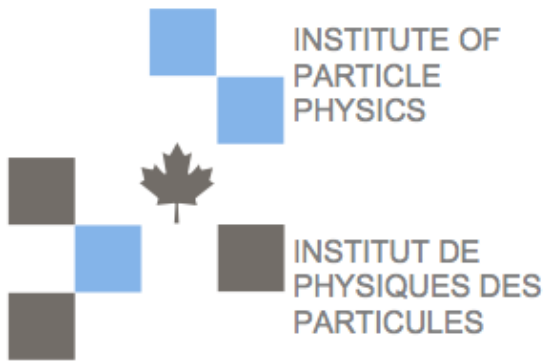


Institute of Particle Physics and the Subatomic Physics Long Range Plan 2022-2026

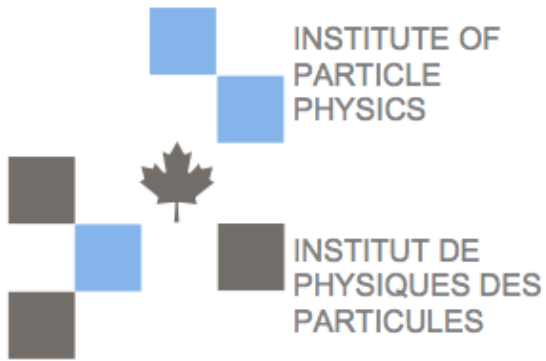
J. Michael Roney
TRIUMF Science Week
18 August 2020
Zoom Meeting



Subatomic Physics Long Range Plan 2022-2026

Co-sponsored by NSERC, IPP, and CINP

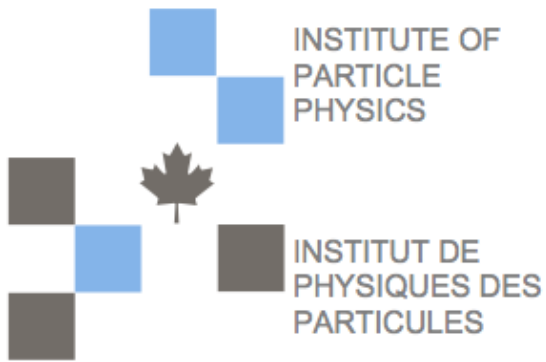
- In effect from 2022 through 2026 with scope extending to 2036
- From LRP Terms of Reference (see Appendix): “These briefs must summarize the scientific vision and priorities put forward by the sub-communities they represent and serve, including both experimental and theoretical facets.”
- Consultation process of the community started within IPP with community input to the IPP Town Hall meetings 15, 16 and 21 July 2020
- CINP and IPP to prepare briefs that to be submitted by December 1, 2020
- Garth Huber will discuss the CINP process/status in the following presentation (CINP Town Hall meeting held June 22-23)



Subatomic Physics

Long Range Plan 2022-2026

- Long Range Planning Committee Co-Chairs:
Adam Ritz and Brigitte Vachon
see <https://subatomicphysics.ca/> and Adam's presentation at
CINP-IPP Session on June 11 for more information
- LRP Committee to lead the consultation of the community up to the
summer of 2021
- The LRPC to submit its report to NSERC, CINP and IPP by
30 September 2021.



LRP Committee Mandate

Taking into account (i) the ever increasing internationalization of projects and collaborations in addressing the fundamental questions of subatomic physics, (ii) the concurrent requirement to maintain and further develop world-class domestic research programs and infrastructure, (iii) the established expertise and strengths of the Canadian community and (iv) the recognition of the fact that the Canadian subatomic physics community cannot be involved in all research endeavours,

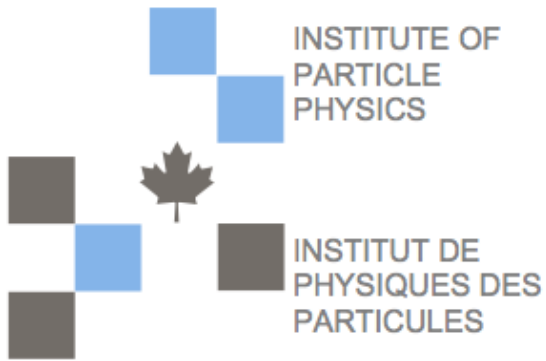
the Committee is asked to identify subatomic physics scientific ventures and priorities that should be pursued by the community on a five to fifteen-year horizon and that would ensure continuous Canadian global scientific leadership.

Budgetary estimates, both for new capital investments as well as for operations, must be provided as well, including funding ranges for prioritized endeavours. These ranges should include funding levels that would allow for a restrained, yet efficient, contribution to the ventures, as well as levels that would enable a more extensive contribution.

The Committee's assessment will be based on a broad consultation with the Canadian subatomic physics community. **The Committee will have to assess the feasibility, technical readiness and risks associated with particular endeavours. It is crucial that such an assessment be made through a fair and rigorous process.**

The Committee is also asked to consider and discuss factors that affect the subatomic physics community and to make recommendations on how to possibly lessen any negative impacts they may have, or enhance any positive ones. Examples of such factors include, but are not limited to, various funding opportunities, the relationship between funding agencies and other organizations, the activities of national research organizations, and the international context.

The report should address Equity, Diversity and Inclusion as well as supporting early career researchers within the context of the subatomic physics research community.

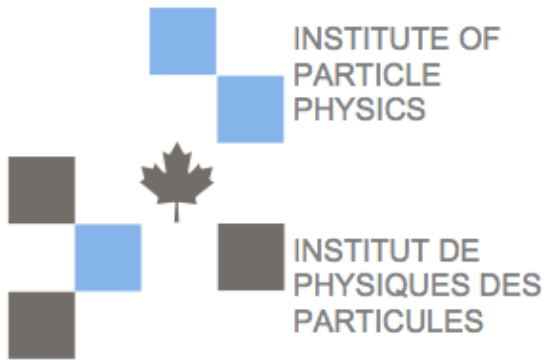


Subatomic Physics Long Range Planning Committee

Committee Membership

Members

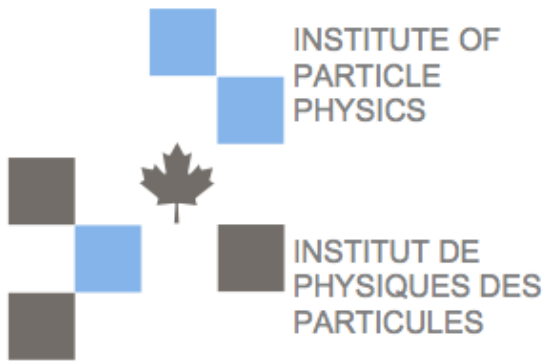
Eckhard Elsen	CERN, Switzerland
Chris Jillings	SNOLAB, Canada
Rituparna Kanungo	St. Mary's University, Canada
Bob Laxdal	TRIUMF, Canada
Augusto Macchiavelli	LBNL, USA
Juliette Mammei	University of Manitoba, Canada
Jeff Martin	University of Winnipeg, Canada
Adam Ritz (co-chair)	University of Victoria, Canada
Niki Saoulidou	University of Athens, Greece
Kate Scholberg	Duke University, USA
Brigitte Vachon (co-chair)	McGill University, Canada
Alex Wright	Queen's University, Canada



Subatomic Physics Long Range Planning Committee

Ex-officio Members

Cliff Burgess	Perimeter Institute (PI)
Emily Diepenveen	National Sciences and Engineering Research Council (NSERC)
Jens Dilling	TRIUMF
Olivier Gagnon	Canadian Foundation for Innovation (CFI)
Garth Huber	Canadian Institute of Nuclear Physics (CINP)
Micheal Roney	Institute of Particle Physics (IPP)
Nigel Smith	SNOLAB
TBD	Co-chairs, NSERC Subatomic Physics Evaluation Section



IPP LRP Brief for Subatomic Physics Long Range Plan 2022-2026

IPP LRP Brief Writing Committee consists of the elected IPP Scientific Councils of 2019-20 and 2020-21

Erica Caden ecaden@snolab.ca

Ken Clark Ken.Clark@snolab.ca

Mark Hartz mhartz@triumf.ca

Blair Jamieson bl.jamieson@uwinnipeg.ca

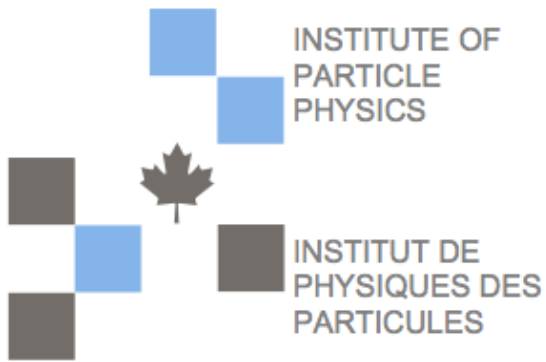
Robert McPherson rmcphers@uvic.ca

Michael Roney (Chair) director@ipp.ca

Bernd Stelzer stelzer@sfu.ca

Daniel Stolarski stolar@physics.carleton.ca

Reda Tafirout tafirout@triumf.ca



July 2020 IPP Town Hall

- Presentations of input for the IPP LRP Brief for the Subatomic Physics Long Range Plan
- Inform IPP members of developments of interest
- Provide forum to establish and/or refresh professional relationships amongst members:
 - Encourage awareness of status of IPP Projects and other scientific opportunities
- Consider potentially new initiatives, including approaches to funding

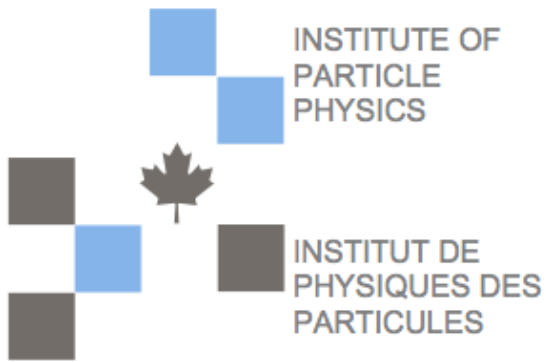
IPP Process and Status for Long Range Plan

February 26th email announcing the LRP process with the general call April 1st to IPP Membership for input into the LRP, via written submissions and the town hall meeting:

- 12 IPP Projects going into the LRP timing window
- 5-6 other efforts that may be IPP Projects in the future
- some projects reporting have physics of interest in both CINP and IPP
- technical support needs: detector development support: MRS, TRIUMF; computing; accelerator R&D
- Theory activity related to experimental program

IPP Process and Status for 2022-2026 Long Range Plan

- Community saw the ‘lay of the land’ at the July Town Hall
- Initial draft of written submissions from various projects and efforts was due June 30 & final version due July 28
 - Also requested additional briefs from:
 - Formal theory community
 - Accelerator physics community on projects related to particle physics
 - Survey community for data on HQP training record in the past 10 years and compelling success stories of HQP after their training period, both in and outside the field
 - Consult community to develop broad priorities regarding resource allocation for particle physics in Canada
 - These submissions will also be used to assist IPP to advocate for the field in general.



Submissions Guidelines for IPP LRP Brief

Section 1: Plans for the project in the period 2022-2026

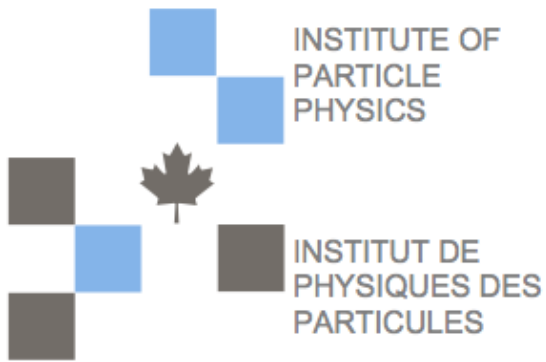
- 1) Physics and other research goals for the project;
- 2) Canadian hardware or software interests and contributions to the project;
- 3) Relationships with international partners including relative size of Canadian team within the collaboration
- 4) Expected HQP training; include numbers and roles in the project
- 5) Equipment and/or infrastructure needs – including cost estimates and time profile, whether NSERC or CFI will be requested for funds, other partners;
- 6) Computing requirements – CPU and storage, time profile;
- 7) Expected calls on technical support and/or infrastructure from TRIUMF, SNOLAB or the MRS facilities
- 8) Relationships with other projects being conducted by Canadian subatomic physicists – either physics or technical.

Table 1: Canadian grant eligible members on the project, their institution, and their FTEs

Section 2: Equity, Diversity and Inclusion Considerations (1 page)

Describe the existing and planned policies and practices for the Project to support:

- 1) an equitable, diverse and inclusive team environment; and
- 2) the recruitment of a diverse group of HQP and an inclusive training environment.



Submissions Guidelines for IPP LRP Brief

Section 3: Plans for the project from 2027 to 2036 (up to 2 pages)

- 1) Physics and other research goals for the project;
- 2) Information about resource requirements associated, for example, with upgrades in the period from 2027 to 2036;
- 3) R&D plans (e.g. detector, accelerator) for efforts that extend into 2027 to 2036;
- 4) Relationships with other projects being conducted by Canadian subatomic physicists – either physics or technical; and
- 5) Relationships with international partners

Section 4: Broader Societal Impact (up to 2 pages + table of HQP trained)

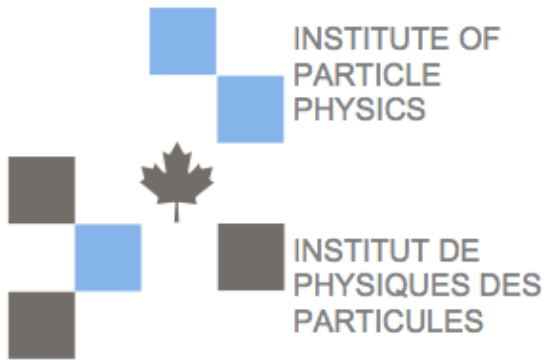
- 1) Profiles of a sample of HQP that have been trained in past. Use this section to highlight a few exceptional examples of HQP training and list all HQP trained in Table 2 (see below),
- 2) Role of the project in fostering physics education in general;
- 3) Public education and outreach associated with the project;
- 4) Application of particle physics research and connections of the project to industry, including existing or potential economic impact that the project may have; and
- 5) Plans to further facilitate greater economic and broader societal impact of the project and the field in general.

Table 2: List of HQP that have been trained on the project over the past 10 years or less. Include name (if possible), dates of training, role in project, what they are doing now


IPP TownHall July 2020


ALL TIMES ARE EDT

Wednesday July 15	Start	End		Thursday July 16	Start	End		Tuesday July 21	Start	End	
11h30-13h30ET	11:30	12:00	Goals of IPP Planning discussion	11h30-13h30ET	11:30	11:45	T2K (D. Harris)	11h30-13h20ET	11:30	12:00	ATLAS (P. Krieger)
	12:00	12:15	DEAP (M. Boulay)		11:45	12:00	HyperKamiokande (M. Hartz)		12:00	12:15	Alex Maloney(McGill) - "Quantum Field Theory and Quantum Gravity"
	12:15	12:30	PICO (C. Krauss)		12:00	12:15	DUNE (N. Ilic)		12:15	12:30	Belle II (C. Hearty)
	12:30	12:45	SuperCDMS (S. Oser)		12:15	12:35	IceCube&P-ONE (R. Moore)		12:30	12:40	Chiral Belle (M. Roney)
	12:45	13:00	Yue Zhang (Carleton) "Novel Aspects of DM Direct Detection"		12:35	12:50	VERITAS (K. Ragan)		12:40	12:50	MOLLER (M. Gericke)
	13:00	13:15	SNO+ (M. Chen)		12:50	13:05	Jean-Francois Fortin (Laval) "Conformal Field Theory"		12:50	13:05	Ruben Sandapen (Acadia) "Hadronic Structure, QCD & BSM"
	13:15	13:30	EXO/nEXO (T. Brunner)		13:05	13:20	MoEDAL (J. Pinfold)		13:05	13:20	NA62 (D. Bryman)
					13:20	13:35	MATHUSLA (M. Diamond)				
	13:30	14:30	BREAK		13:35	14:35	BREAK		13:20	14:20	BREAK
14h30-16h30ET	14:30	14:45	David McKeen (TRIUMF) "New physics in hidden sectors"	14h30-16h30ET	14:35	14:50	Joseph Bramante(Queens) "WIMP Dark Matter and the Next Two Decades"	14h20-16h30ET	14:20	14:35	ILC & Future e+e- Colliders (A. Bellerive)
	14:45	15:00	DarkSide-20K (A. Hallin)		14:50	15:00	ALPHA (M. Fujiwara)		14:35	14:55	Accelerator R&D (O. Kester)
	15:00	15:15	LEGEND-1000 (R. Martin)		15:00	15:10	TUCAN (J. Martin)		14:55	15:15	Broader societal impact & EDI
	15:15	15:25	Scintillating Bubble Chamber (K.Clark)		15:10	15:20	RD50 - detector R&D (T. Koffas)		15:15	15:30	David Curtin(Toronto) "Perspectives on Hidden Sector Searches from Colliders to Astrophysics"
	15:25	15:45	Photon to Digital Converter and Beyond (F. Retiere)		15:20	15:35	MRS + TRIUMF Support (F. Retiere)		15:30	16:30	Forum for Discussion
	15:45	16:05	ACP Report Summary (T. Noble)		15:35	15:45	HEPNET & Computing (R. Sobie)		16:30		CLOSE
	16:05	16:30	Forum for Discussion		15:45	16:30	Forum for Discussion				
	16:30		ADJOURN		16:30		ADJOURN				



Written Submissions

Energy Frontier

ATLAS

Precision Frontier

Belle II

NA62

TUCAN

MOLLER

Neutrino Properties

T2K

HyperK

DUNE

IceCube and P-One

SNO+

nEXO

LEGEND-1000

Written Submissions

Dark Matter Direct Astrophysical Searches

SuperCDMS

PICO

DEAP and Darkside

NEWSG

Dedicated Direct Accelerator Searches for New Physics Particles

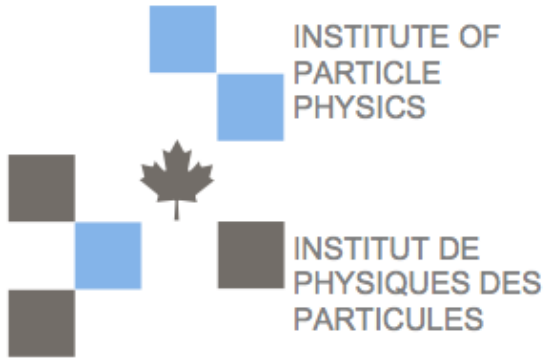
MoEDAL

MATHUSLA

Particle Astrophysics

VERITAS

HALO



Written Submissions

R&D Efforts

ILC and Future Colliders

SuperKEKB e- Beam polarization upgrade: Chiral Belle

Accelerator R&D

Radiation Hard Semiconductor Devices for Future Collider Experiments

Scintillating Bubble Chamber

Photon to Digital Converter R&D and

Silicon Photonics-based low power data comms system

Infrastructure Support

HEPNET and Computing

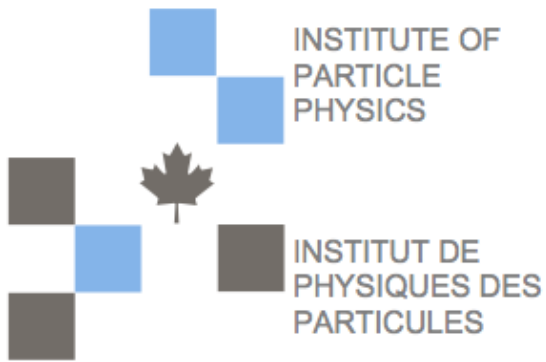
MRS support

Theory

Hadron Structure, QCD and Physics BSM: ATLANTIC Theory Group

Other Submissions

Astroparticle Community Plan



IPP Process and Status for 2022-2026 Long Range Plan

- Briefs, and other feedback, submitted to IPP Writing Committee by end of July
- IPP Writing Committee has begun reviewing the briefs and will produce working draft of IPP LRP document: goal is to ensure it addresses all points in the request from the LRPC and accurately captures the input from the community

The IPP and CINP briefs “must summarize the scientific vision and priorities put forward by the sub-communities they represent and serve, including both experimental and theoretical facets. Overall recommendations may also be included in the briefs. It is expected that each institute will broadly consult with the sub-communities through various formats and ensure a fair and rigorous process. The briefs are to be submitted to the LRP Committee and to NSERC no later than December 1, 2020.”

Big Questions ...

- What is the nature of Dark Matter?
- What is the origin of the matter-antimatter asymmetry in the universe?
- What are the properties of neutrinos?
- What lies behind the Standard Model ?
 - Direct Searches
 - Precision probes (e.g. Higgs, flavour,...)

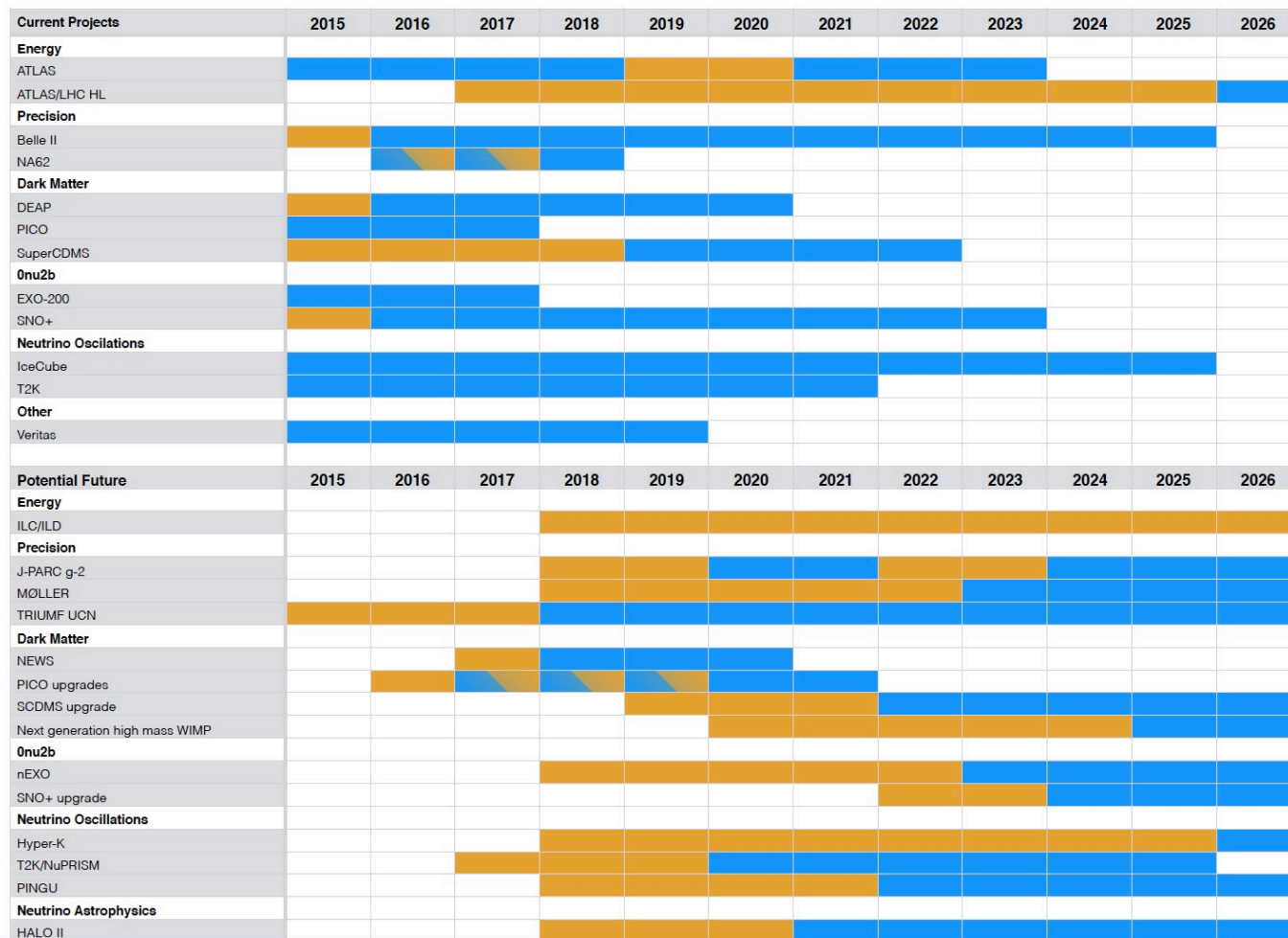
From IPP 2015 LRP Brief...

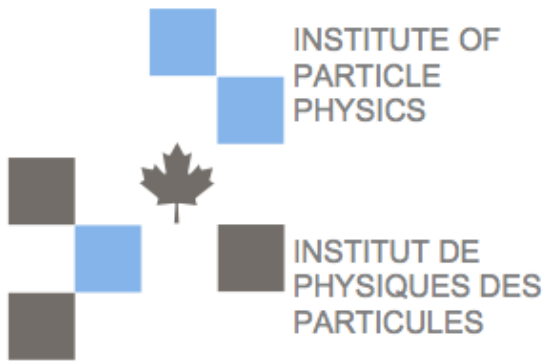
	Fundamental Questions Being Addressed			
	Dark Matter/Sector	New Physics >TeV-scale	matter-antimatter asymmetry	Neutrino Properties
Existing IPP Project				
ATLAS	x	x	x	
Belle II	x	x	x	
DEAP	x			
EXO			x	x
IceCube	x			x
NA62		x		
PICO	x			
SNO+			x	x
SuperCDMS	x			
T2K			x	x
VERITAS	x			
Potential New Projects				
g-2 E34 (J-PARC)		x		
HALO				x
MOLLER		x		
UCN at TRIUMF			x	
Hyper-Kamiokande	x	x	x	x
NEWS	x			
ILD/ILC	x	x	x	

Table 1: Most important fundamental questions in particle physics and which IPP Projects and potential future projects address them.

From IPP 2015 LRP Brief...

Figure 1: Timelines of experimental projects. Blue corresponds to physics data-taking, while orange corresponds to funded construction following formal approval of a project.





IPP Process and Status for 2022-2026 Long Range Plan

IPP Writing Committee has identified the need to solicit additional information from the community:

Fully understanding the synergies, including technical and scientific expertise and interests, across the program will require additional information – related to question of how our community is positioning itself to participate at future colliders

Impact of COVID19 on the plans of each project

Collect additional, more detailed, information on overall computing needs of the community in the future – to be used to engage with New Digital Research Infrastructure Organization

In addition, more information about the outreach efforts by Canadian particle physicists that address matters related to equity, diversity and inclusion efforts is needed

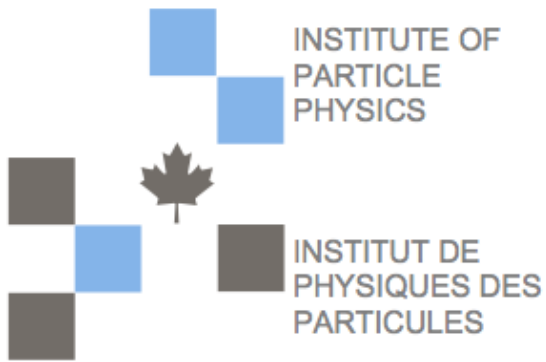
IPP Process and Status for 2022-2026 Long Range Plan

NEXT STEPS and SCHEDULE

- Committee is meeting through summer and early autumn to work on document – goal to circulate to the community by Nov 1 and solicit feedback from the community
- There will be a second ‘virtual’ IPP Town Hall meeting in the autumn to facilitate final community discussion and input to the document
- Finalize and submit the IPP LRP Brief to the LRPC no later than 1 December 2020

Continuing the discussions...

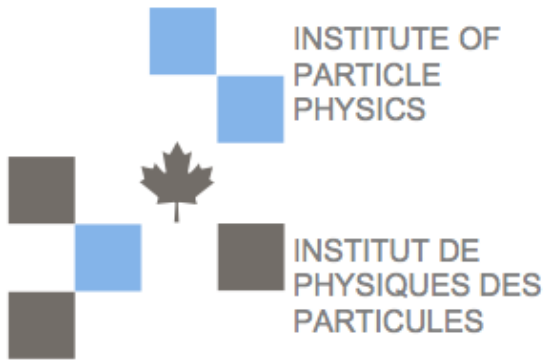
- IPP Members asked to consider and discuss:
 - their own future research interests going forward
 - their priorities are for IPP, what is valued
 - RS Program; conference support; summer student program; early career theory fellowship ...
 - What they see as the broad priorities regarding resource allocation for particle physics in Canada
- IPP Members asked to:
 - Share their research aspirations with IPP Council members
 - Consider opportunities further collaboration between individuals and projects
 - Use this LRP process as an opportunity to consider ways of improving the processes in our funding system
- The Town Hall provided a first opportunity for formal input into 2022-2026 Long Range Plan for our community via (remote) interactions



IPP and TRIUMF Vision for Next 20 years

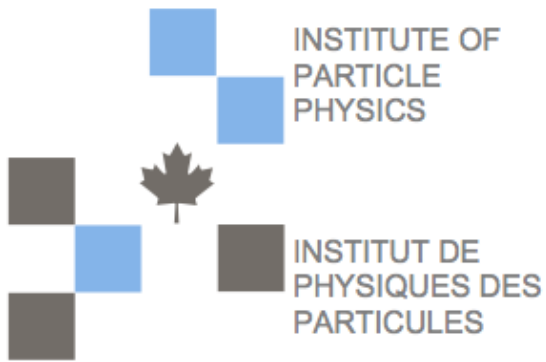
The IPP LRP Brief will provide important input for the Roadmap for a 20-year Vision for TRIUMF

The IPP LRP Brief Writing Committee will take into account TRIUMF's desire to understand the long-term research aspirations of the particle physics community as they relate to TRIUMF's mission in particular in addressing its 20-year Vision



Appendix

LRP 2022-2026 TERMS OF REFERENCE



LRP 2022-2026

TERMS OF REFERENCE

THE LONG-RANGE PLAN FOR CANADIAN SUBATOMIC PHYSICS: 2022-2026

TERMS OF REFERENCE

I. CONTEXT

The Canadian subatomic physics community establishes its scientific, and thus funding, priorities through five-year Long-Range Plans (LRP). These plans advise the Canadian subatomic physics research community and relevant stakeholders on priorities for both current and future endeavours. The most recent Long-Range Plan covered the period 2017-2021, in addition to providing an assumption-based forecast for into 2026. A new LRP exercise is to be conducted. The new plan will be in effect from 2022 through 2026, with its scope extending through 2036. A renewal of this 2022-2026 plan will occur before 2026. The Canadian Subatomic Physics Long-Range 2022-2026 is jointly supported by the Institute of Particle Physics (IPP), the Canadian Institute of Nuclear Physics (CINP) and the Natural Sciences and Engineering Research Council (NSERC). The additional stakeholders, TRIUMF, SNOLAB, the Perimeter Institute and the Canadian Foundation for Innovation (CFI), are supportive of this process.

II. COMMITTEE

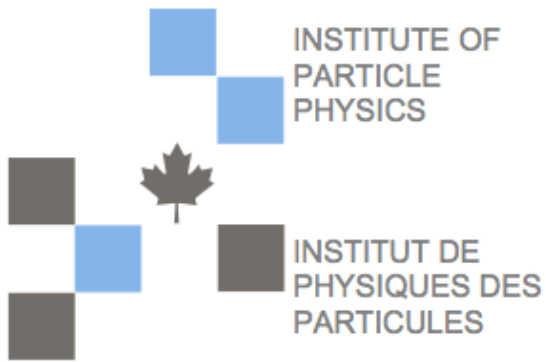
The LRP process will be driven by the Canadian subatomic physics community. A Committee will be asked to review this community's input and to formulate the Long-Range Plan. The LRP Committee will be composed of an appropriate number of experts who will cover the main sub-disciplines of subatomic physics in Canada, including both experimental and theoretical aspects: nuclear physics, nuclear astrophysics, physics of elementary particles and fields, and particle astrophysics. The Committee will be co-chaired by senior members of the research community with an extensive knowledge of the Canadian and international subatomic physics research environments. The membership may have some overlap with that of the previous LRP Committee to ensure continuity.

The following representatives from the LRP commissioning bodies will be non-voting members on the LRP Committee.

- Director of the Institute of Particle Physics
- Executive Director of the Canadian Institute of Nuclear Physics
- NSERC Team Leader working with subatomic physics
- Co-Chairs of the NSERC Subatomic Physics Evaluation Section for 2020-2021

In addition, the LRP Committee will invite *ex officio* members who will be non-voting observers and resources for the other members:

- TRIUMF Director
- SNOLAB Director
- Perimeter Institute representative
- CFI Director of Programs working with subatomic physics



LRP 2022-2026 TERMS OF REFERENCE

The LRP Committee may choose to hold certain closed sessions without the presence of *ex officio* members.

III. MANDATE

Taking into account (i) the ever increasing internationalization of projects and collaborations in addressing the fundamental questions of subatomic physics, (ii) the concurrent requirement to maintain and further develop world-class domestic research programs and infrastructure, (iii) the established expertise and strengths of the Canadian community and (iv) the recognition of the fact that the Canadian subatomic physics community cannot be involved in all research endeavours, the Committee is asked to identify subatomic physics scientific ventures and priorities that should be pursued by the community on a five to fifteen-year horizon and that would ensure continuous Canadian global scientific leadership. Budgetary estimates, both for new capital investments as well as for operations, must be provided as well, including funding ranges for prioritized endeavours. These ranges should include funding levels that would allow for a restrained, yet efficient, contribution to the ventures, as well as levels that would enable a more extensive contribution.

The Committee's assessment will be based on a broad consultation with the Canadian subatomic physics community. The Committee will have to assess the feasibility, technical readiness and risks associated with particular endeavours. It is crucial that such an assessment be made through a fair and rigorous process.

The Committee is also asked to consider and discuss factors that affect the subatomic physics community and to make recommendations on how to possibly lessen any negative impacts they may have, or enhance any positive ones. Examples of such factors include, but are not limited to, various funding opportunities, the relationship between funding agencies and other organizations, the activities of national research organizations, and the international context.

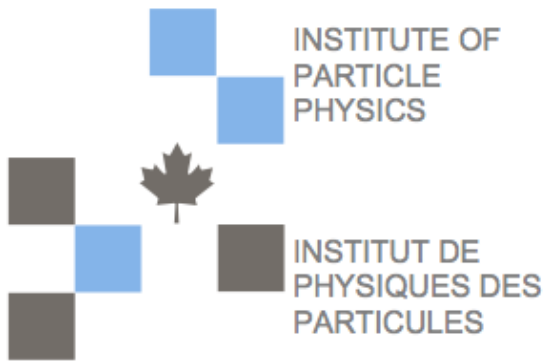
The report should address Equity, Diversity and Inclusion as well as supporting early career researchers within the context of the subatomic physics research community.

IV. PROCESS AND TIMELINE

The LRP Committee membership recruitment will be completed by Spring 2020, and a kickoff meeting will be held immediately after. NSERC staff will coordinate membership recruitment in consultation with the Committee Co-Chairs as well as CINP and IPP.

CINP and IPP will be tasked to prepare briefs for the LRP Committee. These briefs must summarize the scientific vision and priorities put forward by the sub-communities they represent and serve, including both experimental and theoretical facets. Overall recommendations may also be included in the briefs. It is expected that each institute will broadly consult with the sub-communities through various formats and ensure a fair and rigorous process. The briefs are to be submitted to the LRP Committee and to NSERC no later than December 1, 2020. The Institutes must ensure that the briefs are available to the entire community through their public Web sites. Eventual responses to the briefs by individuals or organizations would be accepted. Throughout the process, the LRP Committee may also solicit additional input from various sources, as it sees fit.

The LRP Committee will hold public consultations (town hall meetings) in early 2021, after receiving the briefs. Face-to-face or phone meetings of the Committee will then be held up to the Summer of 2021.



LRP 2022-2026 TERMS OF REFERENCE

V. Deliverables

The LRP Committee will submit its final report to NSERC, CINP and IPP no later than September 30th, 2021. The report will be publicly released, thereafter, in both official languages.

VI. CONFLICTS OF INTEREST AND CONFIDENTIALITY

All members must strictly comply with the Code of Ethics and Business Conduct for Members of NSERC Standing and Advisory Committees. Moreover, for the purpose of this exercise, a member will be considered to be in a situation of conflict of interest during a discussion on prioritization of a specific endeavour that would directly benefit the member or the member's organization.
