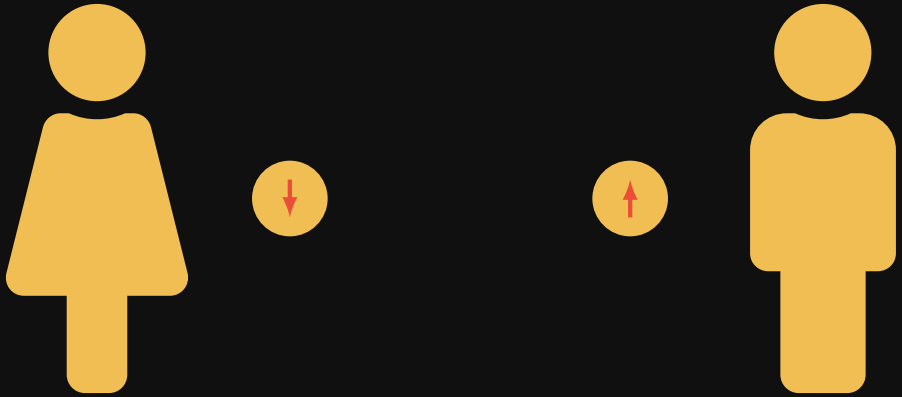
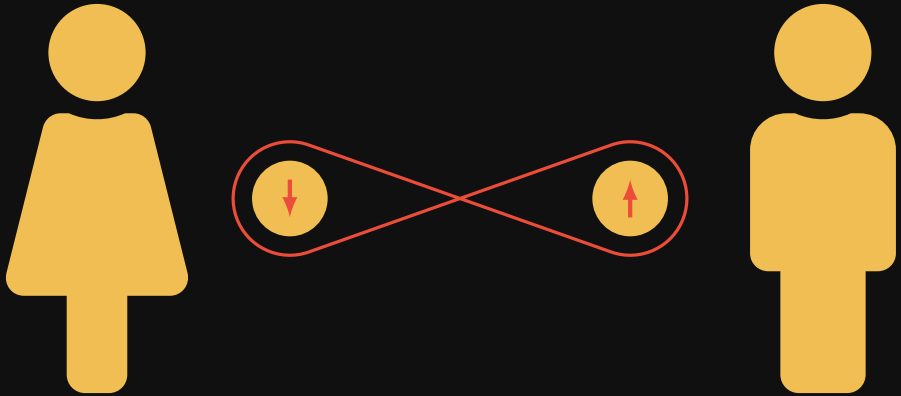
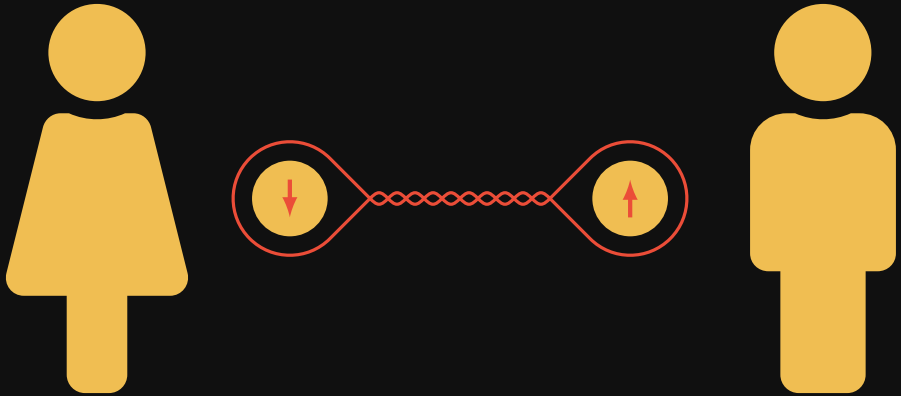
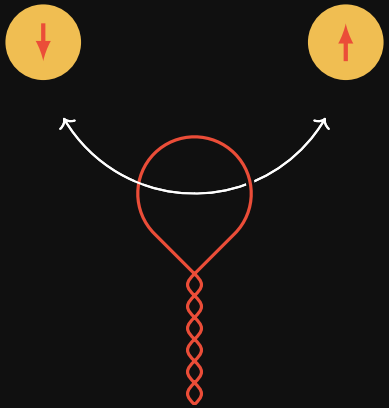
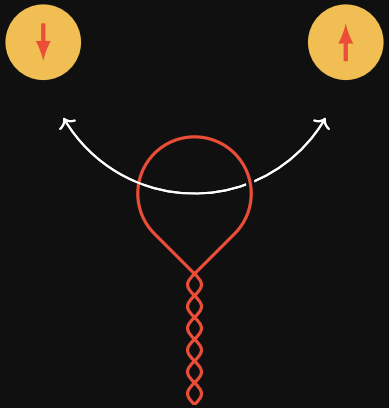
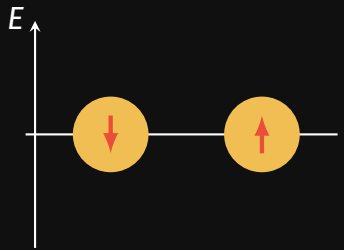












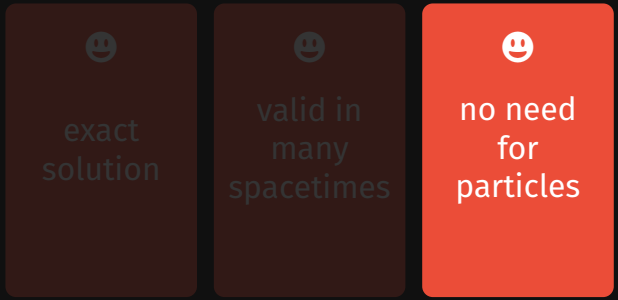
Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].

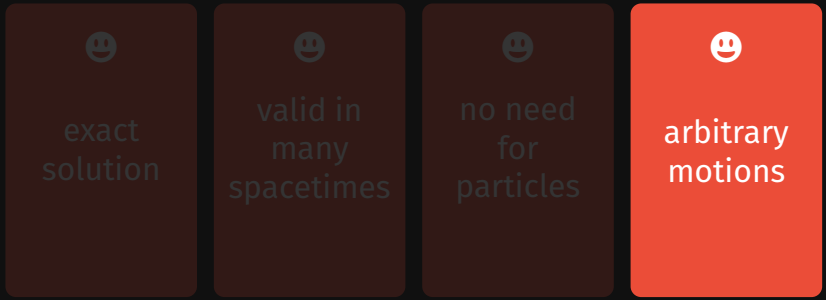
Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].


exact
solution

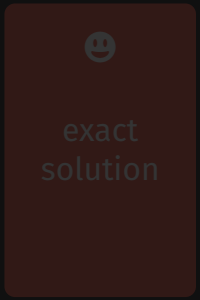
exact solution

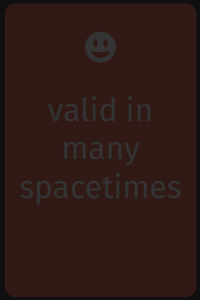
valid in many spacetimes

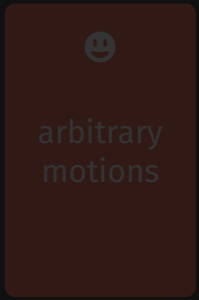

exact solution
valid in many spacetimes
no need for particles



Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].







Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].

exact solution

valid in many spacetimes

no need for particles

arbitrary motions

interactions in bounded regions

valid in many states

exact solution

valid in many spacetimes

no need for particles

arbitrary motions

interactions in bounded regions

valid in many states

allows classical comms

Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].

exact solution

valid in many spacetimes

no need for particles

arbitrary motions

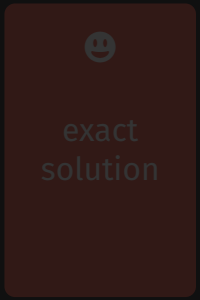
interactions in bounded regions

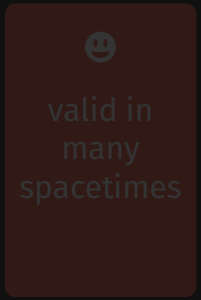
valid in many states

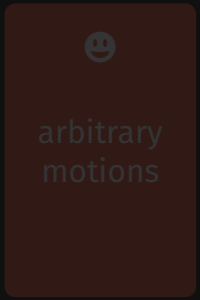
allows classical comms

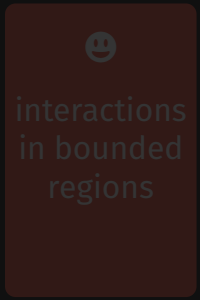
manifest causality

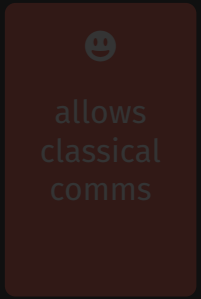
Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].

