Maddenin yeni yapı düzeyi – Preonlar: Ne İşe Yarar ve Nasıl Bulunur?

Saleh Sultansoy

Bu sunum Mart 2018 de TOBB ETÜ'de düzenlediğimiz Preon Çalıştayı'nın (https://indico.cern.ch/event/680611/) açılış konuşmasını içeriyor https://indico.cern.ch/event/680611/contributions/2788434/attachments/1615631/2567488/Preon_Calistayi_08.03.2018_Saleh_son.pdf

YEF alanının 20 yıl önceki ve bugünkü durumunu karşılaştırmak için bu iki makaleyi dikkatle okumanızı tavsiye ediyorum

Four ways to TeV scale

S. Sultansoy (Ankara U. & Baku, Inst. Phys.)

Jun 1997 - 14 pages

Turk.J.Phys. 22 (1998) 575-594
In *Ankara 1997, Linac-ring type e p and gamma p colliders* 575-594
Talk given at Conference: C97-04-09
Proceedings
AU-HEP-97-04

Keyword(s): INSPIRE: talk: Ankara 1997/04/09 | electron p: linac-ring collider | photon p: colliding beams | radiation: laser | Compton scattering: backscatter | luminosity | electron nucleus: linac-ring collider | photon nucleus: colliding beams | free electron laser | family: 4 | supersymmetry | model: composite | supergravity | numerical calculations | bibliography

Record added 1997-09-26, last modified 2017-05-24

Dream Machines

Chris Quigg

Aug 17, 2018 - 10 pages

FERMILAB-PUB-18-305-T
e-Print: arXiv:1808.06036 [hep-ph] | PDF

Abstract (arXiv)
Particle accelerators and their detectors are the world's most powerful microscopes. They enable us to inspect the constituents of matter at attometer scales, study matter under unusual conditions, and concentrate extraordinary amounts of energy into tiny volumes to create new forms of matter and initiate new phenomena. The progress of particle physics and of accelerator science and technology go hand in hand. I look to the past, present, and future, raising questions that we would like to answer about nature along the way.

Note: * Temporary entry *
Note: 10 pages, submitted to Reviews of Accelerator Science and Technology

Record added 2018-08-21, last modified 2018-08-22

Maddenin Yeni Yapı Düzeyi Ne İşe Yarar ve Nasıl Bulunur?

Saleh Sultansoy

TOBB Ekonomi ve Teknoloji Üniversitesi, Ankara
AMEA Fizika İnstitutu, Bakı
ATLAS, LHeC and FCC Collaborations, CERN
PECFA member

1870'ler: Mendeleyev Tablosu

1960'lar: Sekizli Yol

Bugün: Fermiyon Aileleri

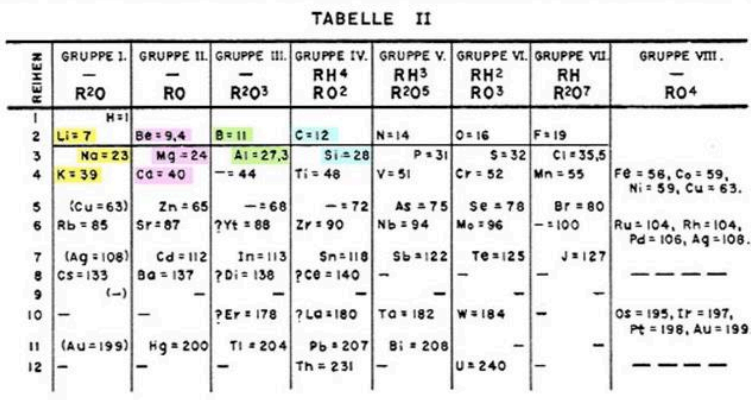
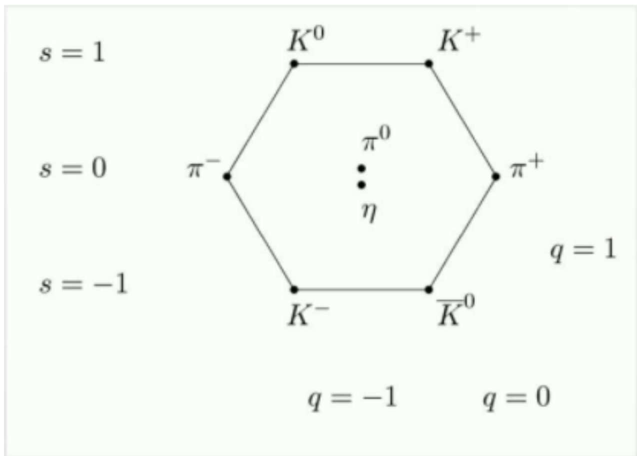
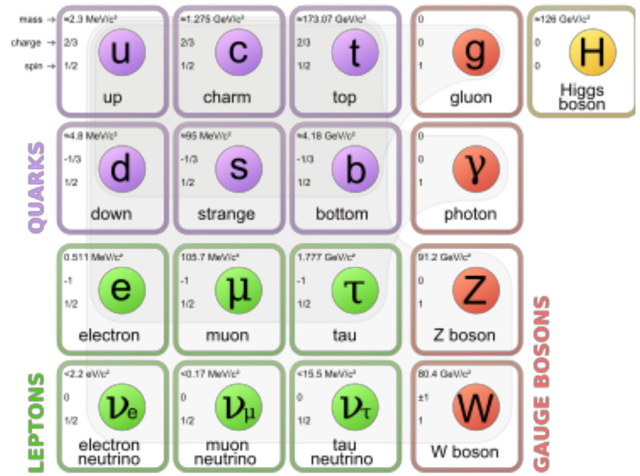


TABELLE II

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.





Asım'ın nesline çağrı

"Sen geçenlerde demiştin ki: Yazık hala biz,
Dünkü ilmin bile biganesiyiz, cahiliyiz,
İşte fıktanı bu ihmal edilen ma'rifetin
Nesli bir acze düşürmüş ki, bugün, memleketin,
Bir yığın kuvveti var, hem ne tabii de, henüz
Biz o kuvvetlere eller gibi hakim değiliz!

Yarının ilmi nedir, halbuki? Gayet müthiş!
"Maddenin kudret-i zerriyesi" uğraştığı iş,
O yaman kudrete hakim olabilsem diyerek,
Sarf edip durmada bir çok kafa binlerce emek,
Onu bir buldu mu, artık bu zemin: Başka zemin,
Çünkü bir damla kömürden edecekler te'min,
Öyle milyonla değil, na-mütenahi kudret!
İbret al kendi sözünden aman oğlum gayret... "

Safahat, 6.bölüm (1919)

Sebe, 3; Yunus, 61.

Nükleer

CERN, TAC ve ötesi

Aldık mı?

