

ELyT Programs as a Platform for Collaboration by Université de Lyon, Tohoku University and CNRS



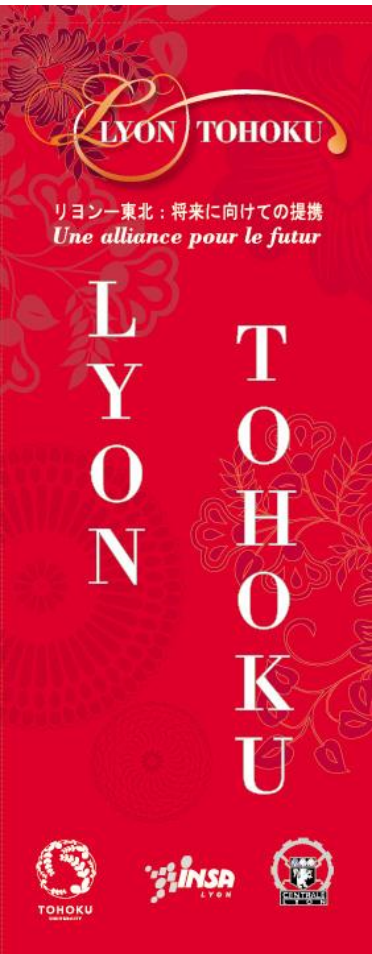
Gael Sebald

ELyT MaX, CNRS - UdL - INSA Lyon - Tohoku University

Tetsuya Uchimoto

Lyon Center, Institute of Fluid Science, Tohoku University

Genesis of “ELyT” Engineering Science Lyon - Tohoku



- A long history of collaboration initiated more than 30 years ago... in the field of Smart Materials and Tribology
- Prof Georges, Prof Kato, Prof Gobin, Prof Tani
- Organization of various bilateral workshops
- Series of joint projects
(IRCP – JSPS&CNRS, etc.)
- Extension of collaboration fields...
- 2004: opening of **Liaison Offices**, at INSA and at TU
- 2005: **double Master degrees** between ECL and TU and between INSA and TU
- **2007**: Joint anniversary for
50th anniversary of INSA-Lyon
100th anniversary of Tohoku University
150th anniversary of ECL
- 2009: first **double PhD degrees** between ECL and TU and between INSA and TU started...



Towards ELyTMax

ELyTMax
2018

Launch of
ELyTMax@Lyon,
located in Univ. Lyon
(INSA Lyon and ECL)

ELyTGlobal
2017
Creation of LIA
ELyT Global

ELyTMax
2016
Creation of ELyTMax
Located in Tohoku
University



ELyTMax agreement signing, Sendai, 2015



ELyT Lab agreement signing, Sendai, 2008

2012
Double-degree
agreements
TU / INSA Lyon
and TU / ECL

ELyT School 2009
First ELyT School

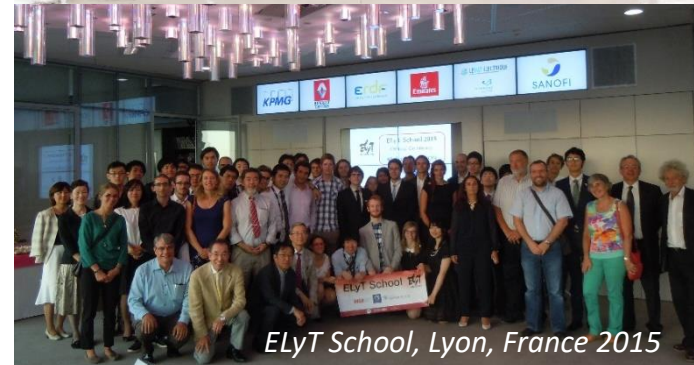
ELyT
Laboratory
2008
Creation of LIA
ELyT Lab

2005
Double Master
degrees between ECL
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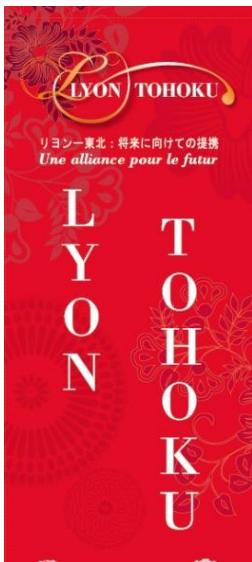
2004
Liaisons offices
opened



ELyT workshop, Matsushima, Japan 2015



ELyT School, Lyon, France 2015



INSTITUT NATIONAL
DES SCIENCES
APPLIQUÉES
LYON



ÉCOLE
CENTRALE LYON



TOHOKU



UNIVERSITÉ
DE LYON

ELyT: Engineering Science Lyon-Tohoku

Integrated cooperation



• Laboratoire International Associé (LIA):

- Large researchers network, bridging Engineering Science between Lyon and Tohoku, with ~25 ongoing projects
- Annual workshop (80~100 attendees)
- 150+ joint peer-reviewed papers
- 250+ joint conferences
- **DD programs** agreements at Master and PhD levels: 19 double degree PhD from 2009, 10 ongoing

• Summer school ELyT School

- Since 2009, held alternatively between France and Japan institutions (INSA-Lyon, Ecole Centrale de Lyon, and Tohoku University).
- Thematic: "Energy, Environment, Safety and Engineering"
- ~50 graduate school students, including ~25 from abroad.

