

DAΦNE-Light INFN-LNF Synchrotron Radiation Facility



Mariangela Cestelli Guidi
on behalf of the Dafne-L group

Outline

Dafne as a synchrotron radiation source from THz to Soft-X.

- ▶ Beamlines & staff.
- ▶ **European programs supporting infrastructures, user exchange and training: from Dafne to Eupraxia .**
 - ▶ Calipso Plus (2018-2021)
 - ▶ LEAPS (2018-2030)
 - ▶ OPEN SESAME (2017-2019)
 - ▶ EuroCirCol (2016-2019)
- ▶ **Funded scientific and technological programs:**
 - ▶ **MATERIAL SCIENCE:** Graphene 3D (MAECI-2018-2019), TERA (2018-2020), Tmagic (2017-2019), CERN MoU (2018-2022), MICA (2015-2018)
 - ▶ **SPACE:** Space and SEY, Ariel ESA space satellite
 - ▶ **CULTURAL HERITAGE:** E-RIHS EU research infrastructure for cultural heritage, CHNet-INFN, DTC Lazio.
 - ▶ **TechTransfer:** ArdesiaRAI (2019), CERN Machina compact accelerator
- ▶ **Future opportunities**

Beamlines @ DAΦNE

Building 12

OPEN to USERS

- 1) SINBAD - IR beamline (1.24 meV - 1.24 eV)
- 2) DXR1 - Soft x-ray beamline (900-3000 eV)
- 3) DXR2 - UV-VIS beamline (2-10 eV)

Building 13

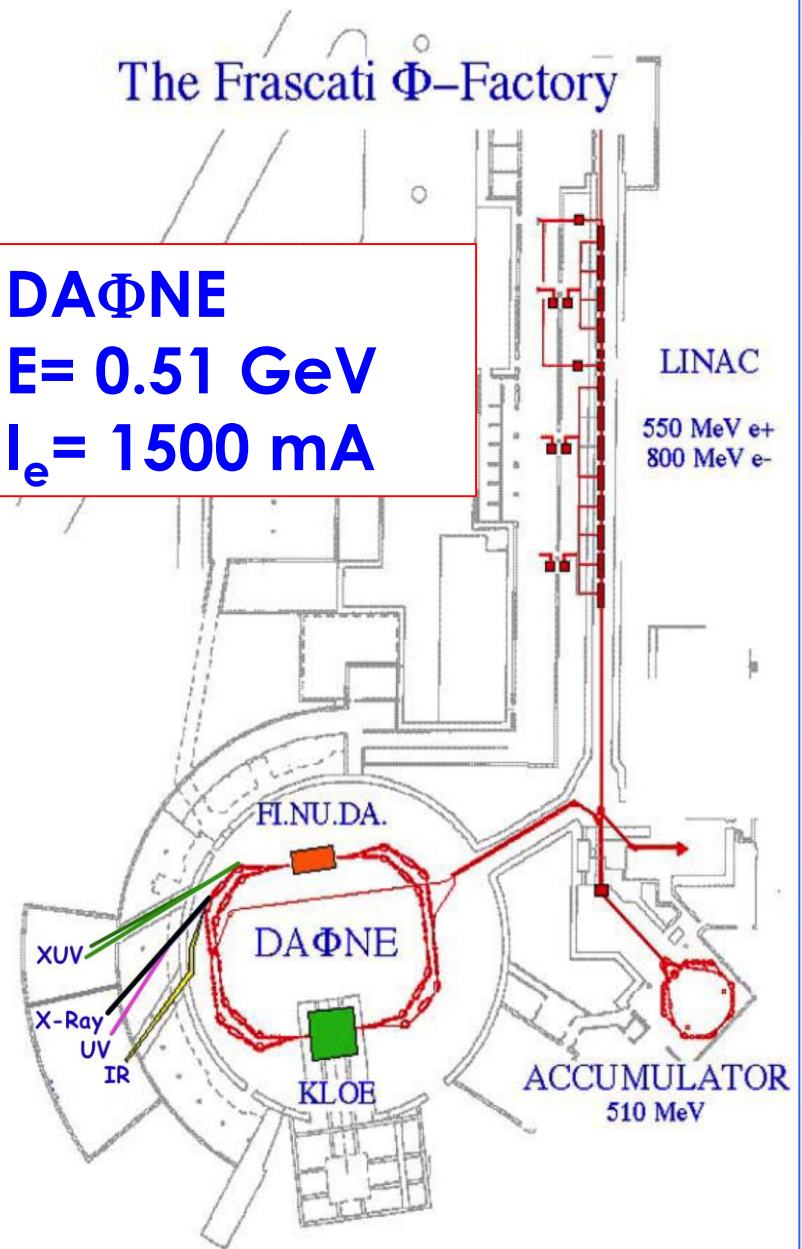
XUV beamlines UNDER COMMISSIONING

- 4) XUV1 - Low Energy Beamline (30-200 eV)
- 5) XUV2 - High Energy Beamline (60-1000 eV)

UNDER Construction

- 6) New XUV2 Branch White Line

DAΦNE
E = 0.51 GeV
I_e = 1500 mA



DAΦNE-Light

Principal Beamline Scientists

SINBAD - Infrared beamline – Mariangela Cestelli Guidi

DXR2 - UV beamline - Emanuele Pace (INFN - Univ. Fi)

DXR1 - Soft X-ray beamline - Antonella Balerna

DXUV- XUV beamlines - Roberto Cimino

Technical Staff

Antonio Grilli, Agostino Raco, Marco Pietropaoli, Vittorio Sciarra, Vinicio Tullio and Giacomo Viviani



EU Projects



**Convenient Access to Light Sources
Open to Innovation, Science and to
the World.**

Integrating Activity for Advanced Communities in Horizon2020
([H2020-INFRAIA-2016-1](#))

Who is involved?

