EPP2 Experimental Particle Physics 2

Stellung im Studiengang: Wahlpflicht **Stellung der Note:** 8/120	Das Modul erstreckt sich über 1 Semester. Das Modul wird jährlich angeboten. Das Modul sollte im 3. Semester begonnen werden.	**Workload:** 8 LP 240 h

Lernergebnisse / Kompetenzen:

Foundations of Elementary Particle and Astroparticle Physics: The students will be familiar with the structure of the Standard Model of elementary particle physics and possible extensions of it. They will acquire the principles for the determination of particle properties and reactions at particle accelerators, both theoretically and experimentally. The interconnection between particle and astroparticle physics is stressed. Foundations of the origin and detection of cosmic rays are given. Introduction to the concepts and techniques of modern detectors for particle and astro-particle physics.
Introduction to Cosmology and General Relativity: The students will understand the basic principles of general relativity as the theoretical foundation of cosmology. They will get familiar with the general structure and contents of the Universe and its evolution from the big bang to the far future and they will understand the concept and observational evidence for the big bang itself. A number of spectacular observations have been made in recent years which have put Cosmology forward to a quantitative science. Solving problems related to the lectures will lead to a consolidation of the achieved competences.
Architectures: The development of computers is particularly important in Particle Physics applications. The lecture on architectures provides the basic understanding of the functioning of a computer.

Voraussetzungen:

No formal pre-requisite.

Bemerkungen:

Quantum Mechanics at bachelor level; particularly suited for students with Bachelor of Physics or Applied Science.

Modulverantwortliche(r):

Prof. Dr. Zoltan Fodor, Prof. Dr. Robert Harlander, Prof. Dr. Karl-Heinz Kampert, Prof. Dr. Wolfgang Wagner

Nachweise zu Experimental Particle Physics 2

Modulabschlussprüfung

Art des Nachweises:	**Prüfungsdauer:**	**Nachgewiesene LP:**	**Nachweis für:**
Sammelmappe mit Begutachtung einschließlich mündlicher Prüfung (uneingeschränkt)	30 min. Dauer	8	ganzes Modul

Nachweise zu Experimental Particle Physics 2 (Fortsetzung)

Bemerkungen:

Das Modul hat folgende Wahlmöglichkeiten:
1) Foundations of Elementary Particle and Astroparticle Physics (Übungen, 2 LP; mündliche Prüfung, 6 LP)
oder
2) Architectures (praktische Übung, 2 LP) + Introduction to Cosmology and General Relativity (Übungen, 3 LP; mündliche Prüfung, 3 LP)
oder
3) Architectures (praktische Übung, 2 LP) + Detector Physics (Übungen, 3 LP; mündliche Prüfung, 3 LP)

English Translation:
Assessment of folder (8 cr), including 30 minutes oral exam, unrestricted repeatable.
For the module the following combinations are possible:
1) Foundations of Elementary Particle and Astroparticle Physics (exercises, 2 cr; oral examination, 6 cr)
or
2) Architectures (practical exercise, 2 cr) + Introduction to Cosmology and General Relativity (exercises, 3 cr; oral examination, 3 cr)
or
3) Architectures (practical exercise, 2 cr) + Detector Physics (exercises, 3 cr; oral examination, 3 cr)

a Architectures

Stellung im Modul:	**Lehrform:**	**Selbststudium:**	**Kontaktzeit:**
Wahlpflicht (2 LP)	Vorlesung	48,75 h	1 SWS $\times$ 11,25 h
Angebot im: WS	**Fremdkomponente:** ja Fremdmodul:Theoretical Particle Physics 2 Verantwortliche(r):Prof. Dr. Zoltan Fodor, Prof. Dr. Karl-Heinz Kampert		

Inhalte:

- The computer system
- The memory system
- Input/output handling
- Internal structure and functioning of the CPU
- The control unit
- The instruction set
- Pipeline hazards
- Architectures for parallel computation

b Foundations of Elementary Particle and Astroparticle Physics

Stellung im Modul:	**Lehrform:**	**Selbststudium:**	**Kontaktzeit:**
Wahlpflicht (8 LP)	Vorlesung/ Übung	195 h	4 SWS $\times$ 11,25 h

b Foundations of Elementary Particle and Astroparticle Physics (Fortsetzung)	
Angebot im: WS	**Fremdkomponente:** nein

Inhalte:

- Feynman diagrams and their application to cross sections and decay rates
- concepts of the Standard Model
- Intensified study of one or several aspcts of the Standard Model, for example: electro-weak symmetry breaking, precision physics, QCD observables, flavor physics
- particle-, gamma- and neutrino-radiation from the cosmos: origin, detection, and open questions
- dark matter
- relations between particle physics, astro-particle physics, and cosmology

c Introduction to Cosmology and General Relativity			
Stellung im Modul: Wahlpflicht (6 LP)	**Lehrform:** Vorlesung/ Übung	**Selbststudium:** 135 h	**Kontaktzeit:** 4 SWS $\times$ 11,25 h
Angebot im: WS	**Fremdkomponente:** ja Fremdmodul:Theoretical Particle Physics 2 Verantwortliche(r):Prof. Dr. Zoltan Fodor, Prof. Dr. Karl-Heinz Kampert		

Inhalte:

General co-ordinate transformations, metrics of space-time, Robertson-Walker metrics, Einstein and Friedmann Equations, cosmic dynamics and world models, Hubble Law, critical density of Universe, cosmological constant, age measurements, cosmic microwave background radiation, primordial nucleo-synthesis, dark matter

d Detector Physics			
Stellung im Modul: Wahlpflicht (6 LP)	**Lehrform:** Vorlesung/ Übung	**Selbststudium:** 135 h	**Kontaktzeit:** 4 SWS $\times$ 11,25 h
Angebot im: WS	**Fremdkomponente:** nein		

Inhalte:

Interactions of particles with matter, showers, momentum and track mesaurement, tracking detectors (gas chambers, semiconductor detectors, timing, energy measurement/calorimeters), particle identification, experiments in particle and astro-particle physics, instrumentation, data acquisition