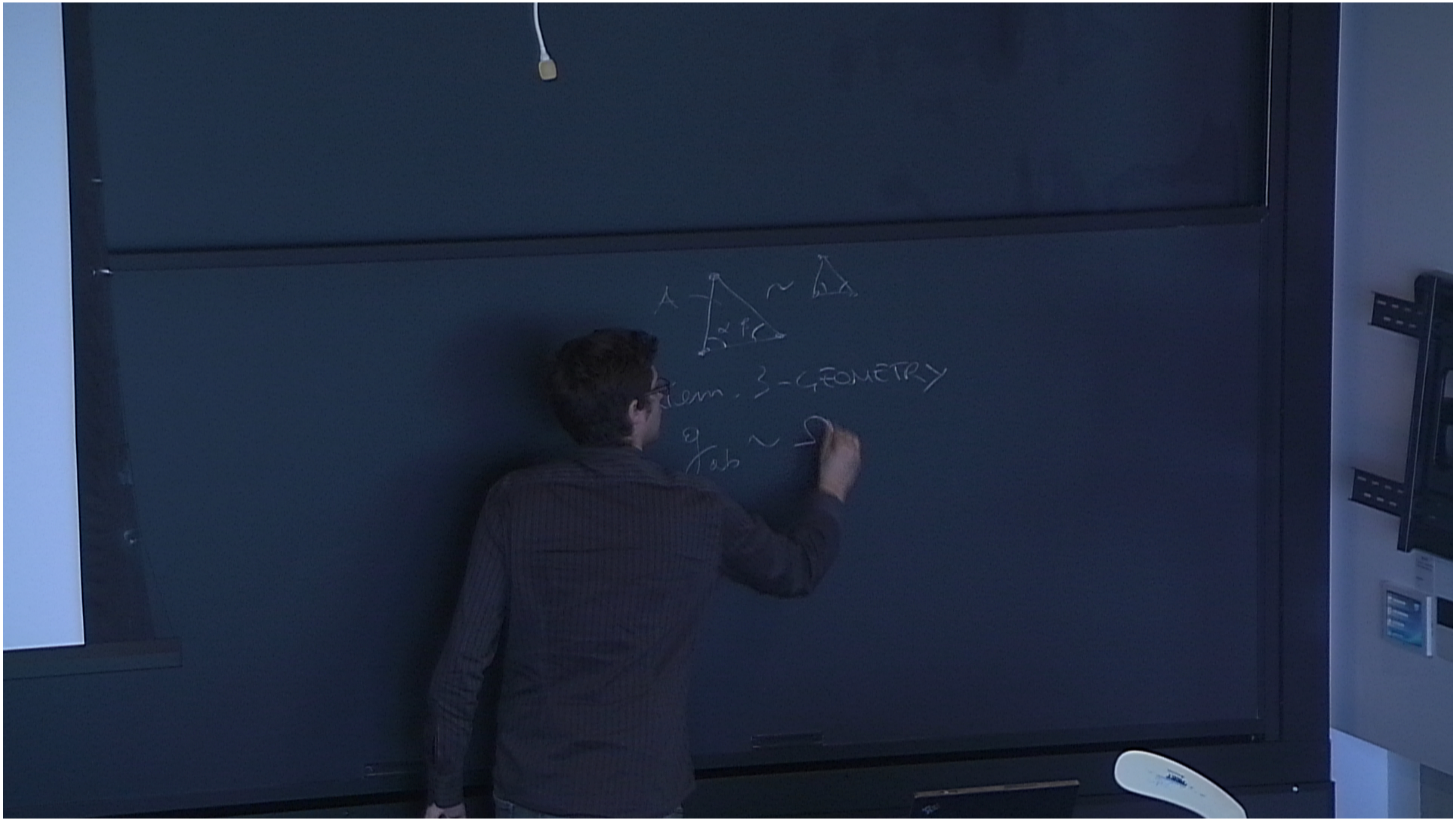
Title: TBA

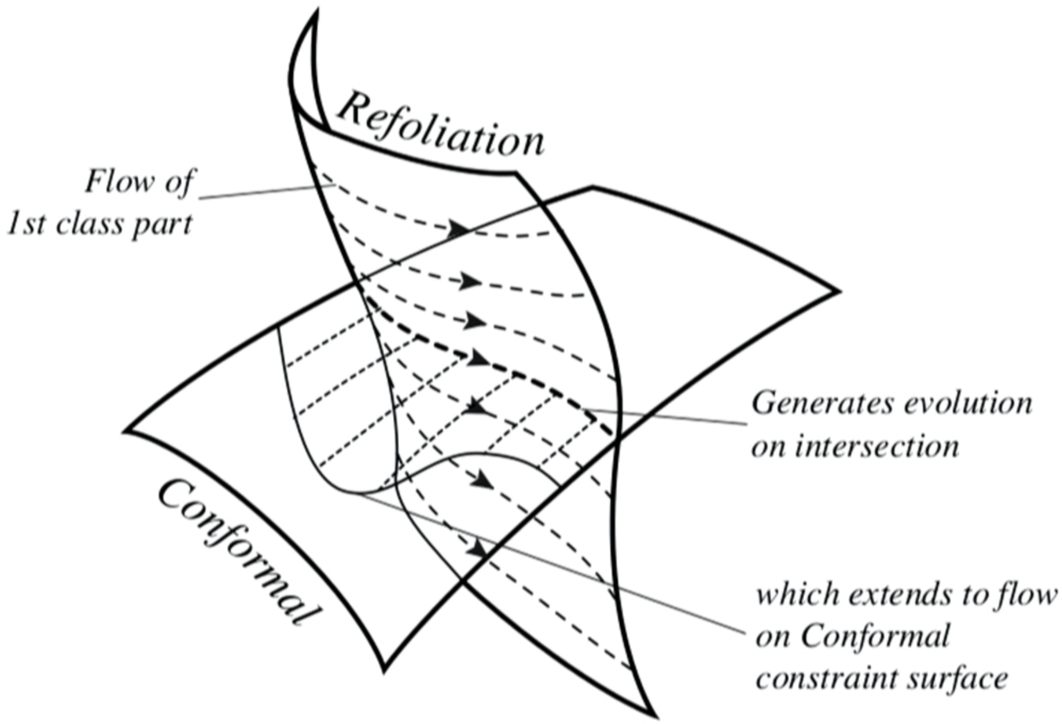
Date: May 21, 2014 05:00 PM