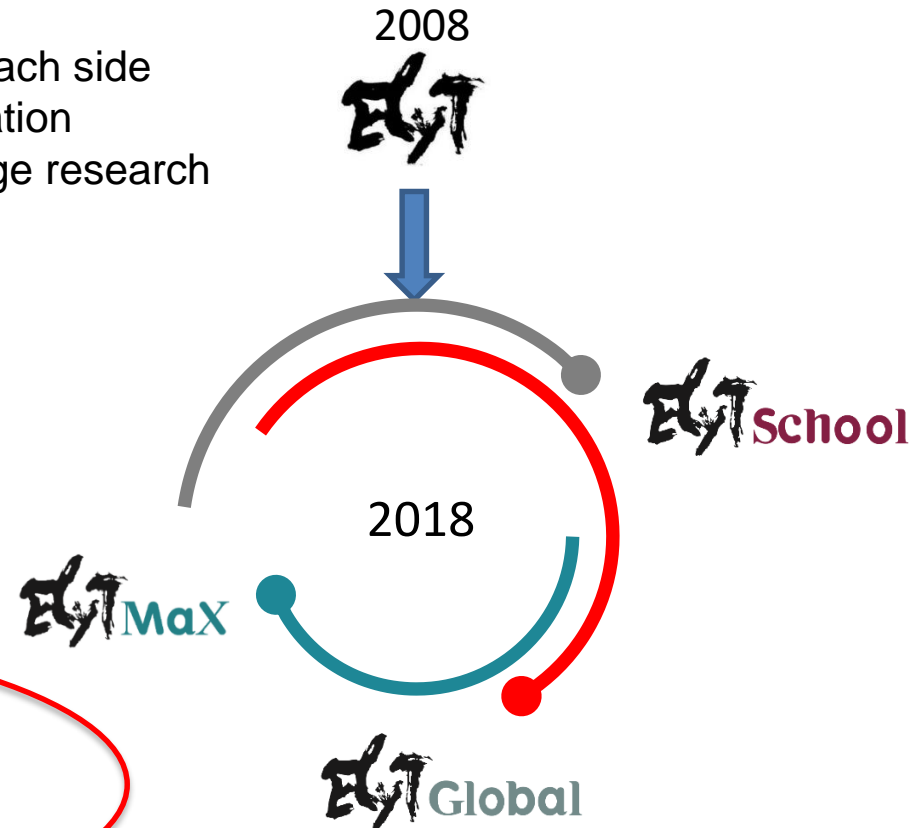
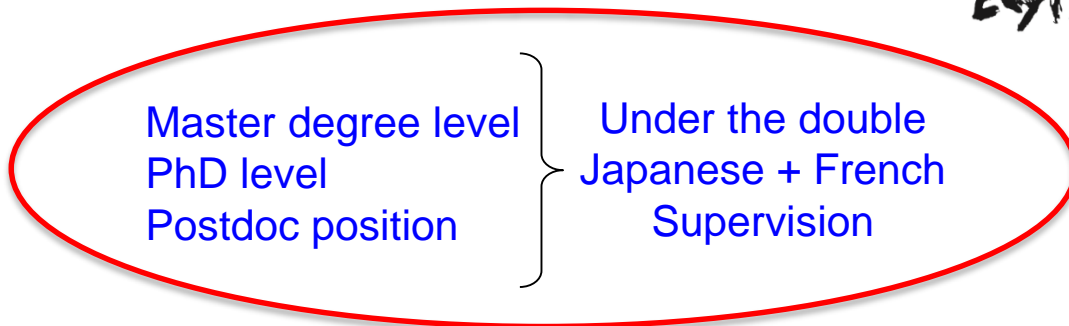


Outlooks... **ELyT** as a "platform"



We have developed an *integrated system*

- **Liaison Office**: to welcome visitors from each side
- **Network of researchers**: to foster cooperation
- **Physical lab**: to conduct jointly cutting-edge research
- **Summer School**: to attract students
- **Double master** degrees
- **Double PhD** degrees
- **Post-doc** positions
- **Permanent staff** long term mobility



...for enhancing scientific collaboration

The ELyT Global Concept



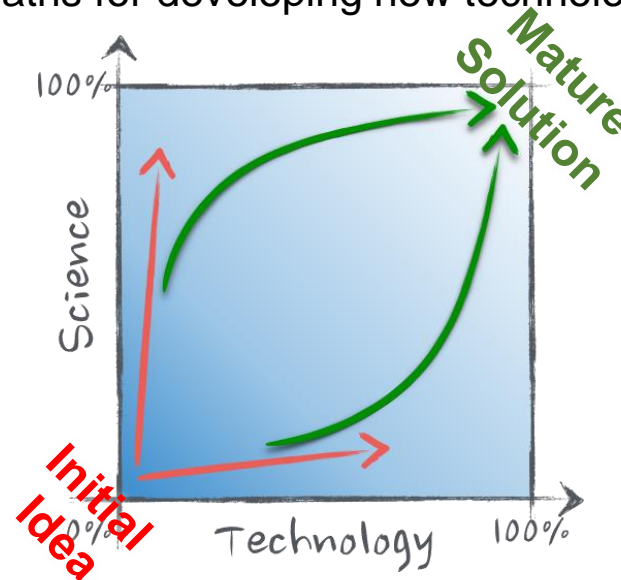
- **Our goal:** *to become a center of excellence in Engineering of Materials and Systems, with the aim of answering currently challenging societal stakes*
- In order to ***gather existing knowledge*** and ***foster innovative research***:
 - Organization of **scientific workshops** for exchanging ideas
 - **Support of travel expenses** for researchers and student exchanges
 - Students training and opening to foreign cultures with the continuation of an **annual summer school** – named “**ELyT School**”
 - Invite partners from French and Japanese Industries and **promote industry-university research collaboration.**



