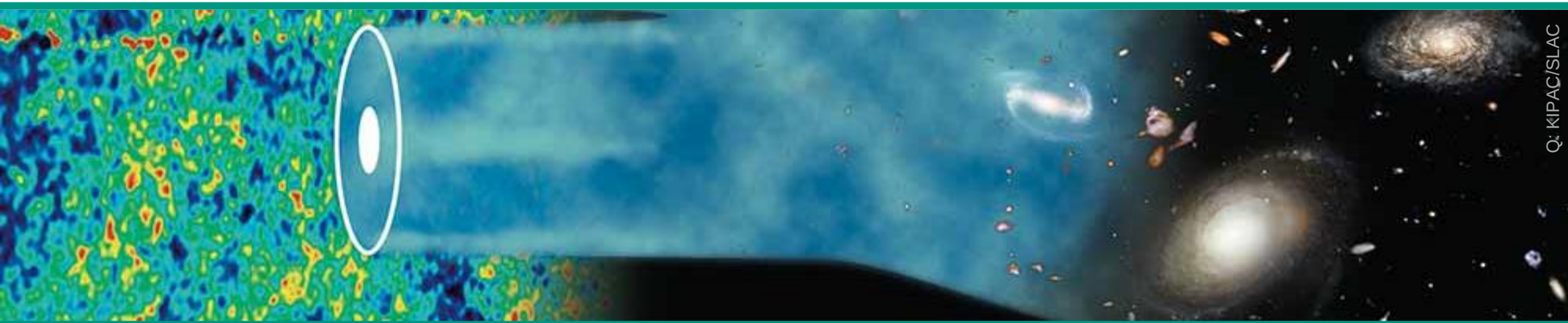


Introduction to Cosmology

Winter term 23/24 Organisation

Oct. 24, 2023



Q: KIPAC/SLAC

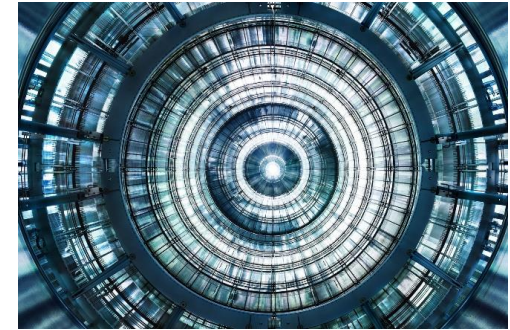
Cosmology – your team

■ Lecturer (4022021): Guido Drexlin

Professor for particle astrophysics

Institute of Experimental Particle Physics (*ETP*)

research: **neutrinos** (*KATRIN*), **dark matter** (*DARWIN*)



■ further information (writing an **email** is faster than regular office hours)

guido.drexlin@kit.edu

Tel.: **0721 – 608 23534**

admin support:

marion.behechti@kit.edu

office at *CN*:

Building **402** room **212**

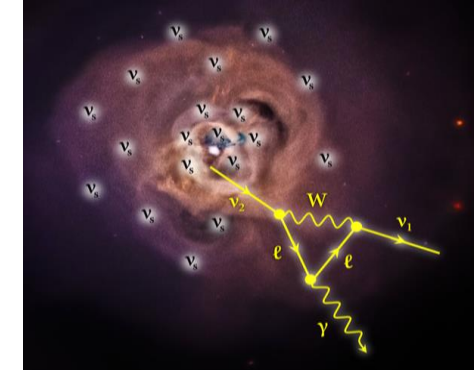
office at *CS*:

Building **30.22** room **F2 – 34**



Cosmology – your team

- Main tutor / organiser (4022021): **Anton** Huber
researcher on *KATRIN/TRISTAN*
Institute for Astroparticle Physics (*IAP*)
research: **neutrinos** (*KATRIN*), **detectors** (*TRISTAN*)



- further information

anton.huber@kit.edu

Tel.: 0721 – 608 26708

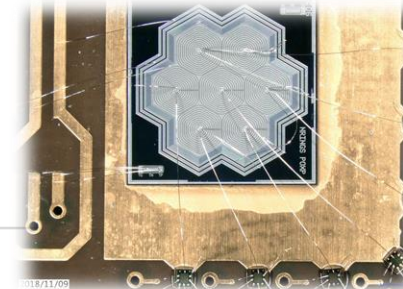
office at *CN*:
Building 402 room 214



- Tutors (post–doctoral res.)

martin.descher@kit.edu

yanina.biondi@kit.edu



Cosmology – your lecture dates

■ Lecture series (in presence at *kl. KS A*, Physik *HS Nr. 3*)

- zoom channel, in urgent cases when you cannot attend in person

<https://zoom.us/j/8364874316>

Tuesday **11:30 – 13:00** (each week, dates see below)

**14 (15)
lectures
(2 SWS):**

24.10. / 31.10

07.11./ 14.11./ 21.11./ 28.11./

05.12./ 12.12./ 19.12./

09.01./ 16.01./ 23.01./ 30.01.

