Introducing ARIES

Accelerator Research and innovation for European Science and Society

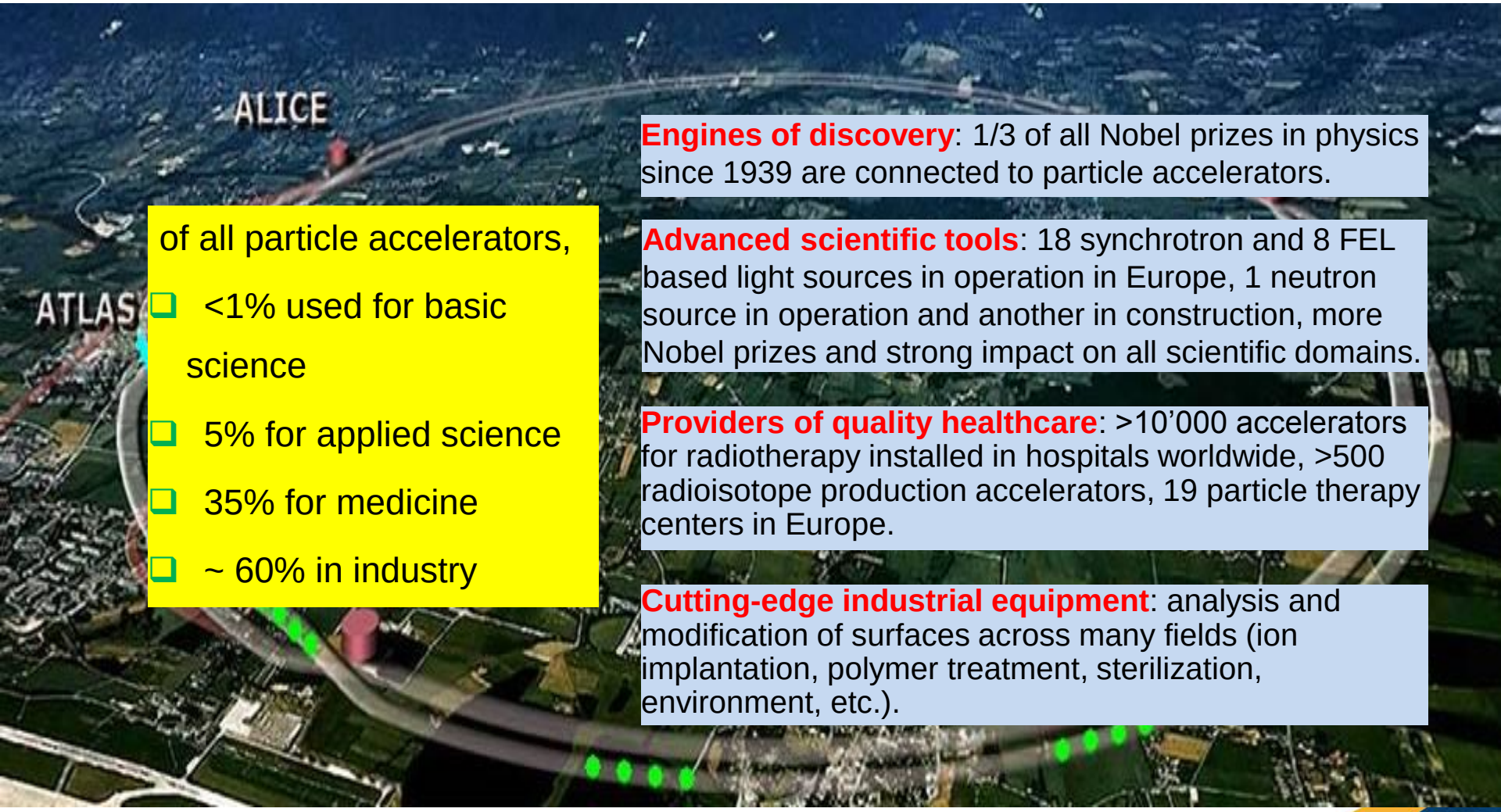
A new Integrating Activity for Particle Accelerator R&D

Maurizio Vretenar, CERN – Project Coordinator

Kick-off, CERN, 4 May 2017

ARIES is co-funded by the European Commission Grant Agreement number 730871

Accelerator Science in the XXI Century



of all particle accelerators,

- <1% used for basic science
- 5% for applied science
- 35% for medicine
- ~ 60% in industry

Engines of discovery: 1/3 of all Nobel prizes in physics since 1939 are connected to particle accelerators.

Advanced scientific tools: 18 synchrotron and 8 FEL based light sources in operation in Europe, 1 neutron source in operation and another in construction, more Nobel prizes and strong impact on all scientific domains.

Providers of quality healthcare: >10'000 accelerators for radiotherapy installed in hospitals worldwide, >500 radioisotope production accelerators, 19 particle therapy centers in Europe.