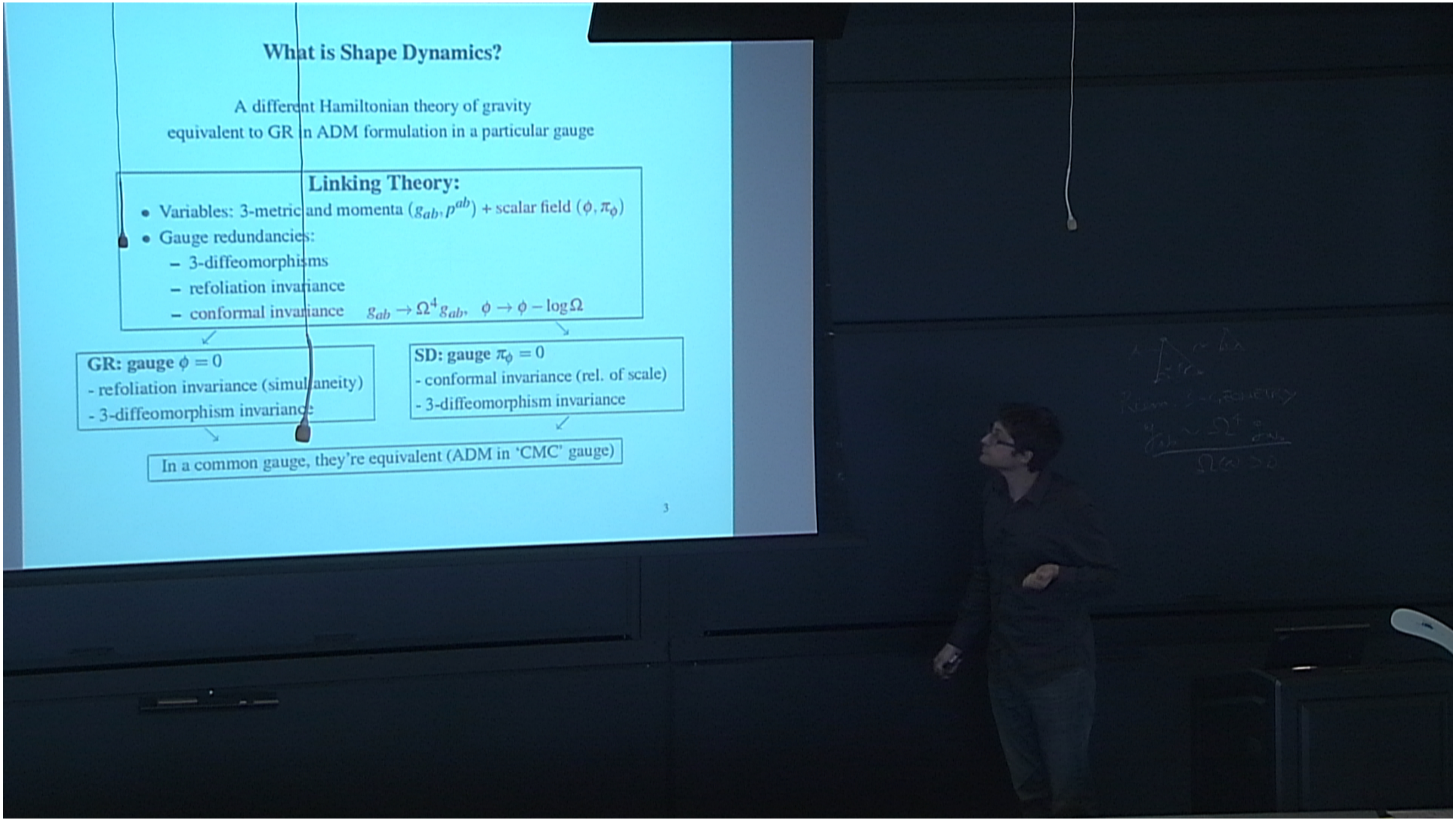
URL: http://pirsa.org/14050123

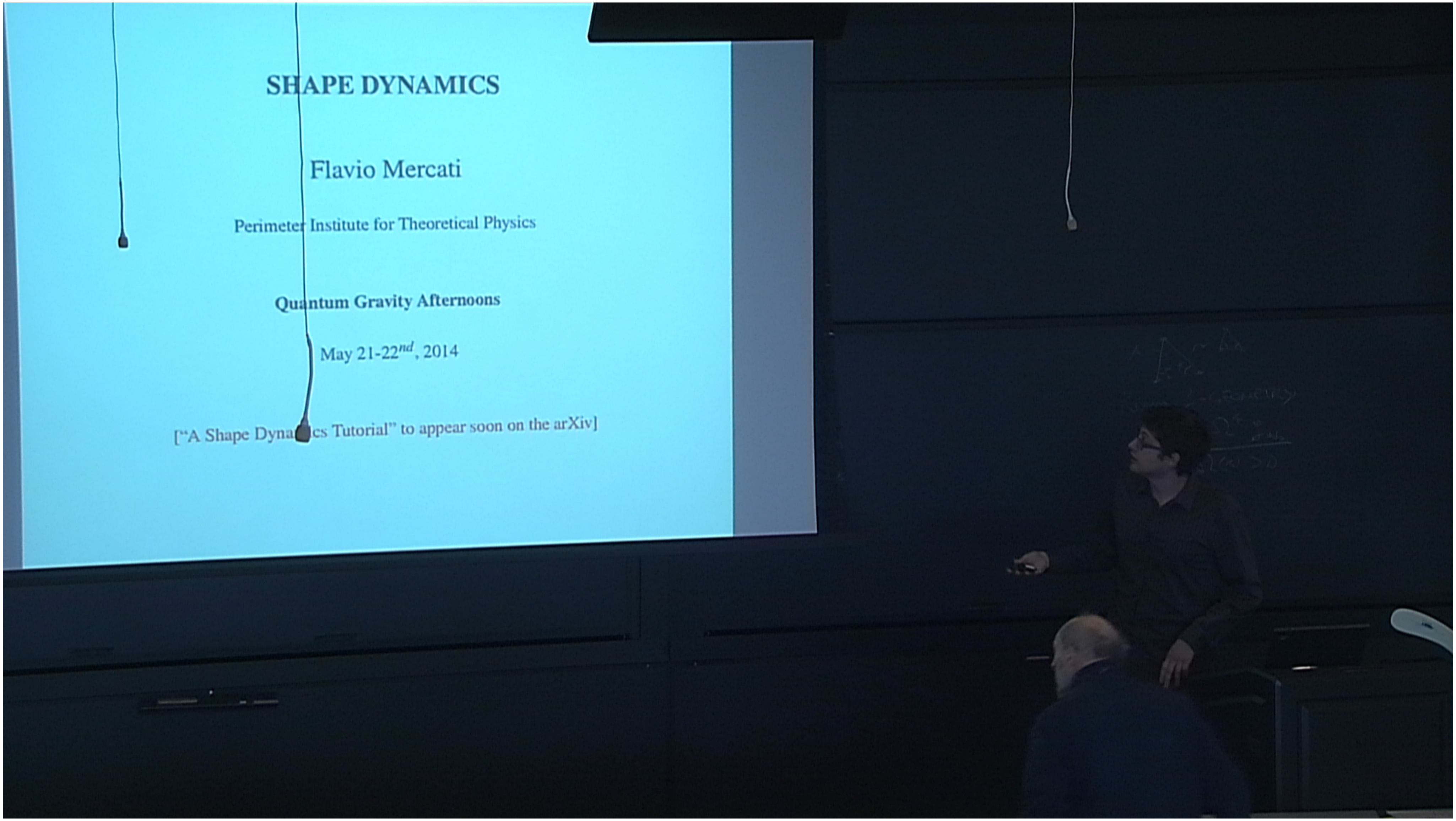
Abstract:

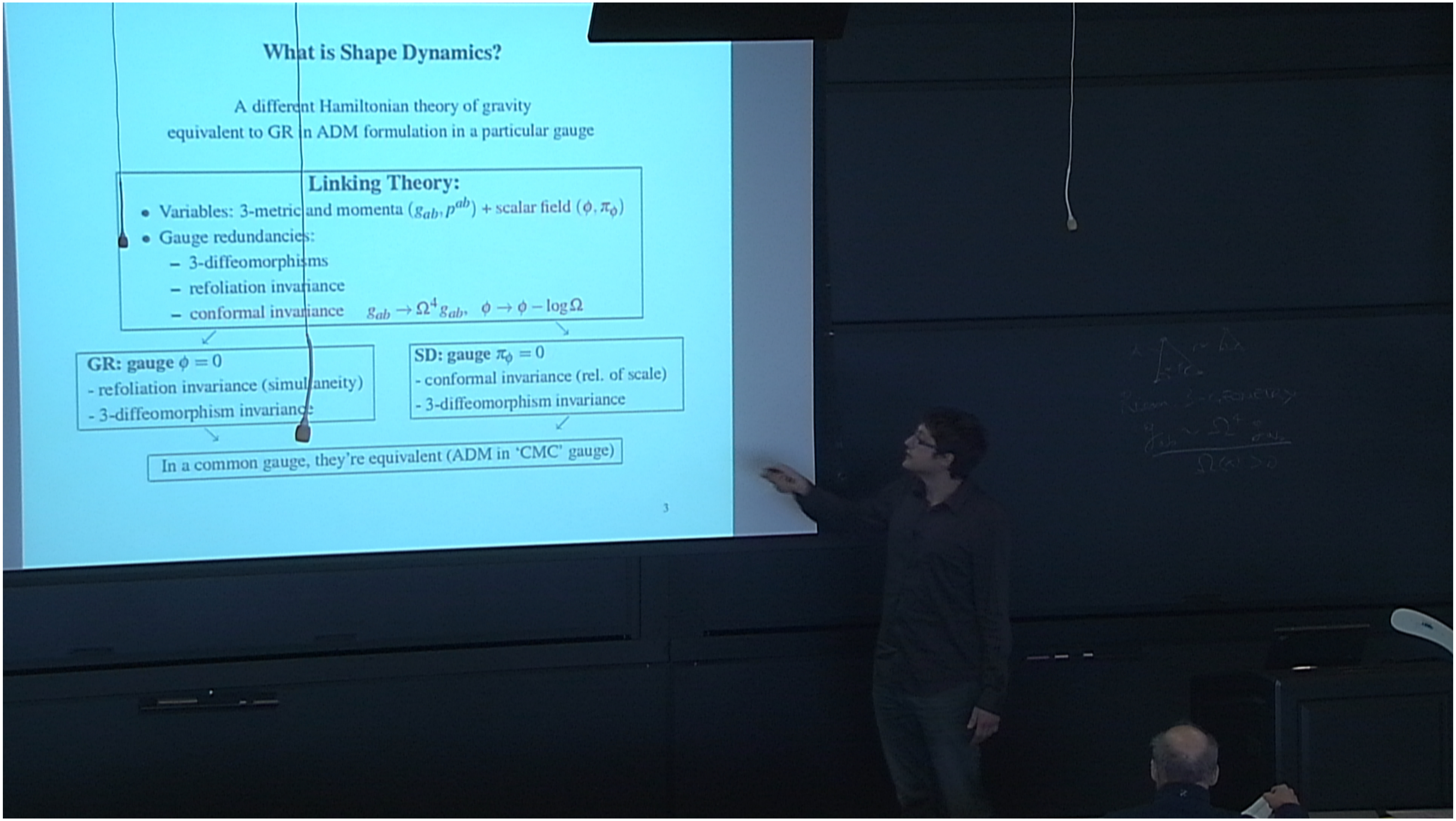


The ‘iconic diagram’ of SD




What is Shape Dynamics?
A different Hamiltonian theory of gravity
equivalent to GR in ADM formulation in a particular gauge
Linking Theory:
• Variables: 3-metric and momenta (g_{ab}, p^{ab}) + scalar field (ϕ, π_ϕ)
• Gauge redundancies:
– 3-diffeomorphisms
– refoliation invariance
– conformal invariance $g_{ab} \to \Omega^4 g_{ab}$, $\phi \to \phi - \log \Omega$
GR: gauge $\phi = 0$
- refoliation invariance (simultaneity)
- 3-diffeomorphism invariance
SD: gauge $\pi_\phi = 0$
- conformal invariance (rel. of scale)
- 3-diffeomorphism invariance
In a common gauge, they're equivalent (ADM in 'CMC' gauge)
3


