

POSTDOCTORAL POSITION (3 YEARS): AI-DRIVEN ENHANCEMENTS TO POLYGENIC RISK SCORES – INTEGRATING PATHWAY ANALYSIS & NON-LINEAR EFFECTS FOR PRECISION MEDICINE

AREA: LIFE SCIENCES AND MEDICINE

START DATE: BEFORE 01/01/2026

DEADLINE: POSTION REMAINS OPEN UNTIL FILLED

Located in the French-speaking part of Belgium, the University of Liège welcomes nearly 27,000 students of 123 different nationalities in a dynamic, multicultural city less than an hour away from Brussels and Cologne, two hours from Paris and three hours from London and Amsterdam. ULiège is spread across 4 campuses and boasts over 5,700 staff members, including 3,600 teachers and researchers active in all areas of the humanities and social sciences, science and technology, and health sciences.

As a key player in social change and environmental awareness, ULiège promotes ethical, transdisciplinary and open science. It contributes to the socio-economic development of its region through numerous partnerships with several institutions, including the university hospital (CHU). Given its international orientation, the University participates [in the European University of Post-Industrial Cities \(UNIC\)](#) initiative and has one of the most extensive collaborative networks in the world.

ULiège offers attractive career prospects [in a high-quality working environment](#) where well-being, diversity and equality of opportunity are promoted. Since 2011, ULiège has been proud to display the European [Human resources strategy for researchers \(HRS4R\)](#) label, which reflects its commitment to open, transparent and merit-based procedures. In addition, it upholds quality and diversity in line with the recommendations of the [Coalition for Advancing Research Assessment \(CoARA\)](#). ULiège encourages its academic staff to travel internationally and welcomes international researchers through its EURAXESS center.

ABOUT THE RESEARCH PROJECT

Derived from comprehensive genome-wide association studies (GWASs), polygenic risk scores (PRSs) distill complex genetic data into a single numeric value, holding the potential to revolutionize diagnostics and treatment strategies. While PRSs have demonstrated promise, much remains to be explored. This project aims to refine the discriminative power of PRSs across diverse populations, map lifetime risk trajectories, and uncover nuanced substructures within patient groups.

By integrating disease-specific molecular networks with large-scale epistasis screening, we are pioneering the development of expanded pathway-PRSs—composite scores that leverage multidimensional genetic interactions. These innovative models will undergo rigorous optimization to enhance predictive accuracy and refine disease subtyping. Beyond advancing PRS technology, this project provides invaluable insights into the utility of pathway-oriented epistasis screening and the complex genetic interplay underpinning disease.

Expected Impact:

Machine learning and AI-driven approaches are reshaping how we analyze genetic risk, offering new ways to refine disease stratification and enhance predictive modeling. Despite significant advances in Polygenic Risk Scoring, there remains a need to integrate functional insights that connect genetic variations to disease mechanisms. By incorporating pathway-based methodologies and AI-enhanced analysis, this project aims to improve the interpretability of genetic risk scores and uncover hidden structures within patient populations.

For Alzheimer's disease and inflammatory bowel disease (IBD), this refined stratification can be transformative. In Alzheimer's, a deeper understanding of genetic interactions may illuminate disease subtypes, leading to tailored intervention strategies. In IBD, integrating functional genomics with PRS can enhance our ability to predict disease progression and treatment response. A biologically informed risk model allows us to bridge the gap between genetic susceptibility and molecular function, ultimately driving precision medicine forward.

Why join us?

This position offers a unique opportunity to excel as an interdisciplinary scientist in Big Data precision medicine. You will work in an international environment alongside leading research teams worldwide, with access to exceptional datasets and collaborative networks:

- **Unparalleled data access:** Work with one of the largest IBD genomic and functional datasets globally.
- **Alzheimer's disease research:** Access one of Europe's most significant Alzheimer's disease databases.
- **Innovative risk modeling:** Develop functionally driven models to identify meaningful patient subtypes.
- **Redefining pathways:** Shape novel approaches in pathway-based analysis with maximum translational scope.
- **Gut-brain axis integration:** Bridge findings from IBD and Alzheimer's disease research to explore gut-brain interactions.