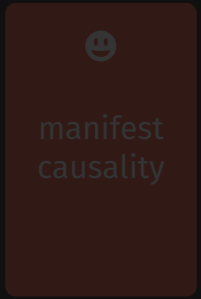




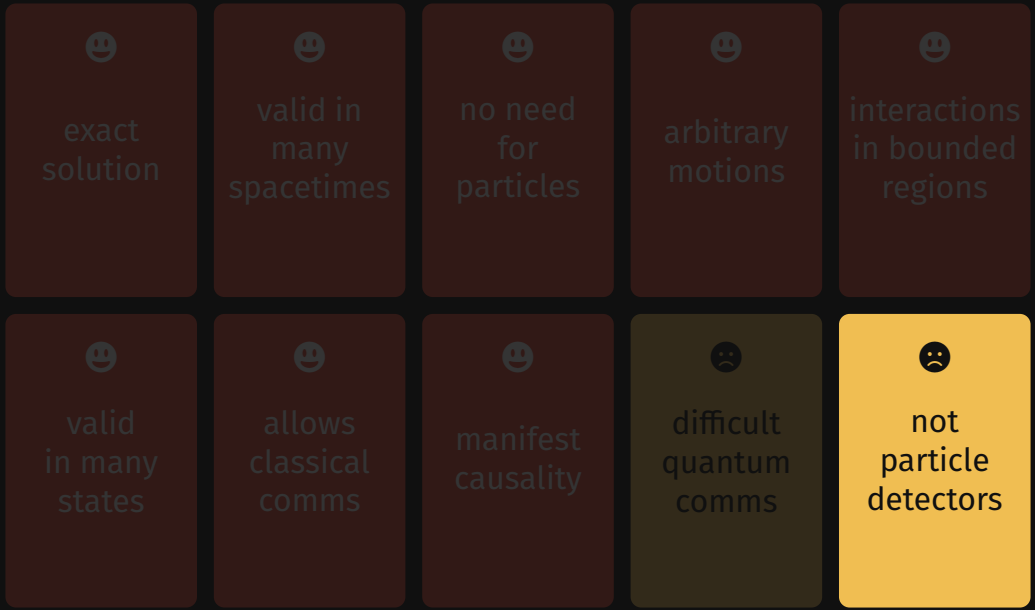




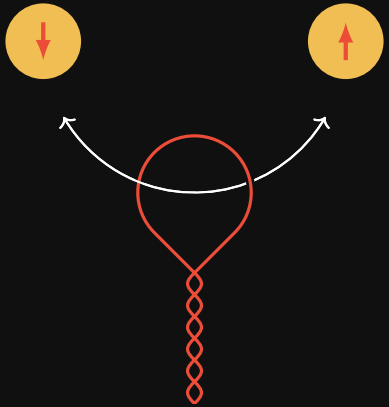


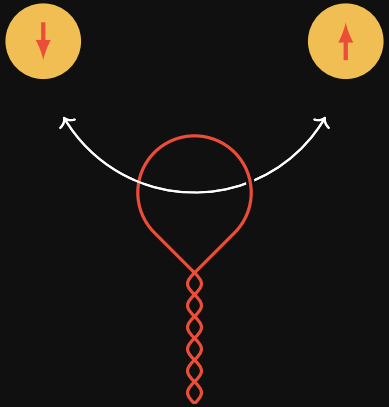


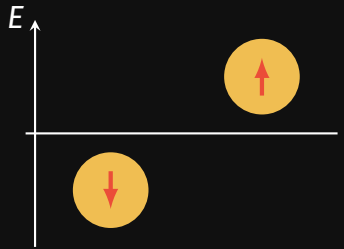
Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].



Landulfo 2016. *Phys. Rev. D* **93**, 104019. arXiv: 1603.06641 [gr-qc].






E

simple
quantum
comms

simple
quantum
comms

qubits
can be used as
particle
detectors

simple
quantum
comms

qubits
can be used as
particle
detectors

no
exact
solution

simple quantum comms

qubits can be used as particle detectors

no exact solution

perturbation theory in energy gap

simple quantum comms

qubits can be used as particle detectors

no exact solution

perturbation theory in energy gap

renormalization group improvement

Nonperturbative Renormalization Group Flow for a Particle Detector

Nonperturbative Renormalization Group Flow for a Particle Detector

Níckolas de Aguiar Alves

Nonperturbative Renormalization Group Flow for a Particle Detector

Níckolas de Aguiar Alves
Federal University of ABC

UFABC

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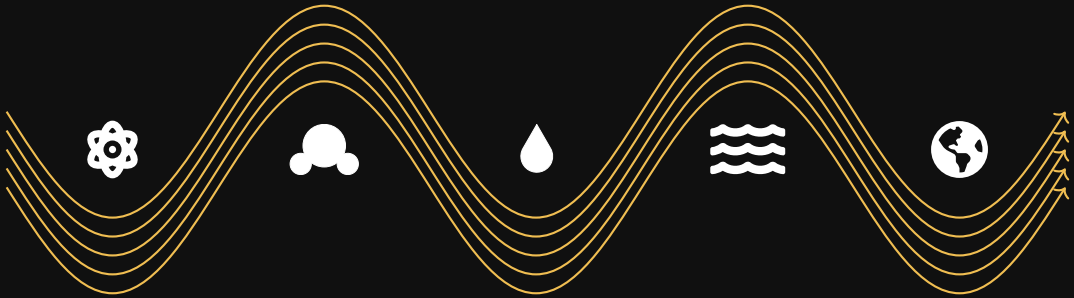
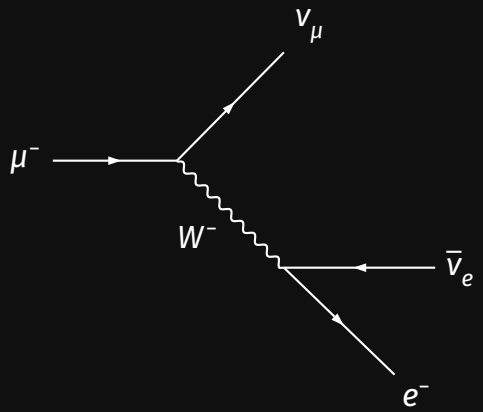
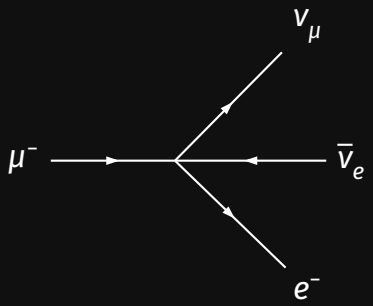
Federal University of ABC

