

**« MEGEVH:
FRENCH SCIENTIFIC NETWORK ON
HYBRID ELECTRIC VEHICLES (HEVs) »**

Co-ordination

Prof. A. BOUSCAYROL (Université Lille1)

Scientific committee

Prof. S. DELPRAT (University of Valenciennes)

Prof. D. HISSEL (University of Franche Comté)

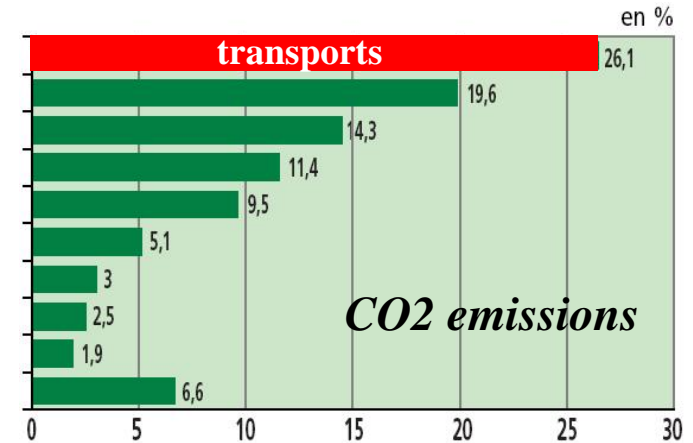
DR R. TRIGUI (IFSTTAR)

January 2016

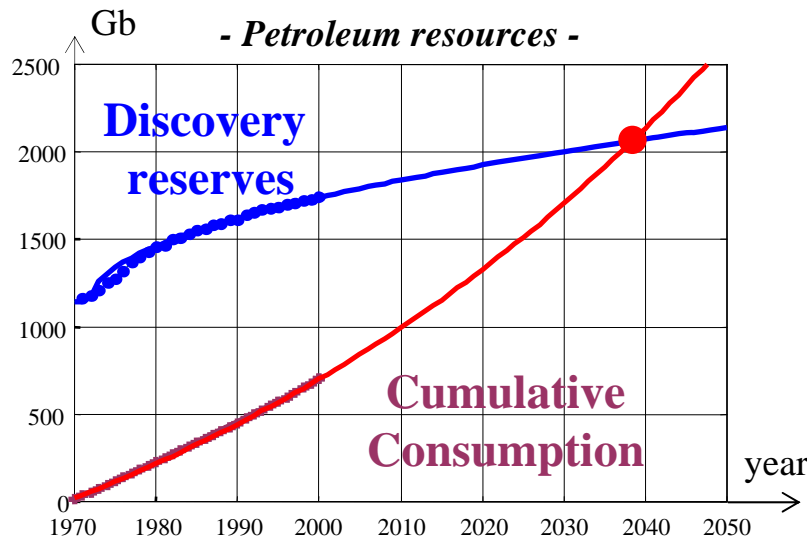
- Societal context -

Requirements:

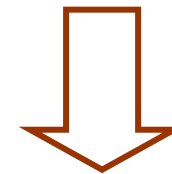
- reduction of pollutant emissions
- reduction of energy consumption



<http://www.ifen.fr/chifcle/tendances.pdf>



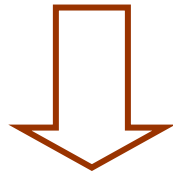
DAO data of USA



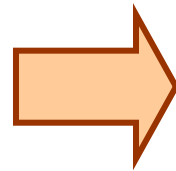
**Hybrid Electric Vehicles
intermediate step?**

- Economic context -

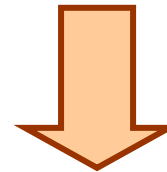
**The Automotive market doesn't integrate
a large part of EVs or HEVs**



Improve efficiency
Reduce emissions
Reduce costs
Improve reliability



Improvement of subsystems
New Energy Storage Subsystems
Importance of interactions
Management of various modes