The ELyT Global approach



- **Our topic:** Engineering of Materials and Systems
- A collaboration between **Tohoku University** and **Université de Lyon** (especially INSA, ECL, UCBL, ENISE, CPE, ENTPE)
- Many involved research institutes:
 - *Japanese side:* IFS, GSE, IMR, FRIS...
 - *French side:* MATEIS, LTDS, ILM, INL, LMFA...
- **Our goal:** promote high quality research **and** answer current societal stakes
- **The facts:** Several paths for developing new technologies!



The ELyT Global approach



- Some projects aims at **achieving better fundamental understanding**, necessary to improve current technologies
- Some projects aims to **develop new technologies**, requiring the combination of several scientific fields
- We thus propose **3 application themes** and **3 scientific topics**:


	Transportation	Energy	Engineering for Health
Materials & structure design			
Surfaces & Interfaces			
Simulation & modeling			

A red arrow points from the 'Materials & structure design' row to the 'Engineering for Health' column. A green arrow points from the 'Energy' column to the 'Simulation & modeling' row.

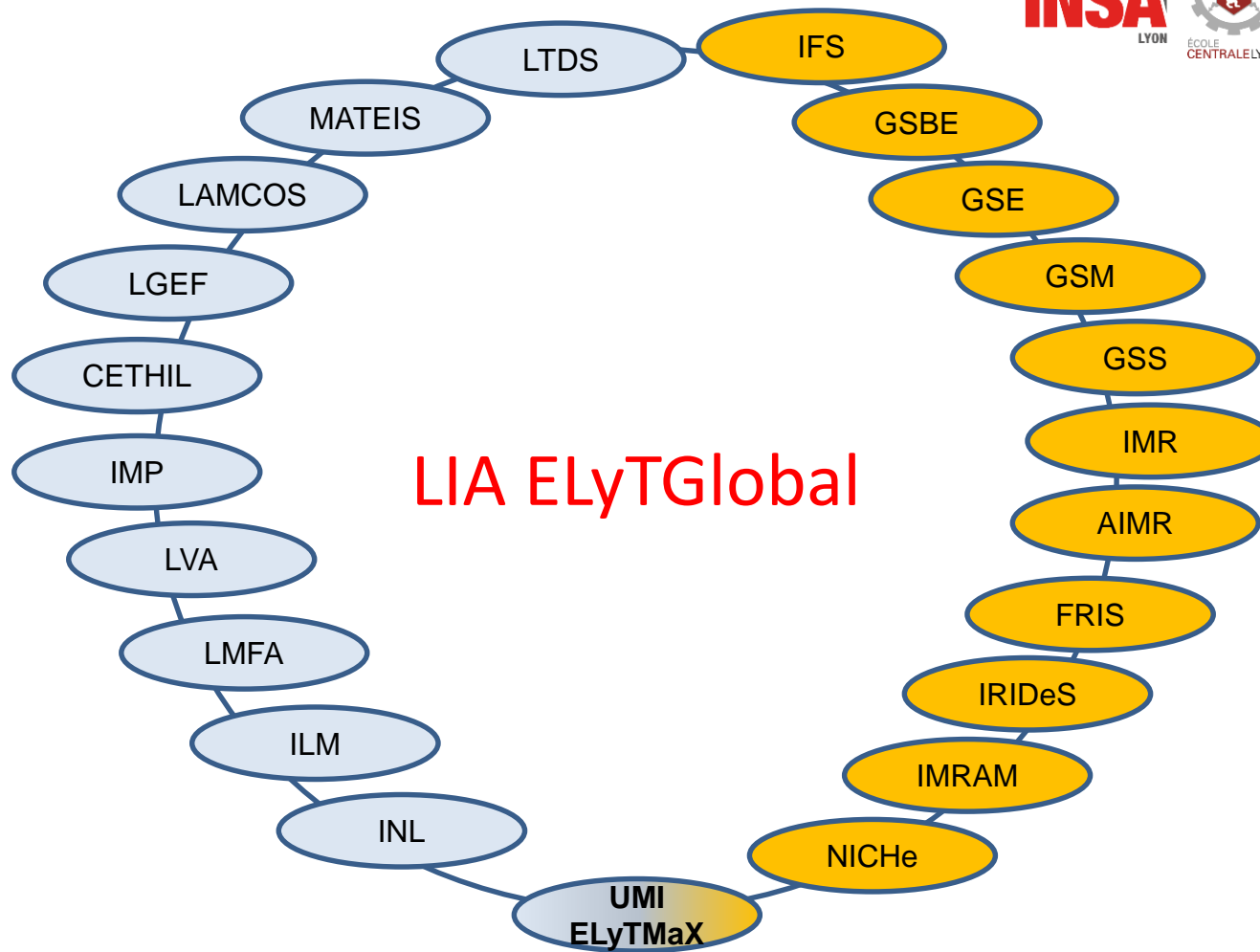
Projects may belong either to an application theme or to a scientific topic

Already 27 collaborative research projects!