CAPES UFABC FAPESP

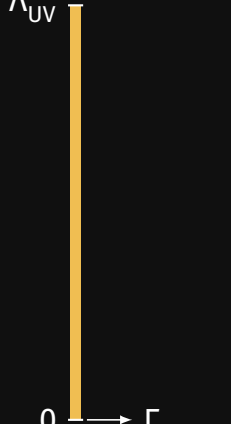



ν_μ
μ^-
W^-
$\bar{\nu}_e$
e^-


ν_μ
μ^-
$\bar{\nu}_e$
e^-


Λ_{UV}
0


Λ_{UV}
0



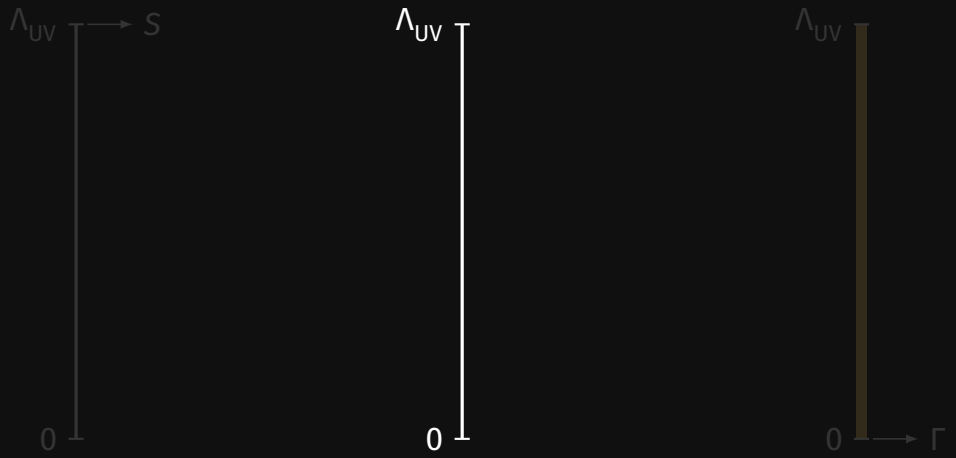
all quantum effects


Λ_{UV}
0


Λ_{UV}
0
Γ
all quantum effects

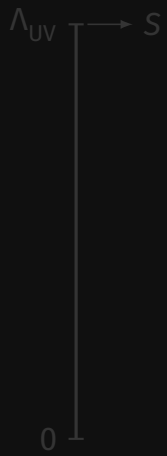
no quantum effects

all quantum effects



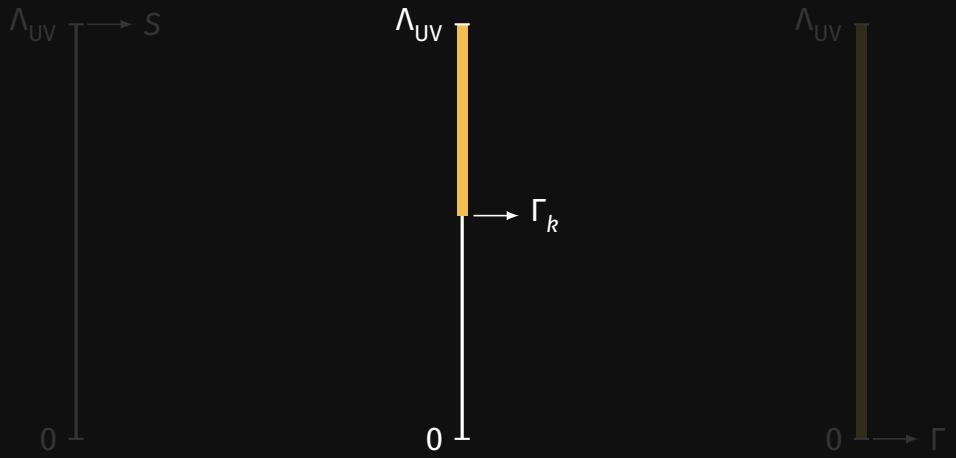
no quantum effects

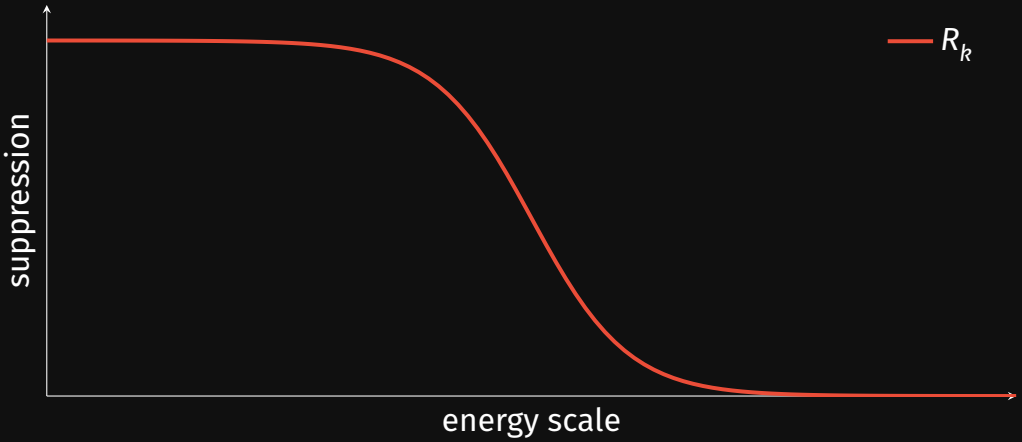
all quantum effects

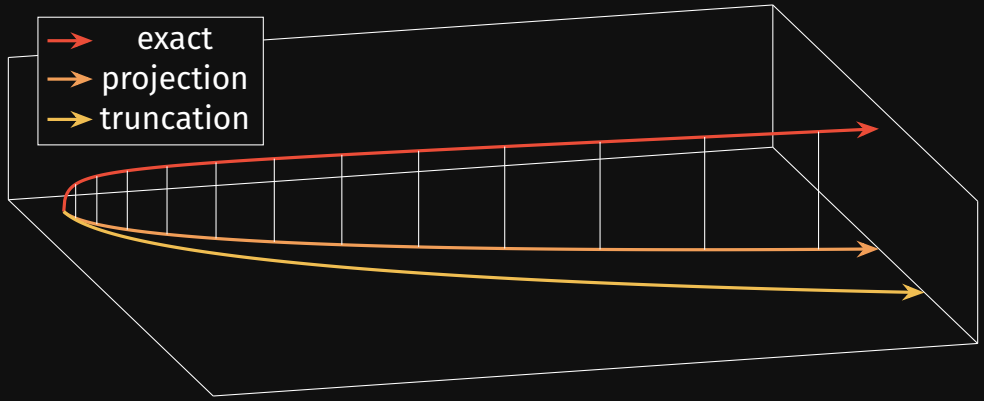


no quantum effects

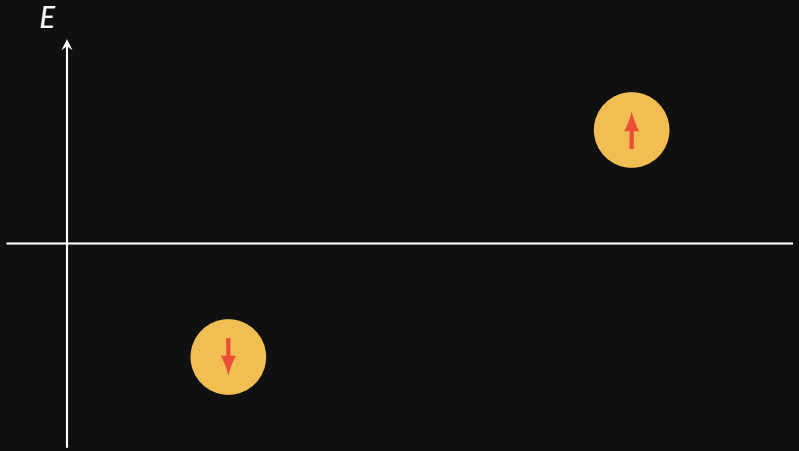
all quantum effects

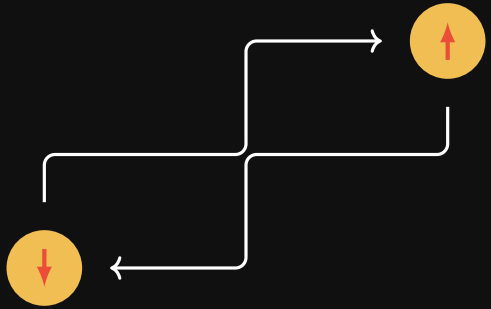

Λ_{UV}
S
0
no quantum effects
Λ_{UV}
Γ_k
0
some quantum effects
Λ_{UV}
0
Γ
all quantum effects

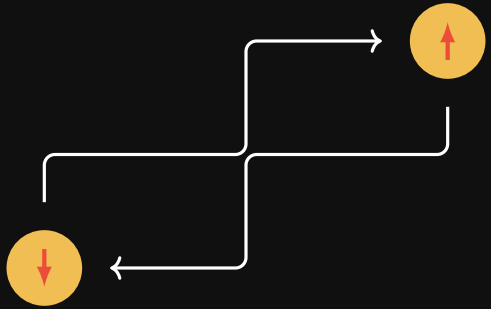

suppression
energy scale
R_k


exact
projection
truncation

what is a good ansatz for Γ_k?

