Integrating Activity FUNDAMENTAL

Fundamental Physics at Accelerators and Reactors: Atomic-Physics Techniques and Precision Tools

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Development & Physics Goals

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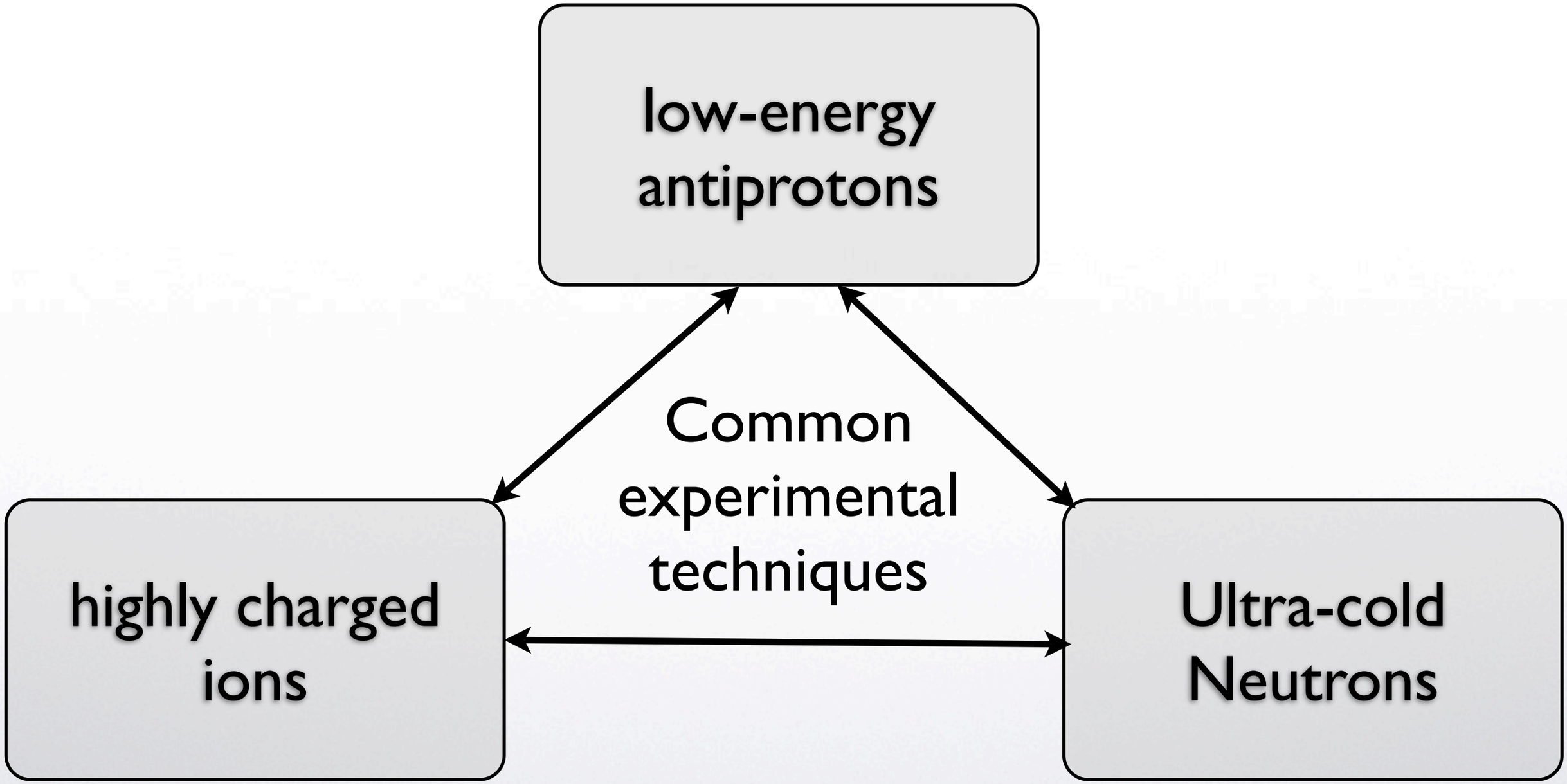
  - Fundamental masses, constants and interactions
    (α, m_e, $m_{\nu e}$, $Q(^3H - ^3He)$, . . .)

