

Working / writing meeting, 01/12/2017
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Lund University

Outline for today's meeting

1. Description of the network and its goals (this presentation)
 1. Participants
 2. Work package structure
 3. Training
 4. Secondments
2. Budget (thanks to Karin Langborger from Research Services)
3. Discussion and next steps

Goals of SMARTHEP network

- International network of physicists and companies for **real-time data analysis**
- Main challenge/big question:
 - **how to take decisions fast and efficiently, starting from large datasets**
 - Physicists need to decide what data to permanently record starting from 40 million collision events/second, *as soon as the collision event occurs*
 - Companies need to take decisions fast based on large datasets in the context of e.g. traffic, self-driving cars, medical surgery simulation, financial transactions
- **Tools:**
 - Machine learning to enable fast decisions
 - Hardware (FPGA, GPU) and optimized software algorithms
- **Goal:**
 - train 15 PhD students on data science and real-time analysis
 - contribute to specific research and industry goals

Open questions on *real-time*

- How do we define **real-time**?
 - Broadly: “as soon as the data is taken, as fast as possible in order to influence subsequent decisions”
- Different fields have different timescales – my guesses:
 - HEP: ns to ms (trigger decision)
 - Financial transactions: ?
 - Fleet control and mobile applications: < seconds
 - Medical simulation: < seconds
 - Traffic predictions: seconds

