

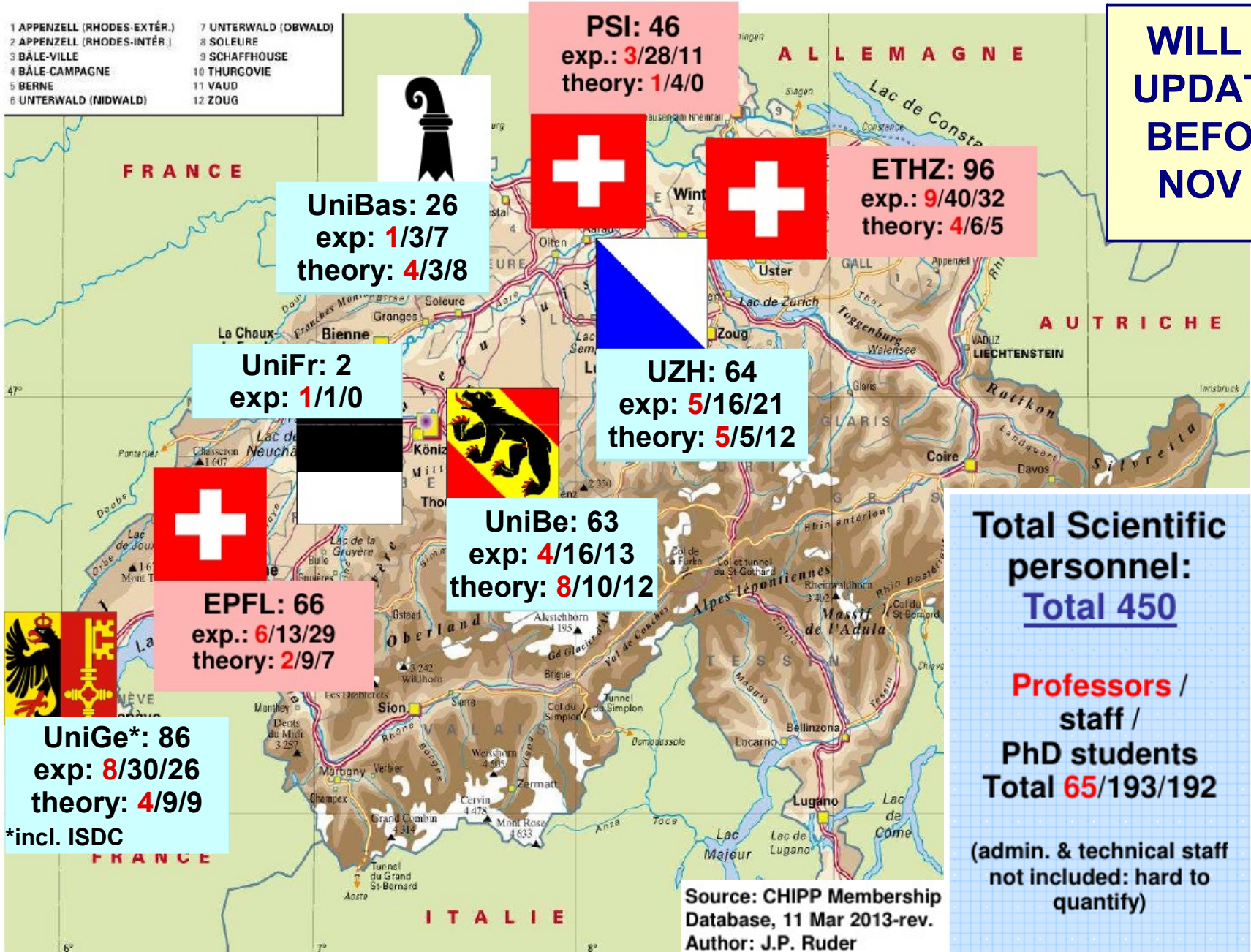
**94th Plenary ECFA
CERN
Nov 21-22, 2013**

