Quantum Sensor & Photoinduced Charge Control for Mass Spectrometry

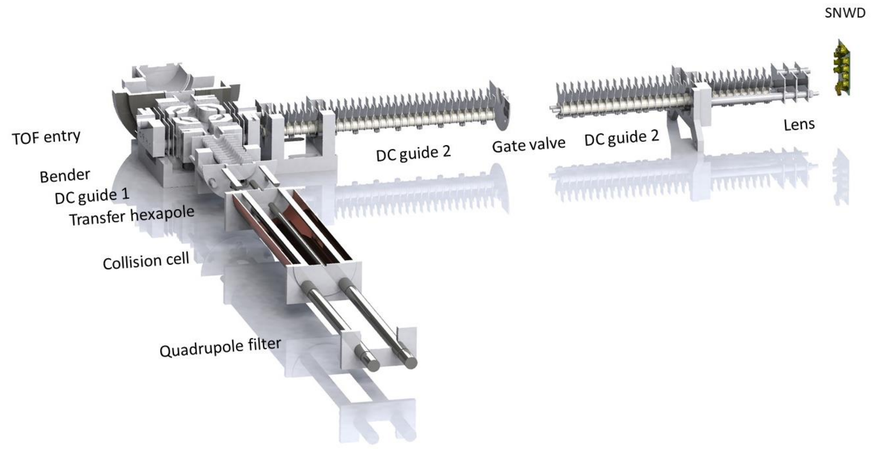
Martin Mauser, Marcel Strauß, Julia Salapa, Pierre Manchet, Philipp Geyer, Armin Shayeghi, Markus Arndt, University of Vienna, Austria
Mario Castaneda, Andreas Fognini, Single Quantum, Delft, The Netherlands
Jad Benserhir, Yatao Peng, Minglo Wu, Claudio Bruschini, Edoardo Charbon EPFL, Neuchâtel, Switzerland
Yong Hua, Valentin Köhler, Marcel Mayor, University of Basel, Switzerland
Steven Daly, Jan Commandeur, MSVISION, Almere, The Netherlands

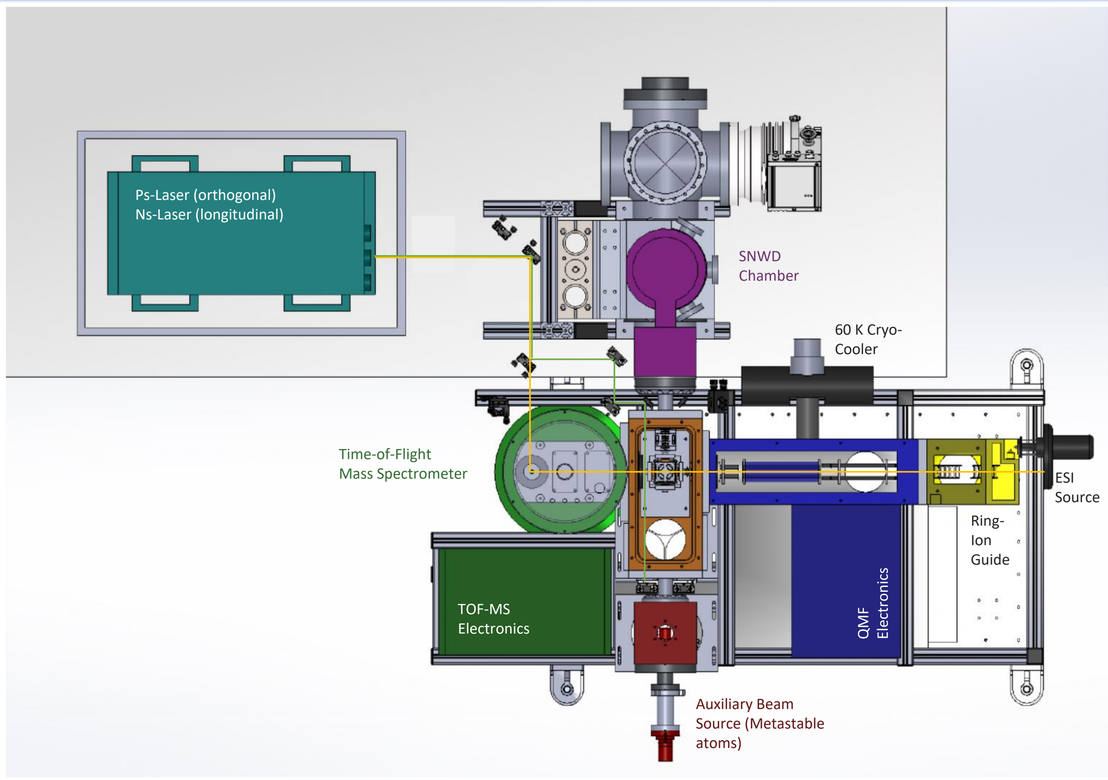
SuperMaMa
FET Open 860713

Implementation of Superconducting Nanowire Detectors in Mass Spectrometry & Molecular Analysis

