A First Course in String Theory

Barton Zwiebach Massachusetts Institute of Technology



A refreshingly different approach to string theory...**77**

Professor Michael Green, University of Cambridge

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Barton Zwiebach has written a careful and thorough introduction to string theory that is suitable for a full-year course at the advanced undergraduate level. There has been much demand for a book about string theory at this level, and this one should go a long way towards meeting that demand.

There is a great curiosity about string theory, not only among physics undergraduates but also among professional scientists outside of the field. This audience needs a text that goes much further than the popular accounts but without the full technical detail of a graduate text. Zwiebach's book meets this need in a clear and accessible manner. It is well-grounded in familiar physical concepts, and proceeds through some of the most timely and exciting aspects of the subject. Professor Joseph Polchinski, University of California, Santa Barbara

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A First Course in String Theory

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		315 15.3 Strings enour	·		
		į.	53 - 51		
lung ele	ctric charge.and particle physics	\downarrow \neq .	B ²		
314 String charge, -	(15.33)	\uparrow $+$:	.: B ³		
components BH = defined	a by $B^3 = 1$. The vector \tilde{B}_H is called the B^3				
Hou = e	symmetric and satisfies e symmetric and satisfies e hack into (15.32), we find (15.34)		of Maxwell charge and of string number of		
Here eine is total	bstituting units $(\nabla \times \tilde{B}_{H})_{R} = \kappa^{2} j^{0R}$.	1	Comparing the comparations of the sphere which encoded		
$e^{k^{lm}} \frac{\partial B_{H^{m}}}{\partial x^{l}} =$	= x ² J ² (15.35)	Figure world with 1	s to the circle which links the survey		
At this stage, the rele) has been recast in the focus	Pe Turbech.	densily. It is also possible to write and		
and equation ($x^2 \tilde{j}^0$.	example can be ci	alculated B _{µV} (Problem 15.47) nsor field B _{µV} (Problem 15.47) For a localized Maxwell charge ball B ³ encussed		
This is Ampère's	equation for the time to the original Col (15.35) is reacting that J UC (15.35) is equivalent to the original condition for (15.35) is reacting that J UC (15.35) is equivalent or the second condition of the second conditit	antisymmetric	with electromagnetistic charge size Figure 15.17. This is the natural of by integrating the electric charge size Figure 15.17. This is the natural along the charge size of the size of th		
ansatz, equation (ution for H. The concerner of a solution signal curve I that the solution of the existence of a solution signal curve I that the solution of the solution of t	charge is calculated	Not ophore S ² that enclosed - by a solute surface S ² that we have a Maxwell charge		
divergence of a divergenceless.	Alternatively, given a the grad form of equal (15.56)	infinite strings	is source way as electric charge links them. To castring without because same way as electric charge in you remove a string without because density, gives the same way end charge density over		
of a two-dimens	$j_0 n_{a1} = \int \tilde{j}^0 \cdot d\tilde{a}$.	strings do not	touch the two-sphere, nor can integral of washing charge charge can turing the two sphere, nor can integral of the local flux of string charge can mercial of the local flux of string charge can integral of string can integral of string can integral of string can i		
$\frac{1}{\kappa^2} \oint_{\Gamma}$	by use J ₃ the link a string if the string pierces dend at that pollin, is the string ended the link a string if the string of the string ended at that pollin, is the string ended at th	t The compute	ation analogo at S ¹ as an integer S ¹ . Finally, in the surface S ² with the surface		
A curve T is s	led at some point, the cells to an inconstant (15.36) would be led at some point, the cells of the source of the s	at a two-ball I	B ² (a disk) where integral of the con- integrated as a flux integral of the con- integrated as a flux integral of the con- integrated analogously as an integral.		
nonvanishing	s () then for any fixed 1 the the choice of surface string number	35	2.0 Electrometrism in three dimensions		
the right-b			41 3.2 Exclusionage-		
the begin			relativistic momentum of a charged particle in inclusion of		
	1	itation	$\frac{dp}{dt} = q \left(\tilde{E} + \frac{v}{c} \times B \right)$.		