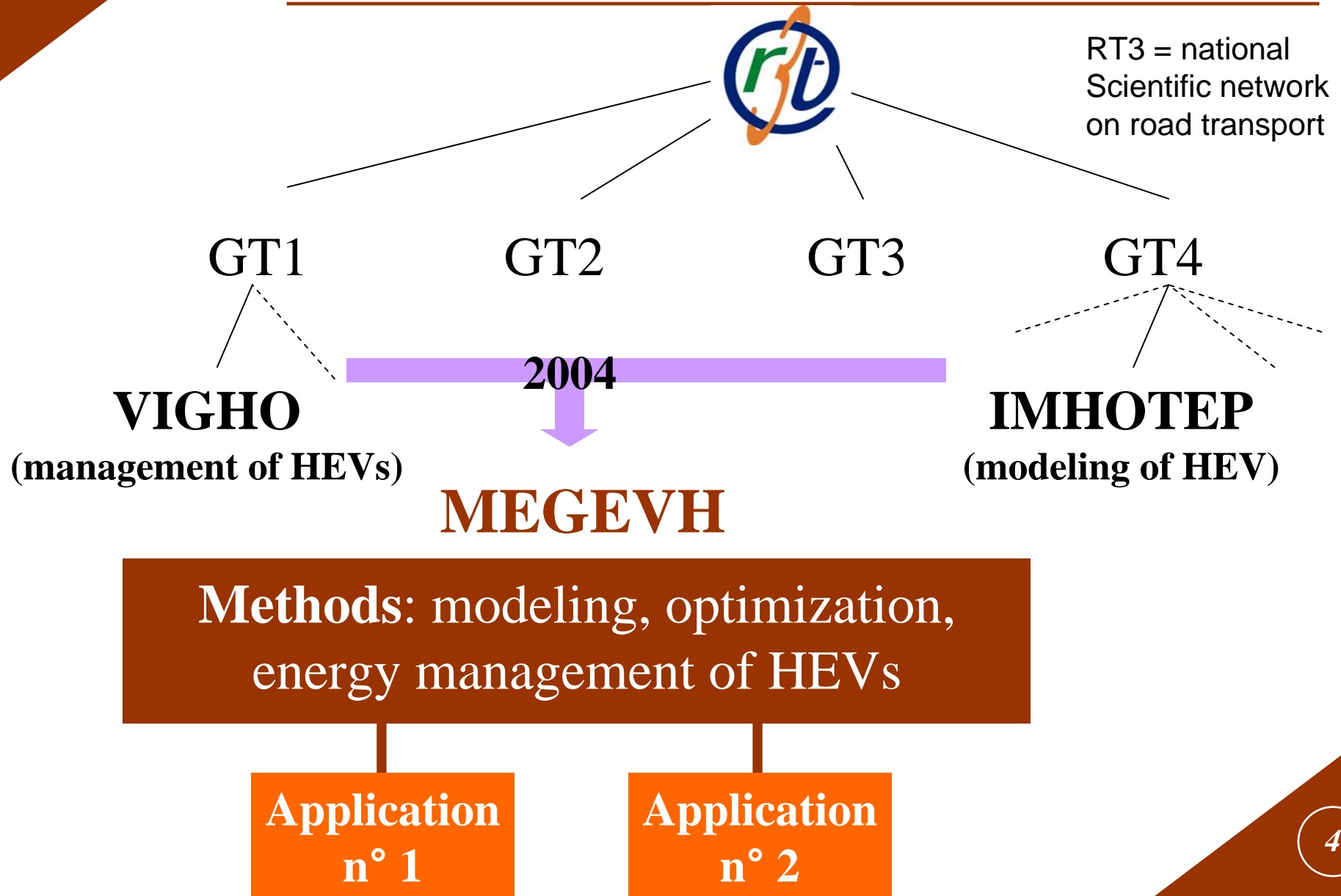


« Systemic »
approach



Véhicule PRIUS II
<http://www.toyota.com/>

- Scientific context -

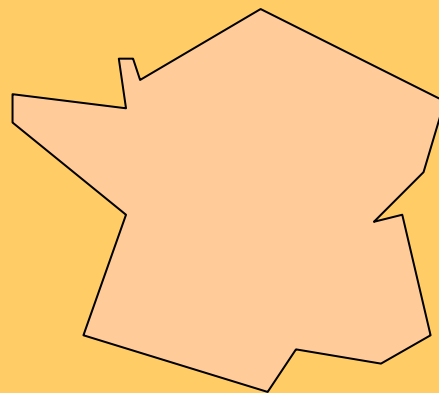


MEGEVH
presentation

MEGEVH
French network on HEV's

MEGEVH network

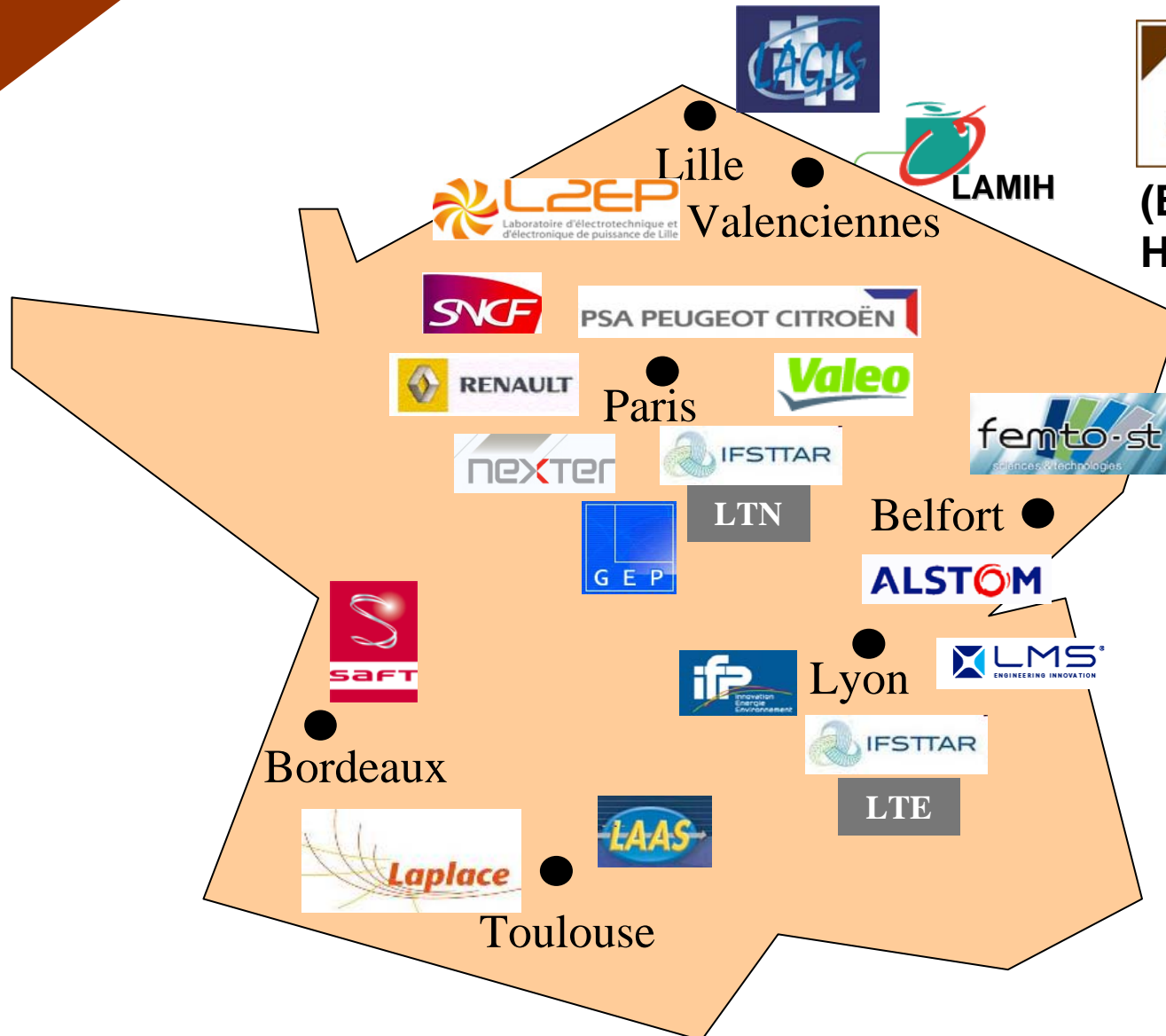
PARTNERS AND ORGANISATION



<http://www.megevh.org>

January 2016

- MEGEVH network -



MEGEVH
French network on HEV's
(Energy management of Hybrid Electric Vehicles)

Coordination:
Prof.A. Bouscayrol

6 projects in progress
3 PhDs in progress
12 PhDs defended
1 HDR defended

8 industrial partners
10 academic Labs