Network participants

Physicists working at the Large Hadron Collider

9 European universities (5 ERC grantees) + 2 research institutes

3 North American universities

LHC experiments ALICE, ATLAS, CMS, and LHCb represented

Companies from Sweden, Germany, France, Italy, Switzerland

Traffic control and self-driving cars

Medical diagnosis

Finance and investment

Instrumentation

Network participants

Industrial beneficiaries & partners



UNIVERSITÄT
HEIDELBERG
ZUKUNFT
SEIT 1386



UNIVERSITY OF HELSINKI



tu technische universität
dortmund



Academic partners



UNIVERSITÀ DI PISA



LUND
UNIVERSITY



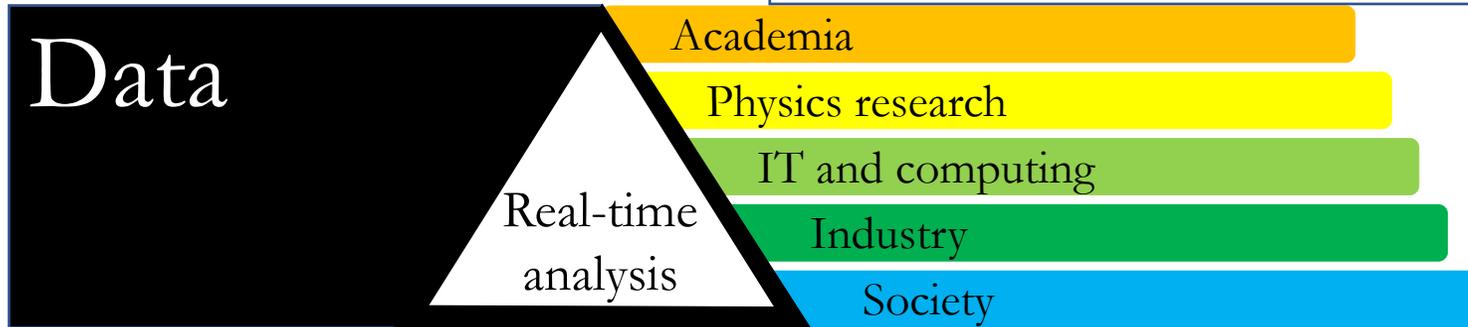
University of
CINCINNATI



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UNIVERSITY
OF OREGON



