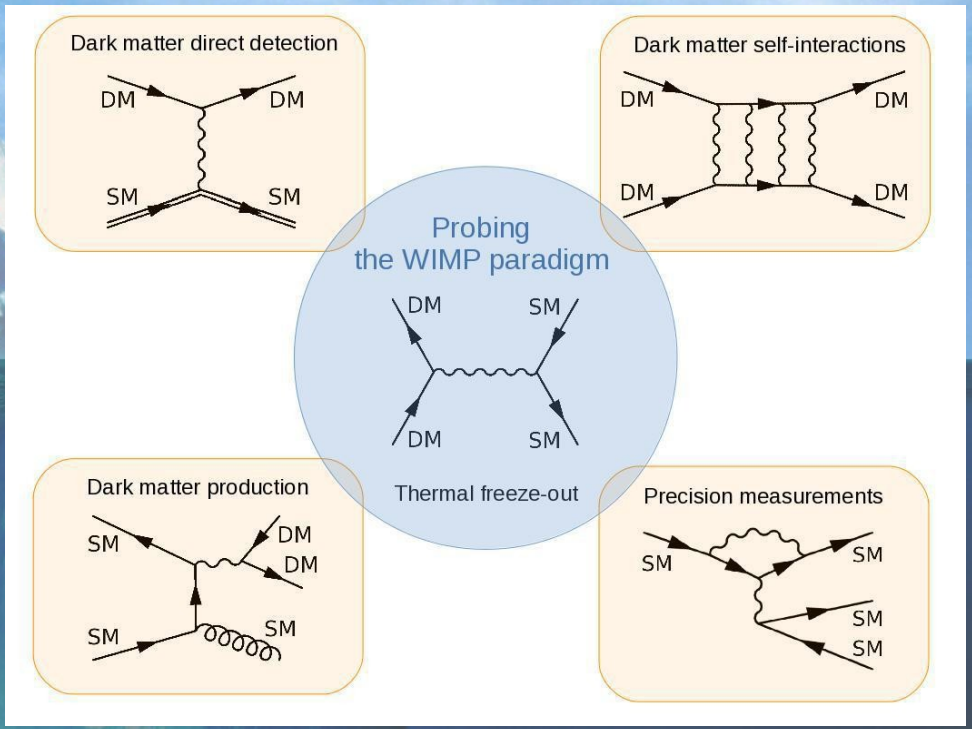
# Felix Kahlhoefer

Junior Research Group leader
Junior professor




## Dark matter physics

Combination of particle physics, astrophysics and cosmology

Exploration of the complementarity of different search strategies

**Group members**

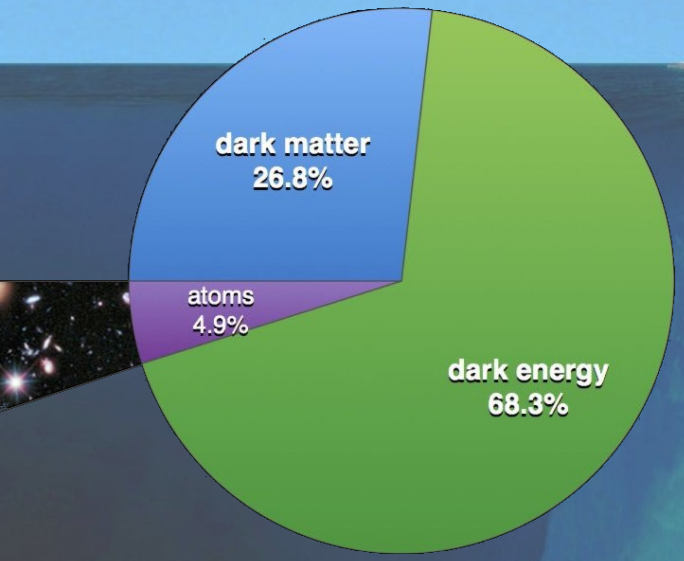
- Postdocs: Patrick Tunney (collider searches for dark matter)
- PhD students: Patrick Stoecker (cosmological constraints)
  Fatih Ertas (loop effects for dark matter)
  Saniya Heeba (dark matter production mechanisms)
- Master students: Eike Mueller, Stefan Schulte, Einar Urdshals

**For more information:**

http://www.particle-theory.rwth-aachen.de/cms/Particle-Theory/Forschung/~qcyo/Arbeitsgruppe-Prof-Kahlhoefer/

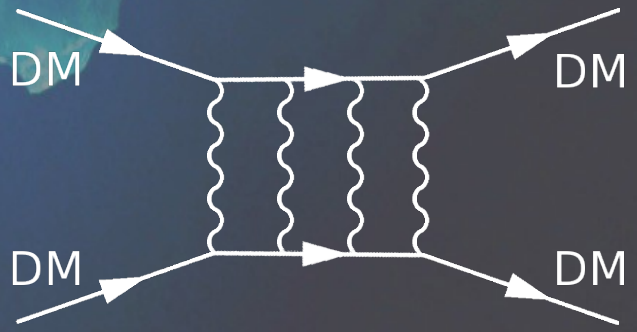
https://web.physik.rwth-aachen.de/user/kahlhoefer/

# Dark matter with long-range interactions

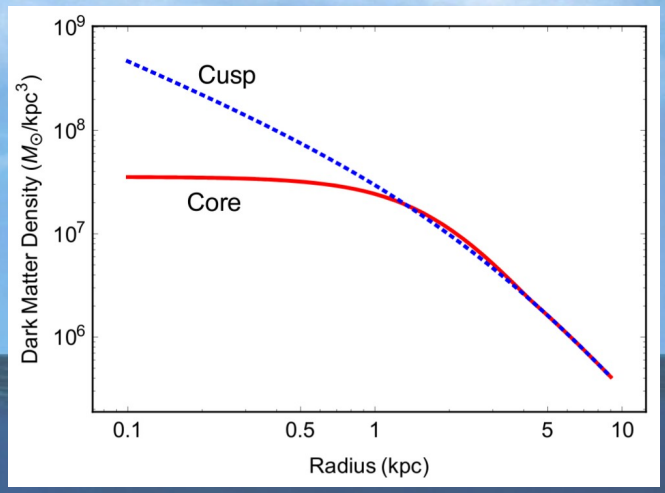



- **What we know:** dark matter exists and constitutes the dominant form of matter in the Universe
- **What we don't know:** any of its properties
- **Usual assumption:** dark matter is cold and collisionless

- **Interesting alternative:** dark matter with long-range interactions → Rutherford scattering
  - What are the implications?
  - How is cosmology/astrophysics affected?
  - What are the signals in laboratory experiments?



# T1: Astrophysical constraints




**Goals**

- Become familiar with the observational evidence for dark matter self-interactions
- Calculate the momentum transfer cross section for a model of self-interacting dark matter
- Use most recent measurements to constrain the model and determine underlying parameters

**Skills**

- How to interpret astrophysical data in terms of particle physics
- How to calculate cross sections for scattering processes
- How to fit a model to data and determine confidence regions

**Requirements**

- General interest in particle physics and analytical methods
- Basic understanding of statistics and data analysis can be learned during the project

# T2: Laboratory constraints

**Goals**

- Become familiar with experimental strategies for the detection of dark matter
- Implement a new model of dark matter interactions into the public code DDCalc
- Study the phenomenology of the model and predict signals in upcoming experiments

**Skills**

- How to calculate event rates in dark matter experiments
- How to use numerical tools for signal predictions
- How to obtain exclusion limits and sensitivity estimates

**Requirements**

- Basic programming skills (Fortran/C++/python)
- Basic understanding of dark matter physics can be learned during the project