EPFL

CHART
Swiss Accelerator Research and Technology

Accelerator developments "young" people vision

T. Pieloni and M. Schenk (EPFL)
With help of All young group brainstorming
+ C. Senatore (UNIGE), B. Auchmann (PSI) and M. Calvi (PSI)
+ 18 real young people …:O)

CHIPP Meeting Kandersteg, 27 August 2020

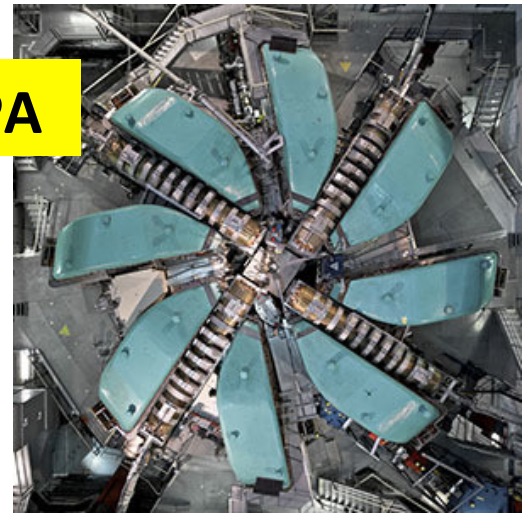
Accelerators information, data

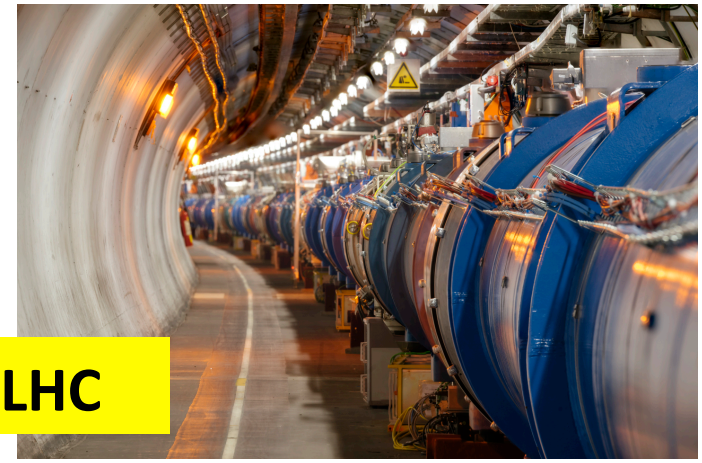
- Open questions and interviews to Master, PHD and Post-docs and extended to young scientists in the field of accelerators physics and related technologies
- Small sample (18 people)
- Institutes involved: UNIGE(1), EPFL (5), PSI (4), CERN(8)
- We merged the answers to bring up dreams, worries and hopes of the young community.

Accelerators in Switzerland

Lepton machines

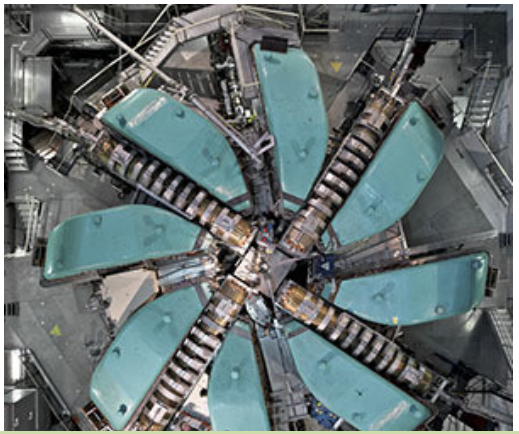
Hadron machines





In addition: FCC and CLIC design studies, LINAC4, …

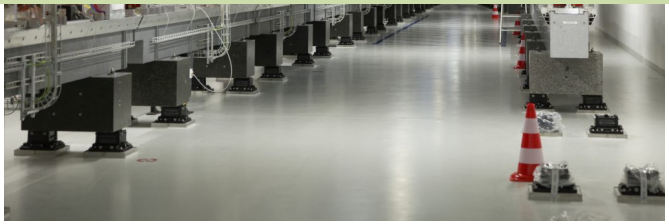
Switzerland at the forefront in accelerator?



