尊敬的理论物理教授：

我是向应明，1963 年生，理论物理硕士。我本次与你汇报的是我的统一场论的工作成果。可以说，我年轻时选了一块木板开始钻孔，一直坚持只钻这一个孔，钻了 30 年，似乎钻通了。

首先，我介绍一下我的工作经历。少年期间，崇尚杨振宁、李政道，立志物理研究。1980-1984 年在北京大学物理系学习理论物理，期间经历了 1983 年发现 W、Z 玻色子（高崇寿老师亲自激动的告诉我们），我在中科院国子监图书馆阅读过中国物理学家 1960 年代提出层子模型的所有文章。对大统一理论非常感兴趣，立志在这个领域做出成绩。但有感于一般粒子物理学家，大多对引力理论缺乏足够的理解，我决定报考了当时引力及天体物理比较强的北京师范大学物理系刘辽教授的研究生，专业方向是天体物理与宇宙学。以《基于 Brans-Dicke 理论的量子宇宙学》论文毕业，并在 Chinese Physical Letter1991 年发表了《The third quantization of a solvable model in quantum cosmology in the Brans-Dicke theory》论文。这期间我参加了 1989 年香山国际物理会议、1989-1990 年中科院理论所郭汉英教授所在组的研究活动，本来被浙江大学物理系汪容教授选中做他的博士研究生，后因当时世界实验室资助去做 Richard A Matzner （Texas University at Austin）教授访问学者等一系列原因，未能读博士而回到河北廊坊石油管道学院做了物理教师。但正是这样相对独立的环境，成就了我全身心投入统一场论的研究。1990-1993 年，我除了教授大学物理之外，没有发表论文的负担，我用全部的时间投入思考与研究。至 1993 年基本想明白了大统一的起源一定是时空结构本身，并且在数学上实现了，为此在 1993 年 8 月 26 日完成了《粒子、相互作用与时空的统一》，尽管我的理论与现有标准模型、定域规范场论、爱因斯坦相对论都非常符合，但我认为要计算出粒子谱的质量，理论才算成功，为此没有发表。当时我认为我短时间内做不到。恰逢有机会从事经济工作，做过国有企业的管理工作，现在自己拥有几家公司。这期间，我对统一场论一直关注，保持与一些物理学家的联系，一直期待有机会完成我的工作。但时间过得真快，转眼 22 年过去了，特别今年是爱因斯坦发表广义相对论的 100 周年，我也有 52 岁了。现在，我认为我 30 岁前的工作依然正确，22 年来我尚未了解到有人做成这个工作，所以我决定现在发表我的理论。

将粒子、相互作用一并考虑是现代统一场论的基本要求，标准模型、爱因斯坦相对论几乎是实验成果，必须要相容。我的想法是给时空一个结构，现有粒子、相互作用等这些是这个结构的结果。设空间不是连续的，而是由空间元胞组成的面心立方密排结构，之所以是面心立方密排，因为他最紧密，并且各向同性。元胞可以移动，也可以变形。物质就像固体物理一样，是缺陷。比如，空隙是粒子，填隙元胞是反粒子，规范粒子是元胞的波动，Higgs 就是元胞的大小。时间就是过程的度量。空间量子化了，那么通过一个元胞的时间也量子化了。面心立方密排的对称性群是 O_h、T_d，真空的对称性就是他们。那么，物质状态就没有这个对称性了。但每个元胞在属于 O_h、T_d 的对称操作 T_α后，如果转得不对，那么我再小量地转一下 $R(\gamma^\alpha(\mathbf{r},t))$进行调整，即对每一个对称操作 T_α，每一个元胞（$\mathbf{r}$,t），那么联合的操作 $R(\gamma^\alpha(\mathbf{r},t))T_\alpha$就是对称操作了，也就是说，一个粒子态$\psi(\mathbf{r},t)$具有以下对称性

$\psi'(\mathbf{r},t)=\exp(-i\theta^\alpha(\mathbf{r},t)\,T_\alpha)\,\psi(\mathbf{r},t)$

这不就是 Yang-Mills 定域规范不变性吗？每个面心立方密排的对称操作就是生成元，那么这些对称操作满足什么代数呢？每个生成元是群元，即这些群代数是什么代数关系？

