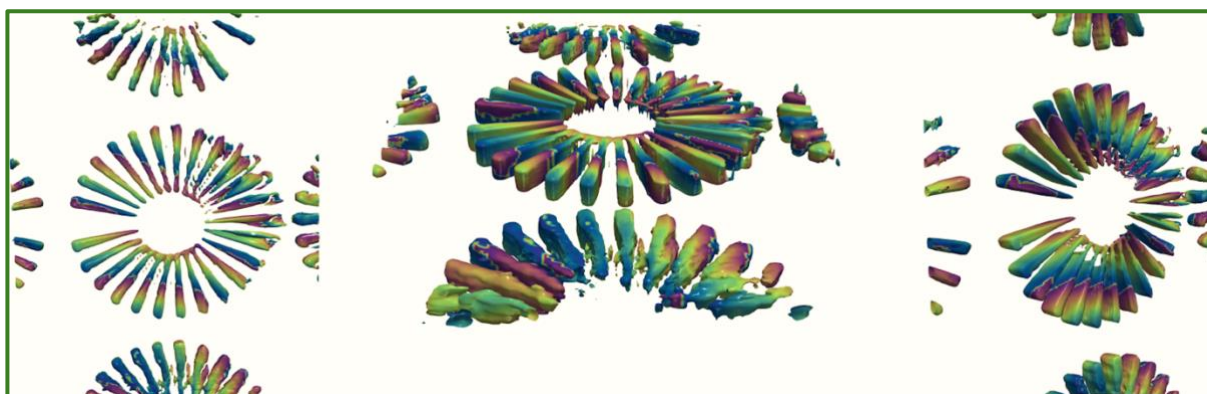


# **X-ray Bragg ptychography: an inverse diffraction 3D imaging approach for crystalline materials**

2 – 4 September 2025

CIRM, Marseille, France



## **Organizing Committee**

Marc Allain (Institut Fresnel, Aix-Marseille Université)

Clément Atlan (ESRF, Grenoble INP – UGA)

Dina Carbone (MAX IV Laboratory, Lund)

Virginie Chamard (Institut Fresnel, Aix-Marseille Université)

Vincent Favre-Nicolin (ESRF, Grenoble INP – UGA)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101004728



## Context and objectives of the workshop

3D Bragg ptychography (3DBP) is a powerful crystalline microscopy method, capable of producing tri-dimensional maps of crystalline materials down to 10 nm spatial resolution, by leveraging the impressive coherence properties of X-ray beams produced at 4th generation sources. It allows the investigation of extended, rather complex crystals, filling the gap between electron microscopy and Bragg coherent diffraction imaging and represents an unparalleled research tool for all kind of crystalline materials.

Mathematically, this inverse problem-based method provides access to the phase of the diffracted field from intensity information only. However, the specificity of the Bragg geometry and the difficulty related to the retrieval of complex displacement fields have inhibited the development of the method towards the synchrotron user community, so far.

In the framework of the LEAPS INNOV EasyBragg funded project “*Implementation of user-friendly 3D Bragg ptychography at synchrotron sources- EASYBRAGG*”, an user-oriented code has been developed, tested and implemented at several beamlines in Europe. This hands-on tutorial workshop aims at delivering to potential Bragg ptychography users all the needed knowledge to design and perform their Bragg ptychography experimental campaigns and fully analyse the produced data-sets directly at the beamline or at their home institutes.

Through this workshop, the EasyBragg consortium hopes to contribute to the profitability of economic and technological investments in 4th generation sources, currently being developed at the international level.

<https://conferences.cirm-math.fr/3647.html>



## Lectures & tutorials

Virginie Chamard (Institut Fresnel, CNRS, Aix-Marseille Université)

*Introduction to Bragg ptychography*

Dina Carbone (MAX IV Laboratory, Lund)

*Experimental implementation*

Marc Allain (Institut Fresnel, CNRS, Aix-Marseille Université)

*Numerical inversion of 3DBP data set*

Clément Atlan (ESRF)

*General overview of the 3DBP code*

## Dates

The workshop will be held over two full days, on September 2nd and 3rd. Participants are expected to arrive on the afternoon or evening of September 1st, and to depart on September 4th, either before or after lunch.