Dünün ilmi – bugünün teknolojisi

TÜBA NÜKLEER ENERJİ ÇALIŞTAYI ve PANELİ

9 Mart 2018

Hacettepe Üniversitesi Kültür Merkezi M Salonu

Sıhhiye Yerleşkesi /ANKARA

8:30-9:00 **Kayıt**

9:00- 9:30 **Açılış Konuşmaları**

9:30 – 11:10 **I. OTURUM**
Oturum Başkanı: Prof. Dr. Cemil KOCAR
Hacettepe Üniversitesi Nükleer Enerji Mühendisliği Bölüm Başkanı

9:30 - 9:50 *Türkiye'nin Nükleer Enerji Programı ve Yol Haritası*
Dr. Necati YAMAÇ, Enerji ve Tabii Kaynaklar Bakanlığı Müsteşar Yardımcısı

9:50 – 10:10 *Nükleer Reaktörlerin Bugünü ve Yarını-Ülkemizde Durum*
Prof. Dr. Sadık KAKAÇ, TÜBA Şeref Üyesi
TOBB Ekonomi ve Teknoloji Üniversitesi

10:10 - 10:30 *Yeşil Nükleer Enerji Kaynağı: Toryum*
Prof.Dr. Saleh SULTANSOY, TOBB Ekonomi ve Teknoloji Üniversitesi

10:30 - 10:50 *Mersin Akkuyu Nükleer Santralinin Durumu ve Geleceği*
Dr. Kürşad TOSUN, Mersin Akkuyu Nükleer Santrali A.Ş.

10:50 - 11:10 *Türkiye İçin Uygun Nükleer Enerji Teknolojilerine Bakış*
Prof. Dr. Sümer ŞAHİN, Yakındoğu Üniversitesi

11:10- 11:30 **Kahve Arası**

11:30 - 12:30 **I. PANEL: Türkiye'nin Nükleer Enerji Kabiliyeti, İmkanları ve Kazanımları**
Moderatör: Prof.Dr. Bahri ŞAHİN
Yıldız Teknik Üniversitesi Rektörü, TÜBA Asli Üyesi

Prof. Dr. Cemil KOCAR, Hacettepe Üniversitesi
Prof. Dr. Niyazi MERİÇ, Ankara Üniversitesi
Prof. Dr. İsmail BOZTOSUN, Akdeniz Üniversitesi
İbrahim Halil DERE, Enerji ve Tabii Kaynaklar Bakanlığı Nükleer Enerji Proje Uygulama Dairesi Başkanı
Dr. Fatih ALİM, TAEK Teknoloji Daire Başkanı
Hasan ÇEP, Alper Isıl İşlem Sanayi ve Ticaret A.Ş. Genel Müdürü

12:30 - 14:00 Öğle Yemeği

14:00 - 15:00 **II. PANEL: Türkiye'nin Nükleer Enerji Politikaları, Stratejileri ve Mekanizmaları**
Moderatör: Prof.Dr. Nazmi Turan OKUMUŞOĞLU
Recep Tayyip Erdoğan Üniversitesi Kurucu Rektörü

Prof. Dr. Namık Kemal ARAS, TÜBA Şeref Üyesi
Prof. Dr. Adnan MİDİLLİ, Recep Tayyip Erdoğan Üniversitesi
Prof. Dr. Orhan İÇELLİ, Yıldız Teknik Üniversitesi
Yrd. Doç. Dr. Banu Bulut ACAR, Hacettepe Üniversitesi
Ahmet TAŞKIN, Makina Kimya Endüstrisi Kurumu Genel Müdürü
Dr. Ahmet KÜTÜKÇÜOĞLU, TEK Nükleer Santral Dairesi Eski Başkanı

15:00- 15:20 **Kahve Arası**

15:20 – 16:40 **II. OTURUM**
Oturum Başkanı: Prof. Dr. C. Niyazi SÖKMEN
Hacettepe Üniversitesi Nükleer Enerji Mühendisliği

15:20 - 15:40 *Türkiye'de Nükleer Enerji Eğitimi*
Prof. Dr. Cemil KOCAR, Hacettepe Üniversitesi

15:40 – 16:00 *Nükleer Enerjide Alternatif Boyutlar*
Prof. Dr. İbrahim DİNÇER, TÜBA Asli Üyesi, Yıldız Teknik Üniversitesi

16:00 - 16:20 *Nükleer Enerji Teknolojilerinin Sanayi Boyutuna Bir Bakış*
Hasan ÇEP, Alper Isıl İşlem Sanayi ve Ticaret A.Ş. Genel Müdürü

16:20 - 16:40 *Nükleer Güvenlik ve Mevzuat*
Dr. Serhat ALTEN, TAEK Nükleer Güvenlik Dairesi Başkanı

16:40 - 17:40 **III. PANEL: Türkiye'nin Nükleer Enerji Mevzuatı, Nükleer Güvenlik ve Atık Yönetimi ve Sosyal Kabul**
Moderatör: Prof. Dr. Ayhan YILMAZER
Hacettepe Üniversitesi Nükleer Enerji Mühendisliği

Prof. Dr. Nazmi Turan OKUMUŞOĞLU, Recep Tayyip Erdoğan Üniversitesi
Prof. Dr. Mehmet TOMBAKOĞLU, Hacettepe Üniversitesi
Prof. Dr. Sümer ŞAHİN, Yakındoğu Üniversitesi
Prof. Dr. Prof. Dr. Asiye Beril TUĞRUL, İstanbul Teknik Üniversitesi
Dr. Serhat ALTEN, TAEK Nükleer Güvenlik Dairesi Başkanı

17:40 - 18:00 **Değerlendirme ve Kapanış Konuşmaları**

Yarının İlmi (bu Çalıştay)

Elektromanyetik, zayıf ve kuvvetli etkileşmeleri birleştiren Standart Model binlerce deneyin sonuçlarını doğru yorumlamasına rağmen birçok temel soruya cevap verememektedir. SM'nin açıklayamadığı problemler olarak temel fermiyonların kütleleri ve karışımı, sağ-sol simetrisinin kırınımı, fermiyon ailelerinin sayısı, karanlık maddenin taşıyıcıları sıralanabilir. Temel parçacıkların ve serbest parametrelerin enflasyonu (sayılarının çokluğu), SM'nin daha temel bir teorinin tezahürü olduğunun göstergesidir. Bu kapsamda; preon modelleri, süpersimetri, ek boyutlar gibi bir çok yaklaşım geliştirilmektedir. Maddenin temel yapıtaşları ile ilgili bilgimizin tarihi gelişimi açısından maddenin yeni yapı düzeyini öngören preon modelleri daha gerçekçi gözükmektedir.

Çalıştayda preon modelleri ve öngörülerinin yüksek enerjili çarpıştırıcılarda aranması ile ilgili Türkiye'de yapılan çalışmalar irdelenerek bu alanda yapılacak yeni çalışmaların yol haritası belirlenecektir.