We exp	3 Electromagnetism and graves	Since the magnetic field B is divergenceless, it can be written as			
in the l	in various dimensions		$\vec{B} = \nabla \times \vec{A}$.		
equati			In electrostatics the electric field \vec{E} has zero curl, and it is therefore in electrostatics the electric field \vec{E} has zero curl, and Φ . In electrostatics the electric field \vec{E} has a second		
		a to ada			
Cons that	As a candidate theory of all interactions, string t	heory includes Maxwell electrody- vitation. We review the relativistic	combination of E and of the time derivative of C and		
x di	formulation of four-dimensional electrodynam formulation of four-dimensional electrodynam	ics and show how it facilitates uncons. We give a brief description of	$\nabla \times \left(E + \frac{1}{c \partial t}\right) = 0$.		
1.	definition of electrocity and use the Newtonian lin Einstein's gravity and use the Newtonian lin	t in various dimensions. We study	The object inside parentiness is see equal in in terms of the scalar potential and the vector potential:		
6	by planck's length and the planck on the gravitation by the effect of compactification on the gravitation.	nal constant and explain now large	$\vec{E} = -\frac{1}{2}\frac{\partial \vec{A}}{\partial t} - \nabla \Phi.$		
	extra dimensions could except and		Equations (3.6) and (3.8) express the electric and magnetic field Equations (3.6) and (3.8) express the electric and magnetic field for a second se		
	3.1 Classical electrodynamics		By doing so, the source-free Maxwes equations Equations (3.3) and (3.4) contain additional information. They a		
	Unlike Newtonian mechanics, classical electrodynar	nics is a relativistic theory. In fact,	for \tilde{A} and Φ .		
	Einstein was led by considerations of electrodynamic relativity. Electrodynamics has a particularly elegant	formulation in which the relativistic	3.2 Electromagnetism in three dimensions		
	character of the theory is manifest. This relativistic to of the theory to higher dimensions. Before we discuss	the relativistic formulation we must	What is electromagnetism in three spacetime dimensions? On		
	review Maxwell's equations. These equations describe	the dynamic sol cleanse -	of electromagnetism in three dimensions is to begin what the		
	Although most undergraduate and graduate colarses	in electrodynamics nowadays use the	In four spacetime dimensions, both electric and magnetic ter- $(E - E - E)$ and (B_L, B_V, B_Z) , respectively. It may seen		
	international system of units (SI units), the received	d extra dimensions. In this system of	world without a coordinate would require dropping the coordinate would require dropping the coordinate work? Maxwell's equations and the		
	units. Maxwell's equations take the following form:	6.0	impossible.		
	$\nabla \times \vec{E} = -\frac{1}{c} \frac{\partial B}{\partial t}$.	(3.2)	In order to consider a non- dynamics does not depend on the z direction, the direction dynamics does not depend on the z direction, the direction		
	$\nabla \cdot \vec{B} = 0$,	(3.3)	there is motion, it must termine to the termine the second second and the second secon		
	$\nabla \cdot E = \rho$, $= 1$, $1 \partial \tilde{E}$	(3.4)	with a z index. The Lorentz force law (3.5) is a useful guide to the constru- The Lorentz force law (3.5) is a useful guide to the construc-		
	$\nabla \times B = \frac{1}{c}J + \frac{1}{c}\frac{\partial I}{\partial t}.$	aned with the same units. The first two	theory. Suppose that there is no magnetic field. First, momentum equal to zero we must have $E_z = 0$; the z compo- momentum equal to zero we must have $E_z = 0$.		
	The above equations imply that E and B are mean emutions are the source-free Maxwell equations	The second two involve sources: the	go. The case of the magnetic field is more surprising. House of the velocity of the particle is a vector in the (x, y) plane.		
	charge density ρ- with units of charge per unit v enits of current per unit area. The Lorentz force la	w, which gives the rate of change of the	AA		
	40				

A refreshingly different approach to string theory that requires remarkably little previous knowledge of quantum theory or relativity. This book makes the subject amenable to undergraduates but it will also appeal greatly to beginning researchers who may be overwhelmed by the standard textbooks. Furthermore, all of this is accomplished with great elegance in a single volume. **Professor Michael Green, University of Cambridge**

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