



PROGRAMME
DE RECHERCHE
CALCUL HAUTE
PERFORMANCE



The NumPEX Program

Co-directors

Dr J. Bobin (CEA), Dr J-Y. Berthou (INRIA), Pr M. Krajecki (CNRS)

Project leaders and co-leaders

ExaMa - Pr C. Prudhomme, U. de Strasbourg - H el ene Barucq (Inria)

ExaSoft - Pr R. Namyst, Inria/U. de Bordeaux - Alfredo Buttari, IRIT

ExaDost - Dr G. Antoniu, INRIA - Julien Bigot, CEA

ExaAtoW - Pr F. Bodin, U. de Rennes - Mark Asch, U. Picardie - Thierry Deutsch, CEA

ExaDIP - Dr J-P. Vilotte, DR CNRS - Val erie Brenner, CEA



Les PEPR



Volet « dirigé » de France 2030 :

- **les programmes et équipements prioritaires de recherche (PEPR)** visent à construire ou consolider un **leadership français**
- dans des domaines scientifiques liés à une **transformation technologique, économique, sociétale, sanitaire ou environnementale**

Le CNRS est pilote ou co-pilote de :

- **13 PEPR Accélération** et contribue aux autres PEPR via la participation des UMR dans différents projets.
- **22 PEPR Exploratoires** (dont 5 de la vague 3 en cours de confirmation)
- Le CNRS a créé une Mission de coordination des Programmes Nationaux (MiPN) pour coordonner les actions en lien avec les PEPR et autres programmes nationaux pilotés ou co-pilotés par le CNRS



Les PEPR au CNRS



PEPR ACCELERATION	PEPR EXPLORATOIRE
5G	MOLECULARXIV
BATTERIES	FAIRCARBON
CYBERSECURITE	ONEWATER
DECARBONATION de l'INDUSTRIE (SPLEEN)	DIADEM
ELECTRONIQUE	ATLASEA
GRANDS FONDS MARINS	BRIDGES
HYDROGENE DEARBONE	ENSEMBLE
IA	IRIMA
ICCARE	LUMA
RECYCLAGE	NUMPEX
TASE (SYSTEMES ENERGETIQUES)	O2R
QUANTIQUE	ORIGINS
VILLE DURABLE	PROPSY
	SOLU-BIOD
	SOUSSOL
	SPIN
	TRACCS

**+ 5 Programmes
Exploratoires V3 en
cours de validation**

**dont MATH-VivES
annoncé le 27/09**

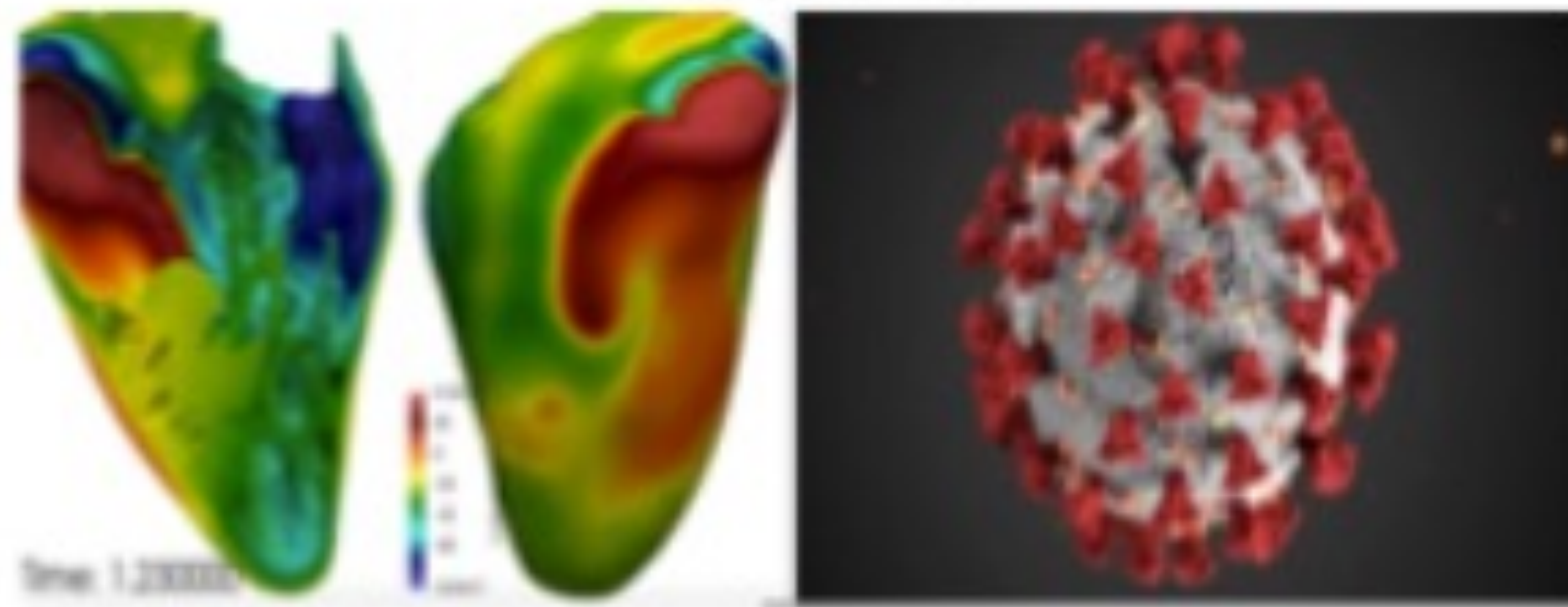
**Informations sur les
différents
programmes**
www.cnrs.fr/fr/pepr

The French NumPEX Program Exascale, what's at stake ?

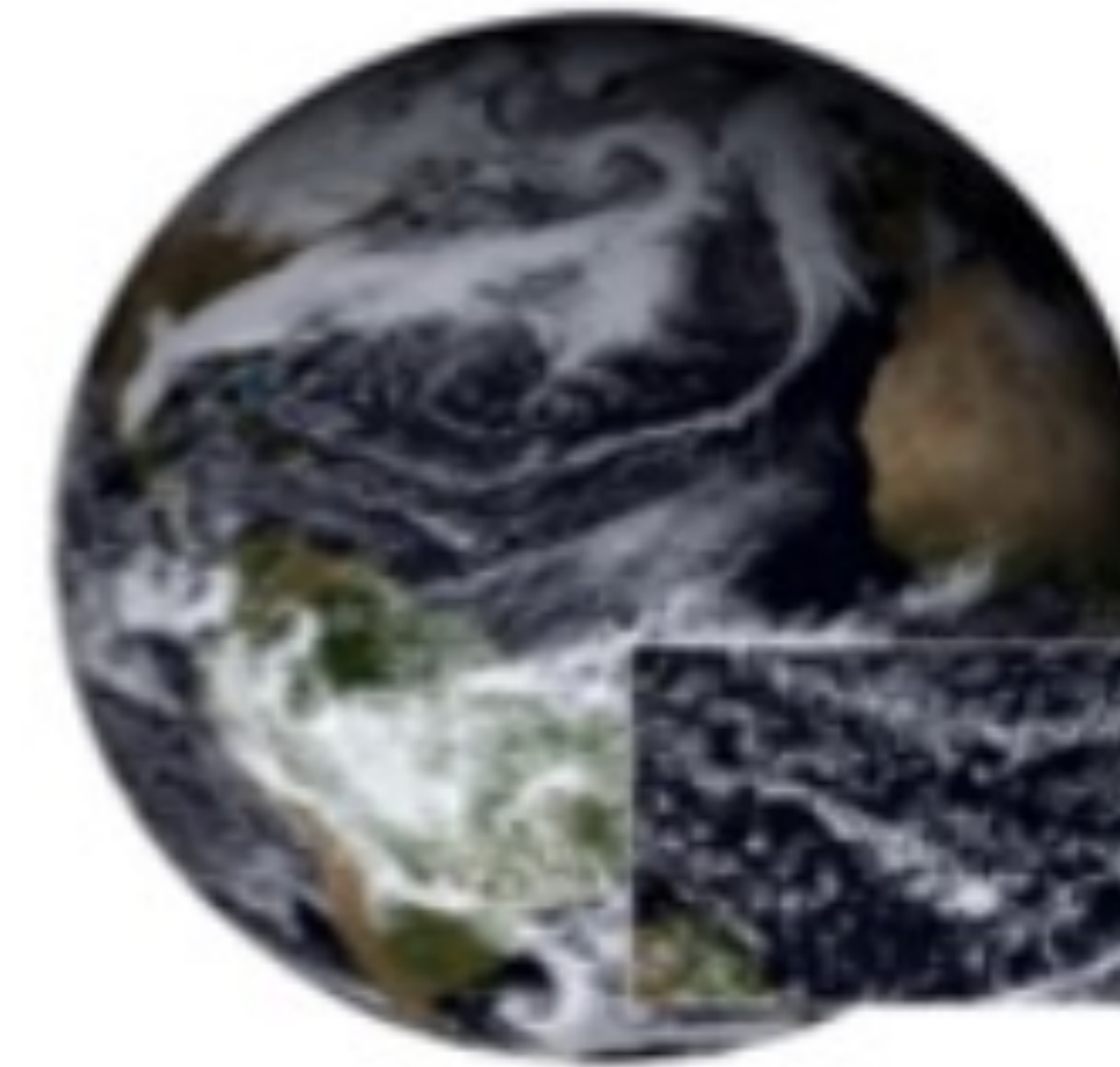
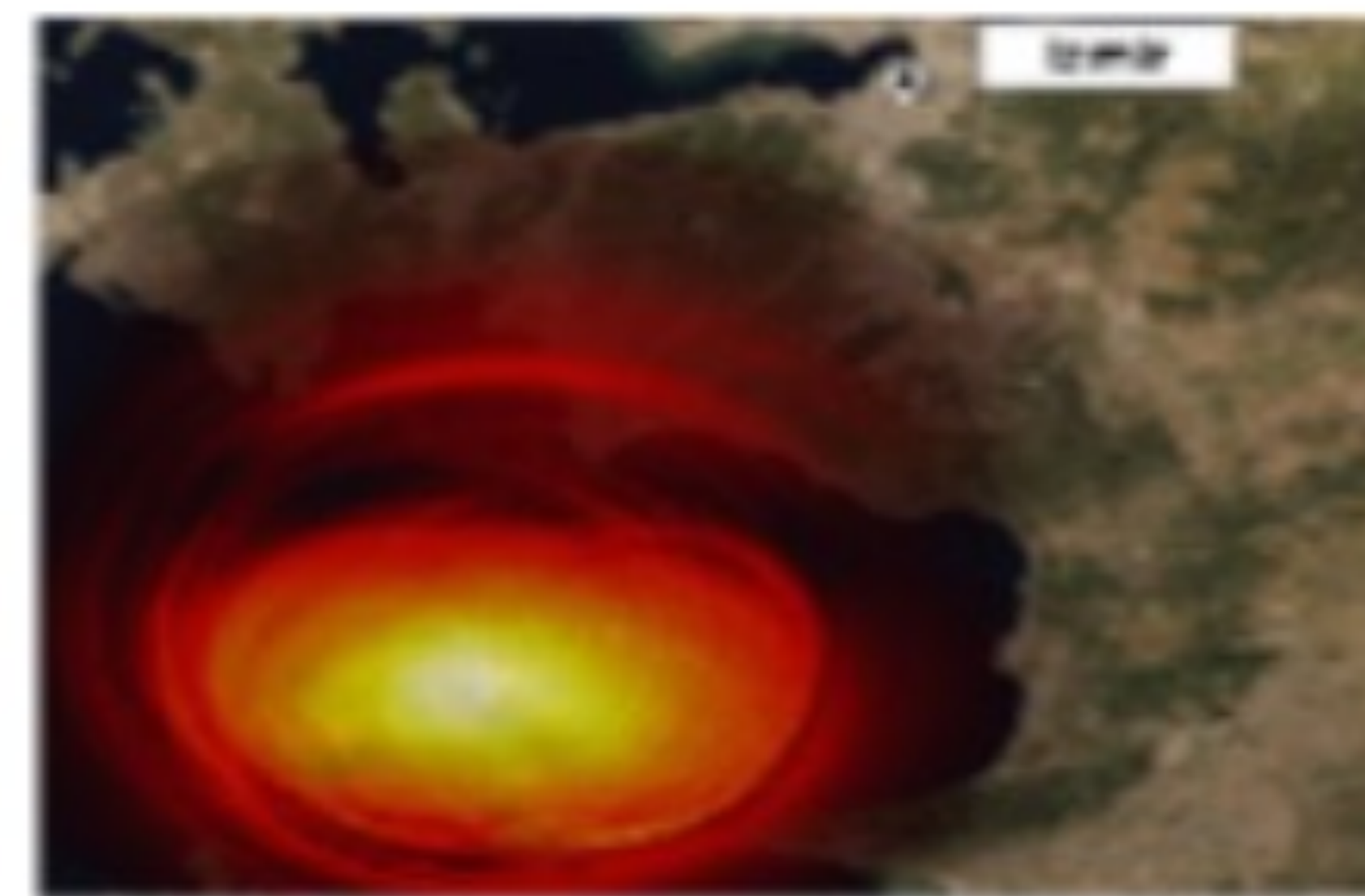
Exascale for scientific breakthrough, environmental sustainability, resilient society, and industrial competitiveness

