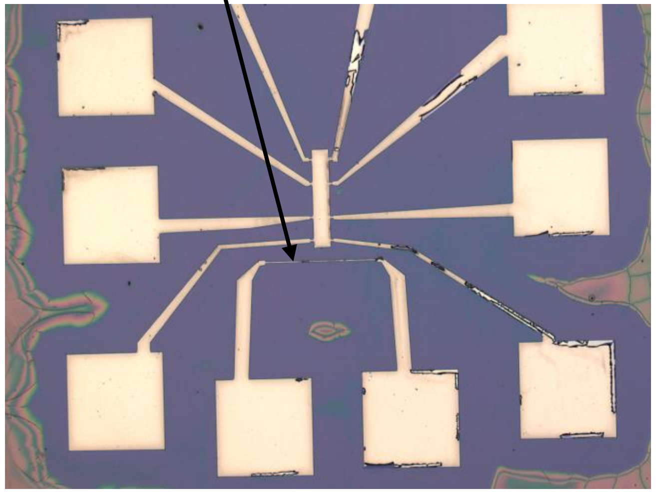


Sample 3
(before evaporation)

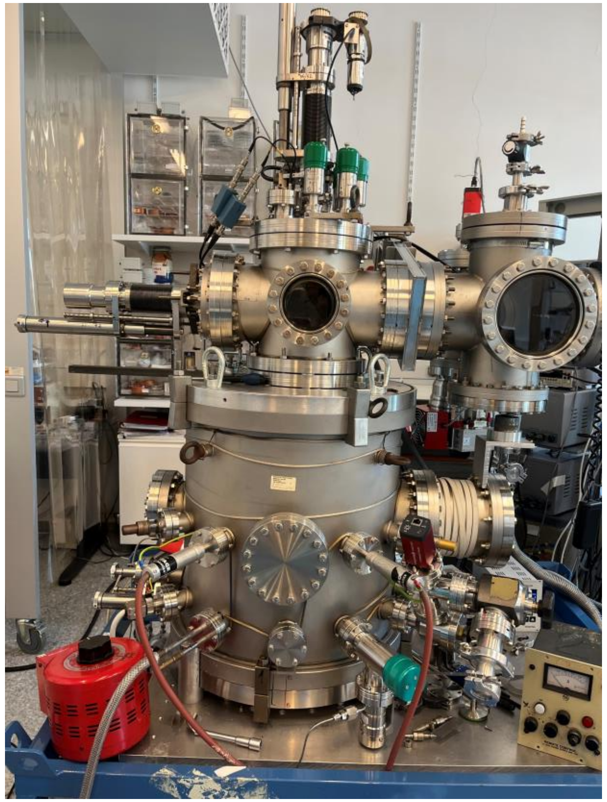


Sample 3
(after bonding)

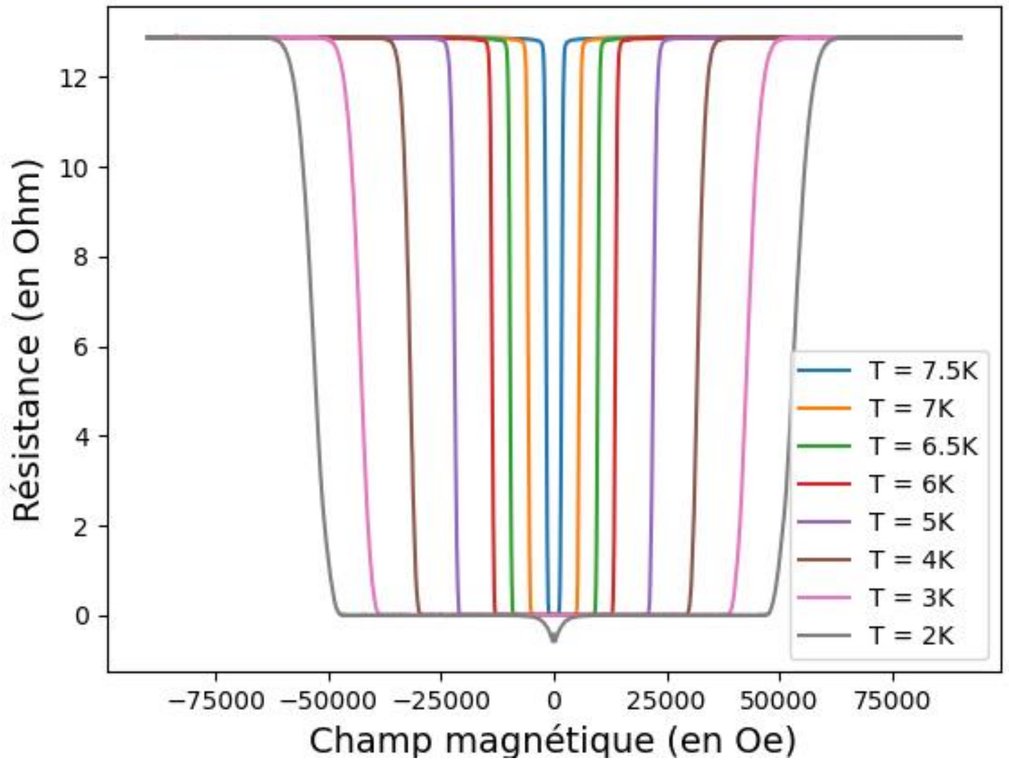
$300 \mu m$



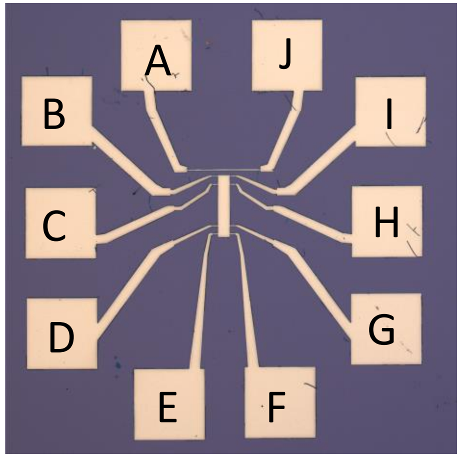
Sample 3
(after evaporation and after lift-off)



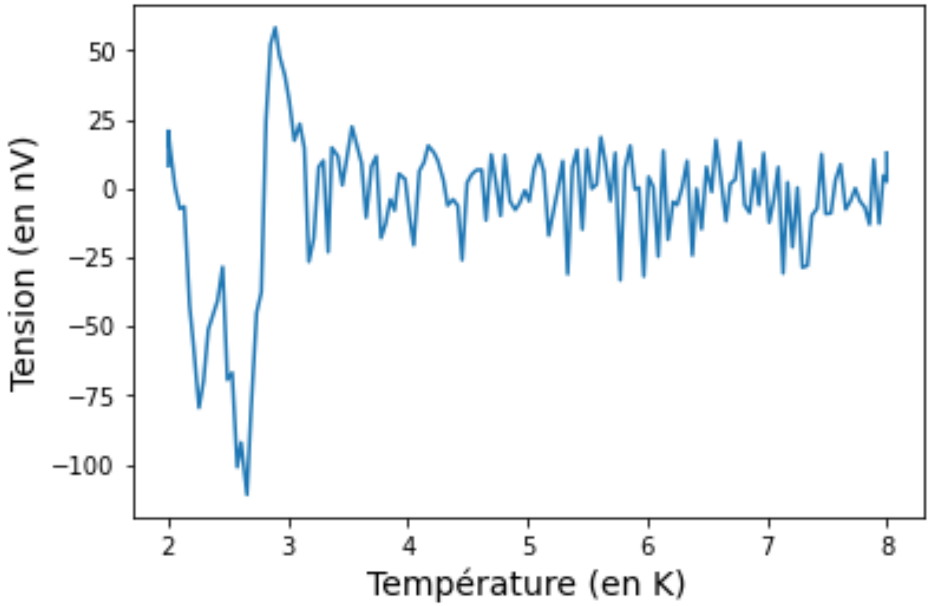
Picture of the evaporator in the clean room of bat.104



Graph showing the resistance of a Niobium sample as a function of the applied magnetic field for different temperatures

