

Pillar 1: High energy/ intensity frontier

- Overarching Theme of Pillar 1: **Search for BSM physics**
 - Direct searches at the high energy frontier (SUSY, extra dimensions, Dark Matter)
 - Precision Higgs boson and elucidation of EWSB
 - Indirect searches in flavor physics and low energy/high intensity frontier
- Deliverables of Today:
 - Provide Pillar 1 perspective into the CH input into the European Strategy
 - Provide input into an Update of the CH Roadmap
 - Prioritization:
 - Medium and Long Term
 - Short term action recommendation, some likely to be used for FLARE decisions
 - Starting Point for all: Draft CHIPP Pillar 1 WP
 - First discussions of an early draft at the CHIPP board 28 August 2018
 - Parallel Session this morning: > 90% consensus with some «radiative corrections» to the submitted CHIPP Pillar 1 WP .draft

To the members of the CHIPP Board and
participants of the 2018 SWICH2 Workshop
Fribourg

**New Draft for the CHIPP Pillar 1 Whitepaper as Input for the CHIPP Strategic Workshops
in 2018**

Dear Colleagues,

On behalf of the CHIPP Pillar 1 whitepaper editorial team, I am happy to present you an updated draft of the Pillar 1 whitepaper as input to the SWICH2 strategic workshop in Fribourg. As you know CHIPP is preparing an update of its roadmap in synch with the European Strategy for Particle Physics. A CHIPP input document to the European Strategy needs to be submitted by the end of the year, and the CHIPP roadmap update finalized soon after. For both endeavors, the Pillar 1 Whitepaper should provide important input.

The CHIPP Pillar 1 whitepaper will complement the already existing whitepapers of the other pillars. During the SWICH2 workshop, our common goal would be to achieve a bottom up consensus about our strategic priorities. The editorial team is happy to submit to you today a draft which includes suggestions for strategic recommendations for the Pillar 1 community with the goal of starting the discussion at the workshop. We will then update the whitepaper after the workshop for its final form.

You are cordially invited to share your thoughts about this draft with us already prior to the workshop. Please send your feedback to the chair of the editorial team and/or the team members. We will then collect all input and open the parallel discussion session summarizing your feedback. We are looking forward to lively discussions in Fribourg!

Sincerely,



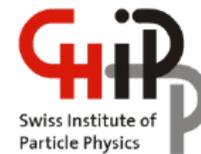
(for the Pillar 1 Whitepaper editorial team)

Status: Pillar 1 Whitepaper

CHIPP Pillar 1 Whitepaper 2018:

Input to the Strategic Workshops in Switzerland

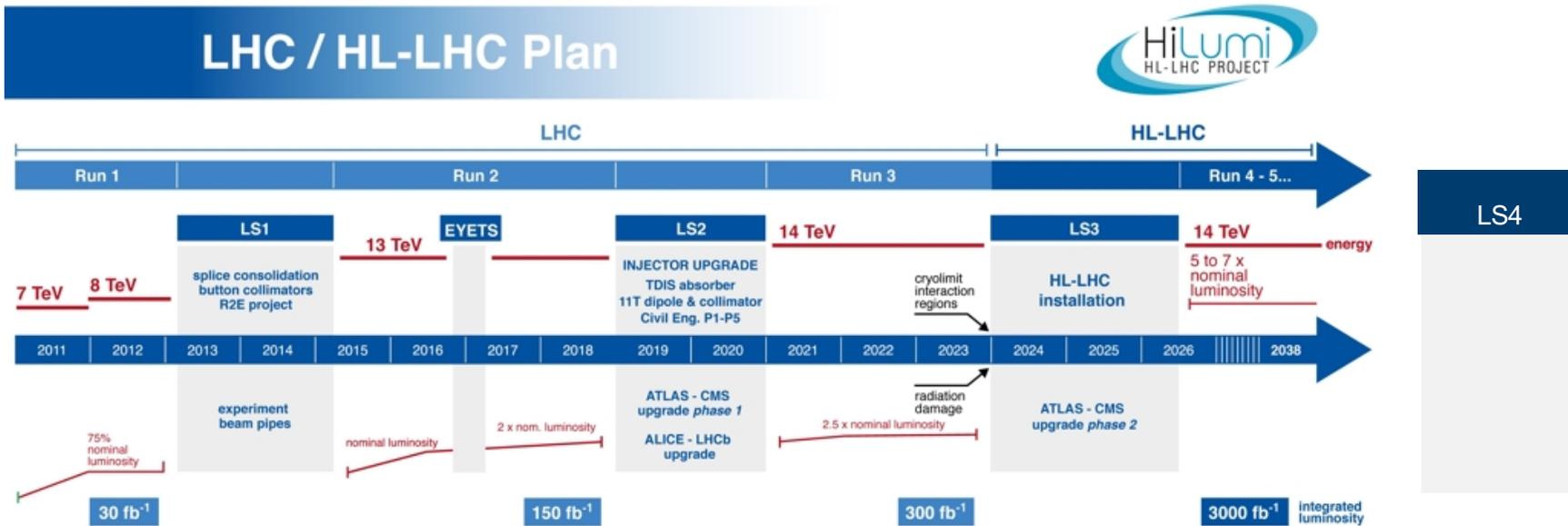
1. The overarching theme of Pillar 1 research activities in Switzerland
2. Current implementation of Pillar 1 research in Switzerland
3. Potential future facilities as drivers for Pillar 1 research
4. Appraisal of the current implementation
5. Strategic recommendations
6. Outlook



DRAFT PRESENTED TO THE
SECOND SWICH WORKSHOP 13-14 SEPTEMBER 2018

September 7, 2018

LHC Experiment Upgrade Timeline



2017
CMS phase1
Pixel upgrade

2019-20
LHCb Upgrade1
ATLAS FTK,
Pixel

2024-26
CMS / ATLAS
Phase2 Upgrade
LHCb consolidation

~2030
LHCb Upgrade2
(to be approved)

(A) near term [2019-2024] /current plus next ERI/FLARE period

During the near-term future, the exploitation of the LHC as flagship infrastructure for Pillar 1 research should continue to be the highest priority, including the operations and upgrades of the ATLAS, CMS and LHCb experiments, that via the intertwined and complementary relationship of the flavour sector and the high energy frontier in the search for BSM physics represent the mainstay of Pillar 1 research activities. The phase-2 upgrades of ATLAS and CMS in LS3 will prepare those detectors for the HL-LHC running period (2026 onward) and the recently approved Upgrade1 (in L2) will extend LHCb's lifetime up to and including Run IV (50 fb^{-1}). Studies are under way for a possible LHCb Upgrade2 in LS4 (2029) that will ensure LHCb's viability beyond Run IV. Even in this financially constrained environment, it is important for the diversity and future of the Pillar 1 community to enable smaller scale activities within the FLARE programme, such as R&D and construction of a flagship experiment operating at the low-energy frontier at PSI as well as basic accelerator and magnet R&D. A sustained effort in the latter area is of crucial importance in order to render the ambitious long-term goals after 2035 realistic and compelling.

- NB: - CHART2 Initiative of SERI and ETH domain +plus Unis for accelerator R&D crucial
- establish flagship experiment at the low energy frontier

(A) near term [2019-2024] /current plus next ERI/FLARE period

1. M&O and computing costs for the LHC experiments (as “FLARE uncuttable”).
2. Construction of the ATLAS and CMS phase 2 upgrades (LS3), completion of LHCb Upgrade1 (LS2), LHCb consolidations (LS3) and R&D for LHCb Upgrade2.
3. Support for accelerator R&D towards FCC (expected to be funded by CHART2).
4. Design and construction of a flagship experiment at the low-energy frontier at PSI; and support of a Swiss involvement in SHiP, if approved
5. Funding of smaller experiments and generic detector  and accelerator R&D efforts.

