# Developments for Direct Mass Measurements and Diagnostics for the FRS Ioncatcher and SHIPTRAP

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## Overview

- Motivation
- Status of the Time-of-Flight Mass Spectrometer System
- Setup for Coupling the TOF-MS to SHIPTRAP
- Setup for Coupling the TOF-MS to the FRS Ioncatcher
- Summary and Next Steps

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# Motivation

## Performance characteristics of current time-of-flight mass spectrometer

- Mass resolving power = 10000 ... 20000
- Mass meaurement accuracy = 1 ppm (~200 keV for Pb)
- Mass measurement duration = 0.1 ms
  (Overall cycle time ~10 ms limited by ion transfer and cooling)

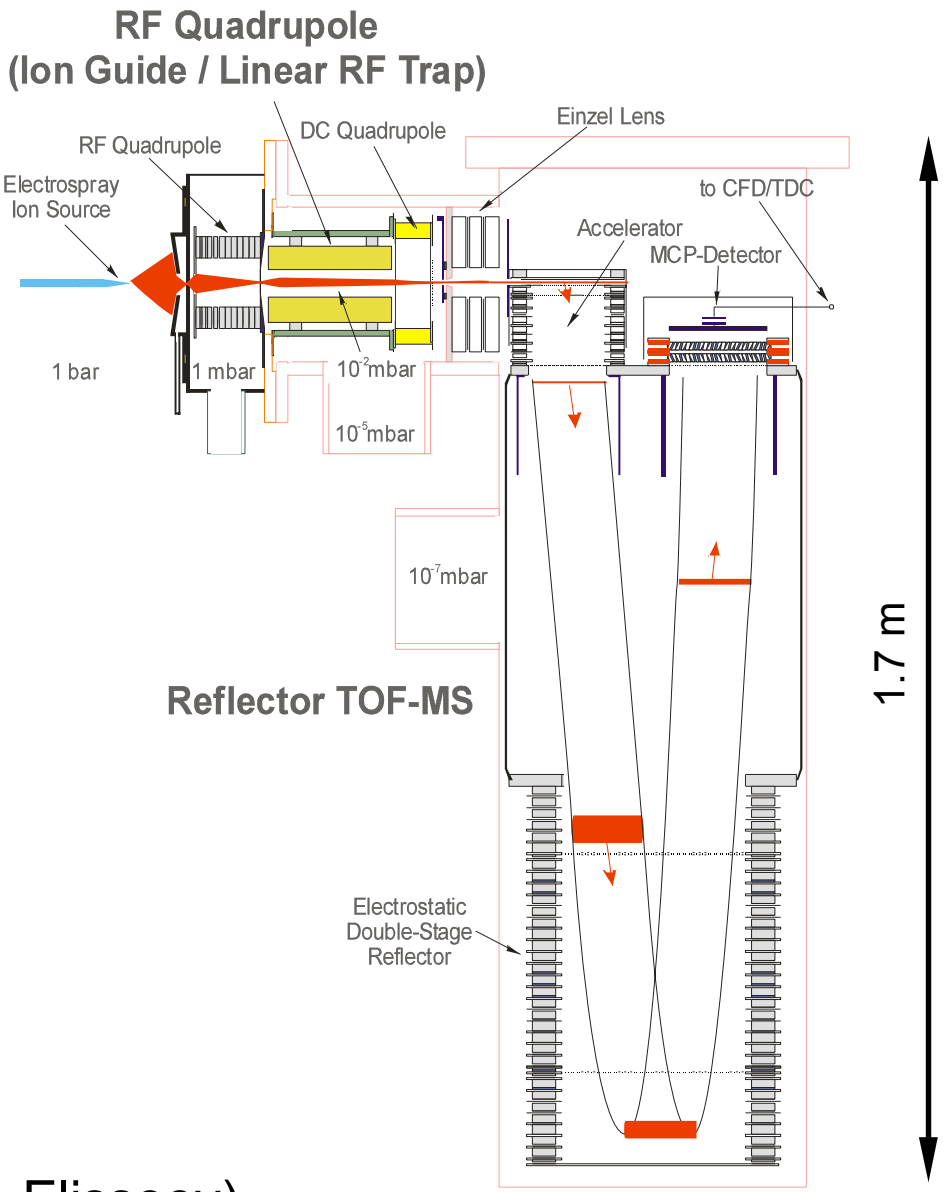
## Advantages

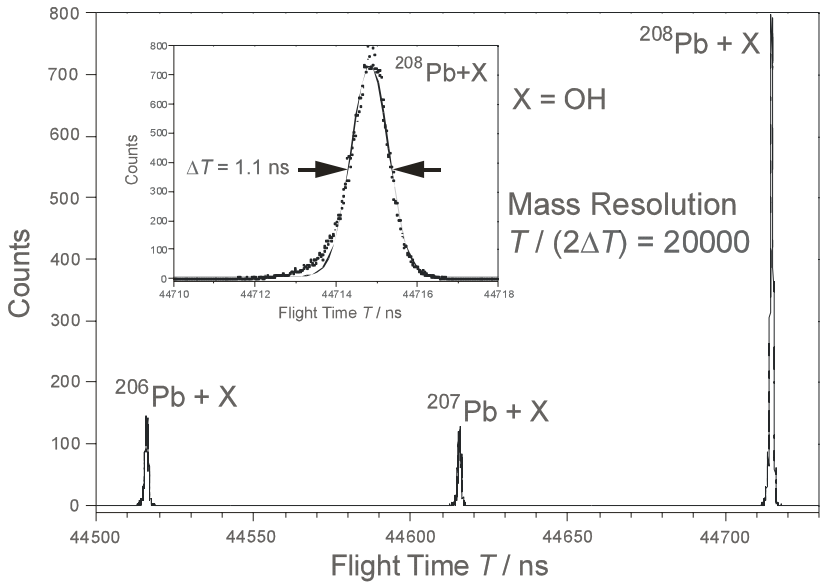
- Direct mass measurements of short-lived nuclei
- Broad-band mass spectra
- Compact instrument
- Includes gas-filled RFQ (low vacuum requirements, simple coupling to gas cells)

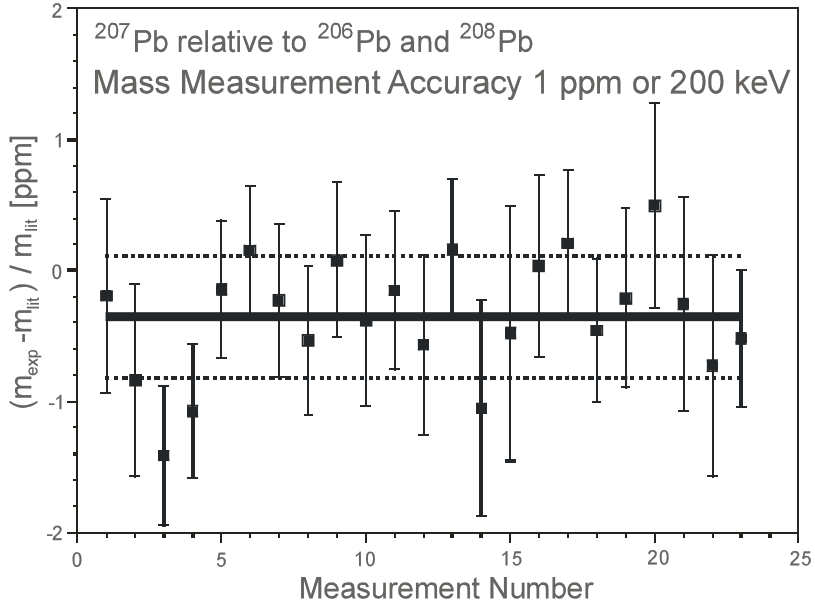
## Planned applications

- Identification of ions formed in gas-filled stopping cells by mass measurement and possibly collision-induced dissociation (molecules)
- Measurement of nuclear binding energies of short-lived nuclei
- Possibly investigation of chemical properties of short-lived nuclei (determination of adducts, bond energies, ion mobility)