<http://l2ep.univ-lille1.fr/megevh.htm>

MEGEVH annual seminars

- PhD in progress
- industrial & clusters presentations
- scientific policy

**MEGEVH label:**

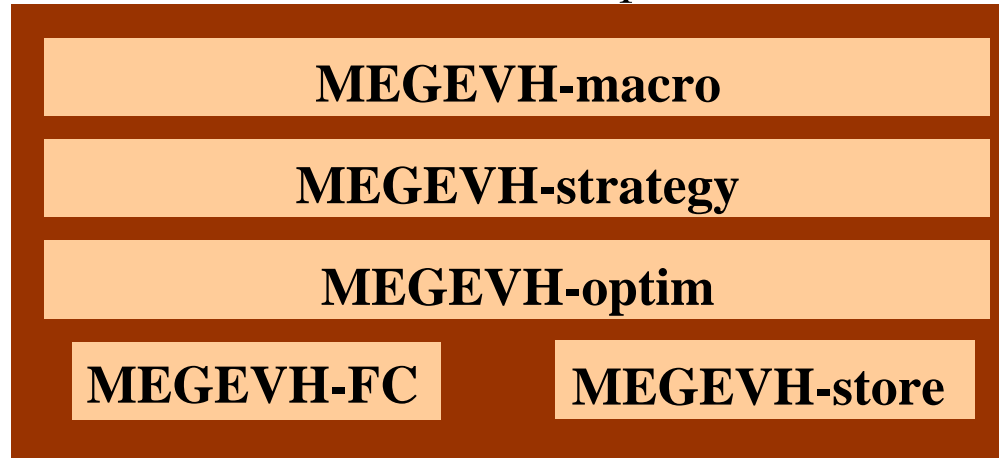
- for funding applications (Regions, ANR, PREDIT, other...)
- coordinator: **MEGEVH** member / at least 2 **MEGEVH** member
- in agreement with the scientific priorities

Collaboration with French clusters:

- Moveo (Ile de France - Normandie) – common projects
- Véhicules du Futur (Franche Comté) – common projects
- i-Trans (Nord-Pas-de-Calais) – common projects
- Lyon Urban Truck & Bus 2015 (Rhône Alpes) ?