Answering key scientific questions

Supporting the development of COVID-19 treatments



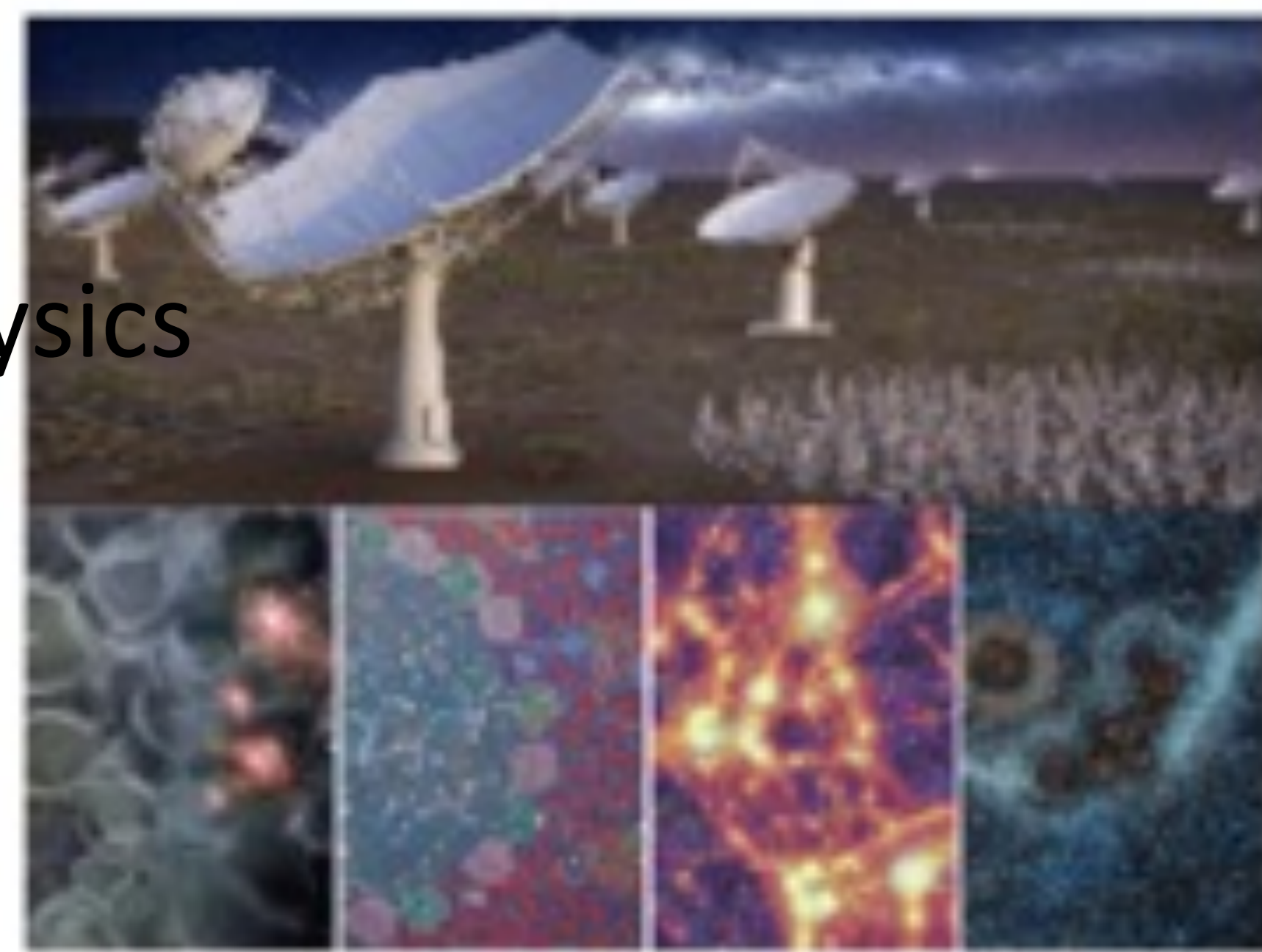
Weather and climate models



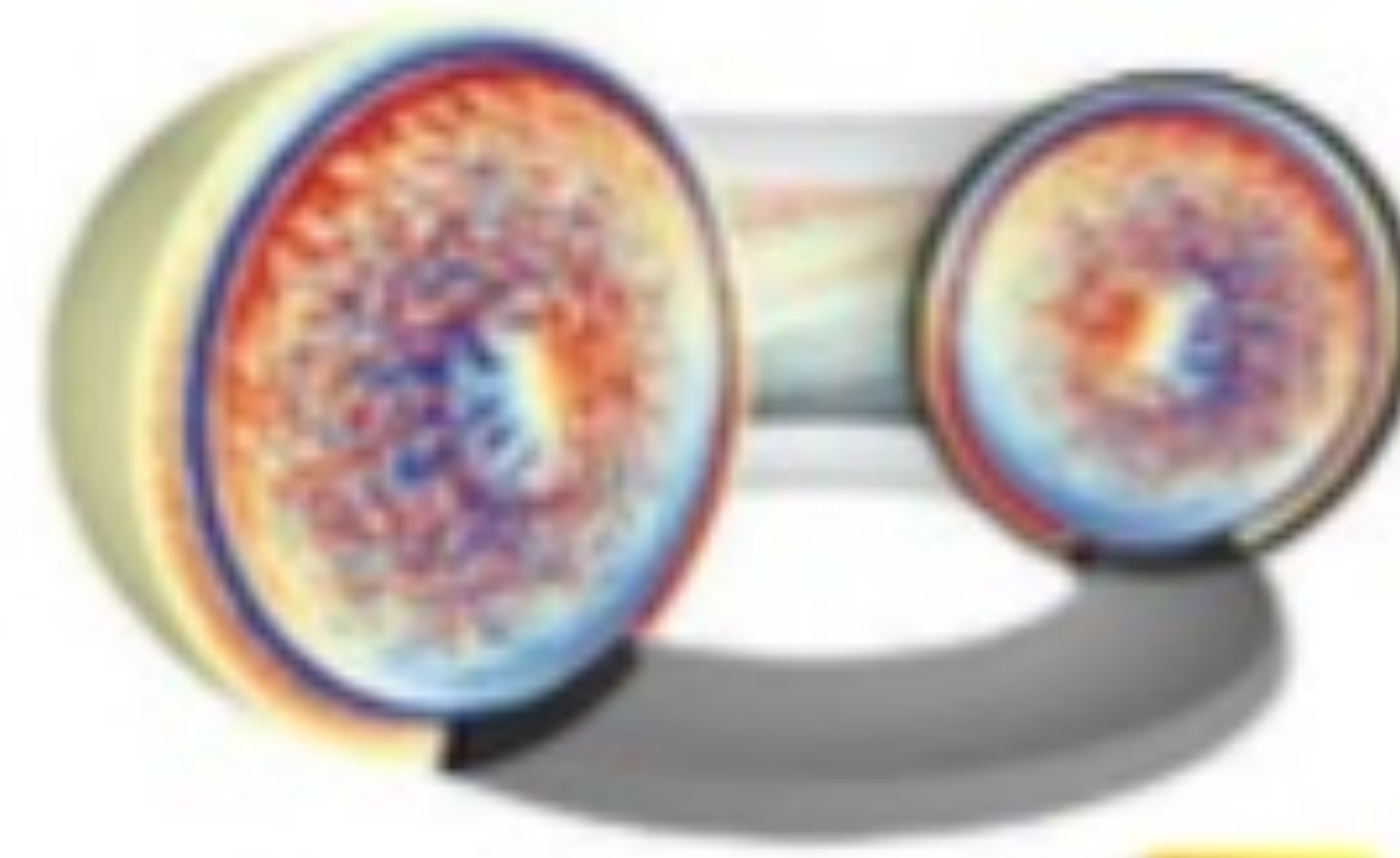
Earthquake simulation

Leading to engineering breakthrough

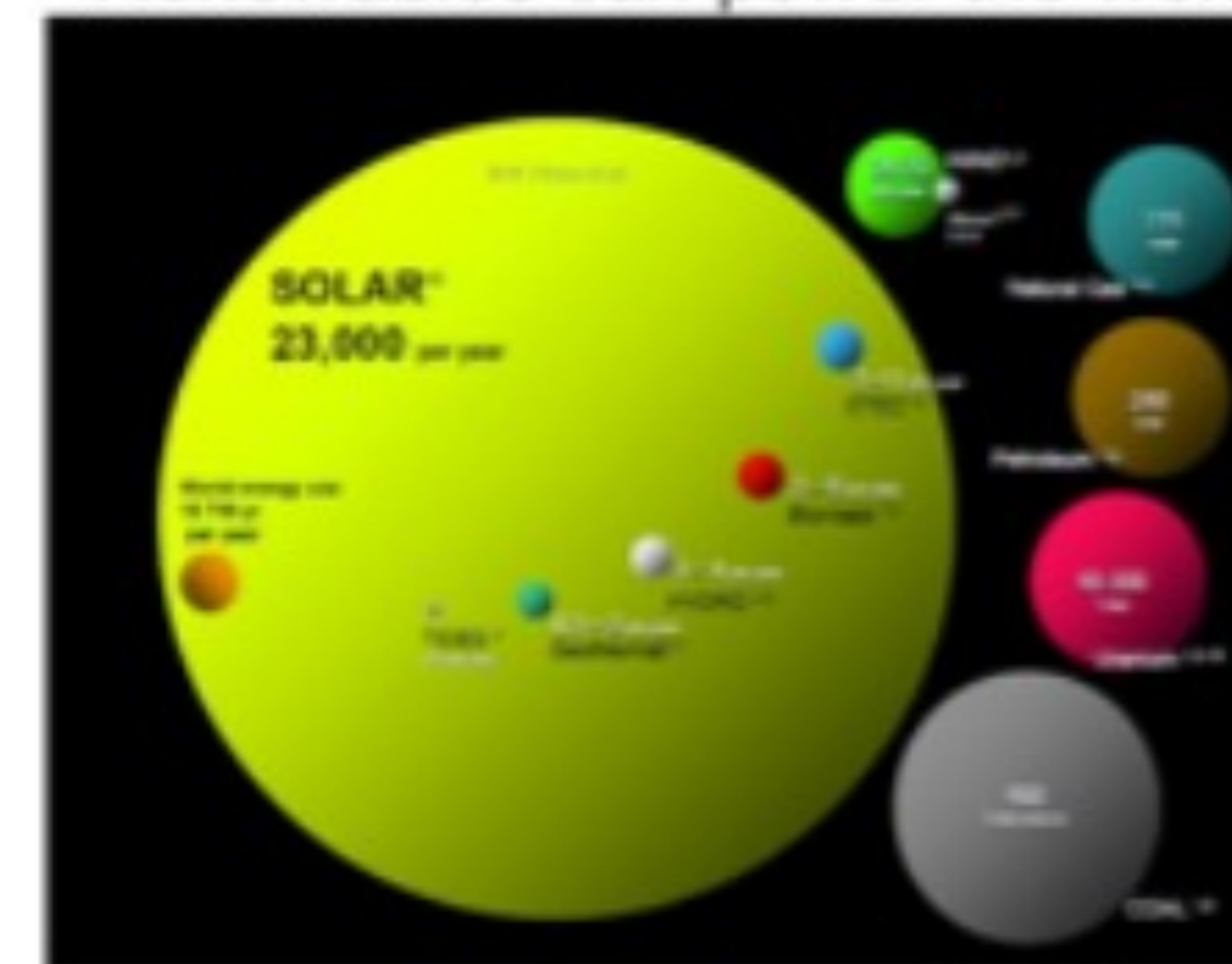
Astrophysics



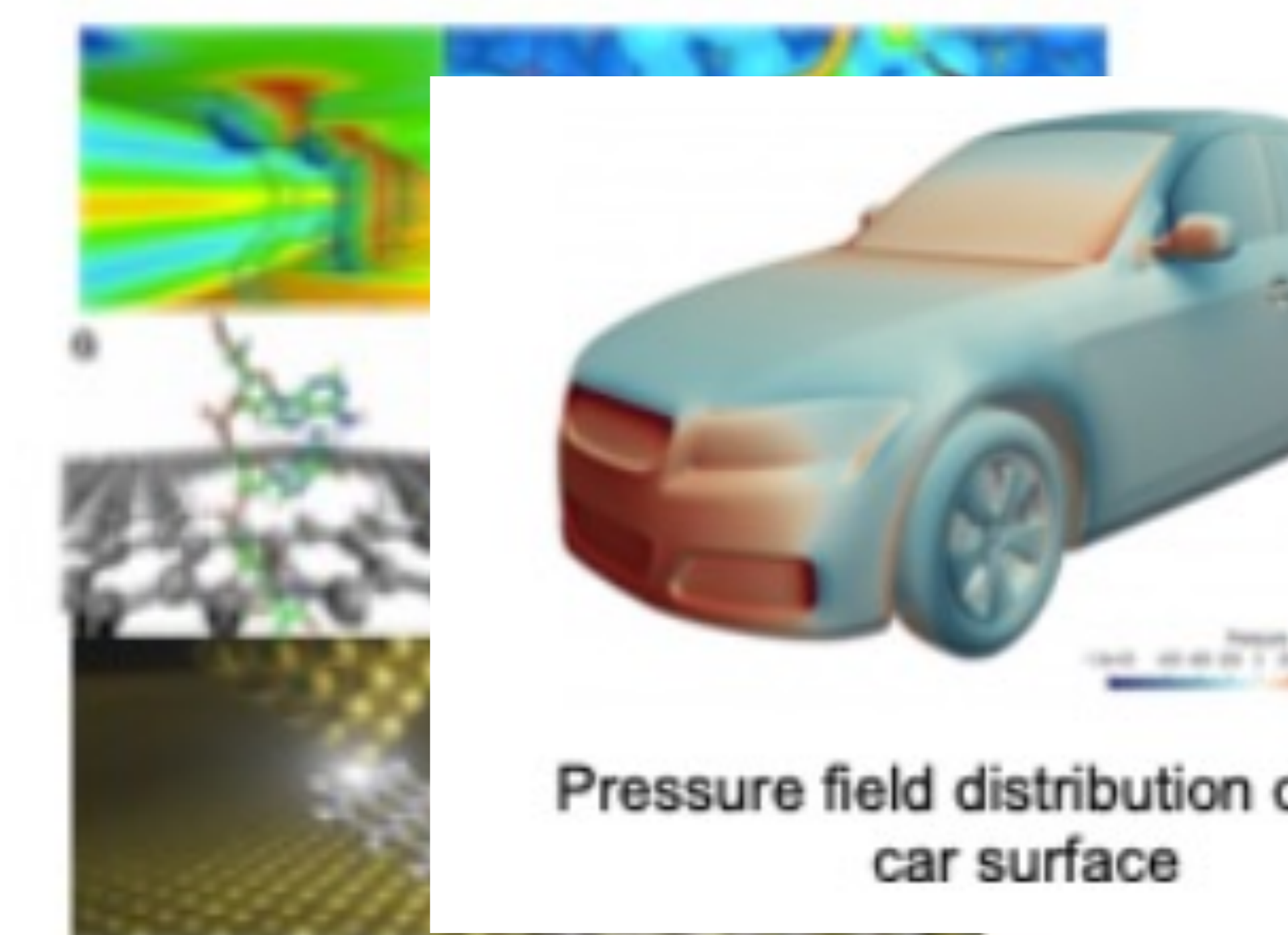
Fusion



Renewables can power the world

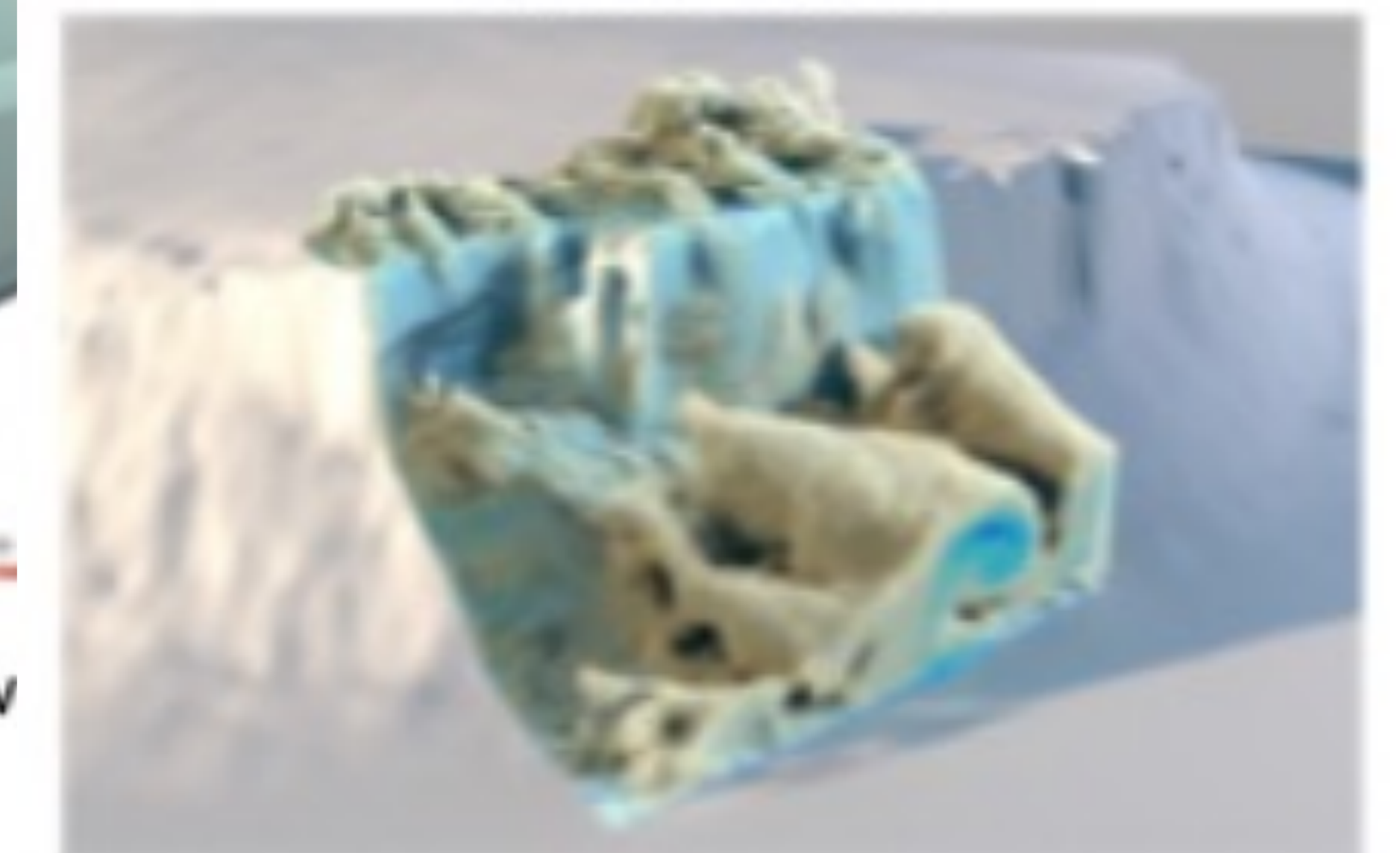


Materials simulation



Pressure field distribution on car surface

AI for wind farm layout optimization



Transportation

The French NumPEX Program

