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Dept. Biomedical Sciences

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# Non-invasive, in-vivo brain research
# Magnetic Resonance Imaging in Small Animals

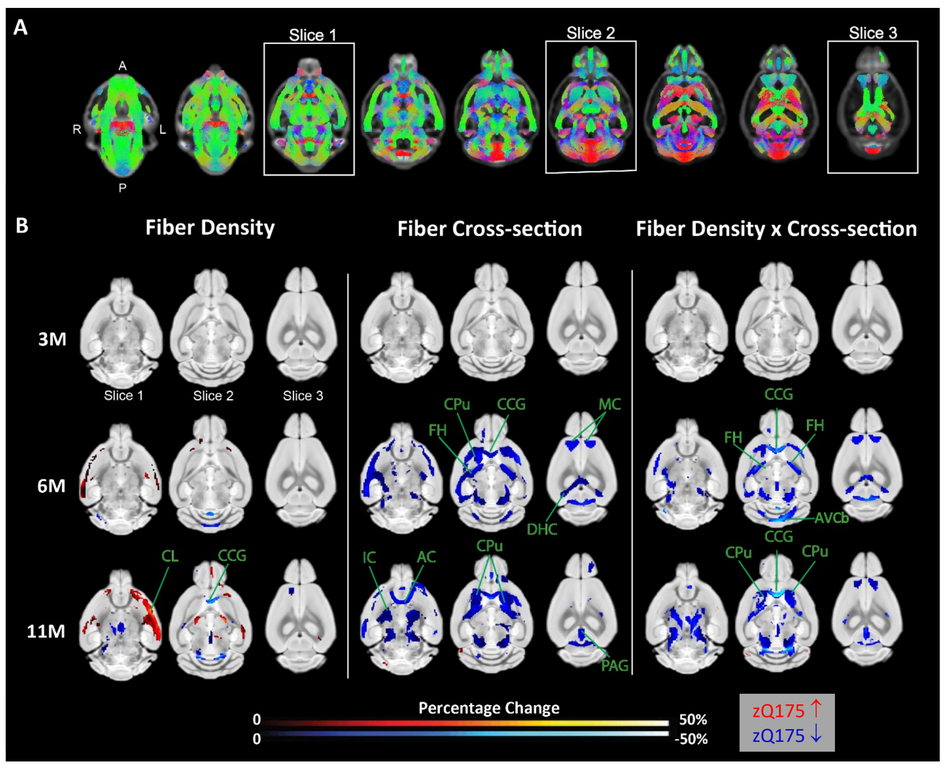
**Searching for translational/early non-invasive MRI markers to monitor and predict the progress of neurological diseases and therapies**

## Huntington's disease (HD)

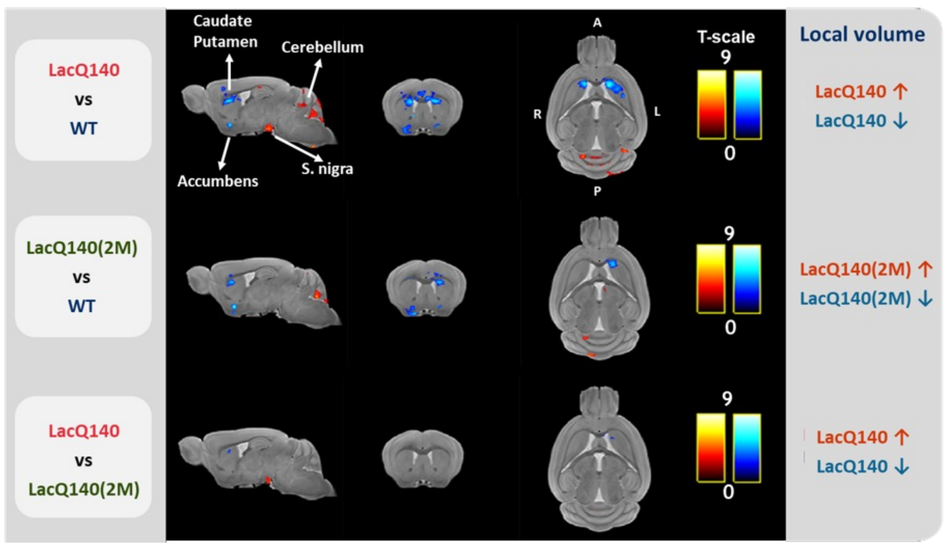
***Post-doc:***
*Mohit Adhikari;*
***PhD students:***
*Nicholas Vidas-Guscic,*
*Joëlle Van Rijswijk*
*Marion Decrop*

Different MRI-derived parameters have shown to be relevant **Biomarkers** in mouse models for **HD**. Current studies aim to test their sensitivity in **evaluating treatment effects in HD animal models.**

