FCC Temelli Enerji Ön-cephesi Lepton-Hadron Çarpıştırıcıları

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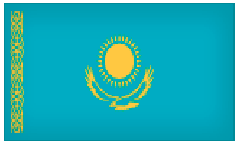
Azerbaycan Elmler Akademiyası **Fizika İnstitutu**
CERN ATLAS, LHeC and FCC Collaborations
Member of Plenary ECFA (Jan 2018 – Jul 2020)






...

Yarının ilmi nedir, halbuki? Gayet müthiş!
"Maddenin kudret-i zerriyesi" uğraştığı iş, ***Safahat (1919)***

1870's: Mendeleyev Table

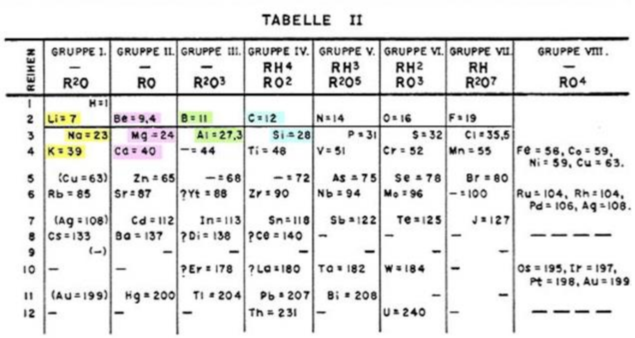
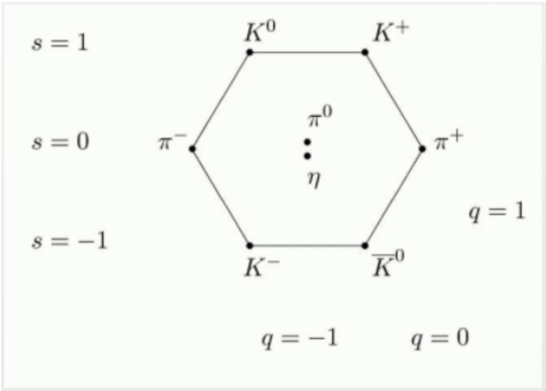


TABELLE II

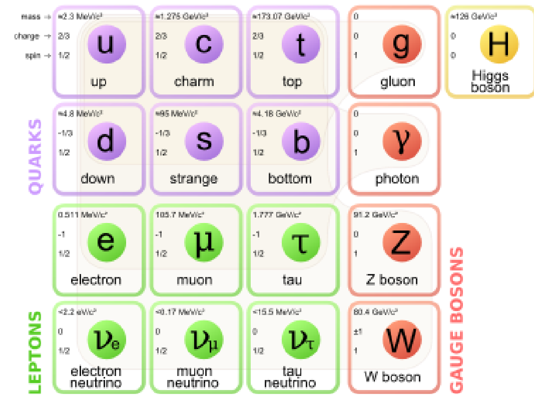
REIHEN	GRUPPE I. — R^2O	GRUPPE II. — RO	GRUPPE III. — R^2O^3	GRUPPE IV. RH^4 RO^2	GRUPPE V. RH^3 R^2O^5	GRUPPE VI. RH^2 RO^3	GRUPPE VII. RH R^2O^7	GRUPPE VIII. — RO^4
1	H = 1							
2	Li = 7	Be = 9,4	B = 11	C = 12	N = 14	O = 16	F = 19	
3	Na = 23	Mg = 24	Al = 27,3	Si = 28	P = 31	S = 32	Cl = 35,5	
4	K = 39	Ca = 40	— = 44	Ti = 48	V = 51	Cr = 52	Mn = 55	Fe = 56, Co = 59, Ni = 59, Cu = 63.
5	(Cu = 63)	Zn = 65	— = 68	— = 72	As = 75	Se = 78	Br = 80	
6	Rb = 85	Sr = 87	?Yt = 88	Zr = 90	Nb = 94	Mo = 96	— = 100	Ru = 104, Rh = 104, Pd = 106, Ag = 108.
7	(Ag = 108)	Cd = 112	In = 113	Sn = 118	Sb = 122	Te = 125	J = 127	
8	Cs = 133	Ba = 137	?Di = 138	?Ce = 140	—	—	—	— — — —
9	(—)	—	—	—	—	—	—	
10	—	—	?Er = 178	?La = 180	Ta = 182	W = 184	—	Os = 195, Ir = 197, Pt = 198, Au = 199
11	(Au = 199)	Hg = 200	Tl = 204	Pb = 207	Bi = 208	—	—	
12	—	—	—	Th = 231	—	U = 240	—	— — — —

Figure 2.5 Dmitri Mendeleev's 1872 periodic table. The spaces marked with blank lines represent elements that Mendeleev deduced existed but were unknown at the time, so he left places for them in the table. The symbols at the top of the columns (e.g., R^2O and RH^4) are molecular formulas written in the style of the 19th century.

1960's: Eight-fold Way



Today: Family Replication



Asım'ın nesline çağrı

Sen geçenlerde demiştin ki:
"Yazık hâlâ biz,
Dünkü ilmin bile bîgânesiyiz, câhiliyiz.
İşte fıkdânı bu ihmâl edilen ma'rifetin,
Nesli bir acze düşürmüş ki, bugün, memleketin,
Bir yığın kuvveti var, hem ne tabî'î de, henüz,
Biz o kuvvetlere eller gibi hâkim değiliz.

Yarının ilmi nedir, halbuki? Gâyet müdhiş:
"Maddenin kudre-i zerriyyesi" uğraştığı iş.
O yaman kudrete hâkim olabilsem diyerek,
Sarf edip durmada birçok kafa binlerce emek.
Onu bir buldu mu, artık bu zemin; Başka zemin.
Çünkü bir damla kömürden edecekler te'min;
Öyle milyonla değil, nâ-mütenâhî kudret!.."

İbret al kendi sözünden, aman oğlum, gayret!

Nükleer

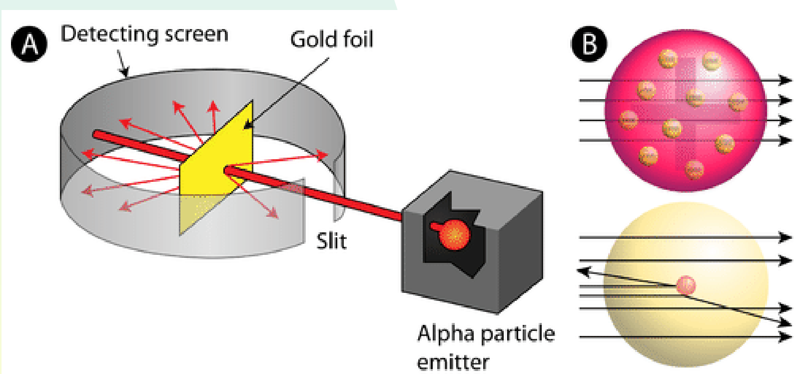
CERN, TAC ve ötesi

Aldık mı?

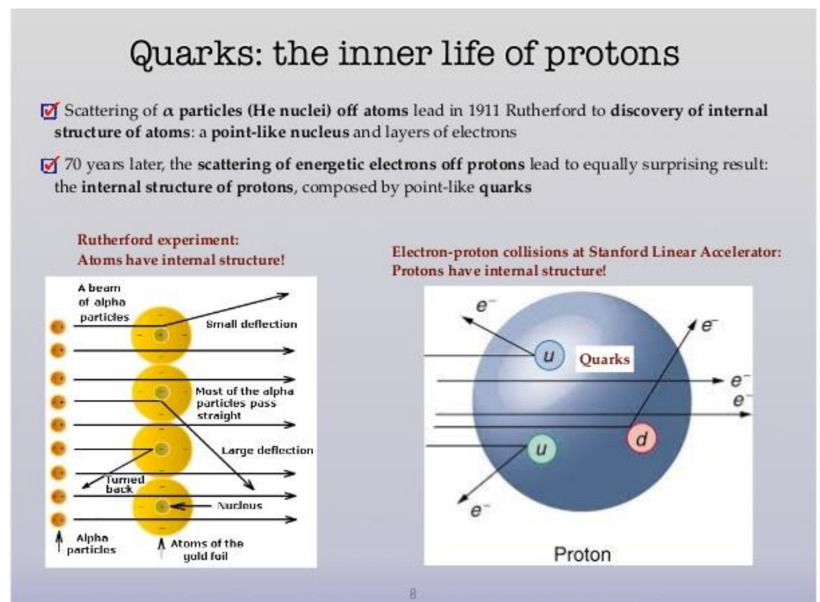
TENMAK Yönetimine Öneri: Sonbaharda Türk Devletleri Teşkilatı himayesinde 'CERN ve Türk Dünyası' çalıştayı düzenleyelim.

✡«Maddenin kudret-i zerriyesi» ile ilgili bilgilerin gelişimi
✡Asım'ın nesli bu tabloyu anlamalıdır !

Aşamalar	1870'ler – 1930'lar	1950'ler – 1970'ler	1980'ler – 2030'lar
Temel öğe enflasyonu	Kimyasal elementler	Hadronlar	Kuarklar, leptonlar
Sistematik	Periyodik Tablo	Sekiz-katlı yol	Aile kopyalaması
Doğrulanan öngörüler	Yeni elementler	Yeni hadronlar	e8, μ8, q6, e*, μ*, … ?
Açıklayıcı deneyler	Rutherford	SLAC DIS	LHC veya FCC/SppC ?
Yapı taşları	p, n, e	Kuarklar	Preonlar ?
Enerji skalası	MeV	GeV	TeV ?
Teknolojiye etkisi	İstisnai !!!	Dolaylı	İstisnai ?



✡Son yüz yılın bilimi ve yüksek teknolojisi Rutherford deneyinin sonuçlarına dayanıyor !!!



