0016 Finding new physics will require a new particle collider

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1. Finding new physics will require a new particle collider

DEEP UNDER the countryside north of Geneva, straddling 跨过，横跨（河流、道路或一片土地）;骑；跨坐；分腿站立 the Franco-Swiss border, 主 one of the most advanced scientific machines ever built 谓 **has been banging 碰撞；磕 subatomic 亚原子的；比原子小的；原子内的 particles together** for more than a decade.

This device, **the Large Hadron 强子 Collider** (LHC), accelerates （使）加速，加快 **beams 光线；波束 of protons** 质子 (members of **a class 种类；类别；等级 of** particle called hadrons 强子) [in opposite directions] [around a 27km ring] **until they reach almost** the speed of light.

Powerful magnets 磁铁,磁体 then <u>force</u> these protons 质子 <u>into</u> **head-on 迎头相撞的；正面相撞的 collisions**, causing the energy (they carry) <u>to be converted</u> — **as described by** Einstein's best-known equation, $E = mc^2$ — <u>into</u> matter.

And **what matter**! For 主 sorting [through the ejecta (火山喷发或流星陨落时的)喷出物 from the collisions] 谓 **gives** physicists **fleeting (a.)短暂的；闪现的 glimpses of** the fundamental building blocks 组成部分；构成要素 of the universe and the forces (that bind or repel 排斥；相斥;推开 them).

Example 1. 标题

straddle

⇒ 改写自 stride,大步，阔步，跨，张开，-le,表反复。引申词义骑，横跨等。

Hadron

强子(Hadron)是一种亚原子粒子，所有受到"强相互作用"影响的亚原子粒子都被称为强子。 强子，包括重子和介子。
按现代的粒子物理学中的标准模型理论而言，强子是由夸克、反夸克和胶子组成的。胶子是量子色动力学中的基本粒子，它将夸克连在一起，强子是这些连接的产物。

proton

⇒ proto-,原始的，最早的，-on,物理名词后缀，来自electron.

beam

a line of light, electric waves or particles 光线；（电波的）波束；（粒子的）束
（建筑物的）梁

fleeting

(a.)lasting only a short time 短暂的；闪现的

- a fleeting (a.) glimpse/smile 短暂的一瞥；一闪即逝的微笑

在日内瓦北部横跨法瑞边境的乡村深处，十多年来，有史以来建造的最先进的科学机器之一,一直在将亚原子粒子碰撞在一起。这个设备，即大型强子对撞机(LHC)，可以加速质子束(一类称为强子的属于粒子类的成员)绕着27公里的环,向相反的方向加速，直到它们几乎达到光速。然后，强大的磁铁迫使这些质子发生正面碰撞，导致它们携带的能量被转换成物质—正如爱因斯坦最著名的方程E=mc2所描述的那样。那又有什么关系呢！因为通过对碰撞中喷出的物质进行分类，物理学家们可以短暂地瞥见宇宙的基本构件，以及束缚或排斥它们的力。

The discovery of the Higgs, though, **was supposed to be** 一般认为；人们普遍觉得会 a beginning as well as an end, 因为 for **the Standard Model** now **needs to be extended into** something bigger.

It does not, for example, include gravity. **That is the province 知识（或兴趣、职责）范围；领域 of** General Relativity.

Dark matter is also absent. This is a substance, invisible but detectable by its gravitational 引力的；重力引起的 effects, that **makes up** 形成；构成 27% of the universe — **over five times as much as** the so-called normal matter of stars, planets, people and so on.

And **it does not include** dark energy, a thing of **unknown nature** 基本特征；本质；基本性质 which constitutes (v.)（被认为或看做）是；被算作,组成；构成 the remaining 68% of reality and somehow 以某种方式（或方法）,不知怎么地 acts (v.) <u>to push</u> everything else (in the cosmos) <u>apart</u>.

Example 2. 标题

然而，希格斯粒子的发现虽然是一个终点, 它也被认为是一个开始，因为现在, 标准模型需要被扩展成更大的东西。例如，它没包括进重力, 重力还属于广义相对论的范畴中。它也没含进暗物质, 这是一种肉眼不可见, 但却可以通过引力效应能检测到的物质，占宇宙构成的27% — 是那些所谓正常的物质的5倍多. 正常物质, 即构成了恒星、行星、人体等的物质。它也没包括进暗能量，这是一种性质未知的东西，它构成了宇宙中剩余的68%，并以某种方式, 将宇宙中的其他一切物质推开 (暗能量被认为是导致宇宙加速膨胀的力量)。

主 **Each of these inadequacies (n.)不充分；不足；不够 谓 points to** physical laws, particles and forces (**yet to be** 有待, 尚未 discovered) — mysteries (which 主 physicists 谓 had expected 预料；预期；预计 that the LHC would have started **cracking 找到解决（难题等的）方法；爆裂声,噼啪声 open** by now). But it has not.

