**PhD program for which it is intended:** Molecular Medicine, Neuroscience and Experimental Neurology

**Title of the project:** Functional and structural connectivity-based parcellation of gray matter structures in multiple sclerosis: towards an improved understanding of disease clinical manifestations.

Gray matter (GM) pathology in multiple sclerosis (MS) has been recognized as a crucial component of the disease. However, the exact mechanisms that contribute to cortical, deep GM and cerebellar abnormalities, as well as their relationship with motor and cognitive impairment in these patients remain partially unclear.

Using advanced magnetic resonance imaging (MRI) techniques and novel post-processing methods, this project aims at building multiparametric models that integrate different measures of regional cortical thinning and of regional basal ganglia and cerebellar structural abnormalities, combined with measures of static and dynamic functional connectivity. Such multiparametric models would allow to investigate the relative contribution of these central nervous system compartments to the presence and severity of motor and cognitive impairment in MS patients.

Specific areas of the present research will be:

- to assess regional cortical GM atrophy (frontal, sensorimotor, posterior parietal, temporal, occipital, insular cortices), using cortical thickness analysis in a large group of MS patients, assessed with a standardized imaging, clinical and neuropsychological protocol;
- to measure baseline deep GM atrophy in the previous cohort, using an atlas-based analysis;
- to perform structural-based parcellation of deep GM-structures based on their profile of structural connectivity with cortical areas, using cortical parcellation, deep GM atlases, and a Diffusion Tensor Imaging (DTI) based analysis;
- to use the previously obtained basal ganglia (BG) parcellation to identify functional connectivity abnormalities of specific BG sub-regions, which may be more closely related to specific deficits in patients with MS;
- to apply the previous methods to analyze the contribution of cerebellar structural and functional abnormalities to MS clinical manifestations;
- to characterize changes over time of structural and functional MRI variables in patients with MS and their correlations with worsening of disability and cognitive deficits.

**Key references**


**Link:**
http://www.hsr.it/research/organization/divisions-centers/division-of-neuroscience/massimo-filippi/
http://www.unisr.it/k-teacher/filippi-massimo/