Changes suggested by Referee 1:

p. 7: "lives in" changed to "acts on".

p. 10: 3rd pargraph changed to

"Here we worked in global coordinates but we could have worked in the Poincare coordinates. That gives a smearing function with support on the boundary of the Poincare patch. This matches with the global smearing function in the Poincare patch coordinates, up to the ambiguities in the defintion of smearing function mentioned above. We refer to appendix C of [18]."

(Here [18] is the reference mentioned by there referee)

Page 13 second para : Changed to:

"Where $\mathcal{O}_{\Delta_n}(X')$ are higher dimensional primaries. This is a natural guess, because $\phi^1(y)$ falls off faster than $\phi^{(0)}(y)$ near the boundary and does not affect the extrapolate dictionary. Further, it doesn't affect the two point function (primaries of different dimensions have vanishing two point functions)."

p. 14, 5th paragraph: Footnote added:

"One can obtain a diffeomorphism-invariant formulation of a field theory in a given background by introducing auxillary variables. This gives us parametrized field theories. The above comment is about when we do field theory without introducing such auxillary variables."

p 20 Reference to hep-th/1604.07383 added.

p. 22: Belstrami -¿ Beltrami. (Typo corrected)

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p. 23: Section 7.1 First paragraph removed.

p. 23: Typo corrected $G^d -> G^1/d$ in equation 78.

p23 Below equation 78 added clarification $r_d \neq GM$ 'in the limit of large Schwarzschild radius'.

p. 31: Last but one paragraph: 'near the boundary' -¿ 'near the singularity'.

Response: Corrected.

Changes suggested by referee 2:

Abstract: The line "The CFT may well have all the answers, but we don't know how to ask the right questions!" changed to "The CFT may well have all the answers, but we don't know how to ask all the right questions!"

p.2 parag.1: Statement to the end that AdS/CFT has nto been studied to solve bulk physics till recently removoed.

p.2 list: Citations added for AMPS, black hole information problem.

1. Overview of the the program

Typo corrected in section title (the the).

p.3 eq. 1 and eq. 3: All the radial distances written as r, and r goes to infinity.

p.3 below eq. 1: Specified that d is the number of space dimensions in the bulk.

p.3 last unnumbered equation:

Normalization term included, clarified that —E¿ are energy eigenstates.

p.3: Statement that "A generic CFT state will be dual to a black hole geometry." removed

p.4: First paragraph of 1.2: like added : 'here l is the AdS radius'.

p.5 Eq 6: missing $\sqrt{g}$ restored in the last three terms. Formatting corrected

p.5: Eq. 8 removed.

p.5 Eq. 7: t2 was duplicated. corrected to t1.

2. Boundary representation of free fields in the bulk

p.5 above Eq. 9: Line added that "In this limit gravity is switched off. So we can neglect gravity and consider the scalar field in a fixed background."

p.5 below Eq. 9: We have added that "where $\Box$ is the D'Alembartian in anti-de Sitter spacetime."

p.6 above Eq. 10: Added that '$Y_{l\vec{m}}$ are the usual spherical harmonics'.

p.6 below equation 14 :Range of n added.

p.6 Eq. 13: Exponent changed to be $\Delta - d$

p.7 equation 17: repeated t_2 to corrected to t_1.

p.7 Paragraph below equation 17: Lines added: " This problem was originally solved in [16–18]. The construction below is known as the HKLL construction after Hamilton, Kabat, Lifschytz and Lowe who did some of the pioneering work in this field."

p.8 equation 28=7: Conjugation on $g_{\omega l\vec{m}}$ removed.

p.8 eqn 29: Factor of 2 added.

p.9: Paragraph below equation 30 rewritten:

"We note that the smearing function is not unique. We can see from [] that modes between $-\Delta$ and Δ appear in the solution for $\mathcal{O}(t,\Omega)$. Therefore if we add any e^{iJt} to the solution where J is an integer between $-\Delta+1$ and

$\Delta - 1$, the integration of its product with $\mathcal{O}(r, t, \Omega)$ vanishes."

p.9, following parag. Added a line and reference: 'We refer to section 2.3 of [17] for details'.

3. Boundary representation for interacting fields

p. 11: "Green function" changed to "Green's function" (here and elsewhere).

p.11 Eq 35: Typo corrected.

p.11 Eq. 37: Δ_- replaced by$(d - \Delta)$.

p.12 Eq. 39: m changed to M.

4. Reconstruction of interacting gauge and gravitational fields

p.14 parag.1:

Electromagnetic action added.

p.14 Eq. 47: Equation re-written in co-ordinate invariant way.

p.14 Eq. 48: g changed to q.

5. Reconstruction in AdS-Rindler and causal wedge reconstruction conjecture

p.16 Eq. 40: RHS corrected to -1.

p. 16 below Eq. 49: 'accelerated observer' changed to 'uniformly accelerated observer. Line added:

"Here τ is the time measured by accelerated observer and $1/\xi$ is their acceleration".

p 16: Typo in equation 54 corrected.

p16: Below eqn 54: Referral to original definition of global coordinates added.

p 18: t changed t' in eqn 57.

p 19 Section 5.2: First paragraph modified to:

"The AdS-Rindler reconstruction can be extended to a more general class of bulk regions – the causal wedges of ball-shaped boundary regions (For AdS_3 these are just intervals on the boundary). An AdS/Rindler chart can be defined on such wedges [**?**, **?**] and the above method applied. This result leads to the causal wedge reconstruction conjecture.

