

Plasma Physics

TU Dresden

Lecturer: Dr. Katerina Falk



Summer semester April – July 2022

Time: Friday, 2 DS (9:20 – 10:50)

Duration: 1 DS (1.5 hours)

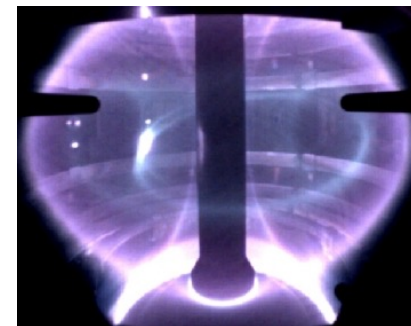
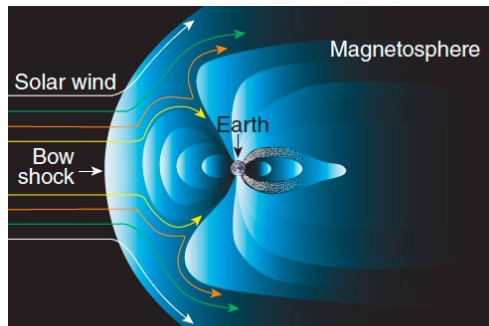
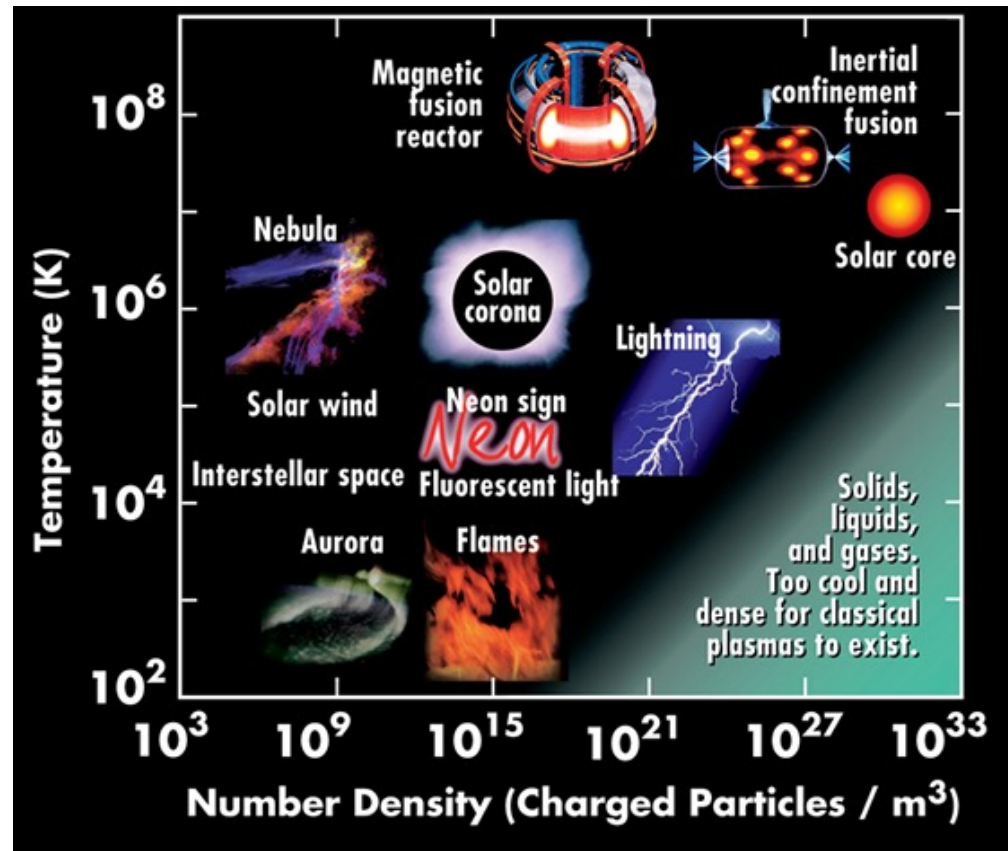
Location: ASB/328/H