The CALIPSOplus Consortium brings together 19 partners offering access to 14 synchrotrons and 8 FELs in Europa and the Middle East.



- HZB (BESSY II)
- ULUND (MAX IV)
- Aarhus Universitet (ASTRID 2)
- Diamond (DIAMOND)
- SOLEIL (SOLEIL)
- ESRF (ESRF)
- CELLS (ALBA)
- SESAME (SESAME)
- KIT (ANKA)
- Uniwersytet Jagiellonski (SOLARIS)
- HZDR (ELBE)
- European XFEL (EU XFEL)
- Radboud University (FELIX)
- CNRS (CLIO)
- Ankara Universitesi (TARLA)
- DESY (PETRAIII/FLASH)
- PSI (SLS/SWISSFEL)
- ELETTRA (ELETTRA/FERMI)
- INFN (DAΦNE/SPARC)

Running time:
May 2017- April 2021
(4 years)



Budget: 10 MEUR
1 PostDoc @ Lnf

Aims of CALIPSOplus

- Improvement of trans-national cooperation and distribution of knowledge, in particular from countries with a highly developed scientific infrastructure to scientifically less active regions
- Removing barriers for access to world-class accelerator-based lightsources in Europe and in the Middle East
- Teaching new users how to successfully use synchrotrons and FELs.
- Collaborating on constantly developing technology to keep the facilities at the cutting-edge
- Tailor-made support and access programmes for SMEs



LEAPS

League of European
Accelerator-based
Photon Sources

2030 Strategy

LEAPS - League of European Accelerator-based Photon Sources - Strategic consortium initiated by the Directors of the Synchrotron Radiation and Free Electron Laser (FEL) user facilities in Europe.

Its **primary goal** is to actively and constructively **ensure and promote the quality and impact of the fundamental, applied and industrial research** carried out at their respective facility to the greater benefit of European science and society.

Exchange with **stakeholders and organizations such as the European Commission** in all matters relevant to the **development and sustainability of SR and FEL user facilities**, with the **objective of informing and shaping future policies**.



Some **pilot projects to be submitted for EC funding that include INFN**:

- 1) LIDs –Insertion devices
- 2) Data reduction and compression
- 3) New positioning and scanning

OPEN-SESAME project has received funding from the **EU's H2020** framework programme for research and innovation under grant agreement n.730943



WP3

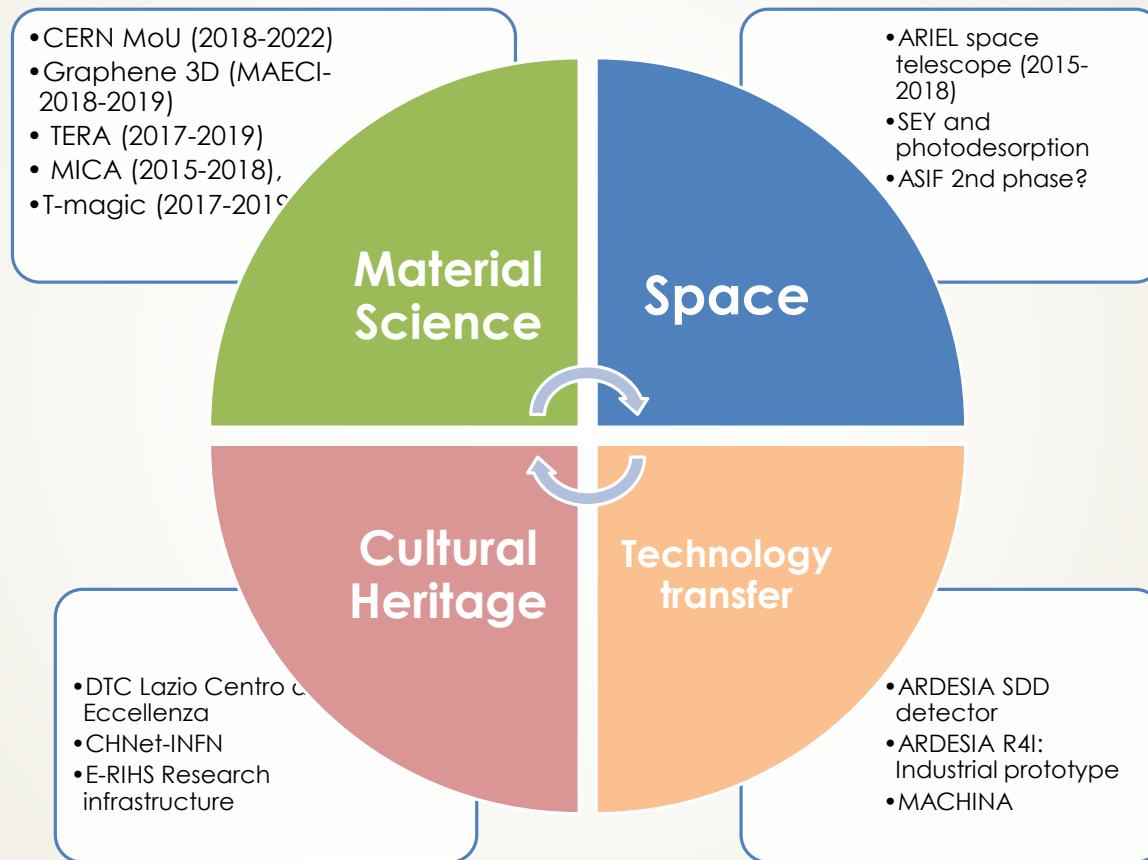
Building user capacity in the local science and technology landscape