# Current Status of the TOF-MS



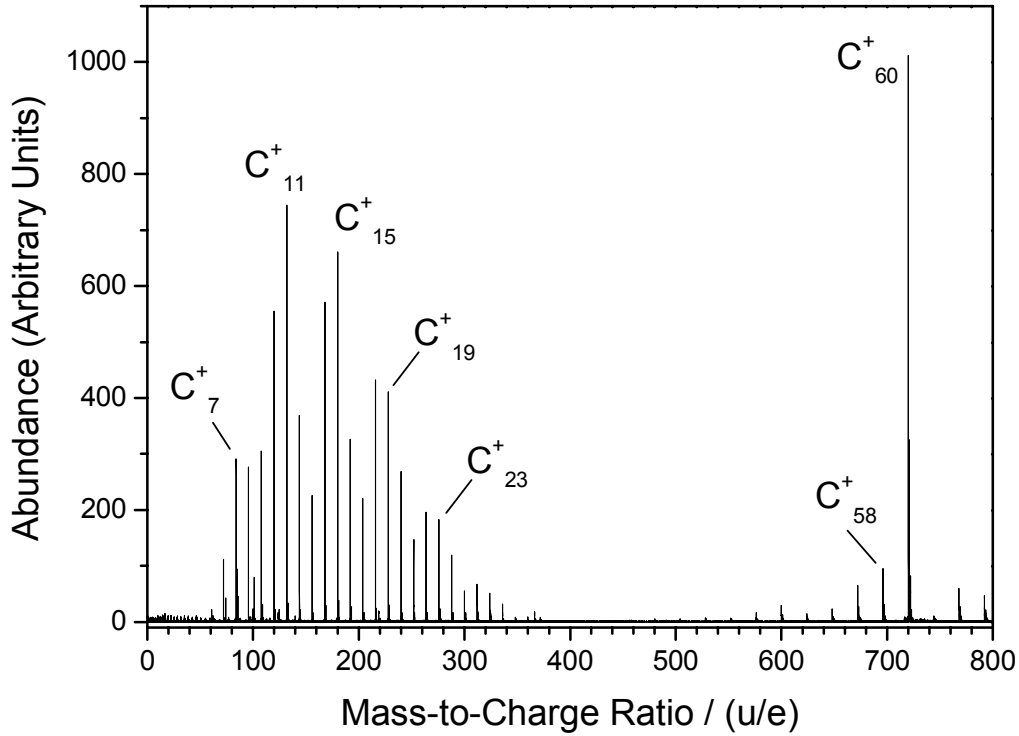



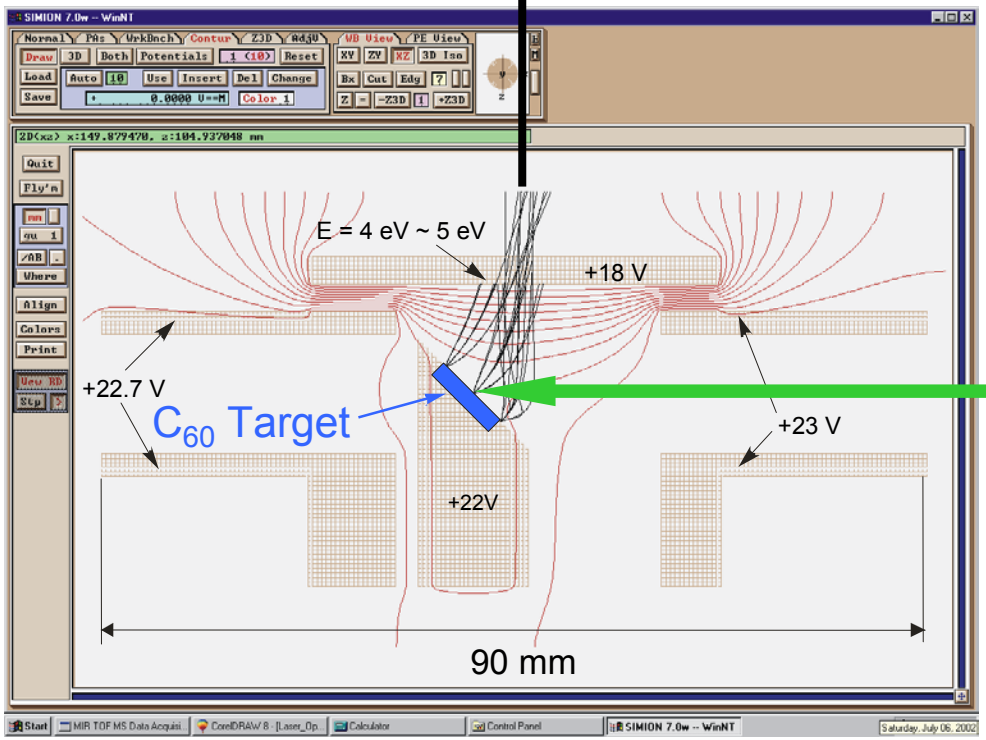




(S. Elisseev)