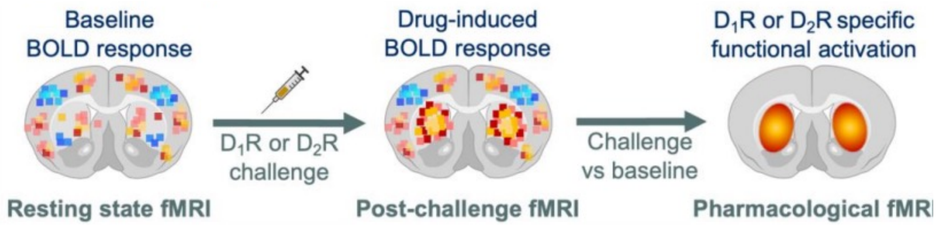
The generation of **Tractograms** allows the visualization of **structural connectivity. Fixel Based Analysis on diffusion MRI data** can be used to evaluate **structural integrity** on a voxel-based level. The different metrics (Fiber Density; Fiber cross-section) can be compared at different states of pathology progression in the same animal over time.

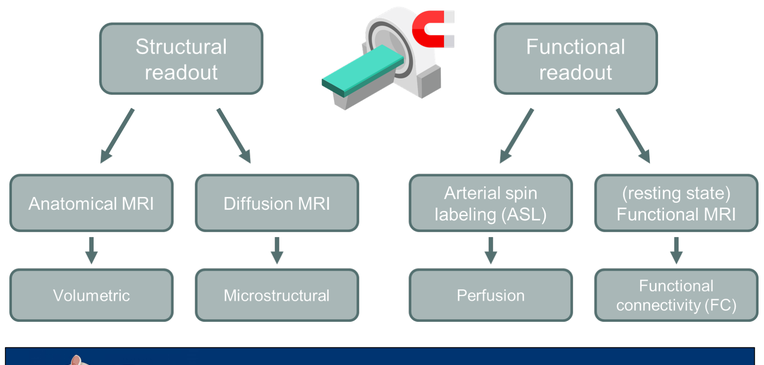



Using high resolution anatomical scans, detailed **volumetric analysis** can be performed for regions expected to change. In addition, data-driven **Tensor Based Morphometry** compares **local changes in relative volume** due to pathology progression. Both can be used to evaluate **treatment** effects.

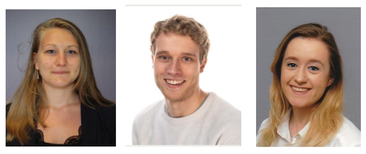



HD is characterized by selective neurodegeneration of medium-size spiny neurons in the basal ganglia. We use a **multidisciplinary approach** to study the integrity of the direct and indirect pathways in basal ganglia.
For this project, we perform **pharmacological MRI** (phMRI) studies to investigate the **pharmacological response** of both the direct and indirect pathways of the dopamine system in animal models of HD. To improve understanding of the neuronal and molecular substrates of the observed deficits, the imaging is complemented by electrophysiology (in collaboration with ENU)