群论早就已经研究清楚了 O_h、T_d 的性质。O 是不含空间反演的八面体的对称群，O_h 是含空间反演的八面体全面对称性群。T_d 是四面体的全面对称性群（没有空间反演），T_d 与 O 同构。而 O 群与 4 元素交换群 S_4 同构。S_4 研究的非常充分了，其 24 个群元素的乘法表都可以在任何群论书中找到。就是从这个乘法表，我们得到这些群元素满足李代数的定义：双

线性、反对易、嘉科比关系。所以是李代数。李代数也是研究非常清楚的。那么，我们这个24个群元素的生成元到底是一个什么李代数。要是他们就是我们标准模型的A_1、A_2的直和就好了，在这个目标指引下，我通过硬计算，得到O群代数是1个A_1、2个不同的A_2、A_2'、5个A_0子代数直和。即$A(O)=A_1\oplus A_2\oplus A_2'\oplus 5A_0$。$A_1$对应于自旋、一个$A_2$对应味（uds夸克）、一个$A_2'$对应色、5个$A_0$对应于整体量子数。这不就是对称性为$SU^{Spin}(2)\otimes SU^{Flavor}(3)\otimes SU^{Color}(3)$的（uds)夸克模型吗！而且，八面体的完全对称性是O_h，$A(O_h)=A(O^+)\oplus A(O^-)$，$O^+$、$O^-$是含空间反演的左右旋部分，故标准模型是左右对称的。而四面体的完全对称性群T_d的群代数与A(O)同构，但他不含空间反演对称性，我们的轻子正好具有这个特点，A_1对应自旋、一个A_2对应三味（左旋中微子、左旋轻子、右旋正轻子）、一个A_2'对应三色（三类轻子eμτ）,共9个轻子，加上共轭表示的9个轻子，正好是18个轻子。轻子的多重态的讨论，基本与（uds）夸克类似，我猜就是我们的（cbt）夸克的多重态。如果这是对的话，那么（cbt）夸克就不必要了。这可能更合理。

相互作用就是定域规范场论。就是标准模型，让规范粒子获得质量的机制，Higgs机制的标量场，在我的理论中有一个非常自然的标量场：元胞大小的变形。它的真空值就是真空中元胞的大小。我的估算是10^{-18}m，2014年似乎测到Higgs粒子质量大约是126Gev，相吻合。由于元胞除了大小变形外，还有多种变形，应该存在其它高阶粒子。

到这里，除了引力外，我们通过时空结构的对称性统一了所有基本粒子和相互作用。我们的时空结构还有平移对称性。我猜想，引力就是源于这个平移对称性。首先，纯几何的引力理论应该是

$$S=\int_M d^4x\sqrt{-g}R$$

这里，M就是物质场的时空元胞结构，即流形。由于物质场的时空结构与真空R^4不同，如果要放在R^4中积分，那么曲率就应该调整，

$$S=\int_{R^4} d^4x\sqrt{-g}(R+L)$$

物质场出来了。

这样，我通过给空间一个结构，统一了所有已知的粒子与相互作用，并且与现有理论吻合。如果这不是真的，有这么巧合的事吗？ 这正是在网站中将量子时空与牛顿时空、爱因斯坦时空并列的胆量来源。

为了介绍我的物理思想，我建立了这个网站：http://www.quantum-spacetime.com，方便阅读与讨论。

论文的英文版题目是A Possible Internal Space，于2016年2月17日提交给Physical Review D，提交号DP11613。论文的中文版题目是《粒子、相互作用与时空的统一》，最后Word版是在2012年10月完成的。最早手稿是1993年8月26日（见照片），当时用四通打印机打出一份电子版（见手稿打印版照片），这些版本的内容是一致的。为了表达我论文的物理思想，我录了中文英文两个演讲视频，主要讲解我的物理思想。我还准备一个中文的PPT，比较详细准确介绍我的物理思想。我最近找到一个关于面心立方密排结构的视频，我给链接上了，有助于对量子时空面心立方密排结构的直观理解。

期待大家批评指正。

此致敬礼！

向应明 2016年10月26日。

Respect Professors of theoretical physics:

I am Yingming Xiang, born in 1963, Master of theoretical physics. This letter for you is about my work of unified field theory. Can say, when I was young I selected a piece of wood to start drilling a hole, has always insisted that only drill the hole.Drilled for 30 years, it seems to drill through.