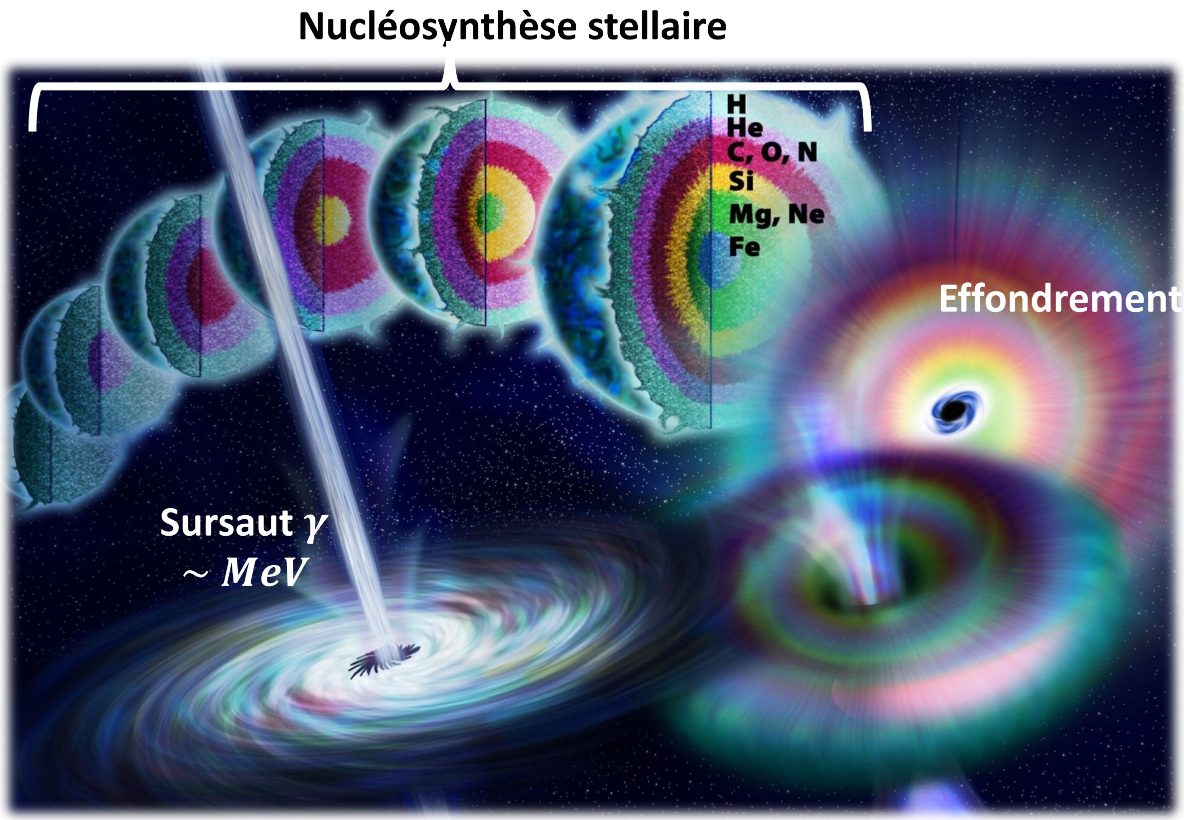


Picture of the sample used

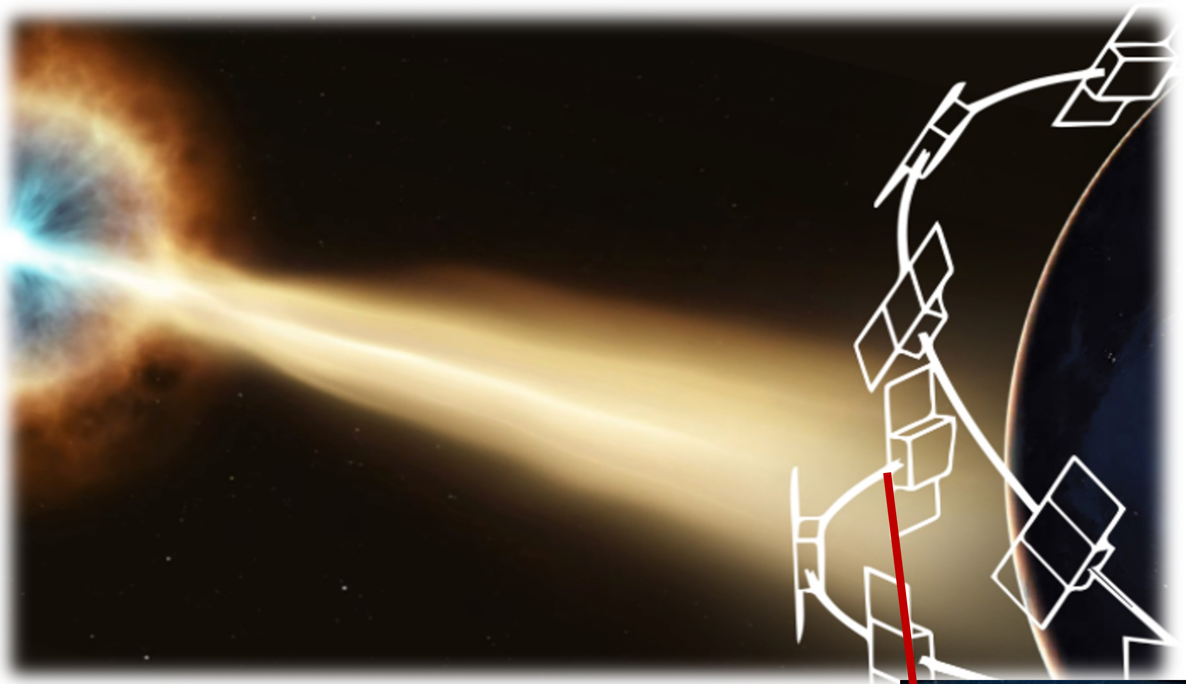


Data of thermoelectric effect

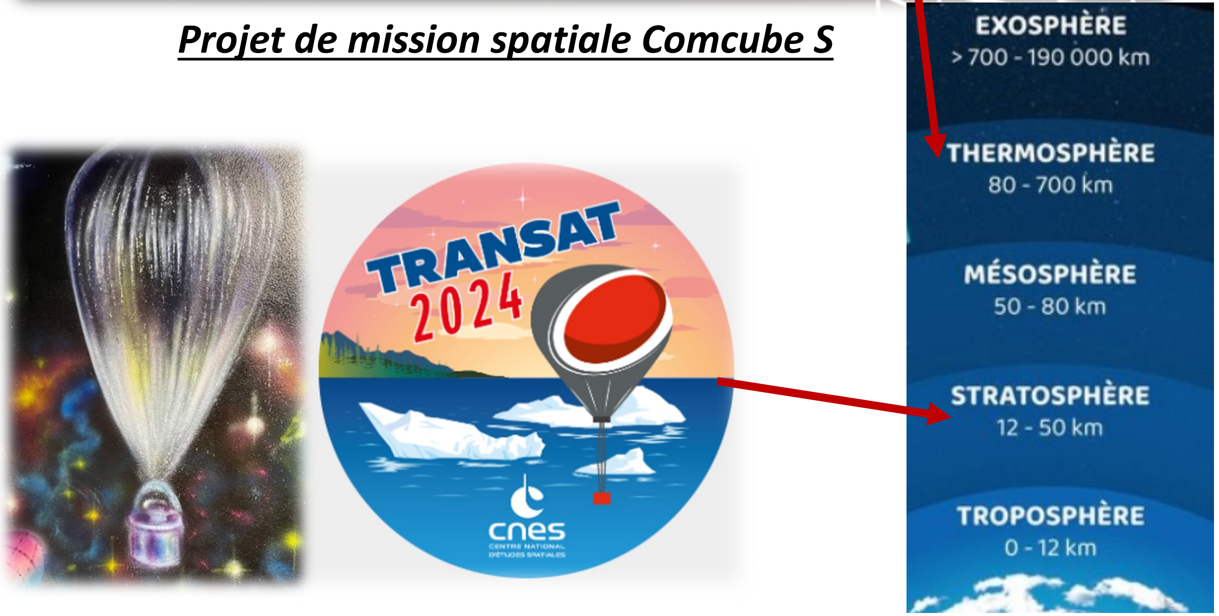
Comment étudier certains phénomènes violents de l'Univers?



Etoile massive

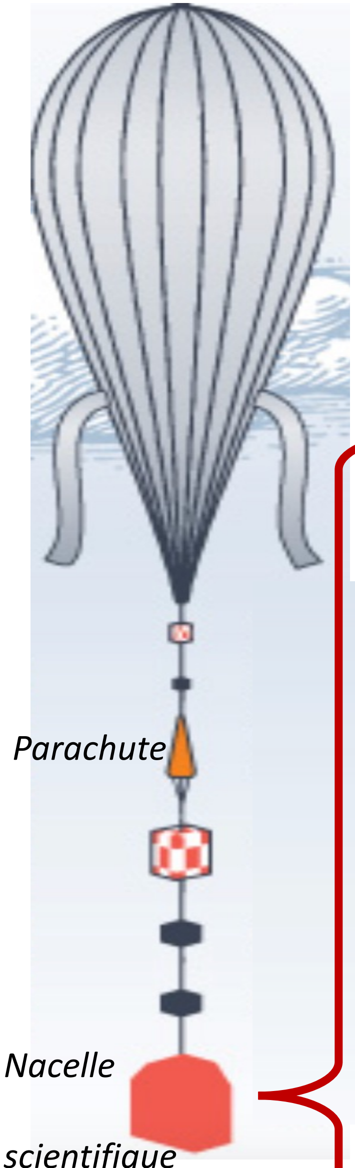


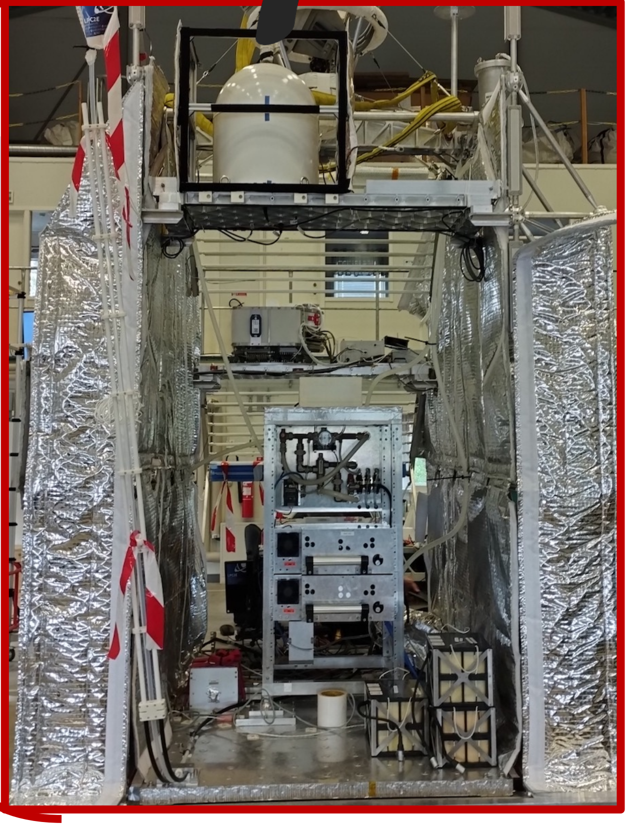
Projet de mission spatiale Comcube S

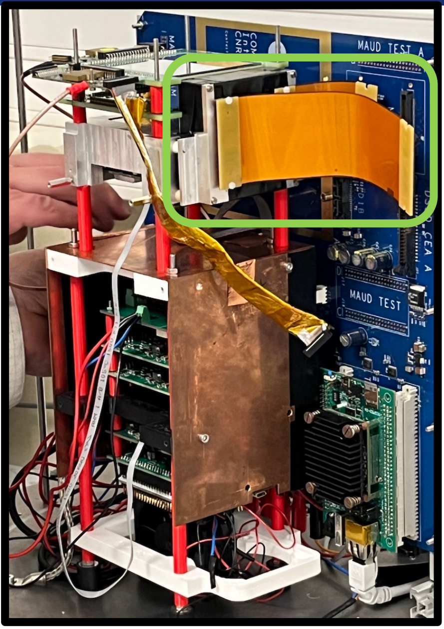


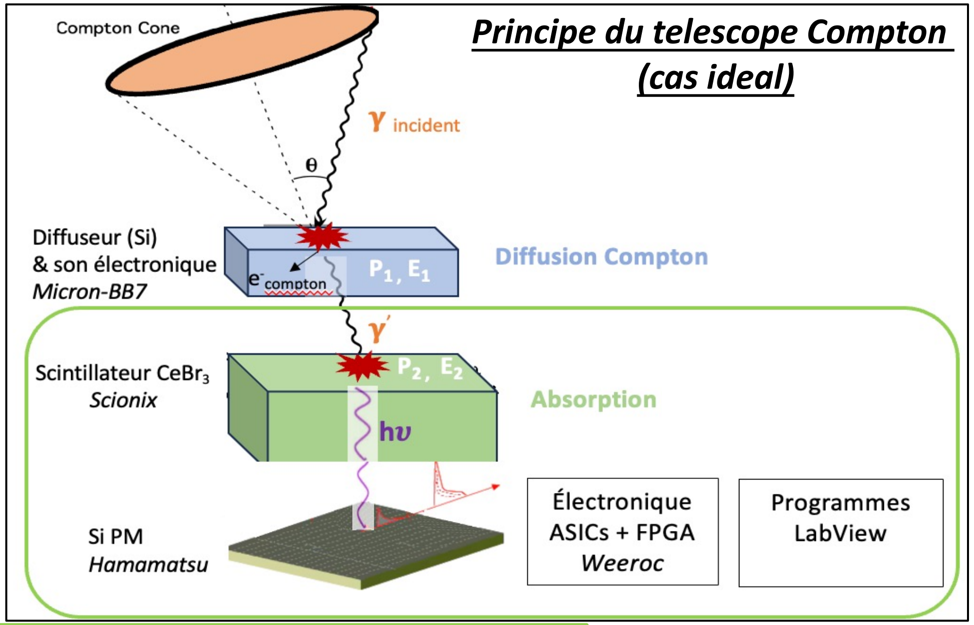
Comcube s'envole dans la stratosphère ! Puis dans l'espace?

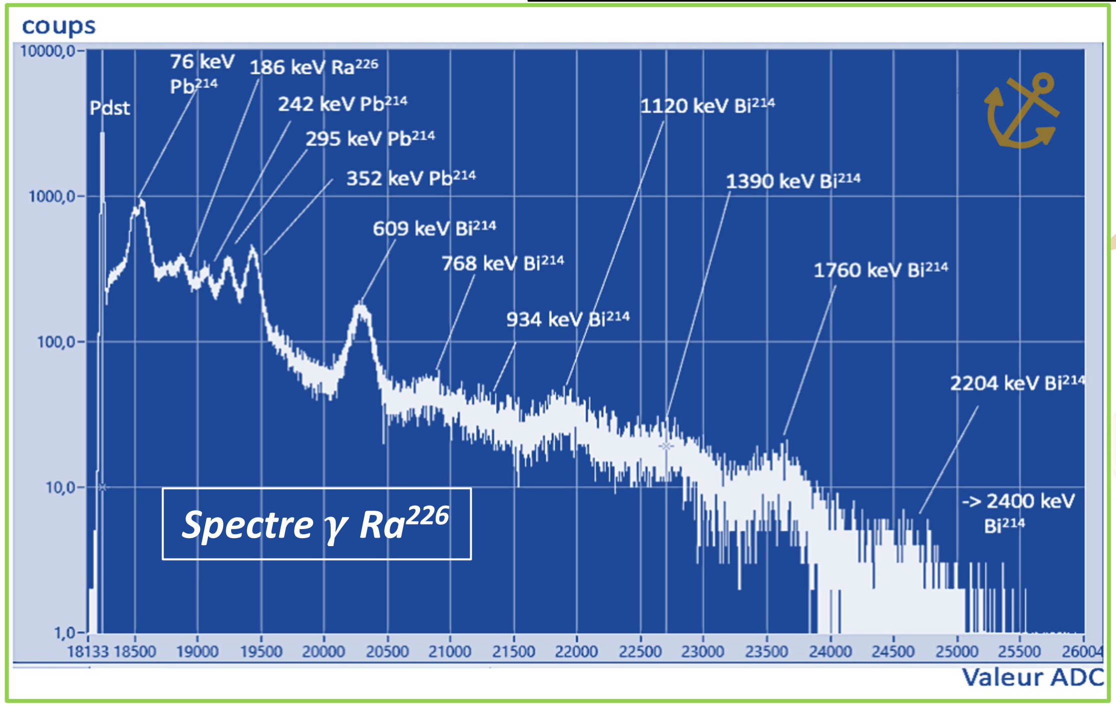
Ballon stratosphérique











école normale supérieure paris—saclay

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

BOUHEDDOU Adam

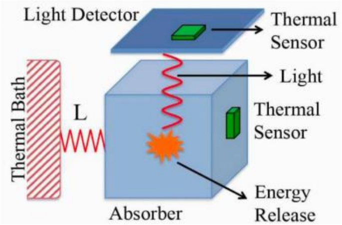
Synthesis and characterization of superconducting thin films

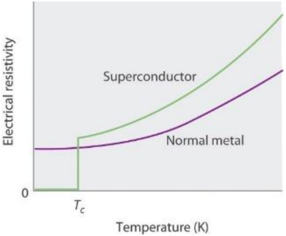
13/05/2024 - 12/07/2024

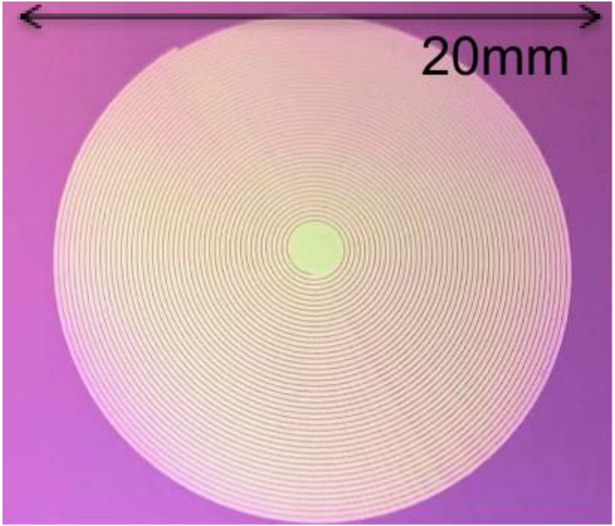
Supervised by :
-Claire MARRACHE-KIKUCHI

