EXPLORE 2021 Workshop: Astrophysical Laboratories of Dark Matter



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EXPLORE project: "Probing Dark Matter with Gravitational Waves" (Dark Matter Team)

Thursday 26 August 2021 16:00 (55 minutes)

- Chair: Y. Fabian Bautista
- Co-Chair: Nassim Bozorgnia

Mentors: Laura Sagunski, Saeed Rastgoo Junior mentors: Niklas Becker, Julia Lienert

Supermassive black holes at the centers of galaxies are surrounded by gigantic dark matter halos. Near these black holes, the dark matter density is extremely high and forms a so-called dark matter density spike. Due to its extremely high density, the dark matter density spike creates a violent environment around the black hole. If the black hole then merges with a smaller companion object, the presence of the dark matter density spike will drastically affect the binary merger dynamics. In particular, it will leave an imprint on the emitted gravitational wave signal. If we detect such a signal, we can thus probe the nature of dark matter with gravitational waves!

Main tasks: 1. Model the profile of the dark matter density spike around the black hole for different dark matter models (cold dark matter, self-interacting dark matter) in Newtonian gravity and then include relativistic effects.

2. Model the merger dynamics and the gravitational wave signal including post-Newtonian and further relativistic effects and then in a fully general relativistic formulation.

3. Compute the gravitational wave signal for different dark matter models, check its detectability with current and future gravitational wave detectors (LIGO, LISA) and constrain the particle nature of dark matter with gravitational waves.

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