6 teachers, 22 students ,
6 countries (Jordan, Egypt, Palestine,
Iran, Pakistan, Turkey)



Scientific and technological funded research projects

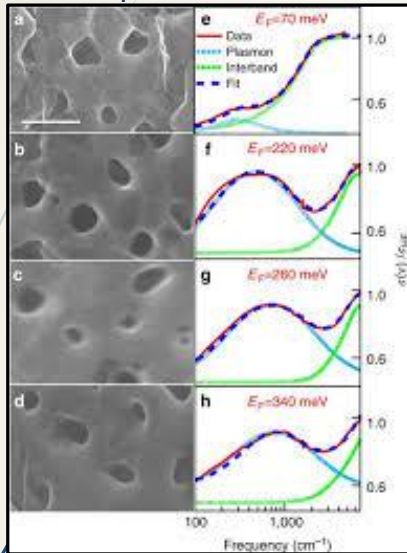




Materials research

THz and IR properties of 3D- Graphene

S. Lupi, A. Marcelli, M. Cestelli Guidi



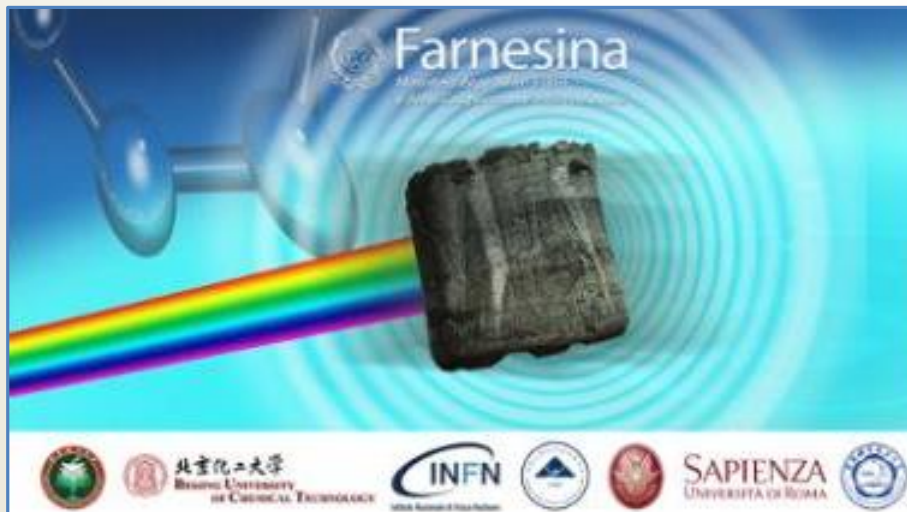
nature
COMMUNICATIONS

Article | [OPEN](#) | Published: 27 March 2017

Terahertz and mid-infrared plasmons in three-dimensional nanoporous graphene

Fausto D'Apuzzo, Alba R. Piacenti, Flavio Giorgianni, Marta Autore, Mariangela Cestelli Guidi, Augusto Marcelli, Ulrich Schade, Yoshikazu Ito, Mingwei Chen & Stefano Lupi [✉](#)

Nature Communications **8**, Article number: 14885 (2017) | [Download Citation](#)



Italian-Chinese Collaborative Research Projects between the Ministry of Foreign Affairs and International Cooperation (MAECI) and the National Natural Science Foundation of China (NSFC)