TOBB ETÜ YEF Grubu

Yer: TOBB Ekonomi ve Teknoloji Üniversitesi Ana Bina 1. Kat Toplantı Salonu

Kayıt: 8 Mart 2018 **Saat:** 10:00

Açılış: 8 Mart 2018 **Saat:** 11:00

Starts 8 Mar 2018, 10:00
Ends 10 Mar 2018, 13:30
Europe/Istanbul

TOBB ETÜ Ankara/TURKEY

Çalıştay programı

8 Mart

Açılış		11:00 - 11:30
Maddenin Yeni Yapı Düzeyi Ne İşe Yarar ve Nasıl Bulunur?	*Saleh Sultansoy*	11:30 - 12:30
Kompozitlik Araştırmaları ve Deneysel Durum	*Orhan Cakir*	14:00 - 15:00
Çay Molası		15:00 - 15:15
SppC'ye Dayalı Lepton-Proton Çarpıştırıcıları	*Bora Ketenoğlu*	15:15 - 15:45
Enerji Öncephesi Çarpıştırıcıların Renk Sekizlisi Elektron Araştırma Potansiyelleri	*Umit Kaya*	15:45 - 16:15
Minimal Fermiyon Skaler Preon Modeli	*Bilgehan Barış Öner*	16:15 - 16:45
Çay Molası		16:45 - 17:00
4. Kiral Aile Yukarı Tipli Kuarkın LHC ve FCC/SppC'de Rezonant Üretimi	*Ali Can Canbay*	17:00 - 17:30
Renk Sekizlisi Müonların mu-p Çarpıştırıcılarında Üretimi	*Yiğit Can Acar*	17:30 - 18:00

9 Mart

IceCube Deneyinde Gözlemlenen PeV Enerjili Olayların Renk Sekizlisi Nötrino Yorumu	*Umit Kaya*	10:00 - 10:30
Uyarılmış u-kuarkın FCC ve SppC çarpıştırıcılarında araştırılması	*Mehmet Şahin*	10:30 - 11:00
FCC'ye Dayalı γp Çarpıştırıcılarında Uyarılmış u-kuarkın Rezonant Üretimi	*Yusuf Oğuzhan Günaydın*	11:00 - 11:30
Spin-3/2 ve Spin-1/2 Uyarılmış Nötrinoların LHeC' de İncelenmesi	*Aysuhan Ozansoy*	11:30 - 12:00
Tartışma		12:00 - 12:30
FCC'ye Dayalı Lepton-Hadron Çarpıştırıcılarında Uyarılmış Nötrino Üretimi	*Abdullatif Çalışkan*	14:00 - 14:30
Minimal Supersimetrik bir Preon Modeli ve Öteleme Simetrisi	*Oktay Doğangün*	14:30 - 15:00
Çay Molası		15:00 - 15:15
FCC Tabanlı Müon-Hadron Çarpıştırıcılarında Uyarılmış Müon Araştırmaları	*Seyit Okan Kara*	15:15 - 15:45
t-kuarkın Anomal Etkileşmelerinin TeV Enerjili Çarpıştırıcılarda Aranması	*İlkay Türk Çakır*	15:45 - 16:15

10 Mart

Yuvarlak Masa Toplantısı	10:00 - 12:00
Kapanış	12:00 - 12:30

İçerik

1. *Neden yeni yapı düzeyi*

- SM parçacık ve parametre enflasyonu, fermiyon aileleri, karışımlar vb
- Tarihi argumanlar: Peryodik Tablo, Sekizli Yol
- SM'in cevaplayamadığı sorular
- SM ötesi modeller

2. *Preon modelleri*

3. *Tezahürler*

- Yeni parçacıklar
- Yeni etkileşmeler: temas etkileşmeleri, anomal etkileşmeler
- Formfaktorlar
- Deneysel sınırlamalar (**Orhan**)

4. *Enerji ön-cephesi çarpıştırıcılar*

5. pp, ll ve lp karşılaştırması

6. *Kozmik ışınlar, nadir bozunumlar, kozmoloji vb*

7. Sonuç

1. *Neden yeni yapı düzeyi*

- SM parçacık ve parametre enflasyonu, fermiyon aileleri, karışımlar vb
- Tarihi argumanlar: Peryodik Tablo, Sekizli Yol
- SM'in cevaplayamadığı sorular
- SM ötesi modeller

10

ANKARA UNIVERSITY FACULTY OF SCIENCES PHYSICS DEPARTMENT

AU-HEP-97/05
11 June 1997

Four Remarks on Physics at LHC
(Talk presented at ATLAS week, 26-31 May 1997, CERN)

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and
Institute of Physics, Academy of Sciences, H.Cavid avenue 143, Baku, AZERBAIJAN

First of all, possible manifestations of the fourth SM family (which is predicted according to the democratic mass matrix approach) quarks at LHC have been considered. Then, the number of free parameters in three family MSSM is estimated to be more than two hundreds, therefore SUSY should be realized at more fundamental (preonic?) level. In this case, each SM particle has more than two (super) partners. If the nature prefers SUGRA scenario, then the existence of (at least) one new neutral vector boson with TeV scale mass seems to be highly probable. Moreover, application of DMM approach leads to the prediction that (at least) one isosinglet quark and one vector isodoublet charged lepton have relatively small (TeV?) masses. Finally, the possible existence of additional space-like dimensions at TeV scale will manifest itself in multiplication of each SM particle.

Bu sunum sayesinde AÜ 1998'de ATLAS deneyine dahil oldu, ardınca GÜ (2002) ve TOBB ETÜ (2008).

Tr. J. of Physics
22 (1998) , 575 – 594.

International Workshop on Linac-Ring
Type ep and γp Colliders

Four Ways to TeV Scale

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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.

1. Introduction

It is known that the Standard Model with three fermion families well describes almost all of the large amount of particle physics phenomena [1]. Today, SM is proved at the level of first-order radiative corrections for energies up to 100 GeV. However, there are a number of fundamental problems which do not have solutions in the framework of the SM: quark-lepton symmetry and fermion's mass and mixings pattern, family replication and number of families, L-R symmetry breaking, electroweak scale etc. Then, SM contains unacceptably large number of arbitrary parameters even in three family case: 19 in the absence of right neutrinos (and Majorana mass terms for left neutrinos), 26 if neutrinos are Dirac particles, ≥ 30 if neutrinos are Majorana particles. Moreover, the number of "elementary particles", which is equal to 37 in three family case (18 quarks, 6 leptons, 12 gauge bosons and 1 Higgs boson), reminds the Mendeleev Table. Three decades ago similar situation led to the quark model!

For these reasons, physicists propose a lot of different extensions of the SM, most part of which predict a rich spectrum of new particles and/or interactions at TeV scale. These extensions can be grouped in two classes, namely standard and radical ones. Stan-

Periodic Table of the Elementary* Particles

family	ν *(direct)*	*l*	*u*	*d*
1	< 2 eV	510.998928(11) keV	1.8 to 3.0 MeV	4,5 to 5.3 MeV
2	< 190 keV	105.6583715(35) MeV	1.275(25) GeV	95(5) MeV
3	< 18.2 MeV	1.77686(12) GeV	173.21(1.22) GeV	4.18(3) GeV
4	> 39.5 GeV	> 100 GeV	> 700 GeV	> 675 GeV

Also, $m_\gamma = 0$ (< 10^{-18} eV) $m_g = 0$ (< few MeV)

$m_W = 80.385(15)$ GeV $m_Z = 91.1876(21)$ GeV

$m_H = 125.09 \pm 0.24$ GeV

PDG 2014

Scale: $\eta \approx 247$ GeV

* *Elementary in the SM framework. At least one more level (preons) should exist.*

$$V_{CKM} = \begin{pmatrix} 0.97427 \pm 0.00014 & 0.22536 \pm 0.00061 & 0.00355 \pm 0.00015 \\ 0.22522 \pm 0.00061 & 0.97343 \pm 0.00015 & 0.0414 \pm 0.0012 \\ 0.00886^{+0.00033}_{-0.00032} & 0.0405^{+0.0011}_{-0.0012} & 0.99914 \pm 0.00005 \end{pmatrix}$$