Midterm Status Report Confederatio Helvetica

Olaf Steinkamp



**Universität
Zürich^{UZH}**



**WILL BE
UPDATED
BEFORE
NOV 21**

**Total Scientific
personnel:
Total 450**

**Professors /
staff /
PhD students
Total 65/193/192**

(admin. & technical staff
not included: hard to
quantify)

Founded 2003, since 2011 an Association according to Swiss law

Members: all particle, astroparticle, and nuclear physicists holding a Master in physics and working for a Swiss institution and Swiss PhD nationals working at CERN. Membership is automatic.

Board: all professors active in particle, astroparticle and nuclear physics and the heads of the corresponding groups at PSI

Executive board [current members: Klaus Kirch (PSI physics), Teresa Montaruli (astroparticle), Gilberto Colangelo (theory), Olivier Schneider (CERN physics)]

Long Term Financial Tables: input to financial planning of funding agencies

Funding requests: M&O of LHC experiments, LHC computing, outreach

Subcommittees: Outreach, Computing, European Strategy, ...

CHIPP PhD school and topical workshops, CHIPP prize for best PhD thesis

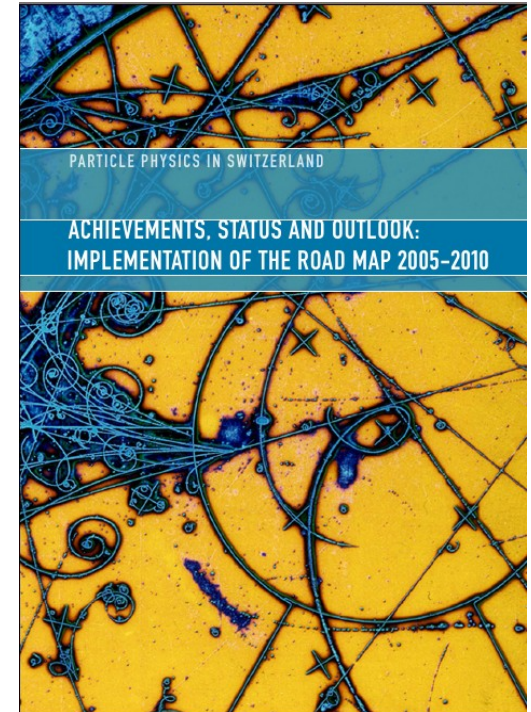
Observer institutions: ASPERA, CERN, CHAPS, SCNAT, SERI, SNSF, SPS

Original roadmap defined in 2004: priorities, strategy recommendations

- LHC and beyond
- Neutrino programme
- Astroparticle physics
- Accelerator R&D
- Education and Outreach

Update document in 2011

- Section on theory added
- Clear recognition of CERN's coordinating role
- Accelerator R&D in line with CERN / PSI priorities
- Better recognition of PSI as a national laboratory
- Outreach expected to get a boost



Spring 2013: “white paper” for Swiss contributions to large ground-based astro-particle physics research infrastructure

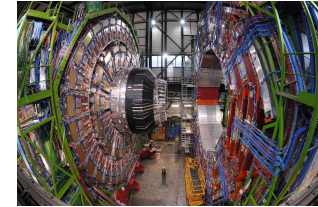
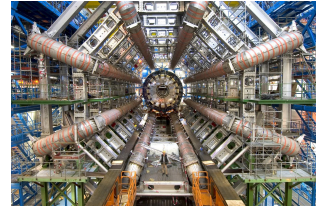
Recommendation to concentrate on 3 large projects: DARWIN, CTA, LAGUNA-LBNO

Plan next update of roadmap for 2016... on time for European Strategy update

<http://www.chipp.ch/documents/roadmap.pdf> http://www.chipp.ch/documents/Achievements_RoadMap2005-2010.pdf
http://www.chipp.ch/documents/astroparticle_whitepaper_17Mar2013_approved.pdf