NB:

- Flagship at high energy frontier remains LHC
- Flagship experiment low energy frontier (not necessarily always the same prioritized)
- If understood as FLARE priorities, it should be clear that funds remain for 5.

(B) midterm [2025-2035] /phase 2 to end of LHC program

The midterm period will be still dominated by the continued exploitation of the LHC programme up to its end. After the completion of the ATLAS/CMS phase-2 upgrades, some financial degrees of freedom should become available for the envisioned LHCb Upgrade2 in LS4 (2029) as well as the upgrade of a low-energy frontier flagship experiment operating at the envisioned HiMB facility at PSI. We expect that on this timescale, the future of the “physics beyond collider” programme will have become more concrete and support of the Swiss involvement in SHiP should be feasible.

The priorities are thus as follows:

1. M&O and computing costs for the LHC experiments (as “FLARE uncuttable”).
2. Completion of the ATLAS/CMS phase-2 upgrades and LHCb consolidations (LS3), R&D and construction of the LHCb Upgrade2 (LS4), if approved.
3. Continued support for accelerator R&D towards FCC (expected to be funded by CHART2)
4. Upgrade of a low-energy frontier flagship experiment at PSI, potentially at HiMB if approved; and support of a Swiss involvement in SHiP, if approved.
5. Funding of smaller experiments and generic detector and accelerator R&D efforts.

(C) long term vision beyond 2035

In the time period after 2035, a new flagship facility needs to be within reach to carry the field forward beyond the LHC. Apart from scientific questions to be addressed in this period, technological, sociological and even political considerations come into play. From a scientific point of view, it seems uncontroversial that the search for BSM physics will need the highest achievable beam energies possible and that a complete precision survey of the mechanism of electroweak symmetry breaking to fully exploit the sensitivity of Higgs boson properties to BSM physics requires a lepton collider of some kind. Such a facility should then preferably also allow, besides the Higgs boson sector exploration, precision electroweak measurements of the W , Z and top, perhaps as an upgrade path. The envisioned ILC programme in Japan would cover a significant part, but not all of the EWSB exploration programme, and its current fate is unclear at the time of writing. In terms of direct searches for BSM, the 100 TeV energy range seems within reach with a 100 km tunnel assuming however a bold magnet R&D that allows to push the field strength by a factor of two or even more (in case a High Temperature Superconductor option is pursued with vigour). Ensuring the success of such an R&D programme to achieve center of mass energies of at least 100 TeV within the next decade should thus be a very high priority.

NB:

- Hadron collider / e^+e^- collider synergy
- Accelerator and magnet R&D are on the critical path for the next hadron machine

(C) long term vision beyond 2035

The CHIPP Pillar 1 community strongly supports that a 100 km circular collider be built by CERN as the next flagship facility that would secure the future of the field beyond 2035 for decades to come. Preceding an FCC-hh collider at $\sqrt{s} \geq 100$ TeV with an FCC-ee option would be timely especially in the scenario where the development of suitable magnets for FCC-hh would need a longer time, and would be scientifically necessary in the scenario where the ILC programme in Japan would not go forward. The CHIPP Pillar 1 community takes note of the option of HE-LHC re-using the LHC tunnel; however at the present time it remains unclear whether HE-LHC will cover a significant enough part of the envisioned physics program that an FCC complex would provide. Further along, if a $\mu\mu$ collider option would come within reach, it could be added to whatever tunnel remains after completion of the previous circular hadron collider programme.

Base Support versus Exceptional/prioritized support:

- Base support should allow a reasonable involvement
 - should somehow reflect community size - particle physics is collaborative, usually needs partners
- Base support should be granted for a limited amount of projects pursued in parallel
 - Else projects become sub-critical
 - Be aware of the «Tragedy of the Commons»
- Funding everything as base support is not prioritizing at all
- Exceptional support entirely based on scientific merit
 - Needs to be selective in order to have impact



Discussion