This work will be conducted in close collaboration with two esteemed international research consortia: the **International IBD Genetics Consortium (IIBDGC)** and the **European Alzheimer's Disease DNA Biobank Consortium (EADB)**.

If you are passionate about pushing the boundaries of precision medicine and working in a dynamic, globally connected research environment, we encourage you to apply and be part of this transformative journey.

JOB DESCRIPTION

Join us on the frontier of genomic medicine as we unlock new possibilities for precision healthcare through the following research objectives:

[I] Disease-biology informed interaction studies on AD/CD

- Increase our understanding of disease mechanisms by identifying gene-gene interactions.
- Implement pathway-driven genomic interaction studies while efficiently handling major genetic effects (e.g., APOE/HLA).
- Reduce multiple testing burdens while enhancing interpretability and translational potential of findings.

[II] Novel pathway-oriented PRS workflow

- Bridge the gap between genomewide PRS for disease risk and variant-driven PRS testing.
- Integrate GWAS results with meta-analyses of high-throughput gene expression studies and disease-specific networks.
- Compare pathway-PRS models with hypothesis-free testing using thousands of curated gene sets.

[III] A groundbreaking protocol for pathway-PRS integration

- Expand PRS models by incorporating interaction-based PRS ("2D PRS") alongside traditional SNP-based PRS ("1D PRS").
- Transition from simulations to real-world applications.
- Formally assess the relative contributions of 1D and higher-order PRS to disease risk.

SPECIFIC DUTIES AND ACTIVITIES

To achieve the specific activities related to the abovementioned goals, we seek individuals passionate about driving scientific innovation to join our team. As a member of BIO3, you will have the opportunity to collaborate with leading researchers, contribute to groundbreaking discoveries, and make a tangible impact on human health research and education. Whether you're a seasoned expert or a rising star in the field, we welcome scientists with a PhD degree and a multidisciplinary track record who share our vision and are eager to push the boundaries of scientific knowledge with ground-breaking research.

PROFILE

► REQUIRED SKILLS & QUALIFICATIONS

Professional expertise

- PhD (or equivalent experience) in **machine learning, statistical genetics, bioinformatics, molecular & computational biology, or biotechnology.**
- Experience in **statistical modeling of large-scale genomic datasets**, particularly those from international consortiums on complex or rare diseases.
- Proficiency in **machine learning and AI techniques** applied to genetic risk modeling and data integration.

Technical skills

- Advanced proficiency in **R/Bioconductor** and scripting/programming languages such as **Python and Bash.**
- Experience working in **Linux environments and high-performance computing clusters.**
- Familiarity with **electronic notebooks** (e.g., Jupyter Notebook, JupyterLab) for reproducible research. Experience with **containerization (e.g., Docker)** for scalable and reproducible data analysis.
- Hands-on experience with **Big Omics Data**, including **DNA and RNA datasets**, and developing tailored algorithms for large-scale data analysis in precision medicine.

Human & soft skills

- Highly motivated, creative, and committed to **excellence in interdisciplinary research.**
- Ability to work both **autonomously and collaboratively** in a diverse, international team environment.
- Strong **team player with excellent communication skills**, bridging the fields of **biostatistics, bioinformatics, and biomedicine.**

Language skills

- **Exceptional proficiency in English** (both written and spoken) for scientific communication, presentations, and collaboration in an international research setting.

► PREFERRED SKILLS

Technical skills

- **Understanding of TinyML fundamentals** and their applications in edge computing.

Contextual data applicative skills

- Familiarity with **pathway-based analysis and network biology** to refine disease stratification.

Soft skills

- Strong **organizational and project management skills** to coordinate interdisciplinary research efforts.