Duration: 2018-2020

Budget: 200K€

1y PostDoc from China

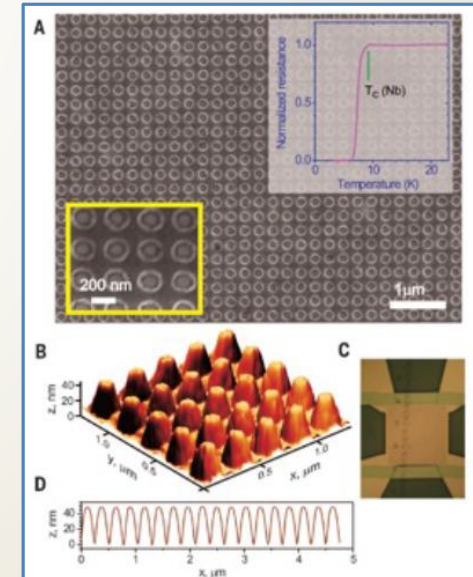
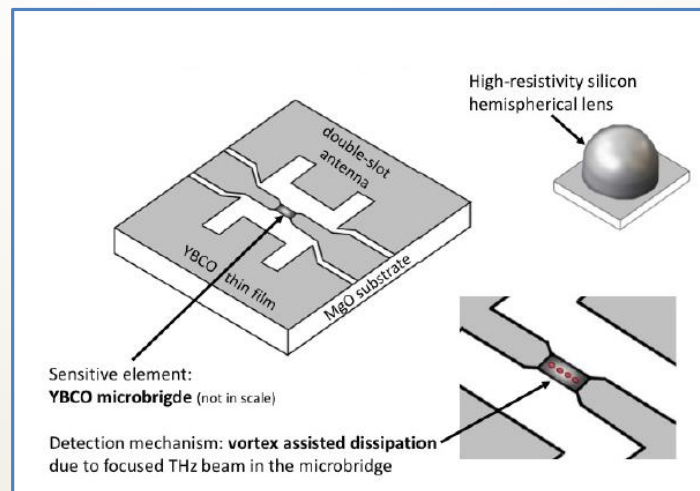
TERA (High Field THz era) open call

Duration: 2018-2020

Budget **900K€**

2 Post Doc contracts /2 years

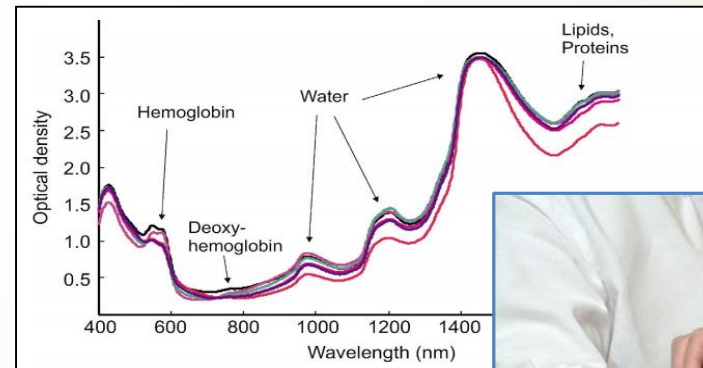
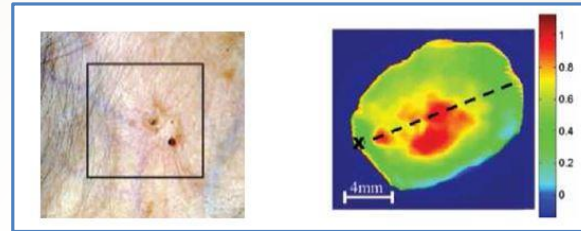
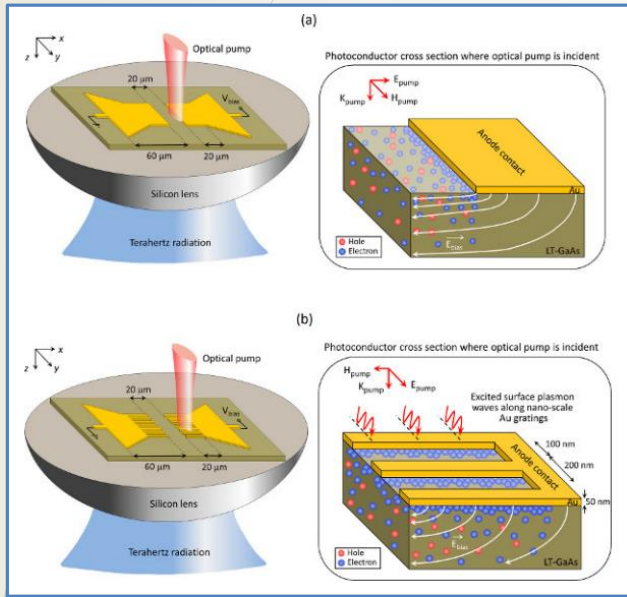
- ▶ THz high intensity laser source
- ▶ **THz beam dynamics, Metamaterial detectors (LNF)**
- ▶ THz Optics and devices (Na, CNR)
- ▶ Superconducting THz detectors (PoliTO)
- ▶ THz accelerators guide coupling (CNR)



T-Magic

Terahertz iMAGIng for Clinics

S.Lupi, M.Cestelli Guidi, A. Marcelli



THz generation:
photoconductive antennas



NR generation: supercontinuum effect



Duration: 2017-2019
Budget 120K€



MoU between CERN and INFN-LNF

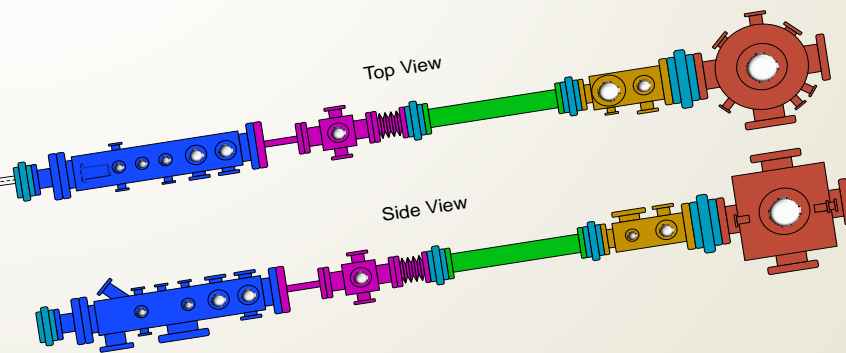
KE3724/TE/HL-LHC-Addendum No.4 to Agreement TKN3083

Contact person: P. Chiggiato (CERN); R. Cimino (LNF-INFN)

Technical Coordinator and safety Correspondentes: R. Kersevan (CERN); R. Cimino (LNF-INFN)

Objective: Synchrotron radiation-based material studies in the framework of the High Luminosity upgrade for the LHC and Future Circular Collider: surface reflectivity, photon and photo-induced desorption yield, secondary electron emission, chemical modifications etc.

