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Introduction to Yang Mills Theory 1



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[2017] **Zohar Komargodski | The long-distance physics of Yang-Mills theory in 2+1 Dimensions** *Lorenzo Sadun on the "Yang-Mills and Mass Gap" Millenium problem* ~~Anthony Zee - Some Thoughts about Yang Mills Theory (Day 1)~~ Quantum Mathematics and the Fate of Space, Time and

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Matter - Robbert Dijkgraaf ?????? ?????  
????? ??????? ?????? ??????? - Yang-Mills  
theory Quantum Yang Mills Theory  
The

Yang–Mills theory is a gauge theory based on a special unitary group  $SU$ , or more generally any compact, reductive Lie algebra. Yang–Mills

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of Gauge Theory seeks to describe the behavior of elementary particles using these non-abelian Lie groups and is at the core of the unification of the electromagnetic force and weak forces as well as quantum chromodynamics, the theory of the strong force. Thus it forms the basis of our understanding

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of the Standard Model of particle physics.

*Yang–Mills theory - Wikipedia*

QUANTUM YANG–MILLS THEORY

ARTHUR JAFFE AND EDWARD

WITTEN 1. The Physics of Gauge

Theory Since the early part of the 20th

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century, it has been understood that the description of nature at the subatomic scale requires quantum mechanics. In quantum mechanics, the position and velocity of a particle are noncommuting operators acting

*QUANTUM YANG–MILLS THEORY*

*Page 13/38*

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## *The Physics of Gauge Theory*

Yang-Mills theory, in physics, a generalization of Scottish physicist James Clerk Maxwell 's unified theory of electromagnetism, also known as Maxwell's equations, used to describe the weak force and the strong force in subatomic particles in terms of a

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Of Gauge Theory, or quantum field theory. The Yang-Mills theory relies on a quantum mechanical property called the “mass gap.”

*Yang-Mills theory | physics | Britannica*

Yang-Mills is a strongly coupled quantum field theory, whose low-

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energy dynamics looks nothing at all like the classical theory. Our understanding of quantum Yang-Mills is far from complete, but we will describe some of the key ideas from Section 2.4 onwards. A common theme in physics is that Nature enjoys the rich and subtle: the most



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## *2. Yang-Mills Theory - University of Cambridge*

By the 1950's, when Yang-Mills theory was discovered, it was already known that the quantum version of Maxwell theory—known as Quantum Electrodynamics or QED—gives an

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Of Gauge Theory  
extremely accurate account of  
electromagnetic fields and forces.

*Quantum Yang–Mills Theory - Arthur  
Jaffe*

Mass in Quantum Yang-Mills Theory.  
(Comment on a Clay Millennium  
Problem) L. D. Faddeev St.

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Petersburg Department of Steklov Mathematical Institute. Among seven problems, proposed for XXI century by Clay Mathematical Institute [1], there are two stemming from physics. One of them is called "Yang-Mills Existence and Mass Gap".

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*Mass in Quantum Yang-Mills Theory - arXiv*

Quantum Yang–Mills theory See also:  
Yang–Mills theory To establish the  
existence of the Yang-Mills theory and  
a mass gap is one of the seven  
Millennium Prize Problems of the Clay  
Mathematics Institute. A positive

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estimate from below of the mass gap in the spectrum of quantum Yang-Mills Hamiltonian has been already established.

*Quantum gauge theory - Wikipedia*

Quantum Yang-Mills theory is now the foundation of most of elementary

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particle theory, and its predictions have been tested at many experimental laboratories, but its mathematical foundation is still unclear. The successful use of Yang-Mills theory to describe the strong interactions of elementary particles depends on a subtle quantum

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mechanical property called the "mass gap": the quantum particles have positive masses, even though the classical waves travel at the speed of light.

*Yang–Mills and Mass Gap | Clay  
Mathematics Institute*

*Page 23/38*

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In Yang-Mills theory, the Faraday tensor is generalized to the curvature,  $F$ . Mathematically, the curvature is derived from the connection essentially by taking commutators of certain differential operators related to the connection.



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## *5 An introduction to Yang-Mills theory - Michael Nielsen*

In mathematical physics, the Yang–Mills existence and mass gap problem is an unsolved problem and one of the seven Millennium Prize Problems defined by the Clay Mathematics Institute, which has

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offered a prize of US\$1,000,000 for its solution. The problem is phrased as follows: Yang–Mills Existence and Mass Gap. Prove that for any compact simple gauge group  $G$ , a non-trivial quantum Yang–Mills theory exists on  $\mathbb{R}^4$  and has a mass gap  $\mu > 0$ . Existence

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*Yang–Mills existence and mass gap - Wikipedia*

Research video based on the papers arxiv:1508.06305, arxiv:1601.04726, arxiv:1607.07463. Part One (general introduction): 0:26 - two paradigms for

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*Quantum Yang-Mills Theory in Two Dimensions - YouTube*

The Yang-Mills theory is, specifically, what is known as a gauge theory based on Special Unitary Group (of degree  $N$ ). Its main goal is to describe

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of the behavior of elementary particles and is the central explanation between the electromagnetic force and the weak nuclear force.

*What is an intuitive explanation of Yang-Mills theory? - Quora*

Sheldon Lee Glashow. Physics /

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Critical Essay / Vol. 5, No. 2. Gauge theories are relevant to contemporary physics because the standard theory of particle physics is based on a generalization of the Yang–Mills model, the first non-abelian gauge theory dealing with particle symmetries. Furthermore, gauge

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interactions have a natural origin in the context of superstring theory. 1 The symmetries of physics may be exact, approximate, or alleged.

*The Yang–Mills Model | Articles | Inference: International ...*

By the 1950s, when Yang–Mills theory

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Of Gauge Theory was discovered, it was already known that the quantum version of Maxwell theory – known as Quantum Electrodynamics or QED – gives an extremely accurate account of electromagnetic fields and forces.

*Yang-Mills theory in nLab*

*Page 32/38*



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Moreover, a derivation of the temperature–redshift relation of the CMB in deconfining SU (2) Yang–Mills thermodynamics and its application to explaining an apparent early re-ionization of the Universe are given. Finally, a mechanism of mass generation for cosmic neutrinos is

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## *The Thermodynamics of Quantum Yang–Mills Theory*

This caused Jaffe and Witten, in 2000, to propose including Quantum Yang–Mills Theory as one of the seven millenium prize questions, in which

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they indicated that QCD indeed shall be a consistent...

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*Quantum Yang-Mills field theory -  
CORE*

For quantum Yang–Mills theory with gauge group  $U(N)$  the Yang–Mills measure is a probability measure

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specified formally by the expression  $d^2g(A) = \int_{A_0} \frac{1}{2g^2} \text{Tr} [F_A]^2$ , where  $F_A = dA + A \wedge A$  is the curvature of a connection form  $A$ ,  $g$  is a parameter that may be viewed as a 'coupling constant', and  $[DA]$  is formal Lebesgue measure on  $A_0$ .

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