Team :
ASSD

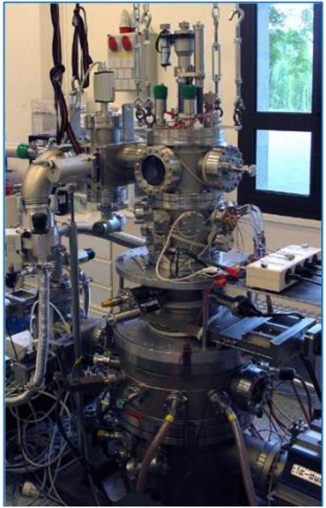
Scintillating Bolometer

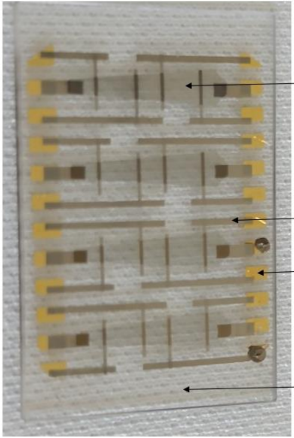




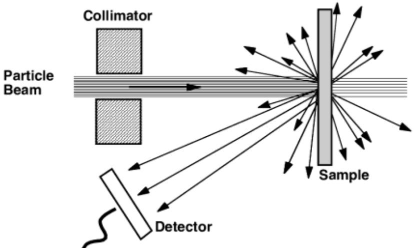


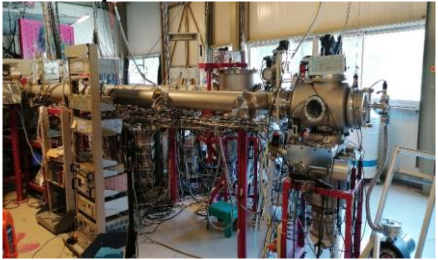
Zhang, Yun. Oxide and Metallic Precursor Powders for Superconducting Bi2Sr2CaCu2Ox/Ag Round Wires

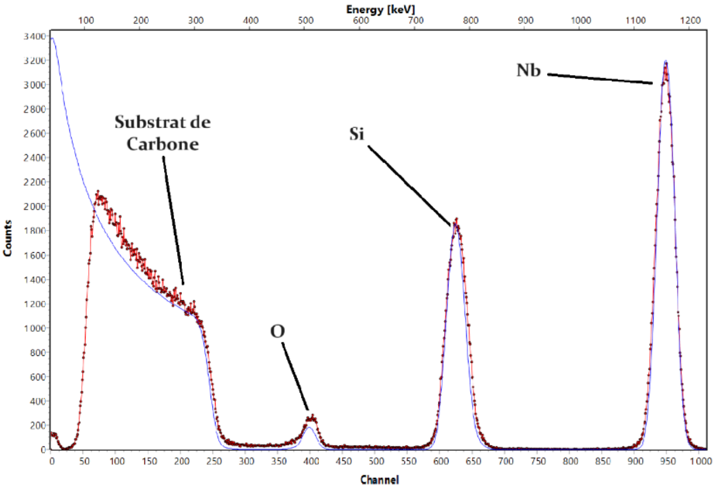



NbSi film
Nb electrode
Gold pre-contact
Sapphire substrate

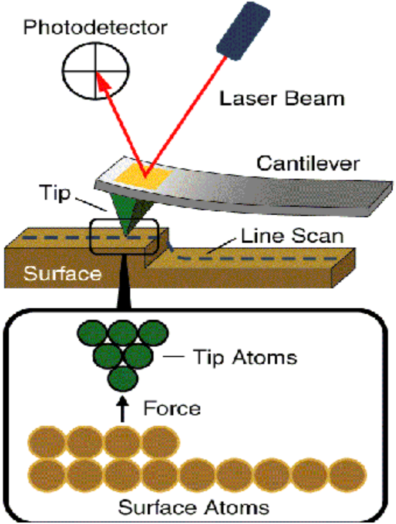
Kötz, Rüdiger. (1990). Rutherford Backscattering Spectroscopy of Electrode Surfaces.

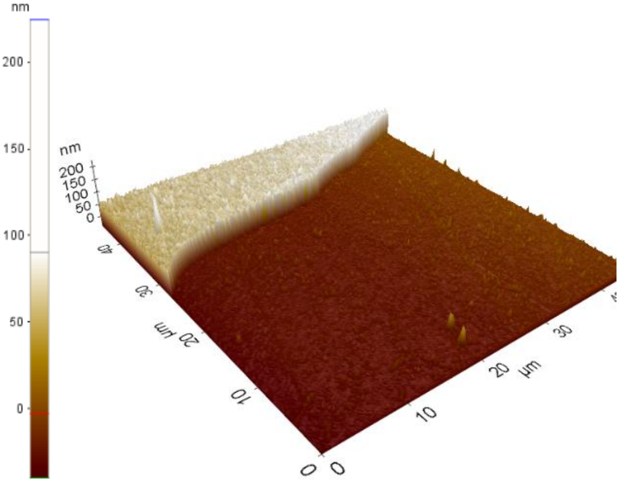






Agarwal, D. & Bhatt, Pina & Pathan, Abrarkhan & Patel, Hitarthi & Joshi, Utpal. (2012). A Portable Experimental set-up for AFM to work at cryogenic temperature.





Three-mirror linear cavity

Pierre Emmanuel Bonningues & Théo Lesieur

PIERRE EMMANUEL BONNINGUES

Study path:

- CPGE PCSI/PC à HEI Lille
- L3 Physique et application à l'universtié Paris-Saclay
- Erasmus Mundus Master Lascala

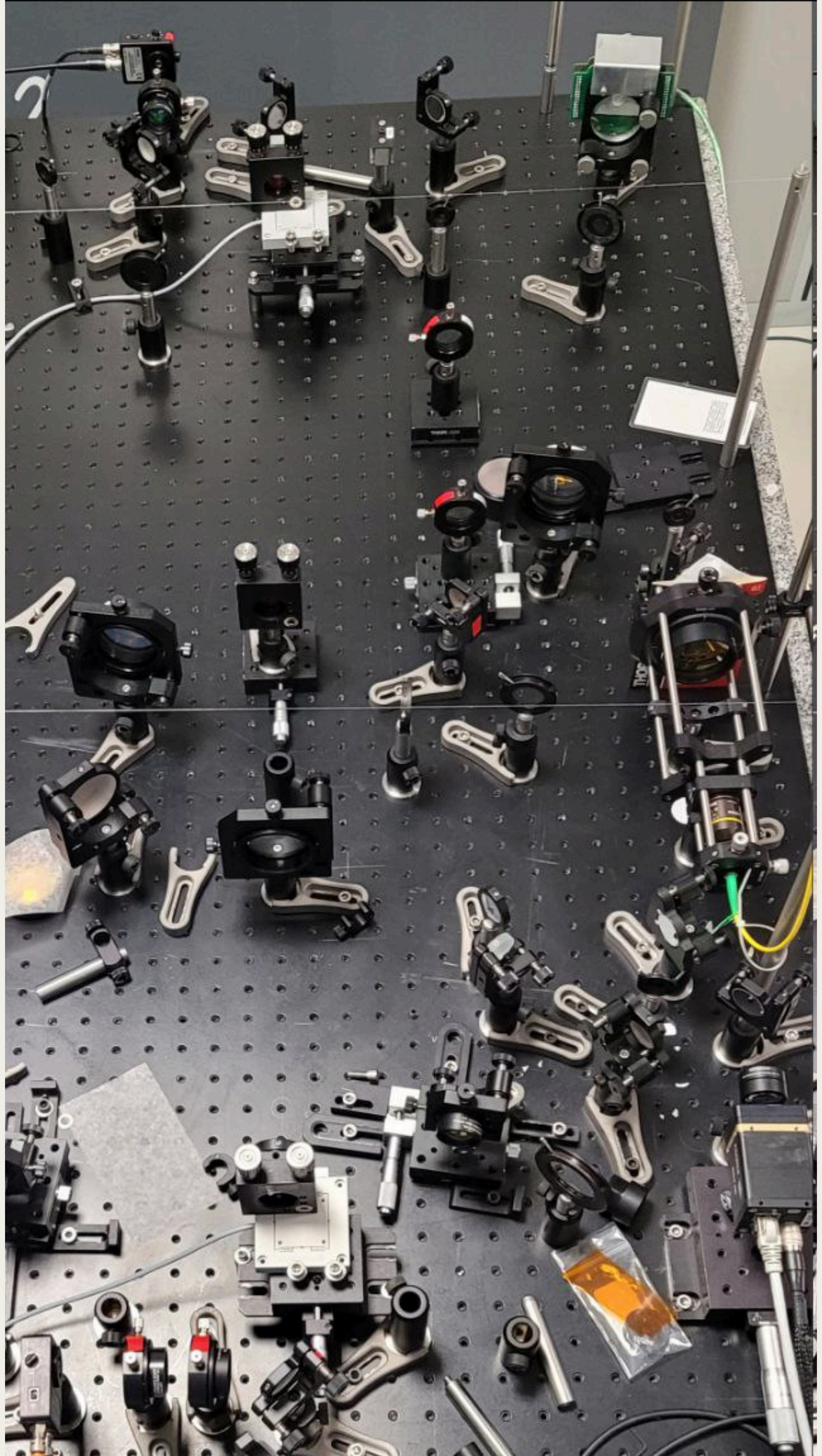
Hobbies:

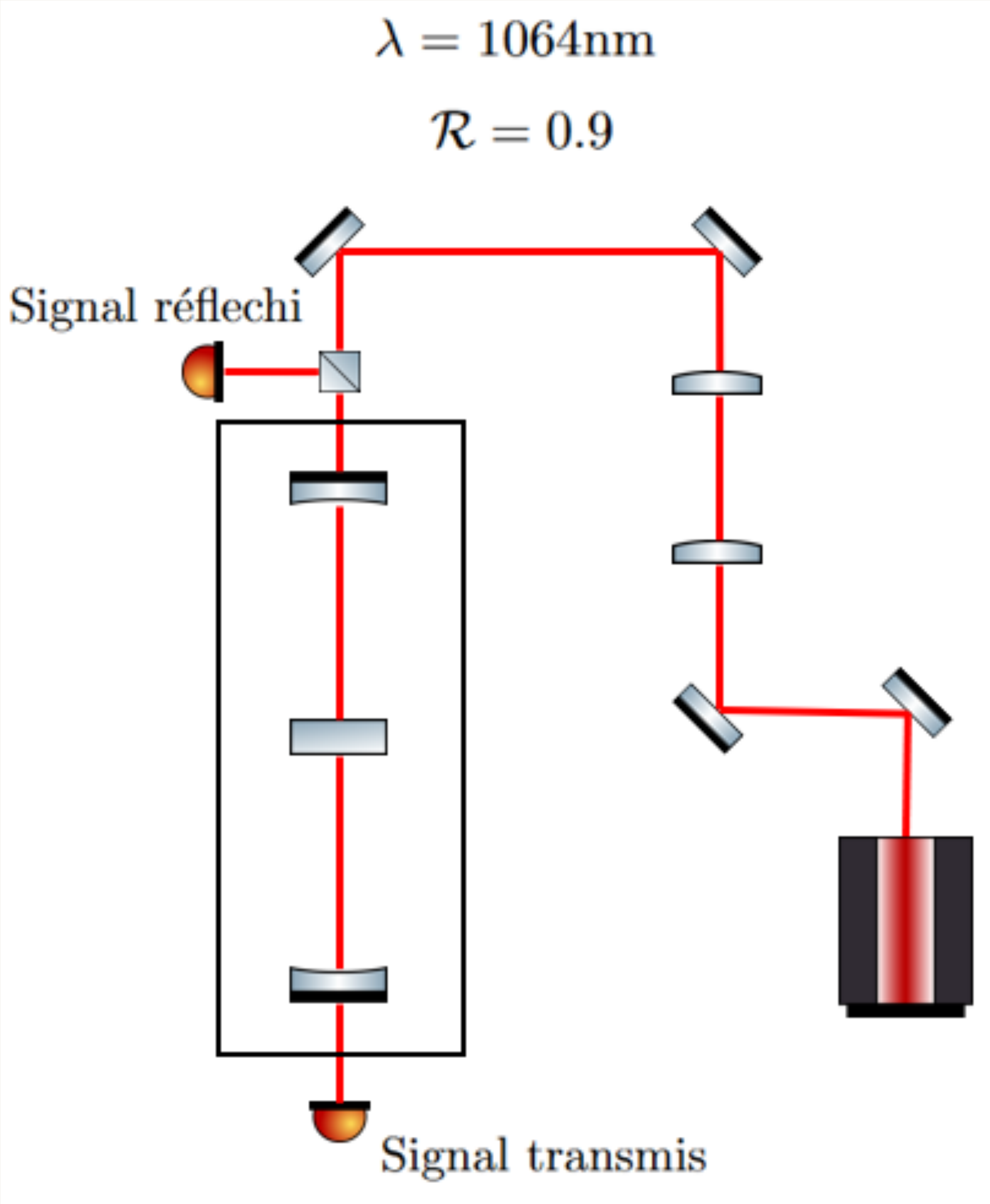
- Cinephile (Yes I do study with the Oppenheimer soundtrack)
- Video-games enjoyer

