Summary

FREE THEORY ← Solve by introducing creation/annihilation operators

Interpret particles as SHO excitations of "field"

Introduced to incorporate SR and QM and preserve locality

particles transform under unitary irreps of the Poincaré group; fields under irreps of the Lorentz group

Cannot do this.

INTERACTING THEORY → "Solve" by calculating all correlation functions

Introduced interaction picture

Used Dyson's formula to express correlation functions in terms of vacuum correlation functions of interaction-picture fields

obey free Klein-Gordon equation

Used Wick's theorem to write time-ordered operators in terms of normal-ordered operators and contracted fields

Expressed vacuum correlation functions in terms of untruncated fields

= propagators!

c-number

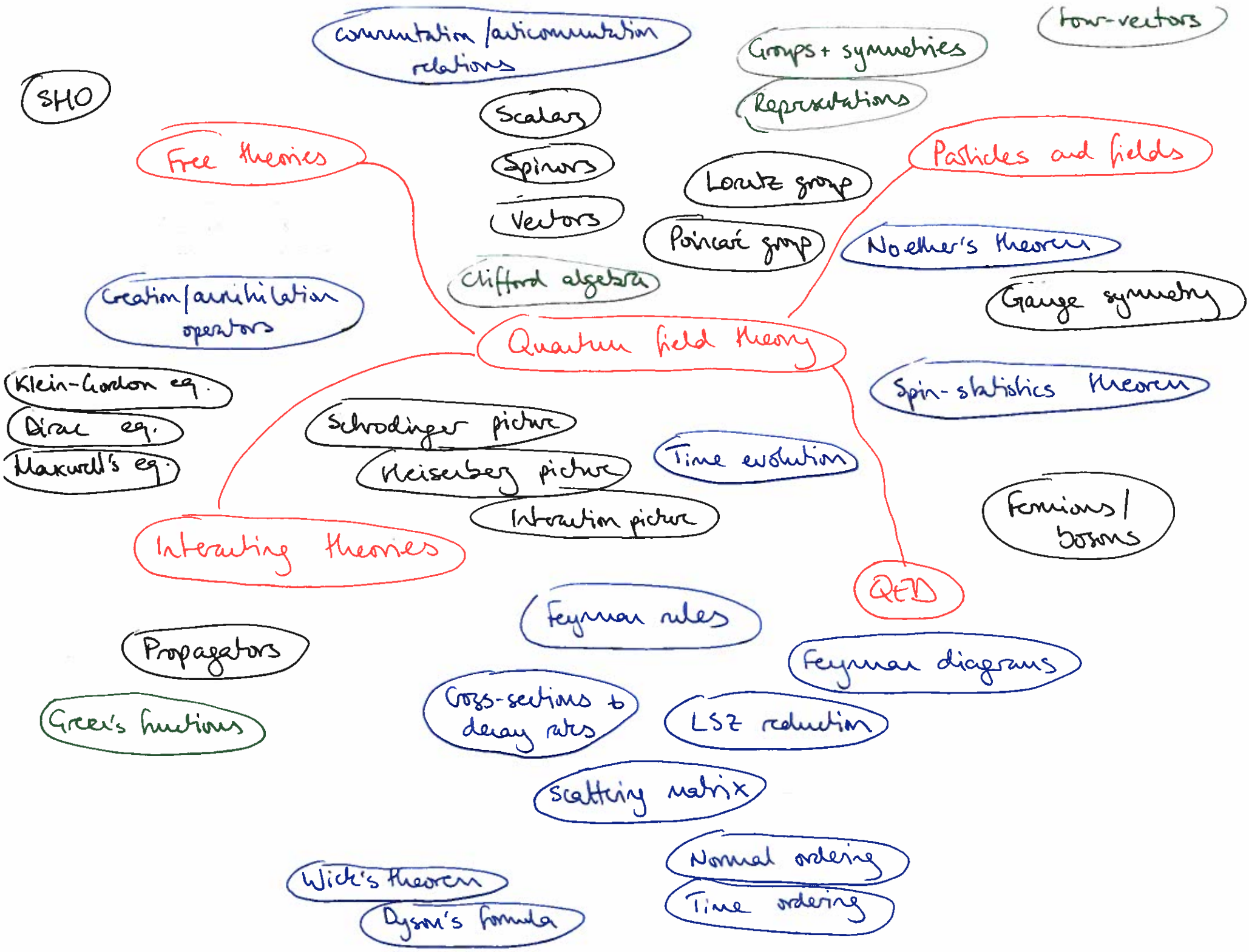
read off from Lagrangian

Used Feynman rules as a shortcut, via Feynman diagrams, to Wick's theorem results