Language: English

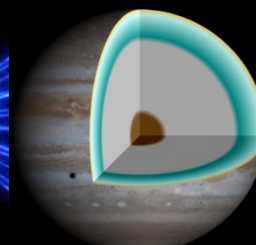
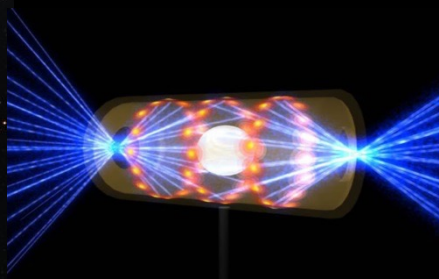
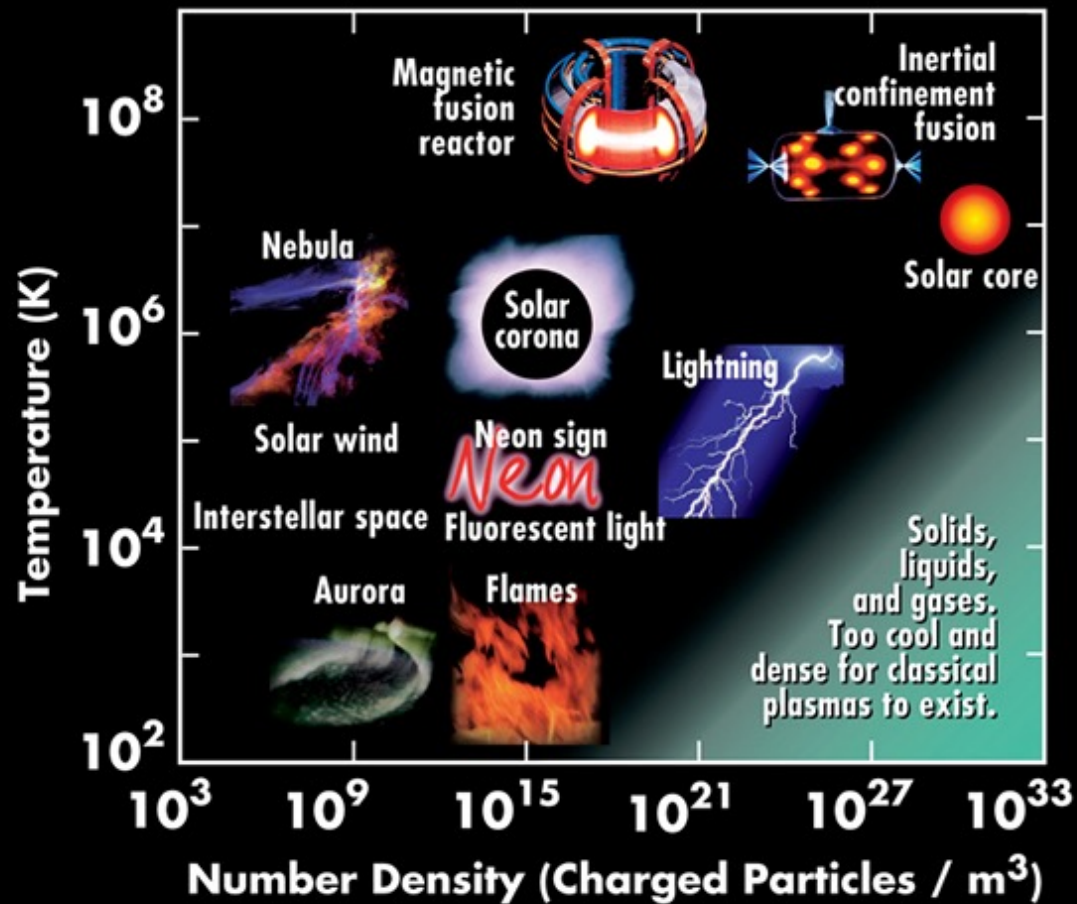
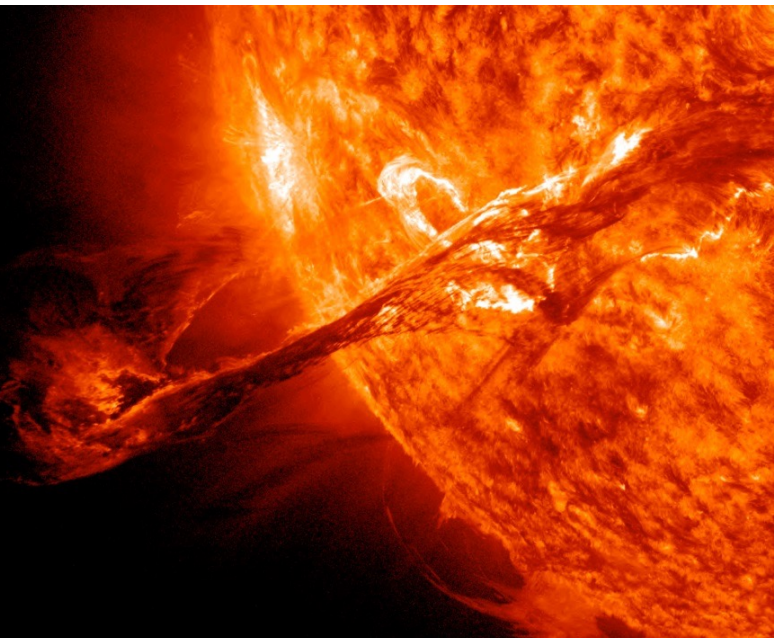