## Location

The workshop will take place at the CIRM in Marseille France. Under the supervision of the French Mathematical Society, CNRS, Aix-Marseille University, with the solid support of the Ministry of Higher Education and Research, LabEx Carmin and Archimede Institute, Cirm has been, for more than 40 years, a tool of excellence at the service of the French school of mathematics and researchers from all over the world. With more than 4500 participants each year, it is one of the world's leading meeting centres in mathematics. Its International Scientific Council ensures the quality of the meetings organized and selects the beneficiaries of the Jean Morlet Chair semesters. The high scientific level and the high quality of the services provided by the Cirm make it internationally attractive and influential.



## Coming to CIRM

Address: CIRM 163 avenue de Luminy, Case 916  
13288 Marseille Cedex 9, France

## From Marseille, by bus

Cirm is served by the B1, 21Jet and 24 buses during the day, and by the 521 bus at night.

## If you arrive by plane

Marseille is at the crossroads of several European countries and relatively well connected to a number of cities. The local airport, « Marseille Provence Airport », has direct flights to 121 destinations including the major air hubs: Amsterdam, Brussels, London, Rome, Munich, New York, etc.

When you arrive, you have two options:

- Take a taxi: about 50 minutes for a cost in the order of 100€.

- Use the Airport shuttle bus which will take you to Gare Saint-Charles – Marseille’s main train station – from where you can access public transport. Then take the metro 2 to the « Rond-Point du Prado » station and continue with the B1 or 21J bus to the terminus, the Luminy Campus.

### **If you arrive by train or coach**

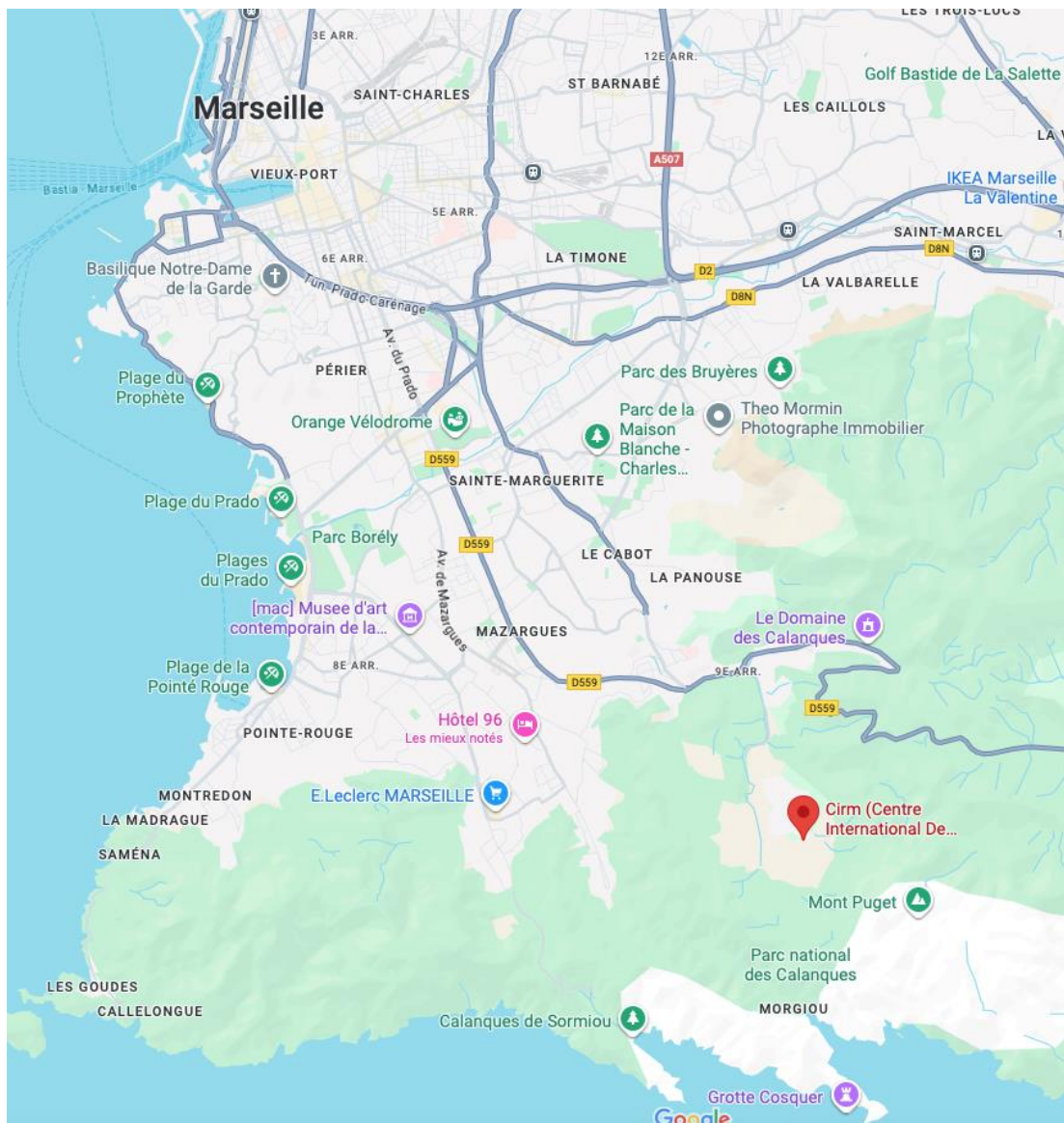
On arrival at the Gare Saint-Charles (train and bus station), you can :