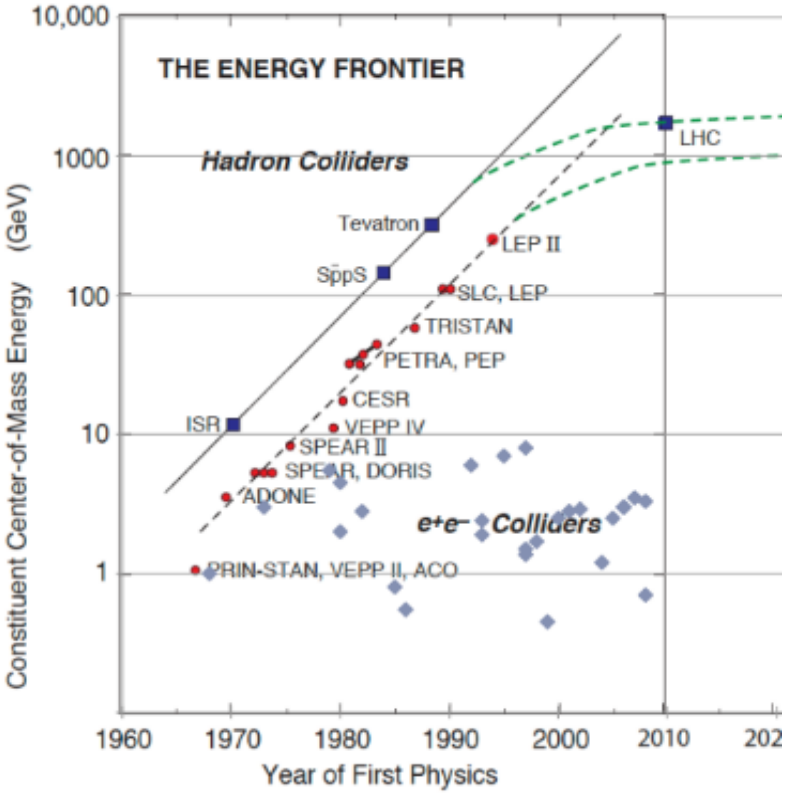
Cutting-edge industrial equipment: analysis and modification of surfaces across many fields (ion implantation, polymer treatment, sterilization, environment, etc.).

A successful technology, but…

- Wide and multidisciplinary community supporting several projects under study or construction – about 4’000 people engaged in accelerator research in Europe.
- Is reaching a critical moment in its evolution:

- expectations for physics discoveries are high but requirements in terms of **size, cost, electrical power** make funding and implementation of new projects increasingly challenging.

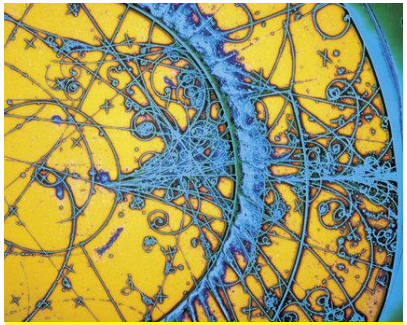
- the rapidly growing use of accelerators for applied science, medicine and industry adds further demands to the **performance, reliability, cost and compactness** of accelerator designs.



Updated Livingstone-type chart (Wikipedia 2014, uploaded by J.Nash, Imperial College) Exponential growth (Moore’s law) of accelerator energy is slowing down.

Accelerators in transition

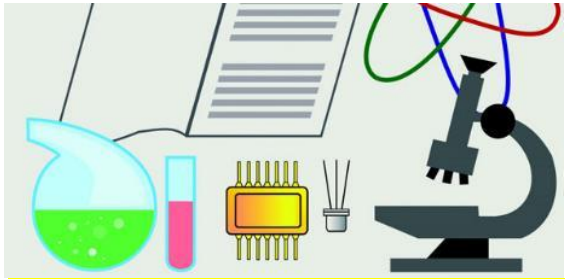
- Transition to new more affordable and sustainable technologies for basic science
- Transition from basic science to applied science, to medicine and industry
- Transition from large scientific laboratories to smaller centres and to industry
- Transition from a centralised configuration to a distributed multi-actor scheme



Basic science

size, cost, energy consumption, operability, reliability of future projects

New ideas and technologies



Applied science (photon and neutron sources)

Societal applications (medicine, industry, environment etc.)

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The role of ARIES

- The goal of ARIES is to accompany and favor this transition, looking at the future of accelerator science beyond the needs of ongoing projects and studies, and promoting new technologies common to different projects and accelerator types.
- In this critical step we need to promote innovation*, in terms of new ideas, new synergies, new applications, new ways of working together, etc.
- Need for a new and stronger multidisciplinary collaborative effort involving all innovation actors and promoting cross-fertilization.
- Such a collaborative effort is possible only with the support of a higher body like the European Commission.

*: An **innovation** is the **implementation** of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method. (from the Oslo Manual, Guidelines for collecting and interpreting innovation data, OECD, 2005)*

Innovation is the process of translating an idea or invention into something (object or service) that creates value.

Example:
For high energy physics there are some established directions: LC, CLIC, FCC.
ARIES wants to look beyond these studies and promote alternative promising options: high-temperature superconductivity, plasma-based colliders, alternative schemes, etc.

EU support to particle accelerator R&D

Integrating Activities

FP6

CARE 01/2004 – 12/2008
5 years, 15.2 M€ EU contribution

FP7

EuCARD 04/2009 – 03/2013
4 years, 10.0 M€ EU contribution

EuCARD-2 05/2013 – 04/2017
4 years, 8.0 M€ EU contribution

H2020

ARIES 05/2017 – 04/2021
4 years, 10.0 M€ EU contribution

Design Studies, Preparatory Phases

- EuroNu DS, 2008/12, 4M€
- SLHC-PP, 2008/11, 5.2M€
- ILC-HiGrade, 2008/12, 5M€
- TIARA-PP, 2011/13, 3.9M€
- HiLumi LHC, 2011/15, 4.9M€
- EuroCirCol, 2016/19
- EUPRAXIA, 2016/19

Low prioritiy of long-term R&D for large laboratories focused on short-term projects, while small institutions lack critical mass and the experience to be effective → a joint collaborative effort with the EU support is the most effective way to push the limits of our technologies.