# $C_{60}$ Laser Ablation Ion Source for Mass Calibration

TOF-MS

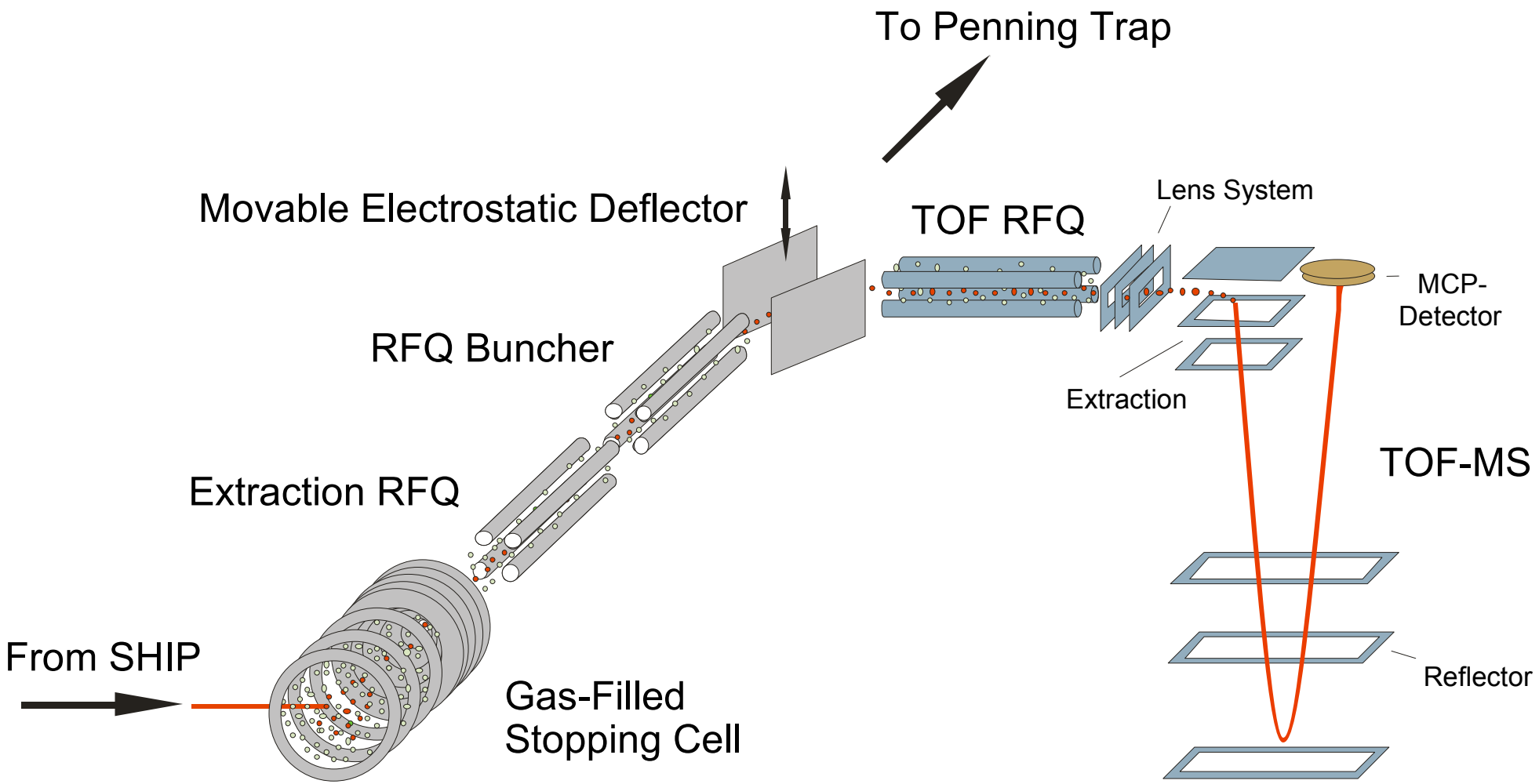



Nd:YAG Laser

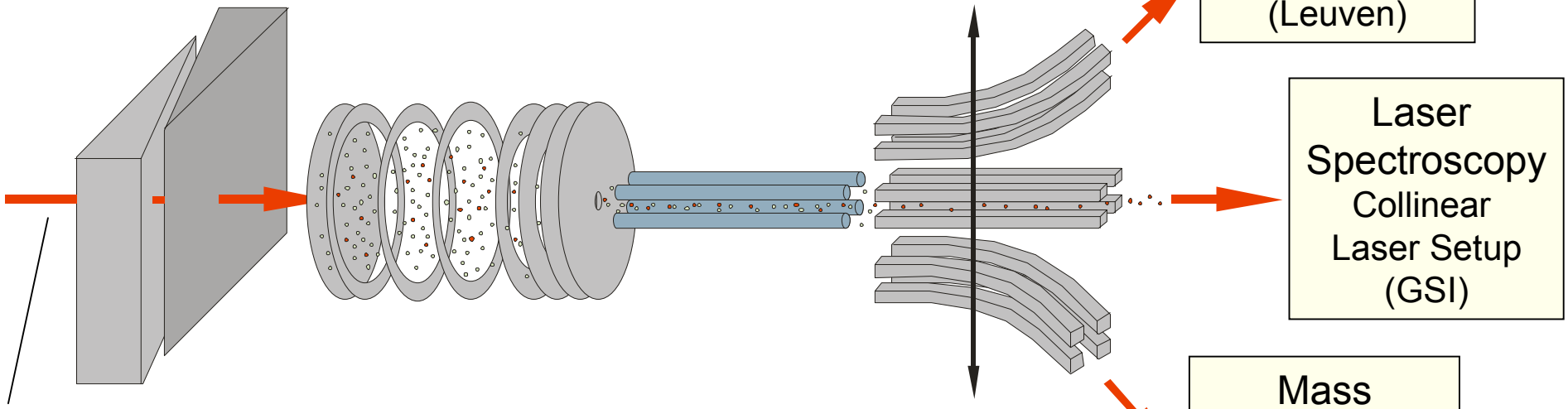
(Z. Wang)

# Setup for Coupling of the TOF-MS to SHIPTRAP

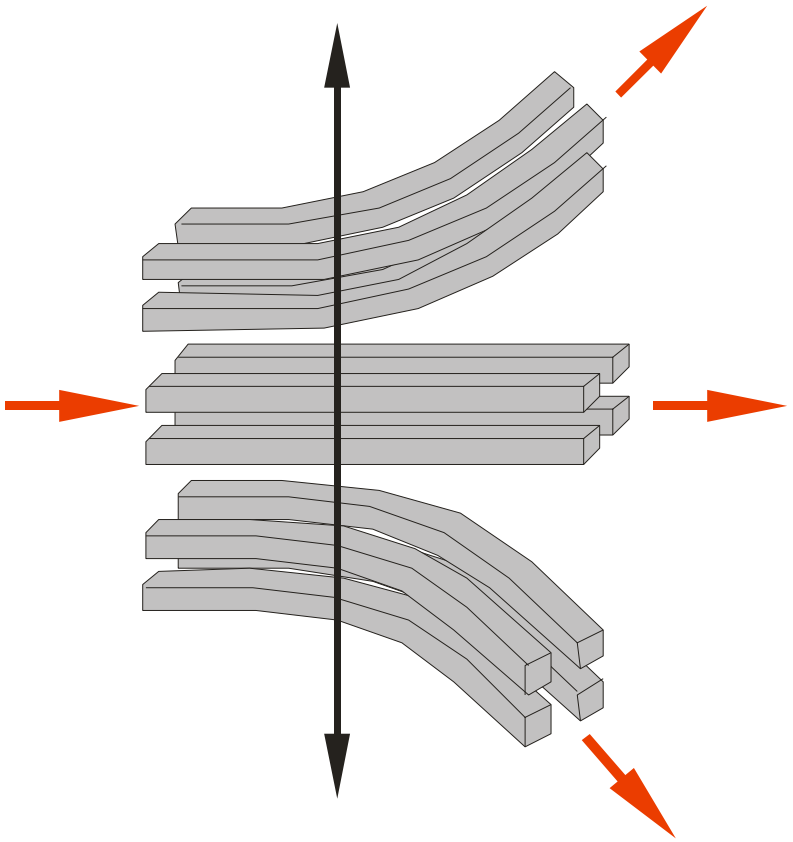



Current status: Ready for mounting and test

# Setup for Coupling of the TOF-MS to the FRS Ioncatcher



# RFQ Ion Distribution System



## RFQ ion distribution system

- Consisting of several curved RFQ (selected by mechanical movement)
- Use of RFQ with rectangular cross-section for easy and reproducible machining

## Advantages of RFQ ion distribution system

- Distribution of ions to several experiments (multi-user facility)
- High transmission efficiency
- Reduced requirements for differential pumping
- No ion reheating

Current status: Simulation and development phase

# Summary and Next Steps

## Summary

- The TOF-MS has been characterized and is ready for operation
- A laser ablation ion source has been built and tested
- The setup for coupling the TOF-MS to SHIPTRAP has been built and is ready for testing
- A concept for coupling of the TOF-MS and other experiments to the FRS Ioncatcher has been developed

## Next Steps

- Test of the TOF-MS at SHIPTRAP
- Construction of the setup for coupling the TOF-MS to the FRS Ioncatcher
- Development of a high-resolution TOF-MS:
  (i) Improvement of the current TOF-MS
  (ii) Development of a multiple-reflection TOF-MS