TERMS OF EMPLOYMENT

- ▶ **TYPE OF CONTRACT:** Appointment to the post-doctoral position requires that the applicant has a PhD within the position's specifications at the time of employment decision. The doctoral degree should have been obtained no more than 10 years before the start of the position. Post-doctoral researcher. Notably, the candidate should be in a situation of international mobility: he/she should not have worked or lived in Belgium for more than 24 months during the three years preceding his/her start date.
- ▶ **WORK SCHEDULE :** full-time ; 38 hrs/week
- ▶ **CONTRACT DURATION :** 1 year, extendable (max 3 years in total)
- ▶ **EXPECTED START DATE :** before 01 January 2026
- ▶ **WORK PLACE:** GIGA, Belgium

OUR OFFER

With your career path and personal details, ULiège Human Resources Department can assess the gross monthly salary. Employment benefits such as reimbursement of public transportation fees and access to a [variety of training](#) opportunities are also included.

WORK ENVIRONMENT: BIO3 (<http://bio3.giga.ulg.ac.be/>) is a dynamic small to medium-sized research team at the forefront of precision medicine, nestled within the GIGA Biomedical Research Center at the University of Liège. GIGA is an interdisciplinary powerhouse with a mission to drive medical innovation. With over 500 members, including principal investigators, senior researchers, post-doctoral scientists, and technicians, GIGA boasts expertise spanning medical genomics, in-silico medicine, neuroscience, oncology, infection and immunity, and cardiovascular sciences. **At BIO3, we are committed to empowering biomedical researchers by providing expert data analysis, designing innovative statistical and bioinformatics methods, and optimising algorithms.** We thrive at the interface of systems medicine and translational science, continually pushing the boundaries of what's possible.

HOW TO APPLY?

If you are ready to embark on an exciting journey at the forefront of translational precision medicine, we invite you to apply for this position.

Please submit a complete application as **1 PDF attachment** to rh.giga@uliege.be with kristel.vansteen@uliege.be in cc, using the subject title "BIO3.PRS Job Offer".

Your application should include:

1. **Your CV**
2. **Contact details of at least two referees** relevant to the job description
3. **A motivation letter** (maximum **2 pages**) explaining:
 - Which **publications from the lab** interest you the most and why
 - Your **passion for joining BIO3**, both in general and specifically for this project

This will help us understand your research interests and how they align with our work.

SELECTION PROCEDURE

- ▶ **EVALUATION TIMELINE:** Submitted dossiers will be assessed for excellence, profile matching, and eligibility; as received.
- ▶ **EVALUATION TEAM:** BIO3 will conduct the evaluation.
- ▶ **INTERVIEW PROCESS:** Shortlisted candidates will be invited for an online video interview (in English). The interview will focus on technical, behavioural, and research-specific questions. The interview date will be arranged by mutual agreement.
- ▶ **SELECTION COMPLETION:** The selection process will conclude once the appropriate candidate has been identified.

Our corporate policy is based on diversity and equal opportunity. We select candidates based on their skills and do not discriminate on grounds of age, sexual orientation, origin, beliefs, disability or nationality.

CONTACT DETAILS

Informal inquiries about the project are welcome. Please feel free to contact Prof Dr Dr K Van Steen by email at kristel.vansteen@uliege.be, **using the subject title "BIO3.PRS Job Offer"**.

Release date: 24/03/2025

Privacy policy

Personal data collected following your application will be processed by application will be processed by the reviewing jury, at the University of Liège for the sole purpose of recruitment.

The data will be processed within the framework of pre-contractual measures (art. 6-1, b. of the General Data Protection Regulation) and kept for up to 9 months after the publication of the vacancy. Your personal data will not be passed on to any third parties.

In accordance with the provisions of the GDPR (EU 2016/679), you may exercise your data protection rights (right of access, rectification, erasure, restriction, and portability) by contacting ULiège Data Protection Officer (dpo@uliege.be - Mr. Data Protection Officer, Bât. B9 Cellule "GDPR", Quartier Village 3, Boulevard de Colonster 2, 4000 Liège, Belgium). You may also lodge a complaint with the Data Protection Authority (<https://www.autoriteprotectiondonnees.be>, contact@apd-gba.be).