SCIENCES & BIOENGINEERING SCIENCES

The Research Groups
Structural Biology Brussels and NanoMicrobiology

have the honor to invite you to the public defence of the PhD thesis of

Vjera Radoničić

to obtain the degree of Doctor of Bioengineering Sciences

Joint PhD with Universiteit Gent

Title of the PhD thesis:

Optical nanomotion detection as a universal method for assessing life from rapid antimicrobial susceptibility testing to the search for extraterrestrial life

Supervisors:
Prof. dr. ir. Ronnie Willaert (VUB)
Prof. dr. Bart Devreese (UGent)

The defence will take place on

Monday, February 16, 2026 at 4 p.m. in Promotiezaal D.2.01, VUB campus Etterbeek

Members of the jury

Prof. dr. Joris Messens (VUB, chair)
Prof. dr. ir. Wim De Malsche (VUB)
Dr. Stefania Torino (VUB)
Prof. dr. Petra Van Damme (UGent)
Prof. dr. Kris Audenaert (UGent)
PD dr. MD Sandor Kasas (University of Lausanne, CH)
Prof. dr. rer. nat. Jürgen Wendland (Hochschule Geisenheim University, DE)

Curriculum vitae

In 2021, Vjera Radoničić obtained her Master's degree in Biophysics from the Faculty of Biology at the University of Belgrade and started a joint PhD between the VUB and UGhent. Her research focuses on Optical Nanomotion Detection (ONMD) as a method to assess microbial vitality, with applications in AST and astrobiology. She was awarded a Frank de Winne FWO Fellowship in 2021. She is the first author of three peer-reviewed publications, with an additional first-author manuscript under revision, and has presented her work at several international conferences, with one award for the best poster presentation. She supervised two Master's students.

Abstract of the PhD research

Life, whether studied in distant worlds as extraterrestrial life or in the context of infections on Earth, expresses itself through nanoscale motion driven by internal cellular activity. This thesis explores Optical Nanomotion Detection (ONMD), a label-free approach for identifying living microorganisms by measuring nanoscale mechanical fluctuations that diminish when cellular activity ceases. Using standard optical microscopy, ONMD enables real-time assessment of microbial vitality without dyes, chemical markers, or reliance on growth-based readouts.

The work establishes ONMD as a robust, label-free, and growth-independent method for monitoring cellular vitality at the single-cell level across diverse microbial systems. A custom microfluidic chip was developed to confine individual cells in microwells, enabling stable long-term observation under controlled environmental conditions. ONMD was first optimised and validated using yeast models, including *Saccharomyces cerevisiae* and *Candida albicans*, where it rapidly resolved cellular responses to antifungal treatment, distinguished fungistatic and fungicidal effects, and detected declines in vitality during prolonged cold storage of industrial brewing yeast. Next, ONMD was extended to bacterial pathogens associated with urinary tract infections, where early changes in cellular activity enabled rapid discrimination between antibiotic-susceptible and resistant strains using a compact optical prototype. Finally, ONMD was applied to extremophilic microorganisms exposed to harsh conditions such as radiation, salinity, alkalinity, cold, and desiccation, demonstrating its potential as an indicator of vitality relevant to astrobiology and future life-detection strategies.

Finally, ONMD was applied to microorganisms adapted to extreme environments, including high radiation, salinity, alkalinity, and low temperatures. These experiments demonstrated that nanomotion-based detection remains effective under conditions relevant to astrobiology. Overall, this work shows that ONMD provides a unifying framework across biomedical diagnostics and space science, based on the principle that life can be detected through its physical activity as well as its chemical composition.