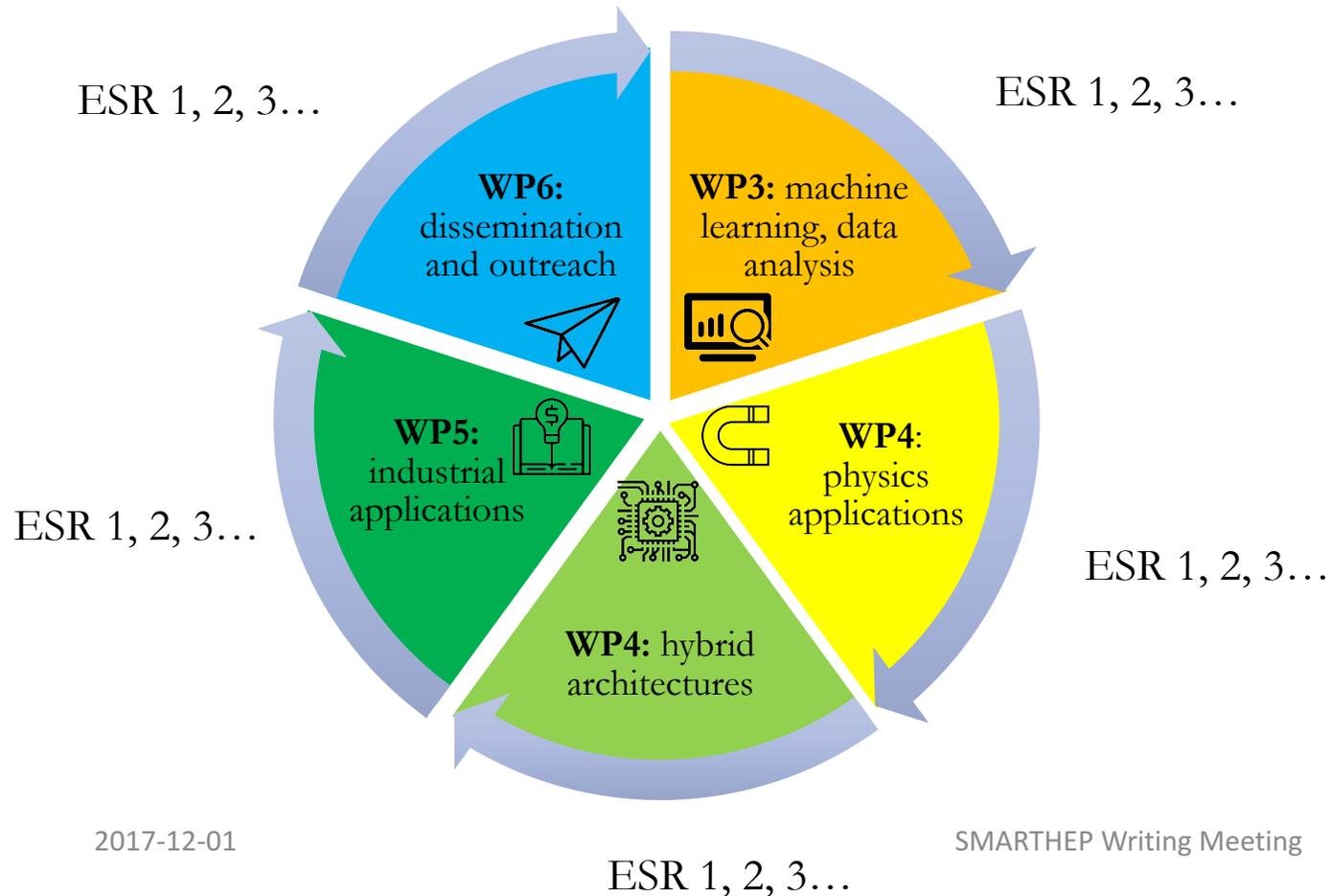
SMAR **W** RTHEP

Work Packages

SMARTHEP

WP1: management

WP2: training

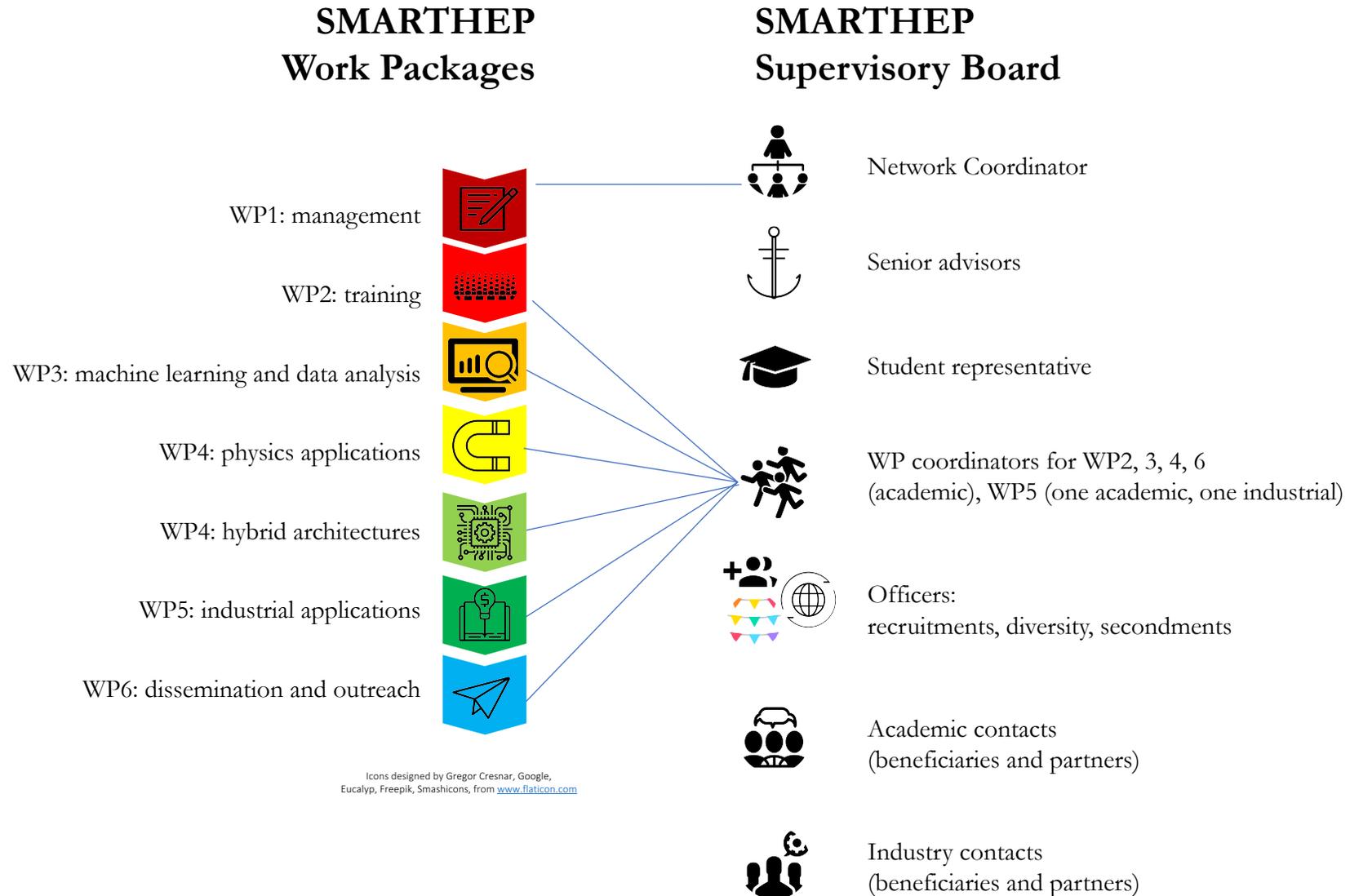


Physics topics

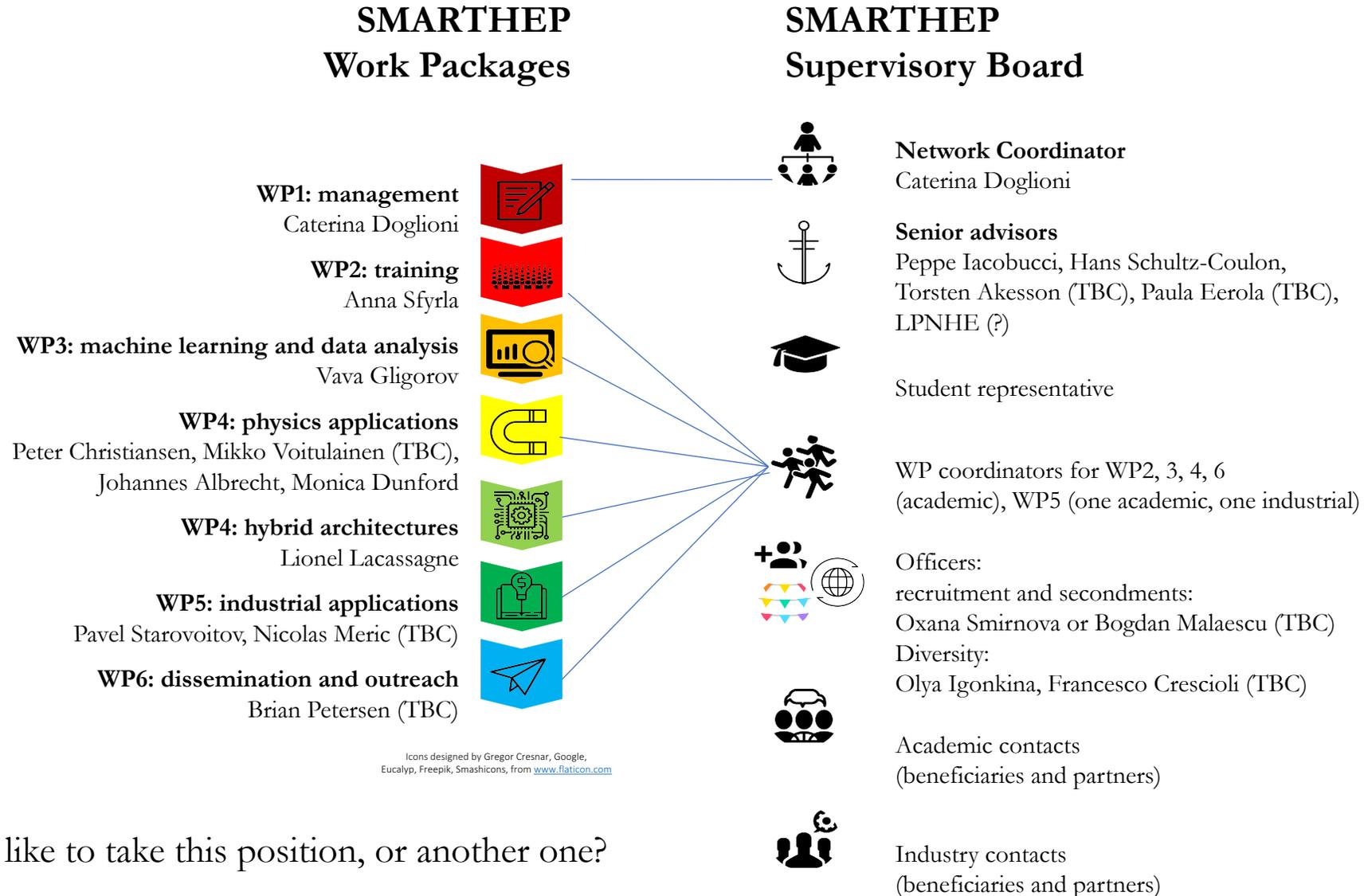
(sub-packages of WP4):

- Dark sectors and Higgs
- Lepton flavour violation
- Precision measurements

Management structure



Management structure, with names



TBC = would you like to take this position, or another one?

Early Stage Researchers (ESRs)

<i>ESR number</i>	<i>Beneficiary</i>
1	Helsinki CMS
<i>Topic/subtopic</i>	Discovery of new physics in jets with RTA
<i>Physics</i>	Higgs, Dark Matter and dark sectors
2	Helsinki CMS
<i>Topic/subtopic</i>	Use ML and RTA for discovering new physics and measuring the SM
<i>Physics</i>	Higgs, Dark Matter and dark sectors, Precision measurements
3	UniGE ATLAS
<i>Topic/subtopic</i>	Use ML-based tracking reconstruction in hardware triggers (GPU)
<i>Physics</i>	Higgs, Dark Matter and dark sectors
4	CERN ATLAS
<i>Topic/subtopic</i>	Increase efficiency of RTA in the ATLAS HLT using multithreading
<i>Physics</i>	Higgs, Dark Matter and dark sectors
5	CERN LHCb
<i>Topic/subtopic</i>	Speed up reconstruction algorithms for LHCb HLT to do RTA
<i>Physics</i>	Lepton Flavour Violation
6	Dortmund LHCb
<i>Topic/subtopic</i>	RTA MVA for identification of particle decays in leptons of different species
<i>Physics</i>	Lepton Flavour Violation (in neutral meson decays)
7	Dortmund LHCb
<i>Topic/subtopic</i>	Triggering on event properties
<i>Physics</i>	Lepton Flavour Violation (in neutral meson decays)