That suggests 主 **their hypotheses（有少量事实依据但未被证实的）假说，假设 about** what lies beyond the Standard Model, which were **the basis 基础,基点 of those expectations 预料；预期**, 谓 must be wrong.

The weightiest 严重的；重大的,沉重的 expectation 期望；指望 was placed on the shoulders of an elegant idea called supersymmetry 超对称性.

This theory, developed over the past 50 years, is a way of removing [from the Standard Model] a lot of things (<u>known</u> in the trade 同业；同行；同人 <u>as</u> **fudge 乳脂软糖,敷衍，装模作样（没有真正解决问题） factors** 系数, 经验系数; 容差系数).

A fudge factor is **an arbitrary 任意的；武断的；随心所欲的 value** that makes a model work, but which itself **defies (v.)不可能，无法（相信、解释、描绘等）;违抗；蔑视 deeper explanation**.

In the Standard Model, many such fudges (n.)敷衍，装模作样（没有真正解决问题）;不太令人满意的折中方案 can be erased [by 谓 introducing, for each and every Standard Model particle, 宾 **a heavier "supersymmetric" 超对称的 partner** (that has not yet been seen)).

主 The putative (a.)推定的；认定的；公认的 superpartners of the electron and quark, for example, 谓 **are known as** the selectron 超电子 and squark 超夸克.

Example 3. 标题

cracking :
(a.)(BrE informal) excellent 优秀的；出色的；极好的；顶呱呱的

- She's in cracking form at the moment. 她这会儿状态好极了。
- We set off at a cracking pace (= very quickly) . 我们迅速地出发了。

(v.)~ sth/sb (on/against sth)to hit sth/sb with a short hard blow 重击；猛击

(v.) 找到解决（难题等的）方法

- to crack the enemy's code 破译敌人的密码

the trade

[sing.+sing./pl.v.] : a particular area of business and the people or companies that are connected with it 同业；同行；同人 → a trade magazine/journal 行业杂志/期刊 → They offer(v.) discounts to the trade (= to people who are working in the same business) . 他们对同行业的人给予折扣。

fudge

/fʌdʒ/

(1)法奇软糖，乳脂软糖（用糖、黄油和牛奶制成）

(2) a fudge [sing.] (especially BrE) a way of dealing with a situation that does not really solve the problems but is intended to appear to do so 敷衍，装模作样（没有真正解决问题）

→ 词源不详。可能来自17世纪真实存在的Captain Fudge, 每次出海总会带回一箩筐的谎言，回避老板和同事的问题，因此，其名字通用化成为胡扯瞎说的代名词。后也用来指一种软糖。

- **This solution is a fudge** [rushed in to win cheers at the party conference]. 这个解决方案, 是为了赢得党的会议的赞誉而仓促搞出来的表面文章。

factor :

→ a suntan lotion with a protection factor(=a particular level on a scale of measurement 系数) of 10 防护系数为10的防晒油

fudge factors

经验系数; 容差系数.

defy :

(v.) ~ belief, explanation, description, etc. : to be impossible or almost impossible to believe, explain, describe, etc. 不可能，无法（相信、解释、描绘等）;/违抗；反抗；蔑视

putative

/'pjuːtətɪv/ (a.)(formal) (law 律) believed to be the person or thing mentioned 推定的；认定的；公认的. SYN presumed

→ putative ⇒ 来自拉丁语putare,计算，判断，思考，词源同compute,repute.

- the putative father of this child 这孩子的推定的父亲

这些不足之处中的每一个, 都指向着尚未被发现的物理定律、粒子和力-- 这些谜团, 物理学家们曾期望大型强子对撞机现在已经开始破解了。但事实并非如此。这表明他们关于标准模型之外的东西的假设, 肯定是错误的，而这些假设是这些预期的基础。

最大的期望, 被寄托在了一种被称为"超对称"的优雅思想的身上。这一理论已经存在了超过50年. 该理论, 能用于将众多的"容差系数"从标准模型中删除出去. "容差系数"是业内的叫法. "容差系数"是一个任意的值，它虽然可以使标准模型工作，但这个容差系数为什么是这个值, 你却无法对它做解释。

在标准模型中，可以通过为每个标准模型粒子引入一个更重的“超对称”伙伴(虽然它还没有被试验证实存在), 来消除许多的"容差系数"的这种任意值。例如，电子和夸克的超对称伙伴, 被称为超电子和超夸克。

Unfortunately, after almost a decade of increasingly energetic collisions at the LHC, **nothing new has emerged beyond** the Higgs itself. No hidden dimensions. No **unexplained phenomena**. No supersymmetric particles. [As a result] supersymmetry **has**, for many physicists, **lost its lustre** 光泽；光辉; 荣光；荣耀.