Plasma Physics: Fridays, 2 DS (9:20 – 10:50)

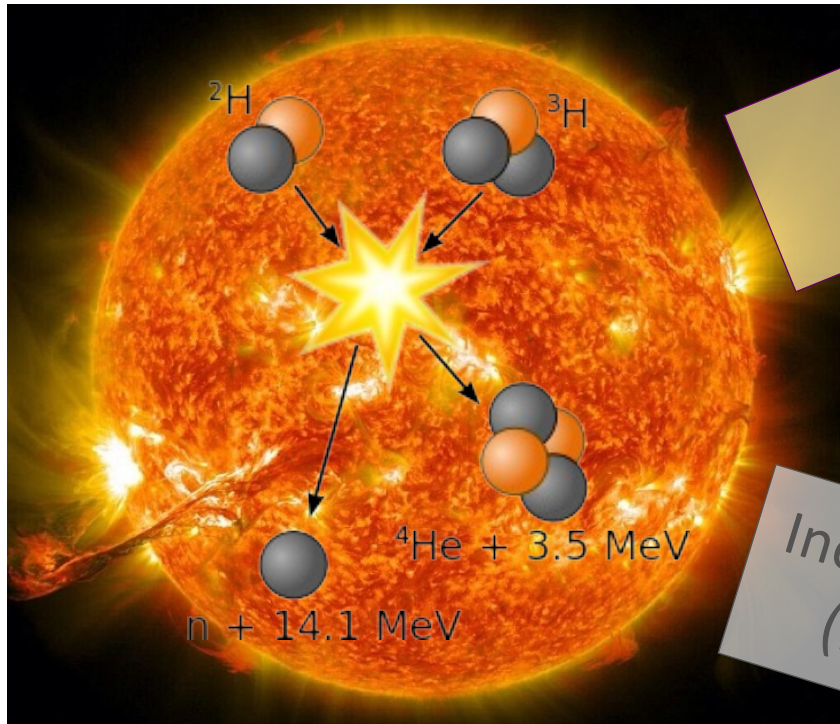
- Basic plasma definitions
- Waves, radiation, kinetic description, magneto-hydrodynamics, shocks, etc.
- Astrophysical Plasmas
- X-ray plasma spectroscopy
- Thermonuclear fusion applications
- Plasma computational simulations



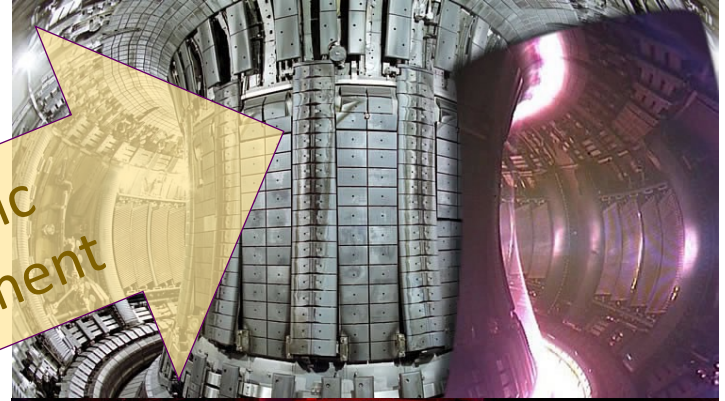
Examples of plasmas



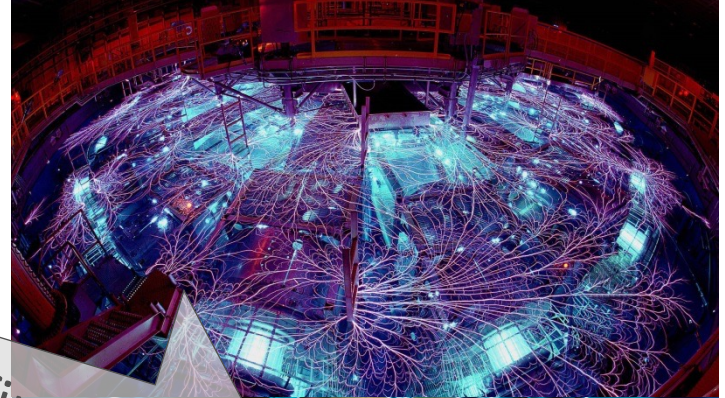
Thermonuclear fusion



Magnetic
confinement



Inertial confinement
(lasers, Z-pinch)