Neutrino mixings

$\sin^2(\theta_{12}) = 0.304 \pm 0.014$

$\sin^2(2\theta_{12}) = 0.846 \pm 0.021$

$\Delta m^2_{21} = (7.53 \pm 0.18) \times 10^{-5}$ eV^2

$\sin^2(\theta_{23}) = 0.514^{+0.055}_{-0.056}$ (normal mass hierarchy)

$\sin^2(\theta_{23}) = 0.511 \pm 0.055$ (inverted mass hierarchy)

$\sin^2(2\theta_{23}) = 0.999^{+0.001}_{-0.018}$ (normal mass hierarchy)

$\sin^2(2\theta_{23}) = 1.000^{+0.000}_{-0.017}$ (inverted mass hierarchy)

$\Delta m^2_{32} = (2.44 \pm 0.06) \times 10^{-3}$ eV^2 [i] (normal mass hierarchy)

$\Delta m^2_{32} = (2.49 \pm 0.06) \times 10^{-3}$ eV^2 [i] (inverted mass hierarchy)

$\sin^2(\theta_{13}) = (2.19 \pm 0.12) \times 10^{-2}$

$\sin^2(2\theta_{13}) = (8.5 \pm 0.5) \times 10^{-2}$

Stable Neutral Heavy Lepton Mass Limits

Mass $m >$ 45.0 GeV, CL = 95% (Dirac)

Mass $m >$ 39.5 GeV, CL = 95% (Majorana)

Neutral Heavy Lepton Mass Limits

Mass $m >$ 90.3 GeV, CL = 95%

(Dirac ν_L coupling to e, μ, τ; conservative case(τ))

Mass $m >$ 80.5 GeV, CL = 95%

(Majorana ν_L coupling to e, μ, τ; conservative case(τ))

We wonder why **m_H = 125 GeV?**

But do not worry on accidental values of SM fermion masses and mixings …; i.e. **$m(e)/m(t) \sim 10^{-5}$**

- **More than 50 fundamental particles** and **26 free parameters** in the minimal SM3 indicates that the Standard Model is manifestation of **more fundamental theory.**
- Physics met similar situation two times in the past:

Stages	1870s-1930s	1950s-1970s	1970s-2020s
Fundamental Constituent İnflation	Chemical Elements	Hadrons	Quarks, leptons
Systematic	Periodic Table	Eight-fold Way	Family replication
Confirmed Predictions	New elements	New Hadrons	BSM particles
Clarifying Experiments	Rutherford	SLAC DIS	LHC or rather FCC
Building Blocks	Proton, neutron, electron	Quarks	Preons?
Energy Scale	MeV	GeV	TeV?
İmpact on Technology	Exceptional	Indirect	Exceptional?

- Periodic Table of the Elements was clarified by Rutherford's experiment
- Hadron inflation has resulted in quark model
- This analogy implies the preonic structure of the SM fermions

SM'in cevaplayamadığı sorular
(ATLAS Week 1997)

Below, we present partial list of problems which have not been solved by the SM

- What determines the pattern of quark and lepton masses and the mixing angles and phases of the CKM matrices?
- Why do the quark-lepton generations repeat? How many generations exist in the nature?
- What is the origin of quark-lepton symmetry? Do the right-handed neutrino components exist in Nature? Are the neutrinos Dirac or Majorana particles?
- What is the origin of L-R symmetry breaking? In the SM this is put by hand.
- Why are there so many arbitrary parameters? Three family SM contains:

  3 coupling constants α_s, α_{em} and $\sin\Theta_W$,
  6 quark masses, 3 mixing angles and 1 phase,
  2 parameters of the Higgs potential,
  3 charged lepton masses,
  1 QCD vacuum phase angle,
  3 neutrino masses (6 in Majorana case),
  3 lepton mixing angles (15 in Majorana case),
  1 phase (? in Majorana case).
  A total of 19 (26 for Dirac neutrinos or 30+? for Majorana neutrinos) arbitrary parameters!
- Why are the all known interactions built on the gauge symmetry?
- What is the (real) origin of CP-violation?
- How is the gravity included in a unified way?
- Are the quarks and leptons (as well as part of or all gauge and Higgs bosons) of the SM elementary or composite? Three family SM contains: 18 quarks, 6 leptons, 1 photon, 8 gluons, 3 massive IVB's, 1 H^0 and 1 graviton; a total of 38 "elementary particles"! Third Mendeleev Table? Second Mendeleev Table (hadrons) result in quark model!
- What is the origin of "confinement" of colored objects? Are they "truly confined"?

o o o

Therefore, we are far from the "end of physics"!

Ek sorular ?

- Karanlık madde
- Karanlık enerji
- …

Nötrino salınımlarının gözlenmesi ⇒ sağ-elli nötrinoların varlığı.
Aslında sağ-elli nötrinolar **BSM değil**, lepton-kuark simetrisine göre sağ-elli üst-kuarkların lepton karşılığıdır, yani SM'dir.

SM ötesi modeller
(ATLAS Week 1997)

A. Standard extensions of the Standard Model

In this class we restrict ourselves within the framework of gauge theories with spontaneously broken gauge symmetry.

1. Higgs sector:

- two or more Higgs doublets (CP violation in scalar instead of fermion sector)
- isodoublet φ (Dirac mass terms), vector isotriplet ξ (Majorana mass term for left-handed neutrino), isotriplet Φ (in order to satisfy relation ρ=1).

A number of new neutral and charged Higgs bosons (including double charged ones for last case) are predicted.

2. Fermion sector:

- fourth SM family
- new isosinglet left-handed ν_L (for ν-oscillation experiments)
- new isosinglet quarks and vector-like lepton isodoublets (E_6 -induced)
- fermion isotriplets etc.

A number of new (non-standard) leptons and quarks are predicted.

3. Gauge sector:

- additional U(1) factor (i.e. leptonic photon or E_6 -induced)
- additional SU(2) factor (L-R "symmetric" electroweak sector)
- etc.

New (massive) neutral and charged intermediate vector bosons are predicted.
The next stage in this direction is represented by GUTs.

B. Radical extensions of the Standard Model

This class includes two well-known directions: Compositness and SUSY.

1. Compositness:

- composite Higgs
- composite quarks and leptons
- composite W and Z
- composite γ and g's ?

A number of new exotic particles (leptoquarks, leptogluons, exited fermions and bosons etc.) and interactions (including residual ones) are predicted.

2. SUSY:

- three family MSSM
- four family MSSM
- SUSY GUTs
- SUGRA

Spectrum of fundamental particles is enriched with inclusion of superpartners.

3. "Unexpected" new physics

- new space-time dimensions
- ?

All extensions (with exceptions of minimal SU(5) and SO(10) GUTs) predict a rich spectrum of new particles and/or interactions at TeV scale. Therefore an exploration of this region will require all possible types of colliding beams.

Ek modeller ?

- SUGRA ⇒ Superstrings (aslında «theory of nothing»!!)
- …

Son 20 yılda Ek Boyutlar «unexpected» sınıfından «radical» sınıfına geçti

«Unexpected»:

- CPT violation
- Fundamental length
- Parastatistics
- …

WHY PREONIC MODELS?