- MEGEVH philosophy -

theoretical developments



Development of modelling and energy management methods

independently of the kind of vehicle

experimental plateforms



Reference vehicle



Paper Prize Award of IEEE-VPPC'08



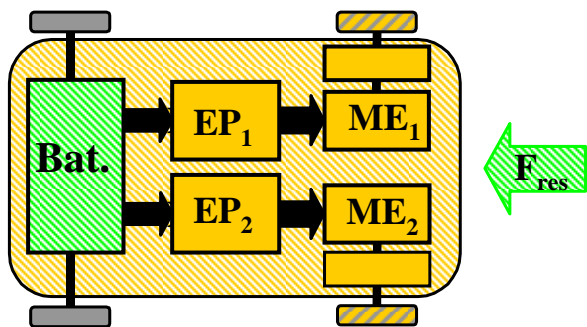
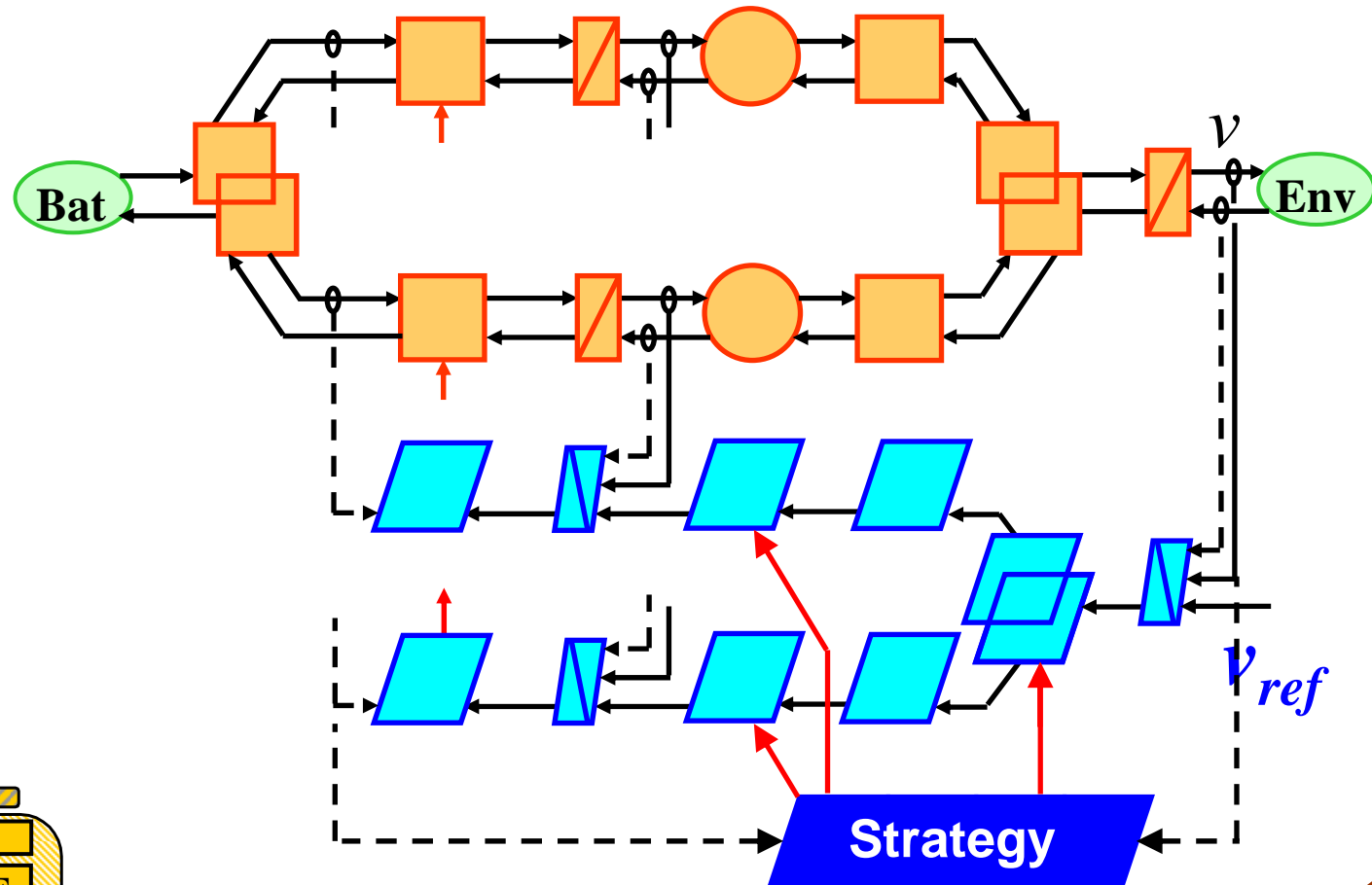
Paper Prize Award of IEEE-VPPC'12

- Common formalism: EMR -

Energetic
Macroscopic
Representation
(REM)



Organization of
control structures
of complex
systems



MEGEVH
presentation

MEGEVH
French network on HEV's

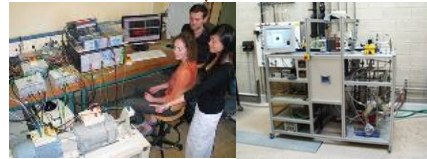
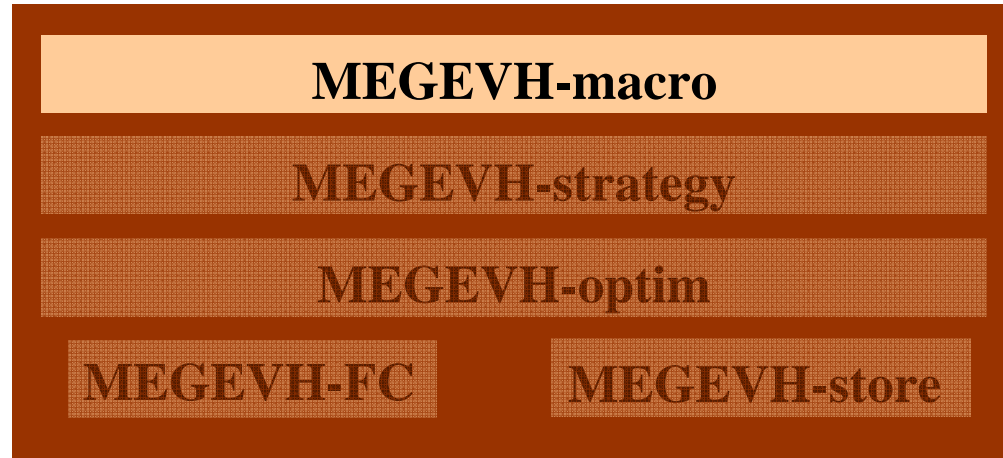
MEGEVH **network**

SCIENTIFIC ACTIVITIES

<http://www.megevh.org>

January 2016

- MEGEVH Macro -



Modelling methodologies of different HEVs

- PhD of L. Boulon (2009)
- PhD of K. Chen (2010)



- EMR as common tool
- Common models
- Common control schemes
- 5 papers in Int. journals
- VPPC'08 paper prize

PhD of L. Horrein (2015)



- extension to ICE and thermal aspects

Funding of Regions "Nord-Pas-de-Calais", "Franche-Comté" & EU (FEDER)
CIFRE PhD funding (ANRT)

- MEGEVH Strategy -

control methodologies
of different HEVs



PhD of W. Lhomme (2007)



- inversion-based control of different vehicles
- different control levels
- 2 papers in Int. journals

PhD of T. Letrouve (2013)



- application to 3008 HY4
- different HIL simulations
- validation on the prototype
- 1 papers in Int. journal
- VPPC'12 paper prize

- Control of x-EV vehicles -



Modelling and control of multi-source EVs

PhD of N. Marx (in progress)



- modelling and control of multi-stack FC

PhD of C. Depature (in progress)