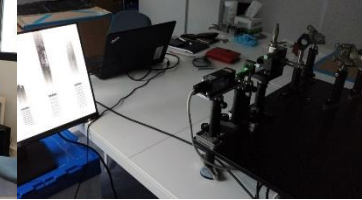
Acronym	Name	Acronym	Name
BeNTo	Nonlinear and dynamic micromagnetic Behavior modeling and characterization for Non Destructive Testing techniques optimization	MicroCell	Microsystems for Cell Engineering
BoneDrill	Development and Friction Characterization of Biomodels of Bones	MICRONS	Multiscale Characterisation of BacteRio-active Nanoglass Surfaces
CarboEDiffSim	Simulation of Carbon electro-diffusion in Iron with phase change	MISTRAL	Miniature-Scale Energy Generation by Magnetic Shape Memory Alloys
CODOMOs	COrrOsion Degradation of cOld spray coating by electrocheMical analysis at the lOcal Scale	MuORode	Robust Multi Objective optimization design approaches
COSMIC	COmpression-Shearing Method – understanding Interfaces in metal Composites	OPSCC	Optimizing surface finish to Prevent SCC initiation in energy industries
DECCOBABA	DEvelopment and Characterization of New CO BASEd alloys for Biomedical Applications	PolymCold SprayCoat	Resilient Polymeric cold spray coating
DeProMiNa	De alloying to produce micro and nano porous metals	POMADE	POLymer-Metal-fiber Adhesions DElamination control
ELiceTrib	Tribology of elastomer/ice contact from nm to mm scale	SilicaGelSim	Prediction of thermal and mechanical properties of Silica Aerogel using atomic scale simulations
FMMD	Friction and sensory models for development of medical devices	SPICE	Sintering and Phase transformation In CERamic materials
IPAMA	Improvement of Plasticity in Amorphous Metallic Alloys	SuperLub	Superlubricity: Experimental and Computer Simulations
LASMAT	Nd3+/Yb3+ rare earth ions-doped transparent laser ceramics by Spark Plasma Sintering method. Comparison with single crystals	TEmpuRA	Theory for Electrostriction of PolymeRic Actuator
lofDIAMS	Low and ultralow friction of microcrystalline diamonds films	TriArtiJoints	Tribology of artificial joints
MARECO	MAgneto-Rheological elastomers for Energy Conversion	PYRAMID	Piping sYstem, Risk management based on wAll thinning Monitoring and preDiction
DESIRE	DESign of Interface structure of fiber-Reinforced polymer blEnd		

The ELyT Global members



Key points on ELYTMAX

- **ELYTMAX is an operational research unit**
 - **Specific staff** (as for Oct. 2018):
 - 13 permanent staff (3 from France & 10 from Japan) ~6 eq. full time researchers
 - 3 postdocs, 5 DD PhD students, 1 master student
 - 3 part-time administrative staff
 - **>20 people,**
 - **Specific research premises (170m² at MaSC, Tohoku Univ. + 100m² lab. space, Lyon)**
 - **Funded projects:**
 - France: ANR ECPOR
 - Japan: 1 JSPS Kiban A, 1 JSPS Kiban B
 - Bilateral: ANR-MEXT PYRAMID
 - 2 industrial contracts
 - **Publications from 2016:**
 - 15 peer reviewed journal papers,
 - 6 invited conferences,
 - 50+ international conferences
 - **ELYTMAX is also a professor exchange platform**



Japan site inauguration, Sendai, Oct 4th, 2016



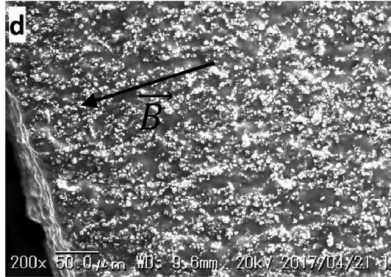
Inauguration of French site, March 5th, 2018 & Lyon Center (IFS), Nov. 21th, 2018, Lyon



Extending lifetime of materials and structures

Abe & Watanabe, *J. Nuclear Mater.*, 2012, doi: 10.5772/23623

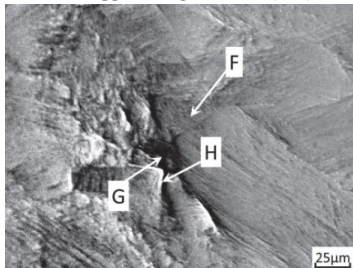
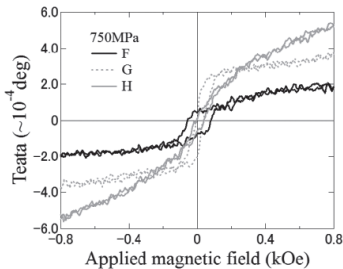
Sebald, *Sci. Tech. Adv. Mater*, 2017, doi: 10.1080/14686996.2017.1377590