Lepton-Hadron Çarpıştırıcılarının Önemi

1. Kuvvetli etkileşmelerin anlaşılması: kuark → hadron → çekirdek

- H-bozonun keşfi ile Standart Modelin elektro-zayıf etkileşmeleri kısmı tamamlandı.
- QCD kısmının tamamlanması için:
  - a) confinement'in doğasını *
  - b) kuark → hadron geçişini

  anlamalıyız.

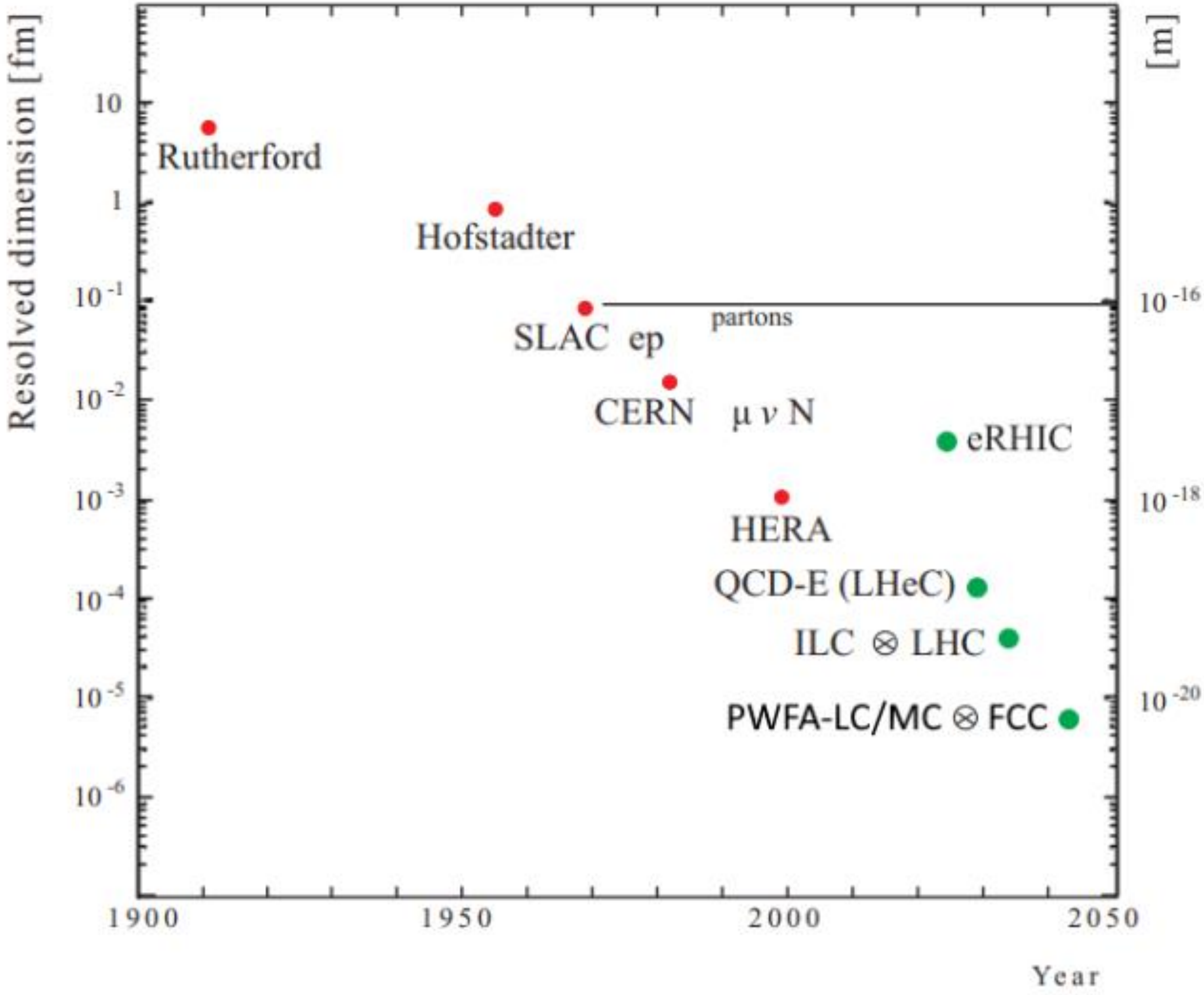
2. Hadron çarpıştırıcıları için pdf'lerin temini

- HERA verileri olmadan LHC (ve Tevatron) verilerinin ayrıntılı analizi mümkün olmazdı

3. Enerji ön-cephesi lepton-hadron çarpıştırıcıları birçok SM ötesi fenomeninin araştırılması için avantajlıdır

- LHC, ILC ve ILC×LHC karşılaştırması

* Confinement kısmi olabilir ve çok yüksek enerjilerde kuarklar serbest hale gelebilir. Bunun pp'de gözlenmesi çok zor! Bu açıdan l^+l^- ve lp çarpıştırıcıları avantajlıdır.



Rutherford deneyinden FCC temelli lepton-hadron çarpıştırıcılarına kadar maddenin iç yapısını araştıran deneylerin çözünürlük gücünün zaman içindeki gelişimi.

FCC based Lepton-Hadron and Photon-Hadron Colliders: Luminosity And Physics

Saleh Sultansoy *

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Azerbaijan Academy of Sciences, Institute of Physics, Baku
ATLAS, LHeC and FCC Collaborations, CERN

* with A. Akay, Y. Acar, S. Beser, U. Kaya and B. Oner

What is the science of tomorrow? Pretty awesome!
"Power of particles of the substance" engaged in the business ...
Mehmet Akif ERSOY, Safahat (1919); great poet and philosopher
The author of the words of the Turkish National Anthem

- Turkey is an Associate Member of CERN since April 2015
- Azerbaijan has applied for associate membership in September 2015
- TOBB ETÜ is member of FCC Collaboration since September 2015

Dedicated to the memory of Professors Engin Arık and Bjorn Wiik

1948 - 2007

1937 -1999

Construction of future electron-positron colliders (or dedicated electron linac) and muon colliders tangential to Future Circular Collider will give opportunity to **utilize highest energy proton and nucleus beams for lepton-hadron and photon-hadron** collisions.

LC×FCC = LC + FCC + ep + eA + γp + γA + FEL γA

μC×FCC = μC + FCC + μp + μA

Contents

Linac-Ring Type Colliders
- Second Way to TeV Scale (→ Appendix 1)
- LHC, ILC and ILC×LHC comparison

Physics
- SM: Triumph and Challenges (→ Appendix 2)
- BSM: standard extensions (→ Appendix 2)
- BSM: radical extensions (→ Appendix 2)
- BSM: «unexpected» new physics (→ Appendix 2)

FCC based
- ep and eA colliders
- γp and γA colliders
- FEL γA colliders
- μp and μA colliders

Process example: color octet electron

Dreams for 2030'ies

FCC Workshop @ CERN, 16-20 January 2017

Exploration of preonic models at the FCC based pp, ep, μp and γp colliders

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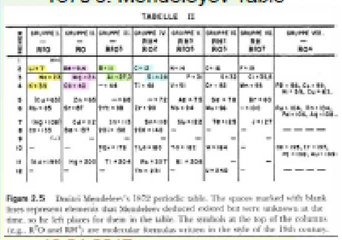
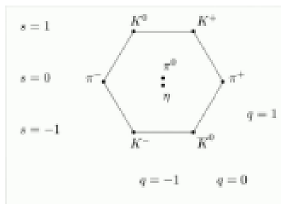
ATLAS, LHeC and FCC Collaborations, CERN

* with Y. Acar, U. Kaya and B. Oner

1870's: Mendeleyev Table



1960's: Eight-fold Way



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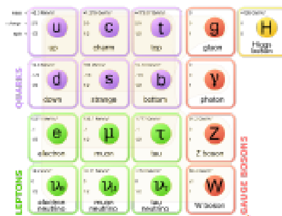


Preface

Higgs boson discovery – triumph of the SM.
But a lot of unsolved problems → BSM models.

1) ν(R) and SM4 are not BSM
- ν(R) is counterpart of d(R). Sea-saw provides small «ν(L)» mass.
- Only minimal SM4 with one Higgs doublet is excluded by the LHC data, 2HDM and doublet-triplet options still survive. General Chiral Fourth Generation cannot be excluded by the LHC.

2) Standard extensions
- Fermion sector, i.e. İnduced by E(6) GUT ore Little Higgs
- Gauge sector (predicted by all GUT's except SU(5)), i.e. Left-Right symmetric models (LR asymmetry posted to Higgs sector, ηR >> ηL)

3) Radical extension
- Compositeness: see next slides
- SUSY: very nice idea, but hundreds free parameters put by hand → thousands if RPV !
- Extra dimensions
- …

Contents

5. Conclusions

LC-FCC and μ-FCC will provide great search potential for a lot of BSM phenomena.