SHAPE DYNAMICS
Flavio Mercati
Perimeter Institute for Theoretical Physics
Quantum Gravity Afternoons
May 21-22nd, 2014
[“A Shape Dyna cs Tutorial” to appear soon on the arXiv]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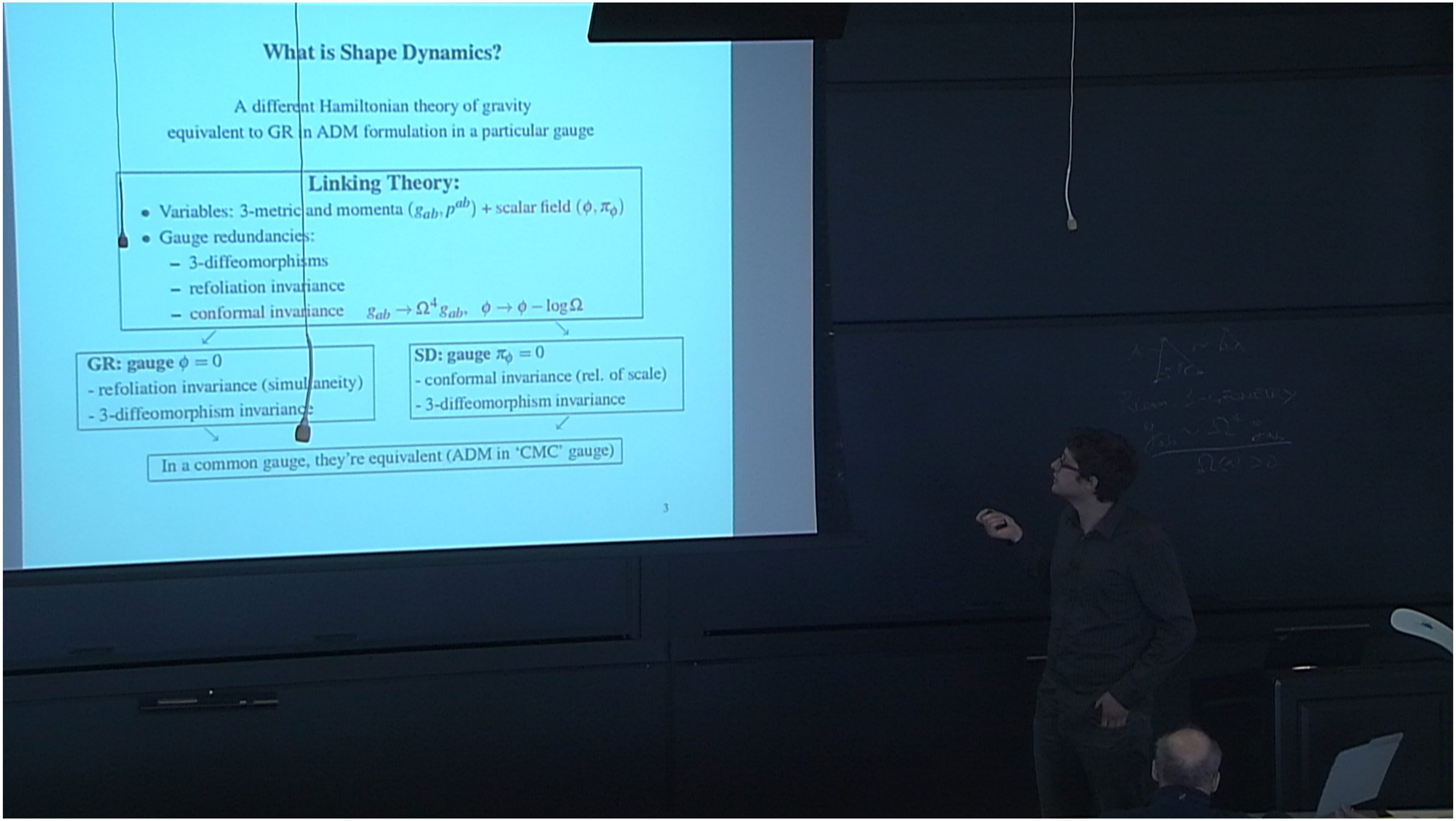