Heterogenous materials for improved electromechanical couplings

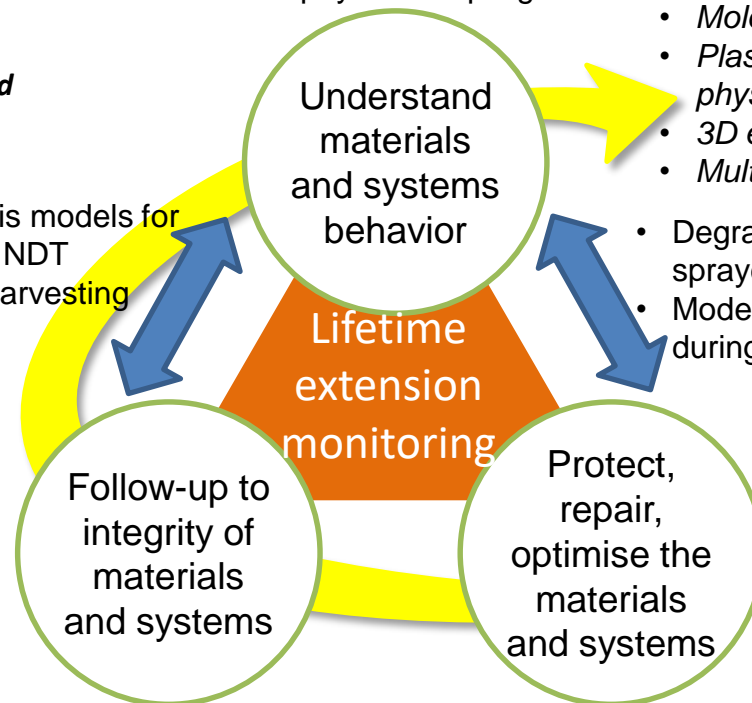
- Hysteresis models for accurate NDT
- Energy harvesting

Terashima, *Int. J. Appl. Electromag*, 2016, doi: 10.3233/JAE-162055



Quantification of residual stresses in ferromagnetic steels

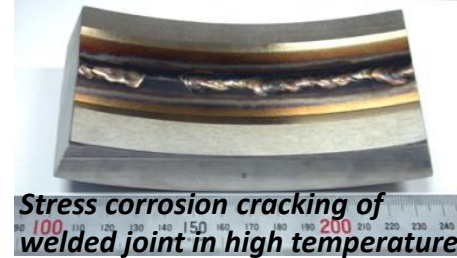
- Electrochemical processes
- Complex solicitations / environments
- Multiphysics couplings



- Nondestructive techniques

- Cold-spray technique
- Multi-objective optimization

➤ **Every project developed within ELyTMaX** involves strong **complementarities** from **Japanese** and **French** sides

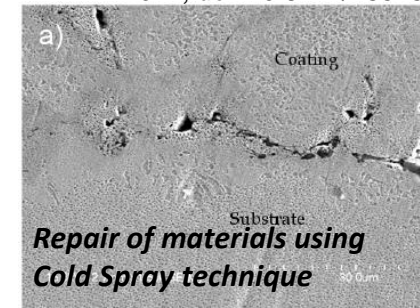


Stress corrosion cracking of welded joint in high temperature

- Molecular dynamics
- Plasticity and hysteresis semi-physical models
- 3D extensions
- Multiphysics models