- The composite models are particularly interesting for the continued simplification and describe nature in terms of its most fundamental building blocks.
- These fundamental constituents were called PREONS by Pati and Salam.
- Family replication and especially SM fermion mixings can be considered as indication of preonic structure of matter.
- Could provide a solution to some of the aforementioned problems with an effective model at the preonic level.
- Quark-lepton compositeness is a well-known BSM scenario and the preonic models predict;
  - Excited leptons and quarks, leptogluons, leptoquarks, diquarks, dileptons, color sextet quarks etc …
- In models with coloured preons, leptogluons have the same status as excited leptons and leptoquarks.

2. *Preon modelleri*

i) Kompozit Higgs bozonu: Technicolor – çıkmaz sokak

W ve Z bozonların kütleleri – Technicolor – iyi

fermiyonların kütleleri - Extended Technicolor – kötü

ii) Kompozit leptonlar ve kuarklar – ana eksen!

fermiyon-skalar

3 fermiyon

iii) Kompozit W ve Z bozonlar – pre-preon düzeyinde?

iv) Kompozite foton ve gluonlar – kütlesiz bağlı durumlar??

SUSY, or not SUSY: that is the Question

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Article

Title	**SUSY or not**
Related title	SUSY, or not SUSY: that is the Question
Author(s)	Sultansoy, S (Gazi Univ., Ankara)
In:	Briefing Book for the Zeuthen Workshop, v.2, pp.2.1.25
Subject category	Particle Physics

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ATLAS ve CMS verileri: SM düzeyinde SUSY kapanmak üzeredir !!

Bu nedenle Preon modellere yönelim başladı!!!

arXiv:1803.01865 [pdf, other]

Supersymmetry versus Compositeness: 2HDMs tell the story

Stefania De Curtis, Luigi Delle Rose, Stefano Moretti, Kei Yagyu

Comments: 5 pages, 6 figures

Subjects: **High Energy Physics - Phenomenology (hep-ph)**; High Energy Physics - Theory (hep-th)

Supersymmetry versus Compositeness: 2HDMs tell the story

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Supersymmetry and Compositeness are two prevalent paradigms providing both a solution to the hierarchy problem and a motivation for a light Higgs scalar state. As the latter has now been found, its dynamics can hold the key to disentangle the two theories. An open door towards the solution is found in the context of 2-Higgs Doublet Models, which are necessary to Supersymmetry and natural within Compositeness in order to enable Electro-Weak Symmetry Breaking. We show how 2-Higgs Doublet Model spectra of masses and couplings accessible at the Large Hadron Collider can allow one to reveal the true mechanism behind mass generation in Nature.

(ATLAS Week 1997)

III. COMPOSITNESS VS SUSY OR COMPOSITNESS & SUSY

It is known that the number of free observable parameters put by hand in SM is equal to 26 in three family case and 40 in four family case (DMM approach reduces this numbers to 20 and 28, respectively), if neutrinos are Dirac particles. The natural question: How many free parameters contain minimal supersymmetric extension of the Standard Model (MSSM)?

- ......

Total number of free parameters is

$$N > 20n^2 + 22,$$

i.e. N>202 for the three family and N>342 for the four family MSSM. Let me remind that 19 free parameters in the three family SM without right-handed neutrinos was one of the main arguments to go Beyond the Standard Model!

Message: *SUSY should be realized at a more fundamental level.*

Today there are two favorite candidates:

1. Preonic level!
2. SUGRA?

Aslında SM düzeyinde SUSY için 2 gerekçe vardı:

- Higgs bozonunun kütlesi
- Etkileşme sabitlerinin birleşmesi

İlki mH = 125 GeV ve SUSY parçacıklarının TeV altında görülmemesinden dolayı geçerliliğini kaybetti

İkincisi sadece SU(5) GUT için geçerlidir

B. Supersymmetric Preonic Models of Quarks and Leptons

There are at least two arguments favoring compositness:

1. SUSY GIM cancellation (K_L-K_S transition etc.) requires $\delta m^2_{\tilde{q}} \approx \delta m^2_q$ ($m^2_{\tilde{u}} - m^2_{\tilde{c}} \approx m^2_c$ etc.) and $U^{\tilde{q}}_{CKM} \approx U_{CKM}$. This has a natural explanation in preonic models.

2. MSSM includes two observable phases even in the simplest case of one family: $N_\Theta = N_\varphi = 2$ for n=1.

Composite models of leptons and quarks can be divided into two classes: fermion-scalar models and three-fermion models. Let us briefly consider main consequences of SUSY extensions for these classes. Below we present the simplified options where only one superpartner for each preon is introduced and flavor mixings are absent (according to N=1 SUSY each charged fermion has two superpartners etc.). More realistic versions will be considered in details elsewhere (Sultansoy, in preparation).

1. Fermion-Scalar Models

In this class SM fermions (quarks and leptons) are composites of scalar preons, denoted by S, and fermion preons, denoted by F. In minimal variant $q, l = \{FS\}$. In principle, there are two opportunities:

- scalar preons are superpartners of fermion preons
- each of them have their own superpartners.

Second option leads to the quadrupling of SM matter fields (instead of doubling in MSSM). One has following states: SM fermion (FS) with $m \sim 0$, scalar $(\tilde{F}S)$ with $m \sim \mu$, scalar $(F\tilde{S})$ with $m \sim \mu$ and fermion $(\tilde{F}\tilde{S})$ with $m \sim 2\mu$.

2. Three-fermion Models

In this class quarks and leptons are composites of three fermionic preons and each of them has at least seven partners. In other words we have: SM fermion $(F_1F_2F_3)$ with $m \sim \mu$, three scalars $(\tilde{F}_1F_2F_3)$, $(F_1\tilde{F}_2F_3)$ and $(F_1F_2\tilde{F}_3)$ with $m \sim 2\mu$, three fermions $(\tilde{F}_1\tilde{F}_2F_3)$, $(\tilde{F}_1F_2\tilde{F}_3)$ and $(F_1\tilde{F}_2\tilde{F}_3)$ with $m \sim 3\mu$ and scalar $(\tilde{F}_1\tilde{F}_2\tilde{F}_3)$ with $m \sim 4\mu$.

Of course, mixings between quarks (leptons, squarks, sleptons) can (and should?!) drastically change the simple mass relations given above. Therefore, it is quite possible that the search for SUSY at LHC will give rather unexpected results.

C. General Remarks on Composite Models

In principle, one can consider four stages of compositness (each stage includes previous ones):
i) Composite Higgs
ii) Composite quarks and leptons
iii) Composite W- and Z- bosons
iv) Composite photon and gluons?

1. New Particles

The well-known representative of the first stage is Technicolor Model, which gives masses to W- and Z- bosons in a best manner but has serious problems with fundamental fermion masses (Extended Technicolor etc.). Therefore, one should deal at least with the second stage. In this case composite models predict a number of new particles with rather unusual quantum numbers: excited quarks and leptons, leptoquarks (HERA events!?), color-sextet quarks and color-octet leptons. If the third stage is realized in nature, excited W and Z, color octet W and Z, scalar W and Z are predicted also. The realization of the fourth stage seems today less natural because photon and gluons correspond to the unbroken gauge symmetries.

The masses of new particles are expected to lie in the range of compositness scale Δ, which exceeds TeV. Of course, if SUSY is realized at preonic level all these new particles have a number of (SUSY) partners.