6

Novelty and added value of ARIES

1. **More focus**: The WPs are focused on **advancing well-defined key topics of excellence** that were identified in EuCARD-2.
2. **More access: Transnational Access** strongly increased as a result of the new concept of opening advanced accelerator test infrastructures to the accelerator community and to industry. TA infrastructures from 3 (in EuCARD-2) to 14.
3. **More integration**: Consortium widened to include partners from south and east of Europe. 41 partners, **20 participate for the first time. Co**untries involved from 12 to 18, for the first time Hungary, Latvia, Portugal, Romania, Slovakia, and Slovenia.
4. **More industry: Industrial participation** increased from 2 to 8 beneficiaries, including 3 **SMEs** and one industry association. Role of the industrial partners changes from supporting specific developments to players in co-innovation activities, experts for innovation and market-pull actions, and partners for exploring applications to society.
5. **More innovation**: **focus on innovation** with identification of innovative technologies, co-innovation programmes with industry, and demonstration of novel accelerator technologies for industrial or societal applications via the new Proof-of-Concept fund.
6. **More society**: **benefits to European society** via training of researchers, support for accelerators for medicine, industry and the environment, development of advanced accelerator technologies.

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The four ARIES pillars

excellence

Develop **key accelerator technologies** to make more performant, affordable, reliable and sustainable the present and future accelerators

Improve the European **accelerator infrastructure**

access

New scheme of Transnational Access opening **14 accelerator test facilities**

Enlarged consortium with **20 new partners** in accelerator projects and **6 new countries** in the East and South of Europe

innovation

Enhanced **industrial participation** (7 industries and 1 association)

3 new **co-innovation programmes** with industry

Development of **societal applications** (medicine, industry, environment)

sustainability

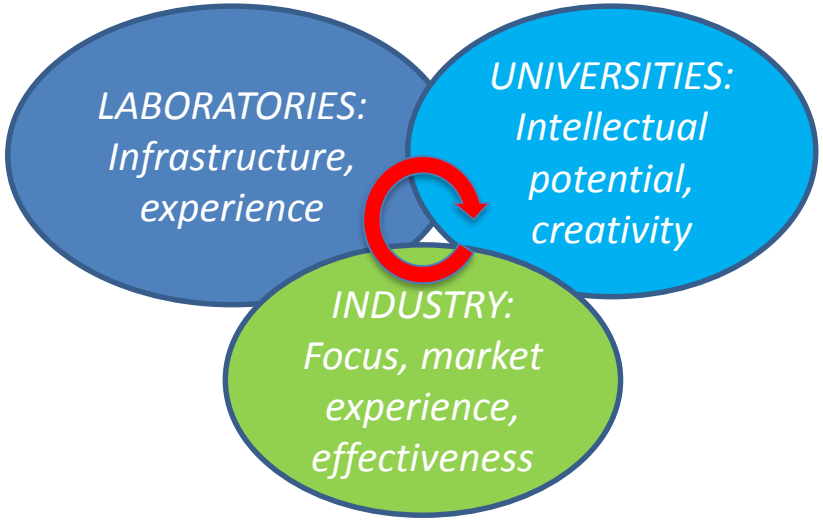
Joint programme with TIARA to develop a **model for sustainable accelerator science** in Europe

Training programme for the new generations of accelerator scientists and engineers

