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Accelerator Design

JUAS'22 - Lecture and Mini-Workshop - Bastian Haerer (KIT)

juas
Joint Universities Accelerator School

Scope: Design a top-factory

Particle collider for precision measurements of the top quark mass

- Measurements at the $t\bar{t}$ pair production threshold

- Produce at least 100000 $t\bar{t}$ pairs per year for sufficient statistics

- The circumference of the machine must not exceed 100 km

- Synchrotron radiation power is limited to 50 MW per beam

Based on these boundary conditions… **propose a collider design!**

Tutor Team

- Bastian Haerer (lecturer)

- Adrian Oeftiger (workshop showrunner)

- Kévin André, Carsten Mai, Bernhard Holzer (tutors)

Topics I - Basic parameter set and general design aspects (Carsten, Adrian)

- Beam energy, cross section, luminosity

- No. of bunches, particles per bunch, β^*, emittance

- General layout, magnet technology, basic cell layout, dipole filling factor

- Synchrotron radiation power, resistive wall impedance induced by power loss

Topic II - Synchrotron radiation emission and RF sections (Kévin, Adrian)

- Synchrotron radiation power, critical energy, beam current

- Momentum compaction factor, transition energy, RF voltage, synchronous phase

- Number of RF cavities, length of RF section, synchrotron tune

- Damping times, equilibrium emittance, energy spread, bunch length

Topic III - Lattice design in MAD-X (Bastian, Bernhard)

- Design a basic cell according to beam requirements, implement a MAD-X model of the cell, close the ring

- Calculate synchrotron radiation integrals with MAD-X and equilibrium beam parameters

- Include dispersion suppressors and straight sections

- Include RF cavities and calculate equilibrium beam parameters with MAD-X

Like in real life: Expert-groups should talk to each other!

Boundary conditions for examination

- Oral group examination in 20 min slots

- 9 min presentation + questions by tutors

- The rest of the time you are free to study for the other written exams.

- In the afternoon session the "best team per topic" presents during the summary session.
  → Target audience: your colleagues from the other groups (not tutors!)

Monday 7 February

10:00 - 10:20	Group 9
10:25 - 10:45	Group 6
10:50 - 11:10	Group 3
11:15 - 11:35	Group 8
11:40 - 12:00	Group 5
13:00 - 13:20	Group 2
13:25 - 13:45	Group 7
13:50 - 14:10	Group 4
14:15 - 14:35	Group 1
15:00 - 16:30	Summary session

Groups

Topic I

Last name	First name	Group
ANGELIS	Ioannis	
DEMURTAS	Francesco	1
ZEITZ	Daniel	
BEGUE	Max	
FERRENTINO	Vittorio	2
NOVELLI	Daniel	
BLONDEAU-PATISSIER	Damien	
KARLSEN-BÆCK	Birk Emil	3
MOSESSO	Lorenzo	

Topic II

Last name	First name	Group
FRAZZITTA	Andrea	
LAMPAKI	Syrmatenia	4
MAFFEZZOLI FELIS	Stefano	
MUIR	Alistair	
PALSKIS	Kristaps	5
HALIS	Duygu	
VOSTREL	Zdenek	
OLIVIERI	Antonietta	6
BOSSOUTROT	Romain	
CAMPRI	Giovanni	

Topic III

Last name	First name	Group
CASTELLI	Luca	
MAGNIN	Arnaud	7
WAAGAARD	Elias	
BROGGI	Giacomo	
PUEL	Louis	8
VERES	Dora Erzsebet	
MARTINEZ LOPEZ	Eduardo	
ANNUCCI	Davide	9
KALLENDORF	Daniel	
ROIKOVA	Eva	