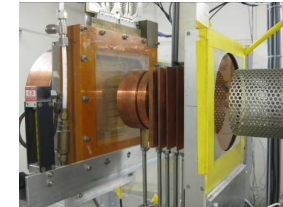
LHC (17 / 82 / 60)

- ATLAS, CMS, LHCb



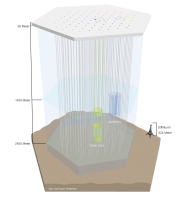
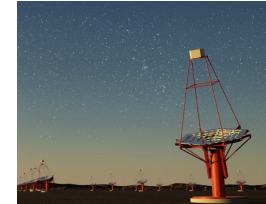
PSI (9 / 33 / 19)

- Low energy precision physics with pions, muons, neutrons (cLFV, nEDM, ...)



Accelerator R&D (1 / 80 / 25)

- LHC + upgrades, Linear Collider
- High-intensity beams at PSI
- Advanced light sources at PSI



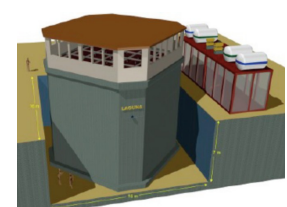
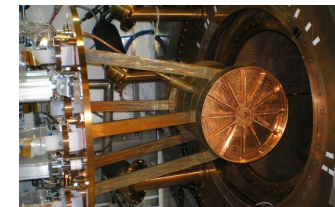
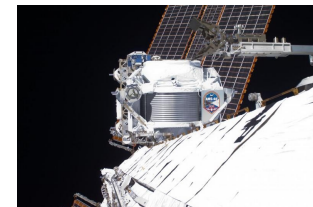
Astroparticle physics (11 / 25 / 25)

- Direct and indirect Dark Matter searches
- Matter acceleration in the non-thermal universe
- Proton decay, SuperNova collapse, solar neutrinos

} in line with EU Roadmaps coordinated by ApPEC

Neutrino properties (9 / 26 / 23)

- Long-baseline neutrino oscillations
- Neutrino-less double beta decay



Theory (28 / 47 / 53)

(Professors / Staff+PostDocs / PhD students)

ATLAS (UniBe, UniGe)

- **Hardware contributions to magnet, silicon tracker, LAr calorimeter readout, Trigger+Dataflow → core investment: 23 MCHF**
- **Analyses: Higgs, SUSY searches, SM physics, exotics**
- **Upgrade: silicon pixel (IBL), fast tracker, pixel readout**

CMS (PSI, ETHZ, UZH)

- **Hardware contributions to magnet, silicon pixel, silicon strips, crystal calorimeter and readout → core investment: 92 MCHF**
- **Analyses: Higgs, SUSY searches, SM physics, flavour physics**
- **Upgrade: silicon pixel, forward calorimeter, calorimeter readout**

LHCb (EPFL, UZH)

- **Hardware contributions to silicon vertex detector, silicon tracker, common readout board, trigger and DAQ → core investment: 8 MCHF**
- **Analyses: CP violation, rare decays, flavour physics, EW bosons, exotics**
- **Upgrade: tracking detectors**

Total of 115 master theses + 109 PhD theses completed since 1996

Contributions to accelerator R&D for LHC, LHC upgrade, CLIC

- Total of 18 PhD theses completed in the field of LHC accelerator physics

Strong accelerators base at PSI

- Highest power proton beams
 - Broad programme on bright pion and muon beams, Ultra-Cold Neutron beams
- Brightest (picometer) electron beams
 - Advanced light sources (SLS, SwissFEL, EuroXFEL)
- Proton therapy

Low energy precision physics with pions, muons, neutrons at PSI

- PEN (UZH, PSI), MEG (PSI), Mu3e (UniGe, UZH, ETHZ, PSI), MuSUN (PSI), MUTON (ETHZ), CREMA (ETHZ, PSI), nEDM (UniFr, ETHZ, PSI), PIF (all universities, CERN, space industry)
- Specific CH-contributions comprise particle beam design, custom electronics & DAQ, scintillating fibre detectors, gas detectors, precision magnetometry, high power lasers
 - Total of 10 PhD theses completed at CH institutions over the past 5 years