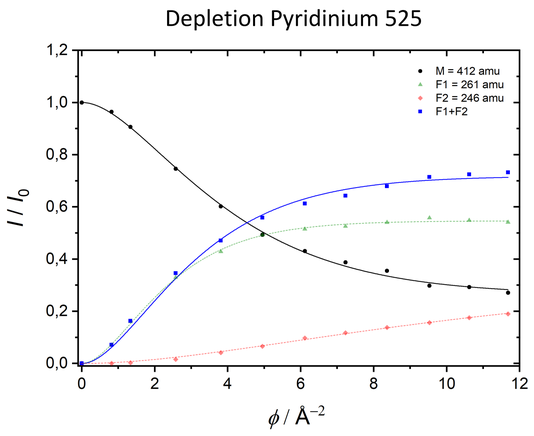
Quantum Tools for Mass Spectrometry and Molecular Analysis

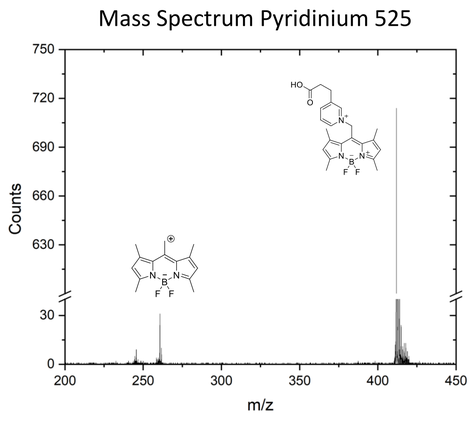
- Superconducting nanowires for **biomolecule detection at low energy**
- Extend the detection range to **neutral and lowly-charged mass-selected molecular beams**
- Neutralize or ionize molecules by **single/few-photon cleavage**
- Superconducting nanowire detectors access the possibility to characterize **internal molecular properties**
- **128-pixel superconducting nanowire camera** with integrated **cryogenic electronics**.

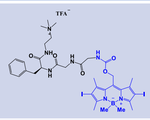
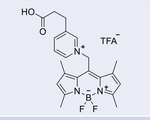
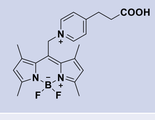
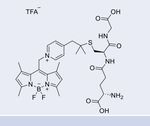
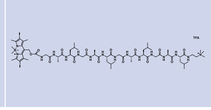




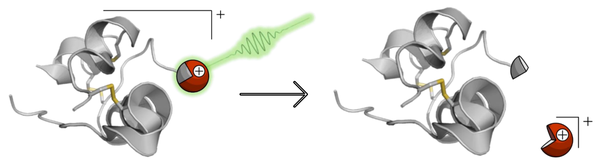
Photoinduced Charge Control in the Gas Phase