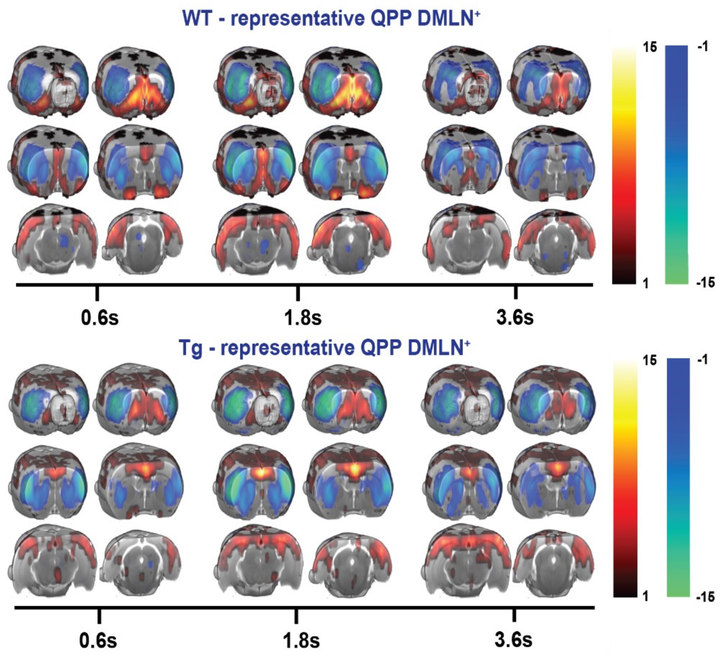




## Alzheimer's disease (AD)

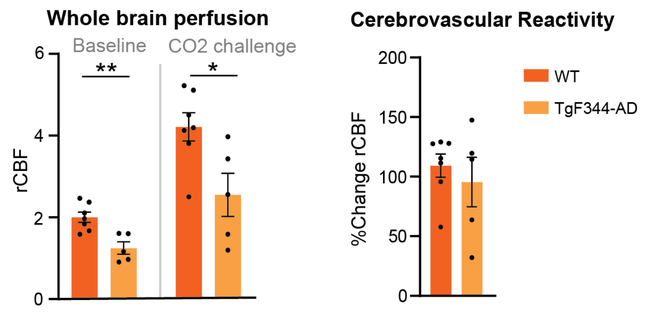


***Post-doc:***
*Monica van den Berg,*
***PhD students:***
*Sam De Waegenaere,*
*Judith Van Rooij*

**Functional imaging** detects **early changes in synaptic and network functioning** in **AD**. **Whole-brain activity patterns** are altered in transgenic (TG), compared to wildtype (WT) animals.




Dynamical acquisition of **Cerebral Blood Flow (CBF)** using Arterial Spin Labeling (pCASL) MRI allows to measure differences in CBF in different condition (baseline vs 10% CO2-challenge) and the **Cerebrovascular Reactivity (CVR)**.




In a next stage, these methods are used **to evaluate Caloric restriction** as a therapy to alleviate both **memory** and **neurovascular deficits.**

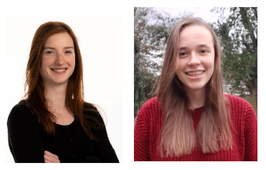
## Multiple Sclerosis (MS)

***PhD student:***
*Leonardo Ricciardi*

MRI in a mouse model for **MS** to **study neuro-inflammation** and **de- and remyelination**, and the effectiveness of **anti-inflammatory neuroprotective drugs.** Visualisation and quantification of changes in T2 relaxation time.

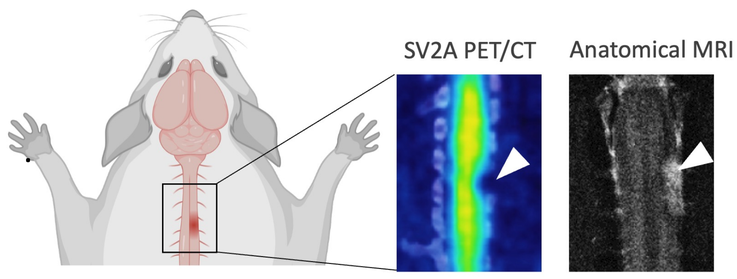

**T2-weighted images** at the level of the Corpus Callosum of a Control mouse (A), Cuprizone mouse showing demyelination/inflammation (B), Cuprizone mouse with neuroprotective treatment (C). (white arrow is injection spot of vehicle (A,B) or drug (C).

## Spinal Cord injury (SCI)



***PhD students:***
*Claudia Schrauwen,*
*Lori Berckmans*

Positron emission tomography (PET) imaging targeting **synaptic vesicle glycoprotein 2A** (SV2A), a pre-synaptic protein regulating neurotransmitter release, is a powerful tool to quantify **synaptic density** (performed @MICA).




**Rat model of unilateral C5 cervical SCI**

**Diffusion-weighted imaging** (dMRI) and myelin water fraction (MWF) can be used to assess **axonal** and **myelin integrity** occurring with SCI.

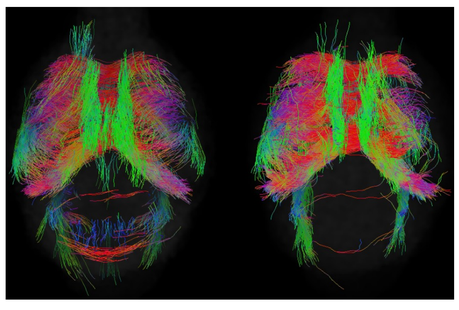
**Functional MRI** (fMRI) is used to study how SCI **affects brain activity and functional connectivity.**

Comprehensive **behavioural assessment** to study functional recovery following SCI in relation to imaging biomarkers.

## Technical Team

Beyond anatomical MRI…Develop new MRI methods & Implement state of the art MRI methods

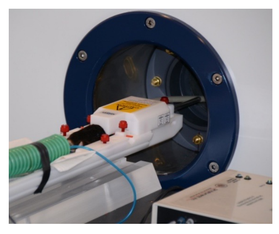
*Johan van Audekerke (Engineer),*
*Ignace Van Spilbeeck*



Original (left) and 3x accelerated (right) **tractography** from mouse brain, using **Compressed Sensing** and **HARDI**

## Infrastructure





**Equipment:**
- two 7 T and a 9.4 T MRI systems
- 4.7 T Benchtop MRI system
- *In vivo* bioluminescence
- Fluorescence camera

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