- Take a taxi\* to the CIRM, for an average cost of 40€.
- Take public transport: first the metro 2 to the « Rond-Point du Prado » station, then the B1 or 21J bus to the terminus, the Luminy Campus.

### **What to do if you arrive after 21:45 at Gare Saint-Charles**

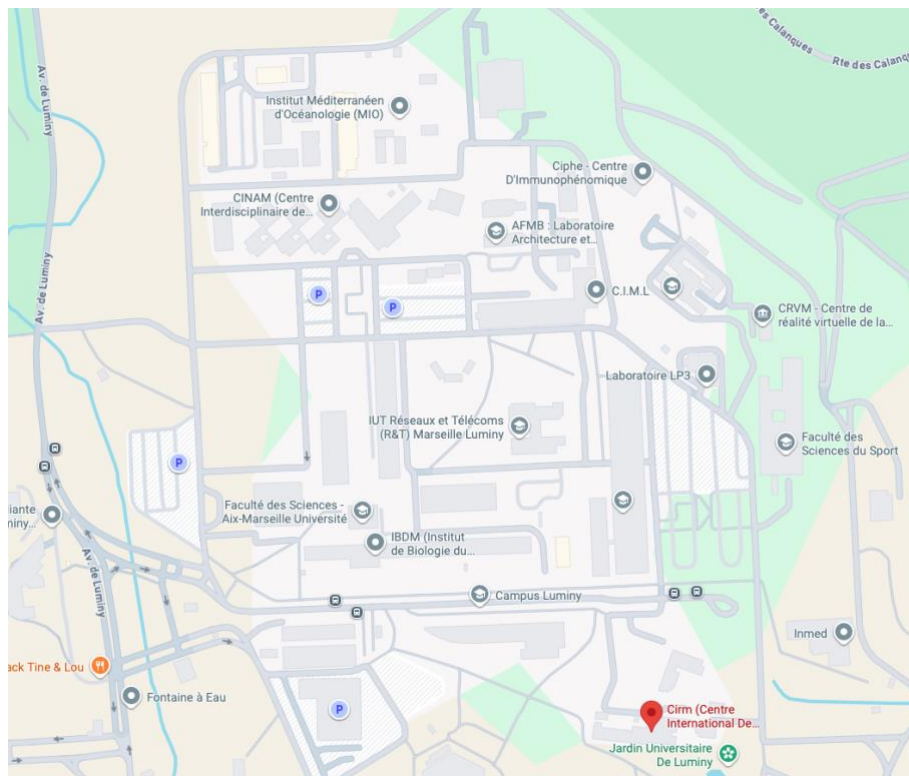
At night (after 9pm) you can catch Bus 521 outside the Gare St Charles. It will take you directly to the « Luminy PN des Calanques » stop, 6 minutes walk from the CIRM (signs will show you the way). You will not need to take the metro.