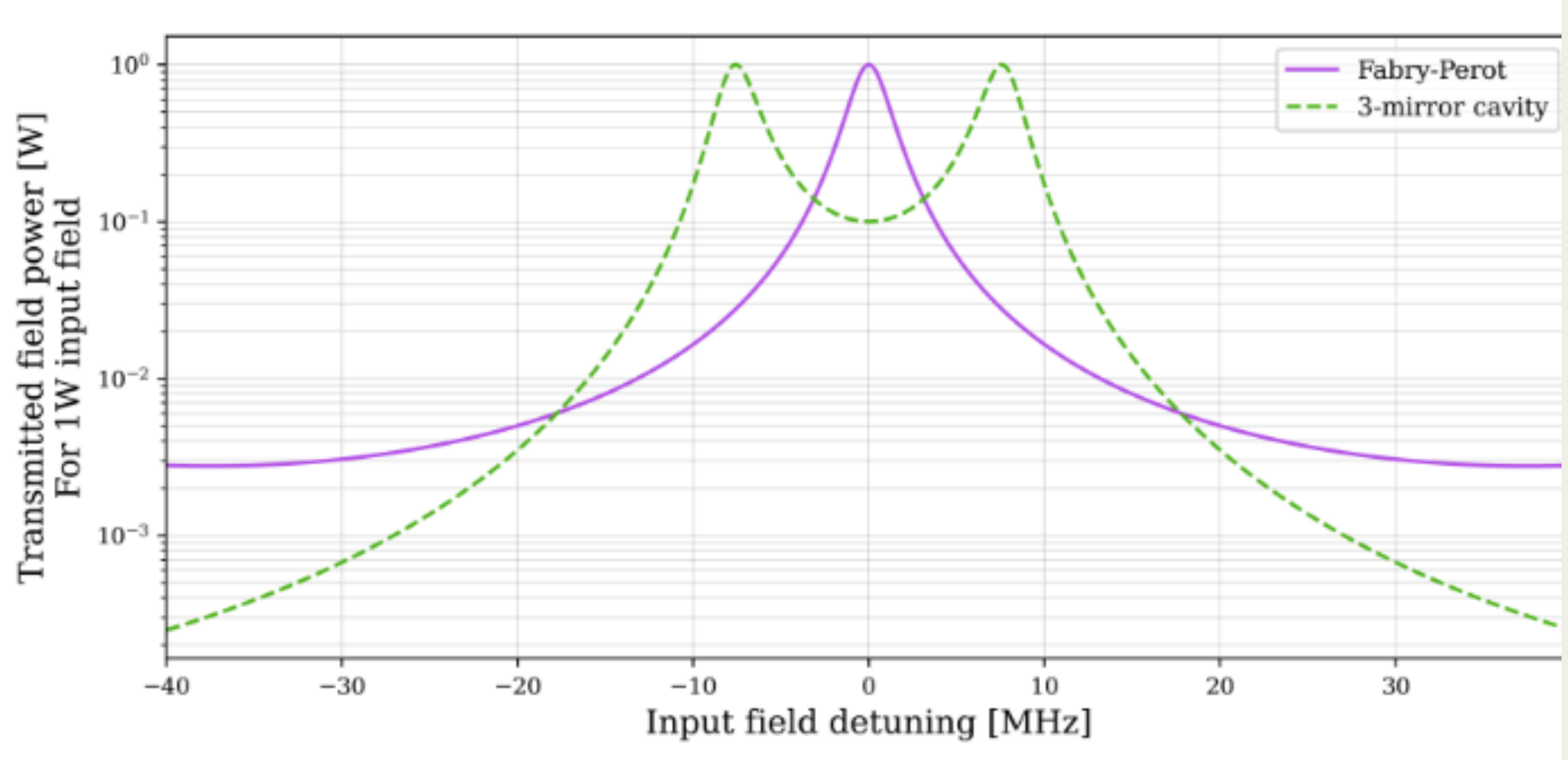
THÉO LESIEUR

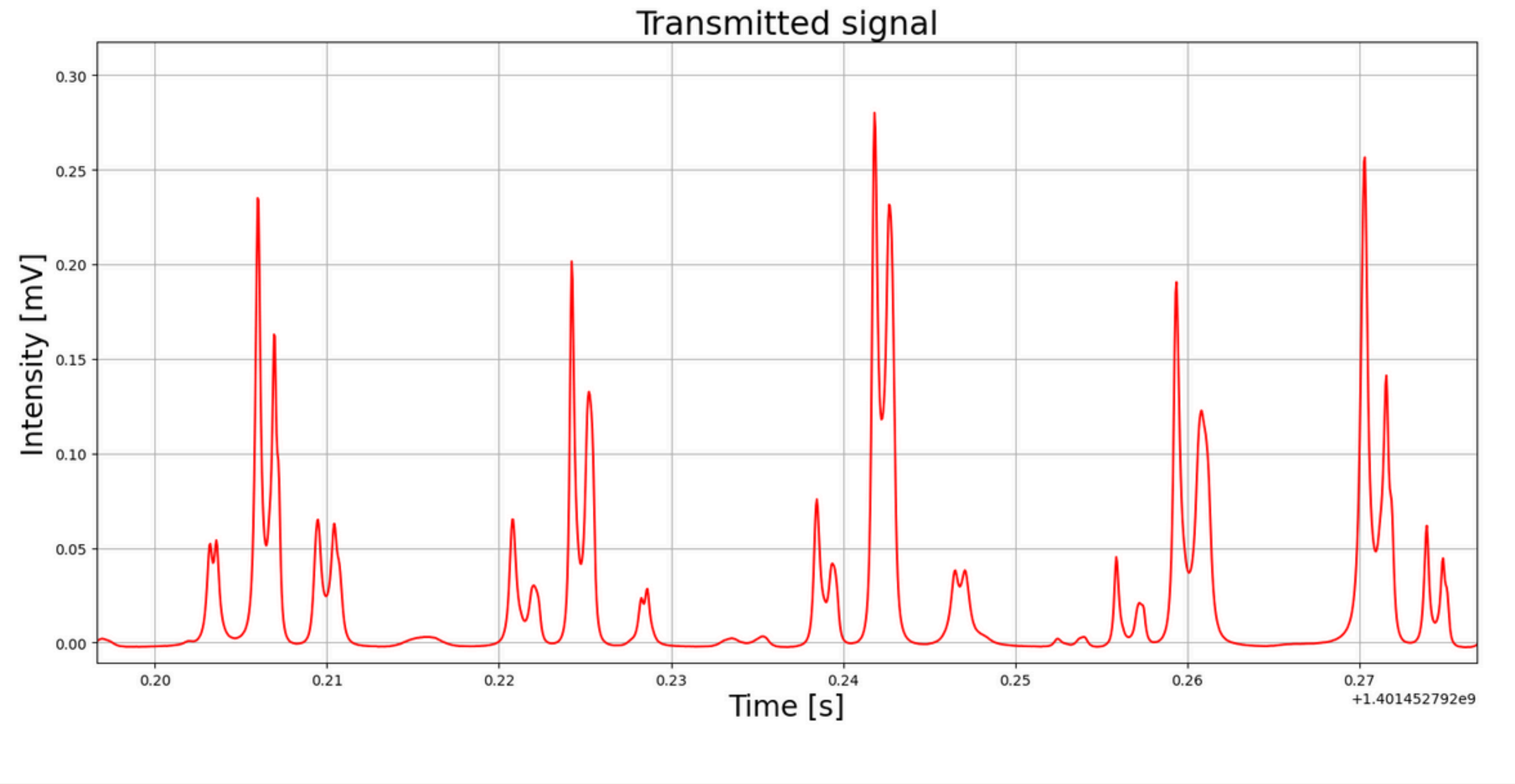
Study path:
- CPGE MPSI/MP* at Lycée Condorcet
- L3 Physics and Applications at Paris-Saclay University
- M1 Fundamental Physics at Nagoya University

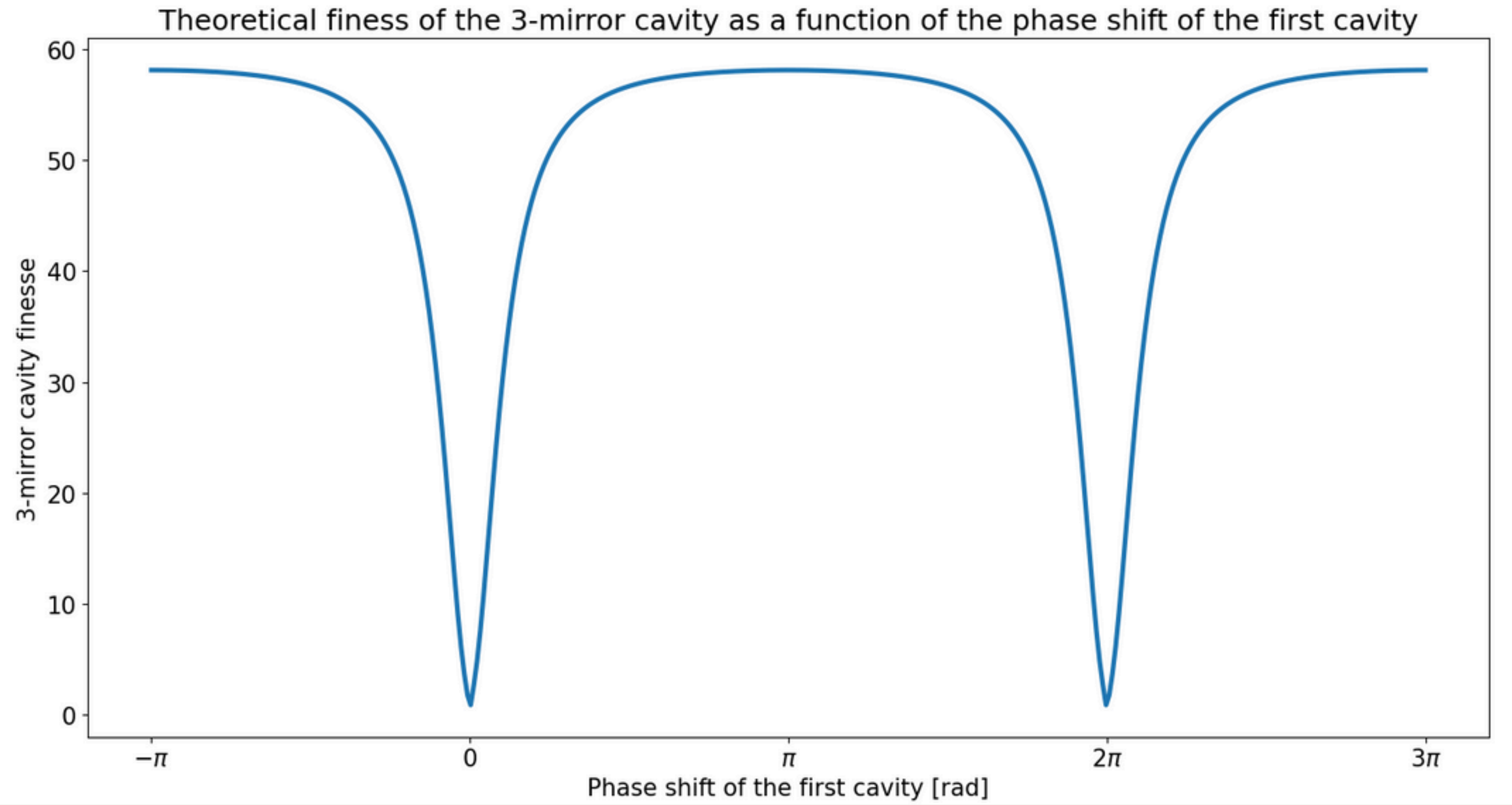
Hobbies:
- Sports: cycling, athletic strength and swimming
- Reading: science fiction, manga
- Amateur photography

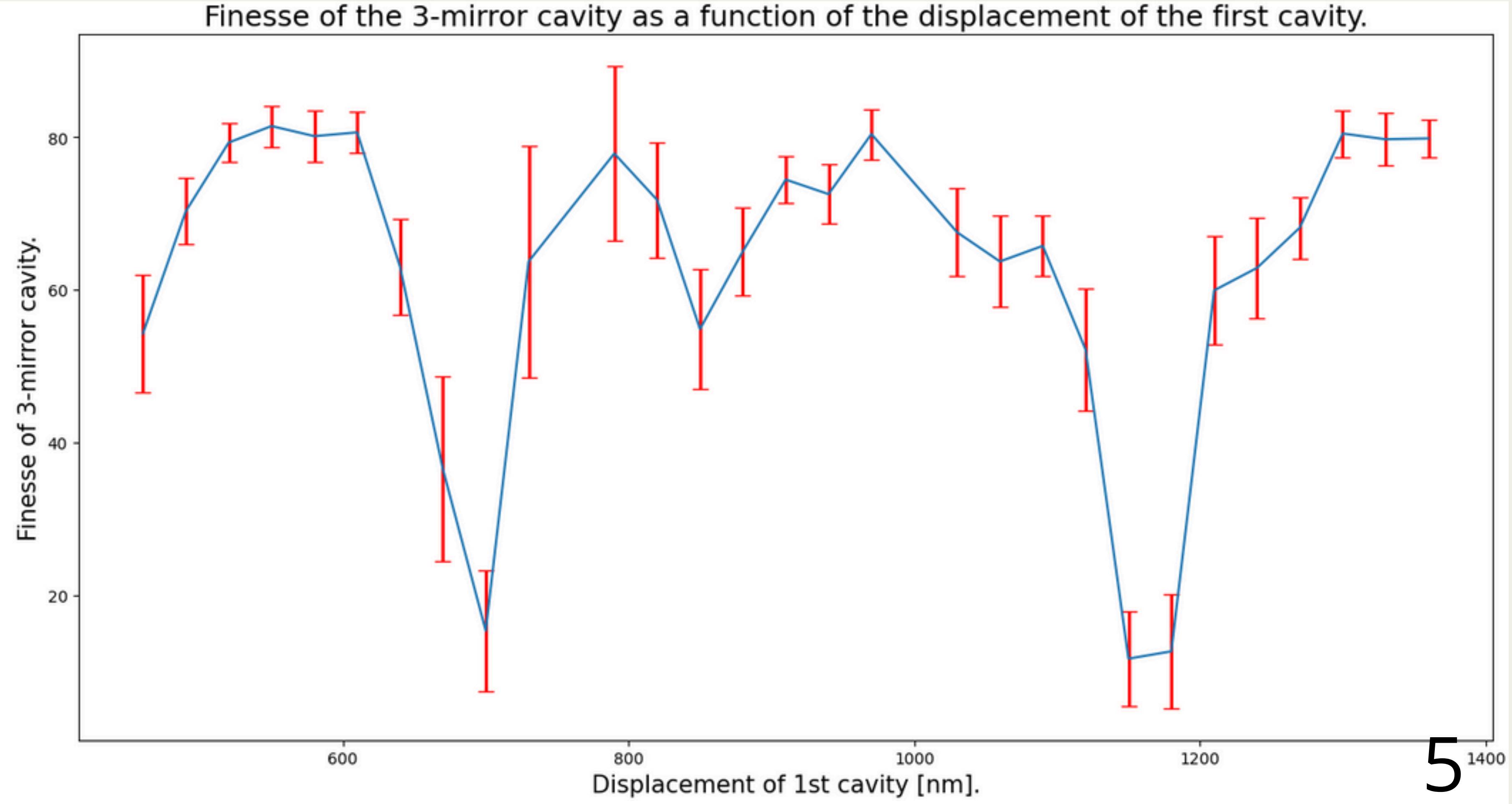



$\lambda = 1064$nm
$\mathcal{R} = 0.9$
Signal réflechi
Signal transmis

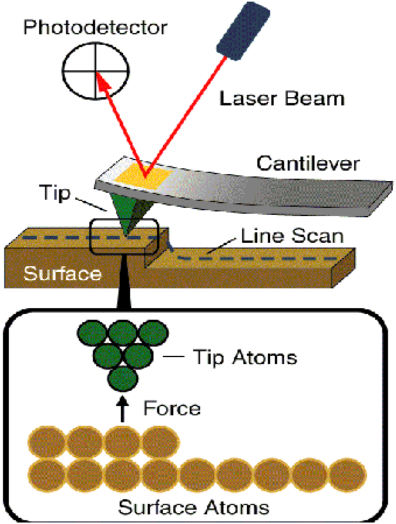

Fabry-Perot
3-mirror cavity
Transmitted field power [W]
For 1W input field
Input field detuning [MHz]