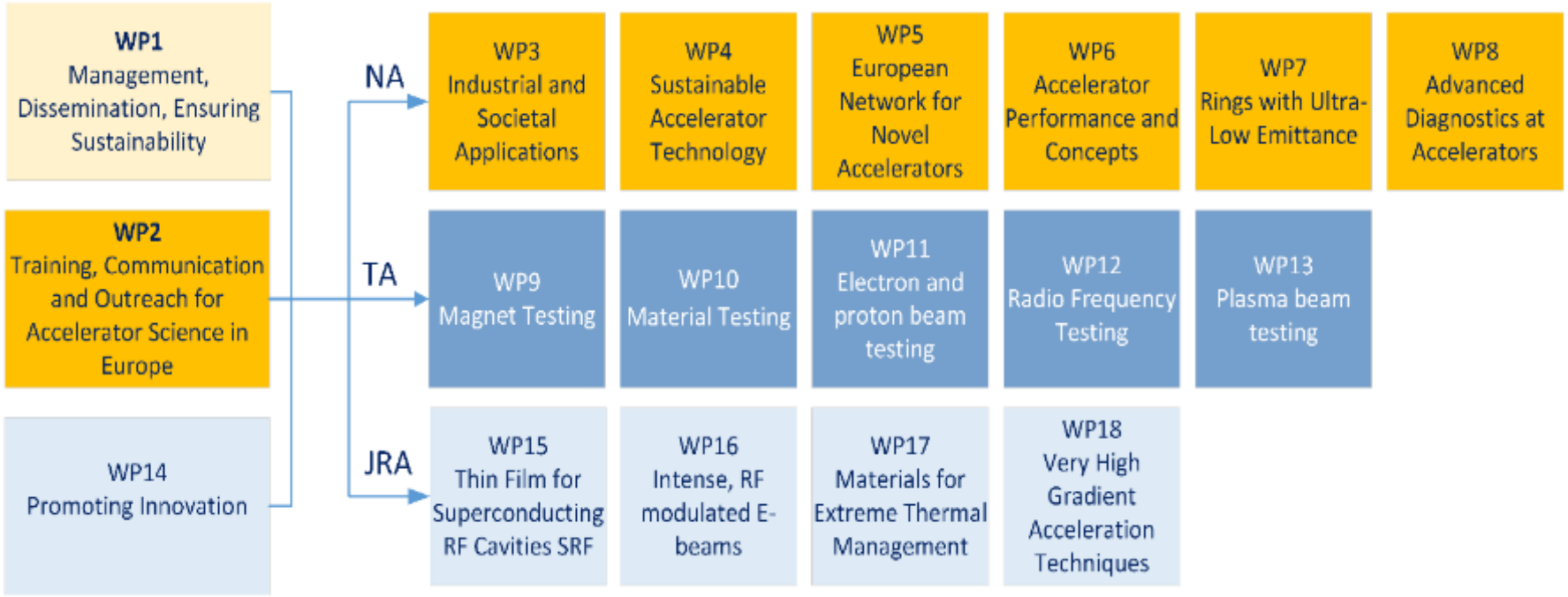
The ARIES magic formula

Joining together accelerator laboratories, universities and industries on a set of common goals.

EuCARD and EuCARD2 have progressed in the integration of universities and laboratories, ARIES now wants to include industry in the integration of the accelerator research area.



ARIES Structure



18 Workpackages:

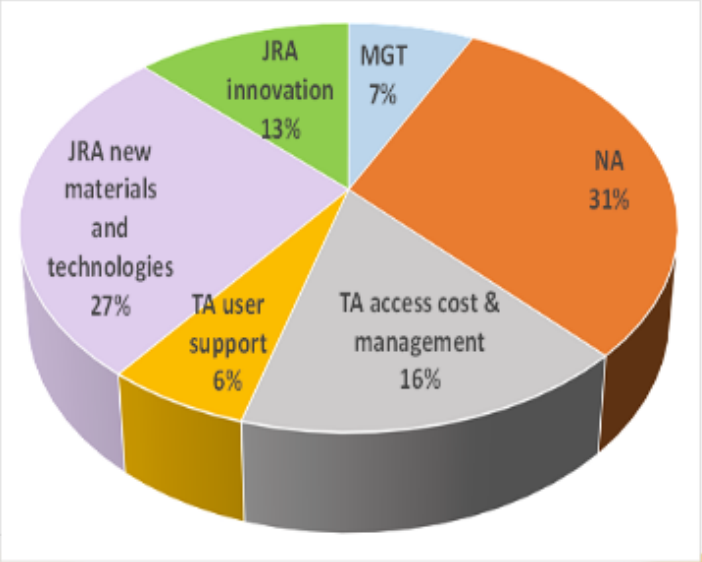
8 **Networks** 5 **Transnational Access**, 5 **Joint Research Activities**.