Projects in running / data analysis phase:

AMS, IceCube, MAGIC+FACT, Xenon, EXO, GERDA, T2K, NA61

Main CH contributions

- **Construction and detector R&D on cryo-noble gases & detectors, calorimetry, TPCs, photosensors and imaging sensors, electronics; data analysis**

Projects in design or construction phase:

CTA, Darwin, LAGUNA-LBNO [← CHIPP white paper]

ArDM, DAMIC, DAMPE, HERD, POLAR, ArgonTube, MicroBooNE, MICE

Main contributions to XENON→DARWIN (UniBe, UZH)

- **TPC design/construction, PMT base, r/o electronics, material screening**

Proposed contributions to CTA (ETHZ, UniGe-DPNC, UniGe-ISDC, UZH)

- **Single-mirror telescopes; mirror actuators & camera for mid-size telescopes**

LAGUNA-LBNO (ETHZ, UniGe-DPNC, UniBe) [← to be decided with TDR]

- **Coordination of FP7 design studies, prototyping of large-scale detectors**

Cosmology & Astrophysics (UniBas, UniBe, UniGe, UZH, EPFL)

- Including connections to particle physics

BSM (UniBas, UniBe, EPFL, PSI, ETHZ, UZH)

- Strings, model building, mathematical aspects of QFT, phenomenology

Nonperturbative QCD (UniBe)

LHC precision calculations (UniBe, EPFL, PSI, ETHZ, UZH)

- Electroweak, QCD, Higgs physics, etc.

Flavour physics and low energy precision (UniBa, UniBe, UZH, PSI)

- B and K physics, leptons, dipole moments etc.

→ **Very high international level of research**

→ **Fruitful interaction between theory and experiment in many places**

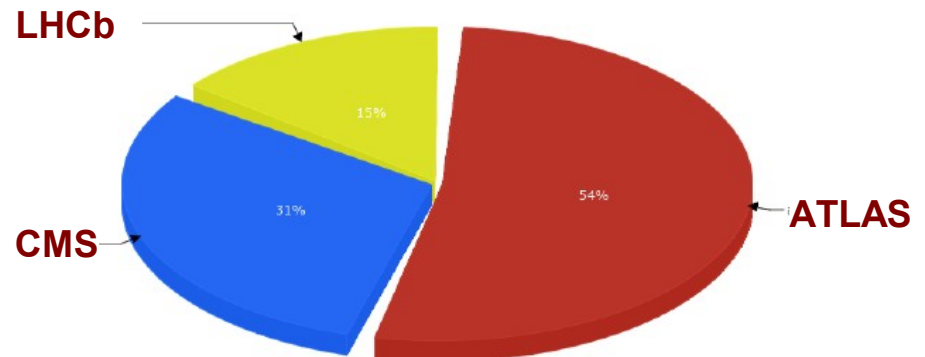
- e.g. Sinergia project "Particle Physics with high-quality data from the CERN LHC", involving researchers from EPFL, ETHZ, UniBe and UZH, with participation from both theory and experiment

CH-LHC computing infrastructure 2013

- Fully integrated into WLCG
- **CSCS = Swiss National Computing Centre in Lugano, autonomous unit of ETH Zürich**
- **Infrastructure costs and 1 FTE for maintenance of T2 at CSCS covered by CHIPP contract, just renewed for 2014 – 2018**
- **CPU/disk usage shared 40:40:20 between ATLAS:CMS:LHCb**
- **LHCb to increase pledges due to revision of computing model**

