

Title: PSI 2018/2019 - Explorations in Quantum Gravity - Lecture 15

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Collection: PSI 2018/2019 - Explorations in Quantum Gravity (Dupuis)

Date: March 22, 2019 - 10:15 AM

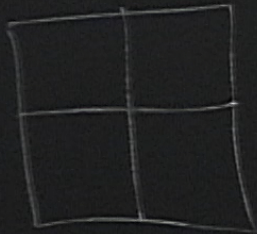
URL: <http://pirsa.org/19030082>

Spin foams and RG

Spin foam quantum gravity

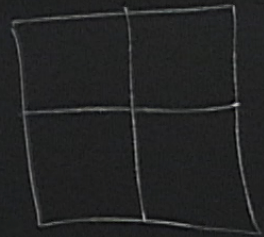
- Background independent RG $\rightarrow$ dynamics
- Observables $\rightarrow$ properties of quantum space-time
- Numerical techniques

- Lattice as a regulator $\rightarrow$ How to remove the regulator?
 - o Diffeo symmetry broken
- Background independent $\rightarrow$ no scale!



Defeo symmetry broken

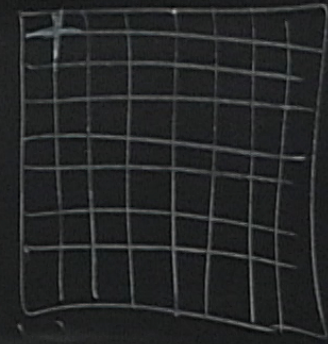
- Background independent $\rightarrow$ no scale!



A''



A'



A

Coarse-graining flow: "fine" dof. vs "coarse" dof.

→ How to remove the regulator?

→ no scale!



Assign family of amplitudes to lattices

↳ RG flow

2nd phase transition → perform continuum limit

Baker, S. H.: 1605.07649

← A

vs "coarse" d.o.f.

Segal CFT. $\rightarrow$ modin.
1d edge modes BFS, IKKT
matrix models

Segal CFT.
1d edge modes

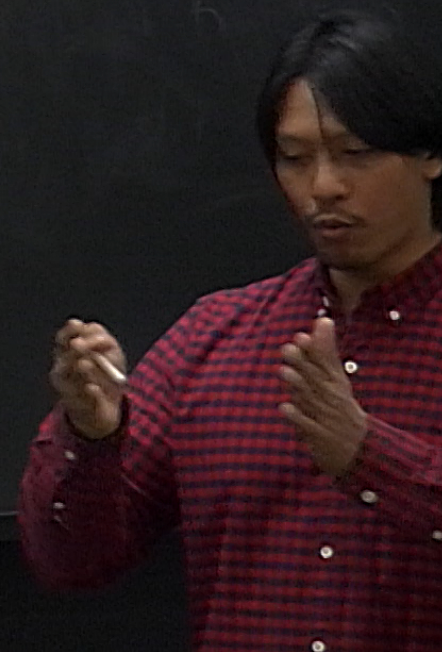
Sindhu.
BFSS, IKKT
matrix models

Revelli, S, F
LQG

time
 $H=0$

ψ (q-geom).

3d



Segal CFT.
1d edge modes

Sundin.
BFSS, IKKT
matrix models.

Rovelli, S, F
LQG.

time
 $H=0$

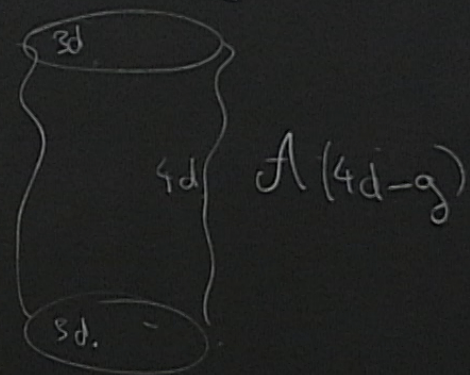
ψ (q-geom).

3d

LQG.