Their potentials are far beyond that of ERL60-FCC and ll colliders and sometimes exceed the FCC pp potential

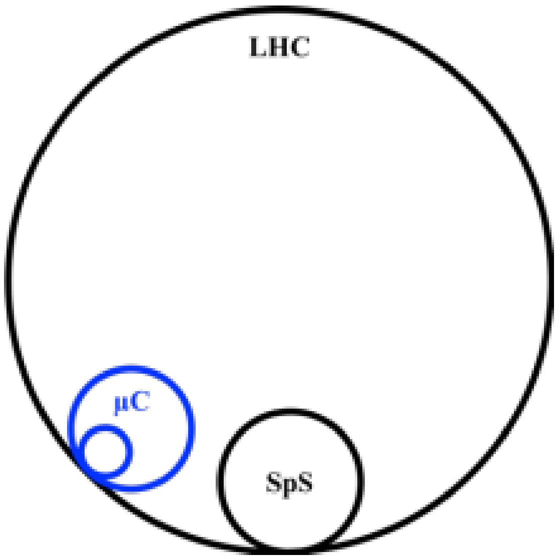
γ options will essentially enlarge the LC-FCC potential

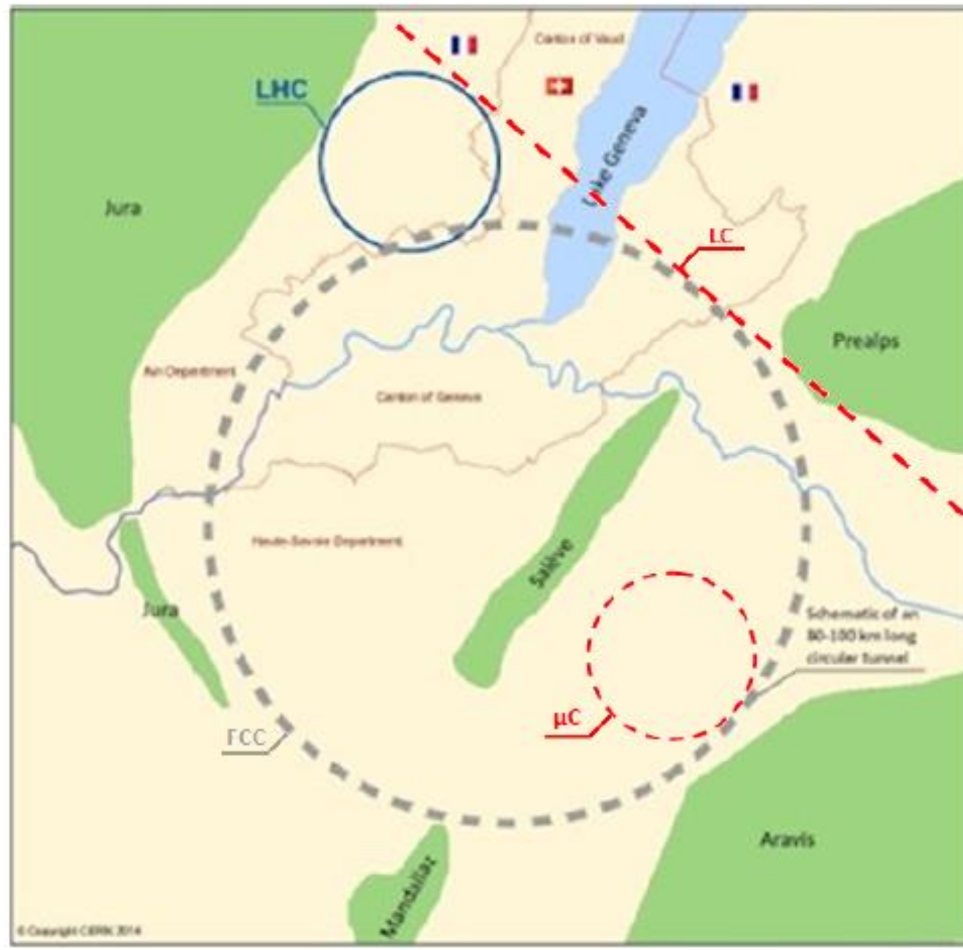
Concerning QCD basics, x up to 10^(-7) will be measured at Q^(2) ≈ 100 GeV^(2)

…

Possible stages for FCC hl colliders are presented in the next slide

Construction of future linear collider (or dedicated e-linac) and muon collider (or dedicated muon ring) tangential to the LHC and FCC will give opportunity to handle multi-TeV center-of-mass energy lepton-hadron collisions at luminosities of order of $10^{33} cm^{-2} s^{-1}$. Proposed colliders have huge potential for clarifying the QCD basics and search for new physics.





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Nuclear Inst. and Methods in Physics Research, A

journal homepage: www.elsevier.com/locate/nima

Future circular collider based lepton–hadron and photon–hadron colliders: Luminosity and physics

Y.C. Acar [a], A.N. Akay [a], S. Beser [a], A.C. Canbay [a,b], H. Karadeniz [c], U. Kaya [a,b], B.B. Oner [a,*], S. Sultansoy [a,d]

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[c] *Giresun University, Giresun, Turkey*
[d] *ANAS Institute of Physics, Baku, Azerbaijan*

A B S T R A C T

Construction of future electron–positron colliders (or dedicated electron linac) and muon colliders (or dedicated muon ring) tangential to Future Circular Collider (FCC) will give opportunity to utilize highest energy proton and nucleus beams for lepton–hadron and photon–hadron collisions. Luminosity values of FCC based ep, μp, eA, μA, γp and γA colliders are estimated. Multi-TeV center of mass energy ep colliders based on the FCC and linear colliders (LC) are considered in detail. Parameters of upgraded versions of the FCC proton beam are determined to optimize luminosity of electron–proton collisions keeping beam–beam effects in mind. Numerical calculations are performed using a currently being developed collision point simulator. It is shown that $L_{ep} \sim 10^{32}$ cm^{-2} s^{-1} can be achieved with LHeC-like upgrade of the FCC parameters. Moreover, "dynamic focusing" scheme could provide opportunity to handle $L_{ep} \gtrsim 10^{33}$ cm^{-2} s^{-1}.

Hindawi
Advances in High Energy Physics
Volume 2017, Article ID 4021493, 6 pages
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Research Article

SppC Based Energy Frontier Lepton-Proton Colliders: Luminosity and Physics

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Main parameters of Super proton-proton Collider (SppC) based lepton-proton colliders are estimated. For electron beam parameters, highest energy International Linear Collider (ILC) and Plasma Wake Field Accelerator-Linear Collider (PWFA-LC) options are taken into account. For muon beams, 1.5 TeV and 3 TeV center of mass energy muon collider parameters are used. In addition, ultimate μp collider which assumes construction of additional 50 TeV muon ring in the SppC tunnel is considered. It is shown that luminosity values exceeding 10^{32} cm^{-2} s^{-1} can be achieved with moderate upgrade of the SppC proton beam parameters. Physics search potential of proposed lepton-proton colliders is illustrated by considering small Björken x region as an example of SM physics and resonant production of color octet leptons as an example of BSM physics.

A LETTERS JOURNAL EXPLORING THE FRONTIERS OF PHYSICS

ACCEPTED MANUSCRIPT

Luminosity and physics considerations on HL-LHC and HE-LHC based μp colliders

Umit Kaya[1], Bora Ketenoglu[2], Saleh Sultansoy[3] and Frank Zimmermann[4]

Accepted Manuscript online 27 January 2022 •

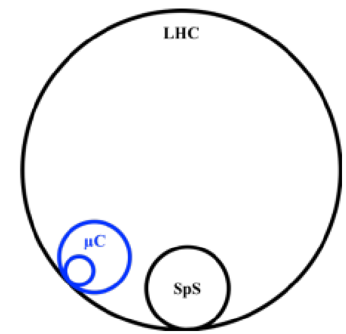

Figure 1. Schematic drawing of proposed μp colliders

Abstract

Construction of future Muon Collider tangential to the Large Hadron Collider will give opportunity to realize μp collisions at multi-TeV center of mass energies. Using the nominal parameters of high luminosity and high energy upgrades of the LHC, as well as the design parameters of muon colliders, it is shown that L_μp of order of 10^33 cm^-2s^-1 is achievable for different options with √s_μp from 4.58 TeV to 12.7 TeV. Certainly, proposed μp colliders have a huge potential for clarifying QCD basics and searches for new physics.

Table 4. Center of mass energies and luminosities of HL-LHC based μp colliders

E_μ, TeV	$\sqrt{s}$, TeV	L (nominal), 10^{33} cm^{-2}s^{-1}	L (upgraded), 10^{33} cm^{-2}s^{-1}
0.75	4.58	0.95	1.4
1.5	6.48	0.84	2.1
3	9.16	0.57	1.5

Table 5. Center of mass energies and luminosities of HE-LHC based μp colliders

E_μ, TeV	$\sqrt{s}$, TeV	L (nominal), 10^{33} cm^{-2}s^{-1}	L (upgraded), 10^{33} cm^{-2}s^{-1}
0.75	6.36	0.59	1.6
1.5	9	0.52	2.8
3	12.7	0.36	1.9

ERLC (Twin LC) and LHC/FCC Based Electron-Proton Colliders

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Abstract

Construction of the ERLC (twin LC) collider tangential to LHC or FCC will give opportunity to realize *ep* collisions at multi-TeV center-of-mass energies. Luminosity estimations show that values well exceeding 10^{34} $cm^{-2}s^{-1}$ can be achieved for HL-LHC, HE-LHC and FCC based *ep* colliders. Certainly, proposed *ep* colliders have great potential for clarifying QCD basics and new physics search in addition to providing precise PDFs for adequate interpretation of LHC and FCC experimental data.

Table 5. *ep* collider parameters for upgraded ERLC and LHC/FCC from Table 3

Parameter [unit]	HL-LHC	HE-LHC	FCC
$\sqrt{S}$ [TeV]	1.87	2.6	5.00
L [$cm^{-2}s^{-1}$]	2.4×10^{34}	3.0×10^{34}	3.3×10^{34}
$\sigma_{x,y}$ at IP [μm]	4.3	4.2	2.5
Disruption, D	12	15	15
Tune Shift, ξ	1.5×10^{-3}	1.2×10^{-3}	1.4×10^{-3}

Table 6. Achievable x Bjorken values at ERLC (ERL60) and LHC/FCC based *ep* colliders.

	HL-LHC	HE-LHC	FCC
$Q^2 = 1$ GeV^2	2.9×10^{-7} (6.0×10^{-7})	1.5×10^{-7} (3.1×10^{-7})	4.0×10^{-8} (8.3×10^{-8})
$Q^2 = 25$ GeV^2	7.3×10^{-6} (1.5×10^{-5})	3.8×10^{-6} (7.8×10^{-6})	1.0×10^{-6} (2.1×10^{-6})

https://arxiv.org/ftp/arxiv/papers/2107/2107.04850.pdf

ERLC (Twin LC) and LHC/FCC Based eA Colliders

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Abstract

Construction of the ERLC (twin LC) collider tangential to LHC or FCC will give opportunity to realize *eA* collisions at multi-TeV center-of-mass energies. Luminosity estimations show that values comparable with that of ERL60 based *eA* colliders are achievable while center of mass energies are essentially higher. Certainly, proposed *eA* colliders have great potential for clarifying QCD basics and nuclear structure.

