

CHIPP strategy & roadmap update meeting, Jan. 18th-19th



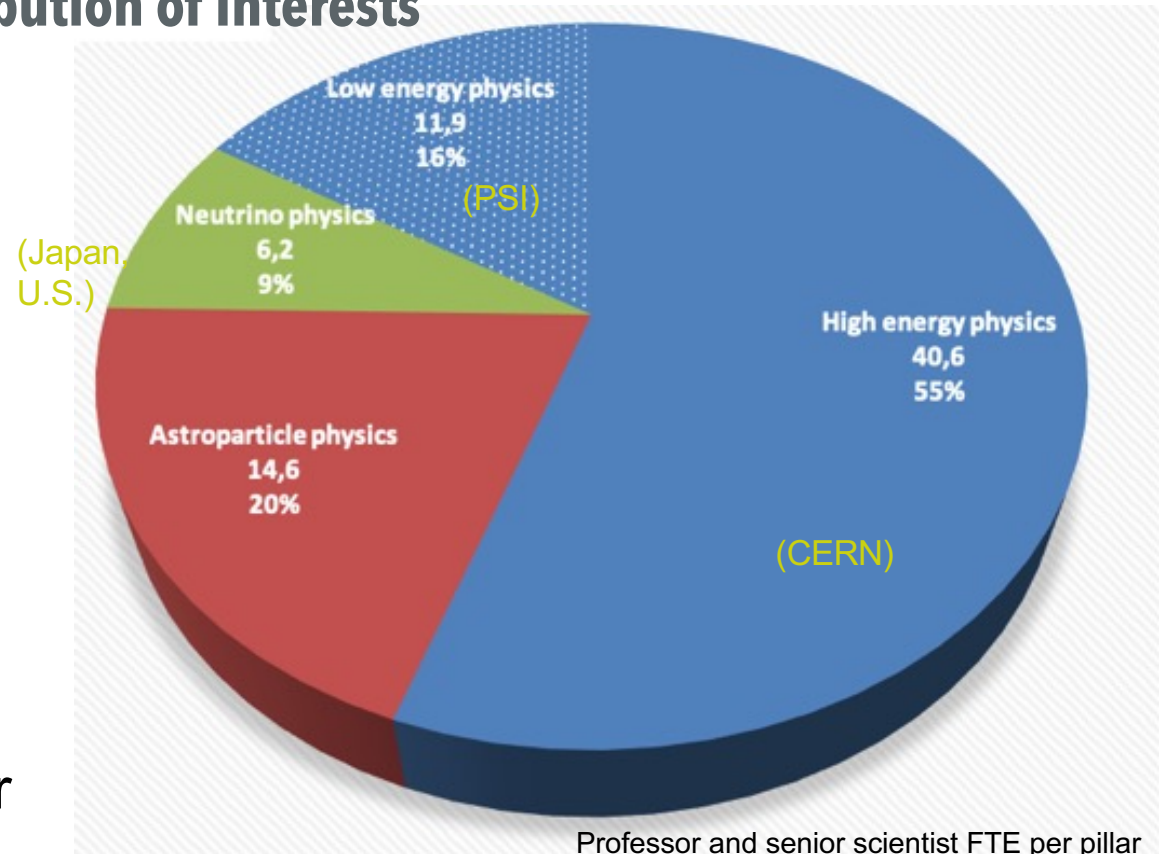
Ben Kilminster
Balsthal, Switzerland
Jan. 18th – 19th, 2024

Big picture

- CHIPP (Swiss Institute for particle physics) is a bottom-up institution for organizing particle physics interests
 - CHIPP board members regularly meet to discuss strategy & priorities
- 2024 is a big year for CHIPP
 - FLARE funding applications (2 or 4 years) due November 2024 for **2025-2028** period
 - RECFA visit March 8th (hosted at PSI)
 - Last RECFA visit 2016
 - CHEF (CH FCC) proposal will be submitted
 - Roadmap covering **2029-2032** due by end of 2024
 - Also, taking into account changes in 2025-2028