(\*) Contact the CIRM reception desk several days before your arrival, during the week, by email or phone, if you need information about taxis. Please note: the workshop does not pay for any transport or travel expenses.



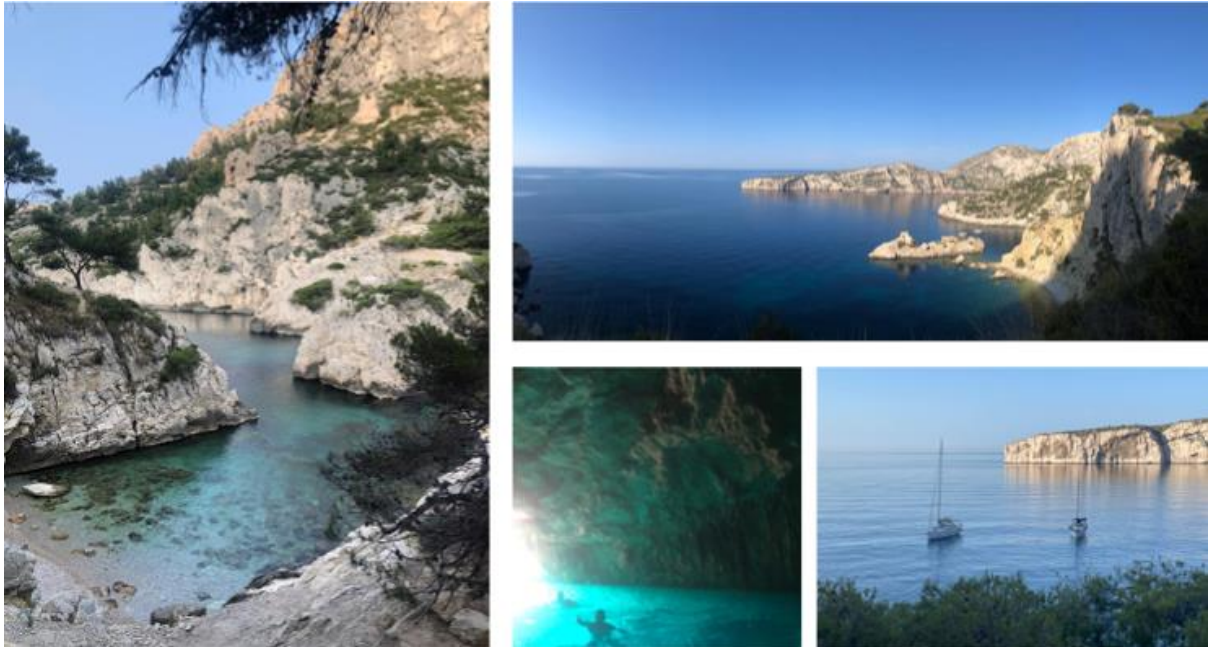


## Cirm at the Luminy Campus



More information on transportation and interactive links at <https://www.cirm-math.com/getting-to-cirm.html>

## Social Event: Hike in the Calanques of Marseille



*Pictures Courtesy of V. Chamard.*

Cirm is located at the entry of the Calanques National Parc.

<https://www.calanques-parcnational.fr/fr>

Weather permitting, we are planning a short (2-hour) outing to the **Calanques of Marseille** at the end of the day on **September 3**.

Please bring good **walking shoes and a swimsuit**.