Table 4. *eA* collider parameters for upgraded ERLC

Parameter [unit]	HL-LHC	HE-LHC	FCC
$\sqrt{S_{eA}}$ [TeV]	16.9	23.5	45.3
L_{eA} [$cm^{-2}s^{-1}$]	$9.04x10^{30}$	$1.70x10^{31}$	$2.32x10^{31}$
$\sigma_{x,y}$ at IP [μm]	$5.94x10^{-6}$	$4.33x10^{-6}$	$2.52x10^{-6}$
Disruption, *D*	0.4	0.7	2.1
Tune Shift, ξ	$1.3x10^{-1}$	$2.0x10^{-1}$	$2.2x10^{-1}$

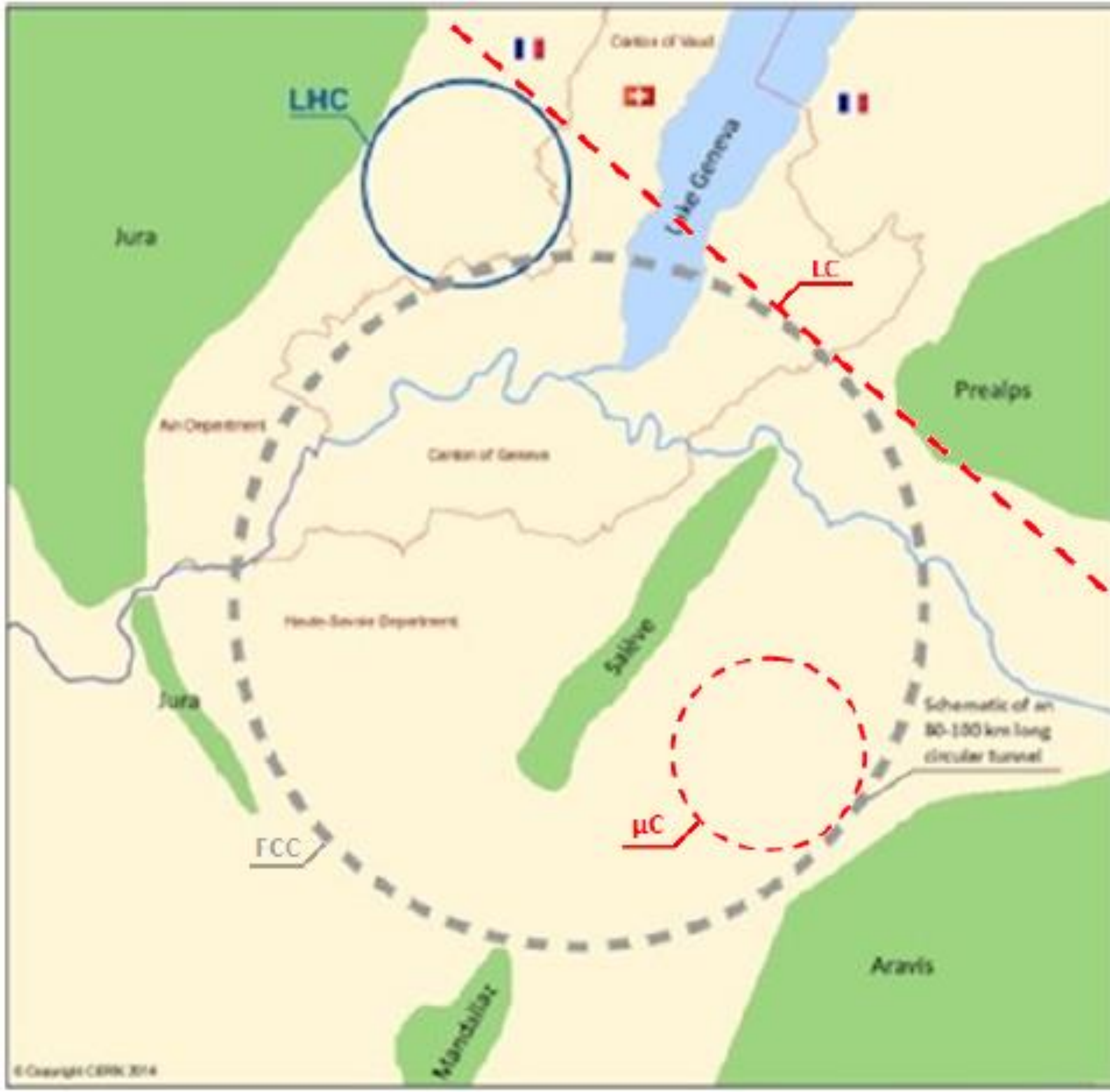
Energy frontier *eA* colliders are a must to providing precision PDFs for adequate interpretation of LHC/FCC *pA* and *AA* experimental data. On the other hand, construction of lepton-nucleus colliders is very important for clarifying QCD basics and nuclear structure. Physics search program of *eA* colliders were widely discussed within LHeC [12] and EIC [13] projects. Several examples are following: physics of non-linear color fields and gluon saturation, particle propagation through matter and transport properties of nuclei, parton fragmentation, production mechanism for quarkonia, confiment mechanism and so on.

https://arxiv.org/ftp/arxiv/papers/2107/2107.08312.pdf

Construction of future electron-positron colliders (or dedicated electron linac) and muon colliders (or dedicated muon ring) tangential to Future Circular Collider will give opportunity to **utilize highest energy proton and nucleus beams** for **lepton-hadron** and **photon-hadron** collisions.

LC×FCC = LC + FCC + ep + eA $+ \gamma p + \gamma A + \mathrm{FEL}\,\gamma A$

$\mu C \times FCC = \mu C + FCC + \mu p + \mu A$



LC×FCC based γp colliders

These machines can be **realised only on the base of linac-ring type** ep colliders
$\sqrt{s}(\gamma p) \sim 0.9\sqrt{s}(ep)$ and $L(\gamma p) \sim 0.6L(ep)$

Nuclear Instruments and Methods in Physics Research A 365 (1995) 317–328

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

ELSEVIER

Main parameters of TeV energy γp colliders

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Received 20 February 1995

Abstract

The main parameters of TeV energy γp colliders have been investigated for HERA+LC, LHC+TESLA and LHC+e-Linac proposals in detail. In this research, the luminosity of γp collisions and the helicity of the high energy γ beam for these colliders are studied in terms of the distance between the conversion region and the collision point as well as γp invariant mass. The main design problems are also discussed.

Available online at www.sciencedirect.com

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Nuclear Instruments and Methods in Physics Research A 576 (2007) 287–293

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

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Conversion efficiency and luminosity for gamma-proton colliders based on the LHC-CLIC or LHC-ILC QCD explorer scheme

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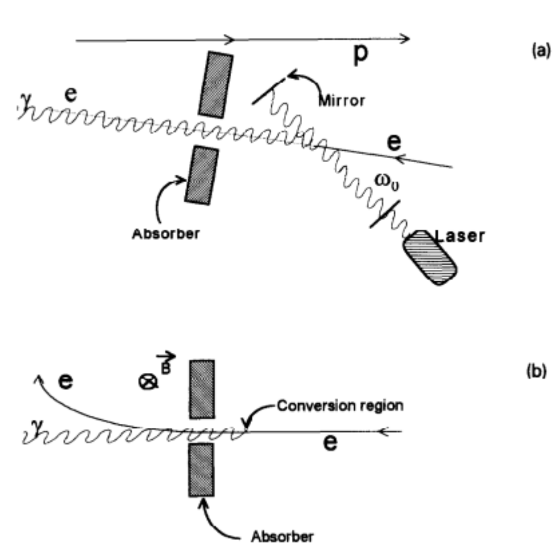
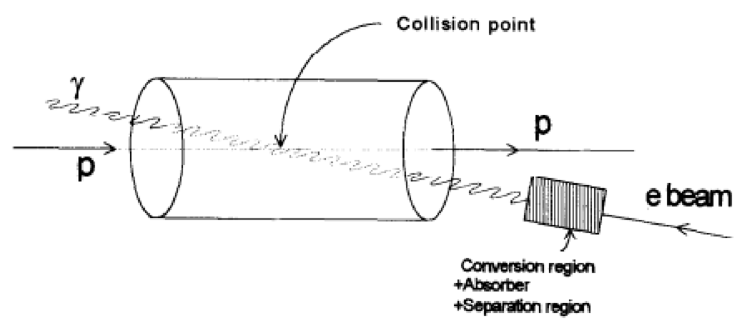


Fig. 16. Schematic view of the part of the design between the conversion region and the detector. (a) Horizontal plane, (b) vertical plane.



According to VMD **γA means ρA collider.** formation of the quark-gluon plasma at very high temperatures but relatively low parton densities

Scenarios for LHC/FCC Based Gamma-Proton Colliders

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[e] *CERN, Switzerland*

Abstract

The advantage of the linac-ring type electron proton collider is that it allows for the straightforward construction of γp collider. In a γp collider high energy photons can be generated from Compton backscattering of laser photons off electrons from a linear accelerator. In this study main parameters of photon-proton colliders based on some future electron linear accelerator projects and protons supplied form LHC or FCC are evaluated.

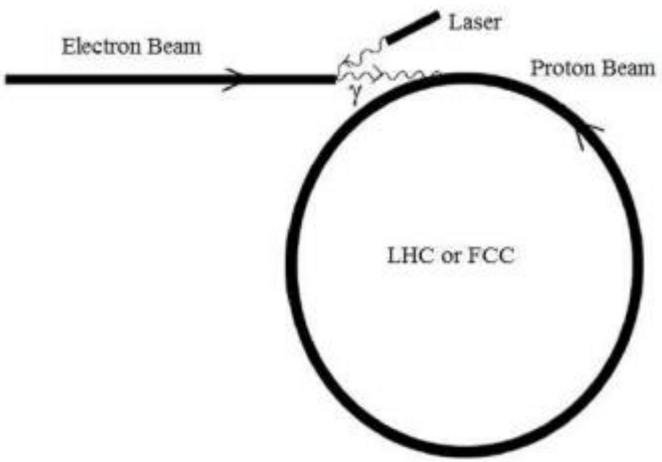


Figure 1: Schematic view of γp colliders.