Context and motivations



A technological breakthrough

Hybrid scalar/acc.
fewer memory/node
more concurrency

In the digital continuum

Increased flux/volume from
the edge to the HPC system

Convergence
HPC/HPDA/IA

Traditional
HPC
Systems

Large-Scale
Numerical
Simulation

Scalable
Data Analytics

Deep
Learning

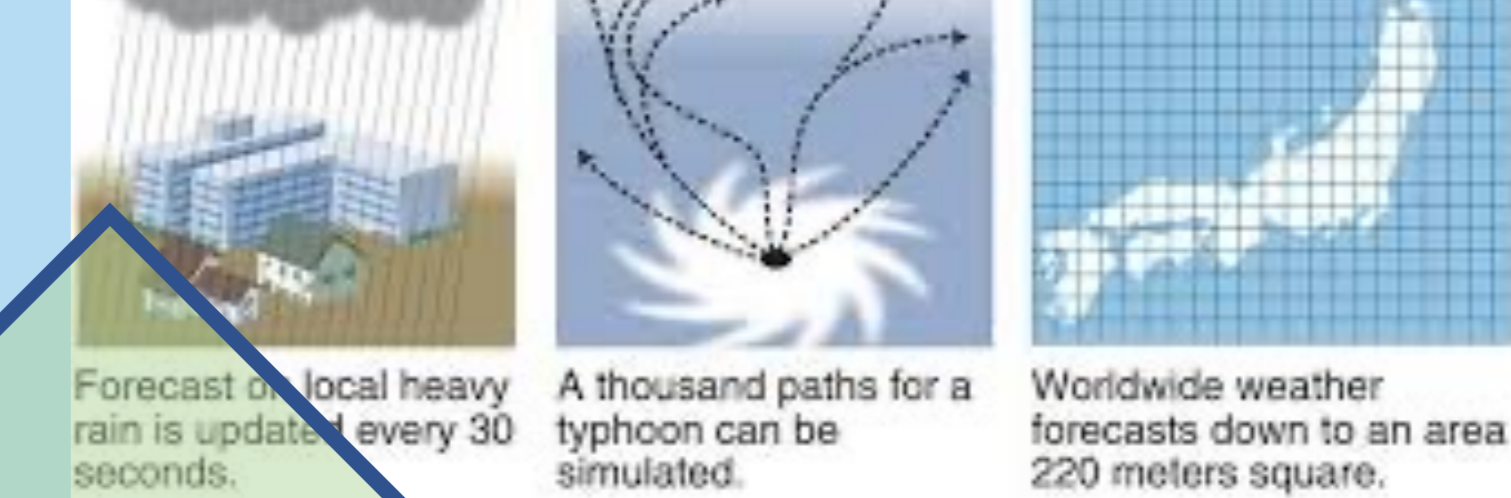
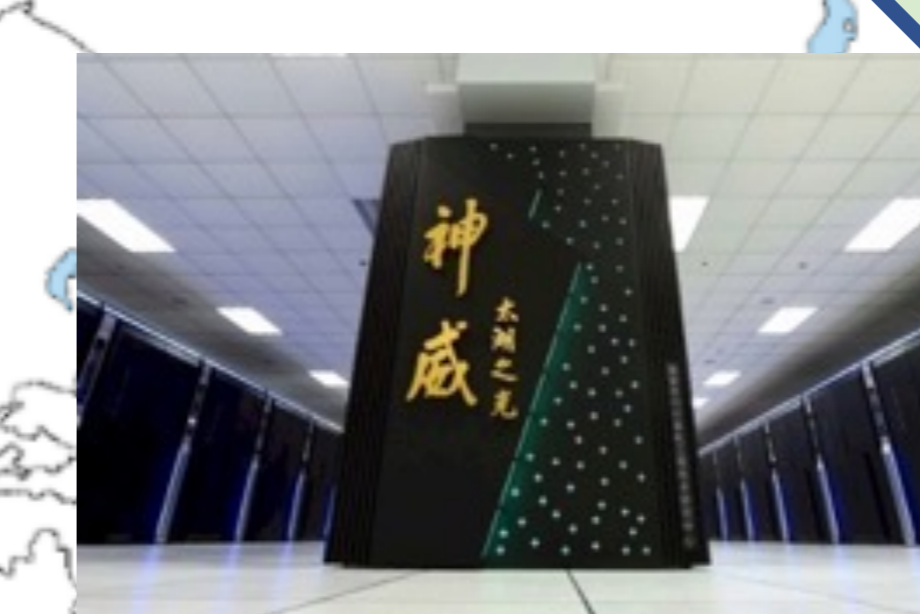
Capable
Exascale system



Context - International initiatives pre-arrival of exascale computers

China initiatives:

- development of applications in preparation for the arrival of the Tianhe3 machine.