- Degradation of cold sprayed materials
- Model of materials during cold-spray

Ogawa, *IntechOpen*, 2011, doi: 10.5772/23623

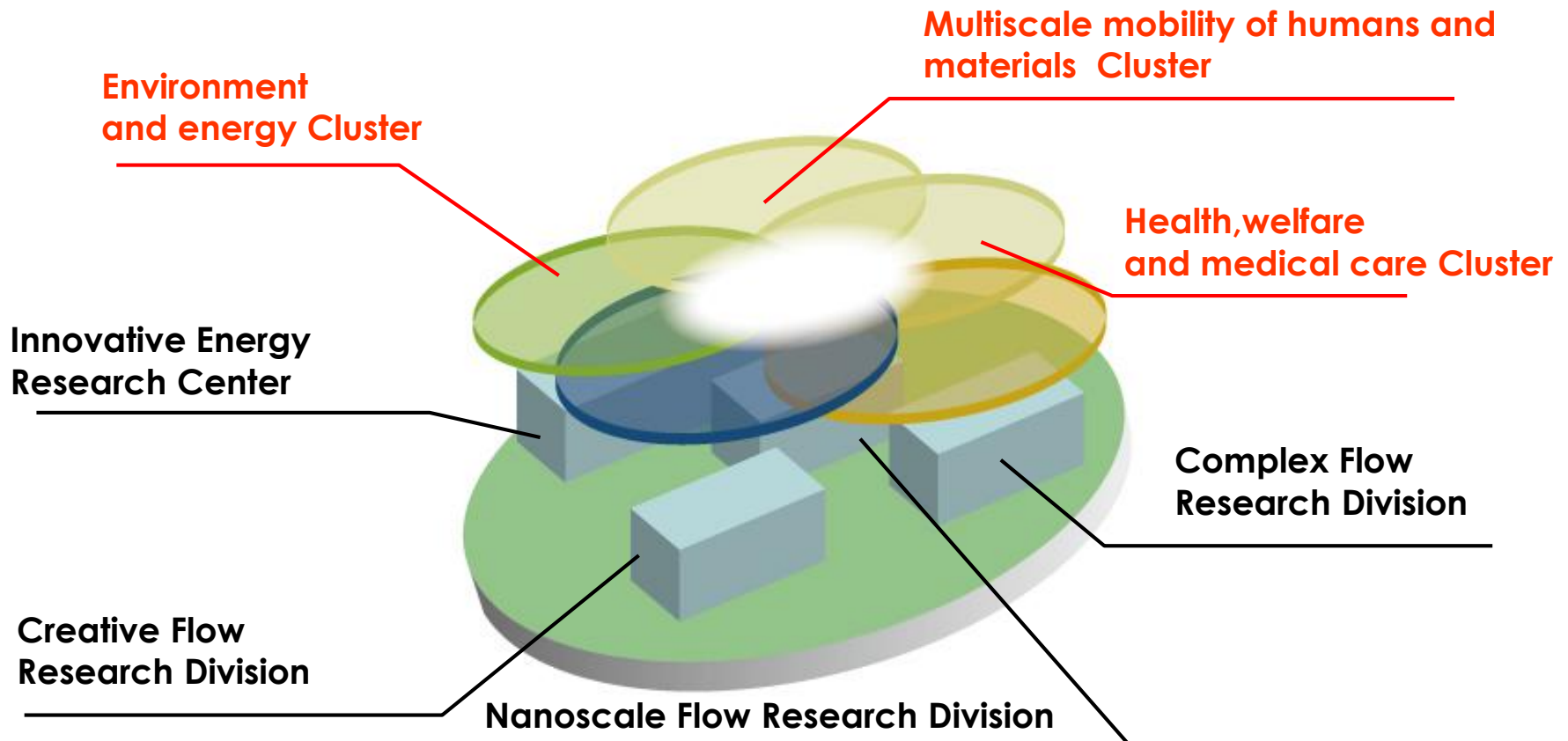


Repair of materials using Cold Spray technique



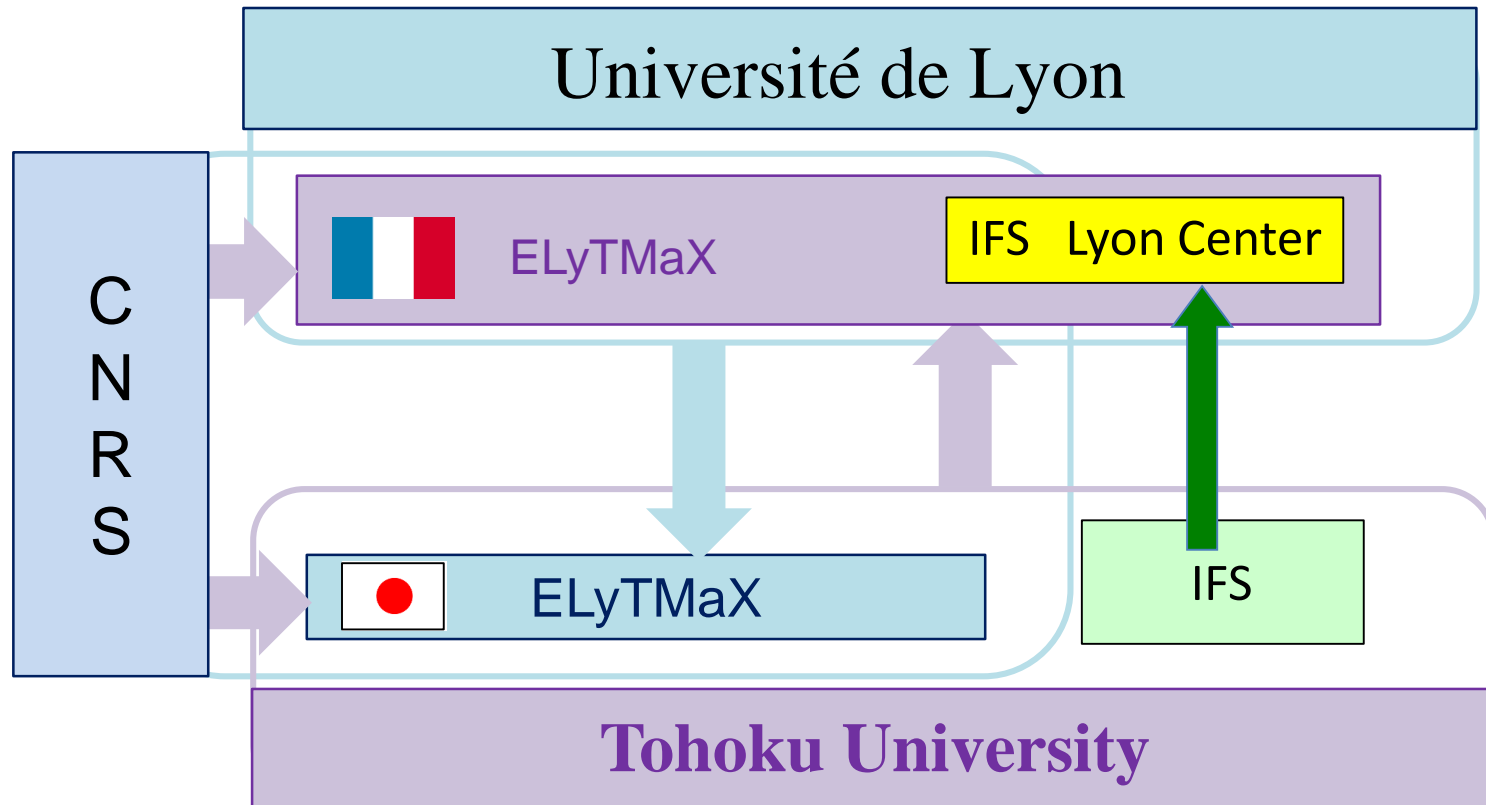
Number of Faculties (as of July 1, 2018)

- | | | |
|---------------------------|---------------------------------------|------------|
| · Professors 17 | · Professors by Special Appointment 2 | · Total 63 |
| · Associate Professors 7 | · Technical staff 15 | |
| · Assistant Professors 14 | · Administrative staff 8 | |