- **Duration:** From August 2018 to August 2022 (4 years)
- **Budget:** From CERN to LNF INFN ~ **720K€** in total
 - 1 TD for the entire length of the project
 - Support to LNF-INF cost
 - Participation to the construction of a **dedicated white light beamline** for **desorption** studies





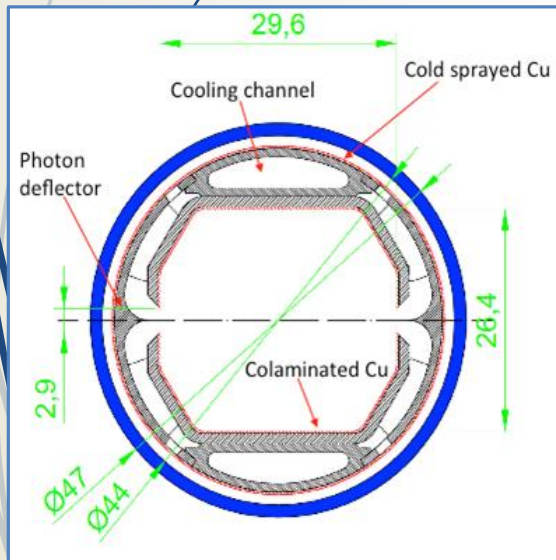
EuroCirCol (2016-2019)

EuroCirCol is a conceptual design study for a post-LHC research infrastructure based on an energy-frontier 100 TeV circular hadron collider.

WP4

Task 4.4: Cryogenic Beam Vacuum System Conception

Task 4.6: Measurements on cryogenic beam vacuum system prototype.

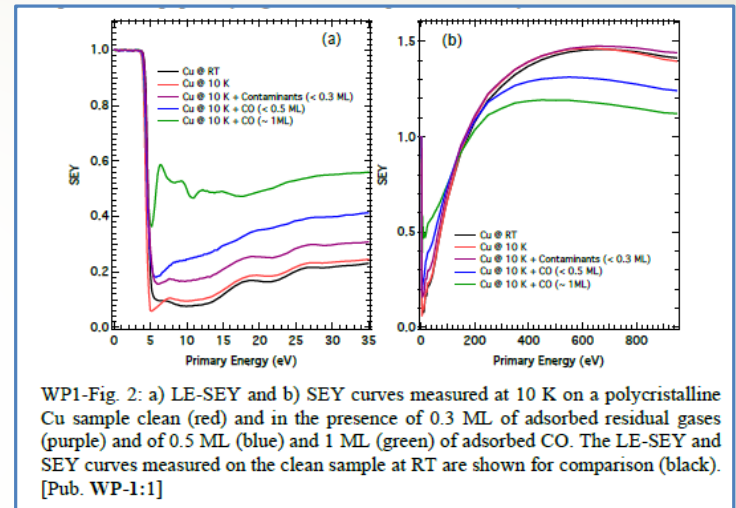
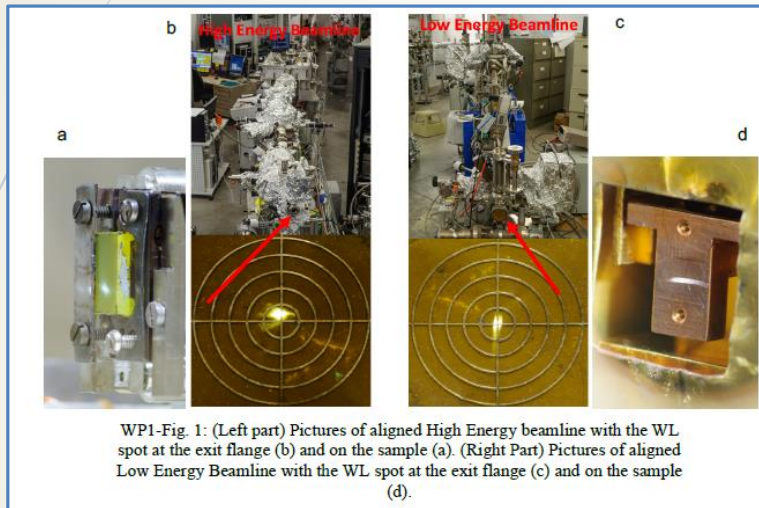