US initiatives:

- Dedicated support of the NSF
- Exascale Computing Project (DoE) creation of 6 co-design centers

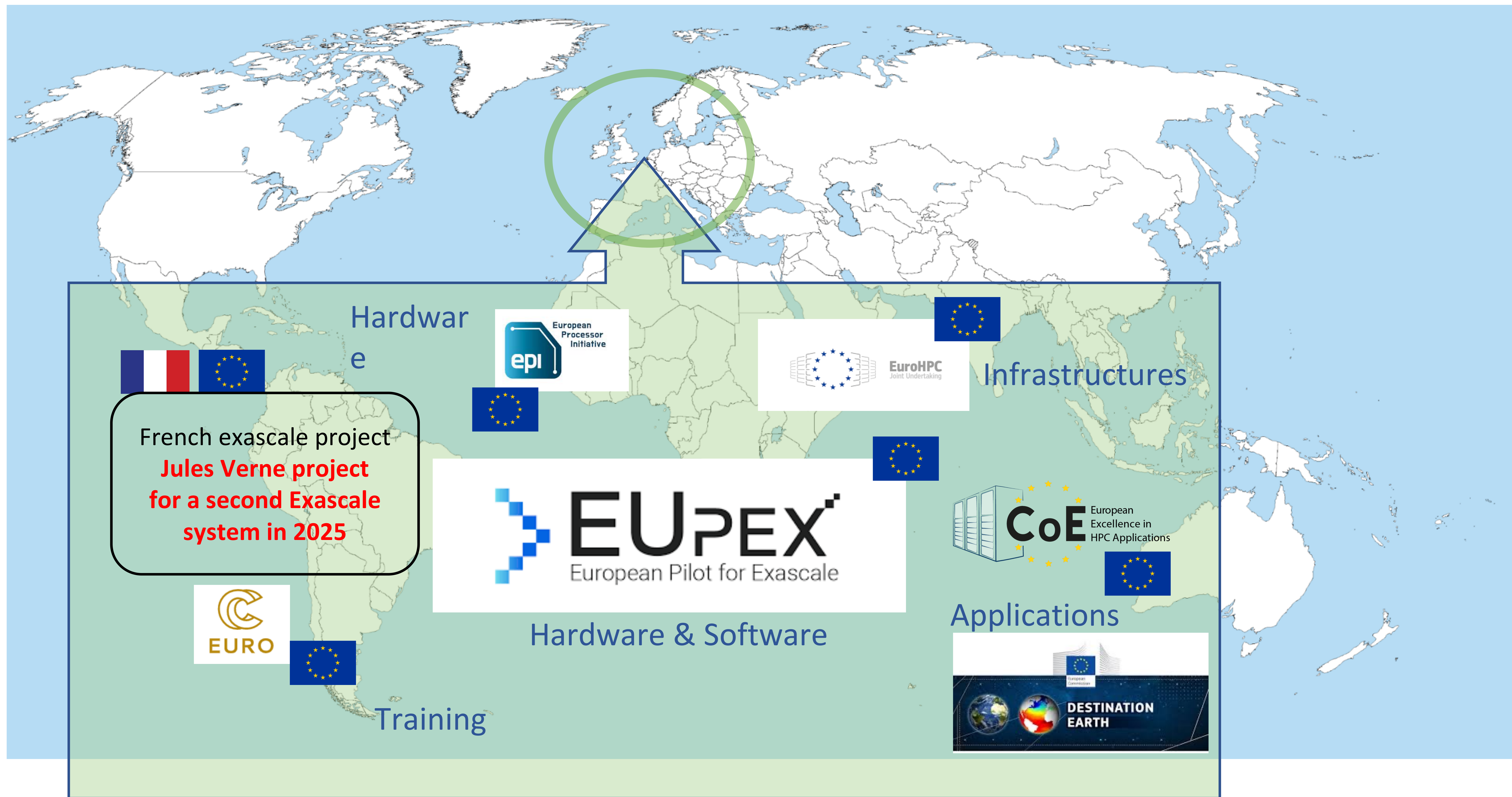


Japan initiatives:

- Fugaku: co-design of an exascale system.
- Riken SC: transverse eco-system

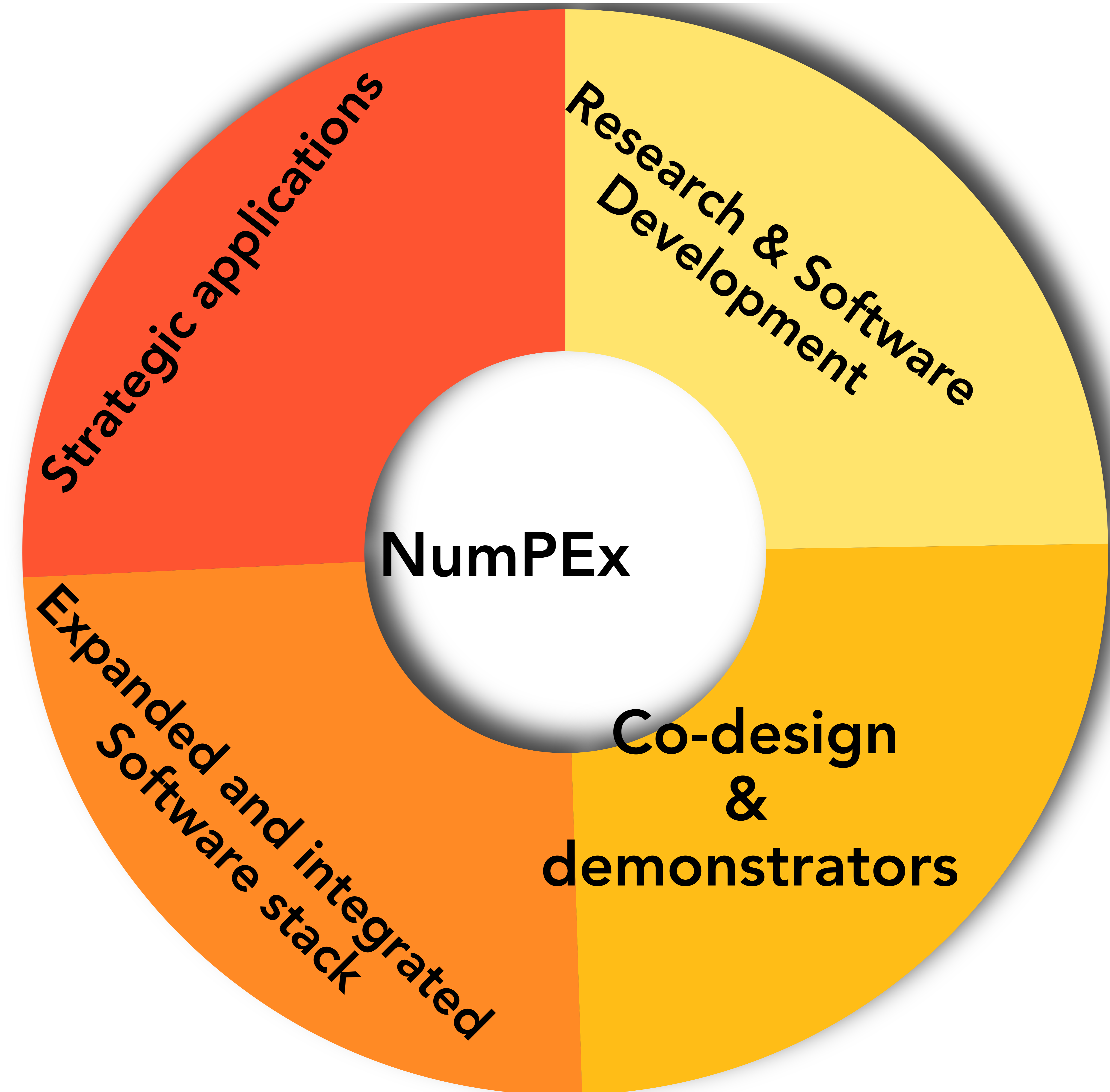
A strong effort in both hardware, software and applications/co-design

Context - European initiatives



The French NumPEX Program Objectives

- Contribute and accelerate the emergence of a **European sovereign exascale software stack** and **strategic applications exascale capability** in a **coherent and multi-annual framework**
- Integrate and validate **co-designed** innovative methods, **libraries and software stack** with demonstrators of strategic applications.
- Accelerate science-driven and engineering-driven developers **training and software productivity**
- **Foster** national and international **collaborations to prepare for the Exascale and post-Exascale era**



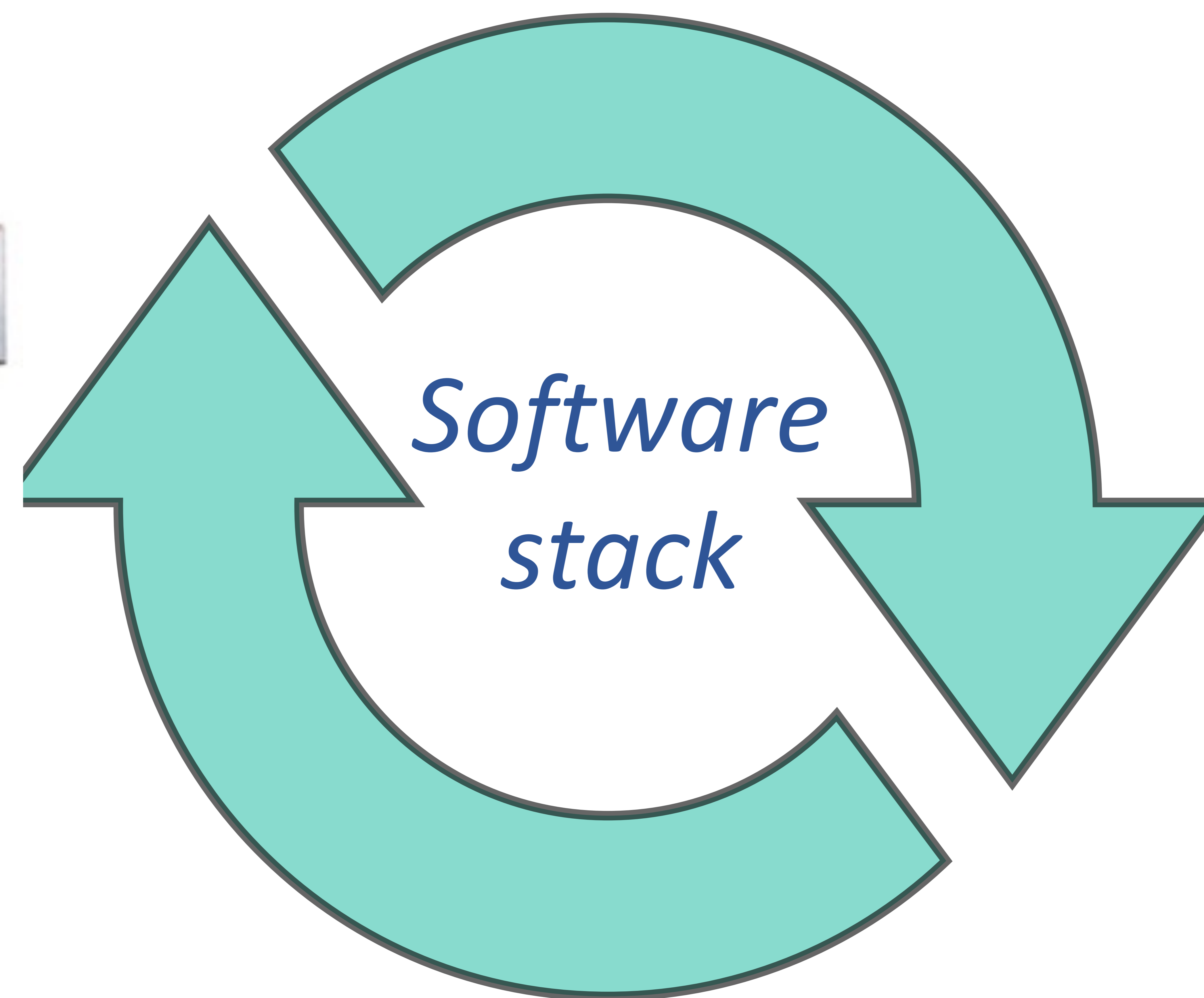
Help aggregate the French HPC/HPDA/IA community