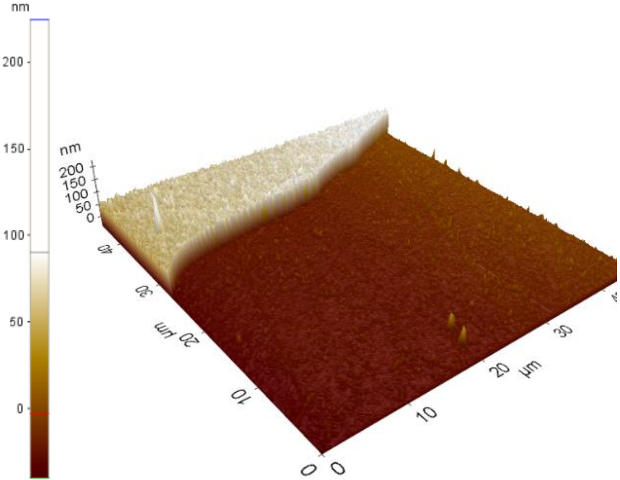

Transmitted signal
Intensity [mV]
Time [s]
+1.401452792e9

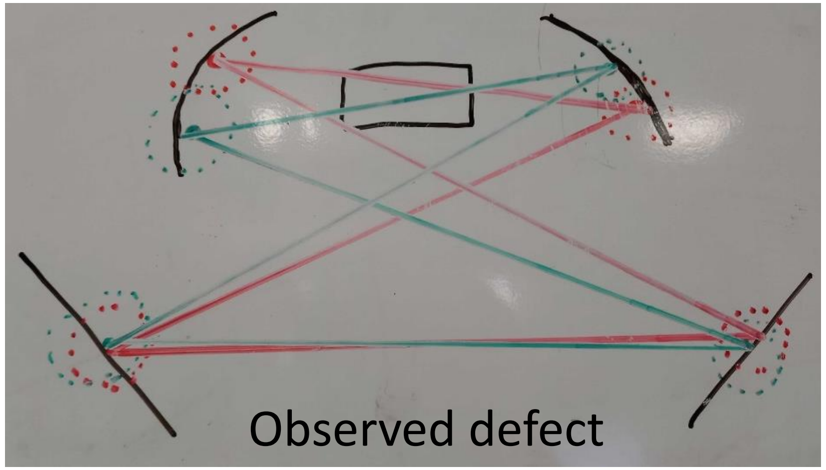

Theoretical finess of the 3-mirror cavity as a function of the phase shift of the first cavity
3-mirror cavity finesse
Phase shift of the first cavity [rad]


Finesse of the 3-mirror cavity as a function of the displacement of the first cavity.
Finesse of 3-mirror cavity.
Displacement of 1st cavity [nm].

Agarwal, D. & Bhatt, Pina & Pathan, Abrarkhan & Patel, Hitarthi & Joshi, Utpal. (2012). A Portable Experimental set-up for AFM to work at cryogenic temperature.





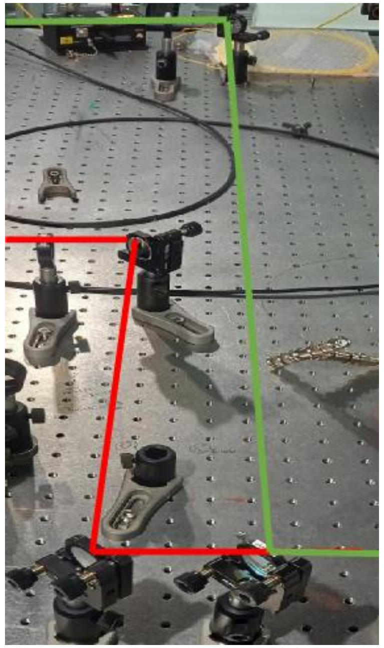


Andriamihoatra Rakoto Eloi

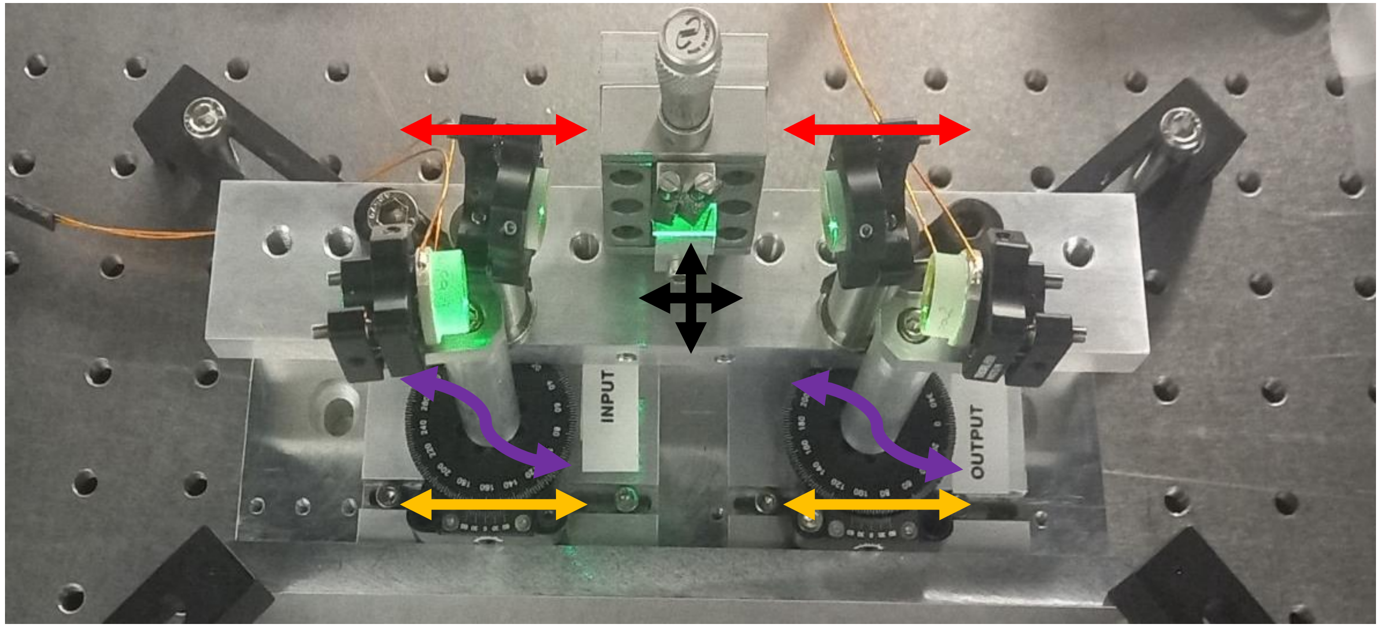
Geometry of a laser cavity

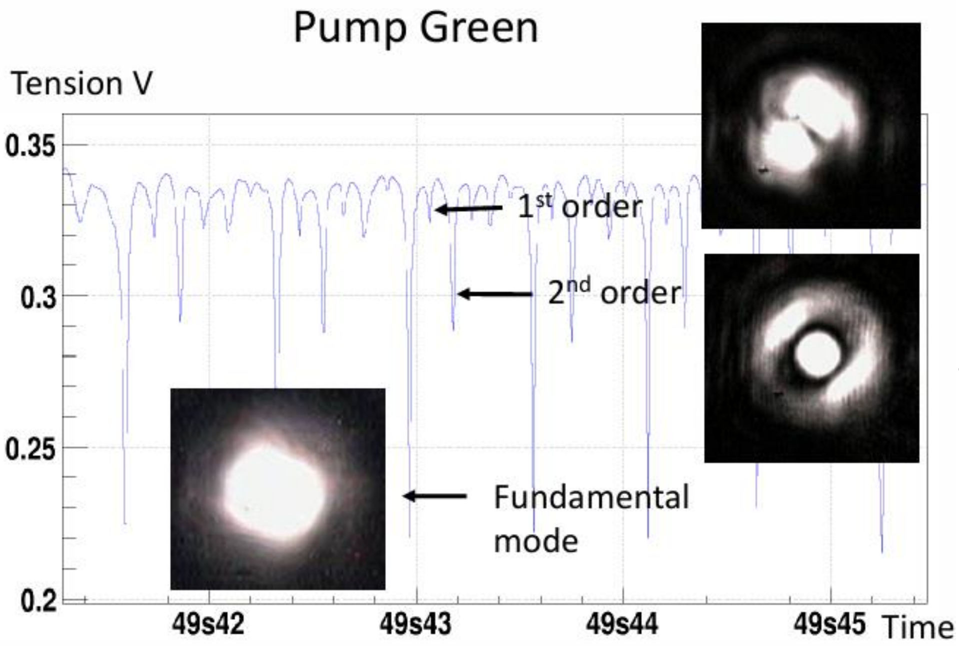
école normale supérieure paris—saclay

Mirrors of alignment of the beams

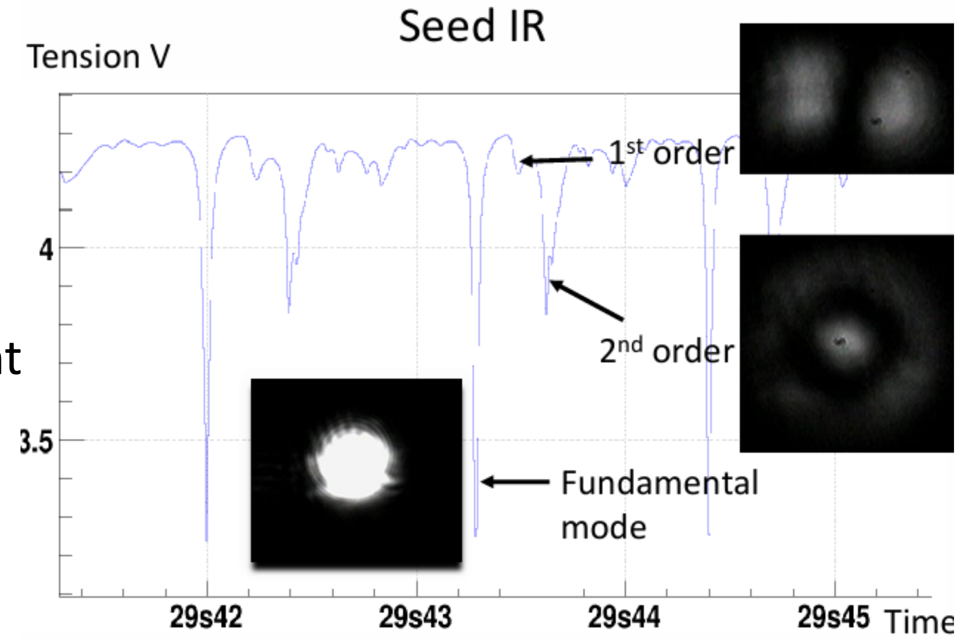


Cavity



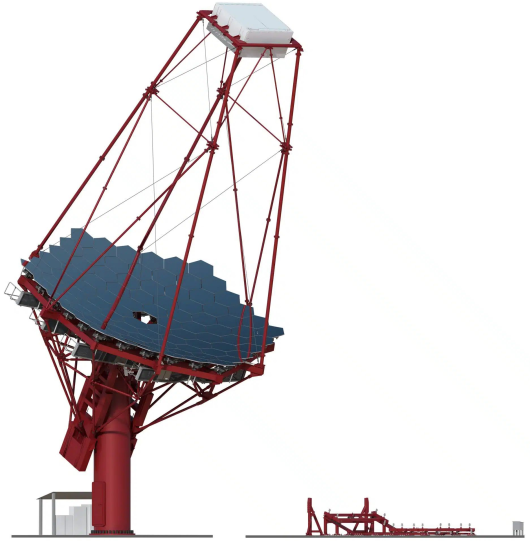


Spectra of the resonant beams

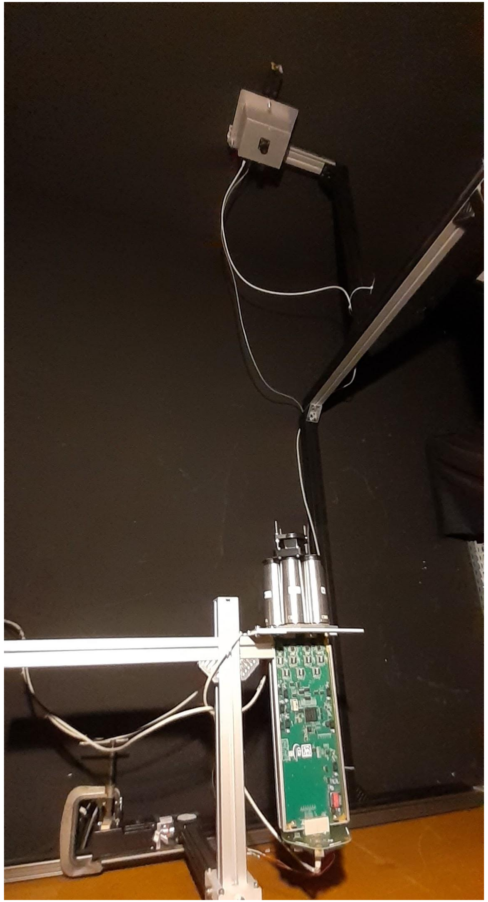


Caractérisation de la réponse angulaire du pulseur de lumière à champ plat pour la caméra NectarCAM