Yes!

PSI and CERN in Switzerland give access to infrastructures at the forefront of accelerator physics and technology

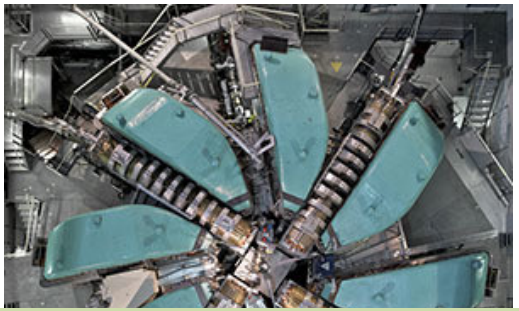
Several opportunities.



PSI

CERN

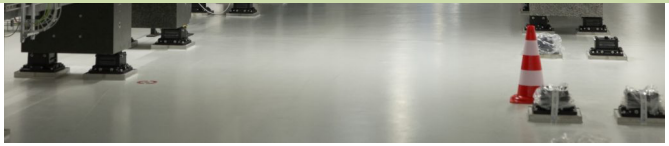
How are they used?

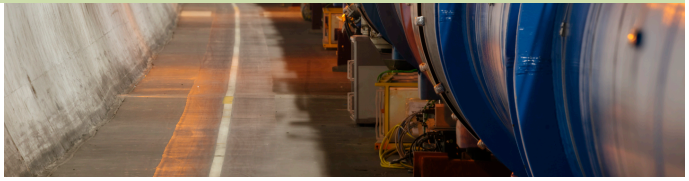


Diverse set of infrastructures→ large variety of research areas very complementary between the two labs

PSI: SwissFEL, SLS, proton therapy, fundamental research in complementary domains to CERN

CERN: LHC discovery machine, non-collider fundamental research experiments, prove of principle studies AWAKE plasma acceleration, target experiments…





Strong Swiss network?

No, but things are improving thanks to CHART !

PSI and ETHZ already working rather closely
EPFL, UNIGE: providing link between different groups at CERN and PSI for beam dynamics collaboration and superconducting and HTS cable developments

- New opportunities for the young community at different Swiss institutes out of the main laboratories
- Not clear if there is any technology transfer between the institutions which is something of interest to the whole community.

Swiss institutes leaders in research areas?

Yes!

PSI-ETHZ: muon spectroscopy, proton therapy, light source developments, superconducting magnets, acceleration on a chip

UNIGE: superconducting cables developments

EPFL: beam dynamics modeling/simulations, future machine design

CERN: High energy colliders, synchrotrons, Plasma wake field acceleration…

What is less developed?

- **Incorporation of modern, automatized solutions** (numerical optimization, machine learning…) into accelerator physics operation and design
- **Fancy ideas**: muon colliders, plasma acceleration studies, HTS

How is research conducted and where?

Small and big collaborations depending on project/budget.
Important is that even in a small group , big results can still be produced in accelerator physics

A mix between Big laboratories, Universities and Collaborations
Even small laboratory teams can make significant contributions (i.e. cables UNIGE, software/simulation domain EPFL, Magnets PSI)

The presence of “independent” small teams on specific research topics is a positive aspects of accelerator physics among young ones!

Synergies with other fields?

Yes, many!

Computer Science: code development, hardware.

Data analytics (i.e. ML)

Material developments (HTS)

Fundamental to many young ones: a deeper involvement into computer science will bring a lot of improvements into our field! We still do things the old way.

ML, New architectures TPU…

Development of new HTS

Are there fields advancing thanks to Accelerator physics?

Yes, many!

Molecular studies

Biology

Chemistry

Material science

Medicine

HEP

…

Relationship to industry: who profits of accelerator developments? Start-up opportunities?

Many opportunities !