The French NumPEX Program

Objectives



European Pre-Exascale system

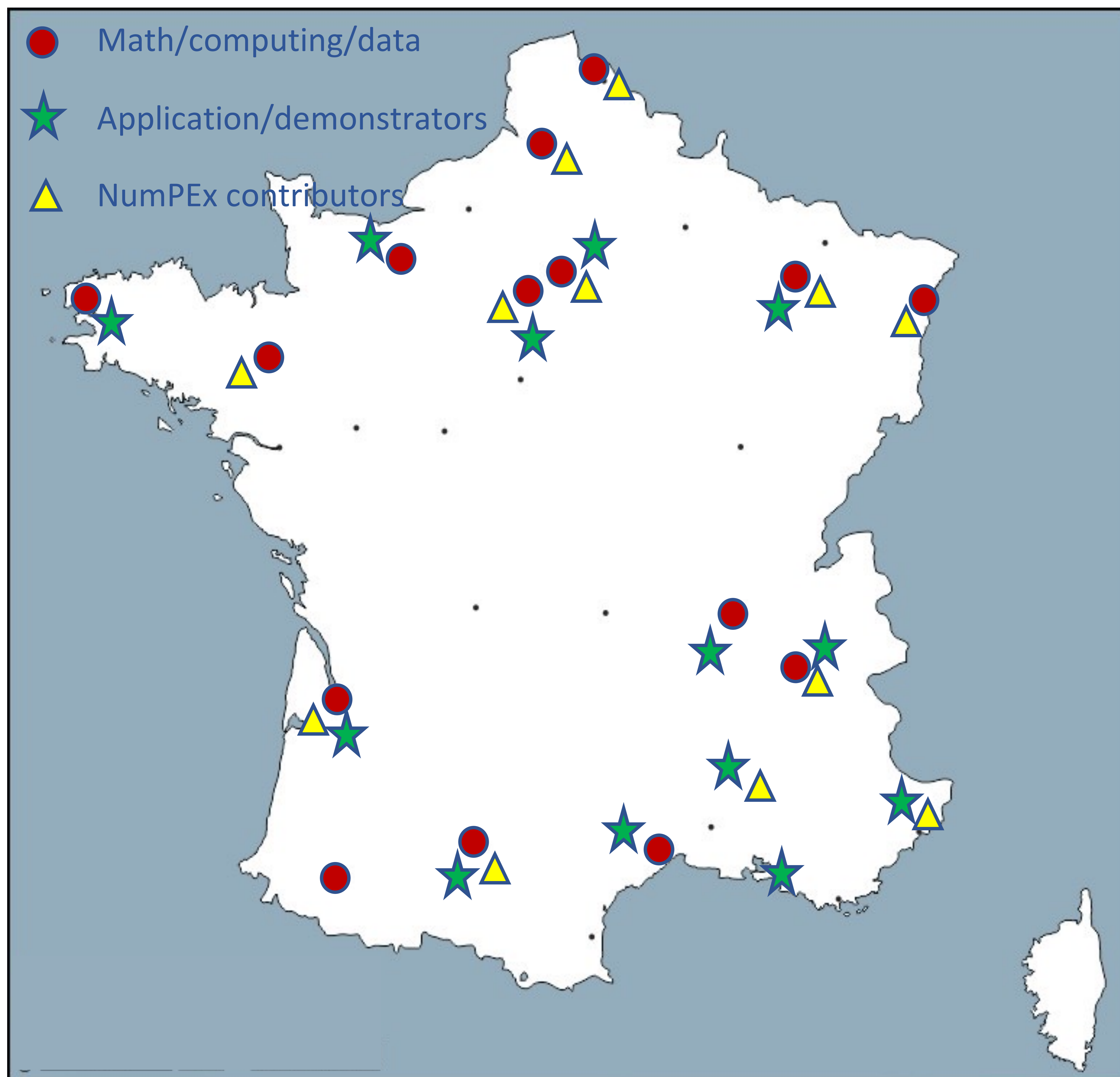


Applications

- Astronomy & Astrophysics
- Climate
- Earth system & environment
- Plasmas physics and accelerators
- Particle physics
- Quantum chemistry and materials
- Energy
- Biology and Health science
- Industrial applications

Co-design the exascale software stack
Preparing the applications for the Exascale era

NumPEX by numbers



6 Years
41 M€*

2023-2028

* Funding 41M€=500 man.year non permanent staff
+ 170 man.year permanent staff
Total cost : 81 M€

Core Research Institutions

Core national Research Institutions:
CNRS, CEA, INRIA, Universities,
Engineer schools, Industry

3 Focus Area

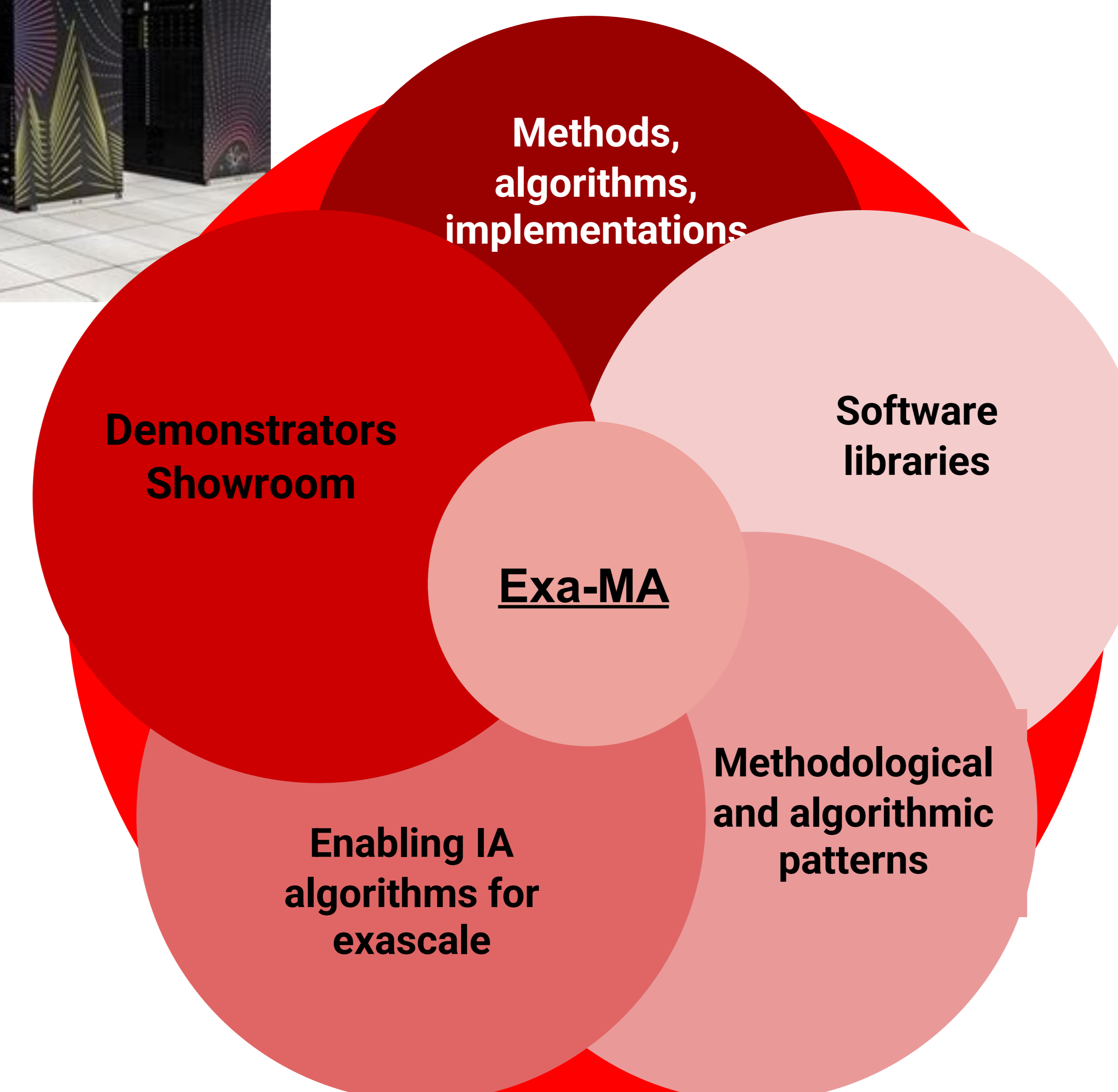
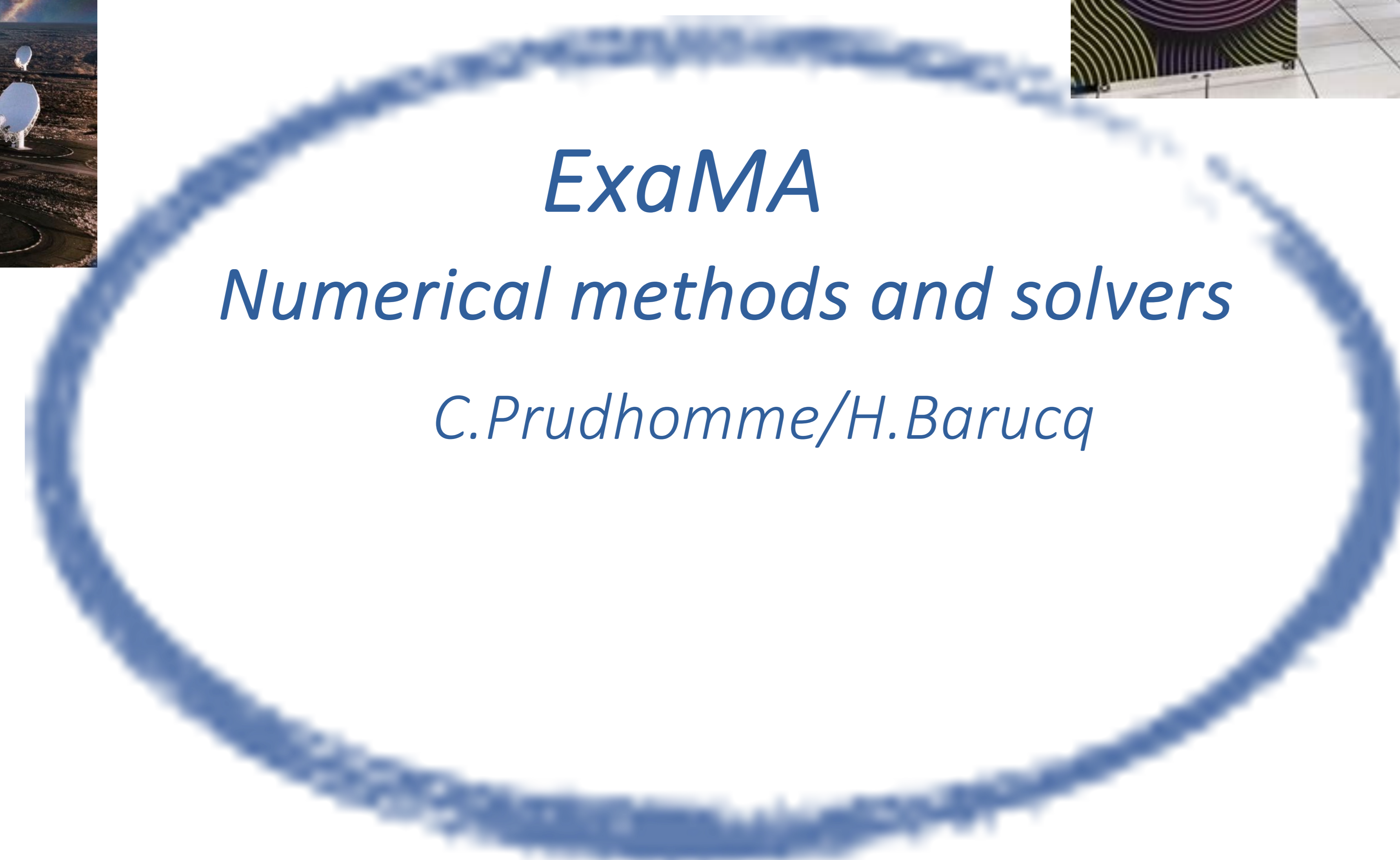
Software stack development (pc 1-3)
Wide-area workflows and architecture (pc 4)
Integration and application development (pc 5)