2 P_{ost}Doc positions

MICA

Mitigate Instabilities in Circular Accelerators

R.Cimino, R.Larciprete, M.Angelucci, C.Milardi



WP1. Surface properties of Carbon and Cu Surfaces for HL-LHC

WP2. Vacuum stability at FCC-hh

WP3. Synchrotron radiation material studies

WP6. Feedbacks for FCC-ee

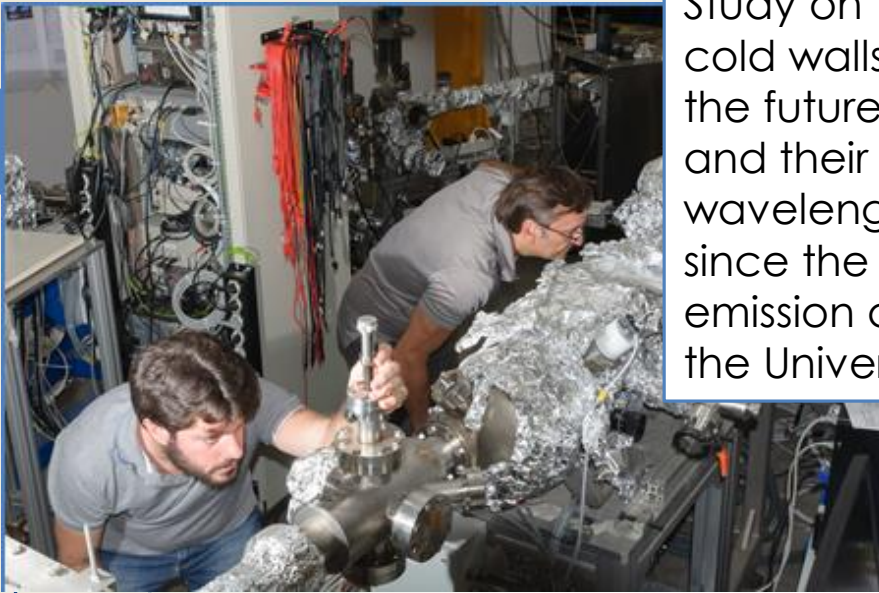
Duration: 2015-2018
Budget 400Ke

The results are relevant in the framework of material study of interest to the Particle accelerators community as well as to the ones studying RF satellite devices coatings.



Space research

Study on the behaviour of the gases absorbed by the cold walls of the Large Hadron Collider (LHC) and of the future large accelerators. The analysis of these ice and their behaviour, whether irradiated by a different wavelength light, is of great value in astrophysics, since the parameters governing ice desorption and emission are at the basis of databases used to study the Universe.



nature
astronomy

Letter | Published: 16 July 2018

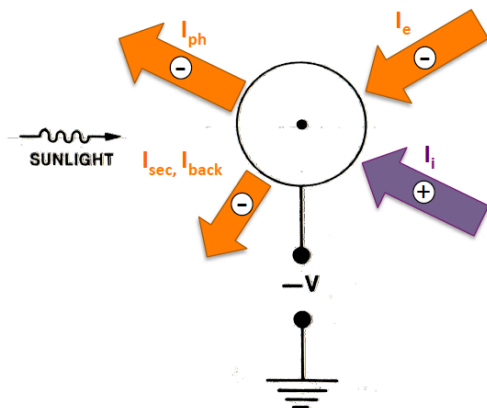
X-ray photodesorption from water ice in protoplanetary disks and X-ray-dominated regions

R. Dupuy[✉], M. Bertin, G. Féraud, M. Hassenfratz, X. Michaut, T. Putaud, L. Philippe, P. Jeseck, M. Lucci, R. Cimino, V. Baglin, C. Romanzin & J.-H. Fillion

Journal of Astronomical Sciences **2**, 796–801 (2018) | [Download Citation](#)

Spacecraft charging is the result of a current balance:

$$\sum I = 0 \rightarrow I_e(V) - I_i(V) - I_{ph}(V) - I_{sec}(V) - I_{back}(V) = 0$$



I_e : Net incoming electron current
 I_i : Net incoming ion current
 I_{ph} : Net emitted photoelectron current
 I_{sec} : Net secondary electron current
 I_{back} : Net backscattered electron current

In spacecrafts, two materials with different **SEY**, PE and R can charge differently and cause disruptive discharge.
(20% SC failure!)

