Paper details/topics

In lieu of the 2-day take-home exam (which will take place from the afternoon of Friday March 13 until the morning of Monday, March 16), students are welcome to spend more (but perhaps less stressful) time writing a paper on a GR-related topic.

These will be due on Thursday, March 19. A good paper will be $\sim 10 - 15$ pages in length, and demonstrate an understanding and synthesis both of material covered in class and some additional material, but will not be expected to be original research. It would provide interesting reading to a fellow classmate or (perhaps more importantly) to me. A bad paper will, of course, just be a regurgitation of some textbook treatment of some set of material.

Those interested in writing a paper should let me know, probably chat with me about it, and have a topic chosen by March 10 at latest.

I've listed a number of possible topics below, but am very amenable to other suggestions, or refinements of any of these.

Topics:

- 1. The cosmic censorship conjecture: weak and strong forms, and its current status.
- 2. Singularity theorems: singularities in gravitational collapse and in the big bang/big crunch, and in what circumstances they are unavoidable.
- 3. Black hole evaporation and thermodynamics: QFT behind black-hole evaporation; Analogies between thermodynamics and black hole mechanics; the area theorem.
- 4. Scalar-Tensor theories and other theories with variable constants: conformal transformations and the Einstein frame; variable speed-of-light theories; evidence for/against changing α .
- 5. GR as a hamiltonian theory: formulation; the Wheeler-deWitt equation.
- 6. Mach's principle: to what degree is it satisfied in GR; the Cauchy problem; Gravitomagnetism
- 7. Inflation: its place and purpose in cosmology; predictions and test of inflation; inflation models; eternal inflation.
- 8. The detection of gravitational waves: astrophysical sources; prospects of LIGO.
- 9. Precision tests of GR: the post-newtonian approximation; tests of GR using pulsars.
- 10. Kaluza-Klein theory and GR in higher dimensions.
- 11. Methods for exact solutions: Israel junction conditions; symmetries and classifications of metrics.
- 12. The interior of black black holes, especially the Kerr solution.