Table 3: Proposed accelerator parameters for different e-FCC based γp colliders.

Parameters	FCC-eh	CLIC-FCC	ILC-FCC	PWFA-FCC
E_p (TeV)	50	50	50	50
E_e (GeV)	60	60	500	5000
Max. C.M.E (TeV)	3.14	3.14	9	28.7
Bunch spacing (ns)	25	25	366 (350)	2×10^5
Protons per bunch (10^{11})	1.0	1	1.0 (2.2)	1.0 (2.2)
ε_p (μm rad)	2.2	2.2	2.2	2.2
IP β_p^* (cm)	15	15	10	10
Pr. bunch length (mm)	75.5	75.5	75.5	75.5
Electrons per bunch (10^9)	0.045	5.2	17.4	10
Electron current (mA)	0.3	0.64	0.027	0.008
ε_e (μm rad)	5	5	10	50
IP β_e^* (cm)	14	14	40	80
El. bunch length (mm)	0.210	0.21	0.225	0.020
Collision Frequency (s^{-1})	40×10^6	78×10^4	9800	5000
CP to IP distance (cm)	30	30	100	100
Tot. Luminosity ($10^{30} cm^{-2} s^{-1}$)	91.0	200	16	5.2
Lumi. 0.9-1W_{max}($10^{30} cm^{-2} s^{-1}$)	50	114	8.3	1.9

Enerji öncephesi çarpıştırıcılar

Hadron – pp
LHC (HE-LHC), FCC, SppC

Lepton – ee, $\mu\mu$
ee: ILC, CLIC, PWFA-LC
$\mu\mu$

Lepton-hadron ep, μp
ep: LHeC, ILC⊗FCC/SppC, PWFA-LC ⊗FCC/SppC
μp: μ⊗LHC, μ⊗FCC/SppC

Foton-hadron γp
ILC⊗FCC/SppC, PWFA-LC ⊗FCC/SppC

+ p→A

Nuclear Inst. and Methods in Physics Research, A 871 (2017) 47–53

Table 1
Energy frontier colliders: colliding beams vs. collider types.

Colliders	Ring–Ring	Linac–Linac	Linac–Ring
Hadron	+		
Lepton (e^- e^+)		+	
Lepton (μ^- μ^+)	+		
Lepton–hadron (eh)			+
Lepton–hadron (μh)	+		
Photon–hadron			+

Çok sayıda çarpıştırıcı seçeneği var (TAC Super-Charm ve benzeri parçacık fabrikaları dahil). Yeni çarpıştırıcılarla ilgili önerilerde bazen gerçekçi olmayan parametreler öne sürülüyor.

Bu yanlışları gidermek için TOBB ETÜ YEF grubunda çarpıştırıcıların ana parametrelerini hesaplayan AloHEP isimli bir program geliştirildi.

Sunumun son 15 dakikasında Burak Dağlı AloHEP'i tanıtacak

pp, ll, lp/γp karşılaştırması

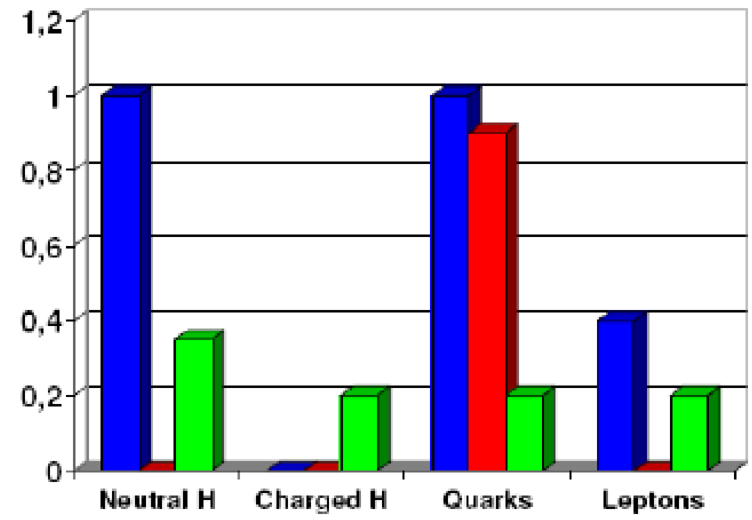
1980'lerde CompHEP bunun için geliştirildi: UNK, VLEPP ve UNK×VLEPP

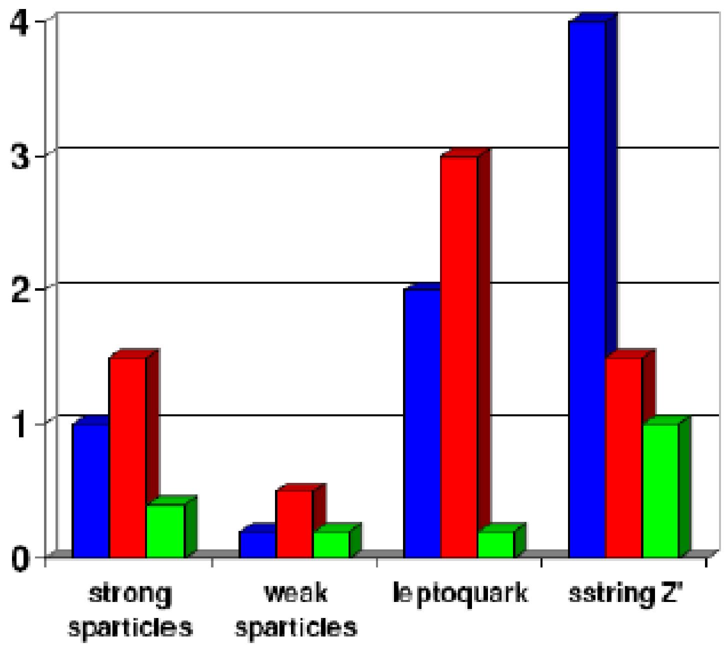
1990'larda AÜ'de bu karşılaştırmayı LHC, ILC ve ILC×LHC için başlattık → LHeC

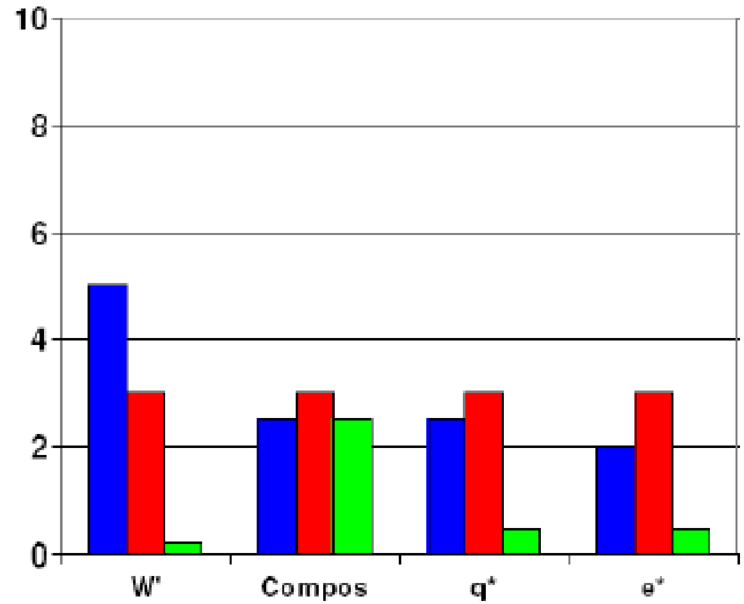
2010'larda Gökhan Ünel'in önderliğinde CutLANG geliştirildi

Benzer sistemli karşılaştırma FCC, LC, μC, LC×FCC ve μC×FCC için yapılmalıdır

Discovery limits in TeV
(rescaled from U. Amaldi 87)

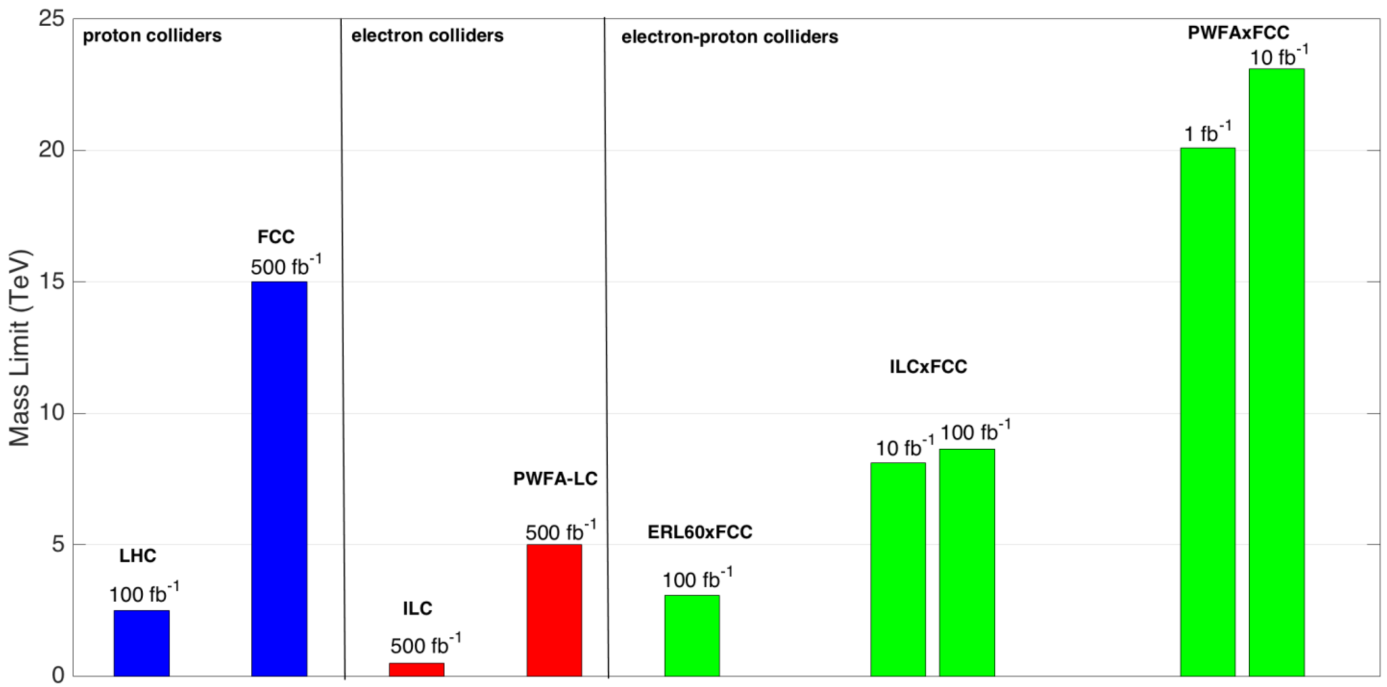






S. Sultansoy 01.09.2009, Divonne 9

Discovery limits for color octet electron ($\Lambda = m_{e8}$)



If FCC will discover e_8, LC×FCC will give opportunity to determine Lorentz structure of e_8-e-g vertex using longitudinal polarization of electron beam, as well as to probe compositeness scale up to hundreds TeV.