[And **of the myriad (n./a.)无数；大量 alternatives** 后定 **jostling (v.)（在人群中）挤，推，撞，搡; 争夺；争抢 to take its place**], no one knows {主 **which**, if any, 系 **might be closest to the truth}**.

Example 4. 标题

lustre

/'lʌstər/

myriad

⇒ 来自希腊语myrias,大量的，无数的，一万，可能来自PIE meu,流动，流出，水流，词源同 emanate(=to produce or show sth 产生；表现；显示), marine(=海的；海产的；海生的). 即由流动的水引申词义丰饶的，许多的，无数的。需注意的是，该词在古希腊语为单个词所表示的最大数。词义演变比较abundant.

jostle

(v.)/'dʒɑːs(ə)l/ to push roughly against sb in a crowd （在人群中）挤，推，撞，搡

→ 来自joust,推挤，打斗，-le,表反复。引申词义竞争，争夺。拼写比较claim,clamor.

不幸的是，在LHC经历了近10年的越来越高能量的撞击试验之后，除了希格斯粒子本身之外，没有任何其他的新发现。没有隐藏的维度。没有原因不明的现象出现。没有超对称粒子。因此，对许多物理学家来说，超对称性已经失去了它的光泽。在无数的替代方案中，没有人知道哪一个(如果有的话)最接近事实真相。

Regardless of the details, though, the consensus (n.)一致的意见；共识 is that {主 the route to finding physics (beyond the Standard Model) 谓 **runs through** the Higgs boson itself}.

This means 宾 examining (v.) and characterising 描述，刻画，表现（...的特征、特点） that object [in exquisite 精美的；精致的 detail].

Physicists do not know, for example, if it is truly **an elementary particle** with no **internal structure** (like an electron or a quark) /or is a composite 合成物；混合物；复合材料 of smaller objects (**in the way** that protons and neutrons are **made of** three quarks each).

It is even possible that {主 what has been identified as the Higgs 系 is not actually the particle **predicted by** the Standard Model—but, rather, a different particle (from **an as-yet-unknown 至今仍未知的 theory**) (that **happens to** 恰好,偶然发生 have the Higgs's predicted mass)}.

Example 5. 标题

> 不管细节如何，人们的共识是，找到超越标准模型的物理学的途径, 是通过希格斯玻色子本身。这意味着要仔细地研究和描述那个物体的细节。例如，物理学家不知道它究竟是一个没有内部结构的基本粒子(比如电子或夸克)，还是由更小的物体组成的复合物(比如质子和中子分别由三个夸克组成)。甚至有可能，被确认为希格斯的粒子, 实际上并不是标准模型预测的粒子，而是来自另一种尚不知名理论的不同粒子，该粒子恰好具有希格斯的预测质量而已。

Higgs bosons are unstable. They decay（力量、影响等）衰弱，衰减 into pairs of other particles [almost as soon as they are created].

The Standard Model predicts that 宾 [around 60% of the time] this will create a bottom quark and its antimatter 反物质 equivalent.
[A further 21% of the time] a pair of W bosons will emerge, and 主 9% of Higgs-boson decays 谓 should **end up with** a pair of gluons (the other 10% **will result in** yet further combinations).

[By making **enormous numbers of** Higgs bosons /and then **measuring the precise rates** (at which 主 bottom quarks, W bosons, gluons and other elementary particles 谓 emerge)], those running 管理，经营；运行 the FCC would be able to **watch for** 观察等待（某人出现或发生某事） discrepancies 差异；不一致 from the Standard Model's predictions.

The more Higgses created, the more **statistical 统计的；统计学的 power** 主 the results 谓 will have, and the more confident 主 researchers 谓 will be (that 主 any deviations 背离；偏离；违背 from Standard Model predictions (which they measure) 谓 actually represent (v.) something real).

Example 6. 标题

The+形容词/副词的比较级+主语+谓语

1. the more...the more...结构其实是一个 从句+主句 的结构:
   第一个the more...相当于一个"原因状语从句", 是从省略了表示原因的连词as等进化而来的(也可理解成是省略了if的条件状语从句); **第二个the more...引导的是主句.**
   → **The thicker** a mammal's skin is(从句), **the less hair** it has(主句).
   = As a mammal's skin is thicker(从句), it has less hair(主句).