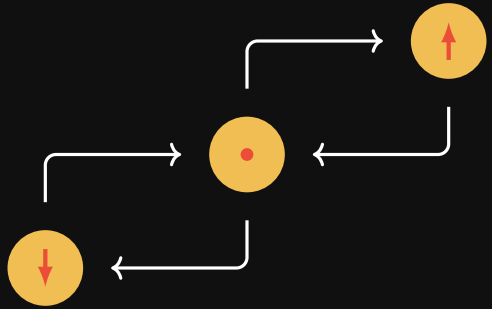

E





☹

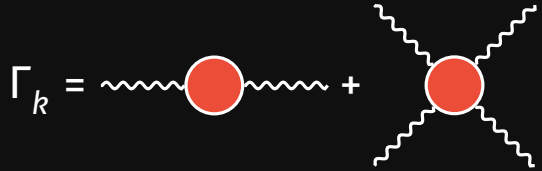
can’t deal with field coupling

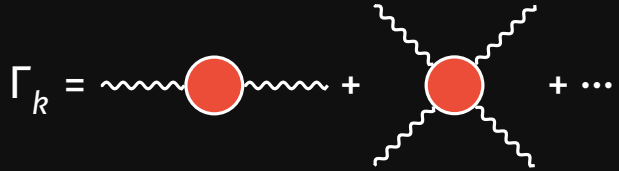


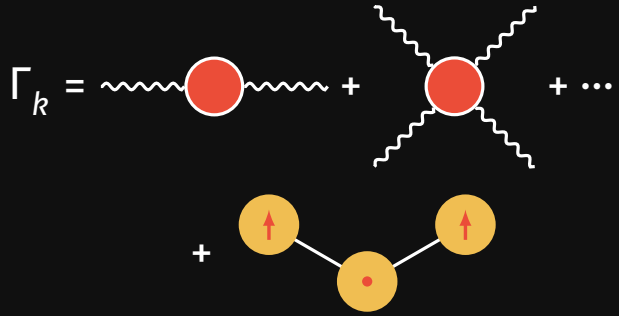
Burbano, Perche, and Torres 2021. *J. High Energ. Phys.* **2021**, 76. arXiv: 2012.14912 [hep-th].

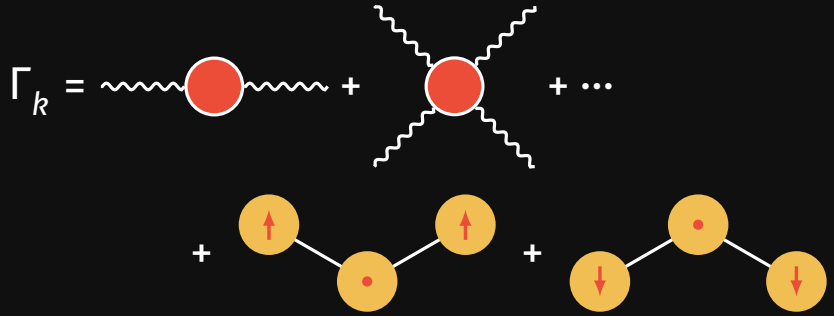
$\Gamma_k =$

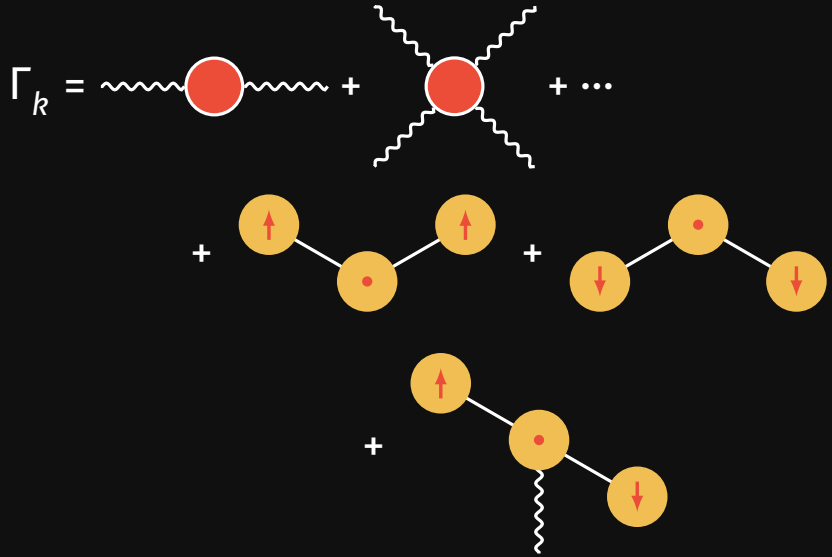

Γ
k
=

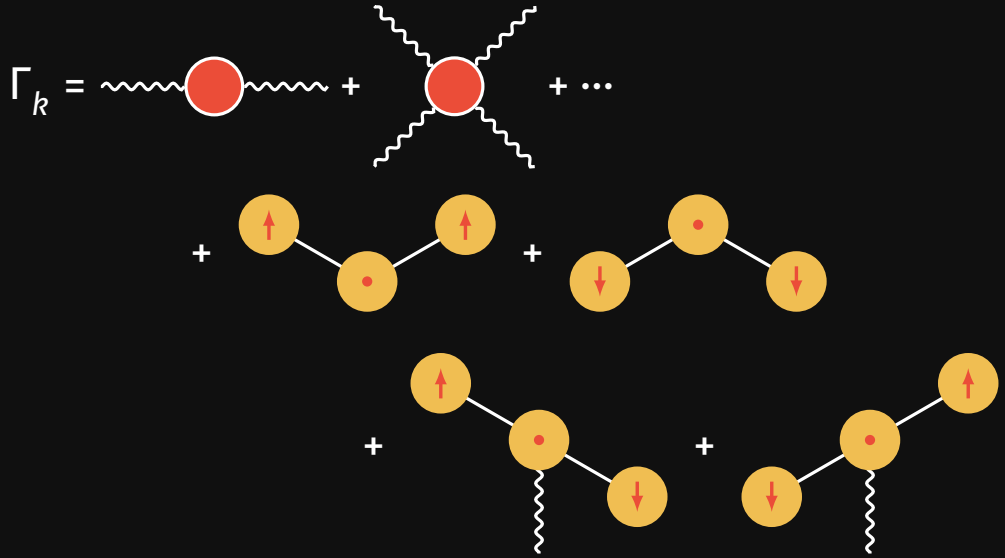

Γ
k
=
+


Γ_k = + + ⋯


Γ_k = + + ···
+


Γ_k = + + ···
+ +

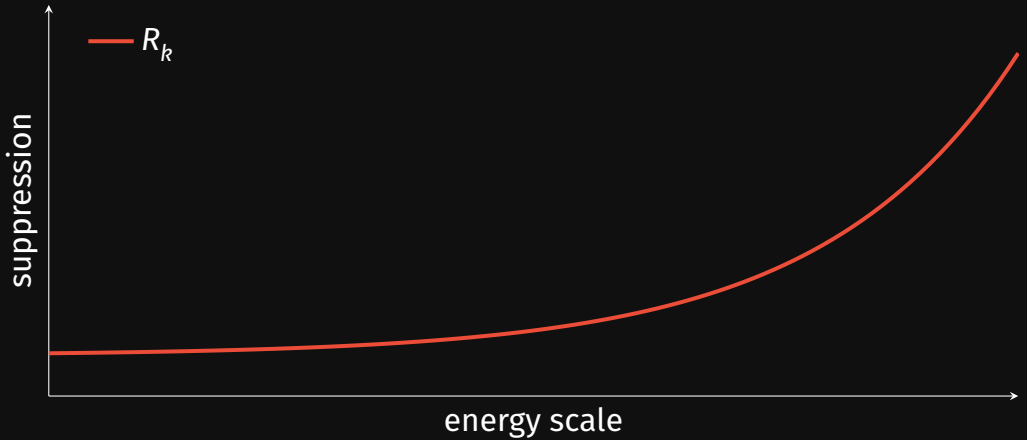

Γ_k = + + ···
+
+
+


Γ_k = + + ···
+ +
+ +

what is a good ansatz for R_k?

Aguiar Alves, Landulfo, and Pereira 2023, in preparation.

Aguiar Alves, Landulfo, and Pereira 2023, in preparation.



