**Master 2 internship project**

**Year 2024-2025**

**Laboratory/Institute:** IAB **Director:** Pierre Hainaut

**Team:** Biomechanics of Host-Parasite Interaction **Head of the team:** Isabelle Tardieux

**Name and status of the scientist in charge of the project:** Isabelle Tardieux

 **HDR: yes ☐ no ☐**

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**Program of the Master’s degree in Biology:**

**☐** Microbiology, Infectious Diseases and Immunology **☐** Structural Biology of Pathogens

**☐** Physiology, Epigenetics, Differentiation, Cancer **☐** Neurosciences and Neurobiology

**Title of the project:**

**Deciphering the invasive nanodevice of the human parasite *Toxoplasma gondii***

Objectives (up to 3 lines):

Primary objectives are to (i) delve deeper into the architecture and function of the unique invasive nanodevice used by the *Toxoplasma* parasite as a force transmission platform during invasion, and to (ii) molecularly and mechanically dissect the host cell cortical cytoskeleton dynamics triggered by the invasive nanodevice properties.

Abstract (up to 10 lines):

Apicomplexans form a large phylum of unicellular eukaryotic microbes, some of which cause severe diseases in humans. Most successful is *Toxoplasma*, which parasitizes and persists in nearly a third of the human population, making it at risk of life-threatening complications in particular upon transient or sustained immune-suppression. This parasite is a highly polarized cell that has evolved an impressive invasive strategy to proliferate in any nucleated cells it will eventually kills, thereby destroying many tissues*.* The “Tardieux”’ team uses multi-disciplinary approaches that combine cell biology, biochemistry, nano-chemistry, biophysics, and a set of live and stating imaging to interrogate how the several micron’s size parasite manages to enter a target cell in only a few seconds, so much faster than bacteria or viruses, and without causing damages to the host cell plasma membrane. This work should allow substantial gain of basic knowledge in cell biology and offer perspective for bio-engineering applications, primarily related to drug delivery strategies.

Methods (up to 3 lines):

Human cell and parasite cultures (2D and 2D models). Human and parasite live imaging (imaging facilities in the lab) to monitor cell invasion, Static expansion microscopy- Image analysis (including deep learning, 3D reconstruction, object tracking …)

Up to 3 relevant publications of the team:

- Luis Vigetti\*, Bastien Touquet\*, Delphine Debarre, Thierry Rose, Lionel Bureau, Dima Abdallah,Galina V. Dubacheva, Isabelle Tardieux. (2024). Uncovering the simple adhesive strategy of the Toxoplasma parasite for high-speed motility. Nature Microbiology (*in revision*).

- Pavlou G, Touquet B, Vigetti L, Renesto P, Bougdour A, Debarre D, Balland M, Tardieux I. (2020) [Coupling Polar Adhesion with Traction, Spring, and Torque Forces Allows High-Speed Helical Migration of the Protozoan Parasite Toxoplasma.](https://pubmed.ncbi.nlm.nih.gov/32432851/) *ACS Nano.* Jun 23;14(6):7121-7139. doi: 10.1021/acsnano.0c01893. Epub 2020 Jun 1

- Pavlou G, Biesaga M, Touquet B, Lagal V, Balland M, Dufour A, Hakimi M-A & Tardieux I (**2018**) Toxoplasma Parasite Twisting Motion Mechanically Induces Host Cell Membrane Fission to Complete Invasion within a Protective Vacuole. Cell Host Microbe **24:** 81-96.e5.

Requested domains of expertise (up to 5 keywords):

We are seeking for a highly motivated candidate with true interest and possibly training in **cell biology**, **live and static** **cell imaging**, **3D cell culture**, **micro-fluidics**, as well as knowledge in **basic biochemistry**