80 R&D teams
500 Researchers

NumPEX - workplan



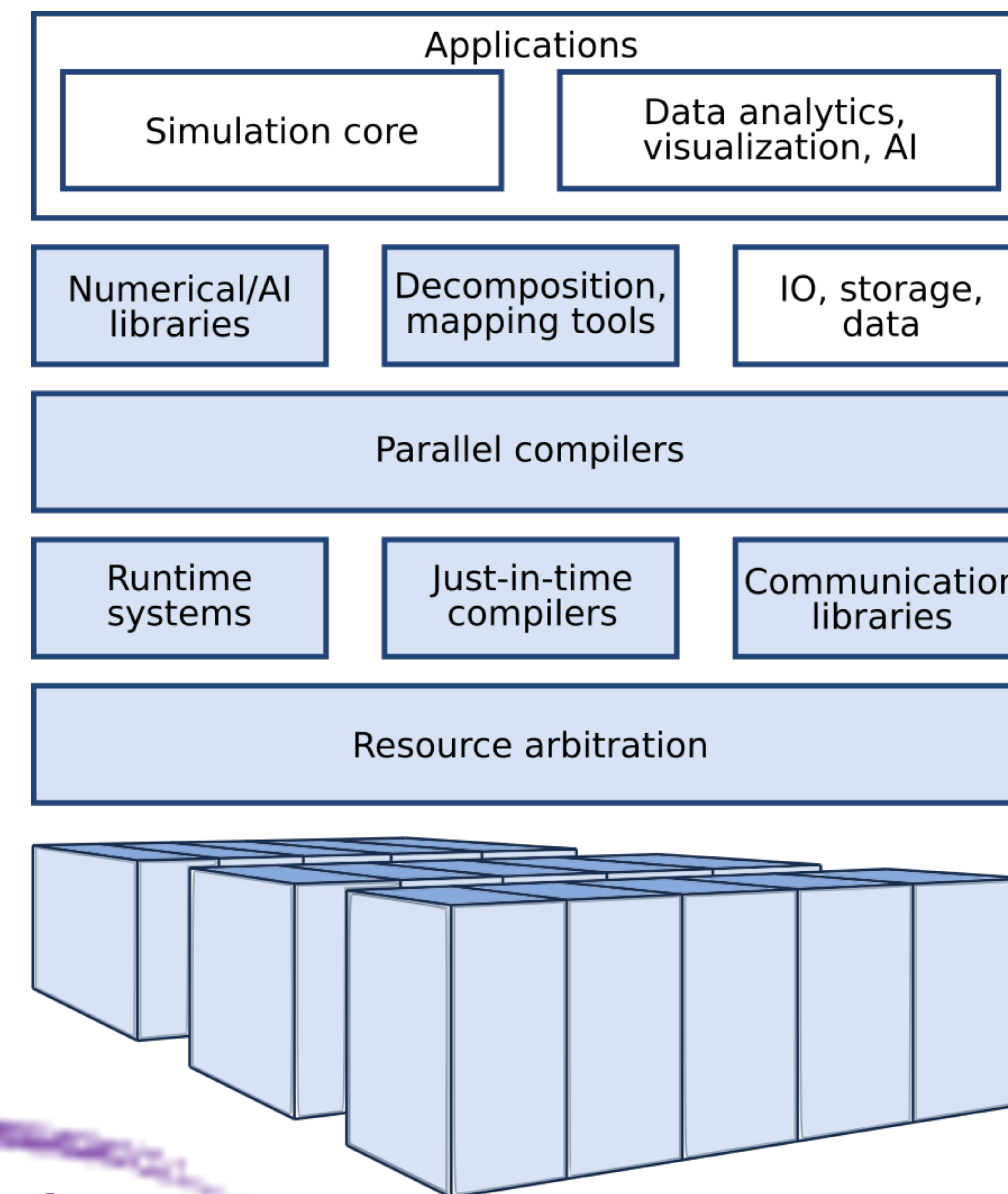
Applications



NumPEX - workplan



Applications



ExaMA
 Numerical methods and solvers
 C.Prudhomme/H.Barucq

ExaSoft
 Computing
 R.Namyst/A.Butari

NumPEX - workplan



Applications



ExaMA
 Numerical methods and solvers
 C.Prudhomme/H.Barucq

WP1: Exascale I/O and storage

WP2: Exascale in-situ data processing

WP3: Exascale ML-based data analytics

WP4: Shared building blocks & integrated illustrators

WP5: Management, dissemination and training



ExaSoft
 Computing
 R.Namyst/A.Butari

ExaDost
 Data
 G.Antoniou/J.Bigot

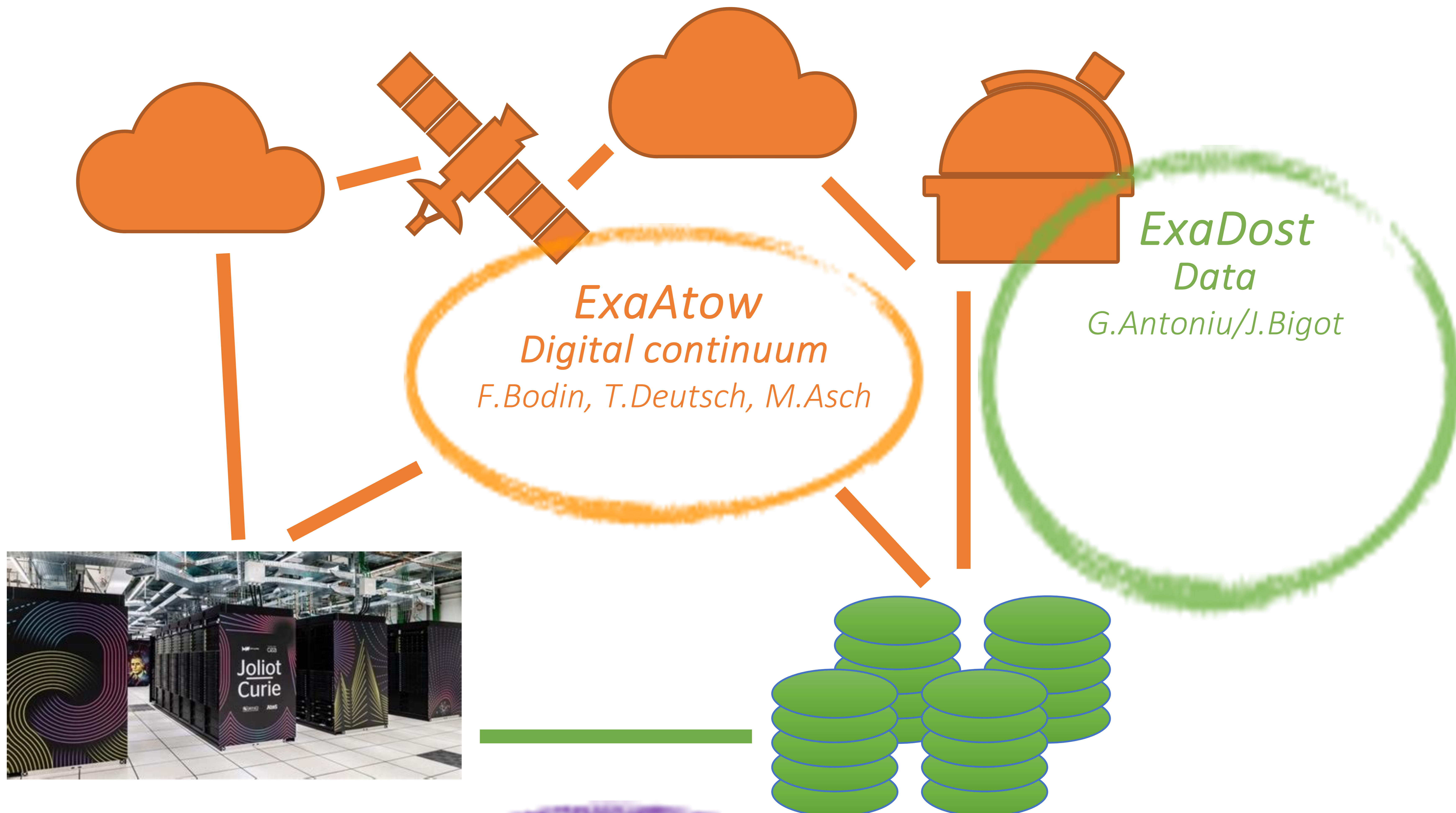
NumPEX - workplan



Applications

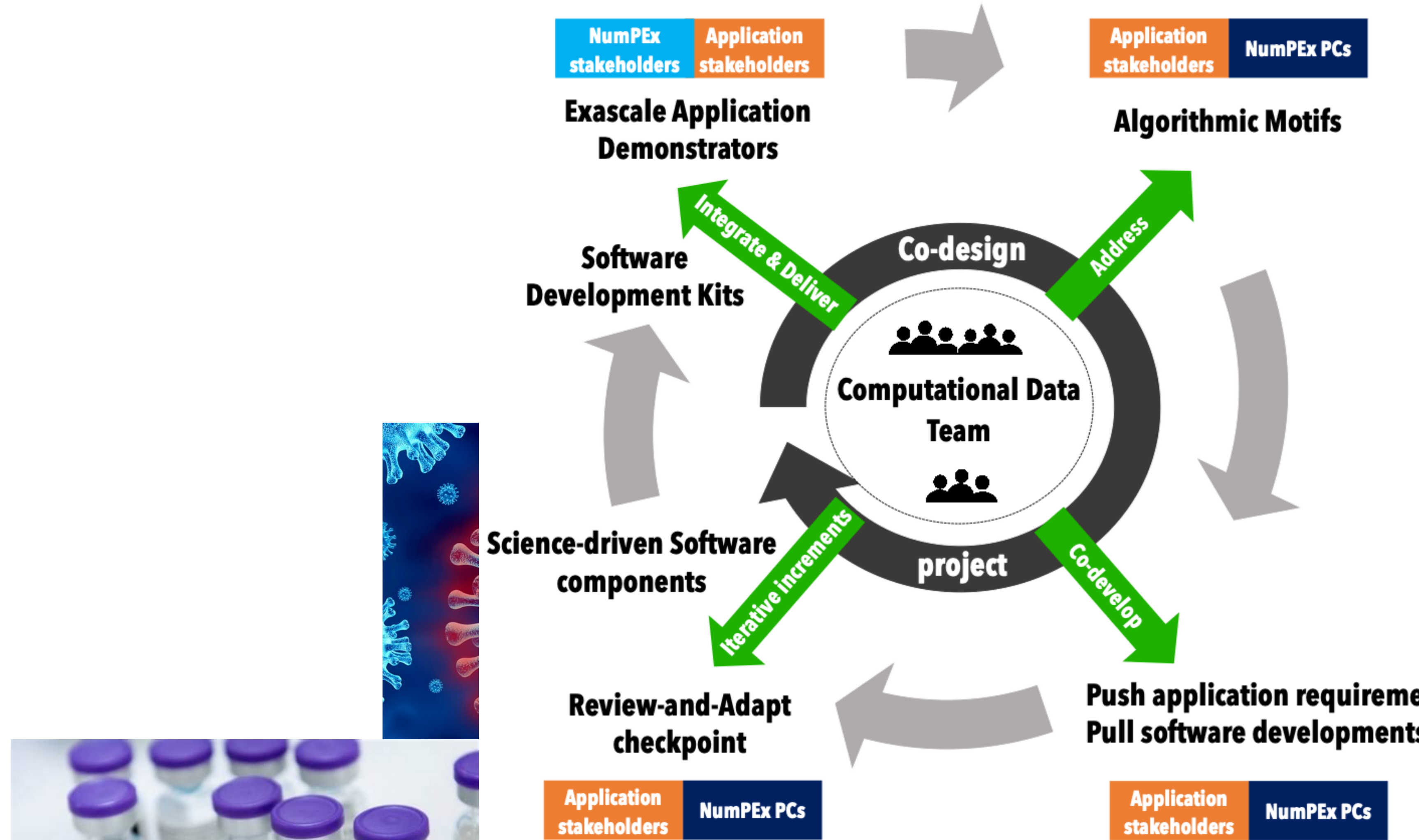


ExaMA
 Numerical methods and solvers