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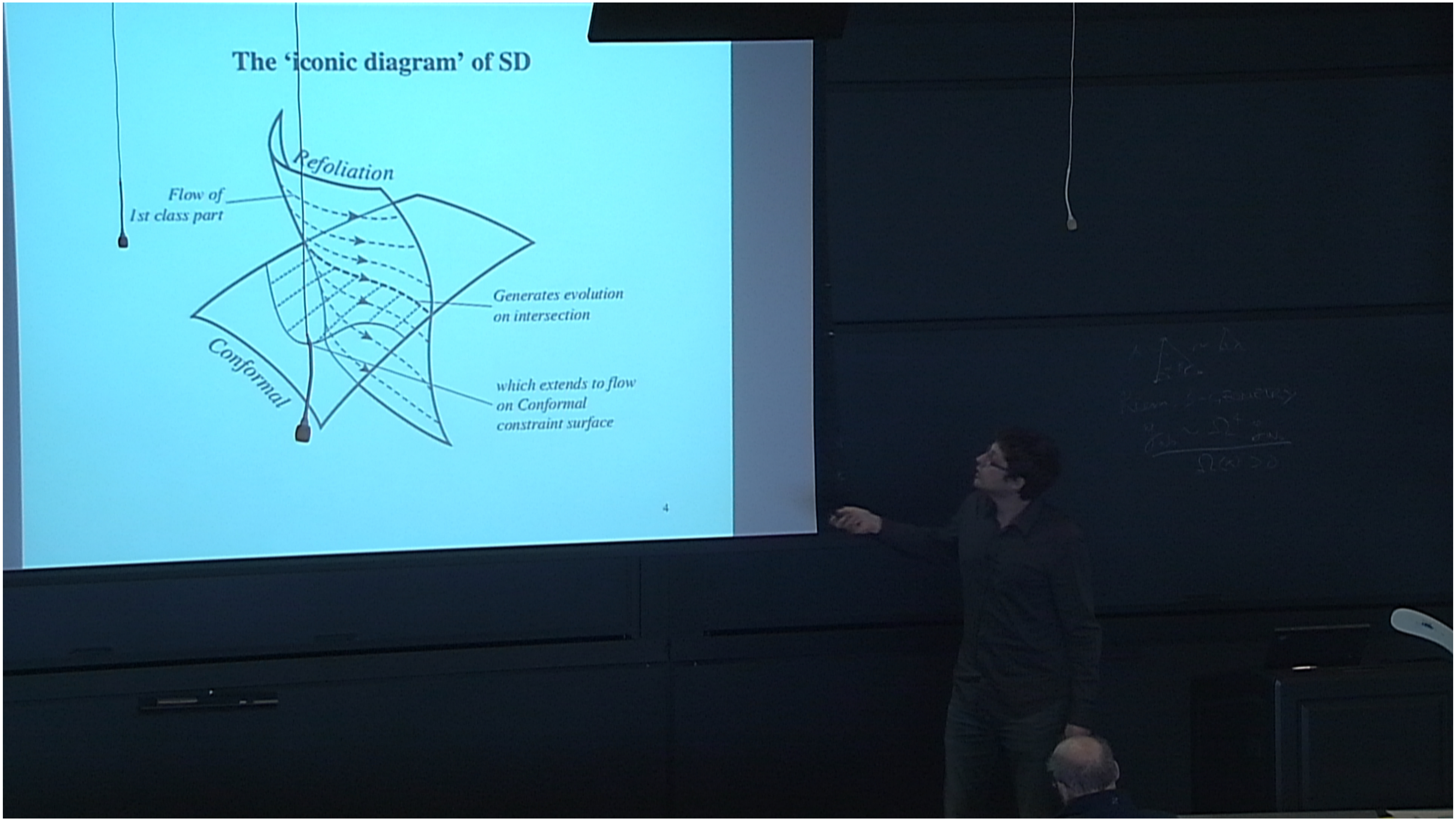
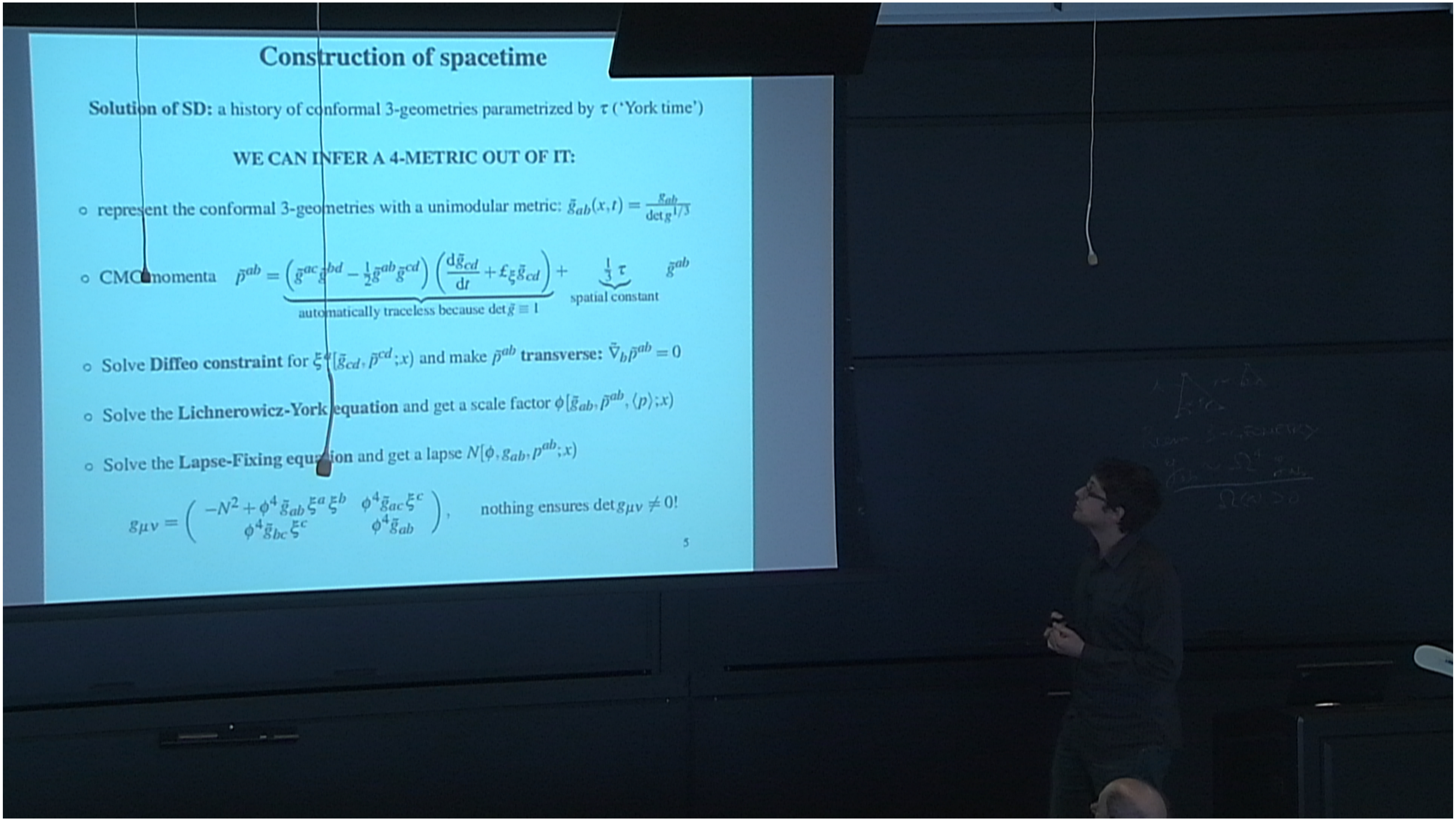
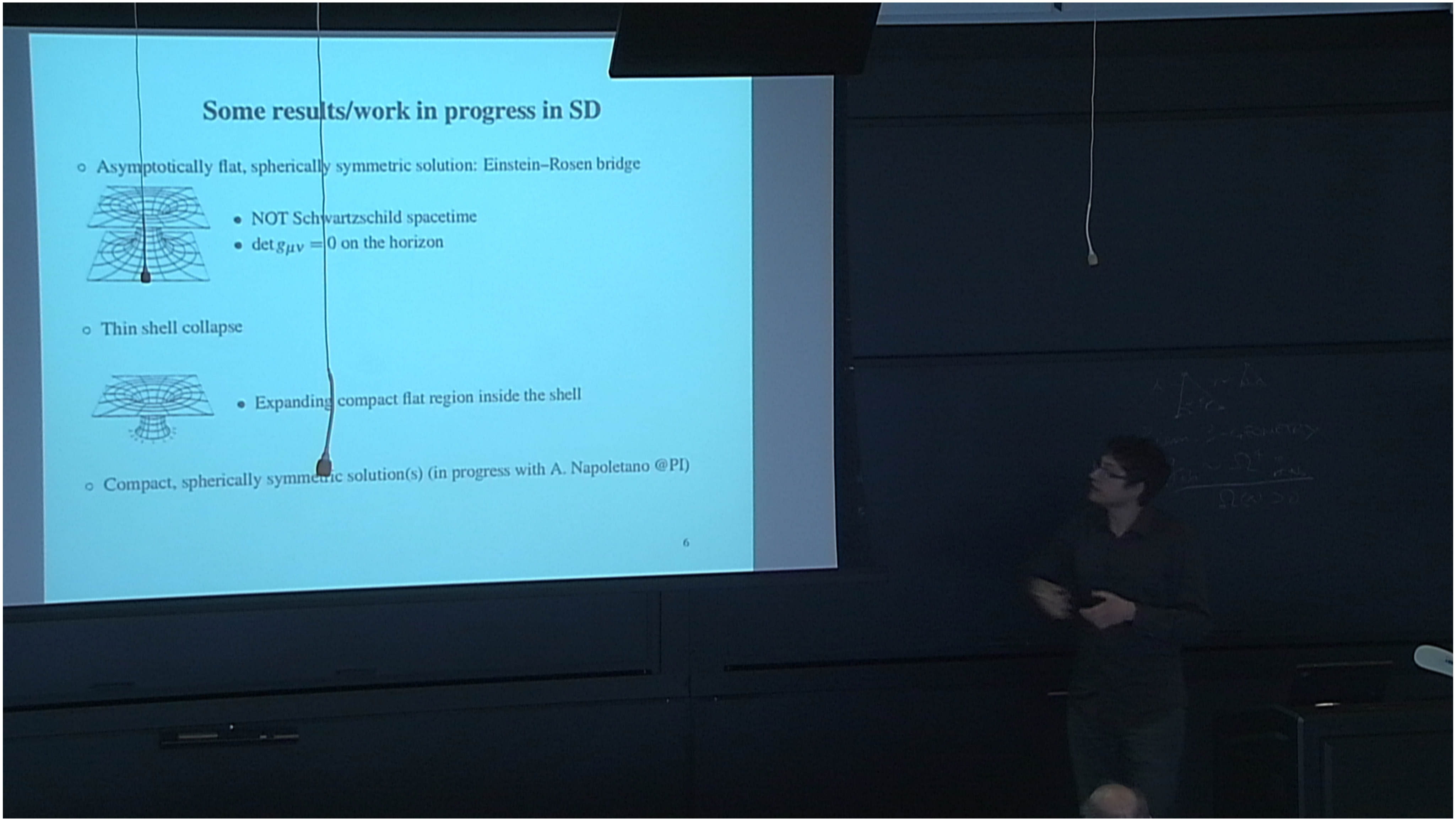
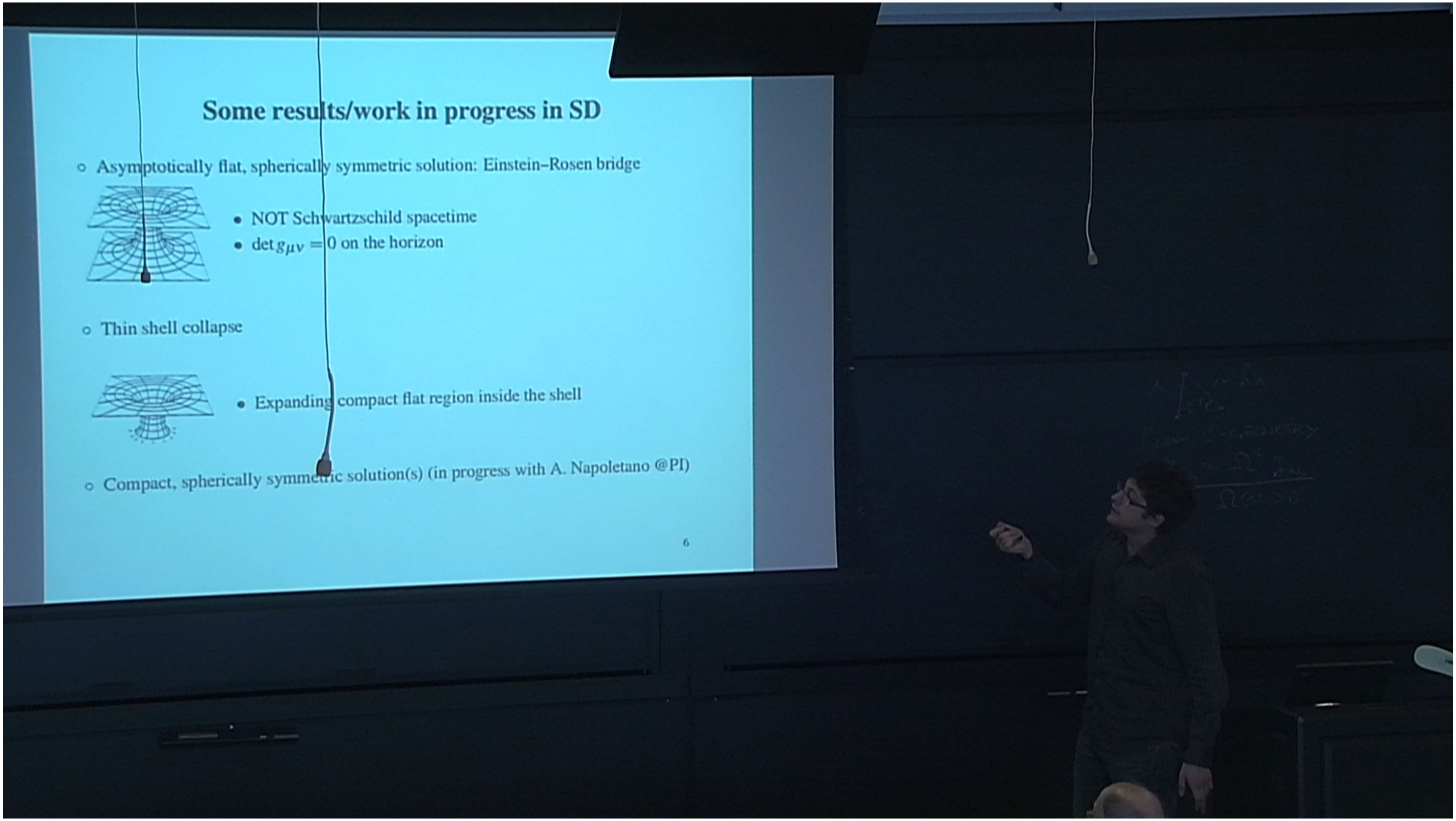