Of interest to Accelerator Technology

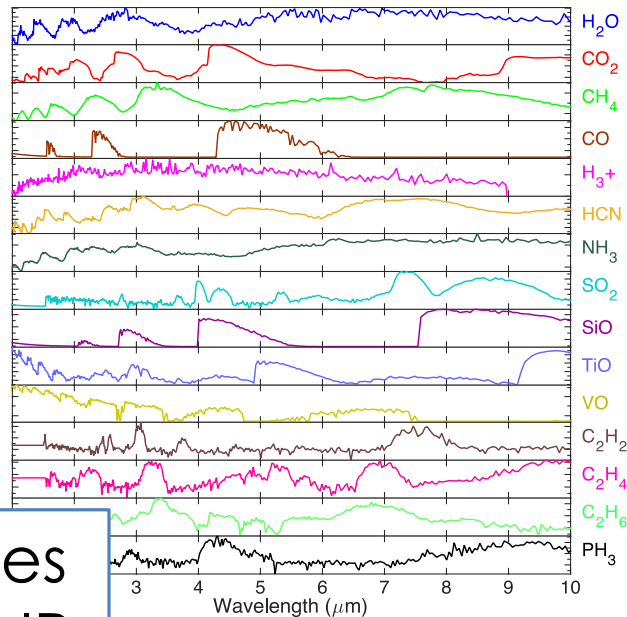
ARIEL

European Space Agency M4 Mission

Atmospheric Remote-sensing Infrared
Exoplanet Large survey

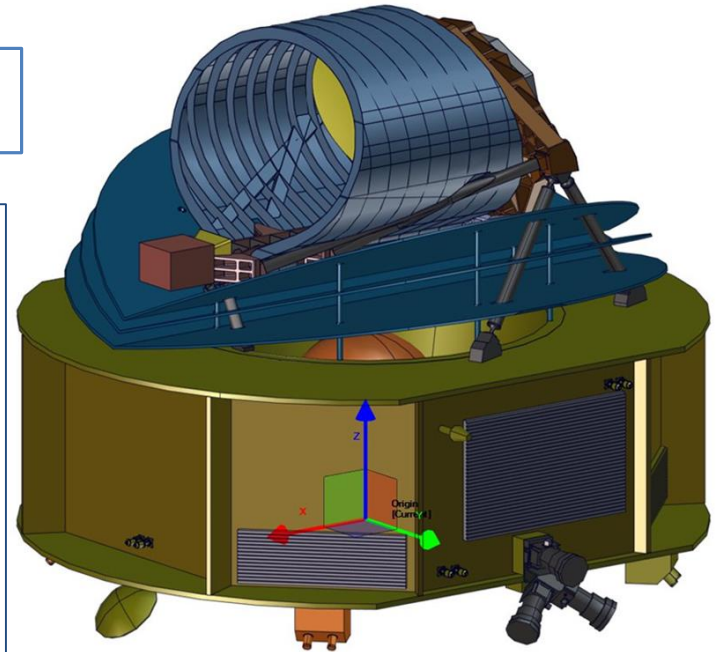


Emanuele Pace - INAF, Università di Firenze



Key molecules
absorbing in IR

Industrial developments are expected



Experimental + R&D

Duration (phase1) 2018-2020

Launch 2028

The Italian contribution to the
phase B1 **budget : 2 M€** in 2 years



Tecnologies applied to Cultural Heritage & Technology Transfer

ANALYSES

Portable Systems:

Raman Spectroscopy (LNF)
X-Ray Fluorescence Spectroscopy (RM2)
Multi Spectral Imaging 370-1700 nm (RM2)
Laser Induced Fluorescence Spectroscopy (LI (RM2)
FORS and Colorimetric Analysis (RM2)

Lab Systems:

SEM Microscopy (LNF)
XRD (RM2)
TOF-SIMS (RM3)
FT-IR Spectroscopy (micro and imaging) by using synchrotron radiation (LNF)
IR ATR Spectroscopy (micro and macro) by using synchrotron radiation (LNF)
Time Gated LIF Spectroscopy (TG-LIF) (RM2)



Budget 6 Meuro



2017-2020 preparatory phase

WP3: T3.1 Characterization by using IR spectroscopy using synchrotron radiation



1 Post-doc @LNF



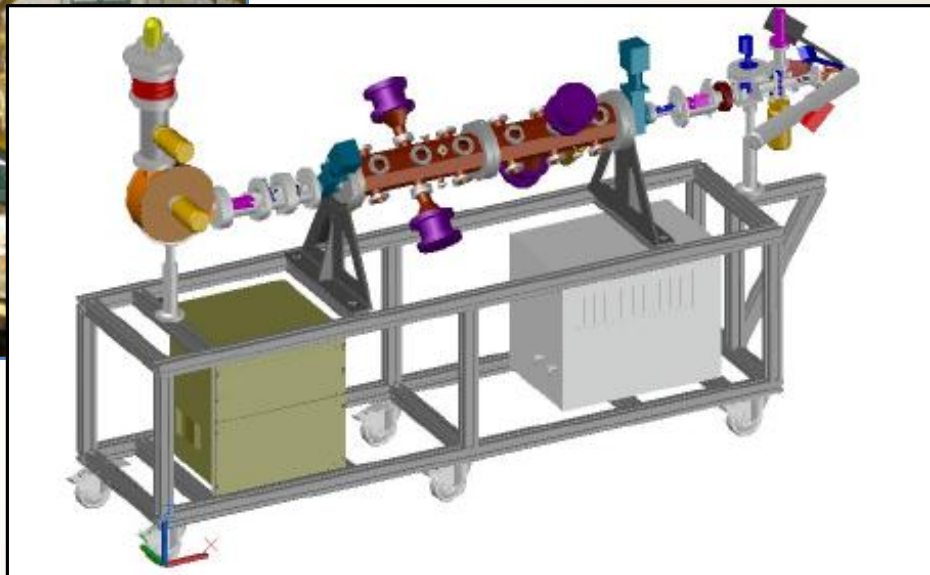
MACHINA

(Movable Accelerator for Cultural Heritage In-situ Non-destructive Analysis)