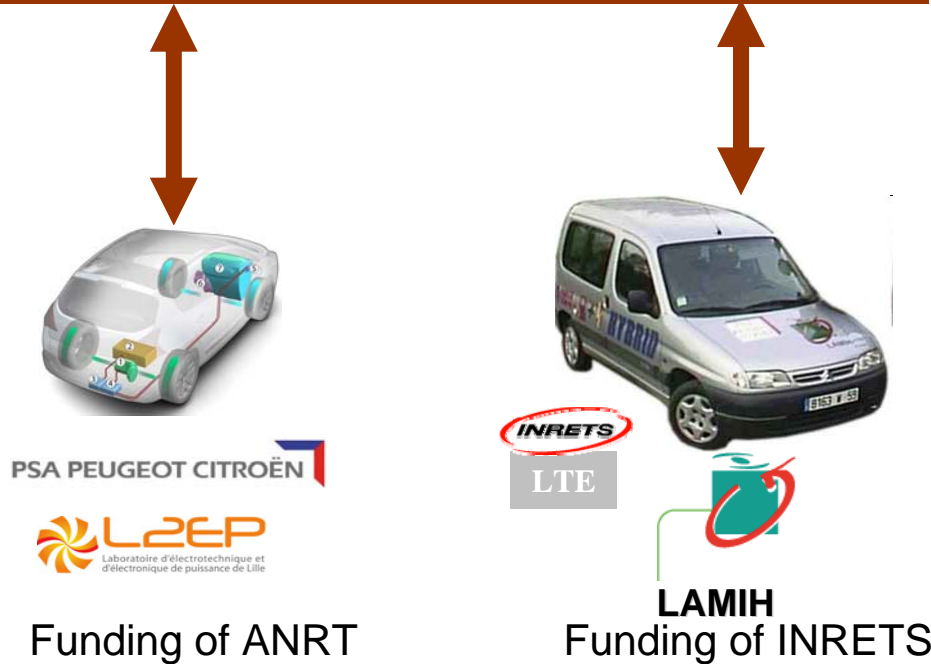
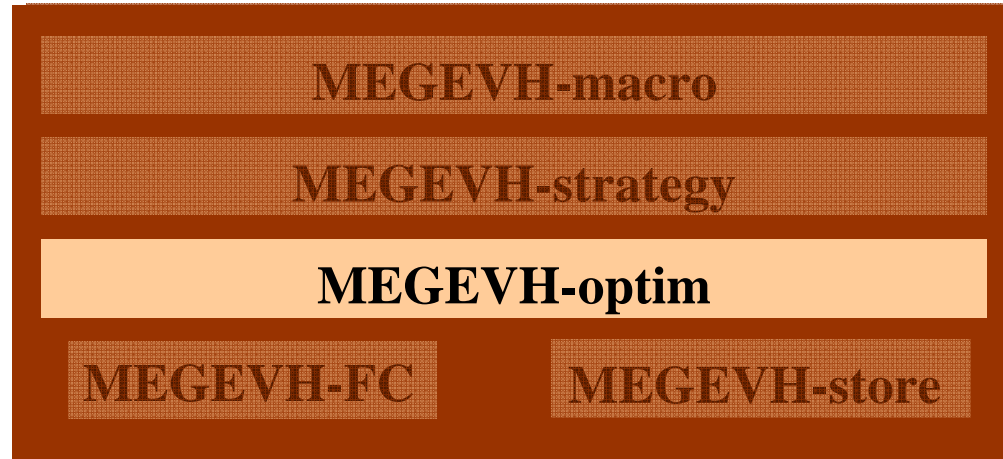
- different control of a FC/SC vehicle

PhD of B.H. Nguyen (in progress)







- energy management of a H-ESS hybrid vehicle

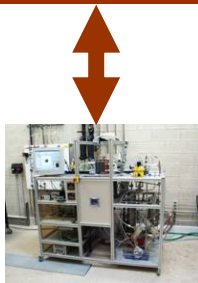
- MEGEVH Optimisation -



optimisation methodologies of different HEVs

- **PhD of S. Kermani (2009)**
 -  
 - optimal energy management in real-time
 - 2 papers in Int. journals
- **PhD of L. Horrein (2015)**
 -  
 - decomposed EMS including Thermal aspects

- MEGEVH Fuel Cell -



Modelling and control of Fuel Cell subsystems

PhD of D. Chrenko (2008)



- modelling and control of FC
- 3 papers in Int. journals

Post-Doc of L. Boulon (2010)



- UQTR/IRH (Canada)
- multiphysical extensions
- 2 papers in int. journals

Post-Doc (in progress)



- integration of a FC system

- MEGEVH Storage -

Modelling and control of Storage subsystems



PhD of A. L. Allègre (2010)



- HESS using Bat / Scap
- generic modelling and EMR
- 1 paper in Int. journals

Post-doc of L. Gauchia (2011-2012)



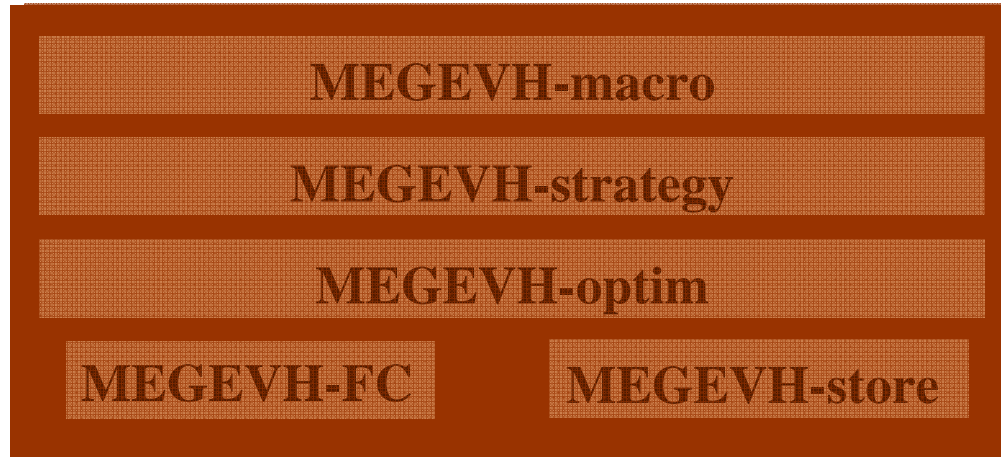
- extension to FC and Scaps

PhD A. Castaings (in progress)