The 'iconic diagram' of SD
Refoliation
Flow of
1st class part
Generates evolution
on intersection
Conformal
which extends to flow
on Conformal
constraint surface
4


Construction of spacetime
Solution of SD: a history of conformal 3-geometries parametrized by τ ('York time')
WE CAN INFER A 4-METRIC OUT OF IT:
represent the conformal 3-geometries with a unimodular metric: $\bar{g}_{ab}(x,t) = \frac{g_{ab}}{\det g^{1/3}}$
CMC momenta $\bar{p}^{ab} = \underbrace{\left(\bar{g}^{ac}\bar{g}^{bd} - \frac{1}{2}\bar{g}^{ab}\bar{g}^{cd}\right)\left(\frac{\mathrm{d}\bar{g}_{cd}}{\mathrm{d}t} + \pounds_\xi \bar{g}_{cd}\right)}_{\text{automatically traceless because } \det \bar{g} \equiv 1} + \underbrace{\frac{1}{3}\tau}_{\text{spatial constant}} \bar{g}^{ab}$
Solve Diffeo constraint for $\xi^a[\bar{g}_{cd}, \bar{p}^{cd}; x)$ and make $\bar{p}^{ab}$ transverse: $\bar{\nabla}_b \bar{p}^{ab} = 0$
Solve the Lichnerowicz-York equation and get a scale factor $\phi[\bar{g}_{ab}, \bar{p}^{ab}, \langle p \rangle; x)$
Solve the Lapse-Fixing equation and get a lapse $N[\phi, g_{ab}, p^{ab}; x)$
$g_{\mu\nu} = \begin{pmatrix} -N^2 + \phi^4 \bar{g}_{ab}\xi^a\xi^b & \phi^4 \bar{g}_{ac}\xi^c \\ \phi^4 \bar{g}_{bc}\xi^c & \phi^4 \bar{g}_{ab} \end{pmatrix}$, nothing ensures $\det g_{\mu\nu} \neq 0$!
5