CHIPP - The Swiss Institute of Particle Physics

Distribution of interests



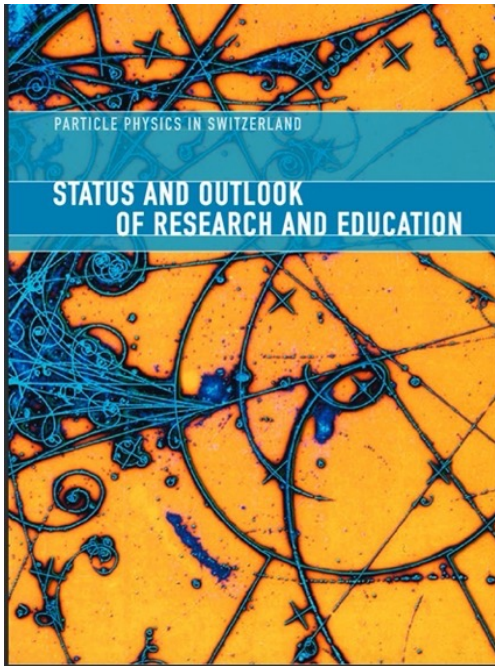
Professor and senior scientist FTE per pillar

440 Scientists

Experimental pillars:

- 1) High-energy frontier
 - 2) Low-energy pillar
 - 3) Neutrino physics
 - 4) Astroparticle physics
- + Theory and accelerator physics

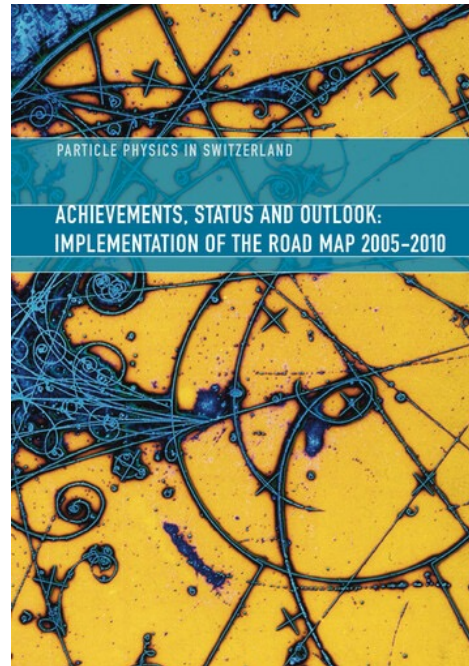
CHIPP roadmaps (2004, 2010, 2020, 2024)



Date: 2004
Authors: CHIPP
Pages: 105

Status, outlook

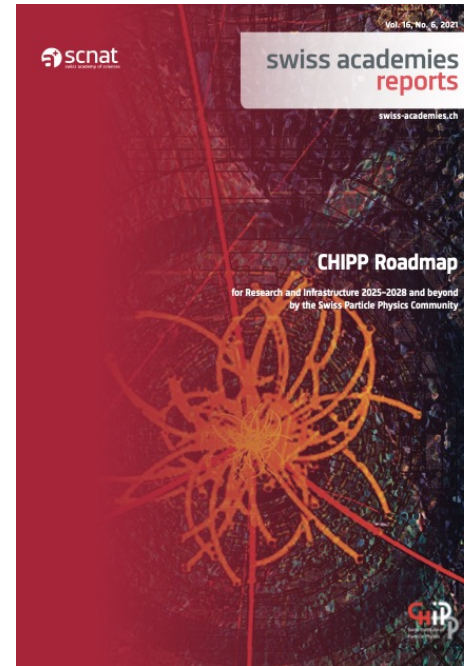
<https://chipp.ch/de/roadmap-2004>



Date: 2010
Authors: CHIPP
Pages: 24

Critical review

<https://chipp.ch/de/roadmap-2010>



Date: 2020
Authors: CHIPP
Pages: 96

Roadmap 2025-2028 &
beyond

<https://chipp.ch/de/roadmap-2021>



Date: 2024
Authors: CHIPP
Pages: ~30

Roadmap update 2029-
2032 & beyond

The current members of the
CHIPP Board are:

UNIVERSITÄT BASEL

B. Krusche

UNIVERSITÄT BERN

J. Gasser, P. Hasenfratz, S. Kabana,
P. Minkowski, K. Pretzl, U.-J. Wiese

UNIVERSITÉ DE FRIBOURG

J.-C. Dousse, A. Weis

UNIVERSITÉ DE GENÈVE

A. Blondel, M. Bourquin, A.G. Clark (Chair),
R. Durrer, M. Maggiore, M. Pohl

UNIVERSITÉ DE NEUCHÂTEL

M. Blau, J.-L. Vuilleumier,
J.-P. Derendinger (Deputy Chair)

UNIVERSITÄT ZÜRICH

C. Amsler, U. Straumann, P. Truöl, D. Wyler

**ECOLE POLYTECHNIQUE FÉDÉRAL
DE LAUSANNE, EPFL:**

A. Bay, T. Nakada, T. Schietinger,
O. Schneider, M. Shaposhnikov

**EIDGENÖSSISCHE TECHNISCHE
HOCHSCHULE ZÜRICH, ETHZ**

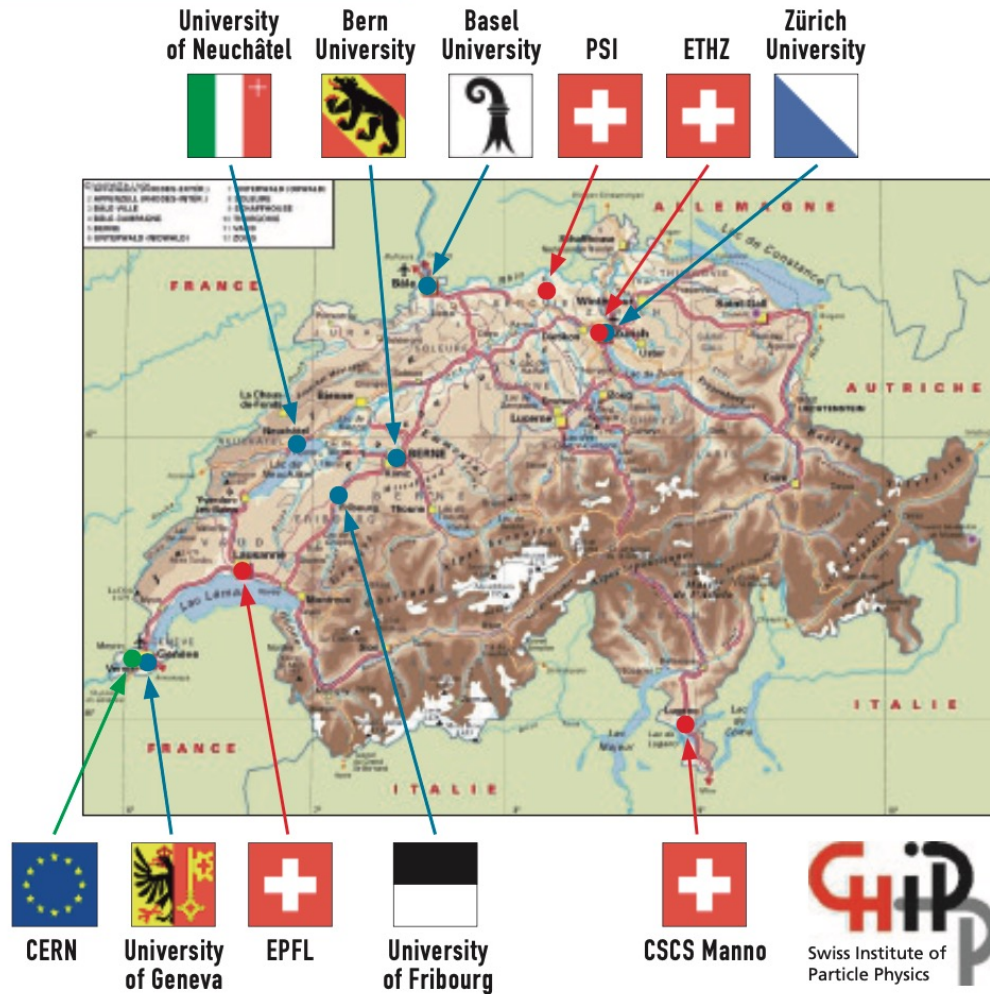
G. Dissertori, R. Eichler, J. Fröhlich,
M. Gaberdiel, Z. Kunszt, F. Pauss,
A. Rubbia (Deputy Chair)

PAUL SCHERRER INSTITUT, PSI

A. Denner, R. Eichler, K. Gabathuler

three complementary experimental ‘directions’:

- I Experiments at the frontier of high-energy interactions between fundamental particles;
- II Experiments to explore the observed transitions between different neutrino flavours and ultimately to search for leptonic CP-violation and the violation of lepton quantum numbers;
- III Fundamental experiments at the interface between observational cosmology and particle physics with a likely emphasis on understanding the content of ‘dark matter’ and the nature of ‘dark energy’.



Scope of the CHIPP roadmap

Inform "bottom up" **SERI Roadmap for Research Infrastructures**

- Concentrate on **2029 to 2032**
- update previous strategy (4 years ago)
- Interested parties: **SERI, SNF, Parliament, ETH domain, SwissUniversities, Univerities**

In addition:

- inform **CH scientific community** and **greater public**
- incorporate outcome of the update of the **European (research) strategy of particle physics** and other international roadmaps
- **Updates to 2025-2029 period**

Review of previous roadmap

Previous roadmap, “CHIPP Roadmap for Research and Infrastructure 2025-2028 and beyond by the Swiss Particle Physics Community” <https://scnat.ch/en/id/mW2qy>

2	Introduction	6	9	Relationship to industry	50
3	Executive summary, findings and recommendations	9	9.1	Examples of spin-off companies	50
4	Purpose and scope	12	9.2	Contacts and collaborations with industry	52
4.1	Particle physics, astroparticle physics and the Standard Model	12	9.3	Future opportunities	53
4.2	The three pillars of CHIPP	14	10	Impact on education and society	55
4.3	Focus of this roadmap document	14	10.1	Education	55
5	The present Swiss landscape	17	10.1.1	Bachelor and Master	55
5.1	Energy frontier of particle physics	18	10.1.2	PhD	56
5.1.1	High energy: LHC experiments	18	10.1.3	High school	56
5.1.2	High energy: Other experiments at CERN	22	10.1.4	Universities of Applied Sciences	56
5.1.3	Experiments with low-energy beams	23	10.2	Outreach activities in Switzerland	56
5.1.4	Accelerator physics and technology	24	10.2.1	International outreach networks	58
5.2	Neutrino physics	24	10.3	Support of young talents	59
5.3	Astroparticle physics	26	10.4	Service to society	60
5.3.1	X- and γ-rays, cosmic rays, and neutrinos	26	10.5	CERN open data policy	60
5.3.2	Dark matter, direct detection	27	10.6	Input from young scientists on the roadmap document	61
5.4	Theoretical physics	28	10.7	Partners	61
6	Major successes (2017–2020)	32	11	Vision for the future	62
6.1	Energy frontier of particle physics	32	11.1	Overall vision	62
6.1.1	High energy: LHC experiments	32	11.2	The Future Circular Collider project	64
6.1.2	High energy: Other experiments at CERN	33	11.3	Short- and mid-term prospects for experiments at accelerator-based facilities	66
6.1.3	Experiments with low-energy beams	34	11.4	Neutrino physics	71
6.1.4	Accelerator physics and technology	35	11.5	Astroparticle physics	74
6.2	Neutrino physics	37	12	Development of national infrastructures (2025–2028)	76
6.3	Astroparticle physics	38	13	Swiss participation in international organisations (2025–2028)	79
6.4	Theoretical physics	39	14	Conclusions	80
7	The international context	41	15	Appendix	82
7.1	Accelerator research	41	15.1	Experiments	82
7.2	Experiments at particle accelerators (energy and intensity frontiers)	42	15.1.1	Experiments with Swiss contributions at particle accelerators (energy and intensity frontiers)	82
7.3	Long-baseline neutrino physics	42	15.1.2	Experiments with Swiss contributions in neutrino physics	83
7.4	Non-accelerator-based particle and astroparticle physics	43	15.1.3	Experiments with Swiss contributions in astroparticle physics from space	84
8	Synergies with other scientific fields	45	15.1.4	Ground-based experiments with Swiss contributions in neutrino and astroparticle physics	85
8.1	Interdisciplinary research	45	15.1.5	Experiments with Swiss contributions for direct dark matter detection	86
8.1.1	Cosmology and gravitational waves	45	15.2	Links	87
8.1.2	Detector technologies, data processing, and computing	46	Acronyms	89	
8.2	Medical applications	48	16	References	92
8.3	Accelerator technology and sustainability	49			

Some goals of 2024 roadmap update

- Revisit high-level recommendations incorporating new information
 - E.g. Pillar 1: changes in HL-LHC schedule, FCC interim report, CHEF
- Incorporate changes in schedules of facilities or experiments, scientific & technological areas of growth
- Highlight any changes in priority
- Specifically refer to expected 2029-2032 projects schedule and planning
- We want to demonstrate:
 - We are a stable, well-organized field, with a clear future
 - But that we are also a growing, vibrant field, reacting to a changing scientific environment

Discussion: Topics of roadmap update

- Introduction
- High-level recommendations
- Present landscape (I,II,III)
- Projects & goals (I,II,III)
 - Synergies between experiments, and between pillars
- Schedule 2025-2032
- Technologies, synergies, outreach
- Concerns / views of funding plans & suitability for addressing our research and long-term infrastructure
- Incorporate RECFA recommendations

Roadmap mandate

- CHIPP has been producing roadmaps since 2004
 - Other scientific fields are now following suit
- Since 2019, SCNAT has been asked by SERI to coordinate roadmaps in biology, chemistry, geosciences, particle physics, astronomy, photon science, and neutron science
 - In 2019 mandate from Gregor Haefliger, CHIPP roadmap provided as example to other communities for “best practice”
 - Community roadmaps served as basis for the process leading to the Swiss Roadmap for Research Infrastructures 2023 for the ERI Dispatch 2025–2028
(<https://scnat.ch/en/id/BGqdL>)
- After some delays, new mandate for Swiss Roadmap 2027 has been received (Dec. 18th, 2023)
 - SCNAT forwarded us this mandate Jan. 10th, 2024
 - Roadmap update to be **published** Dec. 2024
 - However, CHIPP has anticipated this and is on track to deliver
 - As evidenced by your participation today 😊

(See letter attached in indico)

- Summary of main points:
 - ❑ “An update of the existing research infrastructures in Switzerland must be made”
 - ❑ “An update of the prioritized needs for existing and new research infrastructures of the respective research communities in Switzerland will be carried out, taking into account the national and international context”
 - ❑ “The thematic roadmaps should be published by December 2024 at the latest and will be available to BFI partners as a basis for planning the next roadmap for 2027”
 - ❑ Only previous roadmaps will be updated (no new roadmaps, which had been considered)
 - ❑ Term “roadmap” can be misleading, “whitepaper” is preferred

Additional clarifications from SCNAT

- Given relatively short time, only realistic to aim for “short additional document to complement existing roadmaps”
- Specifically, we are asked to address two things: an update on existing infrastructures and an update of the prioritized needs for existing and new infrastructures under consideration of the national and international contexts
- Plan so far:
 - ❑ By Feb. 1st : Document from SCNAT will be delivered on understanding/suggestion on content and timescale for these roadmap updates and how we could organize the work
 - ❑ Feb. 7th: SCNAT will discuss plan with the 7 communities (BK will attend)

Status of CHIPP efforts so far (1)

- CHIPP EB established roadmap editors to be in charge of updating different sections
 - Pillar 1 high energy: Tobias Golling (Geneva)
 - Pillar 1 low energy: Paolo Crivelli (ETH)
 - Pillar 2 neutrino: Michele Weber (Bern) / Davide Sgalaberna (ETH)
 - Pillar 3 astroparticle: Teresa Montaruli (Geneva)
 - Accelerator: Mike Seidel (EPFL / PSI)
 - Theory: Gino Isidori (UZH)
 - Outreach: Katharina Mueller (UZH)
 - Technology transfer: Guenther Dissertori (ETH)
- CHIPP EB has met with editors several times to discuss
- Editors have been in contact with proponents in preparation for this workshop

Status of CHIPP efforts so far (2)

- Data of FLARE requests for 2025-2028 and possible requests for 2029-2032 collected
 - ❑ List of PIs, co-PIs, senior researchers, expected personpower
 - ❑ Expected funding requests
 - ❑ Timeline of projects
- Presentations by FLARE PIs made in Sept. 2023 board meeting:
 - ❑ Physics, Swiss deliverables, Swiss roles on experiments, funding, time profiles, uncertainties
- Established overleaf (latex) skeleton for new update with previous recommendations and findings
- Inputs provided to editors for workshop preparation
 - ❑ FLARE tables, demographics of pillars, timelines, previous roadmaps

Challenges ahead

- Switzerland has a small particle physics community
 - ❑ Many of us have diverse research portfolios
 - ❑ We must invest our time and resources well to have a world-leading impact (we have been doing well at this !)
- Balance should be sought after:
 - ❑ Large experiments vs. small experiments
 - ❑ Decades-long experiments vs. emerging experiments
 - ❑ Operations vs. construction vs. R&D
 - ❑ International research efforts vs. national efforts (I.e., PSI)
- The time period of 2025-2028 is particularly challenging due to a coincidence of many projects under construction

FLARE table summary

Experiment name	TIMELINE									Comments (approval, MOU)		
	2024	2025	2026	2027	2028	2029	2030	2031	2032			
HIGH ENERGY - PILLAR 1												
LHC timeline	Long Shutdown 3											
CERN injector												
ATLAS TDAQ	R&D		Construction			Operation						
ATLAS Pixel	Construction											
ATLAS	Operation					Operation						
CMS	Operation		Construction			Operation						
	R&D									Construction		
LHCb U1	Operation											
LHCb U2	R&D		Construction				Construction/Installation					
FASER	Construction	Operation				Operation						
FASER2	R&D			Construction				Operation				
FASER nu2	Design			Construction			Operation					
SHIP	Design			Construction			Installation		Operation		Not yet approved	
	R&D								Operation			
NA64	Operation		Construction / Upgrade			Operation						
	R&D								R&D			
NA62	Operation		Decommissioning									
HIKE	Design R&D		R&D		Construction			Operation				
GBAR	Operation R&D	Operation R&D	Construction	Operation			Operation ?					

LOW ENERGY - PILLAR 1									
Mu3e	Construction	Operation		Construction / Upgrade			Operation		
n2EDM	Operation		Construction		Operation				
	R&D	Construction		R&D					
PIONEER	Design		R&D	Construction		Operation			
	R&D		Construction		Operation		Operation		
NEUTRINO - PILLAR 2									
JPARC LBNF									
LEGEND 200	Operation								
LEGEND 1000	R&D	Construction				Operation			
T2K HyperK HK ND 280 upgrade	Operation								
	Construction			Operation					
	R&D		Design	Construction			Operation		
DUNE	R&D	Construction			Operation				
ASTROPARTICLE - PILLAR 3									
CTA	R&D	R&D / Construction	Construction						
XENONnT DARWIN	Operation								
	R&D		Construction			Operation			
ET	Design			Construction					
	R&D								

Table of FLARE requests

	Prioritisation	requested 2020	years granted (2020)	granted	request 2022	granted 2022	Total granted 2021-24	Total - plan 2025-28	Total - plan 2029-32
ATLAS	5268	4'967	4	4966			4'966	2'488	1'012
CMS	5100	5'041	4	5041			5'041	4'500	4'421
LHCb	3800	1'803	2	1803	2'018	1'810	3'613	6'000	6'000
M&O LHC experiments	3820	3'729	4	3729			3'729	3'729	3'760
LHC Computing Tier-2	4000	1'985	2	1984	2'137	2'138	4'122	4'388	4'388
FCC/CHEF								0	
GBAR	300	236	2	236	250	250	486	480	480
FASER	1710	1'109	3	1108	0		1'108	1'800	1'800
n2EDM	615	268	2	268	345	345	613	1'350	1'500
NA62				1803				1'300	1'700
Mu3e	1000	1'115	2	1114	539	539	1'653	2'020	2'020
T2K	1650	1'244	2	1244	4'401	4'401	5'645	5'000	1'400
PIONEER								900	300
DUNE	4200	1'000	2	1000	1'961	1'961	2'961	6'000	1'000
LEGEND	1250	471	2	502	0	471	973	1'300	1'400
CTA *	1450	1'500	4	1186			1'186	2'400	300
DARWIN	1350	538	2	537	692	692	1'229	1'750	1'000
SHIP	0	0			0		0	2'000	2'200
ET								3'273	6'276
NA64	220	0			240	240	240	630	480
	35733	25'004		26521	12'583		37'565	51'308	41'437

2025-2029

FLARE funding for particle physics:

38 MCHF

Expected FLARE requests:

51 MCHF

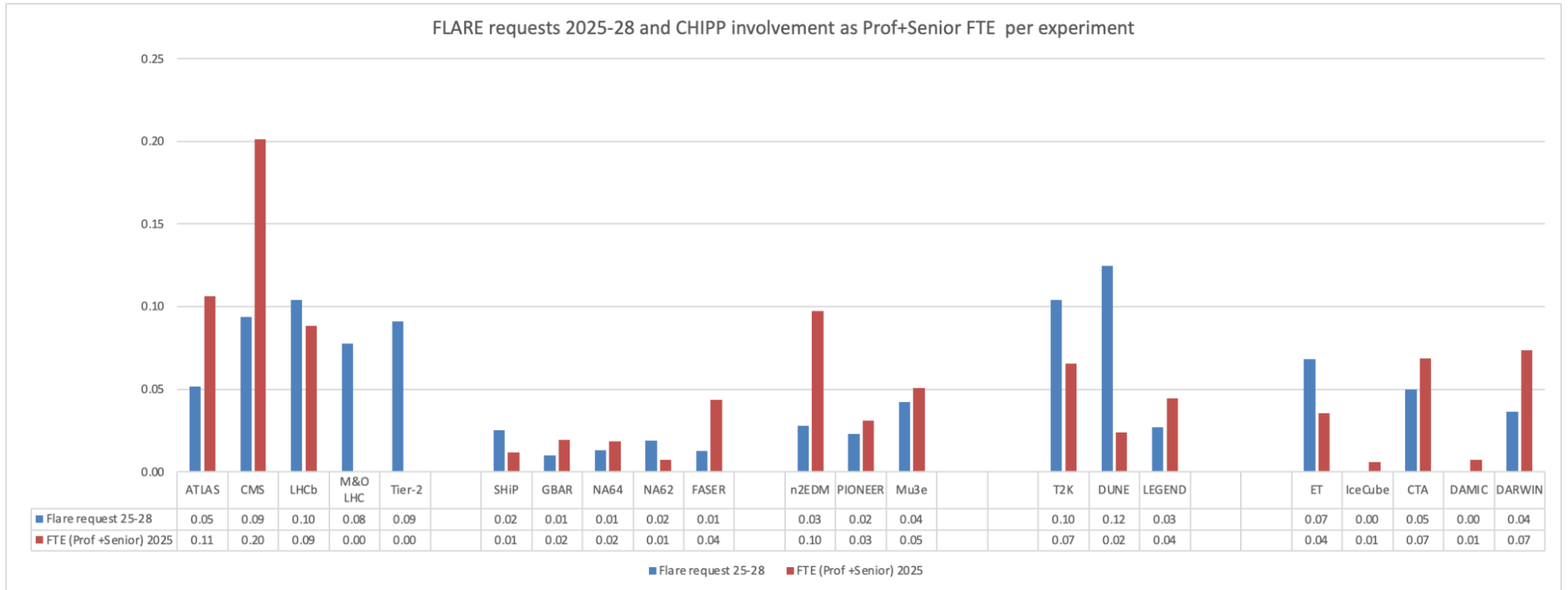
Can we find a way to spread out funding requests beyond (April) 2029 ?