EGI, WLCG	
Operation <ul style="list-style-type: none"> • Monthly meetings 	
EPFL T3 (LHCb) <ul style="list-style-type: none"> • 480 cores 140 TB 	CSCS T2 (ATLAS, CMS, LHCb) <ul style="list-style-type: none"> • 2400 cores • 1300 TB disk • 10 Gb/s to 20 Gb/s backbone • https://wiki.chipp.ch/wiki/bin/view/LCGTier2/WebHome
UZH T3 (LHCb) <ul style="list-style-type: none"> • 150 cores 130 TB 	
PSI-ETHZ-UZH T3 (CMS) <ul style="list-style-type: none"> • 400 cores 500 TB • https://wiki.chipp.ch/wiki/bin/view/CmsTier3/WebHome 	AEC-UNIBE T2 (ATLAS) <ul style="list-style-type: none"> • 2400 cores • 350 TB disk • 10 Gb/s
DPNC-UNIGE T3 (ATLAS) <ul style="list-style-type: none"> • 560 cores 525 TB disk • Direct 10 Gb/s to CERN IT 	
Coordination CHIPP Computing Board (also SwiNG as National interface to European Grid Infrastructure EGI)	

Swiss T2 CPU experiment usage



http://accounting.egi.eu

SERI (State Secretariat for Education, Research and Innovation)

- **Funding of intergovernmental cooperation, e.g. in particle physics:**
 - Membership contribution to CERN, special contributions to CERN
 - Funding of in-kind contributions to related fields (accelerator technology for XFEL, target technology for ESS)
- **Annual average of last few years: 48 MCHF, out of which 37 MCHF as regular contribution to CERN**

SNSF (Swiss National Science Foundation)

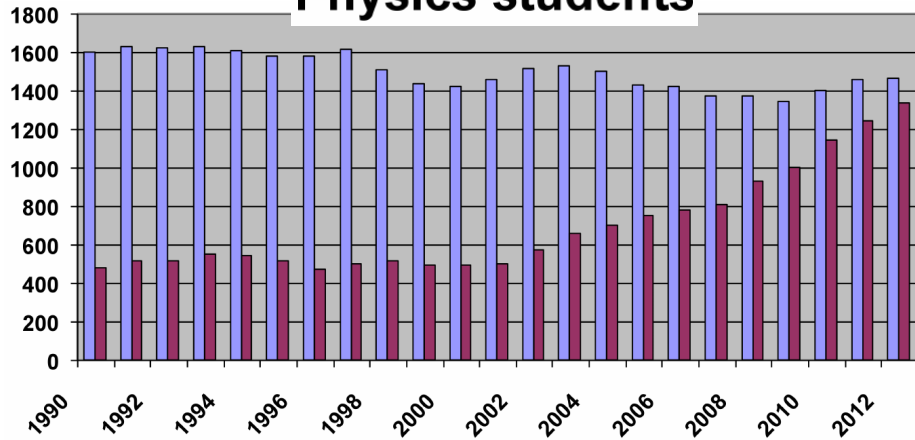
- **Promotion of scientific research through competitive evaluation.**
- **2012: 36 MCHF for physics, out of which 14 MCHF for particle physics, astroparticle physics, nuclear physics & accelerator technology**
 - Includes the special FLARE funding line for CH contributions to international large research infrastructures in these fields (see slide 19)