First, I introduce my work experience. Juvenile period, advocate C.N.Yang and T.D.Lee, aspire to physics. From 1980 to 1984, I studied in department of physics of Peking university in physics theory, excited the found of W± and Z0 bosons in 1983 from Professor Gao. I read all the articles about Chinese physicians straton model in the 1960's in the academy library of Chinese sciences academy. I am very interested in grand unified theory, hoping to make some achievements in this field. But recognizing that particle physicists commonly, the lack of adequate understanding of gravitational theory mostly, I decided to become a graduate student of Professor Liao Liu, Physics Department of Beijing Normal University,with stronger the Gravity and Astrophysics. My professional direction is Astrophysics and Cosmology. My graduate thesis is 'Quantum cosmology based on The Brans-Dicke's theory', and published by The Chinese Physical Letter in 1991 with title "The third quantization of a solvable model in quantum cosmology in The Brans-Dicke found". During this period I participated in the 1989 Xiangshan international conference on physics,and Professor H.Y.Guo's research activities of ICTP in 1989-1990. Physics Professor Wang Rong(Zhejiang University) selected me to do a PhD student in 1990.Because of the World Laboratory funding to do visiting scholar of Professor Richard Matzner(Texas University at Austin) and series of another reasons, I failed to read PhD. I were back to the Pipeline College in Langfang as a Physics Lecturer.Such a relatively independent environment is favor my unified field theory research. In 1990-1993, I use all the time in thinking and research without the burden of published papers in additional of an University Physics Teacher. Untill 1993, I understood that the origin of the grand unification must be spacetime itself and realized in math.On August 26, 1993, I completed the article of 'the unification of the particles,interactions and spacetime (Chinese)'. Even though my theory is very accord with the existing standard model, standard local field theory and Einstein's theory, but I think that successful theory must be to calculate the particles mass. Therefore I did not published the article. I think I can't do that in short time and have other opportunities to engage in economic work as the manager of state-owned enterprises.I am an owner of a few companies now.During this period, I have always focused on the unified field theory, keep in touch with some physicists, has been looking forward to have the opportunity to finish my work. But time flies, which have turned over the past 22 years.Especially this year is the 100th anniversary of Einstein published the General Relativity, I have 52 years old. Now, I think that my work of 30 years age is still correct.No one make this work in past 22 years. So I decided to publish my theory now.

Consideration together of particles and interactions is the basic requirement of modern unified field theory.The standard model and Einstein's theory of relativity is almost experiment results, and the every theory must be compatible. My idea is to give spacetime a special structure,and the existing particle and their interactions are the result of this special structure. Set up the space is not continuous, but by the space of the cell is face-centered cubic close structure.The reason of face-centered cubic close, because it is the most closely and isotropic. The cell can be moved, also

be deformable. Like solid state physics, matter is a defect one. Gap is particle, for example, interstitial cell is the antiparticle, gauge particles are cell fluctuations, Higgson is the cell. Time is the process measurement. The space quantized, then time through a cell quantized. Face-centered cubic symmetry group are O_h and T_d, the vacuum symmetry are them.There is no point group symmetries in matter states. In matter space each cell which operated by O_h and T_d is not in right position. We can use rotation $R(\gamma^{\alpha}(\mathbf{r},t)) \in SO(3,C)$ to adjust position of the cell.Therefore, the joint operator $R(\gamma^{\alpha}(\mathbf{r},t))T_{\alpha}$ is the symmetry operation for every T_{α} and every cell $(\mathbf{r},t)$.That is that there is following symmetry for a particle state $\Psi(\mathbf{r},t)$,

$\psi'(\mathbf{r},t)=\exp(-i\theta^{\alpha}(\mathbf{r},t)\, T_{\alpha})\psi(\mathbf{r},t)$.

It is just the Yang-Mills local gauge invariance! Each symmetry operator in face-centered cubic close is generator. What algebra are the symmetry operations? Each generator is a group element, what algebraic relationship are these group algebra?