Maëlle Perois, A2C/APHE



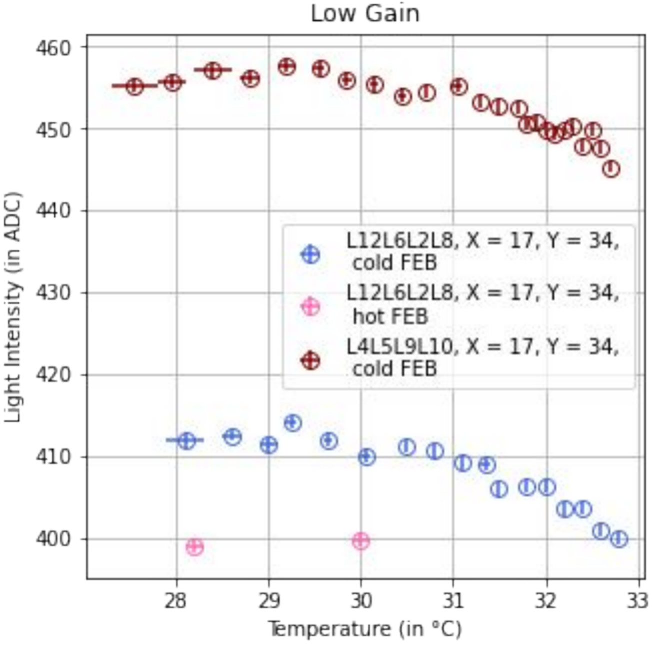
MST Rendering (Credit: Gabriel Pérez Díaz, IAC)



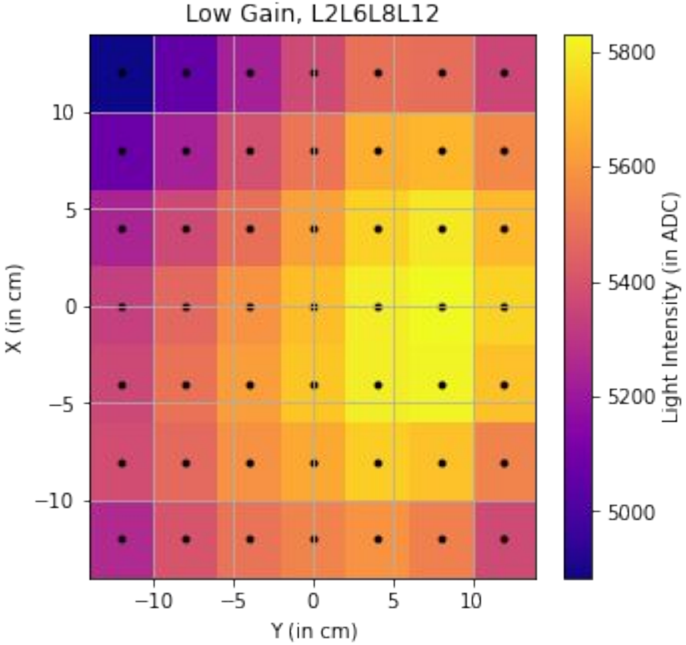
Encadrants : Jonathan Biteau, Quentin Luce

Résultats préliminaires

Evolution de l'intensité lumineuse en fonction de la température des différents composants électroniques



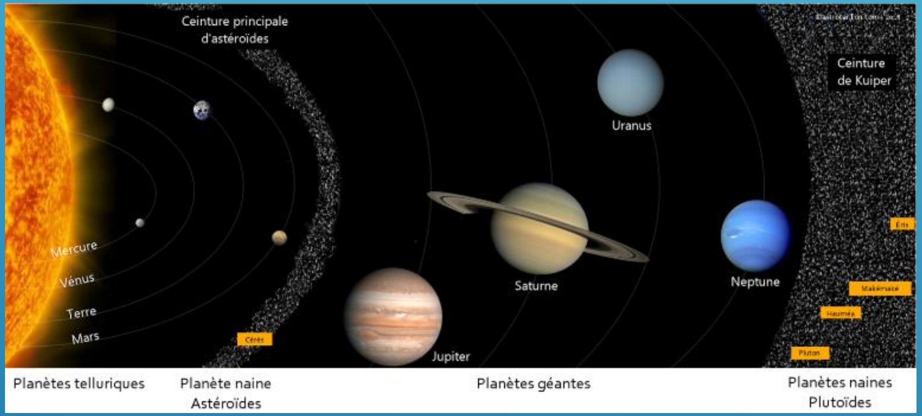
Réponse angulaire du pulseur à champ plat



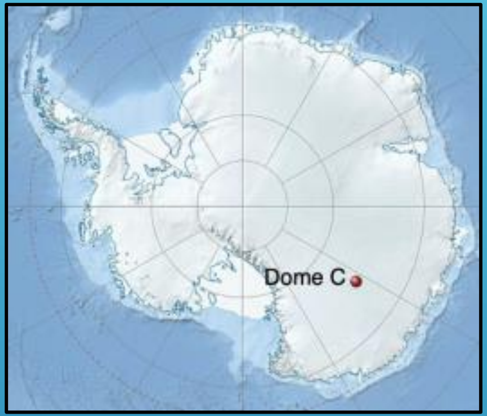
OBJECTIF : RECONNAÎTRE ET CARACTÉRISER DES MICROMÉTÉORITES POUR TROUVER DES UCAMMS

