Astrophysics II - Topics in Gravitational Waves and General Relativity
Physics 8012, Spring 2018

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Office hours. Wednesday 2 - 3 pm, or by appointment.

Class Meeting Time/Place. Monday, 3:15 pm - 4:15 pm; Wednesday 3:00 - 4:15 pm; occasional Friday lectures; Pupin 420.

Prerequisites. I will assume roughly the equivalent of a semester of general relativity (GR). If you haven't taken GR, please come see me. I should also add that for much of the course, only the basics of GR is assumed. If you have any questions at all as to whether this course is suitable for you, please see me.

Requirements. Problem sets and presentation of papers.

Topics we may cover. Gravitational wave generation, propagation and detection, gravitational lensing, gravitational memory, binary orbital dynamics, spin and tidal effects, neutron star structure, neutron star collisions, quasinormal modes, Penrose diagram, Hawking radiation.

Texts. The recommended (not required) texts are Sean Carroll's Spacetime and Geometry: An Introduction to General Relativity, published by Benjamin Cummings; Thorne and Blandford's Modern Classical Physics, published by Princeton University Press; Shapiro and Teukolsky's Black Holes, White Dwarfs and Neutron Stars, published by Wiley. They are available at Book Culture on W. 112th Street. The website is `http://www.bookculture.com`. Much of Thorne and Blandford's book can be found for free here:
`http://www.pmaweb.caltech.edu/Courses/ph136/yr2012/`.

Presentations. This is a course that leads up to current research. You will be asked to read and present on a number of topics. The suggested papers below provide merely a starting point – you are expected to search for potentially more relevant and useful papers and present them.

1. Detection of GW – selection effects e.g. `https://arxiv.org/abs/1102.5421`

2. Detection of GW – quantum technology
e.g. `http://inspirehep.net/record/1345945/files/dwyer_thesis.pdf`

3. Gravitational memory e.g. `https://arxiv.org/abs/1605.01415`
`https://arxiv.org/abs/1003.3486` , `https://arxiv.org/abs/1411.5745`

4. Binary inspiral – perturbation theory e.g. `https://arxiv.org/abs/hep-th/0409156`
`https://arxiv.org/pdf/1601.04914.pdf`
`http://web.mit.edu/sahughes/www/8.971/bhgrow.pdf`

5. Binary inspiral – numerical GR e.g. `https://arxiv.org/abs/1411.3997`
`https://arxiv.org/abs/gr-qc/0602115`

https://arxiv.org/abs/1606.04226

6. Binary inspiral – neutron stars e.g. https://arxiv.org/abs/1508.06986
https://arxiv.org/abs/1712.02992

7. Quasinormal modes e.g. http://inspirehep.net/record/502903?ln=en
https://arxiv.org/pdf/gr-qc/0411050.pdf

8. Neutron star collision e.g. https://arxiv.org/abs/1711.00473
https://arxiv.org/abs/0901.3258
https://arxiv.org/abs/1711.02093

9. Neutron star collision – aftermath e.g. https://arxiv.org/abs/1001.5029
https://arxiv.org/abs/1710.05931
https://arxiv.org/abs/1801.04286
https://arxiv.org/abs/1711.09638

10. Chandrasekhar-Friedman-Schutz instability e.g. https://arxiv.org/abs/1711.10794

11. QCD and neutron star structure e.g. https://arxiv.org/abs/1512.07820
https://arxiv.org/abs/1801.01923
https://arxiv.org/pdf/1707.04966.pdf

12. Binary pulsars e.g. https://arxiv.org/abs/1402.5594

13. Pulsar timing array e.g. https://arxiv.org/abs/1707.01615

14. Signatures of scalar tensor theories e.g. https://arxiv.org/abs/1710.00830
https://arxiv.org/abs/1709.01525
https://arxiv.org/abs/1711.10502
https://journals.aps.org/prx/abstract/10.1103/PhysRevX.7.041025
https://arxiv.org/abs/1711.09893
https://arxiv.org/abs/0912.2724

15. Supernova e.g. https://www.astro.princeton.edu/ burrows/gw.web/index.html