Swiss universities / Paul Scherrer Institut

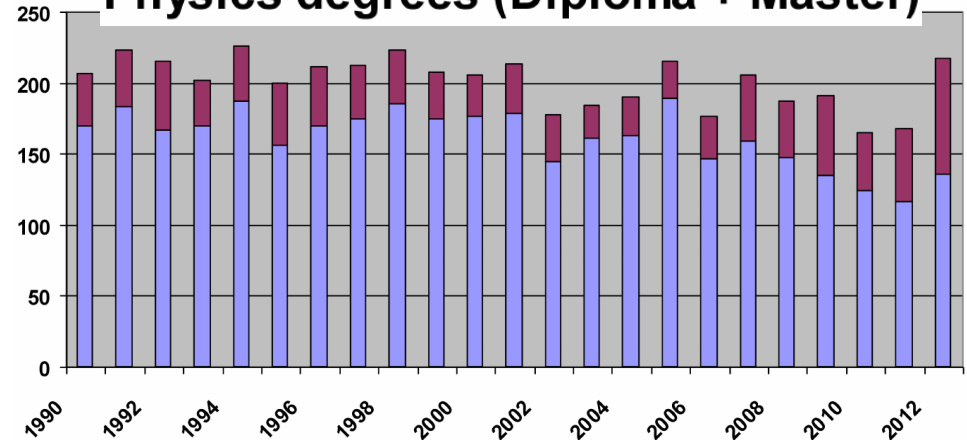
- **Basic funding for the institutes**
- **Specific project support for the research groups**

Swiss universities continue to foster an open, internationally oriented community, attracting excellent minds from all parts of the world and for all levels

Physics students

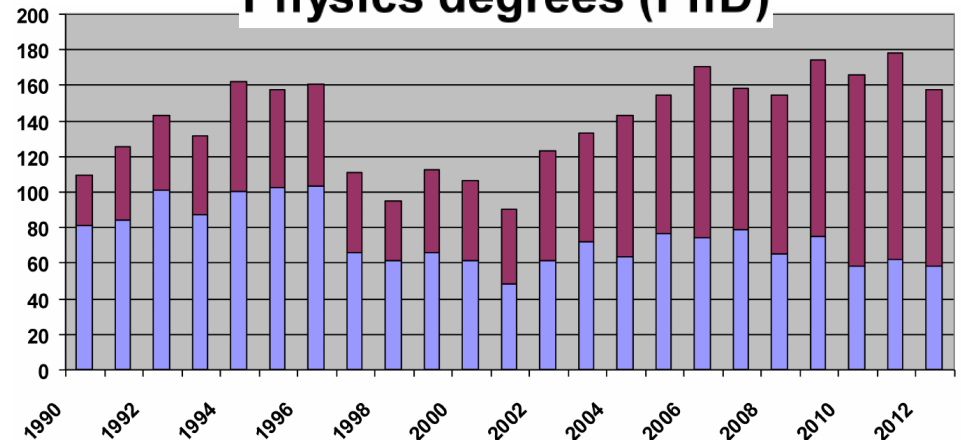


Physics degrees (Diploma + Master)



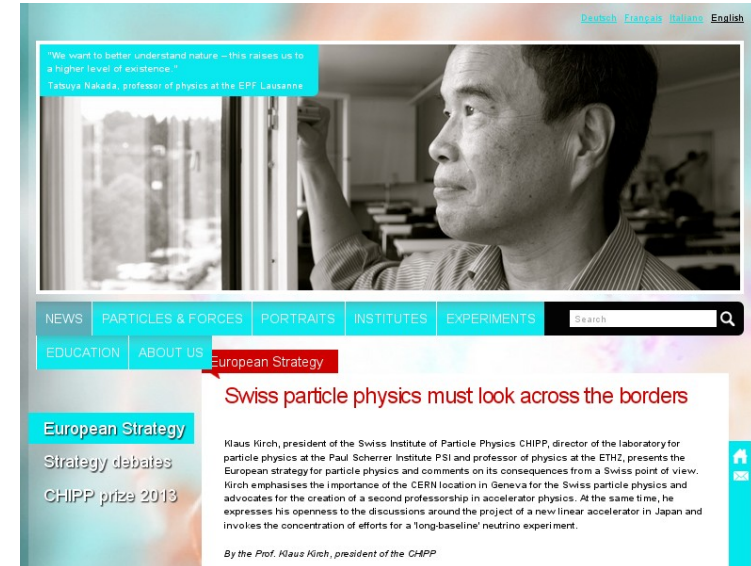
Swiss
 Foreigners

Physics degrees (PhD)