université PARIS-SACLAY
IUT D'ORSAY

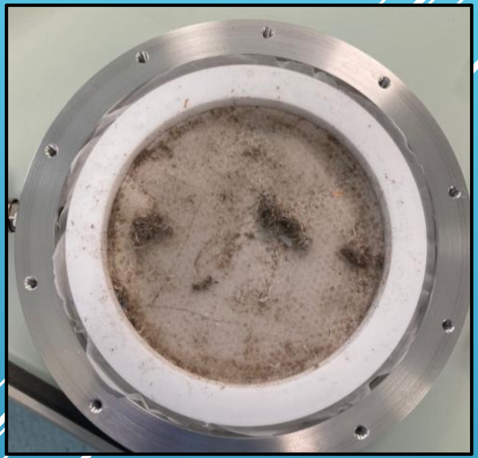
CAPITAINE Chloé
MANNENT Théodore



Localisation des astéroïdes et des comètes dans le système solaire



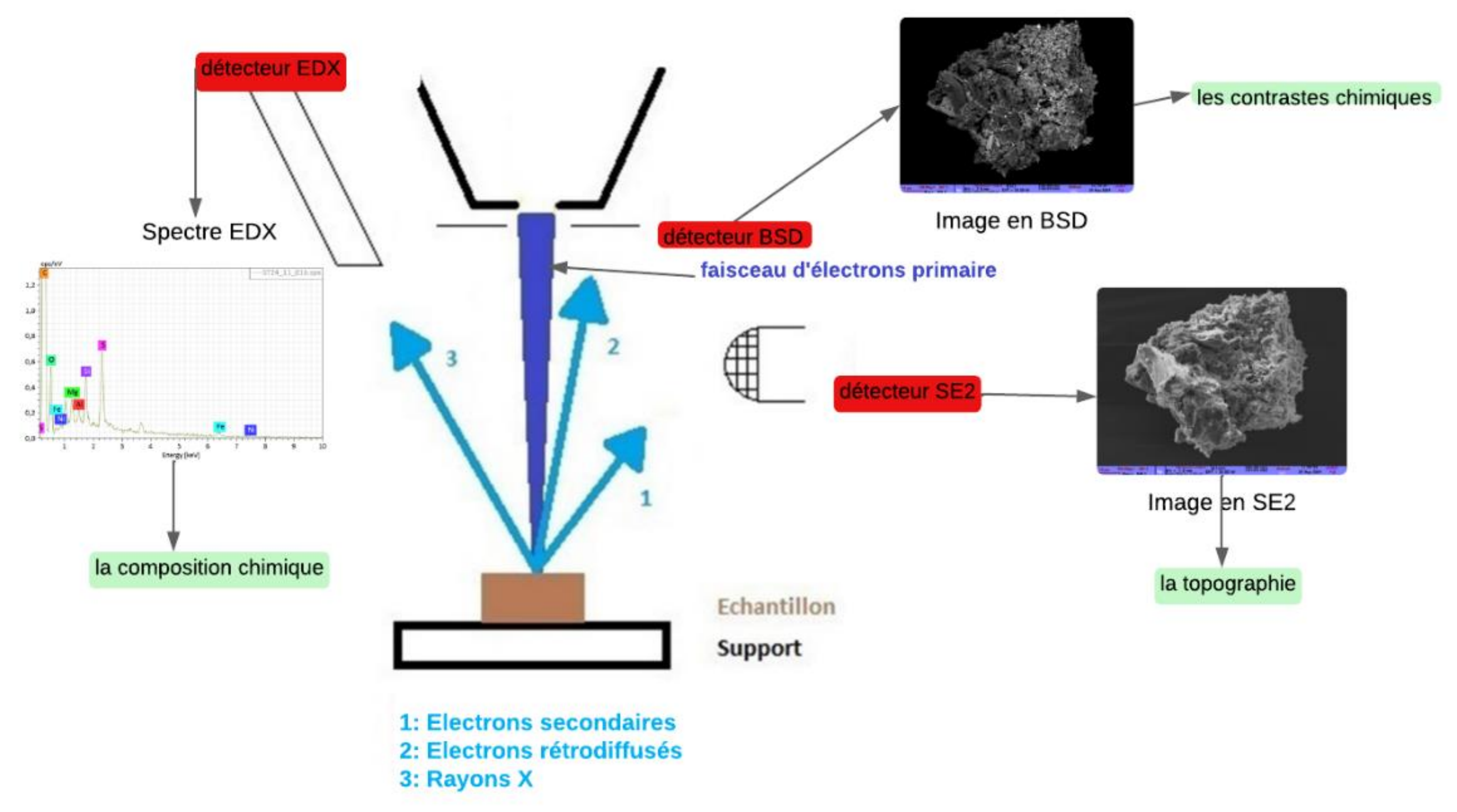
Récolte en Antarctique



Filtre à trier en salle blanche

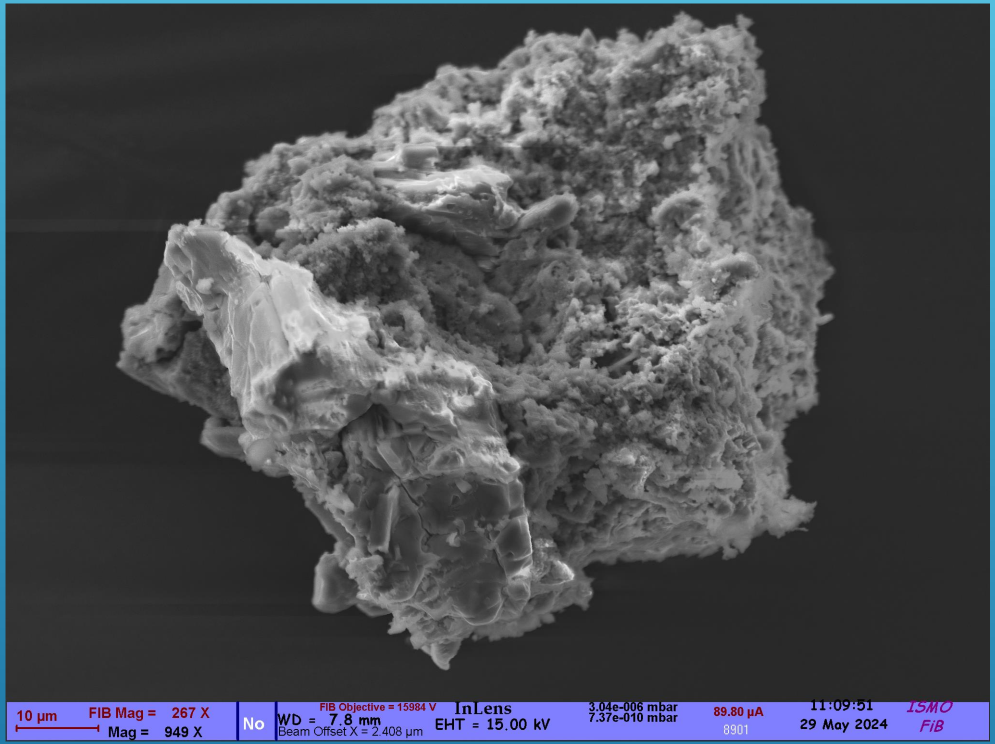
Station Concordia

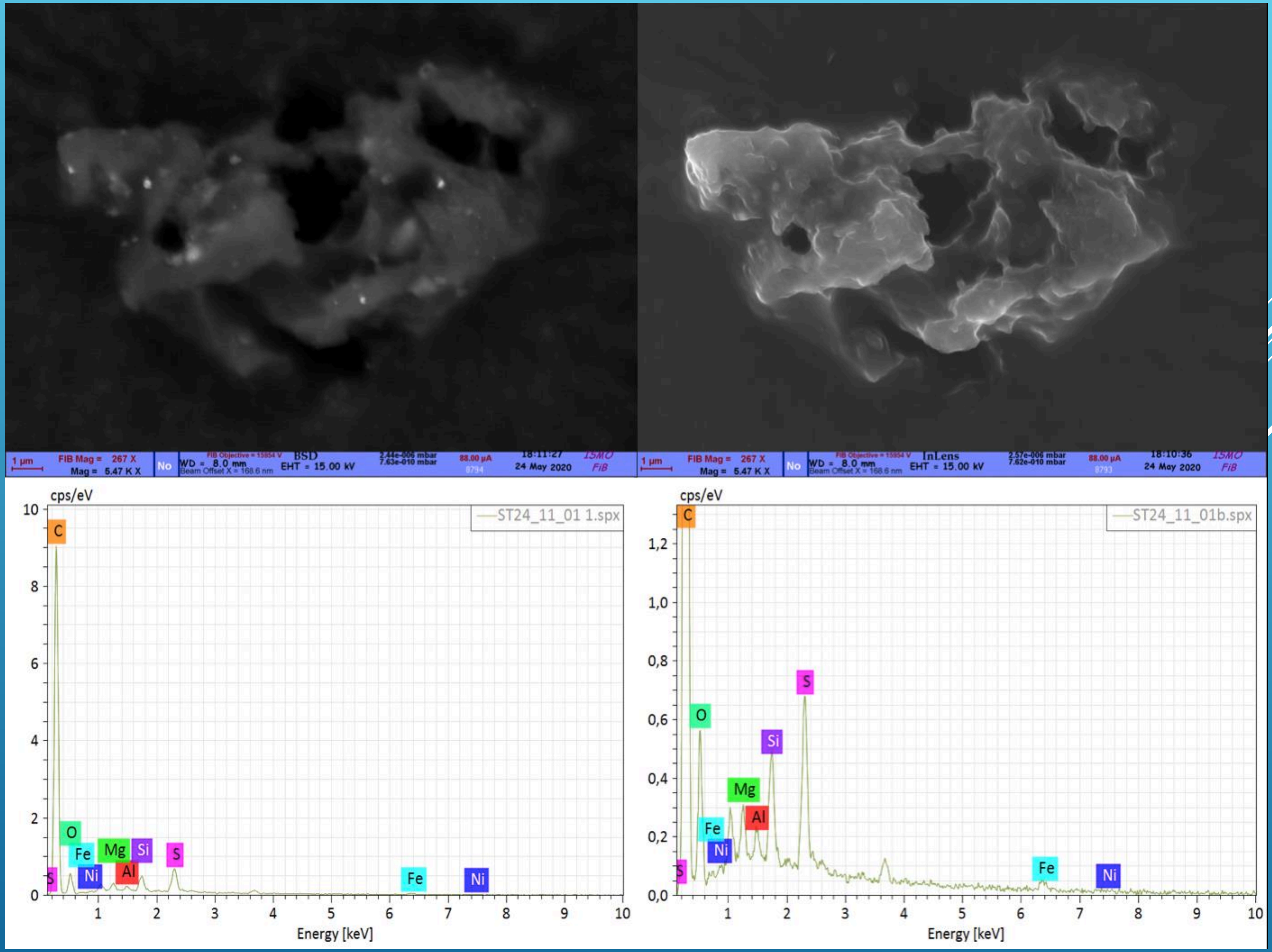
CARACTÉRISATION



Microscope Electronique à Balayage (MEB)

MICROMÉTÉORITES ET UCAMMS





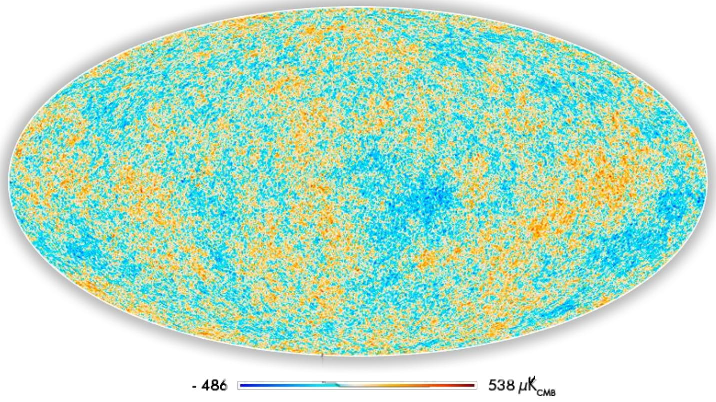
LASNE Thomas
Bachelor's degree internship

Topic

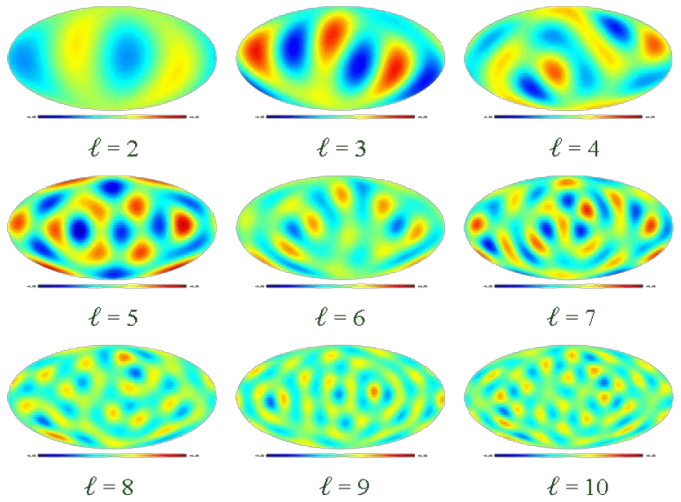
Studying the epoch of reionization with the cosmic microwave background using Machine Learning methods

Tutor

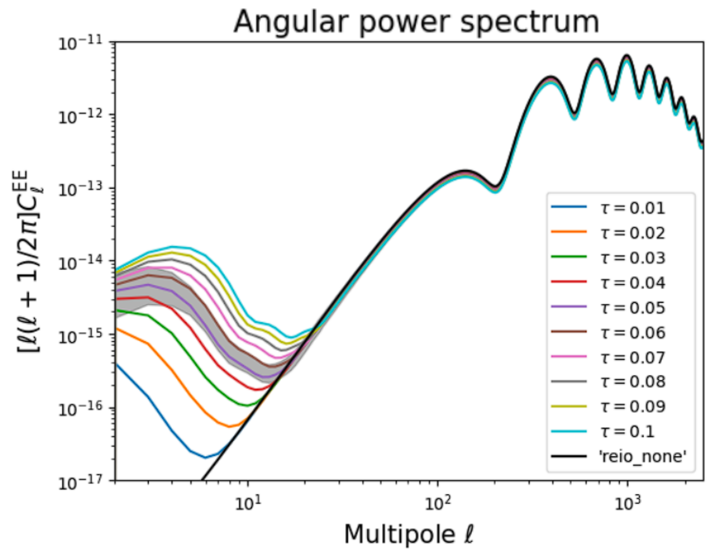
ILIC Stéphane

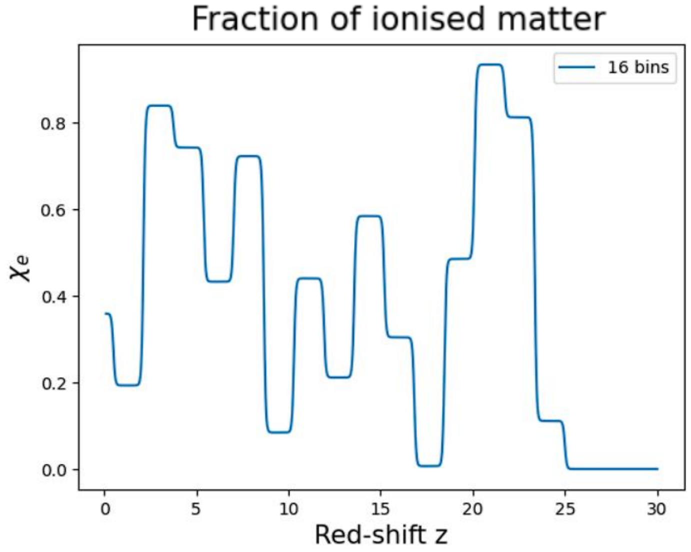


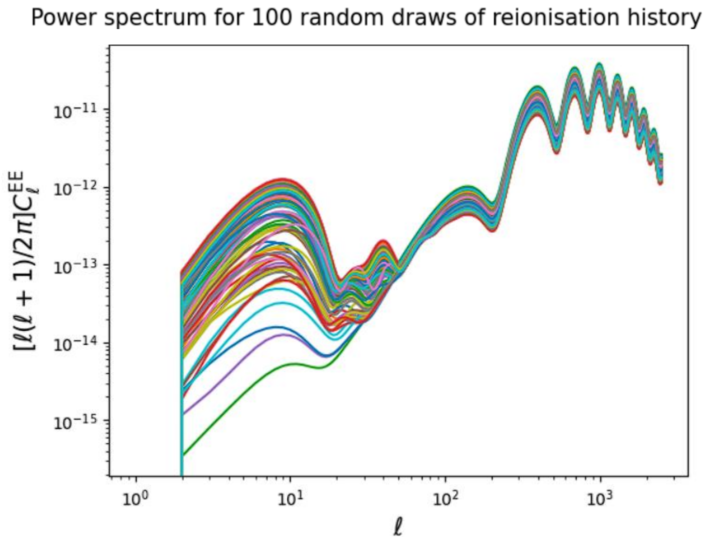
Map of the CMB temperature fluctuations
Coming from Planck's results