Early Stage Researchers (ESRs)

8	LPNHE ATLAS
<i>Topic/ subtopic</i>	Use FTK to reject pile-up for RTA
<i>Physics</i>	Higgs, Dark Matter and dark sectors
9	LPNHE Computing
<i>Topic/ subtopic</i>	RTA in hybrid architectures (make sure CPU, GPU, FPGA work together, next generation)
<i>Physics</i>	N/A (IT)
10	Dreamquark
<i>Topic/ subtopic</i>	Use ML (adversarial networks) for real-time discrimination on financial and insurance dataset
<i>Physics</i>	Lepton Flavour Violation (in strange baryons)
11	NIKHEF ATLAS
<i>Topic/ subtopic</i>	Context-independent performance monitoring for real-time processes (ATLAS)
<i>Physics</i>	Lepton Flavour Violation (in tau to 3mu)
12	NIKHEF LHCb
<i>Topic/ subtopic</i>	Context-independent performance monitoring for real-time processes (LHCb)
<i>Physics</i>	Lepton Flavour Violation (in electron final state)
13	Lund Alice
<i>Topic/ subtopic</i>	Upgrade of TPC for triggerless readout
<i>Physics</i>	Precision measurements
14	Lund ATLAS [beneficiary TBC]
<i>Topic/ subtopic</i>	TBC
<i>Physics</i>	Precision measurements (4th year)
15	Heidelberg ATLAS
<i>Topic/ subtopic</i>	Pile-up noise reduction for the ATLAS calorimeter system
<i>Physics</i>	Higgs, Dark Matter and dark sectors

Training

Table 1.2.1: SMARTHEP doctoral programme

Type of training	Number of credits
Training through research	135
At host	75
Through secondment	3×20 or 2×30
Training through education	45
PhD courses /	
Technical and Research Training	(30)
Transferable Skills Training	(15)
Total	180

Question for beneficiaries: how to register ECTS credits from secondments/schools?

Training events

Table 1.2.4: Main network-wide events, conferences and contribution of beneficiaries

Training Events & Conferences		ECTS	Lead Institution	Action Month
1.	Kick-off meeting	-	Lund	2
2.	Introductory school	3	Nikhef	8
3.	Physics and machine learning school	3	University of Geneva	16
4.	Basic FPGA course	1.5	CERN	25
5.	FPGA bootcamp	1.5	Pisa	26
6.	Intermediate conference	-	Lund	28
7.	CPU and hybrid architectures school	1.5	USC	27
8.	Industry, career and transferrable skills school	1.5	University of Heidelberg	36
9.	Final conference and meeting	-	CNRS	42

Secondments (1/2)