2. the more 后面的谓语, 如果是be动词的话, 可以省略, 这一点对于前后两个都适用. **特别当主谓语是 it is时, 常同时省略.**
   → What size box do you want?—**The bigger, the better**.
   = 其实就是 The bigger **it is**, the better **it is**

3. 第二个the more后面可以使用"倒装", 而第一个后面却不行. (因为 **只有主句才能倒装,从句绝不能倒装!** 如果继续深究第二个the more后面什么时候用倒装时, 可认为 **如果主语长,谓语动词短时, 为避免头重脚轻, 主谓语倒装.**

希格斯玻色子是不稳定的。它们几乎一产生就会衰变成成对的其他粒子。标准模型预测，在大约60%的时间里，这将产生一个底夸克和它的反物质当量。另外21%的情况下会出现一对W玻色子，9%的希格斯玻色子衰变会产生一对胶子(另外10%会产生更多的组合)。通过制造大量的希格斯玻色子，然后测量底夸克、W玻色子、胶子和其他基本粒子出现的精确速率，FCC的管理者将能观察到与标准模型预测的差异。希格斯玻色子创造的越多，结果所带来统计力量, 就越强大，研究人员就越有信心，他们测量的任何与标准模型预测的偏差实际上都代表了一些真实的东西。

2. <pure> Finding new physics will require a new particle collider

DEEP UNDER the countryside north of Geneva, straddling the Franco-Swiss border, one of the most advanced scientific machines ever built has been banging subatomic particles [together] for more than a decade. This device, the Large Hadron Collider (LHC), accelerates beams of protons (members of a class of particle called hadrons) [in opposite directions] around a 27km ring until they reach almost the speed of light. Powerful magnets then force these protons into head-on collisions, causing the energy they carry to be converted — as described by Einstein's best-known equation, E=mc2 — into matter. And what matter! For sorting through the ejecta from the collisions gives physicists fleeting glimpses of the fundamental building blocks of the universe and the forces that bind or repel them.

The discovery of the Higgs, though, was supposed to be a beginning as well as an end, for the Standard Model now needs to be extended into something bigger. It does not, for example, include gravity. That is the province of General Relativity. Dark matter is also absent. This is a substance, invisible but detectable by its gravitational effects, that makes up 27% of the universe — over five times as much as the so-called normal matter of stars, planets, people and so on. And it does not include dark energy, a thing of unknown nature which constitutes the remaining 68% of reality and somehow acts to push everything else in the cosmos [apart].

Each of these inadequacies points to physical laws, particles and forces (yet to be discovered) — mysteries (which physicists had expected that the LHC would have started cracking open by now). But it has not. That suggests their hypotheses about what lies beyond the Standard Model, which were the basis of those expectations, must be wrong.

The weightiest expectation was placed [on the shoulders of an elegant idea called supersymmetry]. This theory, developed over the past 50 years, is a way of removing [from the Standard Model] a lot of things known [in the trade] as

fudge factors. A fudge factor is an arbitrary value that makes a model work, but which itself defies deeper explanation. In the Standard Model, many such fudges can be erased [by introducing, for each and every Standard Model particle, a heavier "supersymmetric" partner that has not yet been seen]. The putative superpartners of the electron and quark, for example, are known as the selectron and squark.
Unfortunately, after almost a decade of increasingly energetic collisions at the LHC, nothing new has emerged beyond the Higgs itself. No hidden dimensions. No unexplained phenomena. No supersymmetric particles. [As a result] supersymmetry has, for many physicists, lost its lustre. [And of the myriad alternatives jostling to take its place], no one knows {which, if any, might be closest to the truth}.

Regardless of the details, though, the consensus is that { the route to finding physics beyond the Standard Model runs [through the Higgs boson itself]}. This means {examining and characterising that object [in exquisite detail]}. Physicists do not know, for example, if it is truly an elementary particle with no internal structure (like an electron or a quark) or is a composite of smaller objects (in the way that protons and neutrons are made of three quarks each). It is even possible {that what has been identified as the Higgs is not actually the particle (predicted by the Standard Model—but), rather, a different particle (from an as-yet-unknown theory) that happens to have the Higgs's predicted mass}.

Higgs bosons are unstable. They decay into pairs of other particles almost as soon as they are created. The Standard Model predicts that around 60% of the time this will create a bottom quark and its antimatter equivalent. A further 21% of the time a pair of W bosons will emerge, and 9% of Higgs-boson decays should end up with a pair of gluons (the other 10% will result in yet further combinations). By making enormous numbers of Higgs bosons and then measuring the precise rates at which bottom quarks, W bosons, gluons and other elementary particles emerge, those running the FCC would be able to watch for discrepancies from the Standard Model's predictions. The more

Higgses created, the more statistical power the results will have, and the more confident researchers will be that any deviations from Standard Model predictions which they measure actually represent something real.