Otherwise, PWFA-LC×FCC will discover e_8, if its mass is below 25 TeV.

Similar situation for a lot of BSM phenomena (i.e. LQ, RPV, l* etc)

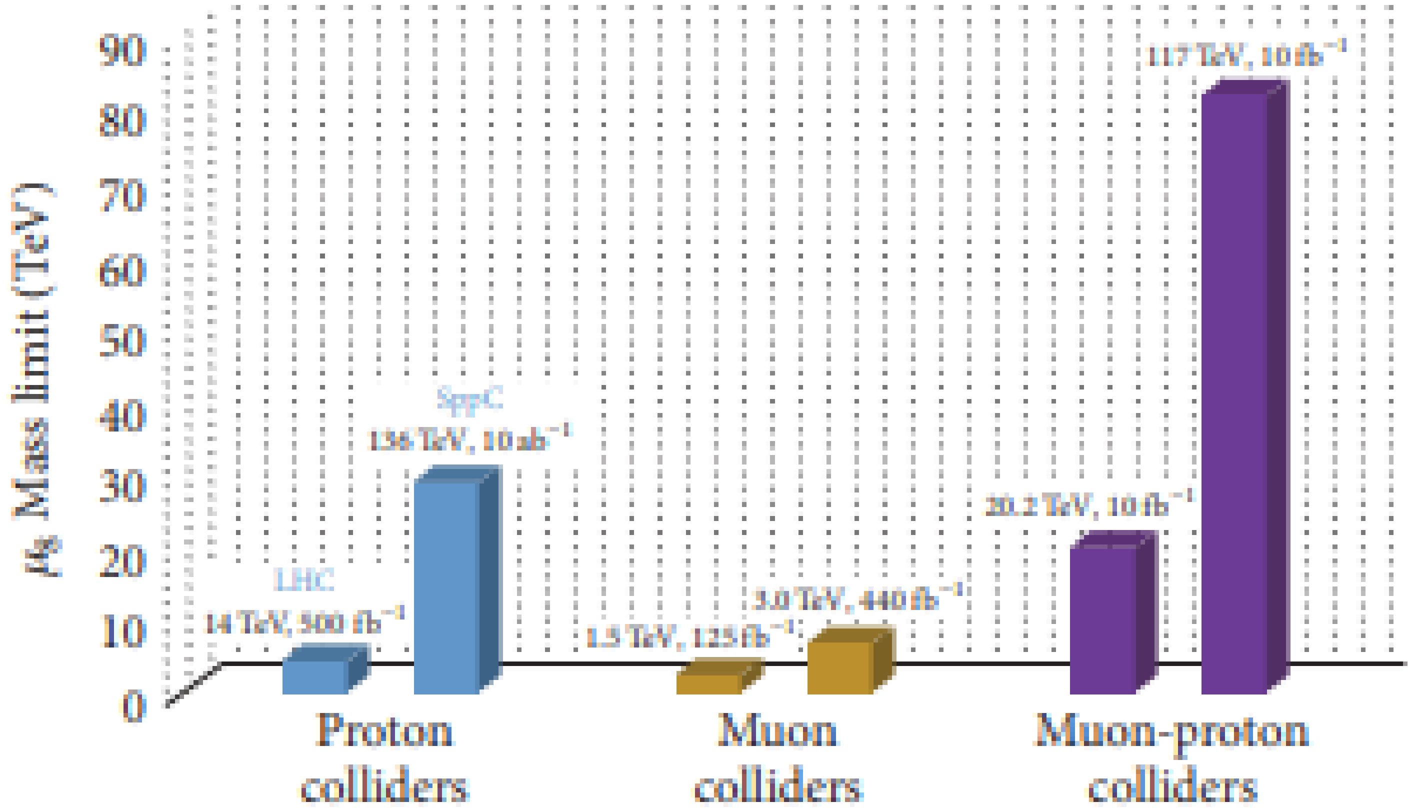
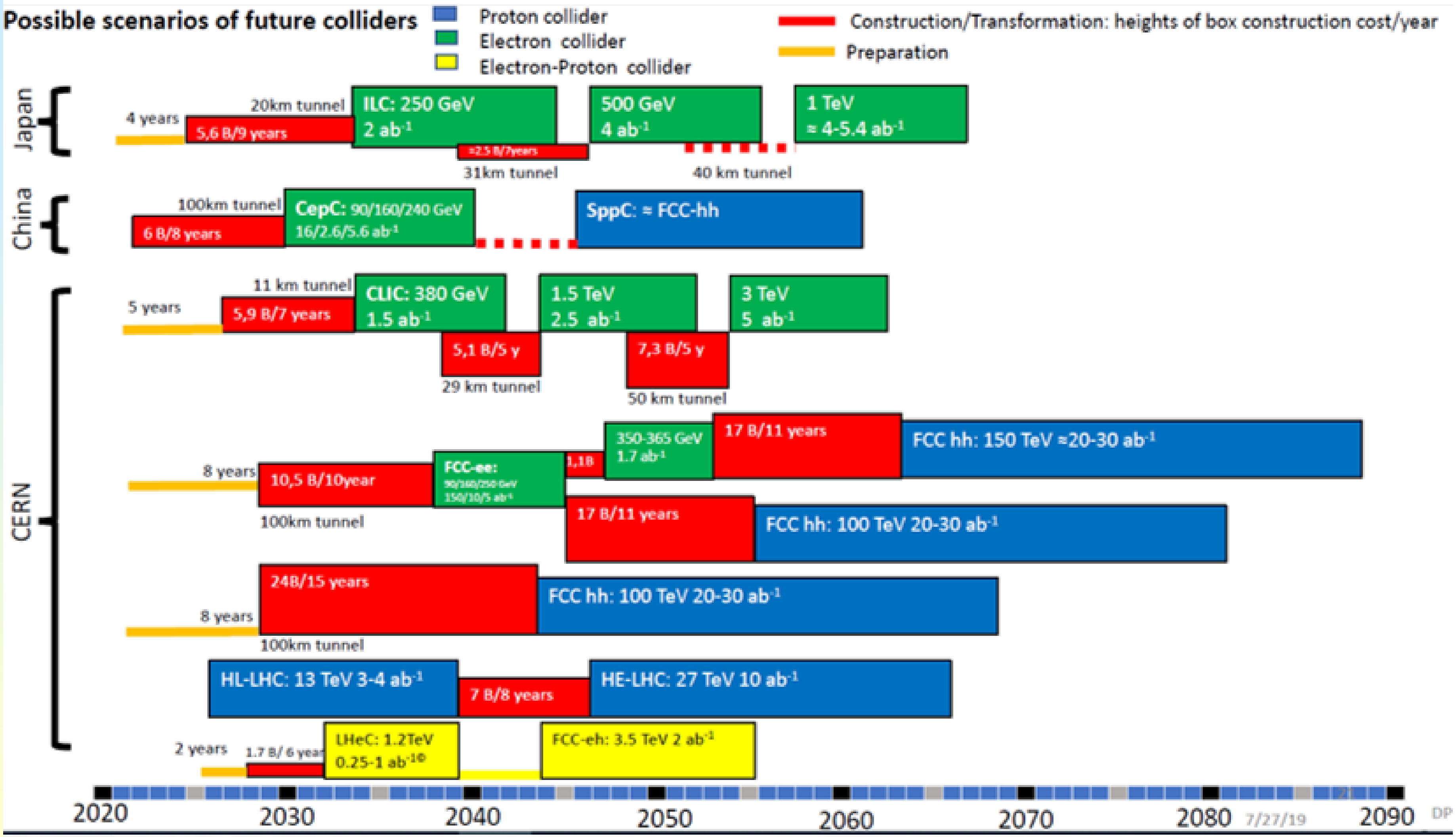


FIGURE 3: Discovery mass limits for color octet muon at different pp, $\mu^+\mu^-$, and μp colliders.

Similar comparison should be made for other new physics processes !!!

Future Colliders Timeline



https://indico.cern.ch/event/765096/contributions/3295812/

Input to the European Particle Physics Strategy Update 2018-2020

European Strategy Update

1 November 2018 to 19 December 2018
Europe/Zurich timezone

- Overview
- Guidelines
- Submit Input
- Submitted Input
- Open Symposium

Energy frontier lepton-hadron colliders, vector-like quarks/leptons, preons and so on

Not scheduled
1m

Beyond the Standard ...