Spinfoams

TQFT Atiyah



gauge CFT. $\rightarrow$ modn. BFSS, IKKT matrix models $\rightarrow$ LQG. $\rightarrow$ Rovelli, S, F

1d edge modes

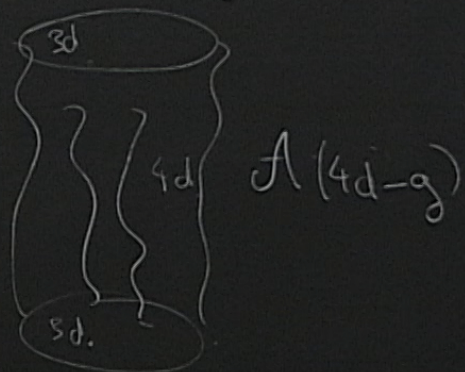
ψ (q-geom).

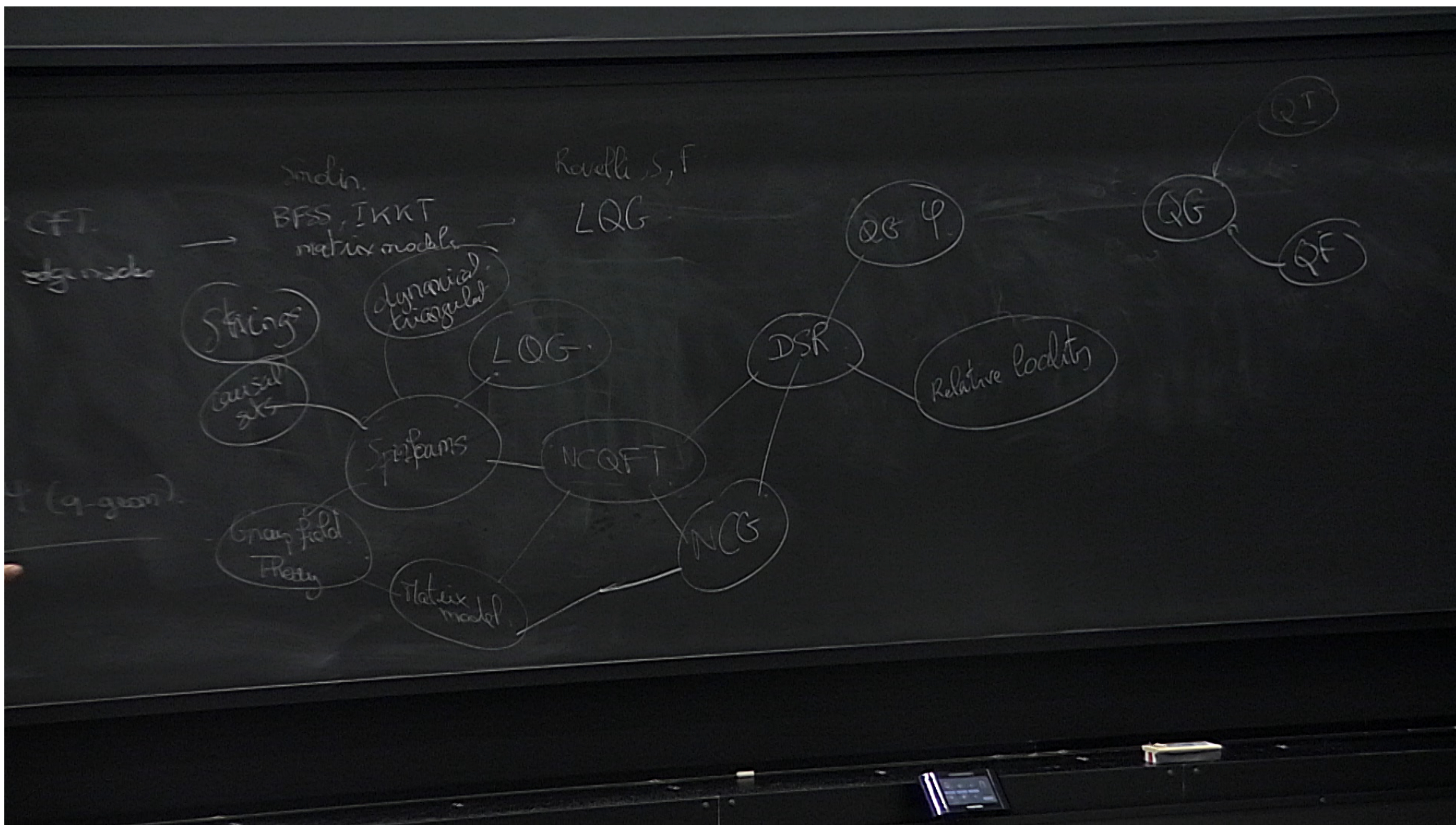
Group field Theory

Spinfoams

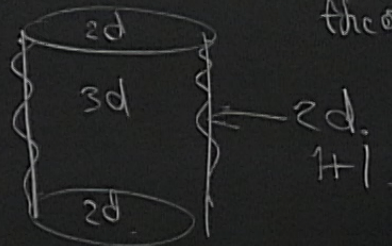
LQG.

TQFT Atiyah



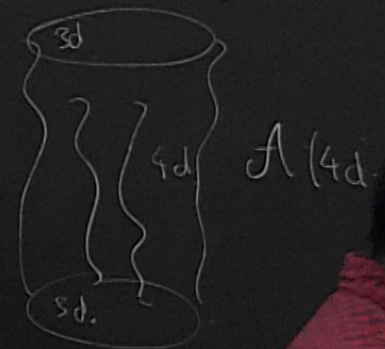


• 3d QG: $3d \rightarrow 2d$ boundary theory.

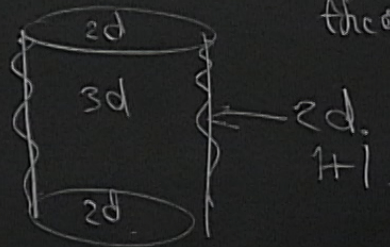


• 3+1d LQG
 coarse-graining & renormalizatⁿ

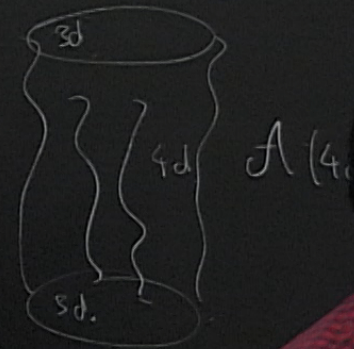
TQFT. Atiyah



• 3d QG: $3d \rightarrow 2d$ boundary theory.



TQFT. Atiyah.



- 3+1d. LQG
coarse-graining & renormalizatⁿ.
- $q \rightarrow$ classical in QG. $\leftarrow$ QF & QT
decoherence $\leftrightarrow$ holography.

QG?: Reconciling tidal length scale Relativity principle.

$QG?$: $\Rightarrow$ Reconciling Fd al length scale Relativity principle.
 $\oplus$ " curie space $\longleftrightarrow$ Born duality.
 G_2

QG? $\Rightarrow$ Reconciling Fd al length scale Relativity principle.
 $\oplus$ " curie space $\longleftrightarrow$ Born duality?
 $\oplus$ " Fd al Quantization $\rightarrow$ ^{p & q} Stability of Classical reality?

QG?

Reconciling

Fd al length scale

Relativity principle?

⊕

"

curie space

$\longleftrightarrow$

Born duality?

⊖

"

Fd al Quantization

$\longrightarrow$

Stability of Classical reality?
= Speculime

⊕ phenomenology?

EFT

QG?

Reconciling

Fd al length scale

Relativity principle?

⊕

"

curie space

$\longleftrightarrow$

Born duality?

⊕

"

Fd al Quantamness

$\longrightarrow$

Stability of Classical reality?
= Speculime

⊕ phenomenology?

EFT

separation of scale

QG?