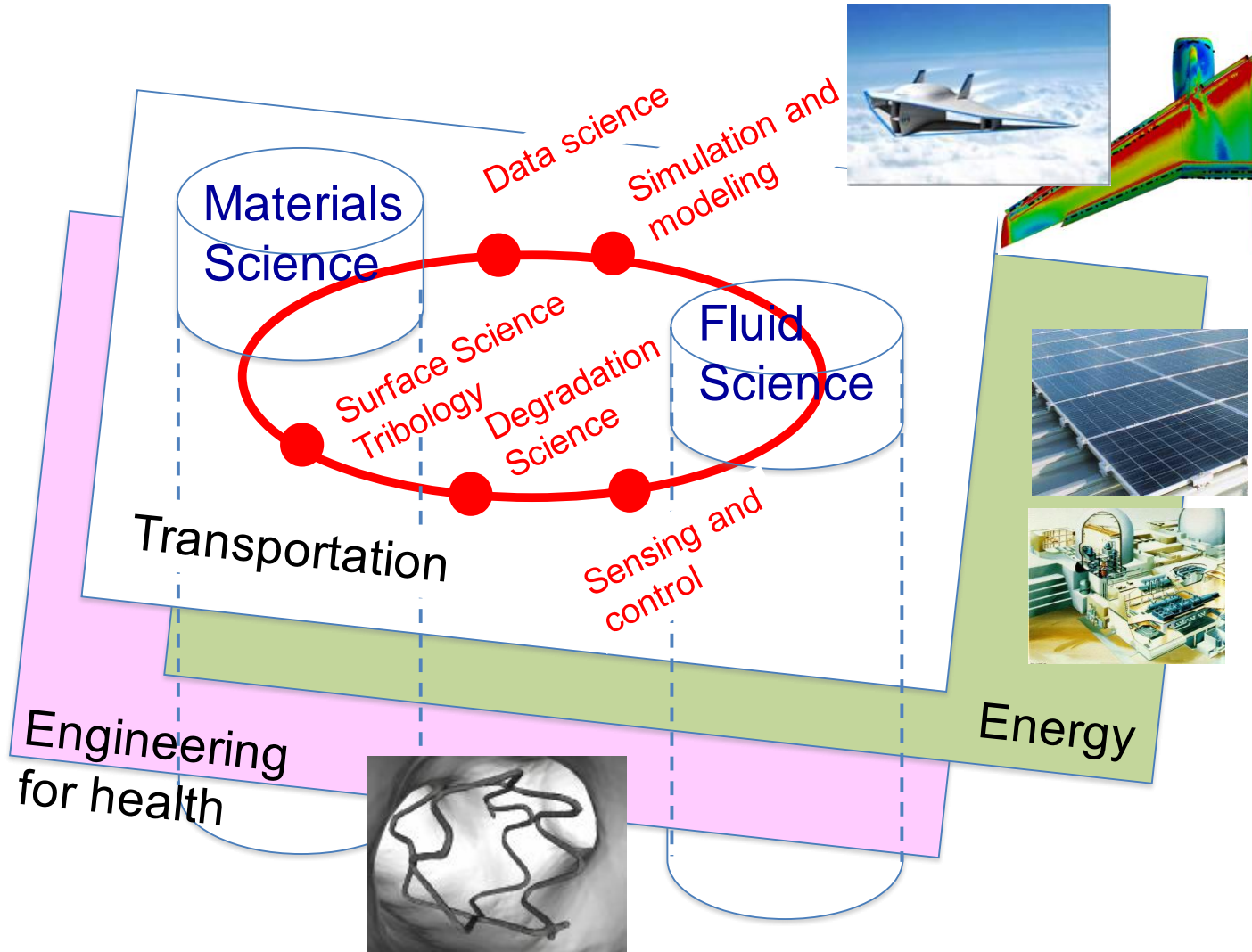
IFS Lyon Center: a component of ELyTMaX

- Both faculty members and **graduate students** promote joint research with UdL and CNRS within the frame of ELyTMaX
- Lyon Center establishes solid research network with UdL and CNRS through **substantial research activities**.



Issues that IFS Lyon Center Tackles

Lyon center explores interdisciplinary science based on fluid science and materials science to answer current societal stakes in the fields of transportation, energy and engineering for health.



