

Abstract Submitted  
for the APR09 Meeting of  
The American Physical Society

**Unitarity and Holography in Gravitational Physics** DONALD MAROLF, UCSB — Because the gravitational Hamiltonian is a pure boundary term on-shell, asymptotic gravitational fields store information in a manner not possible in local field theories. This fact has consequences for both perturbative and non-perturbative quantum gravity. In perturbation theory about an asymptotically flat collapsing black hole, the algebra generated by asymptotic fields on future null infinity within any neighborhood of spacelike infinity contains a complete set of observables. Assuming that the same algebra remains complete at the non-perturbative quantum level, we argue that either 1) the S-matrix is unitary or 2) the dynamics in the region near timelike, null, and spacelike infinity is not described by perturbative quantum gravity about flat space. We also consider perturbation theory about a collapsing asymptotically anti-de Sitter (AdS) black hole, where we show that the algebra of boundary observables within any neighborhood of any boundary Cauchy surface is similarly complete. Whether or not this algebra continues to be complete non-perturbatively, the assumption that the Hamiltonian remains a boundary term implies that information available at the AdS boundary at any one time  $t_1$  remains present at this boundary at any other time  $t_2$ .

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Date submitted: 05 Jan 2009

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