# Institut d'Alembert Special Symposium

## Nanopores for biomedical applications
## June 30, 2022 at 9:30 am
## Amphi Simondon 1B36 – Bât. Sud-Ouest

### Permeation of antibiotics through bacterial pores towards new design of drugs

**By Mathias Winterhalter**
Department of Life Sciences & Chemistry,
Jacobs University, Bremen, Germany

**Presentation:**

Our team is interested in characterization of channel forming membrane proteins. For this we produce or engineer bacterial outer membrane proteins and reconstitute them in planar lipid membrane. The experimental requirement require often small volumes, low noise and high stability for which not always standard solution exists. A particular interest is the permeability of antibiotics. How can we detect the passage of small molecules across biological nanopores? I will outline the main experimental approaches to quantify the permeability of small molecules through nanochannel.

**Biography**:

**Mathias Winterhalter** is Professor of Biophysics at Jacobs University Bremen since 2003. He performed his PhD at the Freie Universität Berlin with W. Helfrich in 1988 and obtained his Habilitation at the Biozentrum Basel. From 1998-2003 he was Professor of Biophysics at the Université Toulouse Paul Sabatier (Institut Pharmacologie et Biologie Structurale, CNRS UMR 5089). From 2013-2018 he was Leader of the Managing Entity of ***Translocation,*** a subprogram of the ND4BB - Innovative Medicine Initiative platform devoted to understand and to provide tools with respect to the permeability barrier of the outer cell wall of Gram-negative bacteria.
Together with Prof Yi-Tao Long and Meni Wanunu he organizes a weekly webinar on Nanopore as a service to the Community : https://sites.google.com/view/nanoporemeeting2020/weekly-meeting

**References**

1. Prajapati JD, Kleinekathöfer U, Winterhalter M. How to Enter a Bacterium: Bacterial Porins and the Permeation of Antibiotics. *Chem Rev.* 121(**2021**) 5158-5192.
2. Pangeni S, Prajapati JD, Bafna J, Nilam M, Nau WM, Kleinekathöfer U, Winterhalter M. Large-Peptide Permeation Through a Membrane Channel: Understanding Protamine Translocation Through CymA from Klebsiella Oxytoca*. *Angew Chem Int Ed Engl.* 60 (**2021**):8089-8094.
3. Bafna JA, Sans-Serramitjana E, Acosta-Gutiérrez S, Bodrenko IV, Hörömpöli D, Berscheid A, Brötz-Oesterhelt H, Winterhalter M, Ceccarelli M. Kanamycin Uptake into Escherichia coli Is Facilitated by OmpF and OmpC Porin Channels Located in the Outer Membrane. *ACS Infect Dis.* 6 (**2020**):1855-1865.

# Institut d'Alembert Special Symposium

## Nanopores for biomedical applications
## June 30, 2022 at 10:30 am
## Amphi Simondon 1B36 – Bât. Sud-Ouest

### Single nanopore sensing to investigate protein aggregation and to develop diagnosis tool for proteinopathies

**By Sébastien Balme**
European Institute of Membranes,
University of Montpellier, France

**Presentation :**

Amyloid fibrils are formed by the proteins assembly into highly ordered β-sheet structures. They are involved in several neurodegenerative pathologies including Alzheimer and Parkinson diseases. The mechanism of aggregation at an early stage is still not totally solved due to the lack of method that allows following under continuous measurement amyloid fibril formation and maturation through a shape analysis. To reach this goal, the solid-state, polymer nanopore and nanopipette can be considered as a versatile tool for the detection of protein aggregates because their sizes can be tuned from 2 until hundreds nanometers. The detection of the protein aggregates is based on resistive pulse sensing which consists to record the current perturbation induced by the protein aggregate passage through the nanopore. Depends on the type of aggregate, the nanopore choice has to be relevant in terms of geometry, stability and reusability. Typically, the SiN nanopore with a low aspect ratio is suitable to detect and size small oligomers (nmer). The conical and bullet-like shape track-etched nanopores functionalized with PEG takes advantage from a long lifetime and favorable geometry to trap the protofibrils. Using such nanopore, the different intermediates can be identified during the kinetic amyloid growth or enzymatic degradation. A deep investigation of the current blockade signal provides information on flexibility or auto-fragmentation. To size the amyloid the quartz nanopipettes are more accurate than the track-etched nanopore. In addition, their large ratio surface volume was the key point to the development of Real-Time Fast Amyloid Seeding and Translocation (RT-FAST) for the semi-quantitative detection of preformed amyloid seeds in a sample.

**Biography** :

**Sebastien Balme** is currently associated professor of physical chemistry at the University of Montpellier. He has obtained his PhD in physical chemistry in 2005 at the University of Montpellier 2 on "proteins surface interaction by time-resolved confocal fluorescence spectroscopy". He went then for a postdoc to Geneva University in physical chemistry department to work on "SPME fiber modification for specific detection of phytosterols in complex matrix". Since 2007, he held a permanent position at the University of Montpellier 2.
He is the head of "biomimetic interfaces and nanopores" group" at the European institute of Membranes. His research activities are focused on three main topics (i) transport under confinement and nanofluidic (ii) bio-inspired nanopores and membranes (iii) the interaction between biomacromolecule and nanostructured materials and (iv) the multifunctional protein-based material.

**References**

1. Meyer, N.; Abrao-Nemeir, I.; Janot, J.-M.; Torrent, J.; Lepoitevin, M.; Balme, S. Solid-State and Polymer Nanopores for Protein Sensing: A Review. *Adv. Colloid Interface Sci.* 298 (**2021**): 102561
2. Meyer, N.; Arroyo, N.; Janot, J.-M.; Lepoitevin, M.; Stevenson, A.; Nemeir, I. A.; Perrier, V.; Bougard, D.; Belondrade, M.; Cot, D.; Bentin, J.; Picaud, F.; Torrent, J.; Balme, S. Detection of Amyloid-β Fibrils Using Track-Etched Nanopores: Effect of Geometry and Crowding. *ACS Sensors* 6 (**2021**): 3733–3743
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