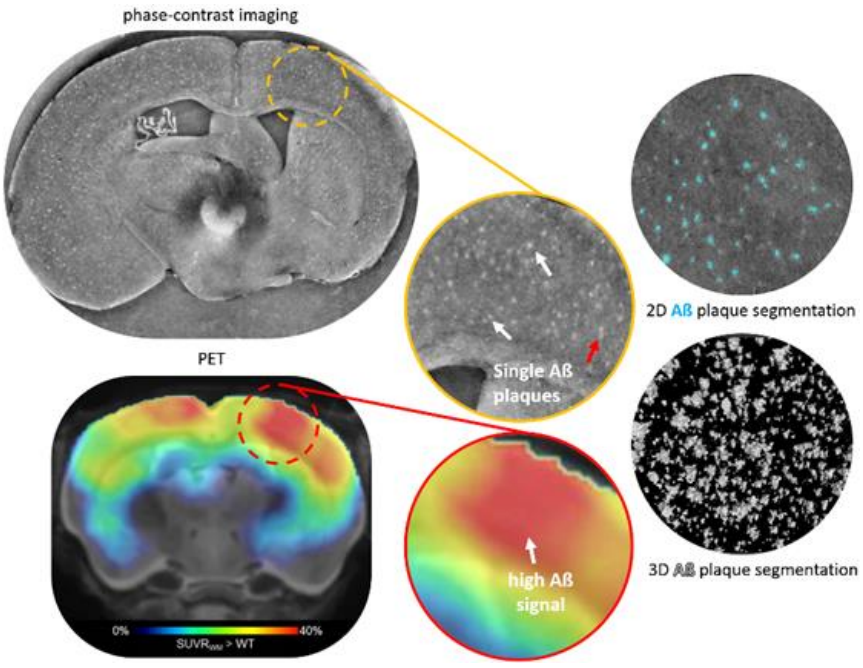
MASTER THESIS PROJEC in the Prof. COAN's GROUP - Brilliant X-Rays for Medical Diagnostics

Our group at the LMU Chair of Medical Physics in Garching (LS Parodi) is working on biomedical applications of X-ray phase contrast CT, and is looking for a highly motivated **MASTER STUDENT** to work with us.

Project Title: "Establish quantitative relationships between the Aß plaque burden signal detected via X-ray phase-contrast CT, PET, MRI and immunohistopathology in a mouse model of AD"

Scientific Case: Alzheimer's disease (AD) is a chronic neurodegenerative disorder that represents the leading cause of dementia. AD is characterized by the formation of amyloid-ß (Aß) plaques in the brain, which are considered the underlying cause of disease. For decades, the only way to detect Aß plaques was invasive ex-vivo immunohistopathology (IHC). At present, the only available non-invasive in-vivo imaging method, positron emission tomography (PET), relies on Aß-binding tracers and identifies patients in early disease stages. Hence, PET is extensively used in clinical trials to monitor treatment effects. The morphologic detection of Aß plaque burden, however, still relies on ex-vivo IHC. Previous studies demonstrated that the specific plaque frequency and topographic distribution in the brain is linked to the symptoms of AD. Aside from distribution, plaque size has been shown to be heterogeneous but its clinical significance has not been established. Regarding PET imaging, it is unclear whether the tracer signal depends on plaque distribution, frequency or size.

X-ray Phase-Contrast CT experiments: Phase-contrast imaging computed tomography (PCI-CT) is suited for ex-vivo brain studies of murine and human samples. The main advantages compared to IHC are complete spatial coverage and non-destructive analysis of the brain. Recently, high resolution PCI-CT has also been established as an accurate method for the non-invasive ex-vivo detection and analysis of Aß plaques. In a unique collaboration of medical physicists, AD researchers, radiologists, and nuclear medicine physicians, our group has access to preclinical AD mouse models and long-standing expertise in PET image analysis.



A preliminary X-ray phase-contrast micro-CT experiment (see Figure) showed the possibility to successfully visualize single Aß plaques at high-resolution and to characterize the morphology of Aß plaque burden, enabling a quantitative analysis of plaque distribution, frequency and size, and dataset comparison to PET and MRI.

Overall Project Objectives: In this project, our group wants to further establish the technique of PCI-CT as a tool to accurately evaluate plaque distribution, frequency and size quantification, as well as perform an inter-modality comparison with *in-vivo* PET (Figure 1) and *ex-vivo* MRI and IHC. Thereby, we will establish PCI-CT as a novel non-destructive method for improved monitoring of Aß plaque burden for preclinical models of AD treatment.

Specific Thesis Work Objectives: You will perform an in-depth analysis of the interrelationships of multiparametric PCI-CT information on Aß plaque burden with in-vivo amyloid PET imaging, and ex-vivo MRI and histopathology. You will learn to reconstruct and explore the acquired phase-contrast CT datasets and extract meaningful structural parameters (e.g. plaque distribution, frequency and size), as well as full-sample volumetric renderings of Aß plaque burden. You will also learn to relate PCI-CT data to MRI and PET data. Finally, you will learn to critically evaluate your analytic methods, and explore new ways to use imaging datasets creatively. Your quantitative analysis work on the morphology of Aß plaque burden will play a central role within this project, and will be instrumental to the successful publication of our results.

Candidate: Previous knowledge in Phython and/or Matlab is an asset, and the candidate should be interested in developing new analysis tools for image quantification.

Travel: The candidate will be given the opportunity to travel to the European Synchrotron in Grenoble, FRANCE to **participate in upcoming experiments of our group**.

Start date: May 2018 onwards

Please get in contact with us if you are interested in knowing more - we would be happy to hear from you!

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