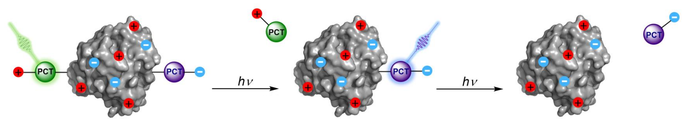


Compound	Structure
20201015	
Pyridinium 525	
20210406	
20211016	
20210128	

➢ **Photoinduced neutralization** of small peptide with **532nm light**

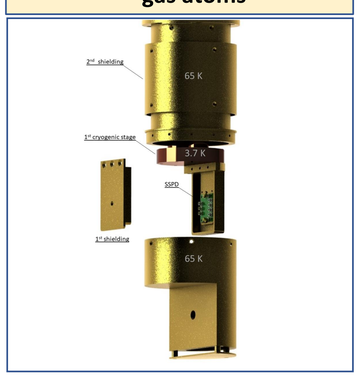


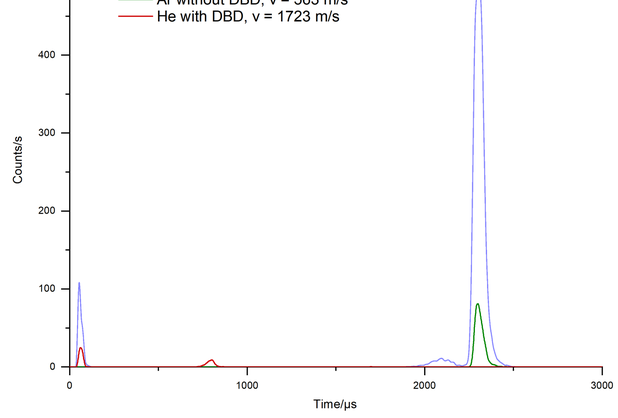
➢ (Near-) Future Goal: in-flight **neutralization** and **reionization** of molecules



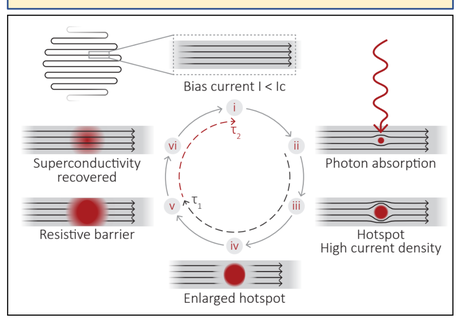
Superconducting Nanowire Detection

➢ Time of Flight measurement of **neutral metastable noble gas atoms**

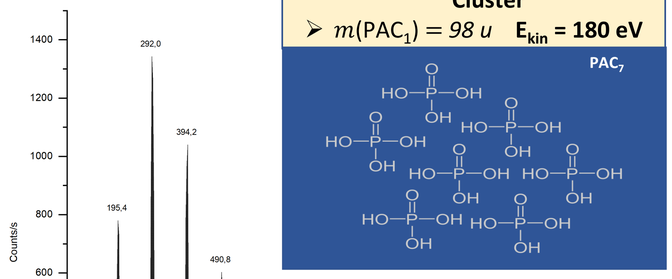




➢ **Hotspot** detection model



➢ Singly charged **Phosphoric Acid Cluster**
➢ $m(\mathrm{PAC}_1) = 98\ u$ $\mathbf{E_{kin}}$ **= 180 eV**



References

1. J. Schätti, M. Kriegleder, M. Debiossac, M. Kerschbaum, P. Geyer, M. Mayor, M. Arndt, and V. Köhler, *Neutralization of insulin by photocleavage under high vacuum,* **Chem. Commun., 55, 12507 (2019).**
2. M Debiossac, J. Schätti, M. Kriegleder, P. Geyer, A. Shayeghi, M. Mayor, M. Arndt, and V. Köhler, *Tailored photocleavable peptides: fragmentation and neutralization pathways in high vacuum,* **Phys. Chem. Chem. Phys. 20, 11412 (2018)**
3. M. Marksteiner, A. Divochiy, M. Sclafani, P. Haslinger, H. Ulbricht, A. Korneev, A. Semenov, G. Gol'tsman, M. Arndt, *A superconducting NbN detector for neutral nanoparticles*, **Nanotechnology 20**, 455501 (2009).
4. M. Sclafani, M. Marksteiner, F.M. Keir, A. Divochiy, A. Korneev, A. Semenov, G. Gol'tsman, M. Arndt, *Sensitivity of a superconducting nanowire detector for single ions at low energy*, **Nanotechnology 23**, 065501 (2012).
5. Mehrpoo, M., Sebastiano, F., Charbon, E., & Babaie, M. *A Cryogenic CMOS Parametric Amplifier.* **IEEE Solid State Circuits Letters,** 3(1), 5-8 (2020.)
6. E. Charbon, *Cryo-CMOS Electronics for Quantum Computing Applications,* **ESSDERC 2019** - 49th European Solid-State Device Research Conference **(2019).**
7. M. Mehrpoo, F. Sebastiano, E. Charbon, M. Babaie, *A Cryogenic CMOS Parametric Amplifier,* **IEEE Solid-State Circuits Letters** (Early Access) **(2019)**.

Acknowledgement, Disclaimer & How to find us

1. This project receives funding from the *European Union's Horizon 2020 research and innovation program* under grant agreement No. **860713**.

3. How to find us

- on **WWW**: https://www.supermama-project.eu
- on **Twitter:** https://twitter.com/supermama_eu
- on **SUMO:** https://attractsumo.univie.ac.at

universität wien
SINGLE QUANTUM Excellence in photon detection
EPFL
Universität Basel
MSVision
Funded by the European Union