ARIES Tasks, Budgets, Partners

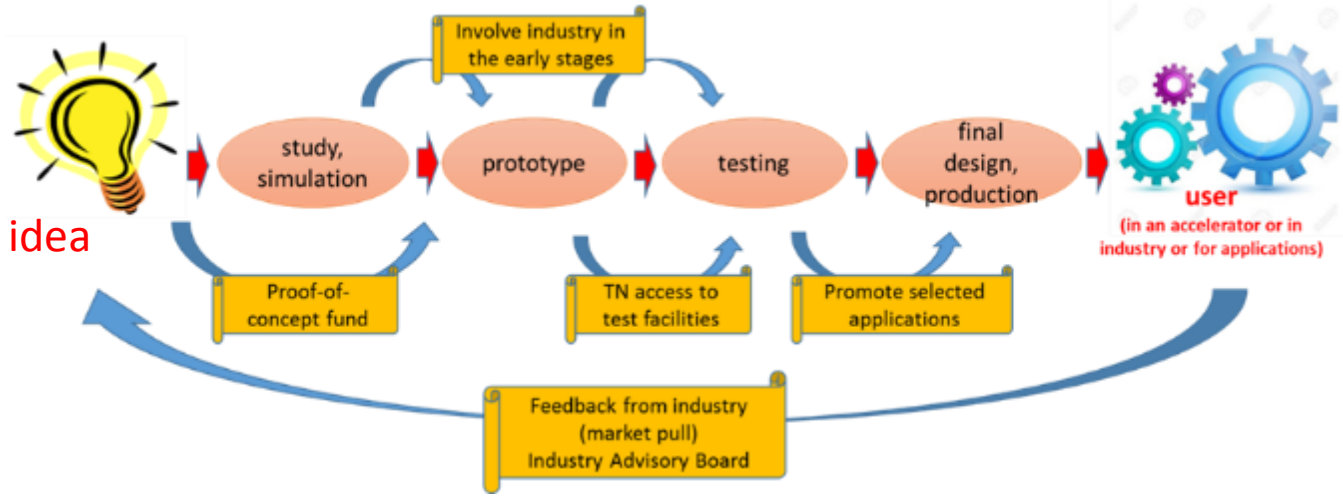
WP	Type	Name	Acronym	Coordinator	Tasks	# of tasks	Requested EC Contr. (€)	Funding Rate (%)	Total Cost (€)	Beneficiaries
1	NA	Management, dissemination, ensuring sustainability	MADISU	M. Vretenar (CERN)	Management - Internal communication, dissemination, scientific publications and monographs - sustainability of particle accelerator research in Europe	3	739,000	48.9%	1,511,000	CERN, WUT, CEA, DESY
2	NA	Training, Communication and Outreach for Accelerator Science	TCO	P. Burrows (UOXF)	Coordination of communications/outreach activities - Coordination of training activities - E-learning course	4	427,400	66.2%	645,150	UOXF, CERN, ESS, CNRS
3	NA	Industrial and societal applications	ISA	R. Edgecock (HUD)	Low energy e-beam applications, technology - Electron beam new applications - Medium energy electron beams - Radioisotope production	5	490,000	49.1%	997,904	HUD, INCT, FEP, IBA, CIEMAT, CERN, CNRS
4	NA	Efficient energy management	EEM	M. Seidel (PSI)	High Efficiency RF Power Sources - Efficiency of the target station - SRF power conversion - Operation of pulsed magnets	5	510,000	34.6%	1,473,746	CEA, GSI, PSI, ESS, CERN, UU
5	NA	European Network for Novel Accelerators	EuroNNAC	R. Assmann (DESY)	EU Strategy Plasma acc. - EU Strategy Dielectric acc. - EAAC workshop - Young scientist networking and academic standards	5	500,000	55.5%	900,454	DESY, CEA, CERN, CNRS, INFN, UOXF
6	NA	Accelerator Performance and Concepts	APEC	F. Zimmermann (CERN)	Beam Quality Control in Hadron Storage Rings - Reliability and availability - Improved beam stabilisation - Beam quality control in linacs - far future concepts	6	523,750	65.0%	805,626	CERN, GSI, INFN, JGU, HIT
7	NA	Rings with ultra-low emittance	RULE	R. Bartolini (UOXF)	Injection systems - beam dynamics and technology - beam test and commissioning	4	349,129	64.0%	545,817	CERN, INFN, KIT, SOLEIL, UOXF, PSI
8	NA	Advanced Diagnostics at Accelerators	ADA	P. Forck (GSI)	Advanced Instrumentation for hadron LINACs - Hadron Synchrotrons - 3rd Generation Light Sources - FELs	5	254,000	54.6%	465,385	GSI, CERN, ALBA, DESY
9	TA	Magnet testing	Mag	M. Bajko (CERN)	SM18 (CERN) - FREIA (UU)	2	269,810	13.1%	2,063,788	CERN, UU
10	TA	Material testing	Mat	A. Fabich (CERN)	HiRadMat (CERN) - UNILAC, M-Branch (GSI)	2	289,456	24.1%	1,200,112	CERN, GSI
11	TA	Electron and proton beam testing	Ep	J. Schwindling (CEA)	ANKA (KIT), VELA (STFC), IPHI (CEA), SINBAD (DESY), FLUTE (KIT)	5	882,296	40.7%	2,169,699	KIT, STFC, CEA, DESY
12	TA	Radio Frequency testing	Rf	R. Ruber (UU)	FREIA (UU), XBOX (CERN)	2	327,417	26.0%	1,257,165	UU, CERN
13	TA	Plasma beam testing	Pb	B. Cros (CNRS)	Apollon (CNRS), LIDyL (CNRS), LULAL (LUND)	3	468,869	38.9%	1,205,708	CNRS, LUND
14	JRA	Promoting innovation	PI	M. Losasso (CERN)	Proof of Concept innovation fund - Coll. with Industry - Materials for extreme thermal management - HTS conductor process - Timing system for applications	6	1,265,623	40.2%	3,149,419	CERN, STFC, CNI, CEA, WIGNER, UT, UNIGE, BHTS, BREVETTI, RHP, COSYLAB
15	JRA	Thin Film for Superconducting RF Cavities	TF/SRF	O. Malyshev (STFC)	Surface preparation - Deposition and analysis - Superconductivity evaluation	4	550,000	35.6%	1,544,188	CERN, STFC, INFN, SIEGEN, HZB, CEA, IEE/SAS, RTU
16	JRA	Intense RF modulated Electron Beams	IRME	D. Ondreka (GSI)	System integration - Electron gun and modulator - Test stand and diagnostics	4	635,250	38.7%	1,642,625	GSI, CERN, IAP, RTU
17	JRA	Materials for extreme thermal management	PowerMat	A. Rossi (CERN), M. Tomut (GSI)	Materials development and characterization - Dynamic testing and online monitoring - Simulation of irradiation effects and mitigation method -Broader accelerator and societal application	5	645,000	45.0%	1,433,125	CERN, GSI, POLITO, POLIMI, ELI-NP, UM
18	JRA	Very High Gradient Acceleration Techniques	VHGAT	A. Specka (CNRS)	Multistage LWFA - LWFA with exotic laser beams - Laser driven dielectric accelerators - Pushing back the charge frontier	5	873,000	47.1%	1,854,174	CNRS, CEA, IST-ID, DESY, FAU, ULUND
						75	**10,000,000**	**40.2%**	**24,865,085**	