Group theory has studied already the properties of O_h and T_d. O is octahedral symmetry group not including space inversion. O_h is octahedral overall symmetry group including space inversion. T_d is tetrahedral symmetry group (no space inversion), T_d and O are isomorphism. O and exchange group S_4 with 4 elements are isomorphism. S_4 has been researched very sufficient.The multiplication table for 24 group elements can be found in any group theory book. From the multiplication table, we get that the group elements meet the definition of Lie algebra: bilinear, anti-commutation, Jacobi relation. So these point group algebras are the Lie algebras. Lie algebra is studied also very clear. So, what Lie algebra meet our 24 generators. I hope that they are direct sum of A_1 and A_2 in Standard model. Following this goal, I calculated hard and got that the O group algebra is direct sum of one A_1, two different A_2,five different A_0. Namely, $A(O)= A_1\oplus A_2\oplus A_2'\oplus 5A_0$. A_1 corresponds to the spin.A_2 corresponds flavor (uds quarks).A_2' corresponds color (RGB).Five A_0 correspond to the global quantum numbers. This is just the (uds) quark model with symmery of $SU^{Spin}(2)\otimes SU^{Flavor}(3)\otimes SU^{Color}(3)$. And octahedral overall symmetry is O_h, $A(O_h)= A(O^+) \oplus A(O^-)$， O^+ and O^- are left hand part and right hand part including space inversion. Therefore, the left hand and the right hand are symmetrical in the (uds) quark model. group algebra of tetrahedron overall symmetry group T_d is $A(T_d)$. $A(T_d)$ and A(O) are isomorphic. $A(T_d)$ does not contain space inversion symmetry.we happen to have the characteristics of the the lepton. A_1 corresponds spin. A_2 corresponds to the three (left-hand neutrinos, left-hand lepton, left-hand anti-lepton), A_2' corresponds three color (three kinds of lepton $e\mu\tau$).The total nine leptons with nine conjugate leptons are just 18 leptons. Lepton's multiplet is similar to (uds) quark. I guess they are that multiplet of (cbt) quarks. If this is right, then (cbt) quark is unnecessary. It may be more reasonable.

Interactions are local gauge fields. In Higgs mechanism with scalar field we got particle mass.There is a very natural scalar field in my theory: the size of a cell deformation. The vacuum value is the size of the cell in a vacuum. My estimate is 10^{-18}m.Higgson is founded about 126 Gev in 2014,and such result coincide with my theory. Because the cell have a variety of deformation in addition to the size deformation, there should be other higher-order Higgsons.

Up here, in addition to gravity, we united all elementary particles and interactions through a special spacetime symmetry. Our space time has translational symmetry. I guess, gravity is originated from the translational symmetry. First of all, pure geometric theory of gravity is supposed to be

$$S = \int_M d^4x\sqrt{-g}R$$

Here, M is the matter cell structure of spacetime, namely manifold. Due to the spacetime structure M of the matter field and R^4 is different, if you want integral to put in R^4, they should adjust curvature,

$$S = \int_{R^4} d^4x\sqrt{-g}(R+L).$$

The matter field L is coming.

So, I unified all known particles and interactions by giving space a special structure which is accordance with the existing theory. If this is not true, there is such a coincidence? This is why I put my quantum spacetime on a par with Newton spacetime and Einstein spacetime.

In order to introduce my physical ideas, I build this website: http://www.quantum-spacetime.com, for readers easy to read and discuss.Papers in English version is “A Possible Internal Space”, submitted to Physical Review D on February 17, 2016,and the submit number is DP11613. Chinese version of the paper is “Unification of Particles,Interactions and Spacetime”, the final Word version was done in October 2012. On August 26, 1993,I have written the earliest manuscripts (see photo).The earlist digital version (see manuscript printed photos) is printed by the Shitong printer.The content of all above version is the same. To express the physical ideas of my paper, I recorded two speech video in Chinese/English. I also prepare a Chinese PPT, more accurate detail introduce my physical ideas. I recently found a video about face-centered cubic close, I give a link, and help to understand intuitive in face-centered cubic close.

Looking forward to your comments.

Yours sincerely，
Yingming Xiang
October 26, 2016.