<i>ESR number</i>	<i>Beneficiary</i>	<i>Industrial secondment (yellow=confirmed)</i>	<i>Mo.</i>	<i>Academic secondment</i>	<i>Mo.</i>
1	Helsinki CMS	Ximantis	4	Lund ATLAS	4
<i>Topic/subtopic</i>	Discovery of new physics in jets with RTA	Apply RTA to traffic predictions		Improve precision of calibration for RTA	
<i>Physics</i>	Higgs, Dark Matter and dark sectors				
2	Helsinki CMS	Fleetmatic (Tensorflow on mobile)	4	CERN CMS	4
<i>Topic/subtopic</i>	Use ML and RTA for discovering new physics and measuring the SM	Use ML on mobile platform for RTA pattern recognition		Devise methods to apply object tagging to ESR1	
<i>Physics</i>	Higgs, Dark Matter and dark sectors, Precision measurements				
3	UniGE ATLAS	ReflexiveInvestments	9	N/A	0
<i>Topic/subtopic</i>	Use ML-based tracking reconstruction in hardware triggers (GPU)	TBC			
<i>Physics</i>	Higgs, Dark Matter and dark sectors				
4	CERN ATLAS	ReflexiveInvestments or IBM	TBD	Heidelberg or LPNHE	TBD
<i>Topic/subtopic</i>	Increase efficiency of RTA in the ATLAS HLT using multithreading	TBC		TBC	
<i>Physics</i>	Higgs, Dark Matter and dark sectors				
5	CERN LHCb	IBM Openlab or IBM France?	TBD	Dortmund	TBD
<i>Topic/subtopic</i>	Speed up reconstruction algorithms for LHCb HLT to do RTA	TBC		TBC	
<i>Physics</i>	Lepton Flavour Violation				
6	Dortmund LHCb	Ximantis (reprogramming AI)	5	NIKHEF LHCb or ATLAS	4
<i>Topic/subtopic</i>	RTA MVA for identification of particle decays in leptons of different species	Apply ML to traffic predictions		TBC	
<i>Physics</i>	Lepton Flavour Violation (in neutral meson decays)				
7	Dortmund LHCb	Wild Tree	3	Lund	5
<i>Topic/subtopic</i>	Triggering on event properties	Monitor and optimise computing cluster (trigger farm) based on global events		Bring WildTreeTech ideas to LU computing cluster	
<i>Physics</i>	Lepton Flavour Violation (in neutral meson decays)				

https://docs.google.com/spreadsheets/d/1OHTNCu2_pvwYCh4ypwV2jaquesuCaog264nQygPDRNk/edit?usp=sharing
for full list with proposed supervisors

Secondments (2/2)

8	LPNHE ATLAS	Fleetmatic (Apache Spark)	5	Pisa	4
<i>Topic/subtopic</i>	Use FTK to reject pile-up for RTA	Parallel computing in the context of fleet tracking		Apply techniques on creation of pattern banks	
<i>Physics</i>	Higgs, Dark Matter and dark sectors				
9	LPNHE Computing	IBM France, NVIDIA		CERN LHCb	
<i>Topic/subtopic</i>	RTA in hybrid architectures (make sure CPU, GPU, FPGA work together, next generation)	Design novel ML method for optimizing heterogeneous computing architectures		Apply to LHCb/ATLAS data processing architectures	
<i>Physics</i>	N/A (IT)				
10	Dreamquark	N/A		Santiago LHCb, CERN	4+5
<i>Topic/subtopic</i>	Use ML (adversarial networks) for real-time discrimination on financial and insurance dataset			Apply same techniques in online discrimination of strange baryons, same topology but different final state	
<i>Physics</i>	Lepton Flavour Violation (in strange baryons)				
11	NIKHEF ATLAS	CATHI	4	CERN ATLAS/LHCb	
<i>Topic/subtopic</i>	Context-independent performance monitoring for real-time processes (ATLAS)	Real-time modelling of ultrasound devices for simulation		Application to new chains and algorithms developed by ESR4, ESR5	
<i>Physics</i>	Lepton Flavour Violation (in tau to 3mu)				
12	NIKHEF LHCb	IBM Openlab?		LPNHE LHCb	
<i>Topic/subtopic</i>	Context-independent performance monitoring for real-time processes (LHCb)	TBC		TBC	
<i>Physics</i>	Lepton Flavour Violation (in electron final state)				
13	Lund Alice	N/A		CERN ALICE	6
<i>Topic/subtopic</i>	Upgrade of TPC for triggerless readout			Implementation of algorithms on hardware and software with local experts	
<i>Physics</i>	Precision measurements				
14	Lund ATLAS [beneficiary TBC]	N/A		CERN/Oregon	3
<i>Topic/subtopic</i>	TBC			Speed up topoclustering to enable full scan in HL-LHC	
<i>Physics</i>	Precision measurements (4th year)				
15	Heidelberg ATLAS	Heidelberg Instruments		LPNHE ATLAS	
<i>Topic/subtopic</i>	Pile-up noise reduction for the ATLAS calorimeter system	TBC		Apply to physics analysis using FTK and connect to ESR8	
<i>Physics</i>	Higgs, Dark Matter and dark sectors				

https://docs.google.com/spreadsheets/d/1OHTNCu2_pvwYCh4ypwV2jaquesuCaog264nQygPDRNk/edit?usp=sharing
for full list with proposed supervisors