

Timetables for the Black Hole course, January - March 2004

- Jan 19 Mon 15:15-17:45: room FL13 (1st lecture)**
Infinitesimal distances on a plane and on a sphere. The metric. Coordinate transformations. Covariant and contravariant vectors and tensors. Tensor algebra. Raising and lowering indices. Einstein's summation convention.
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- Jan 21 Wed 10:00-12:00 room FL72 (2nd lecture)**
Parallel transport. Covariant derivative. Geodesic lines. Frenet's formulae.
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- Jan 26 Mon 15:15-17:45 room FL13 (3rd lecture)**
Curvature. Riemann and Ricci tensors and their geometrical meaning. Intrinsic and extrinsic curvature. Examples: sphere, cylinder.
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- Jan 28 Wed 10:00-12:00 room FL72 (4th lecture)**
Minkowski spacetime. Spacelike, timelike and null curves. Observers. Measurements. Lorentz transformations. Uniformly accelerated observer.
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- Feb 02 Mon 15:15-17:45 room FL13 (5th lecture)**
General spacetime. Geodesic deviation. Einstein's principle of equivalence. Gravitational field.
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- Feb 04 Wed 10:00-12:00 room FL72 (6th lecture)**
Matter. Stress-energy tensor. Killing vectors. Conservation laws.
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- Feb 09 Mon 15:15-17:45 room FL13 (7th lecture)**
Einstein's field equations. Schwarzschild equations. The Schwarzschild metric. Circular motion of particles and photons in the Schwarzschild metric.
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- Feb 11 Wed 10:00-12:00 room FL72 (8th lecture)**
The effective potential. Epicyclic frequencies. Perihelion of Mercury advance.
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- Feb 16 Mon 15:15-17:45 room FL13 (9th lecture)**
Non-static spacetimes. The Kerr metric. Ergosphere. Dragging of inertial frames. The Penrose process.
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- Feb 18 Wed 10:00-12:00 room FL72 (10th lecture)**
Conformal transformations. Optical geometry. Centrifugal force paradox.
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- Feb 23 Mon 15:15-17:45 room FL13 (11th lecture)**
This lecture will be given by Rickard Jonsson
Kruskalization. The horizon. The singularity. Cosmic censorship.
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- Feb 25 Wed 10:00-12:00 room FL72 (12th lecture)**
This lecture will be given by Hans Westman
The area of horizon theorem. Quantum effects. Hawking radiation.
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- Mar 01 Mon 15:15-17:45 room FL13 (13th lecture)**
Astrophysical black holes. Other compact objects: neutron stars and white dwarfs. Stellar mass black holes. Supermassive black holes. Primordial black holes. Black hole in our Galaxy centre.
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- Mar 03 Wed 10:00-12:00 room FL72 (14th lecture)**
Accretion disks around black holes. Shakura-Sunyeav, slim, thick disks. Adafs. A review of the most challenging problems in black hole astrophysics.
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