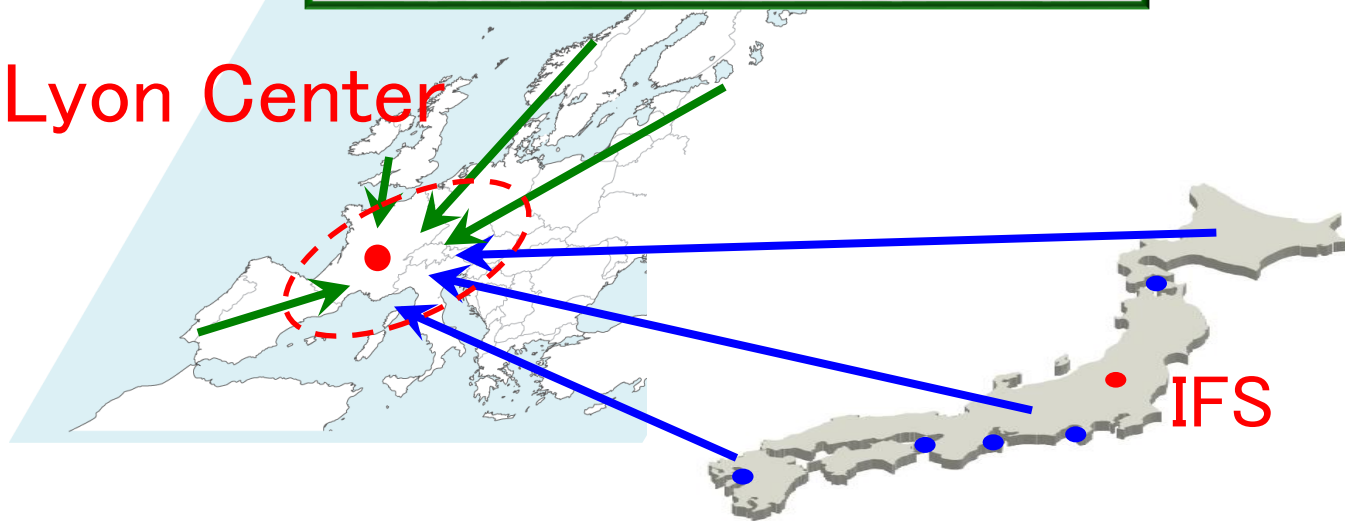
A strong contribution to the attractiveness of ELyT

Joint Usage / Research Center *Fluid Science Global Research and Education Hub*

- IFS has been certified as “*Fluid Science Global Research and Education Hub*”, where our members work together with researchers from other organizations through collaborative research projects.
- IFS Lyon Center will attract researchers from the European and Japanese fluid science communities.

Fluid Science Community in Europe

Lyon Center



Annual Conference
ICFD



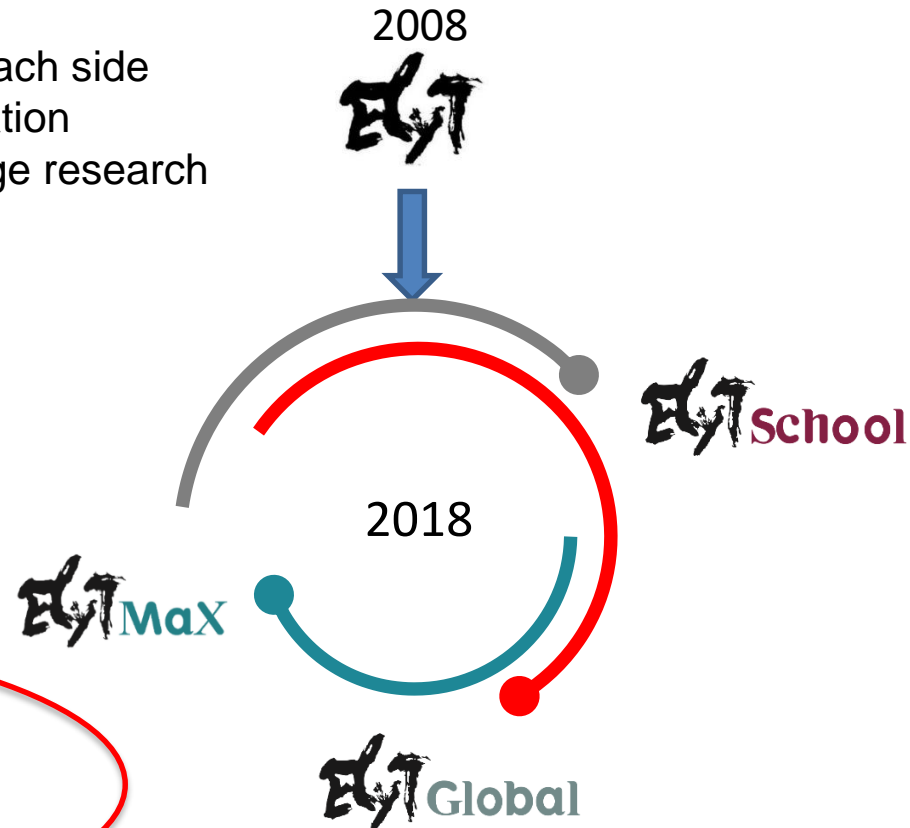
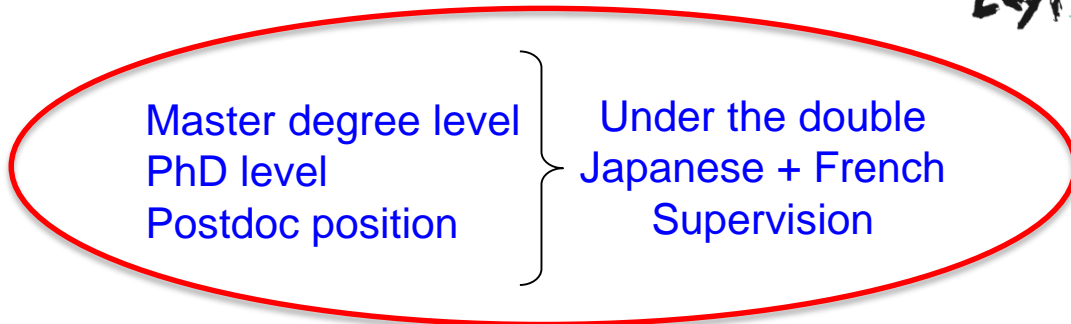
Fluid Science Community in Japan

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