06.02./ (13.02.) /

2023

2024

Cosmology – your tutorial & sheet handout dates

■ Tutorials / tasks sheets

6 task sheets: ~ each second week:

09.11./ 23.11./ 07.12./ 21.12./ 25.01./ 08.02.

Thursday 14:00 – 15:30 @ kl.HS A

■ Distribution of task sheets

6 task sheets: distributed each second week, directly after the lecture via **ILIAS**

i.e. you have **one week** to work on it before the actual tutorial

Cosmology – tutorials

■ Tutorials: from the basics up to the details

- please sign up via **ILIAS** (central hub, also for distribution of task sheets)
- we expect you to be present at **all tutorials** (Physik *HS Nr. 3*, *kl. HS A*)
- no credits in case of unexcused absence
- two (sub–) blocks of tutorials: **Sheets 1 – 3** & **Sheets 4 – 6**
- we expect you to have worked on a **fraction of 60 %** of all problems in each the two sub–blocks ‘**in earnest**’
- we expect you to have **presented the solution** to at least **1** task at the **board**

Cosmology – *ILIAS*

■ **central hub** for all relevant materials, discussions, topical events...

4022021 – Introduction to Cosmology

ILIAS

Inhalt



Discussion Forum

If you have organisational questions or questions about the content of the lecture and
Beiträge (Ungelesen): 0 (0)



Exercises & Tutorials

Here you can find the problem sheets.



Lectures

Here you find the pdf-copies of all lectures.



Solutions (only visible for tutors)

Please don't hand out the solutions to students.



Introduction to Cosmology

Winter term 23/24

Lecture 1

Oct. 24, 2023



KIT – The Research University in the Helmholtz Association

www.kit.edu

the physics master curriculum at *KIT*

■ experimental astroparticle physics: an ideal topic for your master studies

Sem	Physikalisches Schwerpunktfach und Masterarbeit	Physikalisches Er- gänzungsfach	Physikalisches Ne- benfach	Praktika	Nichtphysik. Wahlpfl.fach	Überfachliche Quali- fikationen	LP
1	Module des Physik. Schwerpunktfachs 8	Module des Physik. Ergänzungsfachs 8	Module des Physik. Nebenfachs* 8	Fortgeschrittenen- praktikum* P4 6			30
2	Module des Physik. Schwerpunktfachs 12	Module des Physik. Ergänzungsfachs 6			Module des Nicht- physik. Wahlpfl.fachs* 8	ÜQ - überfachl. Qua- lifikationen* 4	30
3	Spezialisierungs- phase 15 Einf. wiss. Arbeiten 15	participate in world–leading <i>ATP</i> –experiments: <i>KATRIN, XENON – nT, IceCube, Auger, ...</i> future: <i>DARWIN, ET</i>					30
4	Masterarbeit 30						30

**Modulhandbuch
Physik Master 2015 (Master of Science)**
SPO 2015
Wintersemester 2022/23
Stand 16.08.2022

KIT-FAKULTÄT FÜR PHYSIK



KIT – Die Forschungsuniversität in der Helmholtz-Gemeinschaft

www.kit.edu

Astro *P*article *P*hysics – the master curriculum

■ the curriculum of *ATP* at *KIT*: my lecture programme

Astroparticle Physics – I

winter term 2023/24

Introduction & Overview,
Cosmic Rays, Gammas,
Neutrinos, **Dark Matter**



ATP – II: Particles & Stars

summer term 2024

ν –properties, stellar evolution,
supernovae & compact objects,
gravitational waves



Introduction to Cosmology

winter term 2023/24

Big Bang, cosmological
models, evolution of structure
in the universe, **dark universe**



