Spring 2011

PHY 983: Nuclear Astrophysics

Physics 983 is a discussion-centered, inquiry-driven, graduate-level course on current research in nuclear astrophysics. These adjectives are significant: the course is based on discussing key papers in nuclear astrophysics; the direction and quality of this discussion depends on the willingness to dig into the readings; and the students are expected to drive this inquiry, with the instructor acting as facilitator.

The above image[1] is of M2-9, a planetary nebula produced as a low-mass star expels its outermost layers and enriches the interstellar medium with heavy elements.

Instructor

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Office Hours

I don't have set office hours, but you are welcome to stop by if my door is open, or you may make an appointment.

Course web page

Course materials—notes, discussion summaries, links to further reading, blogs, etc.—will be posted on ANGEL.

Meeting time and venue

The course meets MWF 10:20–11:10 in 1308 BPS.

Coursework

We shall be working through a number of key papers on nuclear astrophysics. I envision that we shall divide a topic into a number of sub-topics. A student team will lead the discussion of each sub-topic, and submit a write-up summary. I expect that this summary will be a few pages in length (I'll provide a template). Summaries should be turned in no later than one week after the discussion, and the summaries will be posted on the course's ANGEL page. We'll rotate through the teams to evenly distribute the work. In addition, I will occasionally assign short reading problems. These are meant to guide your reading, and will be discussed in a subsequent class. Because this is a graduate-level class, you should come to class prepared to present your solution.

Grading

The grading policy is simple: for each item turned in, the default grade is a "✔": this means the work is at the level expected of a graduate student studying this topic. If the work is of exceptionally high quality, a "+" can be given. Work that is below expectation will receive a "–".

Primary Texts

There is no single primary text for this course. Our readings will be based on journal and review articles as well as the following texts. We shall decide on the most efficient way to provide access to these texts on the first day of class.

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[1] Image Credit: APOD: 2005 June 12—M2-9: Wings of a Butterfly Nebula, B. Balick et al.

1. Arnett, *Supernovae and Nucleosynthesis.* Princeton University Press (1996).
2. Blatt and Weiskopf, *Theoretical Nuclear Physics*. Dover (1979).
3. Boyd, *An Introduction to Nuclear Astrophysics*. University of Chicago Press (2008).
4. Clayton, *Principles of Stellar Evolution and Nucleosynthesis*. University of Chicago Press (1983).
5. Illiadis, *Nuclear Physics of Stars.* Wiley-VCH (2007).
6. Pagel, *Nucleosynthesis and Chemical Evolution of Galaxies* (2d ed.) Cambridge University Press (2009).
7. Rolfs and Rodney, *Cauldrons in the Cosmos.* University of Chicago Press (1988).
8. Thompson and Nunes, *Nuclear Reactions for Astrophysics,* Cambridge University Press (2009).

Supplemental texts

You may find the following references helpful. I have these in my office, and you are welcome to borrow any of them on a short-term basis (must be returned to me same day by 5:00pm).

1. Binney & Merrifield, *Galactic Astronomy*. Princeton University Press (1998).
2. Hansen, Kawalar, and Trimble, *Stellar Interiors.* Springer-Verlag (2004).
3. Landau & Lifshitz, *Statistical Physics*. Pergammon (1980).
4. Landau & Lifshitz, *Fluid Mechanics*. Pergammon (1987).
5. Lewin and van der Klis, ed., *Compact Stellar X-ray Sources.* Cambridge Astrophysics Series, no. 39. Cambridge University Press (2006).
6. Pathria, *Statistical Mechanics*. Butterworth-Heinemann (1996).
7. Shapiro and Teukolsky, *Black Holes, White Dwarfs, and Neutron Stars.* Wiley (1983).
8. Weinberg, *Cosmology.* Oxford University Press (2008).