Aguiar Alves, Landulfo, and Pereira 2023, in preparation.


hard to
interpret
Γ_k

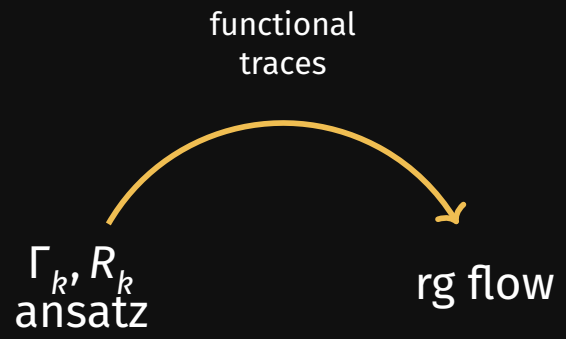

hard to
interpret
Γ_k

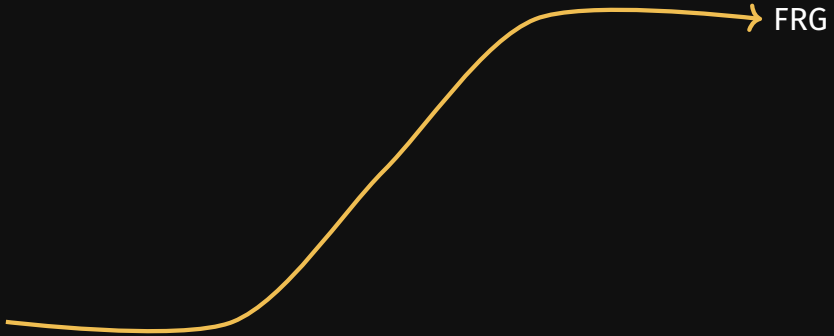

possible to
recover
Γ

Γ_k, R_k
ansatz

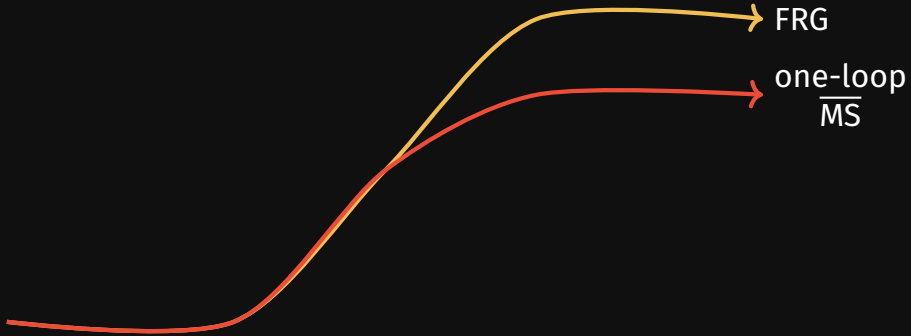
Γ_k, R_k
ansatz

rg flow


functional
traces
Γ_k, R_k
ansatz
rg flow



Aguiar Alves, Landulfo, and Pereira 2023, in preparation.

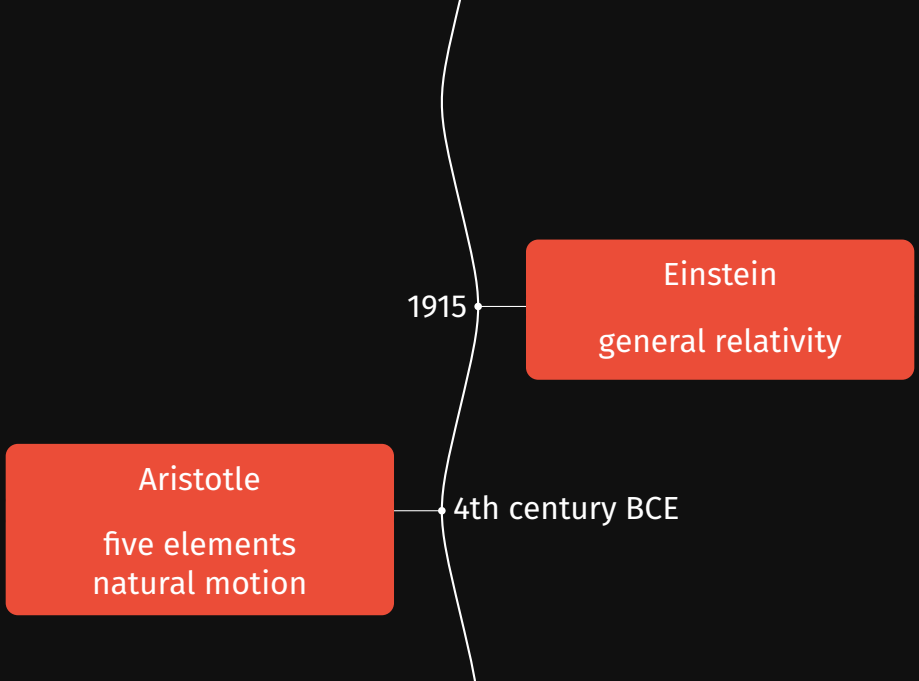


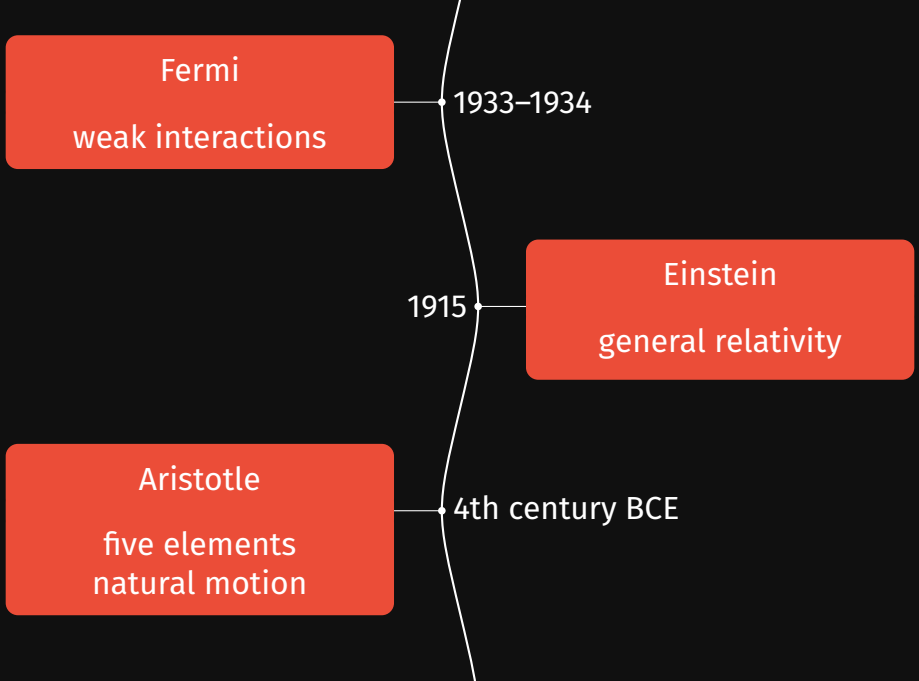
Aguiar Alves, Landulfo, and Pereira 2023, in preparation.