Some results/work in progress in SD
Asymptotically flat, spherically symmetric solution: Einstein–Rosen bridge
NOT Schwartzschild spacetime
det $g_{\mu\nu} = 0$ on the horizon
Thin shell collapse
Expanding compact flat region inside the shell
Compact, spherically symmetric solution(s) (in progress with A. Napoletano @PI)
6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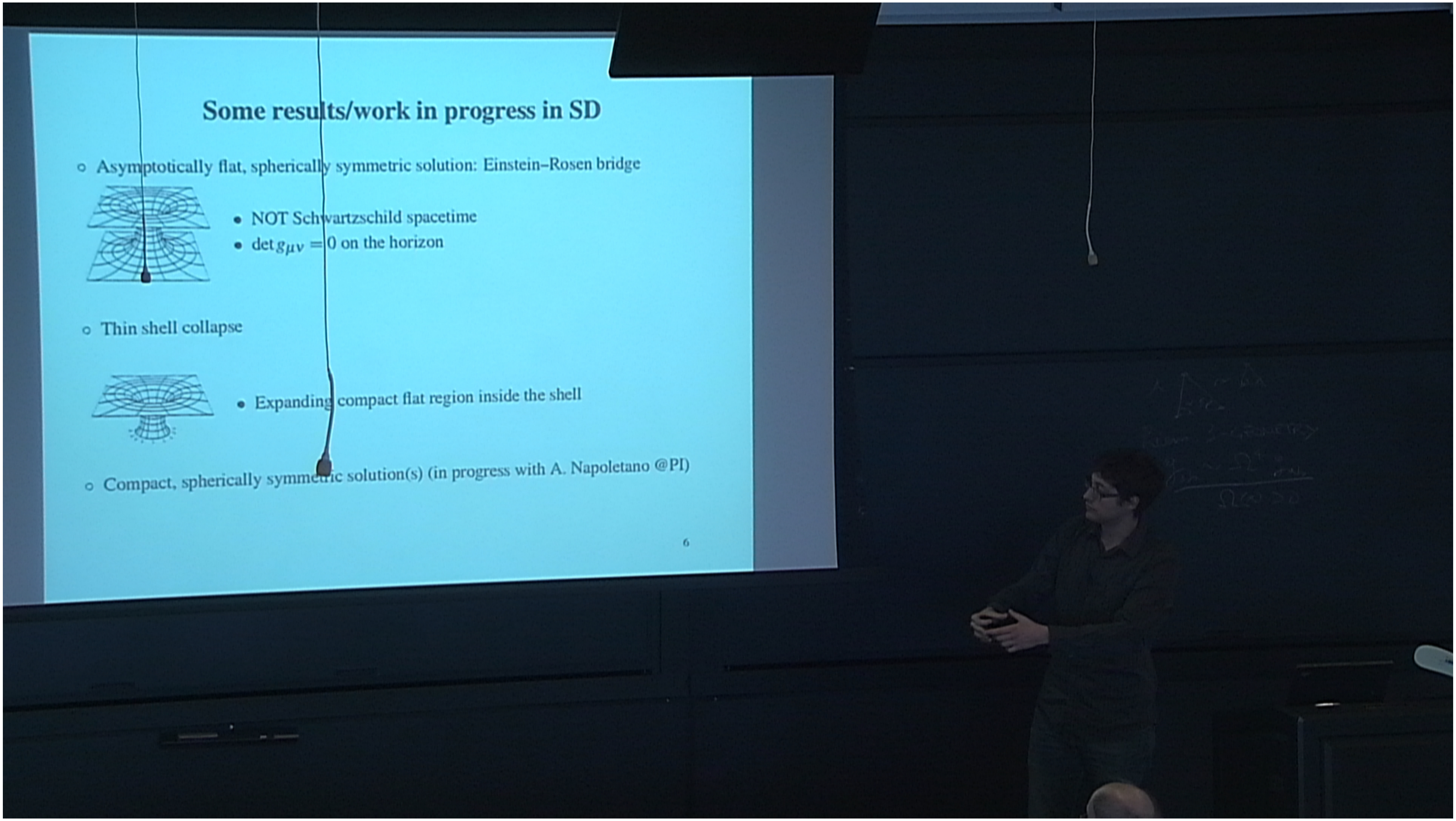

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Some results/work in progress in SD

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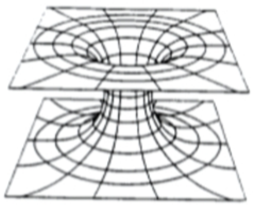
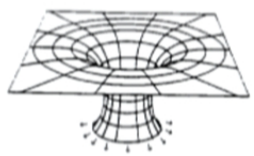