Physics Communities & Facilities



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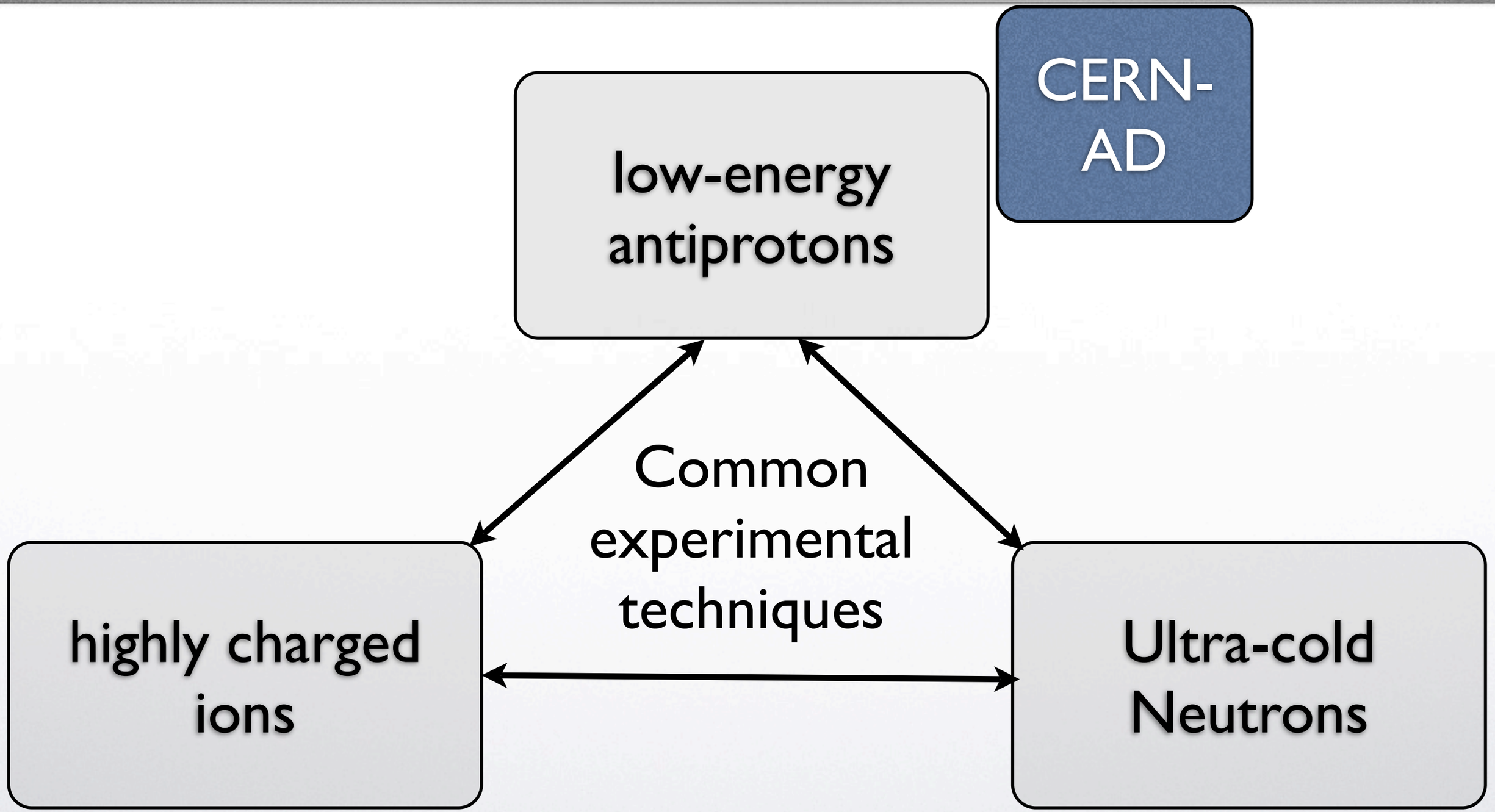