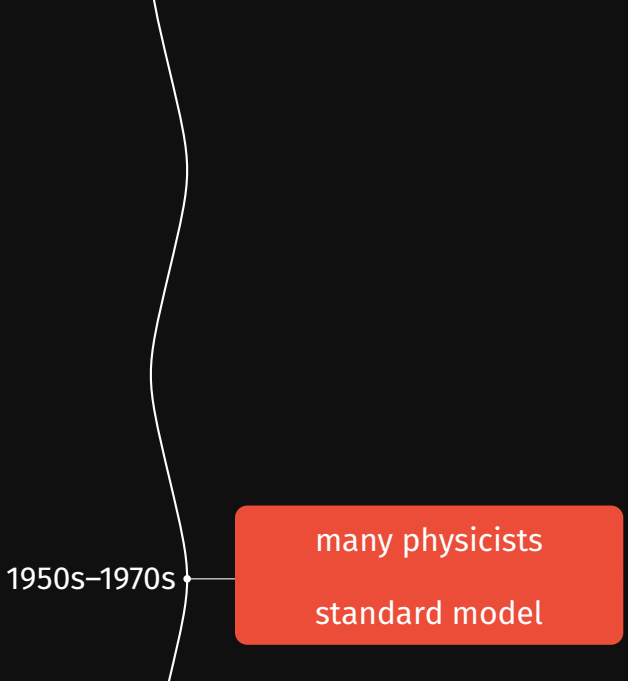
Aristotle

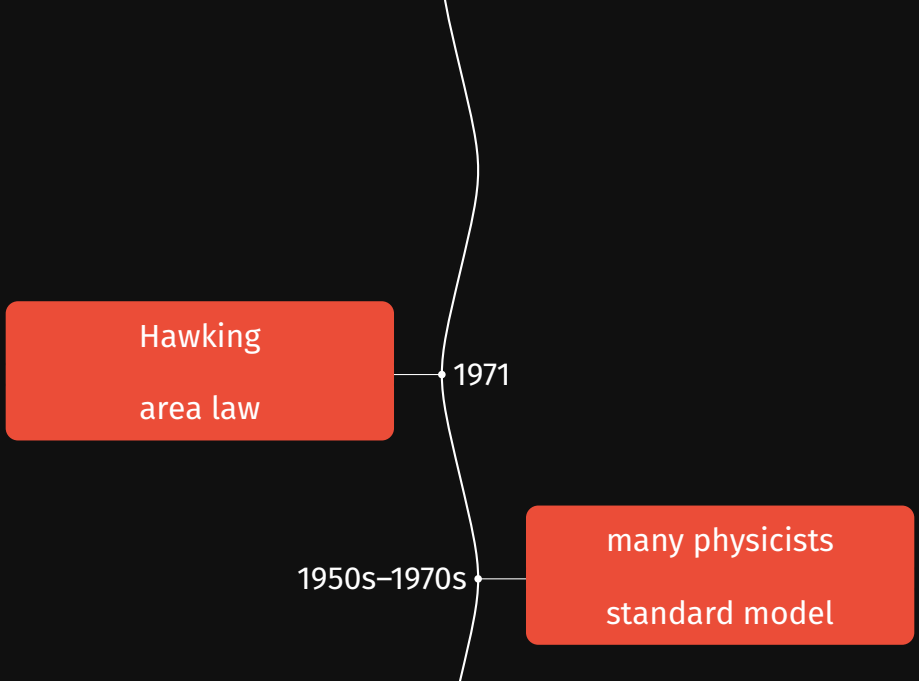
five elements
natural motion

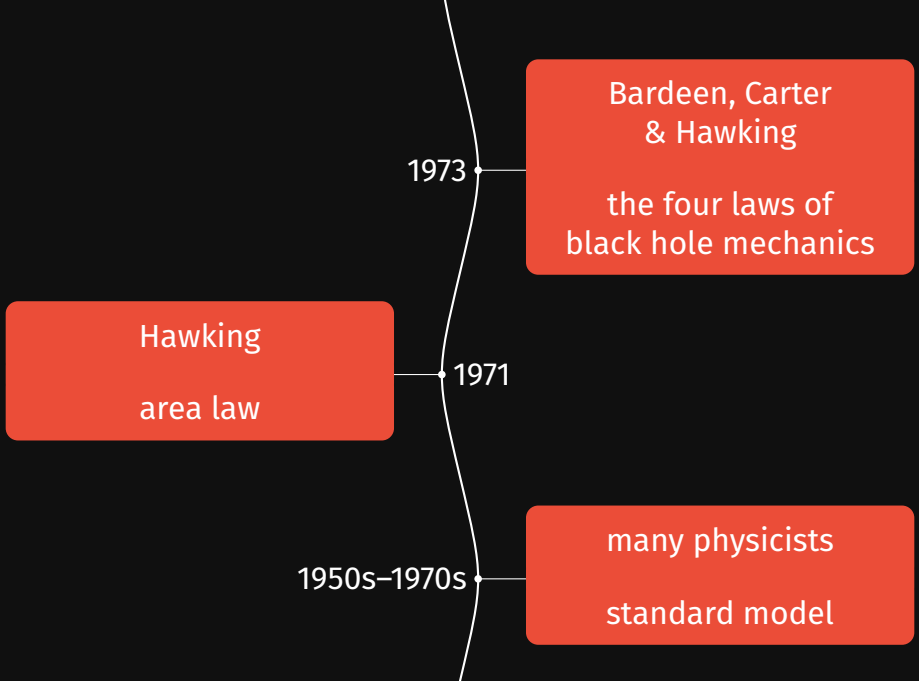
4th century BCE


Einstein
general relativity
1915
Aristotle
five elements
natural motion
4th century BCE


Fermi
weak interactions
1933–1934
Einstein
general relativity
1915
Aristotle
five elements
natural motion
4th century BCE


1950s–1970s
many physicists
standard model

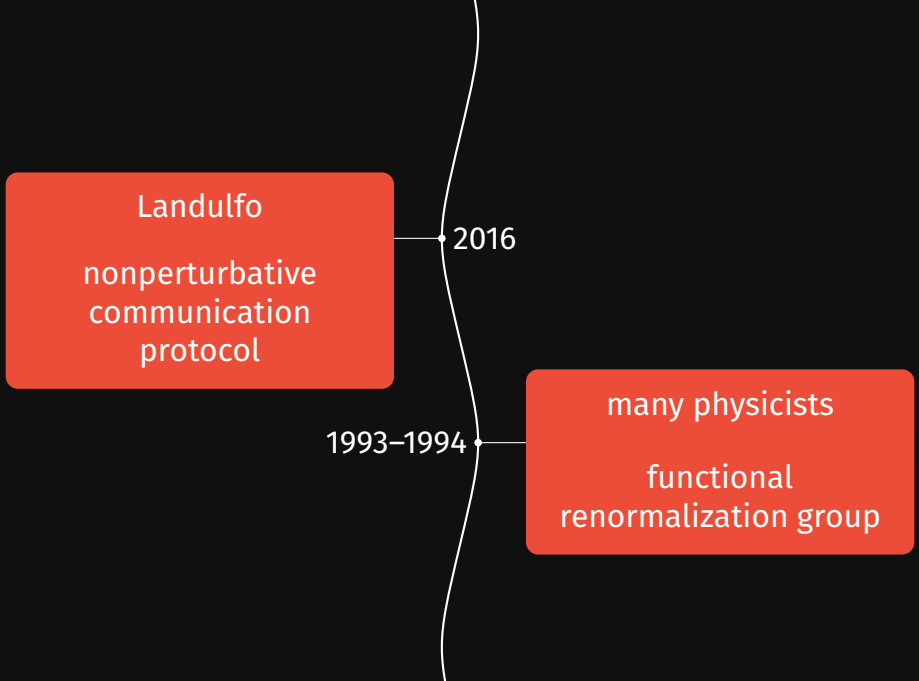

Hawking
area law
1971
1950s–1970s
many physicists
standard model


Bardeen, Carter
& Hawking
the four laws of
black hole mechanics
1973
Hawking
area law
1971
many physicists
standard model
1950s–1970s