  - NOT Schwartzschild spacetime
  - $\det g_{\mu\nu} = 0$ on the horizon

- Thin shell collapse



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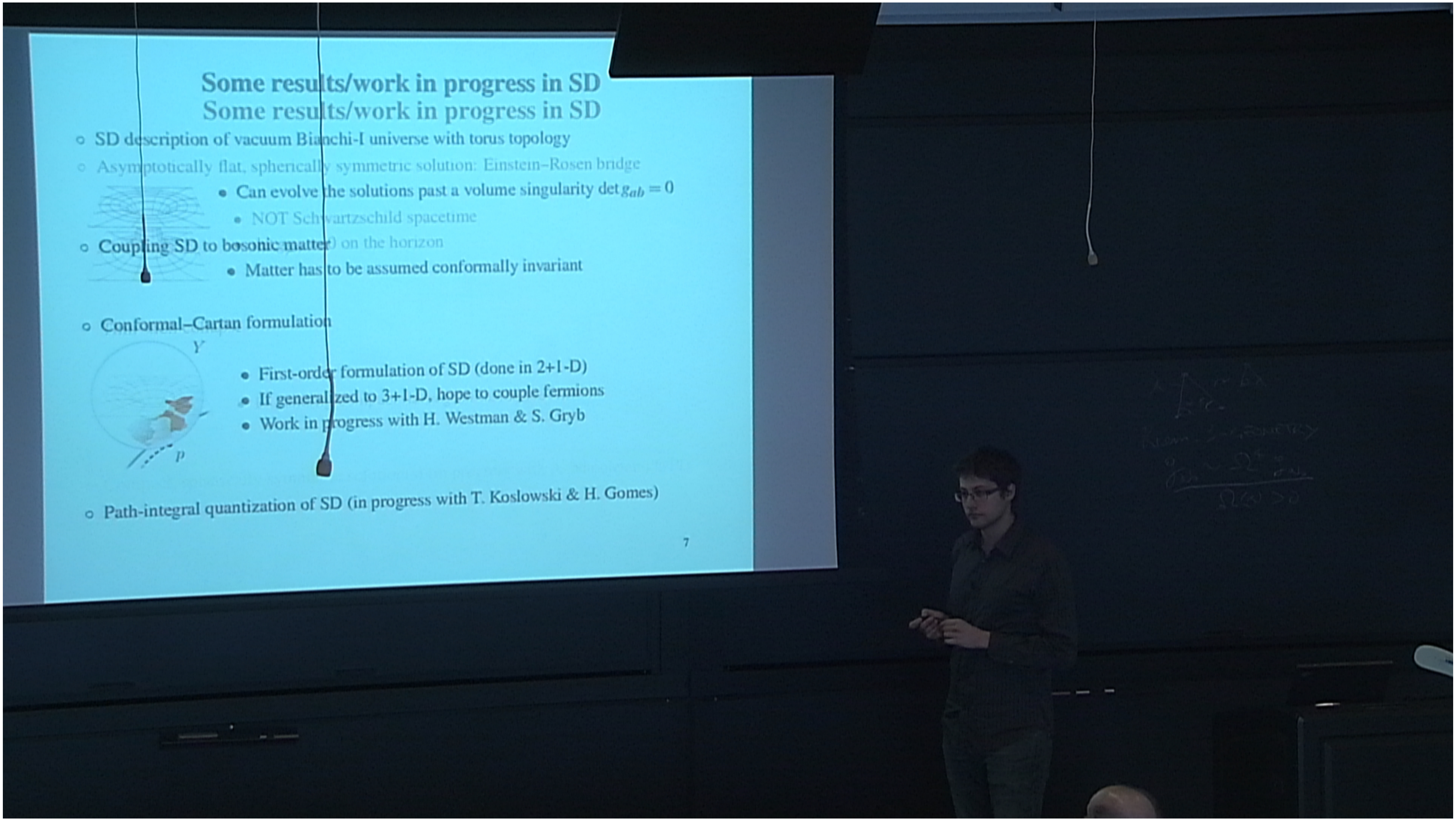
Some results/work in progress in SD
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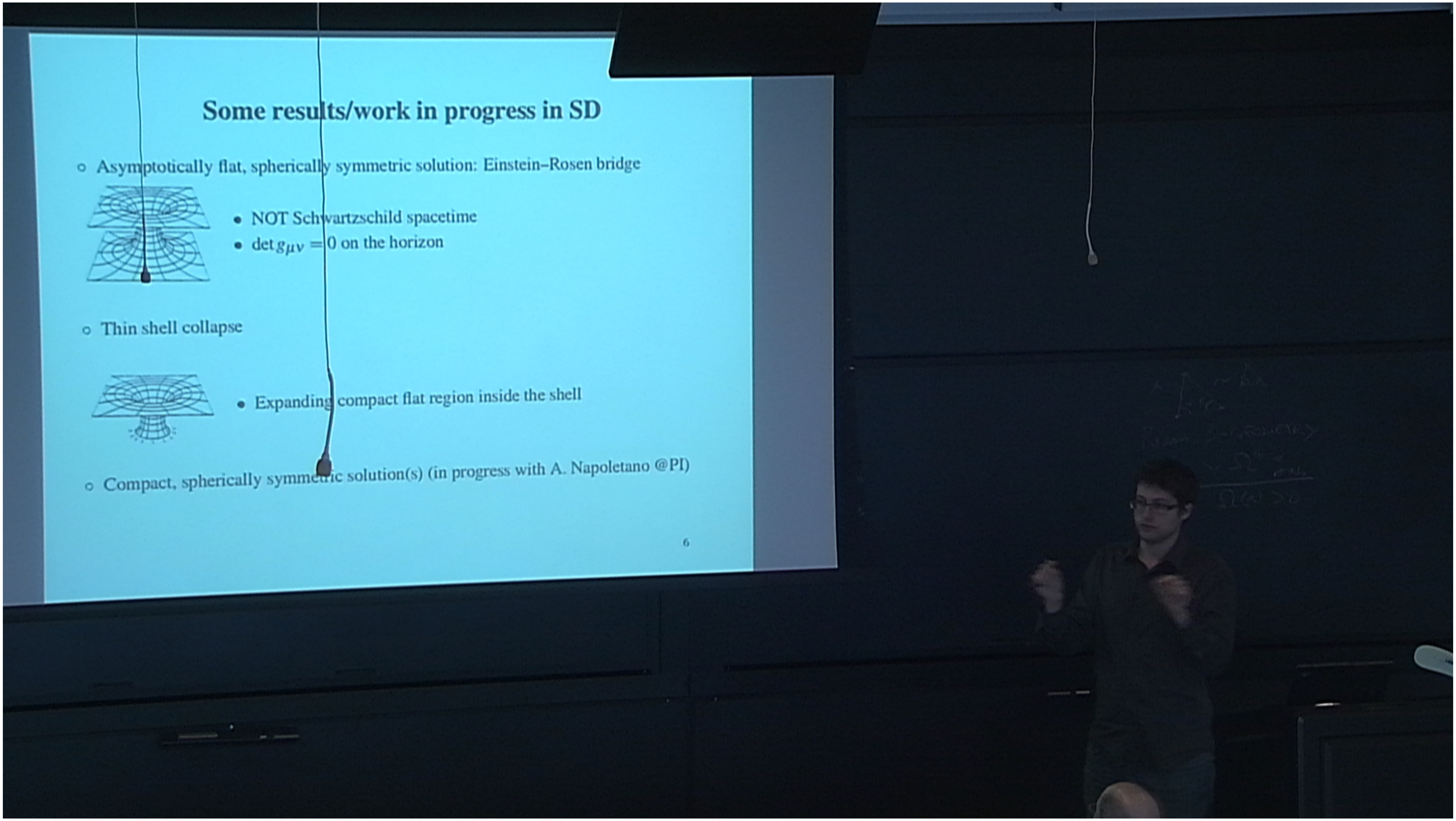
SD description of vacuum Bianchi-I universe with torus topology
Asymptotically flat, spherically symmetric solution: Einstein–Rosen bridge
Can evolve the solutions past a volume singularity det $g_{ab} = 0$
NOT Schwartzschild spacetime
Coupling SD to bosonic matter
Matter has to be assumed conformally invariant
Conformal–Cartan formulation
First-order formulation of SD (done in 2+1-D)
If generalized to 3+1-D, hope to couple fermions
Work in progress with H. Westman & S. Gryb
Path-integral quantization of SD (in progress with T. Koslowski & H. Gomes)
7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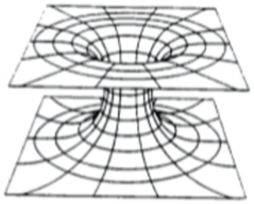
- Asymptotically flat, spherically symmetric solution: Einstein–Rosen bridge



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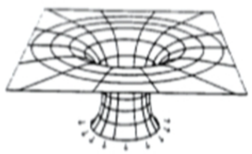

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