Physics Communities & Facilities

low-energy antiprotons

CERN-AD

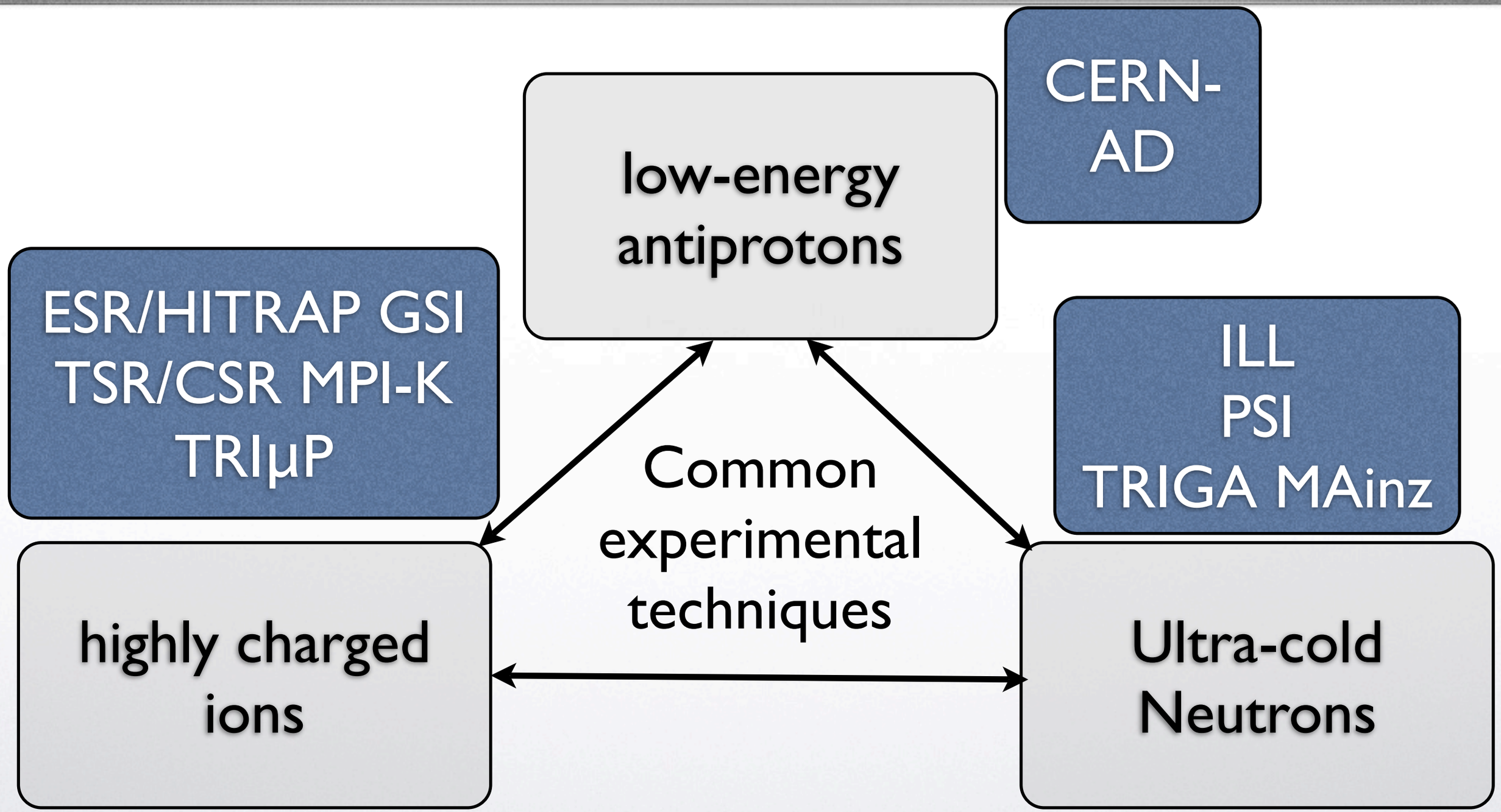
ESR/HITRAP GSI
TSR/CSR MPI-K
TRIμP

Common experimental techniques

highly charged ions

Ultra-cold Neutrons

Physics Communities & Facilities



Common issues

- Move the boundary of what we know about nature and its forces
- Unprecedented precision experiments
- Trapping for storage & elimination of thermal motion
- Study antiprotons, neutrons, ions, atoms

Common techniques, issues

- UHV
- Control of magnetic fields
- Super conducting magnets
- Cryogenic temperatures
- High-purity radio frequency
- Detectors
- Storage
- Cooling
- Penning traps
- Ultra-high precision
- Low energies/low energy spread
- FT-ICR
- Ramsey fringes

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- Fundamental physics
- Small community
- No representation of interest on the European level
- Users of facilities with different main objectives
- Highly attractive for students
- No specialized conferences for fundamental physics