[Use LSZ reduction formula to]

Express S-matrix in terms of correlation functions

Relate S-matrix to experimental observables, cross-sections and decay rates


commutation/anticommutation relations
four-vectors
Groups + symmetries
SHO
Representations
Scalars
Free theories
Spinors
Particles and fields
Lorentz group
Vectors
Poincaré group
Noether's theorem
Clifford algebra
Creation/annihilation operators
Gauge symmetry
Quantum field theory
Klein-Gordon eq.
Spin-statistics theorem
Dirac eq.
Schrödinger picture
Maxwell's eq.
Heisenberg picture
Time evolution
Interaction picture
Fermions/bosons
Interacting theories
QED
Feynman rules
Propagators
Feynman diagrams
Cross-sections & decay rates
Green's functions
LSZ reduction
Scattering matrix
Normal ordering
Wick's theorem
Time ordering
Dyson's formula

QFT outline

Theme	Topic	Textbook sections	Additional reading
Intro	Syllabus review		
Review	Lorentz transforms & 4-vectors	S2.1	T0, PS2.1
	Maxwell's equations	T6.1	
	Plane waves & oscillators	S2.2	T1.2
	Classical field theory	S3.1, S3.2, S3.2	T1, PS2.2
	Symmetries	S3.3, T1.3	
	Lorentz group	S10.1	T4.0
	Fields and the Lorentz group		
Particles and groups	Particles and fields: Unitary reps of the Poincare group	S8.1	
	General reps of the Lorentz group	S10.1.2	
	Spin 0	S8.2.1	
	Spin 1/2 and the Dirac Lagrangian	S10.2	T4.1,PS3.1, PS3.4
	Gamma matrices	S10.3, S10.5	PS3.2
	Free particle solutions of the Dirac equation	S pg 172, S11.2	T4.3, PS3.2, PS3.3
	Chirality, helicity & spin	S11.5, S11.6, S11.7	T4.6, PS3.6
	CPT	PS3.6	
	Continuous symmetries, review		
	Spin 1	S8.2.2, S8.2.3	T6.1
Quantising free fields	Scalar fields & normal ordering	S2.3, S4.2	PS2.3
	Heisenberg picture and time dependence	S2.3.2, T4.6	
	Complex scalars	S8.4, S9.1, S12.3	T2.5
	Spin & statistics & two-point functions	S12.1, S12.2, S12.4	
	Quantising spinor fields	S12.3	PS3.5
	Quantising vector fields	S8.4	
Interacting theories	Interacting fields		
	Cross-sections and decay rates	S5.1	T3.6, PS4.5
	S-matrix & the LSZ reduction	S6.1	PS4.5
	The interaction picture	PS4.2	T3.1
	Normal ordering and Wick's theorem	S7.A	T3.3, PS4.3
	Position space Feynman rules & diagrams	S7.1.1	T3.4, PS4.4
	Momentum space Feynman rules	S7.3	
	2->2 scattering examples	S7.4	

Theme	Topic	Textbook sections	Additional reading
Scattering in QED	Gauge invariance & covariant derivatives	S8.3, S8.6	T6.2, T6.3
	Scalar QED Feynman rules	S9.2	
	Mandelstam variables	S7.4.1	
	Scattering in scalar QED	S9.3	
	Ward identity in scalar QED	S9.4	
	QED Feynman rules	S13.1	T6.4, T6.5, PS4.8
	Scattering in QED – e+e- -> mu+mu-	S13.3	T6.6, PS5.1
	Contraction identities	S13.2	T6.6, PS5.1
	Rutherford scattering e-p+->e^-p^+	S13.4	
	Crossing symmetry	PS5.4	
	Compton scattering	S13.5	PS5.5