Description

First of all, an importance of the LHC/FCC based energy frontier lepton-hadron and photon-hadron colliders is emphasised. Then arguments favoring existence of new heavy isosinglet down-type quarks and vector-like isosinglet or isodoublet leptons are presented, following by historical arguments favoring new (preonic) level of matter. The importance of Super-Charm factory and GeV energy proton linac for Turkey's national road map is argued. Finally, several recommendations for ESPP2020 are suggested.

Primary author

Prof. Saleh Sultansoy (TOBB University of E...)

Presentation Materials

Saleh_ESPP2020.pdf

Bu projelerin Türk Dünyasına Katkısı

- **UNK+VLEPP**
  AMEA Fizika İnstitutu 1.No'lu Devlet AR-GE Programına katıldı

Maalesef, YerPHI benzerinin Azerbaycan'da kurulma imkanı engellendi…

- **Linac-HERA**
  1996 yılında DESY Ankara Üniversitesi ile İşbirliği Anlaşması imzaladı

Maalesef, bu Anlaşmanın sağladığı imkanlar yeterince kullanılmadı. DESY yönetimi TESLA'dan yana karar alınca, S-band linak'ın test tesisini bize hibe etmeyi önerdi. Uygun bir yer ve taşıma masrafı bulamadığımız için 15 yıl önce yüksek kaliteli elektron demetine sahip olma şansını kaçırdık.

- **Linac-LHC**
  Türk fizikçileri CLIC ve LHeC projelerine katıldı

Uluslararası **CTF3 projesi** AÜ ile CERN'in imzalarıyla resmen başladı!
Bu imzaları AÜ tarafından Prof. Dr. A. K. Çiftçi, CERN tarafından Dr. J. P. Delahaye attı…

13.02.2015 Saleh@ODTÜ 22

- **LR Charm-Tau**
  Turkic Accelerator Complex (TAC) projesinin temel taşı

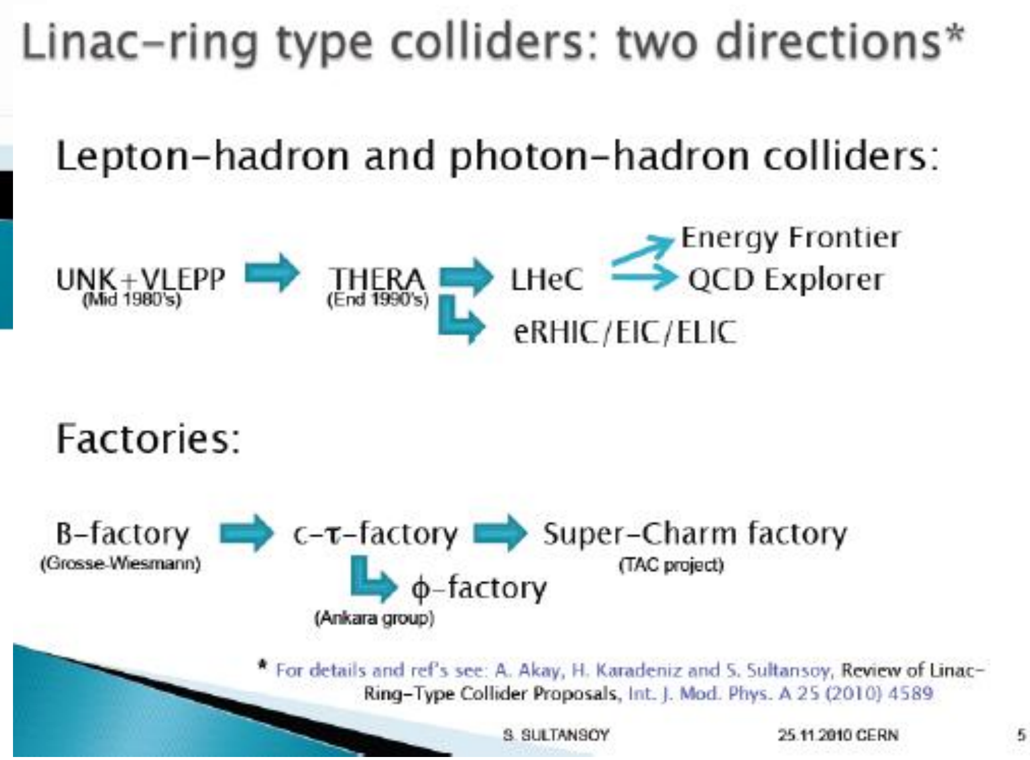
Maalesef, Super-Charm ve Proton Hızlandırıcısı kısımları ihmal ediliyor.

+ Türk bilim insanlarının **EPAC, PAC, IPAC, ECFA ve ICFA** 'ya katılımı
  EPS-HEP 2003 Konferansında ve PAC 2005'te Çağrılı konuşmalar;

ICFA 2002 "Future Perspectives in HEP" seminerinin kapanış oturumunda "Turkish comments on …" sunumu (**E. Arik, S. Sultansoy**, e-Print: hep-ph/0302012)

Ek: UNK×VLEPP → THERA (TESLA×HERA) → LHeC

Plenary ECFA – CERN (25-26 November 2010)
https://indico.cern.ch/event/111130/contribution/27/material/slides/1.pdf



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REVIEW OF LINAC–RING-TYPE COLLIDER PROPOSALS

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There are three possible types of particle colliders schemes: familiar (well-known) ring–ring colliders, less familiar but sufficiently advanced linear colliders, and less familiar and less advanced linac–ring-type colliders. The aim of this paper is twofold: to present a possibly complete list of papers on linac–ring-type collider proposals and to emphasize the role of linac–ring-type machines for future HEP research.

IC/89/409

International Atomic Energy Agency
and
United Nations Educational Scientific and Cultural Organization
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

PROSPECTS OF THE FUTURE ep AND γp COLLIDERS: LUMINOSITY AND PHYSICS*

S.F. Sultanov**
International Centre for Theoretical Physics, Trieste, Italy.

ABSTRACT

The new type of ep colliders based on TeV energy e^+e^- linacs (VLEPP, CLIC, LSC) and large pp storage rings (UNK, LHC, SSC) is considered. This type of ep colliders is advantageous not only in $\sqrt{s}$ comparing with standard ep machines (HERA, LHC+LEP), but it also provides a unique possibility to construct γp colliders with practically the same $\sqrt{s}$ and luminosity. It is shown that within the reasonable optimization of proton beam parameters, the luminosity $L_{ep,\gamma p} = 10^{30} - 10^{31}\,cm^{-2}s^{-1}$ can be achieved for the UNK+VLEPP project. The potential of these machines in testing the standard model and probing new physics at distances $1 \lesssim 10^{-17}$ cm is briefly discussed.

MIRAMARE – TRIESTE

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И Ф В Э 87-48
ОТФ

S.I.Alekhin, E.E.Boos, V.I.Borodulin,
G.V.Djikia, S.R.Slabospitsky,
A.Yu.Smirnov, S.F.Sultanov*)

PROSPECTS OF THE FUTURE ep-COLLIDERS

*) Institute for Physics of Az. SSR, Baku.

Serpukhov 1987

Physics at γp Colliders of Tev Energies

S.I. Alekhin (Moscow State U.), E.E. Boos (Moscow State U.), V.I. Borodulin (Serpukhov, IHEP), G.V. Jickia (Serpukhov, IHEP), S.R. Slabospitsky (Serpukhov, IHEP) Show All(7)

Apr, 1988

22 pages
Published in: *Int.J.Mod.Phys.A* 6 (1991) 21-40
DOI: 10.1142/S0217751X91000034
Report number: IFVE-88-94

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E. Boos (Moscow State U.), M. Dubinin (Moscow State U.), V. Edneral (Moscow State U.), V. Ilyin (Moscow State U.), A. Pukhov (Moscow State U.) Show All(9)

1991

21 pages

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Contribution to: 26th Rencontres de Moriond: Electroweak Interactions and Unified Theories, 501-521

Published: 1991

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E. Boos (Moscow State U.), M. Dubinin (Moscow State U.), V. Edneral (Moscow State U.), V. Ilyin (Moscow State U.), A. Pukhov (Moscow State U.) Show All(9)

Oct, 1991

23 pages

Report number: DESY-91-114

View in: KEK scanned document

International Workshop on Linac-Ring Type ep and Gamma γp Colliders

9-11 April 1997. Ankara, Turkey

TURKISH JOURNAL OF PHYSICS
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Year: 1998 Volume: 22 Number: 7

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6. **Four Ways to TeV Scale**
   S. SULTANSOY
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   Abstract Full Text: PDF

7. **Topics on the Physics Potential and Detector Aspects of the LC-HERA ep Collider**
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    S. ATAĞ
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12. **Search for Supersymmetry at \gammap - Colliders**
    A. U. YILMAZER
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A.K. ÇİFTÇİ
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Abstract   Full Text: PDF

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Ş. TURKÖZ
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G.L. KOTKIN, V.G. SERBO
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M. KANTAR
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25. **Heavy Quark Production at \gammap Colliders**
O. ÇAKIR, M. YILMAZ
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DESY 99-159
AU-HEP-99/02
October 1999

ISSN 0418-9833
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hep-ph/9911417 v2 25 Nov 1999

The post-HERA era: brief review of future lepton-hadron and photon-hadron colliders

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Department of Physics, Faculty of Sciences, Ankara University, Turkey
Institute of Physics, Academy of Sciences, Baku, Azerbaijan

Abstract

Options for future lp, lA, γp, γA and FEL γA colliders are discussed.

CONTENTS

DESY 97-239
December 1997

[physics.acc-ph] 12 Dec 1997

Linac-Ring Type Colliders: Fourth Way To TeV Scale

R. Brinkmann[a], A. K. Çiftçi[b], S. Sultansoy[b,c], Ş. Türköz[b], F. Willeke[a], Ö. Yavaş[b], M. Yılmaz[d]

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Gazi University
06500 Beşevler, Ankara, TURKEY

The present status of suggested linac-ring type ep and γp colliders is reviewed. The main parameters of these machines as well as e-nucleus and γ-nucleus colliders are considered. It is shown that sufficiently high luminosities may be achieved with a reasonable improvement of proton and electron beam parameters.