AstroParticlePhysics – the master curriculum

■ all courses

Veranstaltungen	WS 22/23	Reg.	SWS	ECTS	SF/EF	NF
Astroteilchenphysik I <i>Astroparticle Physics I</i>	✓	WS	v3u1	8	A	✓
Einführung in die Kosmologie <i>Introduction to Cosmology</i>	✓	WS	v2u1	6	B	✓
Moderne Methoden der Datenanalyse (mit/ohne erw. Übungen)* <i>Modern Methods of Data Analysis (with/without ext. exercises)</i>		SS	v2p4/v2p2	8/6	C	✓
Elektronik für Physiker <i>Electronics for Physicists</i>	✓	WS	v4p4	10	D	✓
Elektronik für Physiker: Analogelektronik <i>Electronics for Physicists: Analog Electronics</i>	✓	WS	v2p2	6	E	✓
Elektronik für Physiker: Digitalelektronik <i>Electronics for Physicists: Digital Electronics</i>	✓	WS	v2p2	6	F	✓
Beschleunigerphysik (mit/ohne erw. Übungen) <i>Accelerator Physics (with/without ext. exercises)</i>	✓	WS	v4u1/v4u0	8/6		✓
Messmethoden und Techniken der Experimentalphysik (mit/ohne erw. Übungen) <i>Measurement Methods and Techniques in Experimental Physics (with/without ext. exercises)</i>			v2u1p2/v2u1	8/6		✓
Detektoren für Teilchen- und Astroteilchenphysik (mit/ohne erw. Übungen) <i>Detectors for Particle and Astroparticle Physics (with/without ext. exercises)</i>	✓	WS	v2p4/v2p2	8/6		✓
weitere Veranstaltungen	WS 22/23	Reg.	SWS	ECTS	SF/EF	NF
Astroteilchenphysik II – Kosmische Strahlung (mit/ohne erw. Übungen) <i>Astroparticle Physics II – Cosmic Rays (with/without ext. exercises)</i>	✓	WS	v2u2/v2u1	8/6	G	✓
Astroteilchenphysik II – Gamma Rays and Neutrinos (mit/ohne erw. Übungen) <i>Astroparticle Physics II – Gamma Rays and Neutrinos (with/without ext. exercises)</i>		SS	v2u2/v2u1	8/6	H	✓
Astroteilchenphysik II – Teilchen und Sterne (mit/ohne erw. Übungen) <i>Astroparticle Physics II – Particles and Stars (with/without ext. exercises)</i>		SS	v2u2/v2u1	8/6	I	✓
Allgemeine Relativitätstheorie <i>General Relativity</i>			v3u2	10 (T)		✓
Computational Methods for Particle Physics and Cosmology <i>Computational Methods for Particle Physics and Cosmology</i>	✓		v2u1	6 (T)	J	✓
Moderne Methoden der Spektroskopie: Anwendungen in der Astroteilchenphysik** <i>Modern Methods of Spektroskopy: Applications in Astroparticle Physics</i>	✓	WS SS	5 Tage Blockpraktikum	2		✓

Astro *P*article *P*hysics – join our advanced seminar

■ deepen your presentation skills with a 45 *min.* seminar in *D*, *GB* ...

- topics focused on **experimental astroparticle physics** & **cosmology**:
 - neutrino properties (mass), evidences & direct searches for dark matter, ...
 - cosmic rays, neutrino astronomy, gravitational waves, ...
 - *CMB*, compact objects,...
- a **one–week block seminar at CN (IAP, B401)** (end of semester)
- **3 talks/day**, plus discussions, coffee breaks,...
- plus: preparation of **posters** (win a poster prize!)



Astro *P*article *P*hysics – the master curriculum

■ the curriculum of *ATP* at *KIT*: *SPF* or *EF*

- **Schwerpunktfach (*SPF*)** / **Ergänzungsfach (*EF*)**
[**major/main subject**] [supplementary subject]



20 ECTS



12 ECTS

- also possible: subsidiary subject (Nebenfach)
- mandatory courses for *SPF/EF*:

either/ **Astroparticle Physics I (Astroteilchenphysik I)**
or **Introduction to Cosmology (Kosmologie)**

Astro *P*article *P*hysics – the master curriculum

■ the curriculum of *ATP* at *KIT*: *SPF* or *EF*

- | | | |
|---------------------------------------|---|------------------------------|
| - Schwerpunktfach (<i>SPF</i>) | / | Ergänzungsfach (<i>EF</i>) |
| [major/main subject] | | [supplementary subject] |



20 ECTS



12 ECTS

■ **Major subject (Schwerpunktfach, *SPF*)** / suppl. Subject (*EF*)

- oral examination ~ **45 – 50 min.** / ~ 30 – 45 min.
 - cross–module topics (modulübergreifend)
 - **2nd** examiner can be selected from specific lecture you have attended (e.g. electronics, detectors,...)