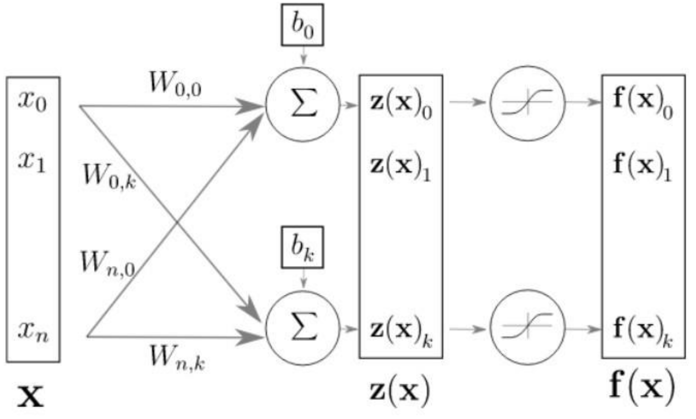
Decomposition using spherical harmonics





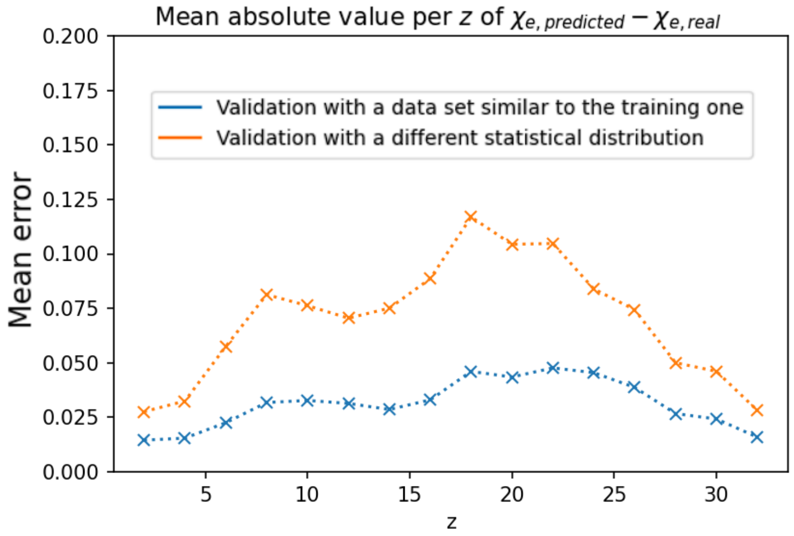


Method : Training a neural network

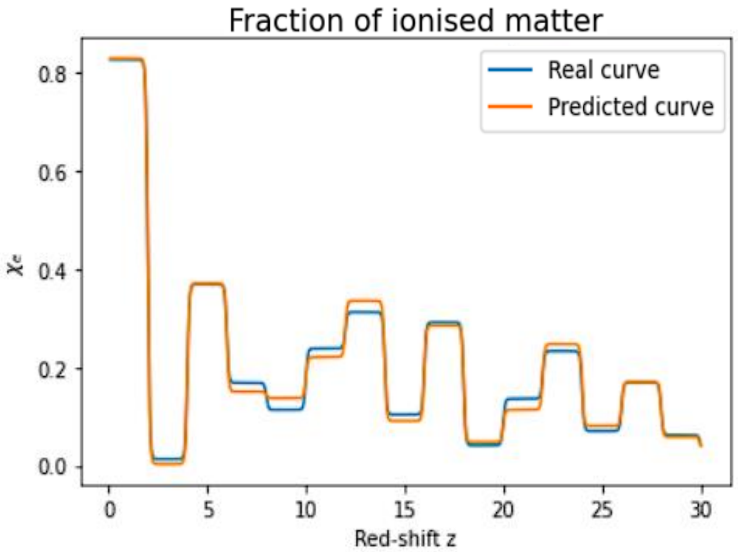


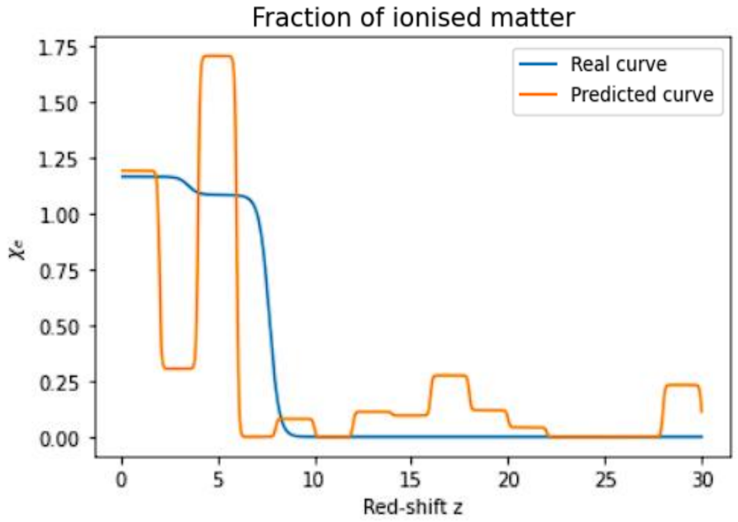
A layer of a neural network

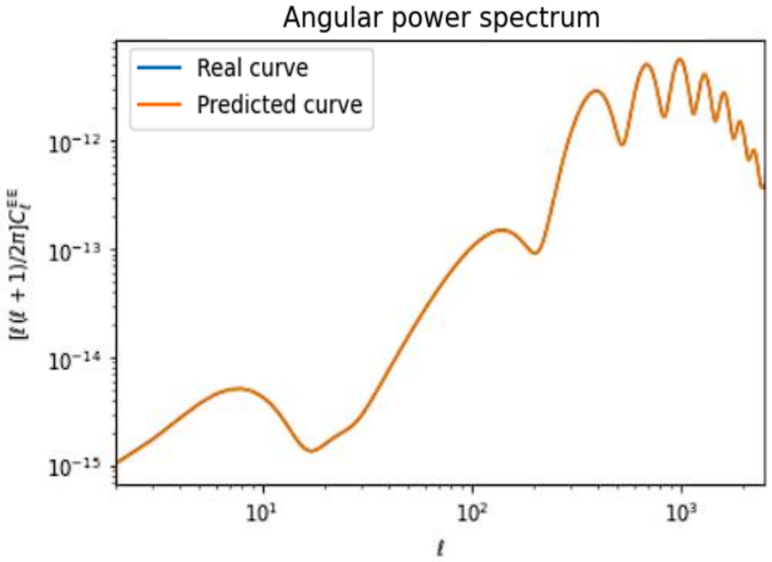
Errors

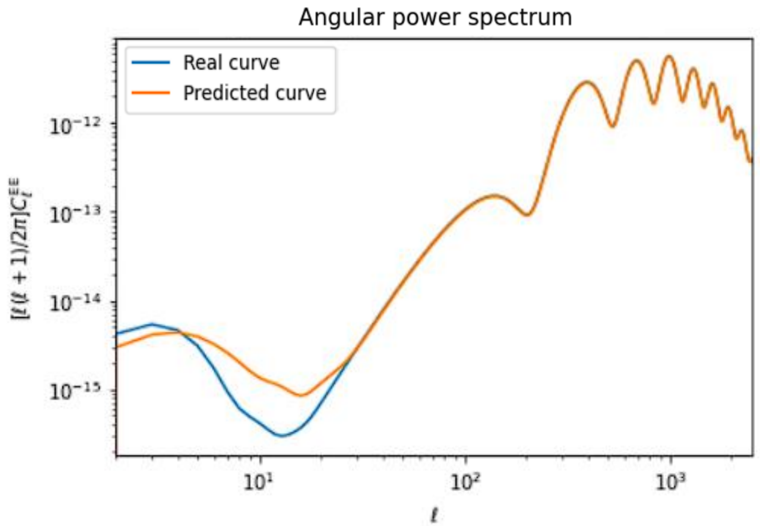


Predictions









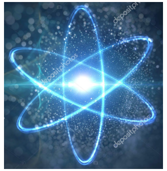
Clara BOKOBZA

My internship in 180 seconds

Universe of Pole A2C

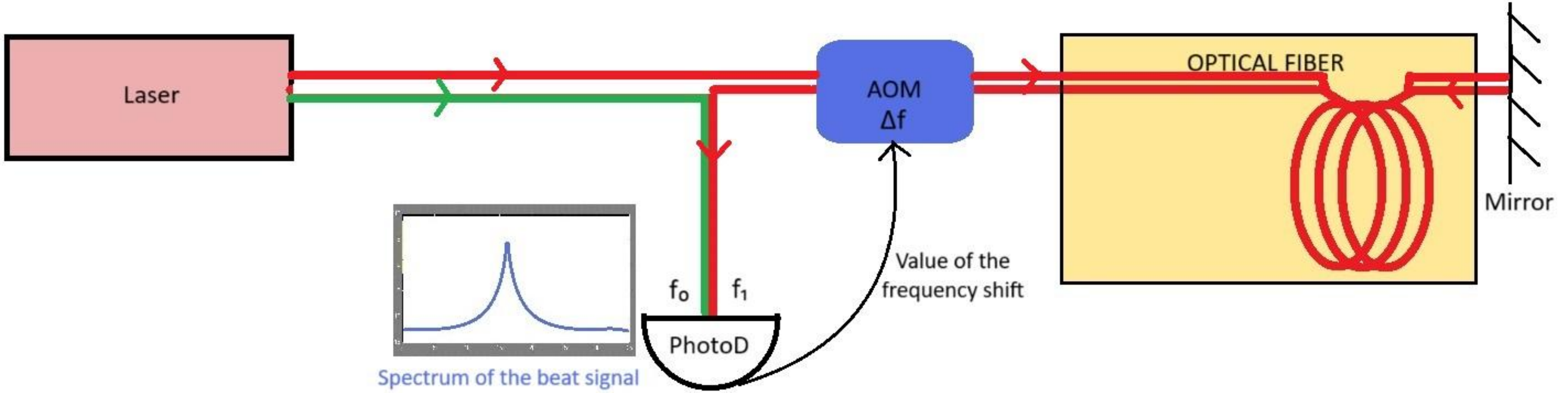
Fiber-phase-noise cancellation for Virgo detectors

Calva Team



INSTITUT d'OPTIQUE GRADUATE SCHOOL ParisTech

université PARIS-SACLAY



Project/Internship

Study in Metastable EeV Dark Matter Model Phenomenology and Experiment

B. Qian

(Supervisor: O. Deligny)

Master1

General Physics

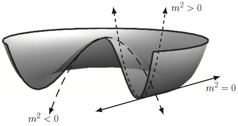
Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

université PARIS-SACLAY

June 20, 2024

The Origin of Mass(Fermion & Boson)

I.Brout-Englert-Higgs Mechanism



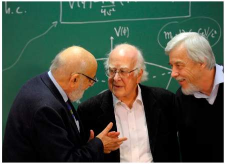
《QFT&SM》 M. Schwartz P.566

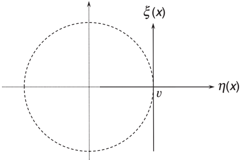
$$\mathcal{L} = -\frac{1}{4}F^{\mu\nu}F_{\mu\nu} + (D_\mu\phi^*)(D^\mu\phi) - V(\phi)$$

$$V(\phi) = \mu^2\phi^2 + \lambda\phi^4$$

$\phi(x) = \frac{1}{\sqrt{2}}(v + \eta(x) + i\xi(x))$ Vacuum: $\phi(0) = \frac{v}{\sqrt{2}}$

Covariant derivative: $D_\mu = \partial_\mu + igA_\mu^a t_a$ $SU(3)_c \times SU(2)_L \times U(1)_Y$

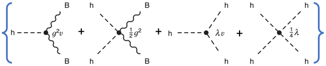




$$\mathcal{L} = \frac{1}{2}\partial_\mu\xi\partial^\mu\xi + \frac{1}{2}\partial_\mu\eta\partial^\mu\eta - \lambda v^2\eta^2 - \frac{1}{4}F^{\mu\nu}F_{\mu\nu} + \frac{1}{2}g^2v^2B^\mu B_\mu + gvB_\mu\partial^\mu\xi - V_{int}(\eta,\xi,B)$$

Massless ξ | Massive η | Massive Gauge Field

$$= \frac{1}{2}\partial_\mu h\partial^\mu h - \lambda v^2h^2 - \frac{1}{4}F^{\mu\nu}F_{\mu\nu} + \frac{1}{2}g^2v^2B'^\mu B'_\mu - \{\ldots\}$$

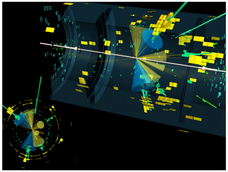


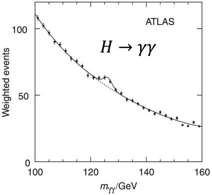
Higgs Field h | Massive Gauge Field

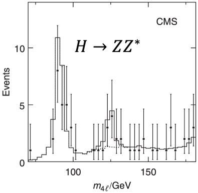
Fix Gauge: $B_\mu(x) \to B'_\mu(x) + \frac{1}{gv}\partial_\mu\xi(x)$

Toy Model in U(1) Gauge

10.1016/0031-9163(64)91136-9
10.1103/PhysRev.145.1156
10.1103/PhysRevLett.13.508







Mixing Matrix, Yukawa Coupling, Dark Matter

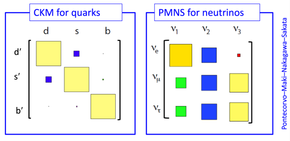
II. What Happened for Neutrino?

$$\mathcal{L}_{Yukawa} = \underbrace{-Y^d_{ij}\bar{Q}^i H d^j_R - Y^u_{ij}\bar{Q}^i \tilde{H} u^j_R}_{\text{Quark}} - \underbrace{Y^e_{ij}\bar{L}^i H e^j_R}_{\text{Lepton}} + h.c.$$

After Symmetry Spontaneously Breaking…

$$\mathcal{L}^{Quark}_{Yukawa} = -\frac{v}{\sqrt{2}}\{\bar{d}^i_L Y^d d^i_R + \bar{u}^i_L Y^u u^i_R + h.c.\}$$

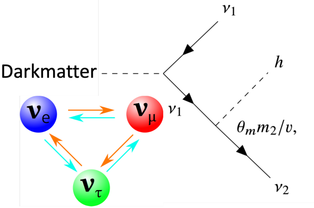
$$V_{CKM} = V_{L,u}V^\dagger_{L,d} \qquad m_u = {}^{v}\!/\!_{\sqrt{2}}\, V_{L,u} Y^u V^\dagger_{R,u} \qquad m_d = {}^{v}\!/\!_{\sqrt{2}}\, V_{L,d} Y^d V^\dagger_{R,d}$$



Flavour eigenstates ≠ Mass eigenstates

Dirac Mass term and(or) Majorana Mass term :

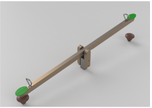
$$\mathcal{L}_D = -m_D\bar{v}v = -\frac{1}{2}m_D(\bar{v}_L v_R + \bar{v}_R v_L) + h.c.$$



$$\mathcal{L}_{DM} = -\frac{1}{2}m_D(\bar{v}_L v_R + \bar{v}^c_R v^c_L) - \frac{1}{2}M\bar{v}^c_R v_R + h.c.$$

$$= \frac{1}{2}(\bar{v}_L, \bar{v}^c_R)\begin{pmatrix} 0 & m^T_D \\ m_D & M_R \end{pmatrix}\begin{pmatrix} v^c_L \\ v_R \end{pmatrix} + h.c. \qquad v_L : \tilde{m}_L \sim \frac{m^2_D}{M_R} \ll M_R$$

$$\approx \frac{1}{2}(\bar{v}_L, \bar{v}^c_R)\begin{pmatrix} \tilde{m}_L & 0 \\ 0 & \tilde{M}_R \end{pmatrix}\begin{pmatrix} v^c_L \\ v_R \end{pmatrix} + h.c. \qquad v_R : \tilde{M}_R \sim M_R$$



$$\frac{1}{2}(\bar{\nu}_L, \bar{\nu}^c_s, \bar{\nu}^c_R)\begin{pmatrix} 0 & m^s_D & m^R_D \\ m^R_D & m_s & 0 \\ m^s_D & 0 & M_R \end{pmatrix}\begin{pmatrix} \nu_L \\ \nu^c_s \\ \nu^c_R \end{pmatrix} + h.c.$$

2003.02846

$$m_1 \simeq m_N \qquad m_2 \simeq y^2_m v^2/2M_N \qquad m_3 \simeq M_N$$

Other Possible Ways to... Dark Matter

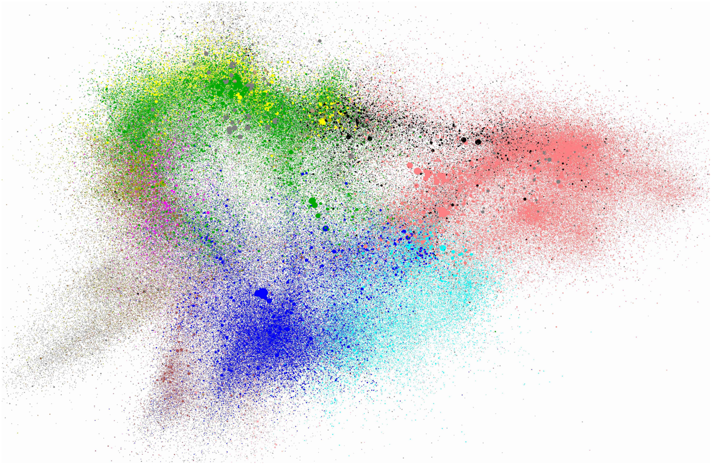


Figure: Each dot is a paper, with size proportional to its number of received citations, positioned such that papers that cite each other are nearby, and colored according to its arXiv bulletin: hep-ph, astro-ph, hep-th, gr-qc, hep-ex, nucl-th, hep-lat, etc. Papers with ‘dark matter’ in the title are in black and lie at the interface between experiment, phenomenology and astrophysics.[2406.01705]