1993–1994

many physicists

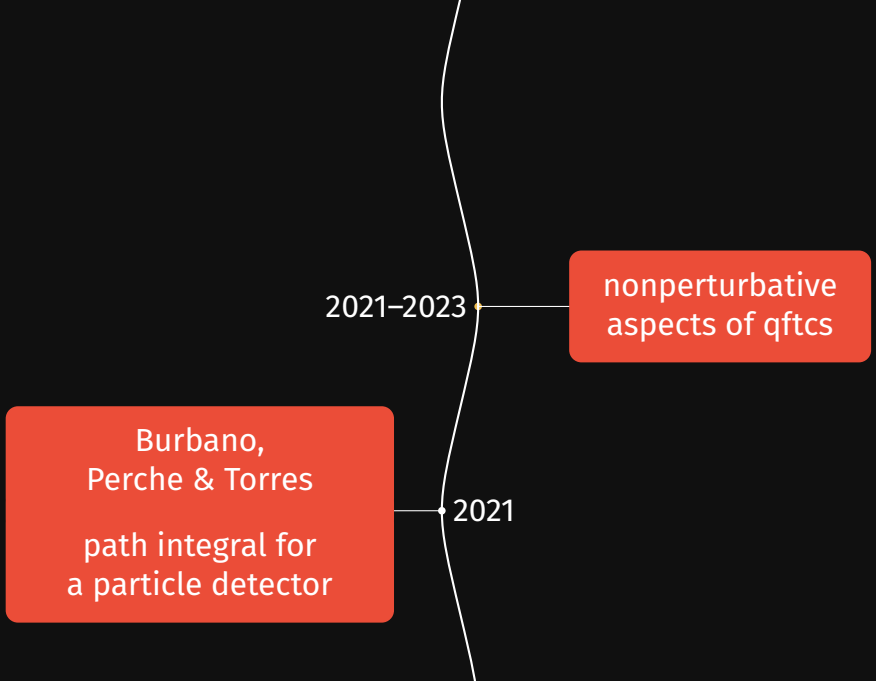
functional
renormalization group

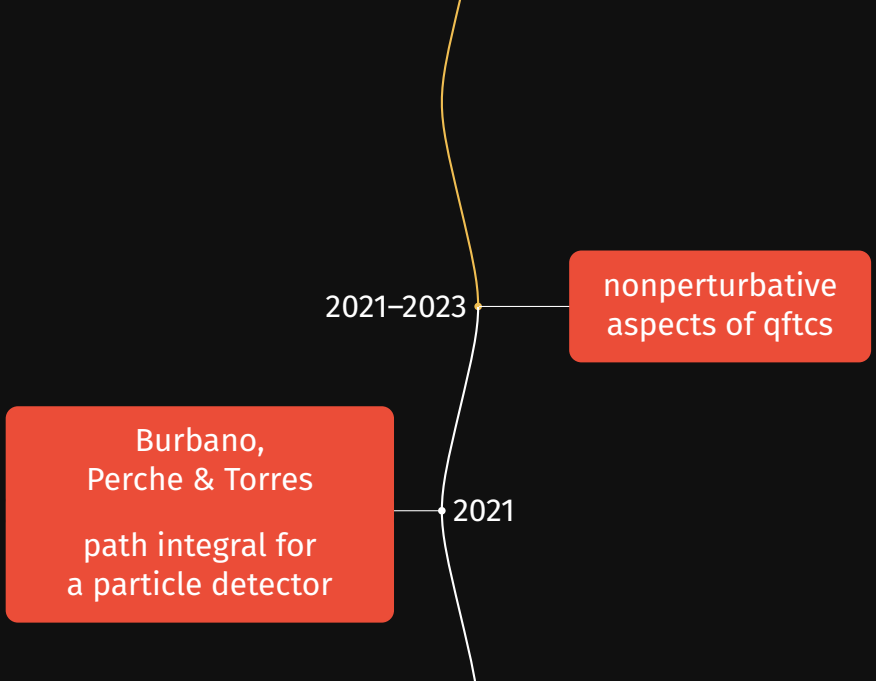

Landulfo
nonperturbative communication protocol
2016
1993–1994
many physicists
functional renormalization group

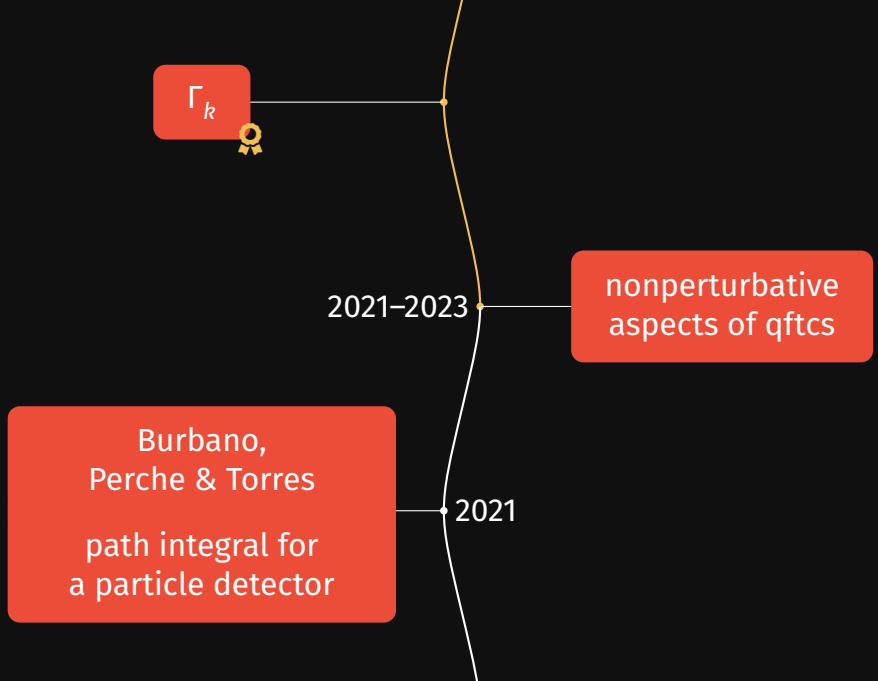
Burbano,
Perche & Torres

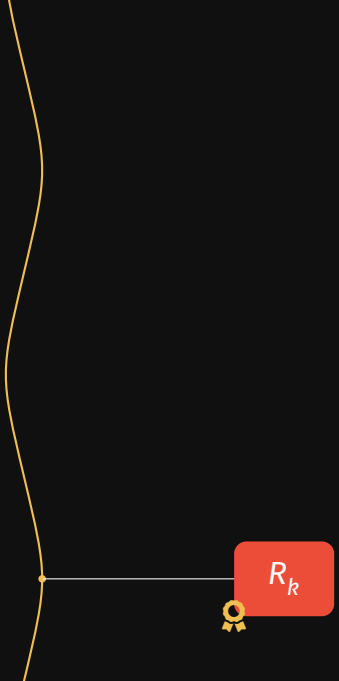
path integral for
a particle detector

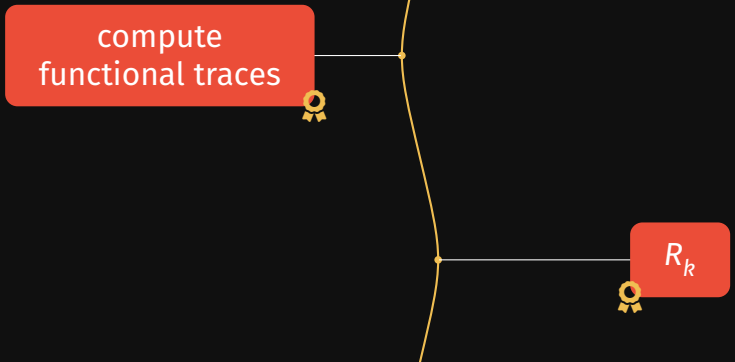
2021

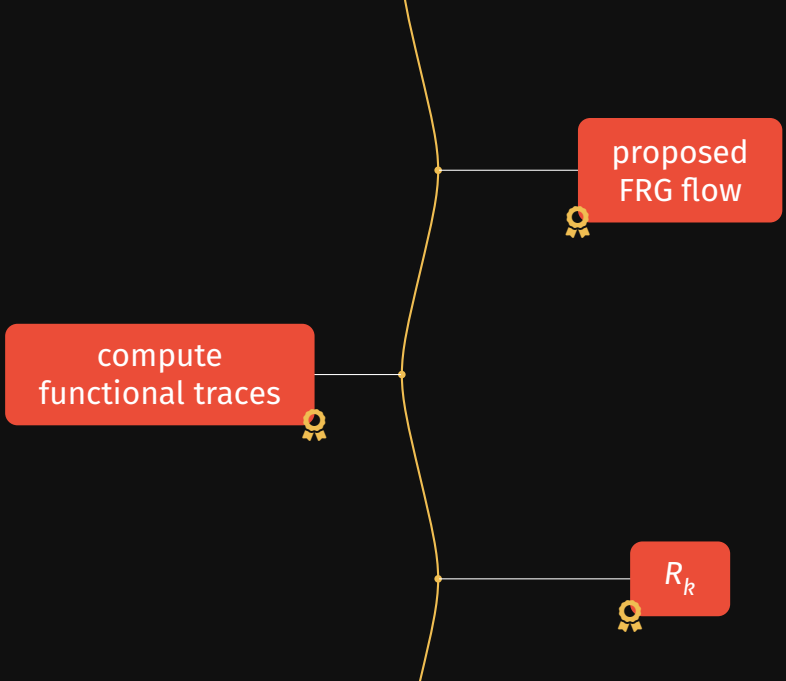

2021–2023
nonperturbative aspects of qftcs
Burbano, Perche & Torres
path integral for a particle detector
2021

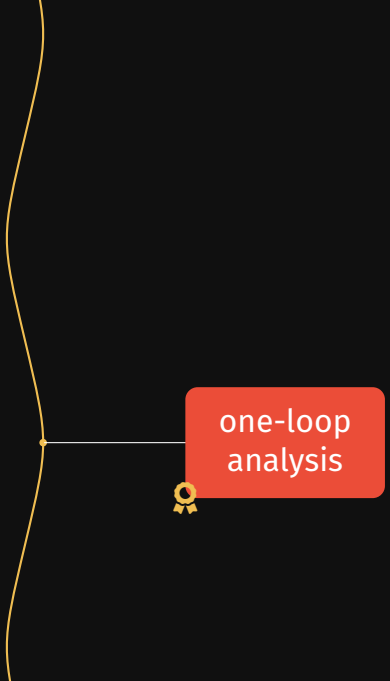

2021–2023
nonperturbative aspects of qftcs
Burbano, Perche & Torres
path integral for a particle detector
2021