Finally, it is quite possible that SUSY is realized at pre-preonic level!

2. New Interactions

Nobody knows real dynamics, which keeps together preons to form SM particles. Today, the most popular candidate is hypercolor (some extension of QCD). However, it is quite possible that a new dynamics is based on certain concepts, which differ drastically from known ones (like the difference between quantum and classic physics). In any case, we expect that some residual "contact" (Fermi-like) interactions should manifest themselves at scale $\leq \Lambda$ with intensity proportional to $1/\Lambda^2$.

In our opinion, it is useful to form "Preonic subgroup" within ATLAS Physics Working Group in order to analyze possible manifestations of compositness at LHC.

Maalesef, bu öneri kabul görmedi.

SUSY için özel subgroup kurulurken, Preon modelleri Exotics subgroup'un sub-subgroup'ları arasında yer aldı.

SM düzeyinde SUSY dışlanmak üzere olduğundan, «Preonic subgroup» önerisini yeniden gündeme getirmeliyiz.

Aynı ATLAS Week'te 4.aile ve genel olarak yeni kuarklar ve leptonlar ile ilgili özel subgroup önermiştim, ama bu öneri de kabul edilmedi. Bu konu da Exotics subgroup'un sub-subgroup'ları arasında yer aldı. Mesela, yeni kuarklar HQT sub-subgroup içerisinde inceleniyor.

3. *Tezahürler*

- Yeni parçacıklar (Çalıştay sunumlarının çoğu)
- Yeni etkileşmeler: temas etkileşmeleri, anomal etkileşmeler (Ali Can, İlkay)
- Formfaktorlar
- Deneysel sınırlamalar (Orhan)

4. *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

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

CrossMark

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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
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Hindawi

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.

FCC based lepton-hadron and photon-hadron colliders

- ep and eA
- γp and γA
- μp and μA (ultimate 100 TeV !!!)

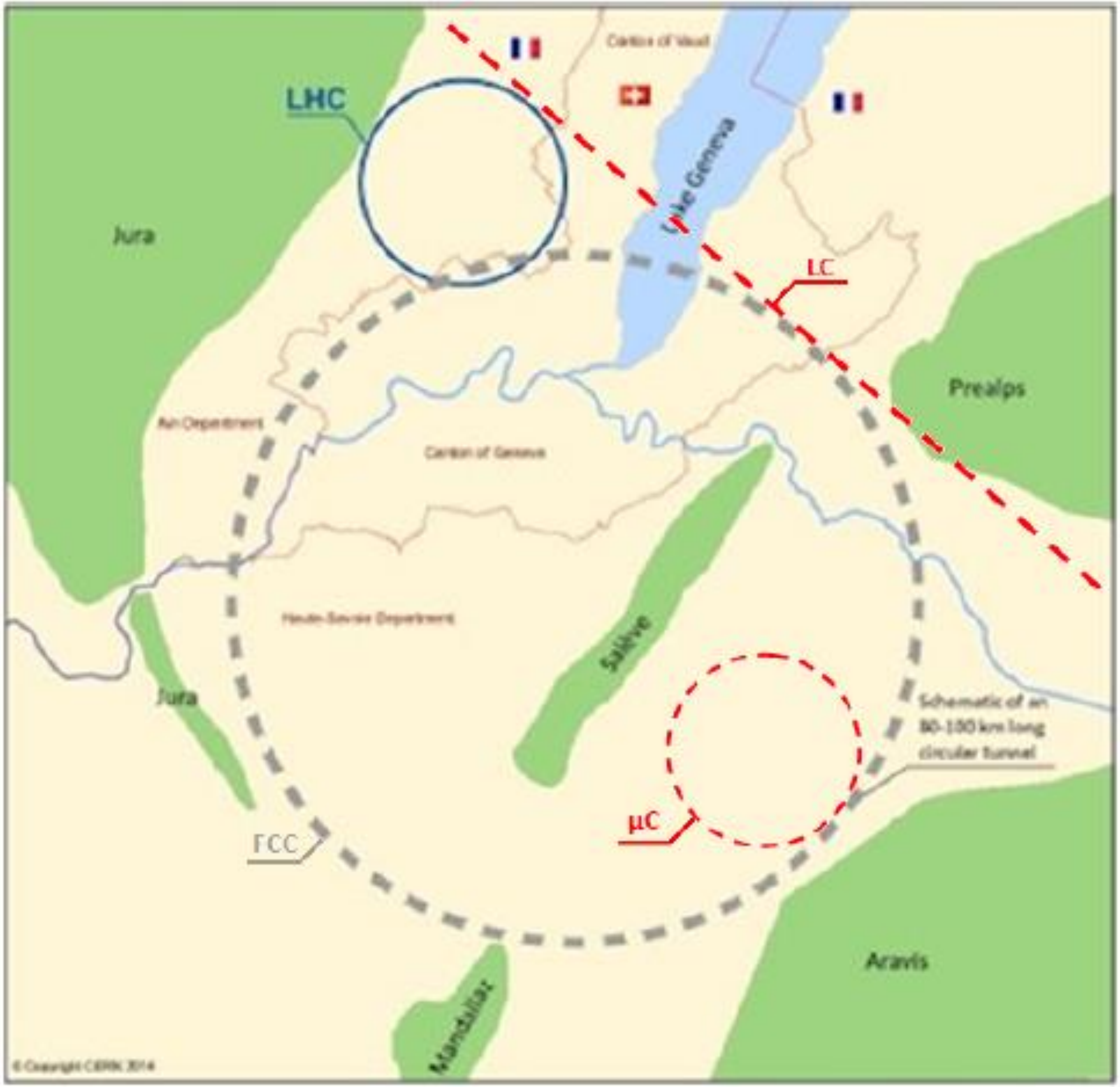
For details see presentation at FCC Week Rome

and arxiv https://arxiv.org/abs/1608.02190

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.

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

$\mathrm{\mu C{\times}FCC = \mu C + FCC + \mu p + \mu A}$



LC×FCC based ep colliders

Table IV. Main parameters of ILC⊗FCC based ep collider.

		Nominal FCC		
$E_e(GeV)$	$\sqrt{s}(TeV)$	L_{ep}, $cm^{-2}s^{-1}$	D_e	ξ_p
250	7.08	2.26×10^{30}	1.0	1.09×10^{-3}
500	10.0	2.94×10^{30}	0.5	9.40×10^{-4}
$E_e(GeV)$	$\sqrt{s}(TeV)$	Upgraded FCC		
250	7.08	55.0×10^{30}	24	1.09×10^{-3}
500	10.0	70.0×10^{30}	12	9.40×10^{-4}

Table V. Main parameters of ILC⊗FCC based ep collider corresponding to the disruption limit $D_e = 25$.

$E_e(GeV)$	$\sqrt{s}(TeV)$	$N_p(10^{11})$	L_{ep}, $cm^{-2}s^{-1}$	ξ_p
250	7.08	2.3	57×10^{30}	$1.09x10^{-3}$
500	10.0	4.6	149×10^{30}	$9.40x10^{-4}$

Table VII. Main parameters of PWFA-LC⊗FCC based ep collider.