- extension to multiple HESS

- Hybrid Trucks -



New powertrain topology for different hybrid trucks

- PhD of Z. Wu (2012)
- PhD of S. A. Syed (2012)
- PhD of S. Butterbach (2012)



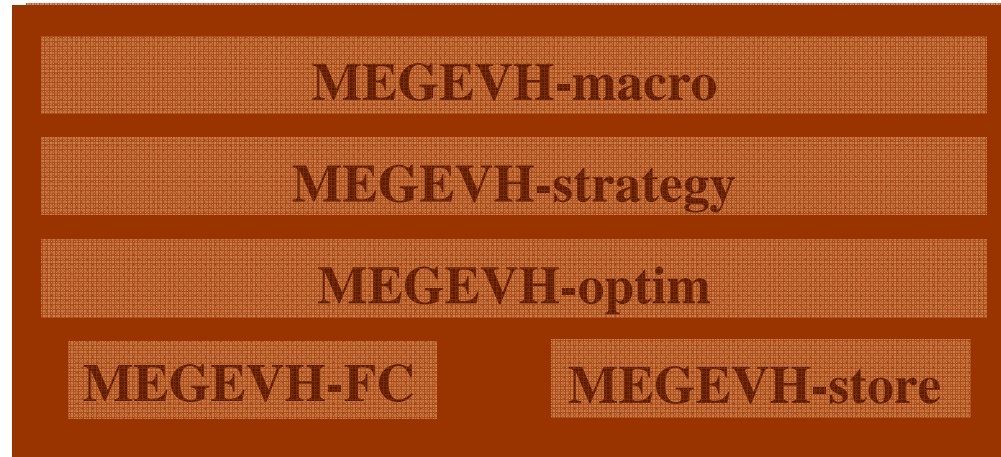
- double-planetary gear train
- common model and control
- different designs
- different energy management

ARCHYBALD ANR Project

Funding of ANR-PREDIT



- MEGEVH - EVT-



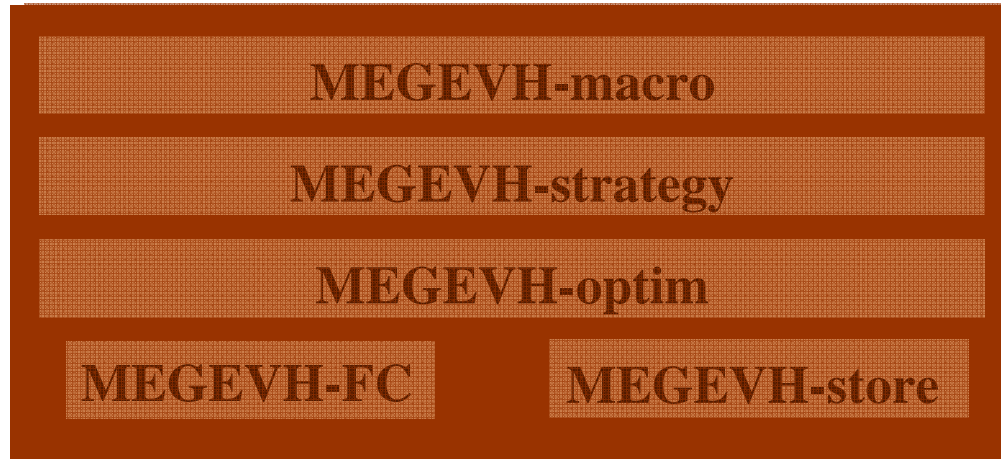
New powertrain topology
Using Electric Variable Transmission

- **Post-Doc of Y. Cheng (2010-2012)**



- Habin Institute of Tech (China)
- specific EVT design
- EVT control
- comparison with other HEVs
- 3 papers in Int. Journals

- MHYGALE -



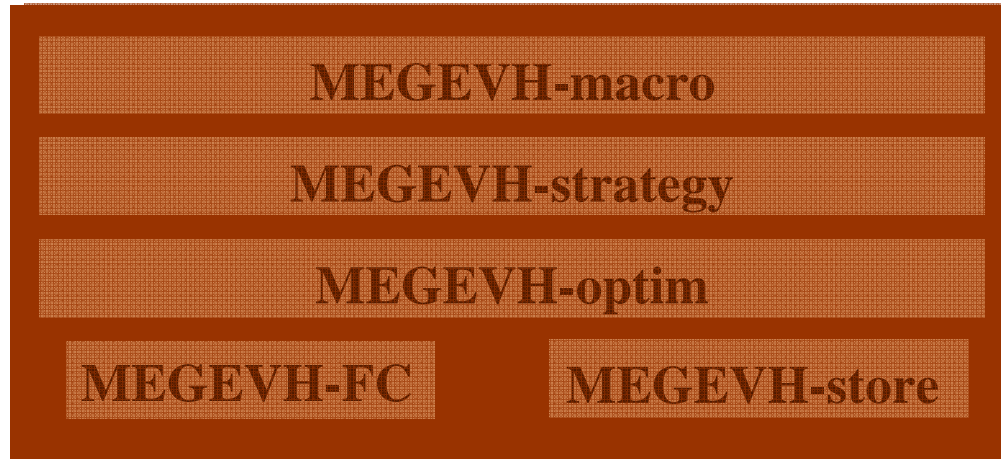
Multi-phase starter-alternator
for mild HEVs