 C.Prudhomme/H.Barucq



ExaSoft
 Computing
 R.Namyst/A.Butari

NumPEX - workplan



Applications

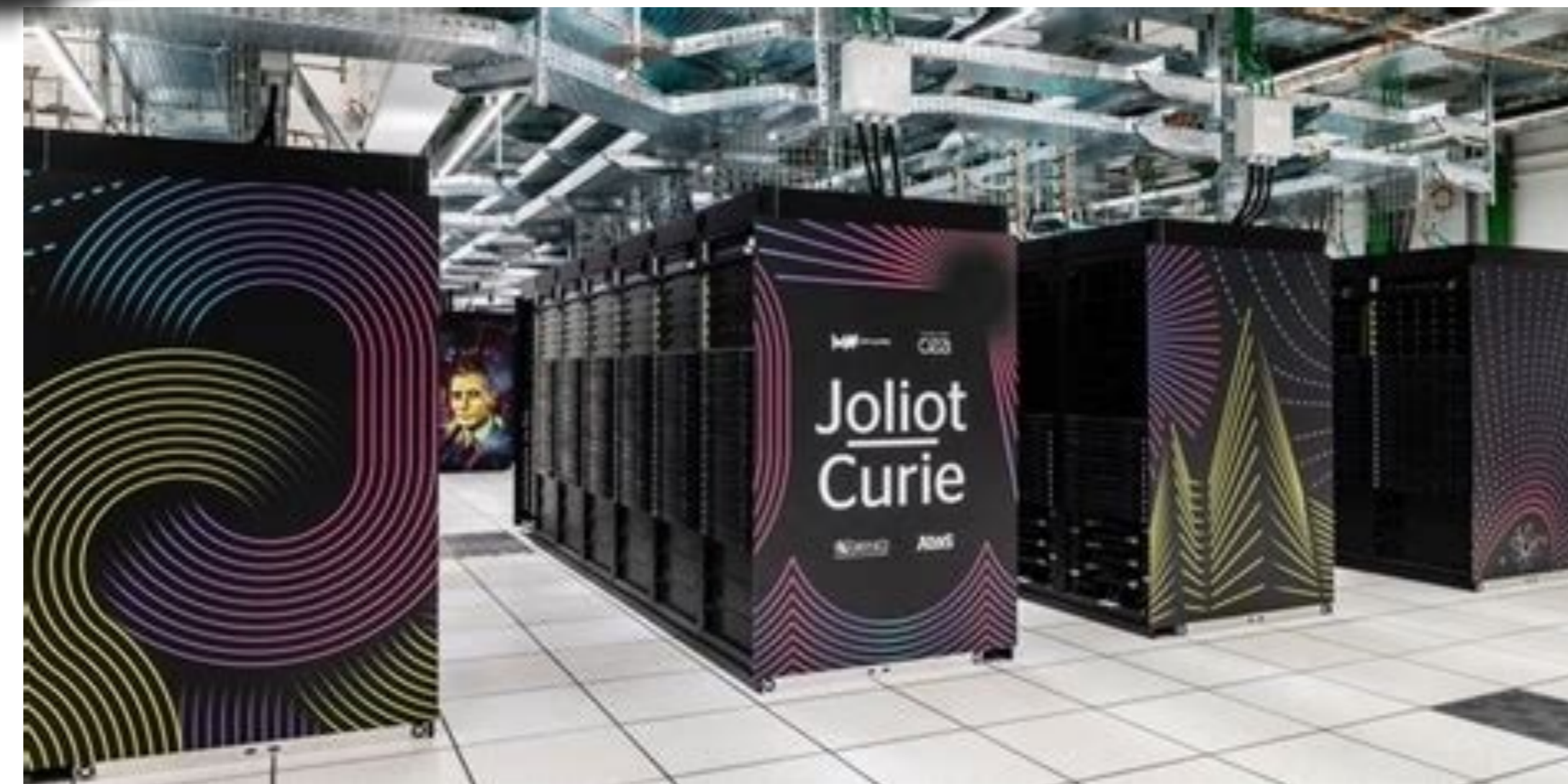
ExaDip
Application co-design and software integration
 JP.Vilotte/V.Brenner

ExaAtow
Digital continuum
 F.Bodin, T.Deutsch, M.Asch

ExaDost Data
 G.Antoniou/J.Bigot

ExaMA
Numerical methods and solvers
 C.Prudhomme/H.Barucq

ExaSoft
 Computing
 R.Namyst/A.Butari



NumPEX - workplan

Governance



Applications

ExaDip
 Application co-design and software integration
 JP.Vilotte/V.Brenner



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 Digital continuum
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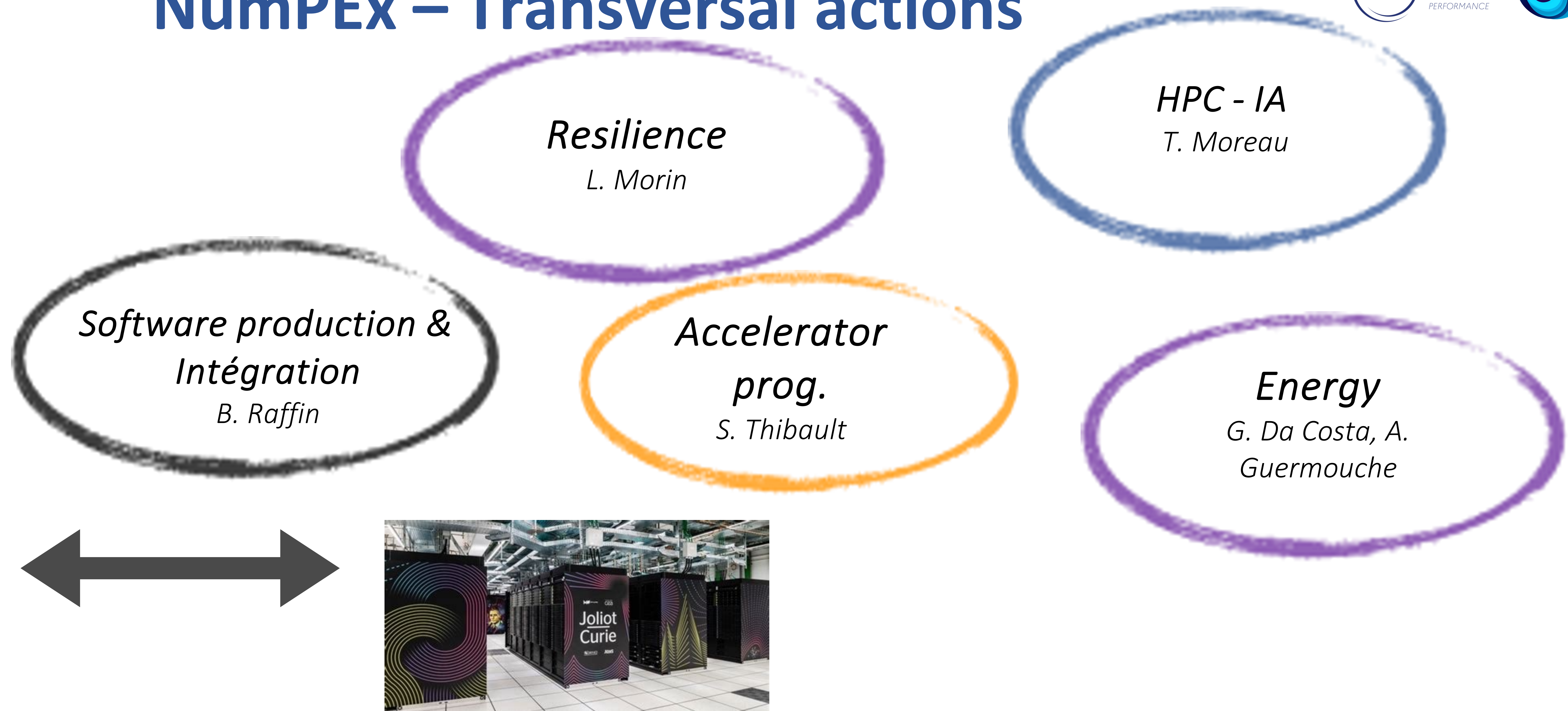
ExaMA
 Numerical methods and solvers
 C.Prudhomme/H.Barucq