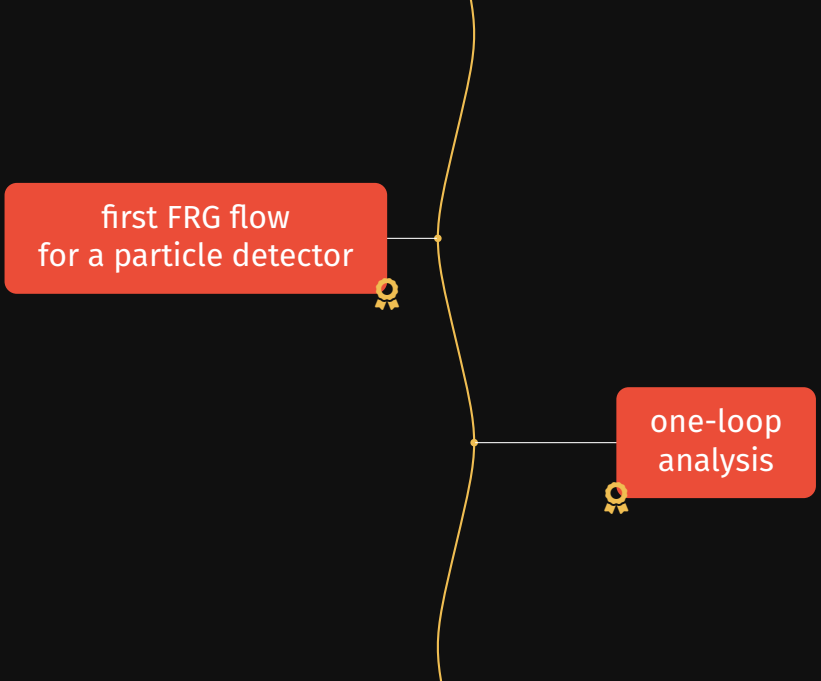

Γ_k
2021–2023
nonperturbative aspects of qftcs
Burbano, Perche & Torres
path integral for a particle detector
2021

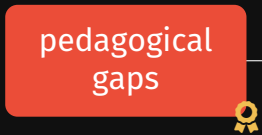

R_k


compute
functional traces
R_k

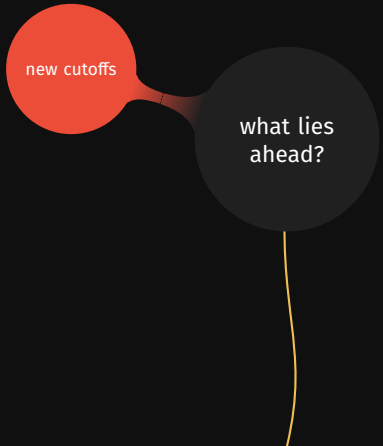

proposed
FRG flow
compute
functional traces
R_k

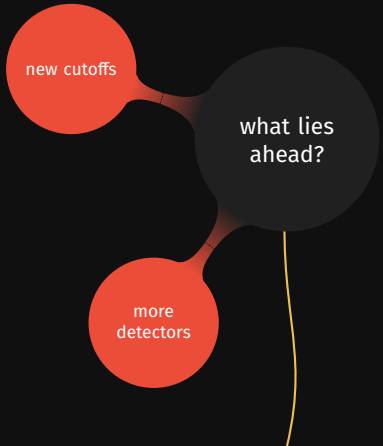

one-loop
analysis

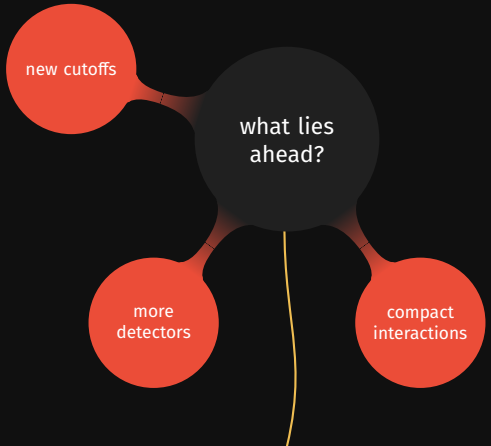

first FRG flow
for a particle detector
one-loop
analysis

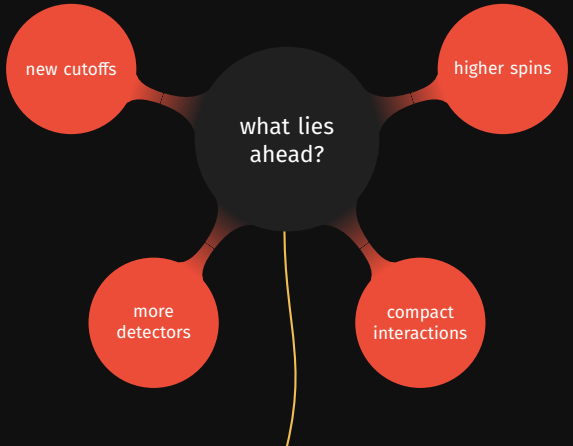

pedagogical
gaps

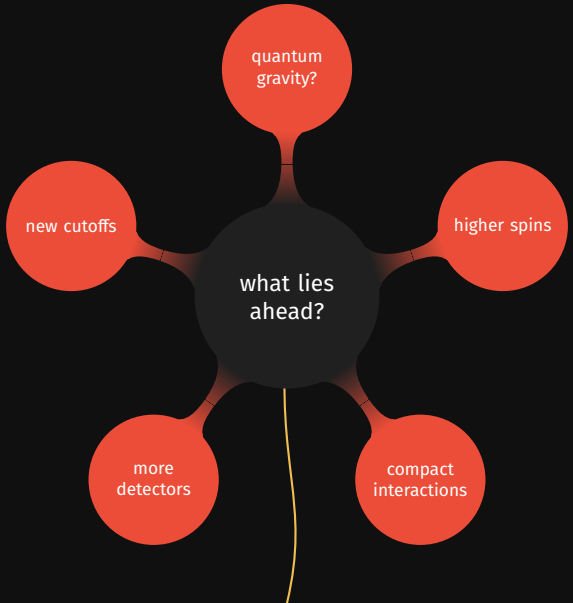
what lies ahead?

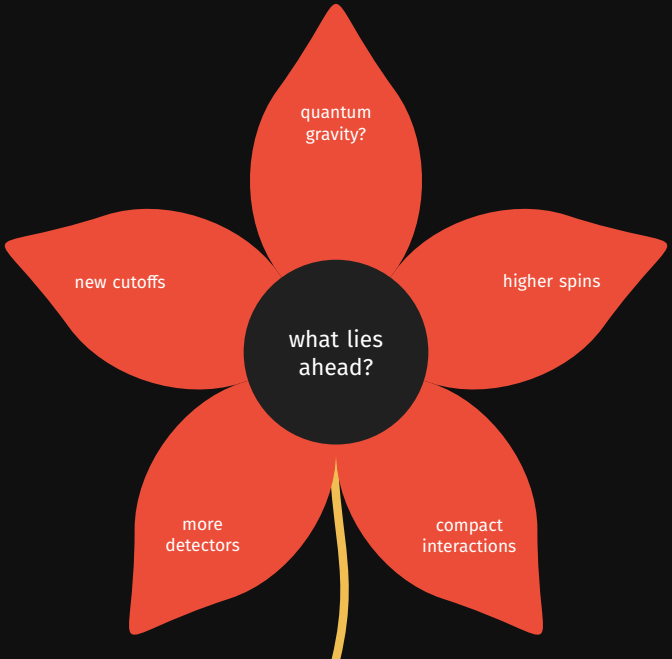

new cutoffs
what lies ahead?


new cutoffs
what lies ahead?
more detectors


new cutoffs
what lies ahead?
more detectors
compact interactions


new cutoffs
higher spins
what lies ahead?
more detectors
compact interactions


quantum gravity?
new cutoffs
higher spins
what lies ahead?
more detectors
compact interactions


quantum gravity?
higher spins
compact interactions
more detectors
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what lies ahead?

Nonperturbative Renormalization Group Flow for a Particle Detector

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