Tr. J. of Physics
22 (1998) , 575 – 594.
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International Workshop on Linac-Ring Type ep and γp Colliders

Four Ways to TeV Scale

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Azerbaijan Academy of Sciences, Institute of Physics,
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Abstract

Four known types of colliders, which may give an opportunity to achieve TeV center of mass energies in the near future (10-15 years), are discussed. Parameters of the linac-ring type ep and γp machines are roughly estimated. Some speculations on TeV scale physics are given. The physics goals of the TeV energy ep and γp colliders are considered.

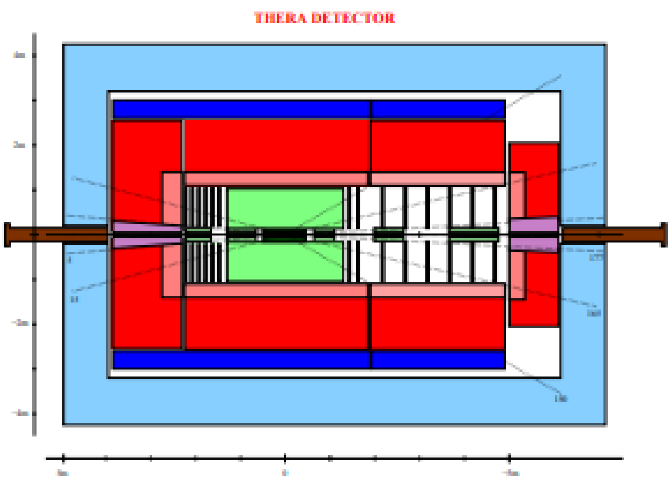
Ankara workshop 1997

http://journals.tubitak.gov.tr/physics/issue.htm?id=175

DESY 01-123F vol. 4
DESY-LC-REV-2001-062
December 2001

Physics and Experimentation at a Linear Electron–Positron Collider

Volume 4: The THERA Book. Electron–Proton Scattering at $\sqrt{s} \sim 1$ TeV



Editors: U. Katz, M. Klein, A. Levy and S. Schlenstedt

ISSN 0418-9833

This volume collects original contributions for THERA, a future electron-nucleon collider operating in the TeV energy range, which can be realised combining the $e^{\pm}$ linear accelerator TESLA with the proton ring accelerator HERA at DESY. The material presented here has been worked out during the preparation of the TESLA Technical Design Report in the years 2000 and 2001. The THERA option was discussed in a series of meetings involving about 100 physicists. These meetings are documented on `http:/www-zeuthen.desy.de/thera`.

Working Groups and Convenors:

Low x and Diffraction	E Levin (U Tel Aviv) A Levy (U Tel Aviv) P Newman (U Birmingham)
Tests of QCD and MC Simulation	H Jung (U Lund) L Lönnblad (U Lund) H Spiesberger (U Mainz)
Heavy Flavours	K Daum (U Wuppertal) L Gladilin (U Hamburg, Moscow)
Photon Structure	J Butterworth (UC London) M Krawczyk (U Warsawa) S Söldner-Rembold (CERN/U Freiburg)
High Q^2 and BSM	M Kuze (KEK) K Long (IC London) E Perez (Saclay)
Detector and Machine	J Crittenden (U Bonn) U Katz (U Bonn/ U Erlangen) M Klein (DESY Zeuthen) D Pitzl (DESY Hamburg) S Schlenstedt (DESY Zeuthen) U Schneekloth (DESY Hamburg) F Willeke (DESY Hamburg)
eA Scattering	M Strikman (Penn State)
Real Photon-Proton Interactions	S Sultansoy (Ankara)
Polarisation	A Deshpande (Yale U) E Rondio (U Warsawa)

2 THERA: Electron–Proton Scattering at $\sqrt{s} \sim 1$ TeV

A Contribution to the TESLA Technical Design Report
13. Feb. 2001

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Linac ring type colliders: Second way to TeV scale

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Table 1. Energy Frontiers

Colliders	Hadron	Lepton	Lepton-Hadron
1990's	Tevatron	SLC/LEP	HERA
$\sqrt{s}$, TeV	2	0.1/0.2	0.3
L, 10^{31} cm^{-2}s^{-1}	1	0.1/1	1
2010's	LHC	"NLC"	"NLC"-LHC
$\sqrt{s}$, TeV	14	0.5	3.7
L, 10^{31} cm^{-2}s^{-1}	10^3	10^3	$1 \div 10$
2020's	VLHC	CLIC	"CLIC"-VLHC
$\sqrt{s}$, TeV	200	3	34
L, 10^{31} cm^{-2}s^{-1}	10^3	10^3	$10 \div 100$

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Linac-ring type colliders: Second way to TeV scale

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Abstract. Main parameters and the physics search potentials of the linac-ring type lepton-hadron and photon-hadron colliders are discussed. The THERA (TESLA on HERA), "NLC"-LHC and "CLIC"-VLHC proposals are considered.

7 Conclusion

The importance of linac-ring type ep colliders was emphasized by Professor B. Wiik at Europhysics HEP Conference in 1993 [27]. Following previous article [28], he argued TESLA type linear accelerator to be used as linac. The argument is still valid for LHC-based *ep* collider. As for VLHC-based *ep* collider, CLIC type linear accelerator seems to be advantageous, since the energy of TESLA of reasonable size is less than 1 TeV for the time being.

At the first glance, our way of arguing and conclusions seem to be a bit unusual. However, it might happen that LHC results will support this approach. Therefore, linac-ring type lepton-hadron and photon-hadron colliders must be taken into account as seriously as linear lepton and photon colliders.

Table 1. Energy frontiers

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Bir bizden, bir onlardan

CERN – EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CLIC

CLIC Note 613

CERN-OPEN-2004-026
20/09/2004

Mini-Workshop on Machine and Physics Aspects of CLIC based future Collider Options

Editor: F. Tecker

Abstract

A one-day workshop took place at CERN to discuss different possibilities for colliding CLIC beam with LHC beam, and to review the physics potential of CLIC and CLIC-LHC based colliders in detail. The options include e-p, e-A, γ-p, and γ-A collisions to study Quantum Chromo-Dynamics in a wide kinematical region and FEL based γ-A collisions for Nuclear Resonant Flourescence.
After a brief introduction to the various options and the related issues, the presentations of the workshop are collected in this note.

Geneva, Switzerland
20 September 2004

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LHeC projesini buradan başladı !

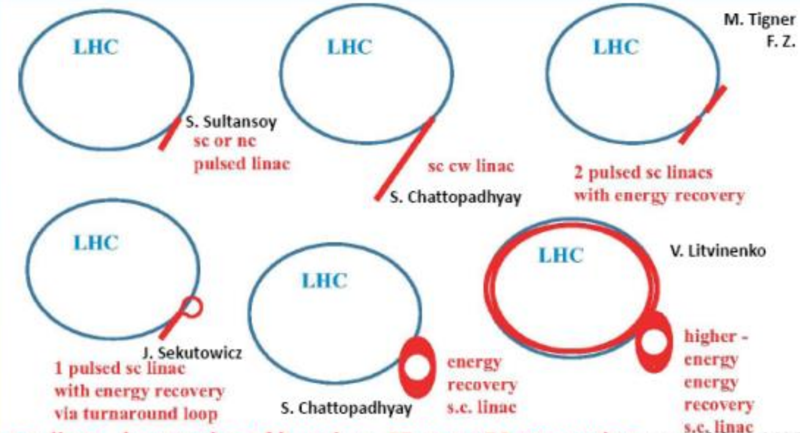
(F. Zimmermann, 1st ECFA-CERN LHeC Workshop, 02.09.2008)

LR e-p motivation

- colliding 7 TeV p's with 25-140 (-300) GeV e-'s:
  - → extending LHC discovery reach
  - → enabling LHC precision physics
- history: - Ankara workshop 1997, Turkish JP, 22, 7 (1998)
  - -S. Sultansoy, Aachen 2003, EPJ C33: S1064 (2004)
  - -D.Schulte,F.Zimmermann, EPAC'04 (CLIC-1/LHC p s-bunch)
  - -H. Aksakal et al, NIM A576: 287 (2007) (CLIC & ILC vs LHC)
  - - S. Chattopadhyay: *cw!, ERL!* (2007), A. Eide's report (2008)
  - -V. Litvinenko, CERN AB Form 11 March 2008
  - -F. Zimmermann et al, EPAC'08
  - -J. Skrabacz' report (2008)
- e- linac offers several distinct advantages
  e.g.: separation from LHC, high beam quality, synergies

(F. Zimmermann, 1st ECFA-CERN LHeC Workshop, 02.09.2008)

LR scenarios

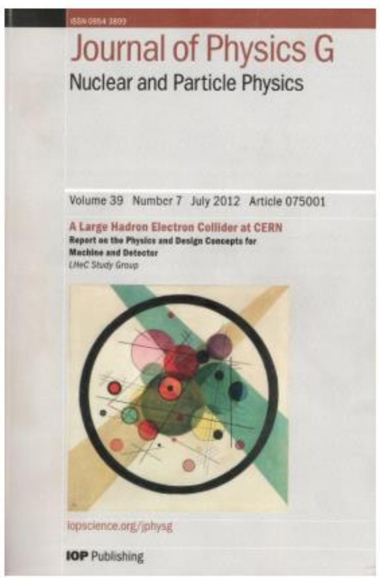


s.c. linac , long trains of bunches, 25-ns or 50-ns spacing, matching LHC p beam (*PLACET: stable*); long pulse or cw → high luminosity; optional energy recovery → higher luminosity; 1.3 GHz (ILC) or 700 MHz (SPL)

2. LHeC/QCD-E: son durum

A Large Hadron electron Collider at CERN. Webpage:
http://lhec.web.cern.ch/
Mirror site:
http://www.ep.ph.bham.ac.uk/exp/LHeC/

CDR is published in Journal of Physics G: Nuclear and Particle Physics
Volume 39, Number 7, July 2012.



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