ARIES Key Figures

- 19 Workpackage Coordinators: 6 from CERN, 4 from UK, 4 from Germany, 3 from France, 1 from Switzerland, 1 from Sweden. 4 female (21%).
- EC contribution 10 M€, total cost 24.9 M€, funding rate 40%.
- Share of EC contribution: Management 7%, Networks 31%, TA 22%, JRAs 40%.
- 51 Deliverables and 67 Milestones
- 42 beneficiaries from 18 EU countries (+CERN, ESS)



Innovation Strategy



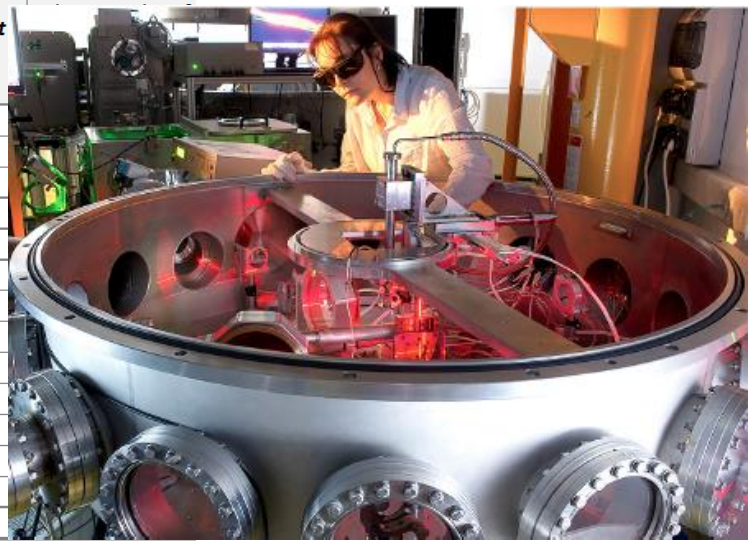
In ARIES Innovation is a Joint Research Activity

Support to all stages of the innovation process:

- **Proof-of-concept innovation fund**: for Business Plan preparation, market assessment, demonstration in connection with industry of the technological viability of new ideas.
- **Industrial Advisory Board**: provide business consultation (eg. business plans) and support market assessments ("market pull").
- **ARIES meets industry events**
- **3 co-innovation programmes with industry:**
- breakthrough in the cost per kAm of industrial High Temperature Superconductors
- production of materials for extreme thermal management
- production of a standardized timing for medical and industrial applications.

Transnational Access

Access provider short name	Short name of infrastructure	Installation		Installation Country code	Type of access	Unit of access	Unit cost (UC) €
		Nr	Short name				
CERN*	MagNet	1	MagNet@CERN	IO	TA-uc	1h	0.00
UU	FREIA	1	Gersemi	SE	TA-ac	1h	-
CERN*	HiRadMat	2	HiRadMat@SPS	IO	TA-uc	1h	0.00
GSI	UNILAC	1	M-branch	DE	TA-uc	1h	274.79
KIT	KIT-ATP	1	KIT-ANKA	DE	TA-uc	1h	416.22
KIT	KIT-ATP	2	KIT-FLUTE	DE	TA-ac	1h	-
CEA	IPHI	1	IPHI	FR	TA-ac	1h	-
DESY*	SINBAD	1	SINBAD	DE	TA-ac	1h	-
STFC	VELA	1	VELA	UK	TA-ac	1h	-
UU	FREIA	2	HNOSS	SE	TA-ac	1h	-
CERN*	XBox	3	XBox@CERN	IO	TA-uc	1h	0.00
CNRS	LULI	1	APOLLON	FR	TA-ac	1h	-
CEA	LIDyL	2	LPA-UHI100	FR	TA-uc	1h	117.00
UL	LULAL	1	LULAL	SE	TA-uc	1h	170.00



- **New concept for the accelerator community**: promote a common usage of the test stands used for the development of new accelerator technologies.
- **14 facilities based in 6 countries**, grouped in 5 thematic WPs
- 664 estimated users for about 18’000 access hours
- Set of **complementary facilities** for testing magnets, materials, components with different beams (protons, high current electrons, variable electron beams, short electron bunches), RF components, plasma acceleration.
- Flagships: IPHI, VELA, ANKA, Apollon.

The community

2 axes of expansion

	Laboratories and research institutions hosting large accelerator infrastructures	Universities and research centres	Industries and industrial associations	Total
Based in the high-technology European hub: DE, UK, FR, IT, CH	PSI, DESY, GSI, KIT, CEA, CNRS, SOLEIL, CERN, INFN, STFC	UNIGE, JGU, SIEGEN, HZB, IAP, FAU, POLITO, POLIMI, UOXF, HUD	FEP, HIT, BRUKER, CNI, BREVETTI	25
Based in other EU-15 countries: BE, NL, PT, ES, AT, SE	ESS, ALBA	CIEMAT, UT, UU, UL, IST	RHP, IBA	9
Based in other EU countries: HU, LT, MT, PL, RO, SI, SK		WIGNER RCP, RTU, UM, WUT, INCT, ELI-NP, IEE/SAS	COSYLAB	8
Total	12	22	8	42

- Goal to connect the technological core of Europe with its dynamic periphery and to connect the large laboratories with universities, research centres and industries.
- 41 beneficiaries from 18 European countries (+CERN and ESS).
- 20 new beneficiaries with respect to the previous programme.
- New in accelerator IA's: Portugal, Hungary, Latvia, Romania, Slovenia, Slovakia.