		Nominal FCC		
$E_e(GeV)$	$\sqrt{s}(TeV)$	L_{ep}, $cm^{-2}s^{-1}$	D_e	ξ_p
250	7.08	3.44×10^{30}	1.00	5.47×10^{-4}
500	10.0	2.58×10^{30}	0.50	5.47×10^{-4}
1500	17.3	1.72×10^{30}	0.17	5.47×10^{-4}
5000	31.6	0.86×10^{30}	0.05	5.47×10^{-4}
$E_e(GeV)$	$\sqrt{s}(TeV)$	Upgraded FCC		
250	7.08	82.6×10^{30}	24	5.47×10^{-4}
500	10.0	61.9×10^{30}	12	5.47×10^{-4}
1500	17.3	41.3×10^{30}	4.0	5.47×10^{-4}
5000	31.6	20.8×10^{30}	1.2	5.47×10^{-4}

Table VIII. Main parameters of PWFA-LC⊗FCC based ep collider corresponding to the disruption limit $D_e = 25$.

$E_e(GeV)$	$\sqrt{s}(TeV)$	$N_p(10^{11})$	L_{ep}, $cm^{-2}s^{-1}$	ξ_p	IBS Growth Time (Horizontal) (h)	
					L_c=106.9 m	L_c=203.0 m
125	5.00	1.15	65.0×10^{30}	5.47×10^{-4}	721	149
250	7.08	2.30	86.0×10^{30}	5.47×10^{-4}	360	75.0
500	10.0	4.60	129×10^{30}	5.47×10^{-4}	180	37.0
1500	17.3	13.8	258×10^{30}	5.47×10^{-4}	60.0	12.0
5000	31.6	45.8	433×10^{30}	5.47×10^{-4}	18.0	3.90

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

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NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

Main parameters of TeV energy γp colliders

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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.

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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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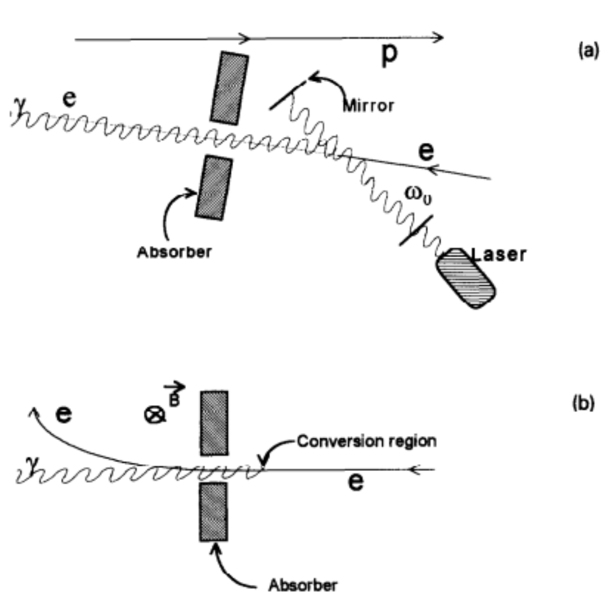
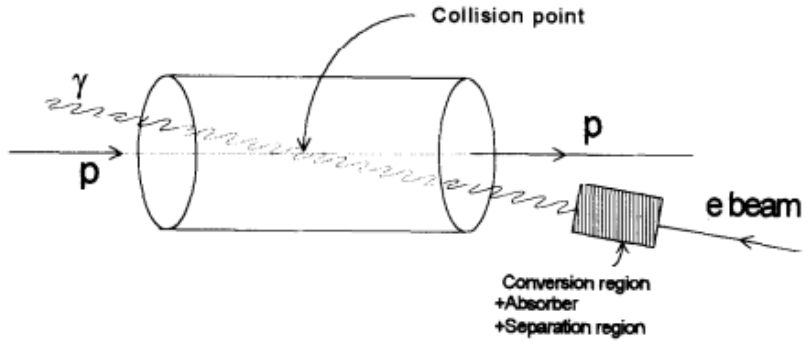


Fig. 16. Schematic view of the part of the design between the conversion region and the detector. (a) Horizontal plane, (b) vertical plane.



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

μC×FCC based μp colliders

Table X. Main parameters of the FCC based μp colliders.

Collider Name	$\sqrt{s}$, TeV	$L_{\mu p}$, $cm^{-2}s^{-1}$ (Avg.)	ξ_p	ξ_μ
μ63-FCC	3.50	0.2×10^{31}	1.8×10^{-3}	5.4×10^{-4}
μ750-FCC	12.2	50×10^{31}	1.1×10^{-1}	3.3×10^{-3}
μ1500-FCC	17.3	50×10^{31}	1.1×10^{-1}	8.3×10^{-4}

Ultimate 100 TeV
See post-HERA DESY preprint …
https://arxiv.org/abs/hep-ph/9911417

SppC bazlı ep ve μp için bak Bora'nın sunumu

5. *pp, ll, lp karşılaştırması*

1980'lerde CompHEP bunun için geliştirildi

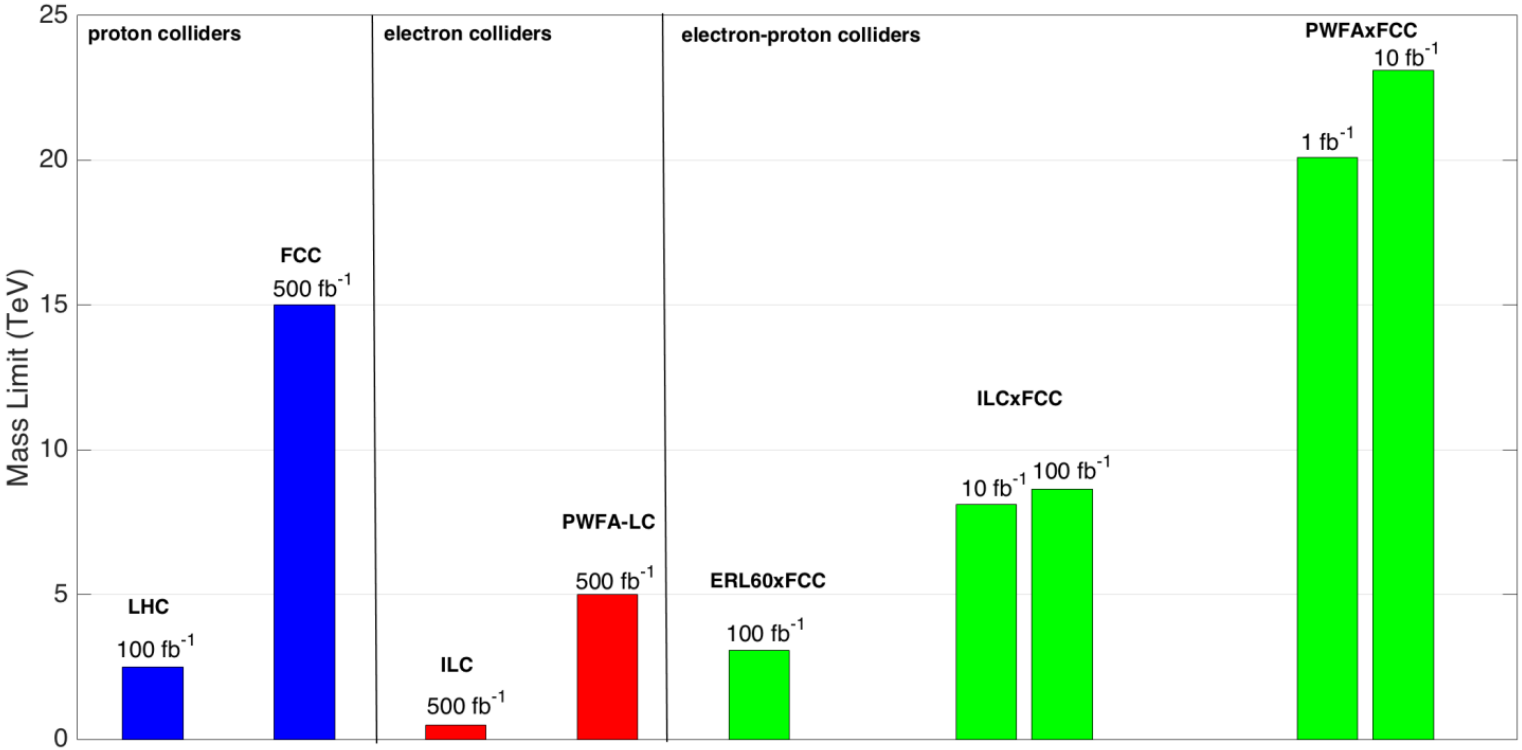
1990'larda bu karşılaştırmayı LHC, ILC ve ILC×LHC için başlattık