- PhD of L. Lu (in progress)
- PhD of A. Bassel (2013)



- multi-phase machine
- starter-alternator

- Hybrid Locomotives -



• PhD of J. Baert (2013)



- Hybrid locomotive
- powertrain design
- energy management

• Post-Doc T. Letrouve (2013)



- HIL simulation of PLATHEE
- 1 paper in int. journal

MEGEVH
presentation

MEGEVH
French network on HEV's

MEGEVH **network**

PROMOTION ACTIVITIES

<http://www.megevh.org>

January 2016

- Conferences 2006-2016 -

IEEE-VPPC, « Vehicle Power and Propulsion Conference »

- 2006 - Windsor (UK), (1 special session)
- 2007 - Arlington (US), (2 special sessions)
- 2008 - Harbin (China), (3 special sessions)
- 2009 - Detroit (USA), (1 special session + 1 tutorial)
- 2010 - Lille (France), (2 special sessions, 1 EV forum))**
- 2011 - Chicago (USA), (1 special sessions+ 1 round table)
- 2012 – Seoul (Korea) (2 special sessions)
- 2013 – Beijing (China) (1 Keynote)
- 2014 – Coimbra (Portugal) (1 tutorial, 2 special sessions)
- 2015 – Montreal (Canada) (1 tutorial, 2 special sessions)
- 2016 – Hangzhou (China) (2 special sessions)



*Introduction of a
MEGEVH special session*



*EPE'13 forum organized by
the MEGEVH PhD students*

Other international conferences,

- 2008 - ElectrIMACS, Québec, (1 special session)
- 2009 - IEEE-IECON, Porto (1 tutorial)
- 2011 - EEVC'11, Brussels (1 common paper)
- 2012 – EEVC'12, Brussels (1 common paper)
- 2012 –IFAC-PPPC'12 , Toulouse, France (1 common paper)
- 2013 – EPE13, Lille (1 special session, 2 industrial sessions, 1 forum)**

Seminars from visiting Professors,

M. K. Hamada (Toyota Motor Corp., Japan) 2007
 Prof. C. C. Chan (Hong-Kong Univ. China) 2007, 2008
 Prof. A. Emadi (IIT Chicago, USA), 2009
 Prof. C. Mi (Univ. Dearborn, USA), 2009
 Prof. C. C. Chan (Hong-Kong Univ. China) 2012, 2014



IEEE-VPPC'10, Lille, Sept. 2010

360 attendees from 35 countries
 5 tutorials, 9 Keynotes,
 2 technical visits, 15 exhibitors
 167 lectures, 104 posters, 1 forum,



Special Section, IEEE trans. on Vehicular Technology, Dec. 2011

“Energy and future transportation systems”
 Guest Editors: A. Bouscayrol, D. Hissel, R. Trigui, A. Emadi
 39 submissions, 7 papers published (1 from MEGEVH)

MEGEVH
presentation

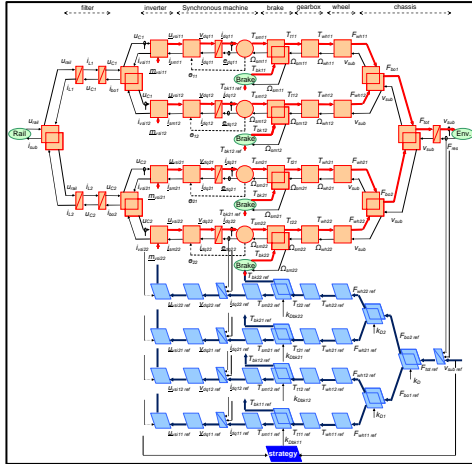
MEGEVH
French network on HEV's

MEGEVH **network**

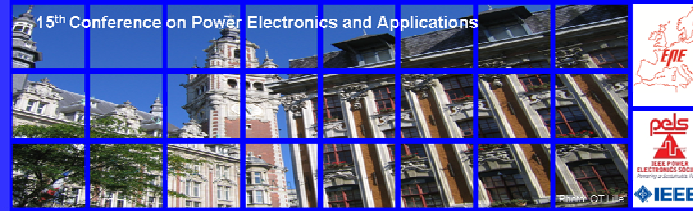
EXAMPLES OF PROMOTION ACTIVITIES

<http://www.megevh.org>

January 2016



EPE'13
ECCE Europe
3-5 September 2013
Lille, France
<http://www.epe2013.com>



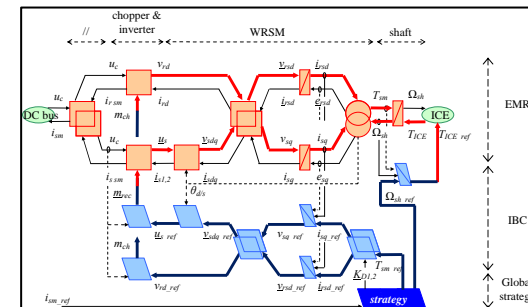
Special Session on Energetic Macroscopic Representation (within the framework of MEGEVH)



Chairs: Prof. A. Bouscayrol (Univ. Lille, MEGEVH, France)
 Dr. L. Boulon (Univ. Quebec Trois Rivières, Canada)
 Dr. J. Pouget (SNCF, MEGEVH, France)
 Dr. J. Trovao (INESC Coimbra, Portugal)

Must included industrial partners :