ExaSoft
 Computing
 R.Namyst/A.Butari

NumPEX – Transversal actions



Applications

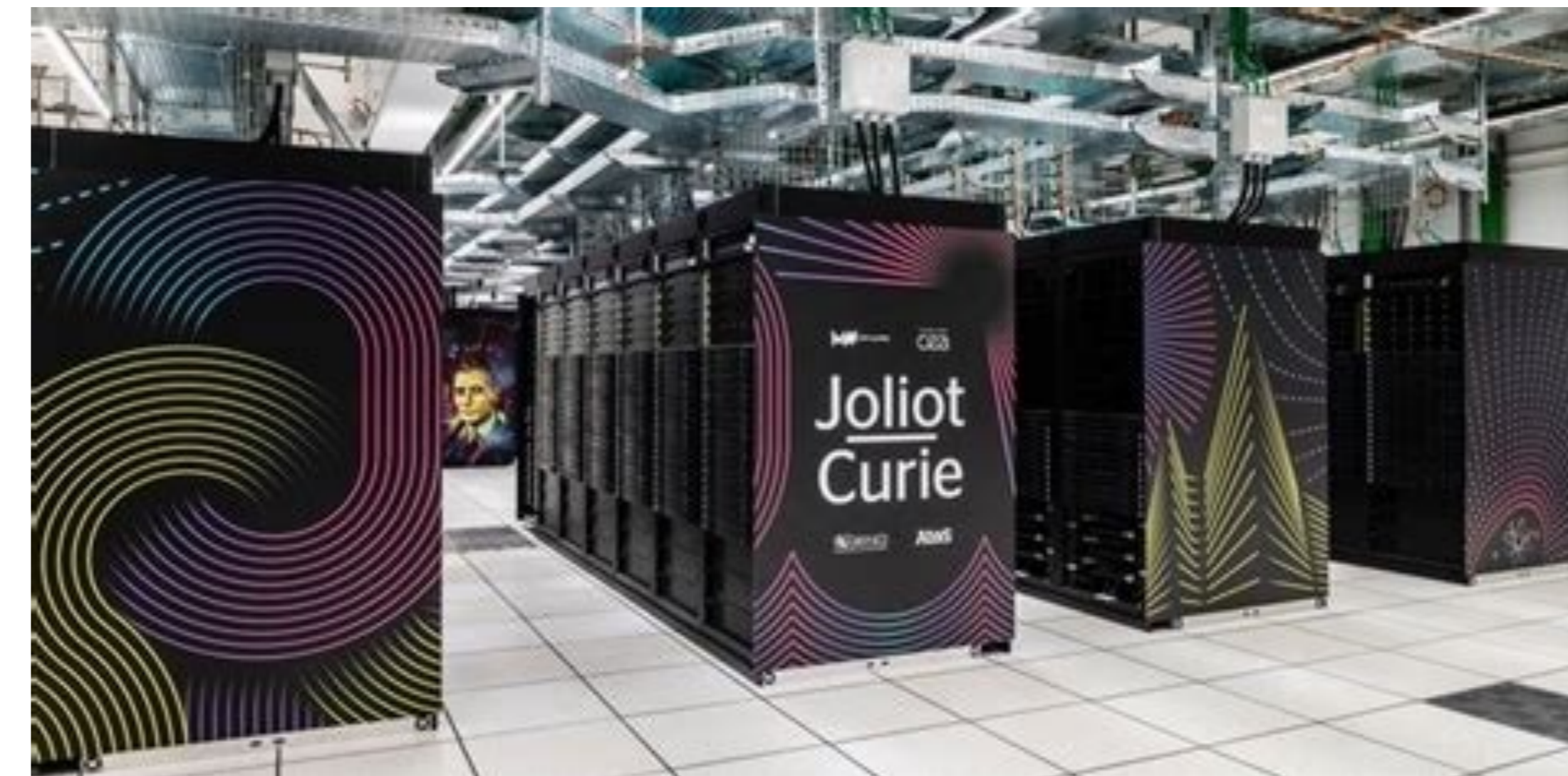


NumPEX – Transversal actions



Applications

Software production & Intégration
B. Raffin



Resilience
L. Morin

Accelerator prog.
S. Thibault

HPC - IA
T. Moreau

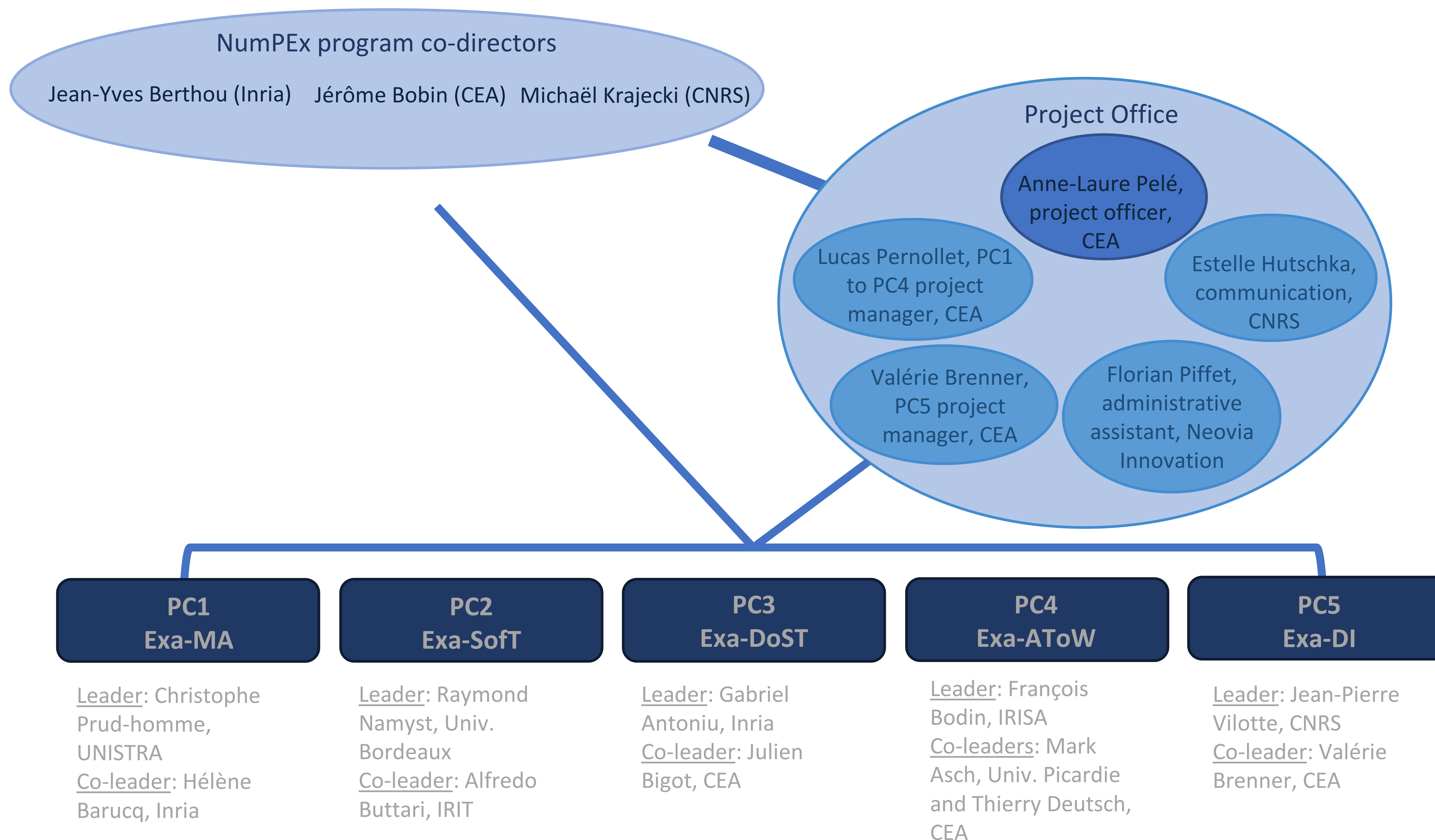
Energy
G. Da Costa, A. Guermouche

Gender/Equity/ Diversity
Anne-Laure Pelé & Virginie Grandgirard

Training
M. Krajecki, R. Namyst, C. Prudhomme

Int. Collaborations
JY Berthou, E. Jeannot

Project office & Operational committee



Coordination



Evaluate



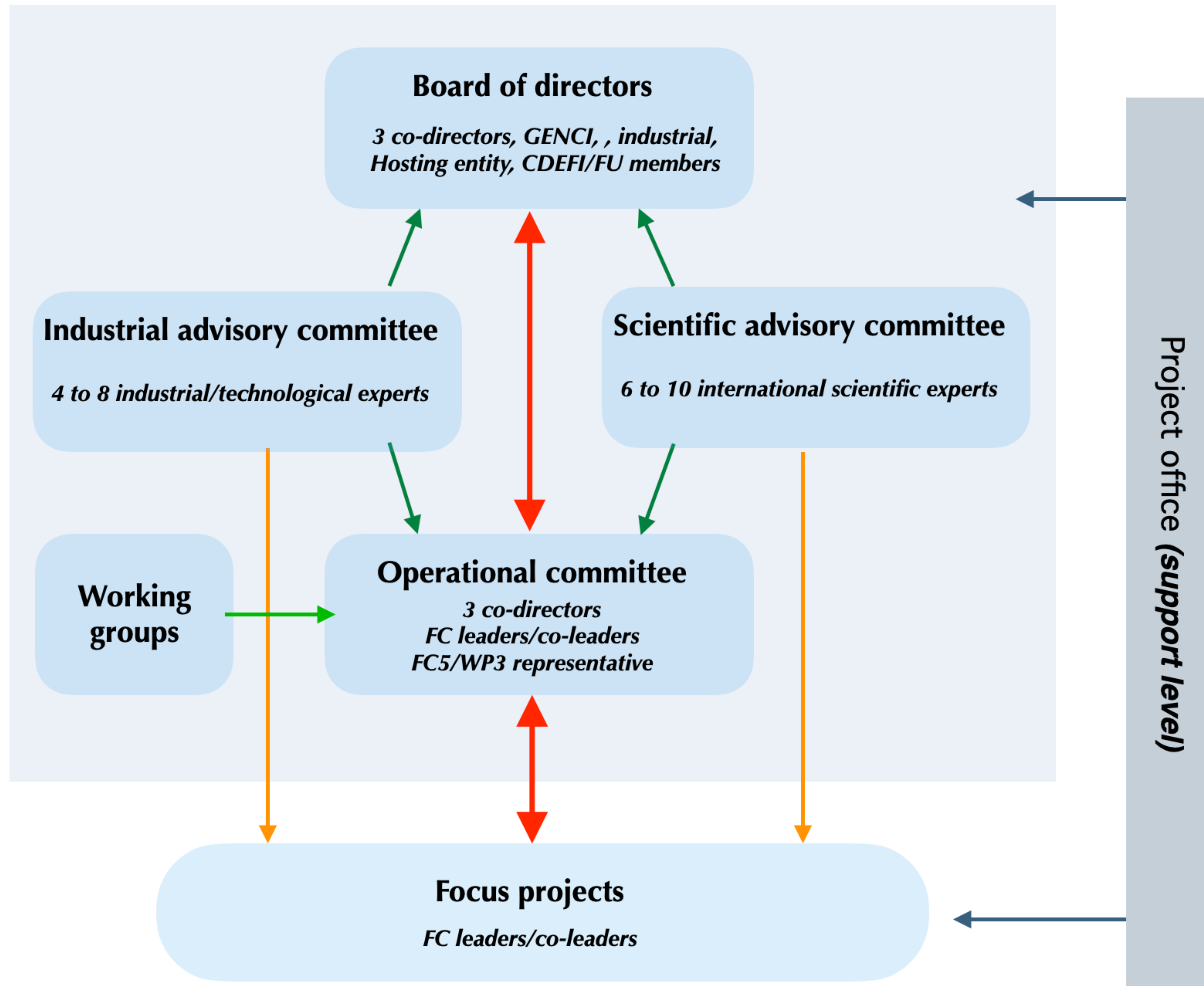
Advise



Support



Report





NumPEX BOF@SC23, 15 Nov 2023



The International Post-Exascale (InPEX) workshop series
Pre-workshop InPEX Agenda (19th and 20th October 2023)

The InPEX pre-workshop will take place in Reims, France, at the following location:

HOTEL LA CASERNE CHANZY 18, rue Tronsson Ducoudray 51100 Reims, France Tel : +33 (0)3 26 83 18 18 contact@lacasernechanzy.com

Your InPEX contact point: Florian PIFFET - +33 (0)6 44 25 33 93 - florian.piffet@neovia-innovation.eu

Thursday, October 19, 2023	
09:45 10:00	<i>Welcoming time (on-site)</i>
10:00 11:00	Introduction <ul style="list-style-type: none"> Objectives of the meeting (challenges and goals following the 5 June 2023 Meeting) - Pete Beckman, Jean-Yves Berthou, Satoshi Matsuoka Presentations and exchanges on the state of the art for Exascale and post-Exascale projects/programs: <ul style="list-style-type: none"> Europe, 15' - Anders Jensen, CEO, EuroHPC Japan, 15' - Satoshi MATSUOKA, Director, RIKEN Center for Computational Science USA, 15' - Ceren Susut-Bennett (DOE-Science) and Thuc Hoang (DOE - NNSA)
11:00 12:00	Panel discussion: sharing experience co-designing the software stack, applications and HW for Exascale machines: USA (Oak Ridge, ...), Japan (Riken), Europe (JSC, BSC, Genci, TGCC/CEA, CSC, CINECA)
12:00 13:00	<i>Lunch</i>
13:00 15:30	Thematic subgroup discussions (around 90d' each themes) Subgroup session 1: <ul style="list-style-type: none"> #1 - Software production and management: packaging, documentation, builds, results, catalogs, continuous integration, containerization, LLVM, parallel tools and sustainability. #2 - HPC/AI convergence: ML, LLM for science, open models and datasets for AI training, #3 - Energy and environmental impact and sustainability

15:30 16:00	<i>Coffee break</i>
16:00 17:30	Subgroup session 2 : <ul style="list-style-type: none"> #1 - Future and disruptive SW & HW technologies and usages (including accelerators): roadmaps, adoption, ... #2 - Co-design, benchmarks/mini Apps/Proxy and evaluation (HW & SW & Applications) #3 - Digital Continuum and Data management
18:00 20:00	<i>Social event & Diner (photo group)</i>

Friday, October 20, 2023	
09:00 10:30	Feedbacks from thematic subgroups and exchanges - <i>Thematic Subgroups Rapporteurs (15' each)</i>
10:30 11:00	<i>Coffee break</i>
11:00 12:30	Preparing the InPEX workshop series and Bird of Feather for SC2023: subjects and key aspects
12:00 13:45	<i>Lunch</i>
13:45 14:45	Preparing the InPEX workshop series: agenda and participants
14:45 15:00	AOB - Conclusion

Organization of each subgroup:

- A leader and a recorder
- Pre-define a list of questions for each subgroup

5 min - "Context: introduction with the state of the art, national/European/international context, technical/political obstacles (if relevant).

10 min - "Problematic(s): open up on anticipated difficulties, why hold a workshop on this theme, etc.

15 min - "What is at stakes: expand on scientific and technical issues, as well as (if relevant) societal and environmental issues, impacts, etc.

1h- "Action plan: expectations/actions to be carried out (what, when/agenda, how, who, how much - resources to be committed: personnel, infrastructure, financial, etc.), potential collaborations.

Deliverable: action plan



NumPEX consortium

National Research Organisation

- CEA, CNRS, Inria
- IFPEN
- Onera

Industry

- Atos
- DataDirect networks – DDN
- Airbus
- Sipearl
- Fermat
- Intel
- En discussion : Safran, EDF, Total, Thales, ...

Engineering school

- Bordeaux INP
- Institut Polytechnique de Paris/Ecole Polytechnique, Telecom Sud Paris

University

- Université de Bordeaux
- Université Paris 1 Panthéon-Sorbonne
- Université de Lorraine
- Université de Strasbourg
- Université Clermont-Auvergne
- Université de Toulouse 3
- Université Gustave Eiffel
- Université de Lille
- Université de Pau
- Université de Picardie
- Sorbonne Université
- Université Paris Saclay
- Université de Rennes
- Observatoire de Paris
- Observatoire de la Côte d'Azur
- Université de Grenoble

Take-away messages

NumPEX is an ambitious program to:

- contribute to the **European Exascale software**
- help preparing scientific and industrial **applications to the Exascale**
- **bridge the gap between** the computer science/application communities
- help **building a French community** for advanced scientific software development
- designing the **future corpus of exascale and post-exascale training courses**
- **foster** national and international **collaborations** (e.g. other PEPRs, CoEs, etc)

Stay tuned

www.numpex.fr



#NumPEX