Bu çalıştayda: Ümit Kaya'nın sunumu

…

Yuvarlak Masa Toplantısında karşılaştırmada kullanacağımız çarpıştırıcı parametrelerini netleştirmeliyiz!

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)

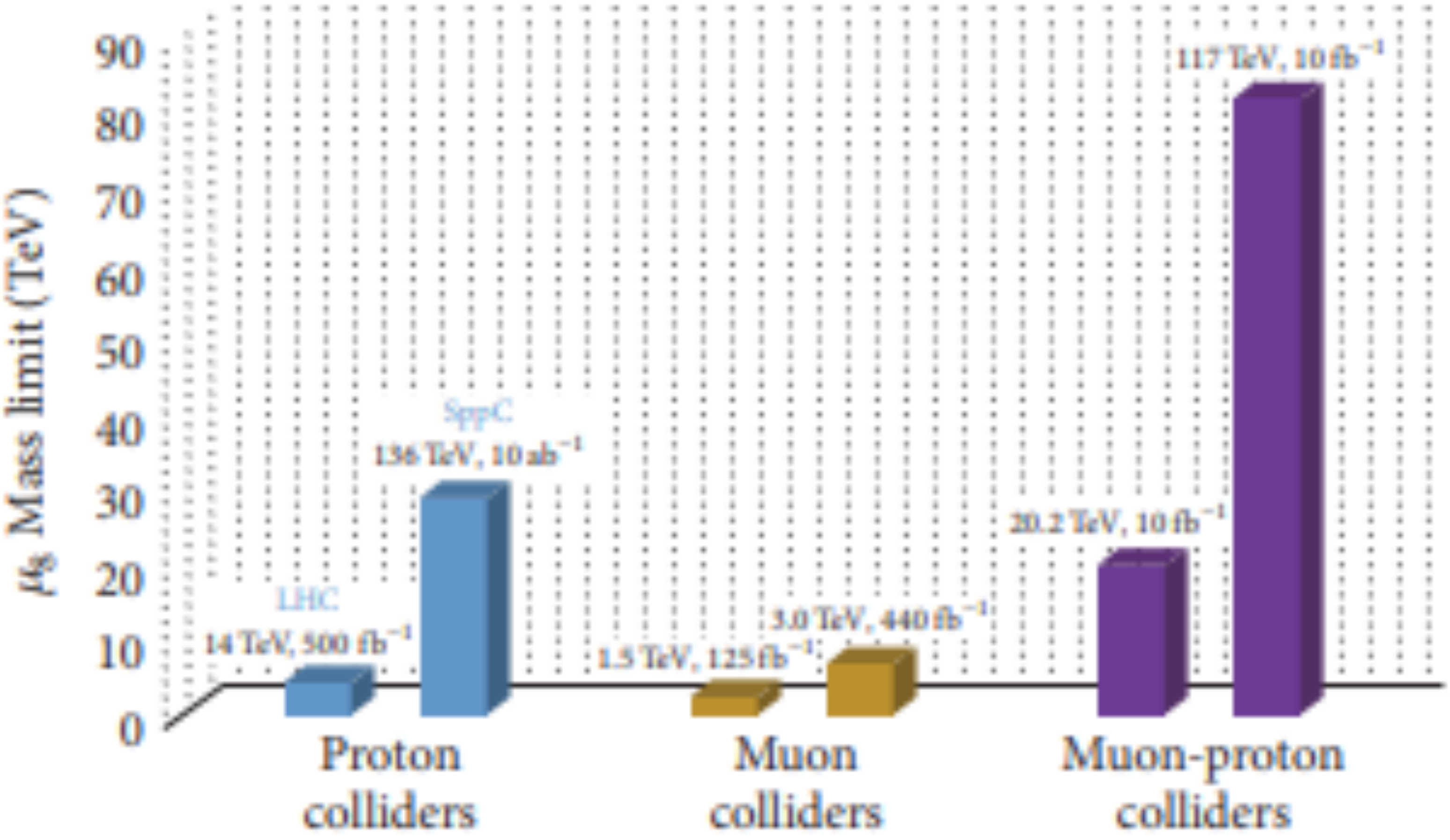


FIGURE 3: Discovery mass limits for color octet muon at different pp, $\mu^+\mu^-$, and μp colliders.

Benzer karşılaştırma diğer yeni fizik süreçleri için de yapılmalıdır

6. *Kozmik ışınlar, nadir bozunumlar, kozmoloji vb*

Kozmik ışınlar LHC'nin çok daha ötesinde enerjilere ulaşma imkanını sağlar, fakat devasa detektörlere ihtiyaç var.
Bu konuda tek sunumumuz: Ümit Kaya (IceCube)

Nadir bozunumlar: maalesef bu çalıştayda yer almıyor

Kozmoloji ve astrofizik: maalesef bu çalıştayda yer almıyor
Son yılların flaş konusu: Preon yıldızları

7. Sonuç

- Uzay-zaman değişmiyorsa «SM», SUSY, Ek boyutlar vb preon düzeyinde olmalıdır.
- Preon dinamiği en önemli konuların başında geliyor, ama büyük olasılıkla bu konu yeni parçacıkların ve/veya etkileşmelerin bulunmasından sonra aydınlığa kovuşacaktır. Yeni matematik gerekebilir.
- Muhammed Abdus SALAM bana 1989 yılında pre-preon düzeyinin gerekliliğini vurgulamıştı. Nedenini sonradan anladım.
- Çok sayıda süreç var: bunları sistematik şekilde incelemeliyiz.
- ATLAS ve CMS için ilginç olacak süreçleri belirleyip önermeliyiz.
- …

Hepinizin Çumartesi Yuvarlak Masa toplantısına aktif katılımını bekliyorum!
Hep birlikte Yol Haritamızı belirleyeceğiz...

Bu çalışma (ve Çalıştay) TÜBİTAK tarafından desteklenmektedir
Proje No 114F337