Lecture course structure

■ Basics of plasma physics:

1)	Fri, April 8, 2022	Basic plasma parameters and definitions
Definition of plasma, Saha equation, plasma parameter, Debye length, plasma frequency		
	Fri, April 15, 2022	NO lecture
Easter vacation		
2)	Fri, April 22, 2022	Single particle motion in plasma
Larmor orbits, guiding centre drift, gradient drift, mag. mirrors		
3)	Fri, April 29, 2022	Collisions and radiation (recorded)
Particle scattering, Coulomb logarithm, Bohm-Gross frequency, resistivity		
4)	Fri, May 6, 2022	Kinetic theory
Distribution functions, Vlasov equation, Langmuir waves, Landau damping		
5)	Fri, May 13, 2022	Magneto-hydrodynamics (macroscopic model)
MHD equations, magnetic flux freezing, magnetic pressure and plasma beta		

Lecture course structure

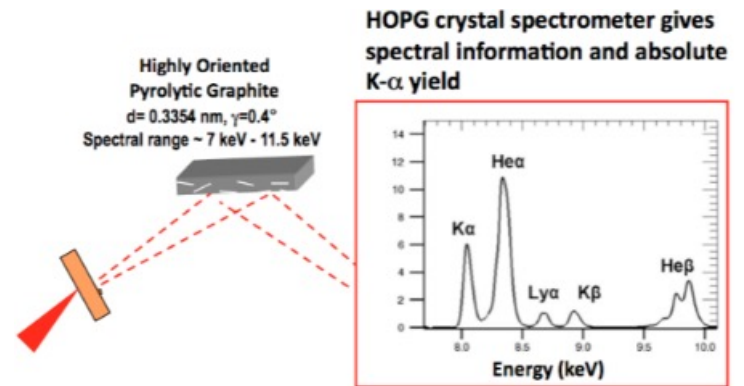
- Basics of plasma physics:

6)	Fri, May 20, 2022	Waves in plasma I
Plasmons, sound waves, ion acoustic waves, Alfvén waves, dielectric tensor		
7)	Fri, May 27, 2022	Waves in plasma II
Waves in magnetized plasma, Whistler, O, X-modes, Alfvén waves revisited		
8)	Fri, June 3, 2022	Magnetic confinement and fusion
Tokamaks, stellarators, Z-pinchs, magnetic instabilities		
	Fri, June 10, 2022	NO lecture
Pentecost (no lecture period)		
9)	Fri, June 17, 2022	Laser plasmas & ICF
Inverse Bremsstrahlung, ablation model, ICF implosion, direct/indirect drive, fast ignition		
10)	Fri, June 24, 2022	Plasma instabilities
Resonance absorption, B-fields, parametric instabilities		
11)	Fri, July 1, 2022	Plasma shocks
Rankine-Hugoniot relations, collisionless shocks, etc.		