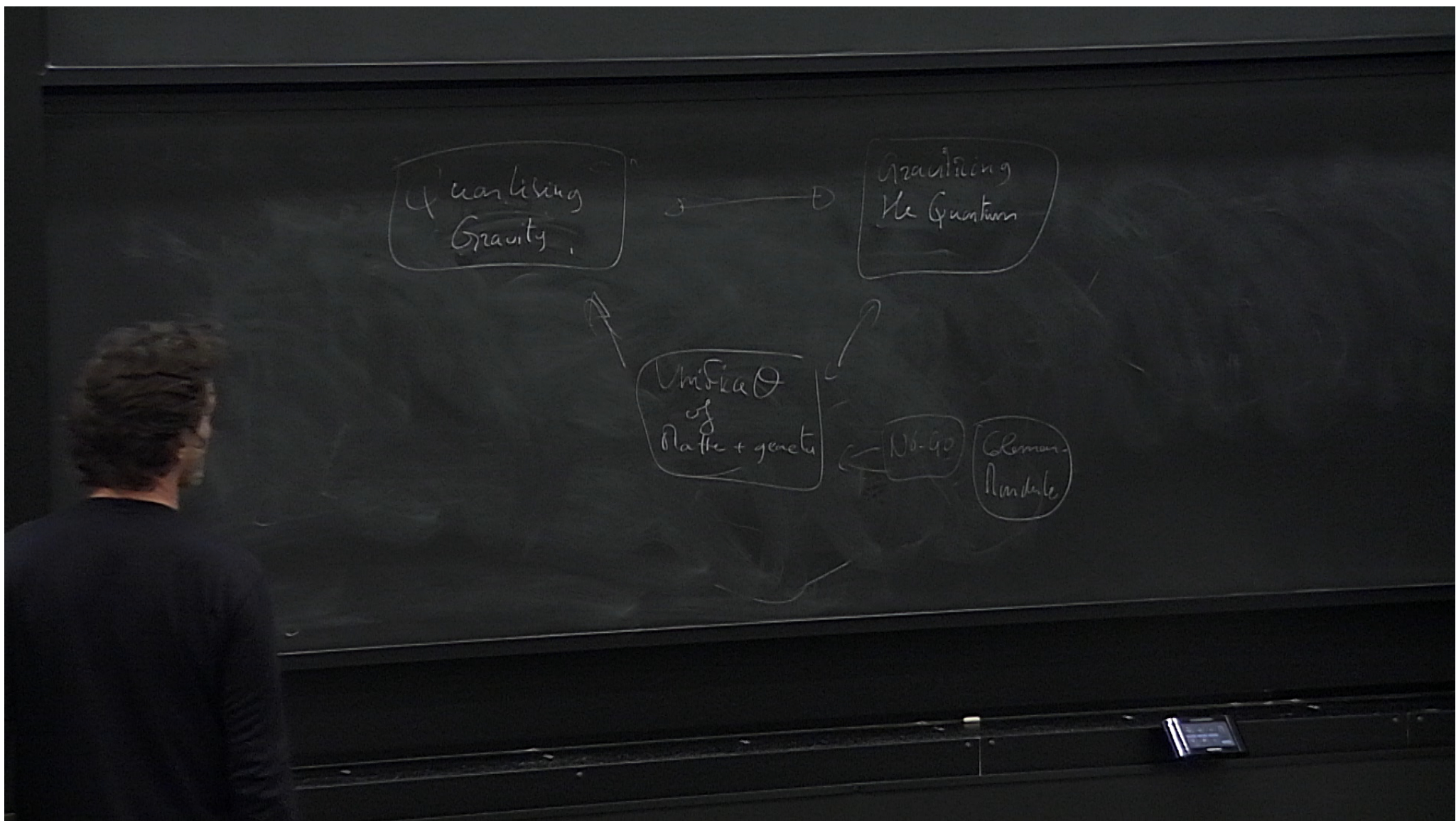
Reconciling Fd al length scale Relativity principle?

⊕ " curie space $\longleftrightarrow$ Born duality?

⊕ " Fd al Quantumness $\xrightarrow{p \leftrightarrow q}$ Stability of Classical reality?
= Spacetime

⊕ phenomenology?

EFT $\leftarrow$ separation of scale



• Relative Locality

• Absolute Locality

• Spacetime $\{X\}$ is independent
on φ poles

$$\bullet \varphi(X) \rightarrow \hat{\varphi}(X)$$

Relative Locality

interact of Q & P
defines locality

Absolute Locality

Spacetime $\{X\}$ is independent
on $\{P$ nodes

$$\phi(X) \rightarrow \hat{\phi}(X)$$

- path $p+q \rightarrow p \oplus q$
- defect in ϕ creates (edge-marks)
- path $\rightarrow$ Shing