## Tentative Program

*The program will be adjusted in real time to allow all participants to fully follow its content.*

(CT): 3DBP Code Tutorial, (D): Discussion, (L): Lecture, (NT): Numerical tutorial,  
(O): Oral presentation,

### **Tuesday 2 September 2025**

8:30 – 9:30 Introduction Session

8:30 – 9:15 (O) **Self-presentation of participants**

9:15 – 9:30 (O) **3DBP workshop introduction**, V. Chamard

9:30 – 10:00 (L) **Experimental set-up**, D. Carbone

10:00 – 10:30

*Coffee break*

10:30 – 11:00 (L) **Data description (in relation with the Easy Bragg convention)**,  
C. Atlan

11:00 - 12:00 (CT) **Shaping the input data**, C. Atlan

12:00 – 14:15

*Lunch Break*

14:15 – 15:15 (CT) Follow up of the tutorial: **Shaping the input data**, C. Atlan

15:15 – 15:45 (O) **3DBP code general overview**, C. Atlan

15:45 – 16:45 (CT) **3DBP code I: Probe and object reconstruction**, C. Atlan  
30 min

16:45 – 17:15

*Coffee break*

17:15 – 17:45 (CT) **3DBP code II: Up-sampling on degraded data**, C. Atlan

17:45 – 18:30 (O) **Data collection & sampling**, M. Allain

### **Wednesday 3 September 2025**

8:30 – 9:00 (L) **Numerical inversion**, M. Allain

9:00 – 10:00 (CT) **3DBP code III: Regularization on the object**, C. Atlan

10:00 – 10:30

*Coffee break*

10:30 – 12:30 (D) **Poster session**

12:30 – 14:15

*Lunch Break*

14:15 – 14:45 (NT) **SNR & spatial resolution**, M. Allain

14:45 – 15:15 (NT) **The 3D detection geometry**, C. Atlan & M. Allain

15:15 – 15:45

*Coffee break*

15:45 – 17:00 (D) **Round table**

Discussion will include the following topics:

experimental difficulties, resolution estimation, the back projection approach, scanning parameter optimisation, estimation of the reconstruction optimum, reconstruction interpretation.

*Do not hesitate to contact us in advance if you identify some topics you would like to be discussed during the round table.*



## List of attendees

(Organiser names are underlined)

First Name	Name	Profile	Affiliation	Country	Sector	email address
Marc	Allain	Senior	Fresnel	France	Academic	marc.allain@fresnel.fr
<u>Clément</u>	<u>Atlan</u>	Post-doc	ESRF	France	Large Facility	clement.atlan@esrf.fr
<u>Dina</u>	<u>Carbone</u>	Senior	MAXIV	Sweden	Large Facility	gerardina.carbone@maxiv.lu.se
<u>Virginie</u>	<u>Chamard</u>	Senior	Fresnel	France	Academic	virginie.chamard@fresnel.fr
Lucy	Fitzgerald	PhD	Uni. Birmingham	UK	Academic	kxf287@student.bham.ac.uk
Julia	Garriga Ferrer	Junior	RESET	Spain	Private company	juliala28@gmail.com
Francesco	Guzzi	Junior	Elettra	Italy	Large Facility	francesco.guzzi@elettra.eu
Ross	Harder	Senior	APS	USA	Large Facility	rharder@anl.gov
Swan	Hunt	PhD	ANL	USA	Academic	swanh@u.northwestern.edu
Petra	Khater	PhD	CEA/Grenoble	France	Academic	petra.khater@esrf.fr
Yoonhee	Kim	Post-doc	XFEL	Germany	Large Facility	yoonee.kim@xfel.eu
Luiza	Manente	PhD	Sirius	Brazil	Large Facility	luiza.manente@lnls.br
Francisco	Mateus Cirilo da Silva	Senior	Sirius	Brazil	Large Facility	francisco.silva@lnls.br
Colum	OLeary	Junior	SSRL	USA	Large Facility	coleary1@slac.stanford.edu
Dina	Sheyfer	Senior	APS	USA	Large Facility	dsheyfer@anl.gov
Chaitali	Sow	Post-doc	DESY	Germany	Large Facility	chaitali.sow@desy.de
Ana	Susana	Senior	ANL	USA	Academic	asuzana@anl.gov
Zifan	Wang	Post-doc	Diamond	UK	Large Facility	zifan.wang@diamond.ac.uk
Abdelrahman	ZAKARIA	PhD	IM2NP	France	Academic	abdelrahman.zakaria@etu.univ-amu.fr
Jiangtao	Zhao	Post-doc	ESRF	France	Large Facility	jiangtao.zhao@esrf.fr