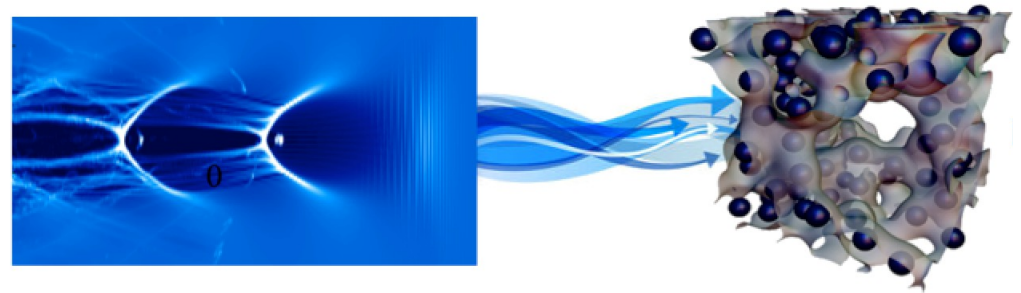
Plasma Physics: guest lectures 2022

→ preliminary dates

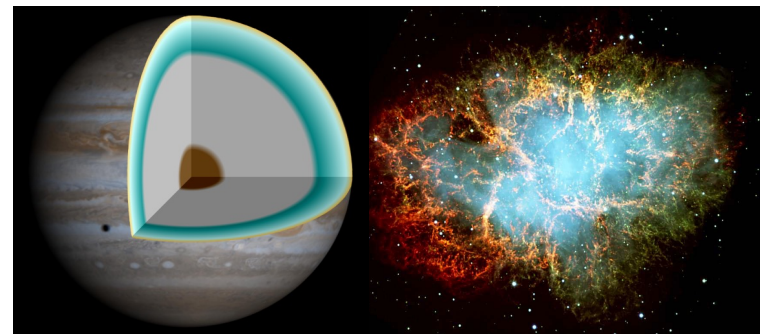
- July 8, 2022: **X-ray plasma spectroscopy and applications** by Dr. Michal Šmíd (HZDR)



- July 15, 2021: **Computer simulations for plasmas** by Dr. Michael Bussmann (HZDR)



- bonus: **Astrophysical plasmas and Laboratory Astrophysics** by Prof. Hideaki Takabe (HZDR)

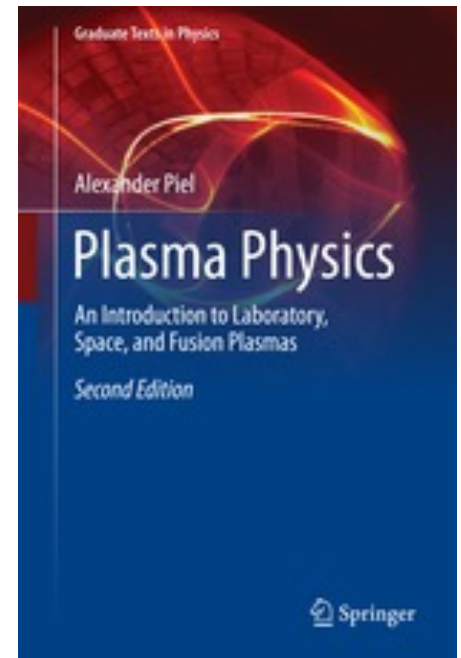
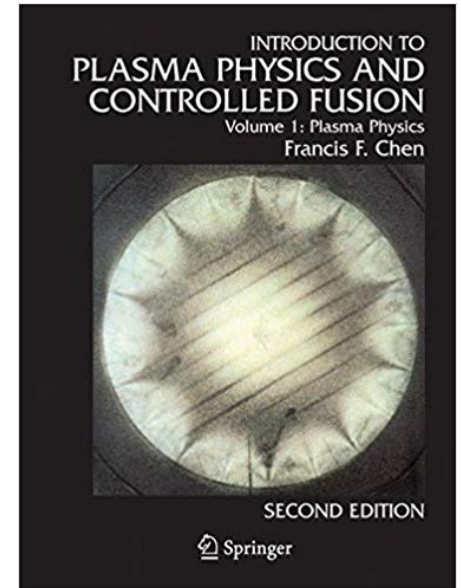


Course level and requirements

- **Advanced course** suitable for Master, PhD students and for keen/advanced bachelor students
- **Assumed knowledge:** Electromagnetism, thermodynamics, statistical mechanics, basic atomic physics
- **Language:** English

Recommended literature

- F. F. Chen: **Introduction to Plasma Physics and Controlled Fusion**, Springer
- A. Piel: **Plasma Physics**, Springer
- R. O. Dendy: **Plasma Dynamics**, Oxford Science Publications
- D. H. Trevena: **Statistical Mechanics**, Horwood Publishing
- R. P. Drake: **High Energy Density Physics**, Springer
- W. L. Kruer: **The Physics Of Laser Plasma Interactions**, Westview Press
- T. Tajima & K. Shibata: **Plasma Astrophysics**, Westview Press



Lecture notes and materials online

- HZDR website: <https://www.hzdr.de/db/Cms?pOid=63014&pNid=917>

(Password: TUD_plasma)

- OPAL online teaching (TUD): 2022 Plasmaphysik
- Lecture video recordings available online
- Notes: presentation and hand-written derivations
- 6 problem sheets (optional)

Thank you for your attention!
Any questions?

Katerina Falk

Helmholtz Young Investigator Group Leader

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