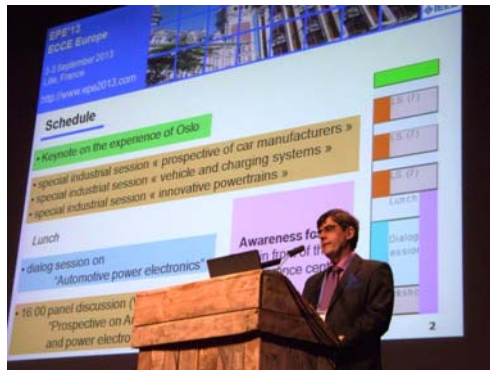
- 2 oral sessions of 3 lectures in the Amphitheater (more than 100 attendees)
- 1 dialog session of 3 posters
- 9 papers from 4 countries (5 from MEGEVH)



EPE'13
ECCE Europe
3-5 September 2013
Lille, France
<http://www.epe2013.com>



Industrial Sessions on New traction powertrain of hybrid vehicles (within the framework of MEGEVH)



Chairs: Dr. R. Trigui (IFSTTAR, MEGEVH, France)
Dr. J. Delsey (PREDIT, France)

Prospective vision of car manufacturers (400 attendees)

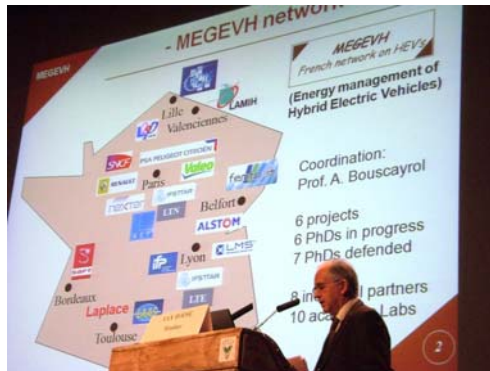
- Renault
- Nissan Europe
- PSA Peugeot Citroën

Selection of key projects funded by national agencies (400 attendees)

- Prius Plug-in in Strasbourg (Toyota, EDF)
- Double planetary hybrid truck (Nexter, MEGEVH)
- Open-winding traction/charger system (Valeo)



EPE'13
ECCE Europe
3-5 September 2013
Lille, France
<http://www.epe2013.com>



Industrial Session on Power electronics for railway (within the framework of MEGEVH)



Chairs: Prof. D. Hissel (FEMTO-ST, MEGEVH, France)
Mr. P. Terrien (i-trans cluster, France)

Keynote (600 attendees)

- Technical solution of power electronics in railways (SNCF)

Selection of key projects funded by national agencies (300 attendees)

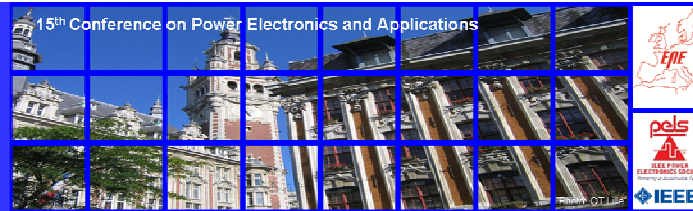
- PM synchronous machine (Bombardier)
- Wide Band Gap power electronics (Alstom, MEGEVH)
- Evolution of subway VAL (Transpole)

Round table on railways innovation (50 attendees)





EPE'13
ECCE Europe
 3-5 September 2013
 Lille, France
<http://www.epe2013.com>



Forum “Electric Vehicle”
 (in the framework of MEGEVH)
 Chair: Mr. L. Horrein
 (L2EP, PSA, MEGEVH, France)
 and the PhD students of MEGEVH



MEGEVH
 French network on HEV's



1. **10 partners**
 4 Lab, school and university ; 3 seller / renters ;
 1 Car manufacturer ; 1 public institution ; 1 infrastructure manufacturer
2. **18 vehicles, 3 charger systems**
 13 vehicles in exhibition and test, 5 vehicles in exhibition only
3. **Large panel of vehicles**
 Hybrid car, Sportive electric car, Electric car, No-licence electric car,
 eMoto, eScooter, eBike, taxi-bike

- EMR summer school 2013 -

supported by

MEGEVH
French network on HEV's

Summer school
EMR'13, 9-11 Sept. 2013,
Univ. Lille1 (France)



Chair
Dr. W. Lhomme
(L2EP, MEGEVH)



54 attendees from 7 countries,
5 lectures on concepts, 14 lectures on applications (1 MEGEVH session)
2 simulations session, 1 practice session, PhD works

<http://emrwebsite.org/>

EMR'06 Lille, EMR'08 Harbin (China), EMR'09 Trois Rivières, Canada)
EMR'11 Lausanne (Switzerland), EMR'12 Madrid (Spain)....

MEGEVH
presentation

MEGEVH
French network on HEV's

MEGEVH **network**

MISCELLANEOUS

<http://www.megevh.org>

January 2016

- PhDs and Post-Docs -

They contribute to MEGEVH. What are their actual positions?

2004	W. Lhomme	Ass. Prof. Univ Lille1
	L. Boulon	Prof. Univ. Trois Riv. (Canada)
	D. Chrenko	Ass. Prof. Univ. Bourgogne
	K. Chen	Ing. Valeo
	S. Kermani	Ing. Valeo?
	A.L. Allègre	Teatcher French Guyana
	L. Gauchia	Ass. Prof. Michigan Tech (USA)
	S. A. Syed	Ing. General Motors (USA)
	Y. Cheng	Ing. PSA Peugeot Citroën
	T. Letrouve	Ing. SNCF
	A. Bassel	Ing. Ferrari (Italy)
	J. Baert	Ing. Alstom
	L. Silva	Ass. Prof. Univ Rio Carto (Argentina)
	J. Trovao	Prof. Univ. Sherbrooke (Canada)
2016	L. Horrein	Post-doctoral position CERN (Switzerland)