Pharma industry: study of molecules, viruses, develop of vaccines, medication

Health industry: diagnostics radioactive tracers, proton and ion beams, superconducting magnets for imaging devices

Many products manufactured thanks to new developed materials (i.e. more durable, lighter, stronger, smaller, renewable energies, batteries…)

Computer chips manufacturing

….

No knowledge of start-up opportunities, very little going on!

As for the technology transfer young people do not know about start-ups but do see the potential ! Need some push here specially for the CERN related transfer while PSI seems doing much better with closer link to local companies.

Impact on education? And society? Politics?

Education:

Almost no mention of accelerators during education! Specially lower level education.

Should raise awareness about the field, the research opportunities and its implications on technological advances everyone benefits of.

Need to change this, the future will need an “army” of accelerator physicist!

Society:

Cancer treatment is quite known together with fundamental research.

All the other aspects are not communicated well enough for the genaral public to understand and appreciate.

Material science, health industry, spin-off technologies…

Society benefits from development of accelerator technologies and physics are enormous! Accelerator physics one way or another involved in almost everything!

Sustainability? Politics?

Sustainability:

Sustainability is an important MUST for young generations! In addition opens the door to other domain energetics managements, new ideas and attention in developments.

At all stages of Acc developments: design, construction, operation…

Politics??????

Young ones have not yet been exposed to this aspect.

Fortunately :O)

Vision for the Future

Future trends and development opportunities?
Challenging projects are motivating: FCC-hh, FCC-ee, FCC-inj…
technologies required!

High temperature superconductors

High field magnets

Improved and modern computer simulations with more complex beam dynamics models and interplays

Cancer treatment

Small-scale in-house accelerators for industries

More effort in new accelerating concepts (i.e. plasma wake-field acceleration, ACHIP)

Vision for the Future

Future trends and development opportunities?
Challenging projects are motivating: FCC-hh, FCC-ee, FCC-inj…
technologies required!

High temperature superconductors

High field magnets

Improved and modern computer simulations with more complex beam dynamics models and interplays

Cancer treatment

Small-scale in-house accelerators for industries

More effort in new accelerating concepts (i.e. plasma wake-field acceleration, ACHIP)

CHART
Swiss Accelerator Research and Technology

Vision for the Future

Future trends and development opportunities?
Challenging projects are motivating: FCC-hh, FCC-ee, FCC-inj…
technologies required!
High temperature superconductors
High field magnets
Improved and modern computer simulations with more complex beam dynamics models and interplays
Cancer treatment
Small-scale in-house accelerators for industries
More effort in new accelerating concepts (i.e. plasma wake-field acceleration, ACHIP)

Game changers in the field?
Wake-field acceleration
HTS → huge impact to society

Vision for the Future

Young accelerator physicist see the potential for society and are positive about the future:

pushing the limits (FCC-ee, FCC-hh, CLIC, ILC, CEPC…) will bring new technologies, new ideas, new concept, new proves, new knowledge no matter what!

Vision for the Future

Young accelerator physicist see the potential for society and are positive about the future:

pushing the limits (FCC-ee, FCC-hh, CLIC, ILC, CEPC. . .) will bring new technologies, new ideas, new concept, new proves, new knowledge no matter what!

Worries:

- **Timeline for big projects so far in the future → many years without machine experience.**
  Can the injector chain of these machine provide a playground for experimental studies while preparing for the collider?

- **Stronger and bi-directional exchanges to build stronger collaborations → better ideas and solutions come out from open collaborations**
  Switzerland should increase networking among institutes!

- **Training and recruiting: more outreach activities to make society more aware of the utility and impact of accelerator research and technology to daily life!**

Summary for discussions

- We are at the forefront of our respective fields, but young people are not convinced they research positively impact the society / or do not see the big picture
- Too little connection between different fields in Switzerland - no knowledge about other projects. CHIPP level organization for social networking - boost innovation, enhance interdisciplinary projects, startup companies...? (Poster + Pizza events)
- Training possibilities in different fields / towards industry? Many PhD students/young postdocs are specialized in a narrow field.
- Sustainability / connection to society?
- Topics in the individual talks: