

BPUII Congress 2022 - Round Table I

HEP Roadmaps to the future

QUARKS			LEPTONS			GAUGE BOSONS		
UP mass 2,3 MeV/c ² charge 2/3 spin 1/2	CHARM 1,275 GeV/c ² 2/3 1/2	TOP 173,07 GeV/c ² 2/3 1/2	DOWN 4,8 MeV/c ² -1/3 1/2	STRANGE 95 MeV/c ² -1/3 1/2	BOTTOM 4,18 GeV/c ² -1/3 1/2	GLUON 0 0 1	PHOTON 0 0 1	HIGGS BOSON 126 GeV/c ² 0 0
ELECTRON 0,511 MeV/c ² -1 1/2	MUON 105,7 MeV/c ² -1 1/2	TAU 1,777 GeV/c ² -1 1/2	ELECTRON NEUTRINO <2,2 eV/c ² 0 1/2	MUON NEUTRINO <0,17 MeV/c ² 0 1/2	TAU NEUTRINO <15,5 MeV/c ² 0 1/2	Z BOSON 91,2 GeV/c ² 0 1	W BOSON 80,4 GeV/c ² ±1 1	

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu}^a F_{\mu\nu}^a + i\bar{\psi}D\psi + \bar{\psi}_i \lambda_{ij} \psi_j + h.c. + |D_{\mu}h|^2 - V(h)$$



Distinguished panelists



Prof. Dr. Joachim Mnich, CERN & DESY
Director of Research and Computing at CERN
former Research Director at DESY



Prof. Dr. Paris Sphicas, CERN & NKU Athens
Fellow of the Royal Society
former Deputy Spokesperson of CMS Experiment



Prof. Dr. Emmanuel Tsesmelis, CERN & Oxford
Head of Relations with Associate Members
and Non-Member States at CERN



Discussion topics

Roadmaps for the R&D of accelerator / detector technologies for HEP

Future of the Particle Physics research

Future projects and international collaboration in HEP

Discussions should try to address the aspects and questions relevant to the researchers and institutions from the BPU countries.

Category	Particle	Mass	Charge	Spin	Symbol
QUARKS	UP	2,3 MeV/c ²	2/3	1/2	u
	DOWN	4,8 MeV/c ²	-1/3	1/2	d
	STRANGE	95 MeV/c ²	-1/3	1/2	s
	CHARM	1,275 GeV/c ²	2/3	1/2	c
	BOTTOM	4,18 GeV/c ²	-1/3	1/2	b
	TOP	173,0 GeV/c ²	2/3	1/2	t
LEPTONS	ELECTRON	0,511 MeV/c ²	-1	1/2	e
	MUON	105,7 MeV/c ²	-1	1/2	μ
	TAU	1,777 GeV/c ²	-1	1/2	τ
	ELECTRON NEUTRINO	<2,2 eV/c ²	0	1/2	ν _e
	MUON NEUTRINO	<0,17 MeV/c ²	0	1/2	ν _μ
	TAU NEUTRINO	<15,5 MeV/c ²	0	1/2	ν _τ
GAUGE BOSONS	PHOTON	0	0	1	γ
	Z BOSON	91,2 GeV/c ²	0	1	Z
	W BOSON	80,4 GeV/c ²	±1	1	W
	HIGGS BOSON	125 GeV/c ²	0	0	h

$$\frac{1}{4} F_a F_a \mu\nu + i\bar{\psi}D\psi + \bar{\psi}i\gamma_5\psi + h.c. + |D_\mu h|^2 - V(h)$$



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Opening questions

QUARKS			LEPTONS			GAUGE BOSONS		
UP mass 2,3 MeV/c ² charge 2/3 spin 1/2	CHARM 1,275 GeV/c ² 2/3 1/2	TOP 173,07 GeV/c ² 2/3 1/2	DOWN 4,8 MeV/c ² -1/3 1/2	STRANGE 95 MeV/c ² -1/3 1/2	BOTTOM 4,18 GeV/c ² -1/3 1/2	GLUON 0 0 1	PHOTON 0 0 1	HIGGS BOSON 126 GeV/c ² 0 0
ELECTRON 0,511 MeV/c ² -1 1/2	MUON 105,7 MeV/c ² -1 1/2	TAU 1,777 GeV/c ² -1 1/2	ELECTRON NEUTRINO <2,2 eV/c ² 0 1/2	MUON NEUTRINO <0,17 MeV/c ² 0 1/2	TAU NEUTRINO <15,5 MeV/c ² 0 1/2	Z BOSON 91,2 GeV/c ² 0 1	W BOSON 80,4 GeV/c ² ±1 1	

$$\mathcal{L} = -\frac{1}{4} F_a^{\mu\nu} F_{a\mu\nu} + i\bar{\psi}D\psi + \psi_i \lambda_{ij} \psi_j + h.c. + |D_\mu h|^2 - V(h)$$

Theme: accelerators, detectors, new technologies

Implementation of the ECFA roadmaps for detector/accelerator R&D, and need for **international large-scale collaborations for long-term R&D** on complex detector and accelerator technologies. **Opportunities for local BPU institutions.**

QUARKS		LEPTONS		GAUGE BOSONS		HIGGS BOSON
UP	DOWN	ELECTRON	ELECTRON NEUTRINO	GLUON	PHOTON	H
mass 2,3 MeV/c ²	4,8 MeV/c ²	0,511 MeV/c ²	<2,2 eV/c ²	0 0 1	0 0 1	126 GeV/c ²
charge 2/3	-1/3	-1	0	g	γ	0
spin 1/2	1/2	1/2	1/2	0	0	0
u	d	e	ν _e			
CHARM	STRANGE	MUON	MUON NEUTRINO			
1,275 GeV/c ²	95 MeV/c ²	105,7 MeV/c ²	<0,17 MeV/c ²			
2/3	-1/3	-1	0			
1/2	1/2	1/2	1/2			
c	s	μ	ν _μ			
TOP	BOTTOM	TAU	TAU NEUTRINO			
173,07 GeV/c ²	4,18 GeV/c ²	1,777 GeV/c ²	<15,5 MeV/c ²			
2/3	-1/3	-1	0			
1/2	1/2	1/2	1/2			
t	b	τ	ν _τ			
Z BOSON	W BOSON					
91,2 GeV/c ²	80,4 GeV/c ²					
0	±1					
1	1					
Z	W					

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + \psi_i \lambda_{ij} \psi_j h + h.c. + |D_\mu h|^2 - V(h)$$



Theme: future of particle physics

Successfulness and incompleteness of the standard models of particle physics and cosmology and **the key open questions/challenges.**

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ELECTRON 0,511 MeV/c ² -1 1/2	MUON 105,7 MeV/c ² -1 1/2	TAU 1,777 GeV/c ² -1 1/2	ELECTRON NEUTRINO <2,2 eV/c ² 0 1/2	MUON NEUTRINO <0,17 MeV/c ² 0 1/2	TAU NEUTRINO <15,5 MeV/c ² 0 1/2	W BOSON 80,4 GeV/c ² ±1 1		
u	c	t	d	s	b	γ	Z	H

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + \bar{\psi}_i \lambda_{ij} \psi_j + h.c. + |D_{\mu}h|^2 - V(h)$$



Theme: international collaboration & future projects

Current status and opportunities for **improvement of the collaboration of CERN with its member and non-member-state BPU countries** (in the domains of research, industry, education).

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ELECTRON 0,511 MeV/c ² -1 1/2 e	MUON 105,7 MeV/c ² -1 1/2 μ	TAU 1,777 GeV/c ² -1 1/2 τ	ELECTRON NEUTRINO <2,2 eV/c ² 0 1/2 ν_e	MUON NEUTRINO <0,17 MeV/c ² 0 1/2 ν_μ	TAU NEUTRINO <15,5 MeV/c ² 0 1/2 ν_τ	HIGGS BOSON 126 GeV/c ² 0 0 H	W BOSON 80,4 GeV/c ² ±1 1 W	

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + i\bar{\psi} D\psi + \bar{\psi}_i \lambda_{ij} \psi_j + h.c. + |D_\mu h|^2 - V(h)$$



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Audience questions

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Thank you for your participation!

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UP mass 2,3 MeV/c ² charge 2/3 spin 1/2 u	CHARM 1,275 GeV/c ² 2/3 1/2 c	TOP 173,07 GeV/c ² 2/3 1/2 t	DOWN 4,8 MeV/c ² -1/3 1/2 d	STRANGE 95 MeV/c ² -1/3 1/2 s	BOTTOM 4,18 GeV/c ² -1/3 1/2 b	MUON 105,7 MeV/c ² -1 1/2 μ	ELECTRON 0,511 MeV/c ² -1 1/2 e	TAU 1,777 GeV/c ² -1 1/2 τ	MUON NEUTRINO <0,17 MeV/c ² 0 1/2 ν_μ	TAU NEUTRINO <15,5 MeV/c ² 0 1/2 ν_τ	ELECTRON NEUTRINO <2,2 eV/c ² 0 1/2 ν_e

GAUGE BOSONS		
GLUON 0 0 1 g	PHOTON 0 0 1 γ	Z BOSON 91,2 GeV/c ² 0 1 Z
HIGGS BOSON 126 GeV/c ² 0 0 H	W BOSON 80,4 GeV/c ² ±1 1 W	

$$\mathcal{L} = -\frac{1}{4} F_a^{\mu\nu} F_{a\mu\nu} + i\bar{\psi}D\psi + \psi_i \lambda_{ij} \psi_j + h.c. + |D_\mu h|^2 - V(h)$$