A European project in a nutshell

ARIES partners

European Commission

Project coordinator

Maurizio Vretenar

Administrative Manager

Svetlomir Stavrev

Project assistant

Valérie Brunner

Deliverables and reporting

Science and Innovation

Revision of the mill (servicing):
Every year at the annual project meeting (April – May)

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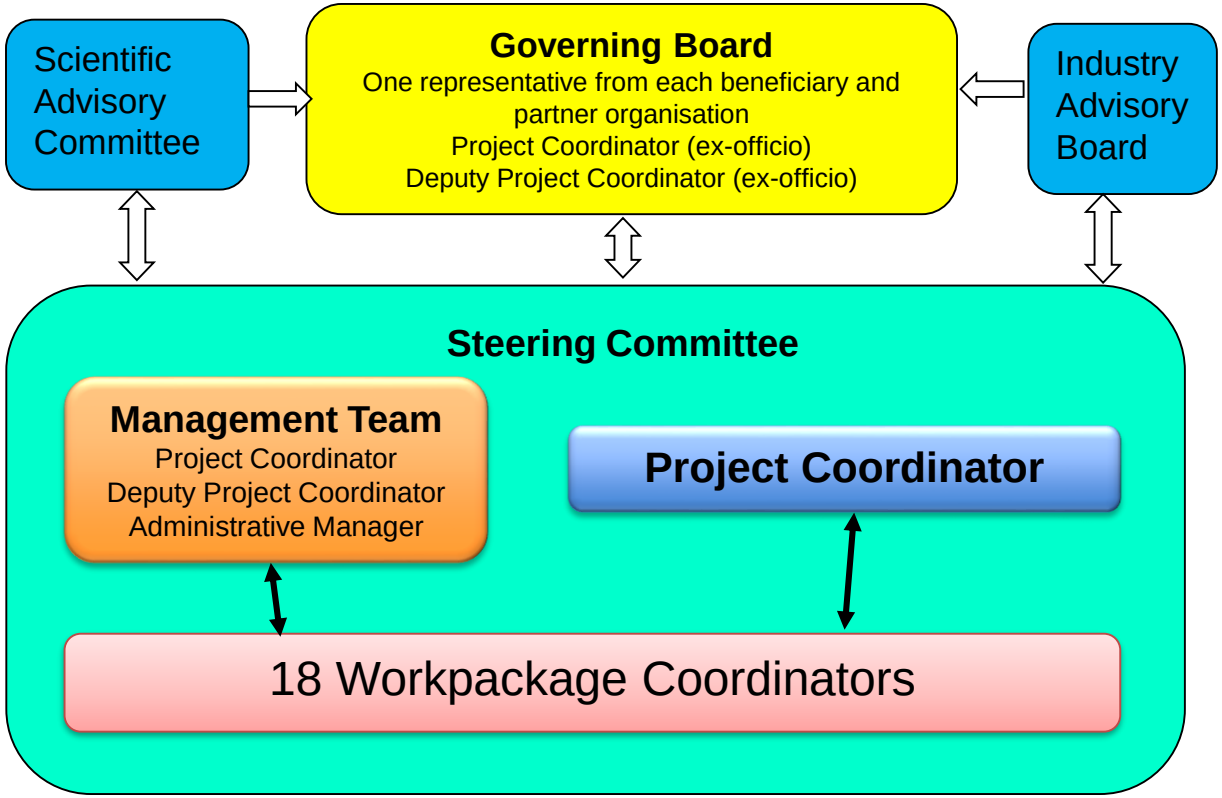
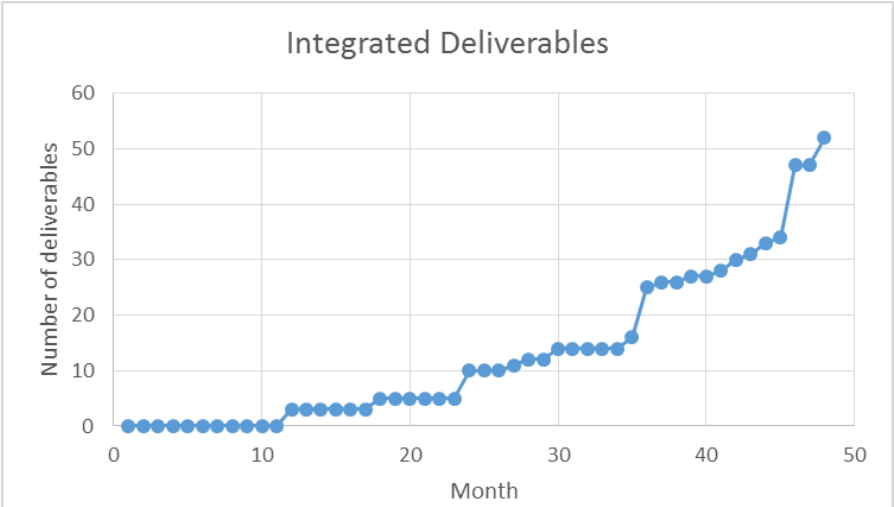
ARIES Governance



Deliverables and Reporting

Our priority is to keep administrative work at a minimum and let you concentrate on your work.