The causal wedge reconstruction conjecture holds that any field at any point in the causal wedge of any boundary region R in an asymptotically AdS spacetime can be reconstructed as an operator in the boundary region $D[R]$. The intuitive explanation for this is that any point in $C[R]$ can be accessed by a causal observer starting from and returning to $D[R]$. But as the boundary theory is unitary, it already knows the information such an observer may bring. Thus the information about the entire causal wedge is already present in R. As noted, it is proved only for causal wedges of ball-shaped subregions in pure Anti-de Sitter spacetimes. For more general wedges in AdS, as well as for any causal wedges in more general asymptotically AdS spacetimes, this remains a conjecture. For more general wedges in AdS, as well as for any causal wedges in more general asymptotically AdS spacetimes, this remains a conjecture."

p.18 under Figure 5: X and Y defined in the text.

p.18. Added comments about entanglement wedge reconstruction:

It has been conjectured that an even bigger region than the causal wedge can be reconstructed from the information in R. This is the region known as the entanglement wedge of R. To define the region we first recall the covariant version of the Ryu-Takayangi proposal (usually called the HRT or Hubeny-Rangamani-Takayanagi proposal) for holographic entanglement entropy of a boundary region R[**?**, **?**]. According to the HRT proposal, the entanglement entropy of R is equal to the area of the extremal surface γ_R, which is (i) An extremal surface; a surface area is extremal under small variations (ii) homologous to R, (iii) whose boundary is the same as the boundary of R.

From the homology condition, we have that there exists a bulk region H_R such that $\partial H_R = \gamma_R U R$. The domain of dependence of H_R or $D[H_R]$ is the entanglement wedge of R (denoted by $W[R]$).

$$W[R] = D[H_R]. \tag{1}$$

Generally, the entanglement wedge will contain the causal wedge. The entangelment wedge reconstruction conjecture holds that one can reconstruct fields in the entanglement wedge in the boundary of the wedge. We will not discuss entanglement wedge reconstruction in these lectures. We refer the reader to [40-43].

6. Scalar field reconstruction from symmetries

p 20-22 : Miscellaneous typos and formatting issues pointed out by referee corrected.

p 20 eq 63 and the paragraph above it added: The set of conformal generators J^μ on the boundary of the AdS spacetime (which is a cylinder $\mathbb{R}XS^{d-1}$) are the global Hamilltonian H on $\mathbb{R}$, rotation generators M_{ab} on the $d-1$-dimensional sphere, P_a and K_a. The latter are respectively the translation and the special conformal generators when the cylinder RXS^{d-1} is conformally mapped to R^d.

We will need the following commutation relations:

$$[K_a, P_b] = 2\delta_{ab}H - 2iM_{ab},\ [H, P_a] = P_a,\ [H, K_a] = -K_a. \tag{2}$$

p. 21- Δ_O was a typo for Δ_ϕ which was been corrected.

6.8- p.19 Eq. 69: Index added.

7. Challenges to bulk reconstruction

p.23 first parag. Large N changed to infinite N.

p23 : Added 'E is energy' above equation 79.

p.25 Fig 7: Quadrant labelled.

p.27 below Eq 83: line added:

" The origin of the phase is the normalizability condition – modes outside the horizon must vanish at infinity and it turns out that only a particular linear combination of the two modes above vanishes at the boundary."

p.28 Equation 88 and paragraph above added.

p. 28 Eq. 90: k defined as number of insertions.

p.28 below Eq. 90: "small powers of the CFT Hamiltonian" explained as $n \ll N$.

p.28-30: Typos and formatting issues corrected.

p. 28 paragraph added above eqn 91:

"Here we introduce the notion of 'equilibrium states' – states which are dual to black holes which are in approximate equiilibrium. The defining property of equilibrium states is that the elements of the small algebra will have approximately (i.e up to $1/N$ corrections) thermal correlators for these states. Note that there can be more than one equilibrium state dual to a given black hole geometry."

p.28 below eqn 91: Mistaken statement about the little Hilbert space not being a Hilbert space removed.

p.29 parag. below Eq. 92: Rewritten this paragraph:

How do we know that mirror operators will exist? In other words, how doe we know that one can always find $\tilde{b}_\omega$ and $\tilde{b}^\dagger_\omega$ that satisfy [92]? As all $B_\alpha|\psi\rangle$ are linearly independent, [92] defines the operators $\tilde{b}_\omega$ and $\tilde{b}^\dagger_\omega$ by a set D_B equations each. But the dimension of the full Hilbert space is approximately e^{N^2} so the operators $\tilde{b}_\omega$ and $\tilde{b}^\dagger_\omega$ can be thought of as a $e^{N^2}Xe^{N^2}$ matrices. But as $D_B \ll e^{N^2}$, solutions can always be found for the above set of equations.

p.30 below Eq. 97: Explanation added: "any factorized state can always be interpreted as a tensor product of two disconnected bulk geometries, which can be possibly quantum (which is to say, they can have large fluctuations)."