Resp. F. Taccetti, LABEC Firenze



2MeV Proton beam
PIXE and PIGE analysis



Timeline: 2018-2019

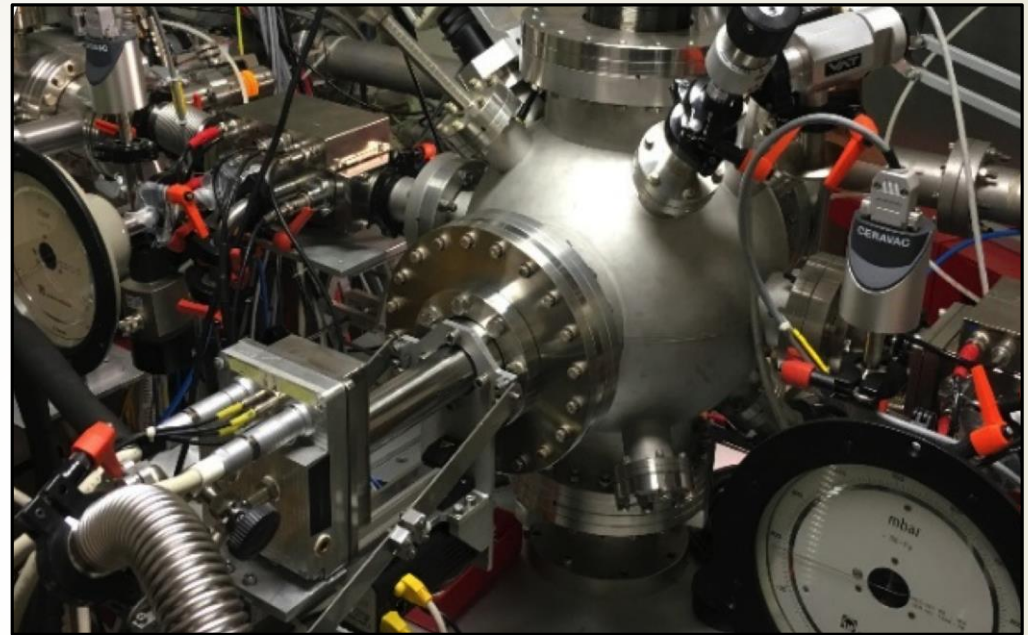
Budget: 1.7 M€

- HF-RFQ technology developed at CERN- Knowledge Transfer
- Possibility to duplicate the accelerator

1 Post-doc @LNF

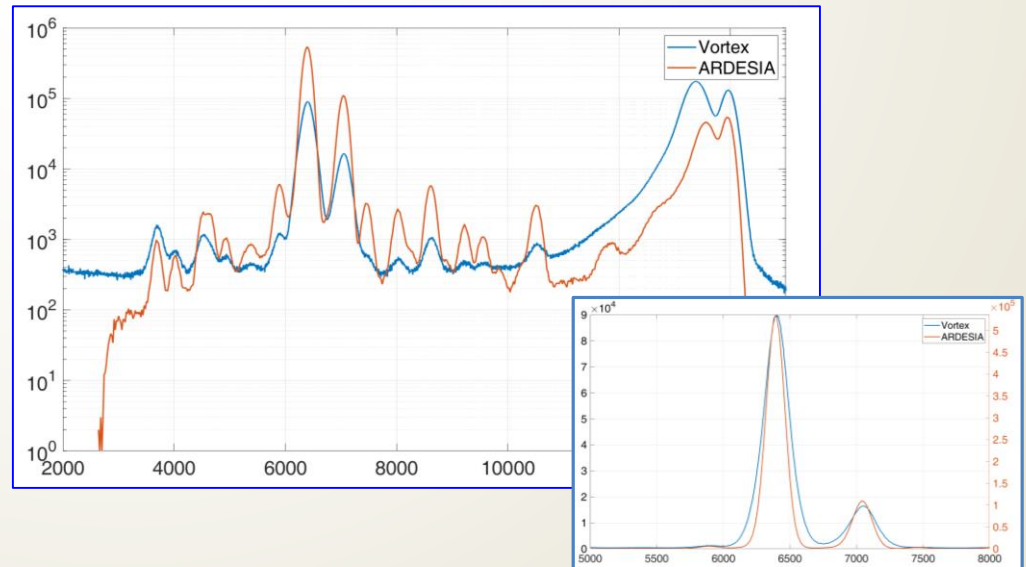
ARDESIA X-Ray Detector

Developed thanks to a collaboration between **DAFNE-Light** and **Politecnico di Milano**.
Financed by **INFN** through the **CSN5 ARDESIA** project.
Tested in 2018 at DAFNE-L soft X-ray beamline and **used at the ESRF - LISA beamline for about 6 months by many users.**



Applied to the **EC H2020 ATTRACT Phase 1 Call** with a proposals for the development of a new multichannel high rate and high resolution detector for x-ray spectroscopy.

Comparison between the **energy resolution** of **ARDESIA** and of a **commercial Vortex SDD detector**.



Conclusions

- Science at Synchrotron Radiation and Free Electron Laser facilities play an essential role in the discovery and characterization of advanced materials, biomaterials and artworks and Europe has achieved global leadership in this field.
- The Dafne-Light facility serves a broad **scientific community of researchers** and attract students and projects. They span many countries, facilitating multinational collaborations, and support a spectrum of disciplines that encompass fundamental and applied sciences, and innovative industrial applications.
- Dafne in a dedicated mode for a few monts/year keeps the SR community active and competitive towards future accelerator machines (Eupraxia) .