*** So far, 2029-2032 requests seem reasonable (but e.g., FCC is missing)**

Where is the wiggle room in the project schedules that can alleviate this ?

We should strive for a sensible 25% reduction, rather than a 25% cut to our program by reviewers

Balance between CHIPP interests and funding requests



Blue > Red indicates FLARE request larger than proportional community size

Goals of workshop

- Provide review of the CHIPP program to board members
 - Understand what needs to be updated
 - Develop plan for updating
- Experimental pillars:
 - Discuss research programs over 2025-2028 & 2029-2032
 - Particular attention to timelines and uncertainties
 - Consider balance of program and funding limitations
 - Consider prioritization of activities within pillar and within each experiment
 - Establish needed content for update (or for material to support update since it will not be long enough for details)
 - Justify program to board
- Special topics:
 - Besides being fun!, we'd like to identify areas of common interest that cross the pillars
 - Accommodate these synergies into next roadmap, indicating added value to the Swiss particle physics program

Discussion: Deliverables from workshop

- Collected:
 - ❑ new information
 - ❑ new physics opportunities
 - ❑ new experiments
- Revised version of project timelines
- Revised version of high-level recommendations
- Vetted out synergies between experiments and pillars
- Determined:
 - ❑ Editing/writing assignments
 - ❑ timeline

Agenda of workshop

Thursday

10:00	Registration & coffee break 09:45 - 10:15				PLENARY: FCC 15:10 - 15:40				
	Welcome <i>Ben Kilminster</i> 10:15 - 10:30				Accelerator report 15:40 - 16:00				
11:00	PLENARY: Introduction of pillars (15 minutes each) 10:30 - 11:45				16:00	Coffee break 16:00 - 16:30			
	PLENARY: THEORY 11:45 - 12:15					PLENARY: Outreach & Education <i>Katharina Mueller</i> 16:30 - 17:00			
12:00	PHOTO 12:20 - 12:25				17:00	PLENARY: Introduction to Topics for next day parallel sessions 17:00 - 17:30			
13:00	LUNCH 12:30 - 13:35				18:00	DINNER 19:00 - 20:30			
14:00	Neutrino <i>Michele Weber</i> 13:35 - 15:10	AstroParticle <i>Prof. Teresa Montaruli</i> 13:35 - 15:10	High Energy <i>Tobias Golling</i> 13:35 - 15:10	Low Energy/High Intensity physics <i>Paolo Crivelli</i> 13:35 - 15:10	19:00	Ghost Particle film projection 21:00 - 22:00			
15:00					22:00				