But it is very important to provide on time the 52 deliverable reports foreseen by the project (with a peak in the last year).
Average of 3 per Workpackage (less than 1/WP.yr): affordable workload, but please help your WP coordinator !

n.	Type	From Month	To Month
1	Internal Activity Report	1	12
	Period 1 Activity Report	*1*	*18*
2	Mid Term Activity Report	19	24
3	Period 2 Activity Report	19	36
4	Period 3 Activity Report	37	48

To the mandatory reports for the EC we have added an «internal» report at M12 that will be a rehearsal for the 1st real report (and its content will be recycled for the P1 report).

+ 66 Milestones, shorter reports for the WP coordinator to verify the achievement of an intermediate result.

Joining ARIES on the new web site

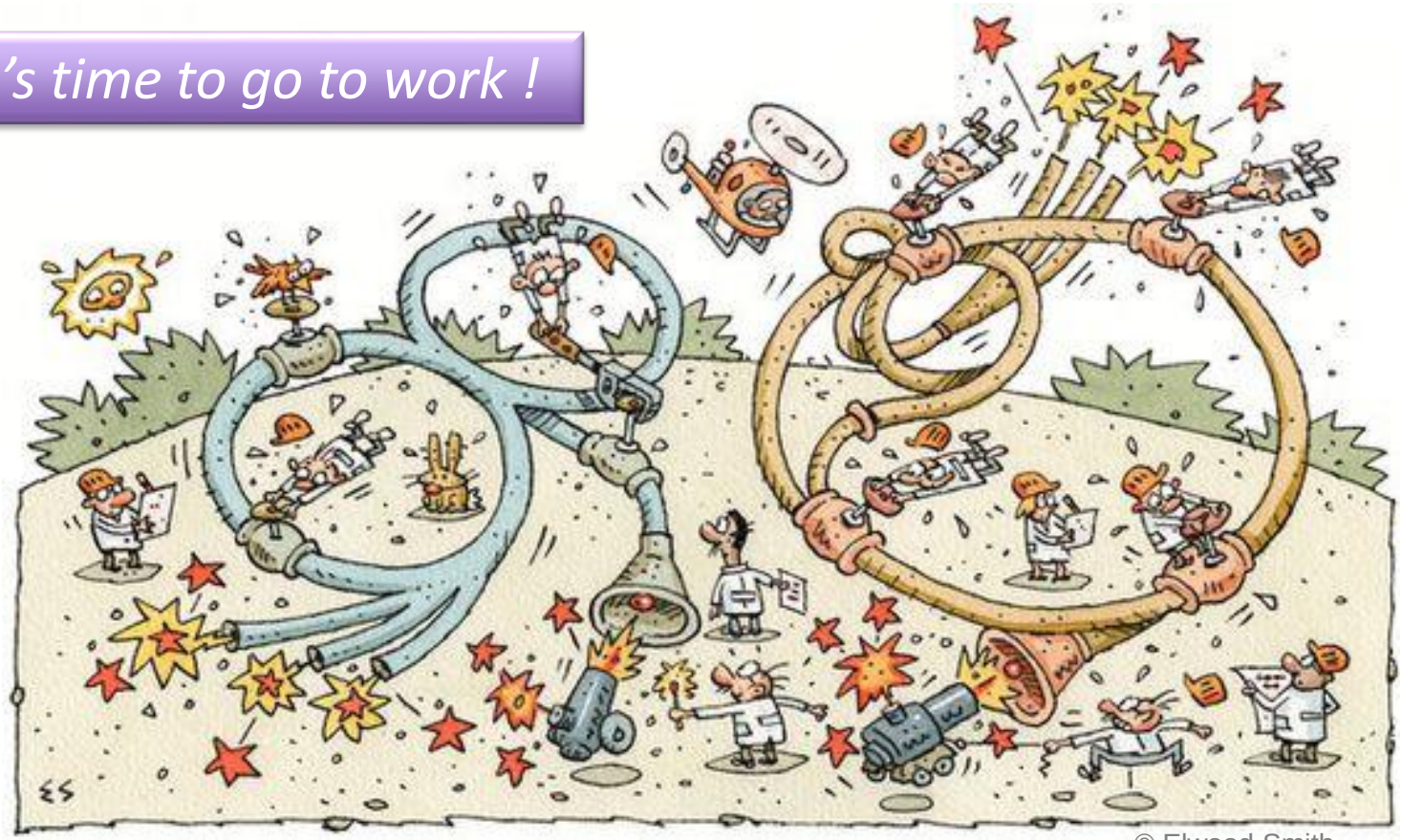
To be included in the ARIES mailing list and be informed of all ARIES events: from the web site (home page) or directly to http://aries.web.cern.ch/content/project-member-registration-form

The ARIES web site is hosted at CERN; it is now up and running at https://aries.web.cern.ch/ .

Many thanks to Jennifer Toes who has prepared the site with the help of Livia Lapadatescu and Sabrina El Yacoubi.

CONCLUSION

And now, it's time to go to work !



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Thanks for your attention and for your help in preparing ARIES !