“Interactions - Swiss particle physicists initiate a dialogue with society”

- Scientific & social relevance of particle physics
- Basic knowledge of underlying science
- Daily work of Swiss particle physicists
- Interdisciplinary discussion sessions with scientists, representatives of industry & society
- Webpage with basic information and news
- Social Networks (Facebook, Google+, Twitter, Youtube)
- Video interviews with Swiss particle physicists
- Poster exhibition for high-schools
- Education days for high-school teachers



<<http://www.particlephysics.ch>>

<<http://www.teilchenphysik.ch>>

<<http://www.physiquedesparticules.ch>>

<<http://www.fisicadelleparticelle.ch>>

“Dialogue”: support for inclusion of French and Italian speaking communities

“Das verflixte Higgs” (“That darned Higgs particle”) - seed project, completed in 2013

+ Local activities, participation in international masterclasses, teachers programmes

Enormous potential of particle physics demonstrated over the past decades

- **Development of medical accelerator technology**
- **X-ray and particle detection systems for imaging techniques**
- **Monitoring and medical diagnostics**
- **Fast data acquisition**

All Swiss universities active in particle and astroparticle physics have set up specific Technology Transfer units

Support of cooperation between university and industry through Swiss Confederation's innovation promotion agency, CTI

- **CTI's mission: to lend support for R&D projects, entrepreneurship, development of start-up companies**
- **One of key measures: to optimise knowledge and technology transfer**

<<http://www.kti.admin.ch/index.html?lang=en>>

Implementation of the Strategy, including a list of concrete action items for each element, presented to SERI

(SERI = Ministry for Education, Research and Innovation)

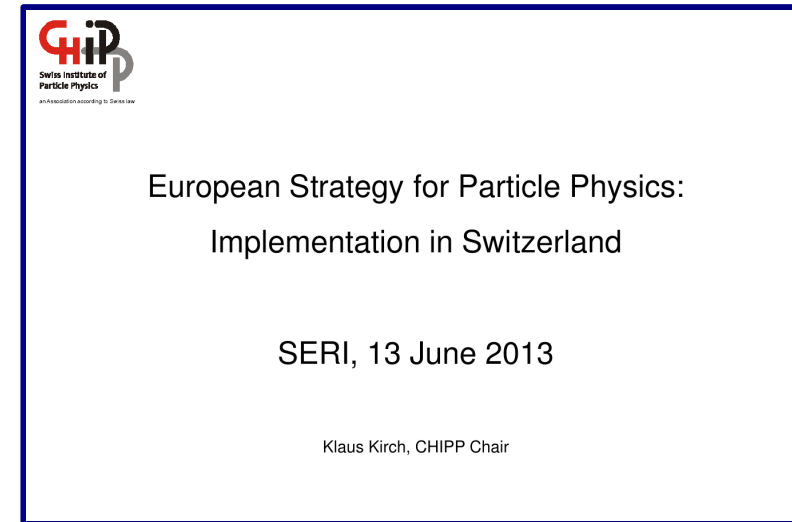
Response from SERI presented at CHIPP plenary meeting in June 2013

Positive overall statements, e.g.

- Continue support for CERN, possibly including further special contributions.
- Recognize adequate funding for outreach and education as a central component of science.

Two statements concerned specific action items:

- Will examine increased funding needs & consider to increase FLARE fund.
- Computing will possibly be included in the Swiss national roadmap for research infrastructures.



Other action items concern scientific community and Swiss scientific funding agency (SNSF), e.g.:

(some of them reflected
also in other slides)

- Continue to have LHC activities among top priorities, as laid down in CHIPP roadmap.
- SNSF should consider to provide additional resources for LHC data analysis.
- CHIPP should aim at enabling active Swiss role towards a visible contribution to a next long-baseline neutrino project.

“Keep scientific breadth, but make sure Switzerland remains to be involved in the future efforts defined in the European Strategy.”