FUNDAMENTAL - Access

- 7 Access facilities

TNA1 - AD-CERN	unique low-energy antiproton facility world wide
TNA2 - ESR/HITRAP - GSI	cooled highly charged ions with highest charge state
TNA3 - TSR/CSR MPI-K	cryogenic storage ring
TNA4 - TRIμP - KVI	trapped radioactive ions
TNA5 - UCN - ILL	currently strongest UCN source
TNA6 - UCN - PSI	will become most intense UCN source
TNA7 - TRIGA-UCN Uni Mainz	high intenstiy pulsed UCNs

3 do not charge access to EC in FUNDAMENTAL

FUNDAMENTAL - Networking

NA1 Dissemination and Outreach	
NA2 Scientific Expertise and Users Network	QED, Weak Interactions, Fundamental Symmetries, Fundamental masses & constants + users training
NA3 Technical Expertise Network	Vacuum & cryogenics, magnetic fields, storing & cooling, detectors & diagnostics, lasers & metrology
NA4 Advanced Computer Control for Precision Experiments	Dedicated Controls Software for trap experiment
NA5 Information Platform	all relevant information plus data base of data related to FUNDAMENTAL physics topics

FUNDAMENTAL - JRAs

Manipulation	Task 1	Polarization of trapped particles, anti-hydrogen and UCN
	Task 2	Tools for precision spectroscopic measurements with trapped particles, anti-hydrogen and UCN
	Task 3	Production of beams of high charge states for both stable and exotic isotopes
	Task 4	Improved transport of ultra cold neutrons
Cooling	Task 1	Development of new and improved cooling techniques for HCI
	Task 2	Development of cooling techniques for negative ions
	Task 3	Laser cooling of anti-hydrogen in a magnetic trap
	Task 4	New UCN production techniques
Storage	Task 1	Design, construction and test of novel Penning traps for ultra-precise measurements of atomic ground-state properties
	Task 2	Neutral atom trapping – expanding the range of trappable isotopes
	Task 3	Design and construction of a cryogenic storage ring (CSR) for highly-charged ions and molecules to be operated at a 2K cryopumped vacuum and investigations of the beam dynamics of low-energy cooler synchrotrons
	Task 4	Design and construction of new traps for the efficient storage of ultracold neutrons.
Detection	Task 1	Development of large-area, segmented solid-state and CCD devices with digital signal processing for operation in the UHV environment of storage rings and traps
	Task 2	Development of high resolution beta-spectrometers for ion traps and in-flight beta decay
	Task 3	Comparative study and development of fast UCN detectors for high flux sources
	Task 4	Novel non-destructive diagnostics for single-ion detection in storage rings and ion traps
	Task 5	Development of a sensitive 3He magnetometer to high precision magnetic field measurements

Consortium (I)

Participant no.	Participant organisation name	Part. short name	Country
1 (Coordinator)	Stefan Meyer Institute for Subatomic Physics, Austrian Academy of Sciences, Vienna	OEAW	AT
2	CERN	CERN	CH
3	Forschungszentrum Jülich	FZJ	GE
4	Gesellschaft für Schwerionenforschung	GSI	GE
5	Laboratoire de Physique Corpusculaire de CAEN	IN2P3	FR
6	Institut Laue Langevin	ILL	FR
7	Jyväskylä University	JYU	FI
8	KU Leuven	KU Leuven	BE
9	KVI Groningen	RUG	NL
10	Mainz University	JoGu Mainz	GE
11	Max-Planck-Institut (MPI-K Heidelberg & MPQ München)	MPG	GE
12	Paul Scherrer Institut	PSI	CH
13	Stockholm University	SU	SE
14	Imperial College London	IMPERIAL	UK
15	Jagellonian University Cracow	JUC	P
16	INFN Florence	INFN	IT

Consortium (II) & budget

Participant no.	Participant organisation name	Part. short name	Country
17	Universita degli studi di Siena	UNISI	IT
18	University of Liverpool (Cockcroft Institute)	ULIV	UK
3	Technische Universität München	TUM	GE
4	University of Tokyo Komaba	UT Komaba	JP

	Total cost	EC contribution	Fraction of total EC contribution
Management		0.9 M€	10%
Networking		1.3 M€	15%
Access		2.2 M€	25%
JRA		4.5 M€	50%
Sum	16.8 M€	8.9 M€	100%