

Master Course on Active Galactic Nuclei - 2009

Lecturer: Léon Koopmans (room ZG160)
koopmans@astro.rug.nl

Short Course Description: The student will gain a general overview of the field of Active Galactic Nuclei and will be introduced to several topics in this field, such as Seyfert galaxies, radio galaxies, quasars and related AGN (active galactic nuclei). Physics and energetics of continuum and line emission. Host galaxies and environments. Relation to starburst phenomena/galaxies. Luminosity functions, cosmic evolution. Quasars as cosmological probes. Unification theories.

Written Exam and Essay: The course exam will consist of two parts: a written exam (50%) and an extended essay covering a more specific topic in detail (50%). The written exam is closed-book and will consist of open questions and some calculations. The essay topics can be chosen in consultation with the lecturer. It should consist of a general introduction to the chosen topic of 1 page, at least 6 pages of text (A4, without figures, 12 pt font size, including possible equations) at the level of a general review. Illustrative figures may be added but they do not count the number of pages and should add to the understanding of the text. Maximally 1 page of references should be given and only refereed articles should be cited. References to web-sites are not accepted as proper reference. The written text has to be original and adapted texts from web-sites or other sources are not be accepted and can lead to failing the course. The essay should be at a level understandable by your fellow students and be relatively self-contained. It should also be quantitative, possibly explaining some of the physics through simple equations (i.e. as reader one should be able extract the essence of the topic). Each student writes his/her own essay and will be graded as such, although consultation and working together is allowed. The essay can be handed in at any time before the written exam. Handing in after the exam can only be done in direct consultation with the lecturer well before (2 weeks) the exam and will only be accepted if a good reason can be given for such a delay (excuses just before the exam are not acceptable). Failure to do so will lead to a grade lowered by 1.0 point plus an extra 1.0 point for every extra week of delay, which is regarded as unfair extra time taken by the student. **A topic has to be chosen before Sept. 15th.**

Examples of Essay Topics:

- Physics of black holes in AGN
- AGN accretion disks
- Physics of AGN jets
- AGN as cosmological tools
- AGN host galaxies
- Quasar surveys
- The physics of quasar spectra
- Etc.

To ensure writing a proper essay, please contact me with a topic and we can discuss a proper

outline of the essay and what is expected of it in more detail.

Course Hours: There will be on average two lectures ("hoorcolleges") per week of 1h45m each with a 15 min break. There are no formal exercise sessions ("werkcolleges"), but where appropriate, homework problems will be given, so the student can practice the covered material. The student is expected to spend several hours per week on reading and writing the essay. Questions about the course, essay or otherwise should preferably first be send to the lecturer by email.

Course Book and Material: The course book is "*An Introduction to Active Galactic Nuclei*" by Bradley M. Peterson which will be mostly covered during the course. The course will be presented via slides and black-board. Topics covered in the lectures are the emphasis and the level at which the book should be studied. The course is partly descriptive, because the field of AGN is wide and can not be covered in every detail. Several black-board lectures will go somewhat deeper into the physics of AGN, such as black-holes, accretion and jets.

Preliminary Course schedule:

Lecture	Date	Description
1	31/08/09	Introduction to the course (45 min), the course schedule, exam requirements, essay topics, other agreements. Start choosing your essay topic!
2	01/09/09	Introduction, History, What is an Active Galactic Nucleus. (PPT)
3	07/09/09	Taxonomy & Unification of Active Galactic Nuclei (AGN). (PPT)
4	08/09/09	AGN Host Galaxies & Environment (PPT)
5	14/09/09	Sources of AGN Energetics (BB/theory)
6	15/09/09	The Black-hole paradigm and some BH Physics (PPT) Final deadline for choosing your essay topic!
7	21/09/09	Continuum Emission: radio - gamma-rays (PPT)
8	22/09/09	Spherical Accretion & Accretion Disks (BB/theory)
9	28/09/09	Broad and Narrow -Line Regions (PPT)
10	29/09/09	Radio-Loud AGN population (PPT)
11	05/10/09	Jet-Physics, Superluminal motion (BB/theory)
12	06/10/09	Quasar Surveys & Evolution (PPT)
13	13/10/09 (tue)	AGN as Cosmological Probes (PPT)
14	14/10/09 (wed)	Overview Course Material (PPT) Start handing in your essays (at the latest during the exam)!
15	TBD	Exam / time: TBD

Table 1: Course schedule; Lecture indicated with (PPT) are given through slides, the others (BB) are given on the black-board.

Course hours and venue (if not specified otherwise):

- On any of the **Mondays** the course is from **9.15 till 11.00**
- On any of the **Tuesdays** the course is from **13.15 till 15.00**

Lectures are given the Zernike building in room **ZG161 (5419.0161)**.

Note that the lecture on Oct. 14th is on a Wednesday, due to Piet vd Kruit's symposium on Monday. Precise time/place is TBD and we can discuss whether this shift is possible for the students (due to other course commitments).

Note: Advanced third year BSc students are allowed to follow the course as well.