- **CHIPP roadmap and its update reflect this well; see also statement by CHIPP chair person at www.particlephysics.ch/swiss-particle-physics-must-look-across-borders**

“Increase support for PSI in the Swiss universities, including additional chairs in accelerator physics.”

- **CH groups getting more involved in precision experiments at PSI**
- e.g. recently in Mu3e, MUTON
- **Need for a 2nd chair in accelerator physics recognized in the community**

“Maintain and strengthen academic support for theoretical physics, in particular in particle physics phenomenology.”

- **Very active, diverse but focused theory community (see slide 9)**
- **Need for continued financial support included in list of action items for SERI**

“CHIPP should also coordinate developing areas like astroparticle physics and neutrino physics in addition to the established accelerator based particle physics.”

- **For astroparticle physics, see CHIPP white paper**
<http://www.chipp.ch/documents/astroparticle_whitepaper_17Mar2013_approved.pdf>
- **Neutrino community converging on long baseline effort**

“PSI should remain well connected ... for example by offering unique facilities for precision measurements, exploiting its competence in accelerator physics and detector instrumentation to support university groups.”

- **Importance of PSI stressed in the 2011 update of the CHIPP roadmap**
- **PSI facilities** (e.g. Proton Irradiation Facility, Chip Design Core Team) **actively used by the CH community** (as well as by international community)
- **Active and growing CH involvement in experiments at PSI** (see slide 7)

“Similar approach to the FORCE programme should be considered in the future to support forward looking projects.”

- **FORCE since 2013 absorbed into FLARE**
(“Funding LArge international REsearch projects”)
- **Includes particle, astroparticle and astrophysics, including GRID computing**
- **Total of 26.5 MCHF made available to SNSF for the 2013-16 funding period**
 - First projects approved by SNSF in spring 2013: 5.7 MCHF allocated
- **Amount of same order of magnitude can be expected for next funding period**
- **SERI and SNSF recently launched call for applications for new research infrastructures (Swiss Roadmap) with implications for funding period 2017-20.**
- **Astroparticle, neutrino physics and astronomy competing for FLARE funding**
 - Decision to focus future astroparticle activities on three large projects
 - Worry that CH community will be forced to sacrifice diversity in these fields

“Make sure that the beautiful concepts of basic science and instrumentation in particle physics are taught at all higher education institutions in the country, even at those without active particle physics research groups.”

Most higher education institutions have active groups in particle physics and offer at least introductory courses in particle and astroparticle physics.

Exceptions are:

Université de Neuchâtel

→ Former physics department and chair integrated into Uni Bern in 2008 (only a course in basic physics for biologists etc. still taught in Neuchâtel)

Université de Lausanne

→ Former physics department integrated into EPFL since 2003

Universität Luzern, Università della Svizzera Italiana, Universität St.Gallen

→ No natural sciences departments

“Strengthen outreach activity by providing more financial support.”

Wide range of activities (c.f. slide 14), made possible thanks to significant funding contributions from

SERI → “Verflixtes Higgs”

SNSF → “Interactions”

Swiss Academy of Natural Sciences (SCNAT) → “Dialogue”

Strong and visible Swiss contribution in three LHC experiments

- Construction, maintenance, management, physics exploitation
- Upgrade programme priority #1 in European Strategy, in line with CH priorities

Swiss community of particle and astro-particle physicists well organized through CHIPP

- LHC involvement is a prime example
- Concentration of astroparticle and neutrino activities on three main projects, comes with the worry that diversity in the field might suffer

Growing involvement of CH groups in high visibility precision particle physics experiments at PSI

Broad theory program, covering all aspects of particle physics

- Precision predictions (EW, QCD, Flavour, Higgs) relevant for both low- and high-energy experiments

State of the art Accelerator R&D at two world leading labs, CERN and PSI

- Powers future development of accelerator driven large research infrastructures
- CH could do more to boost this field

Strong support from SERI and SNSF acknowledged and vital for the future