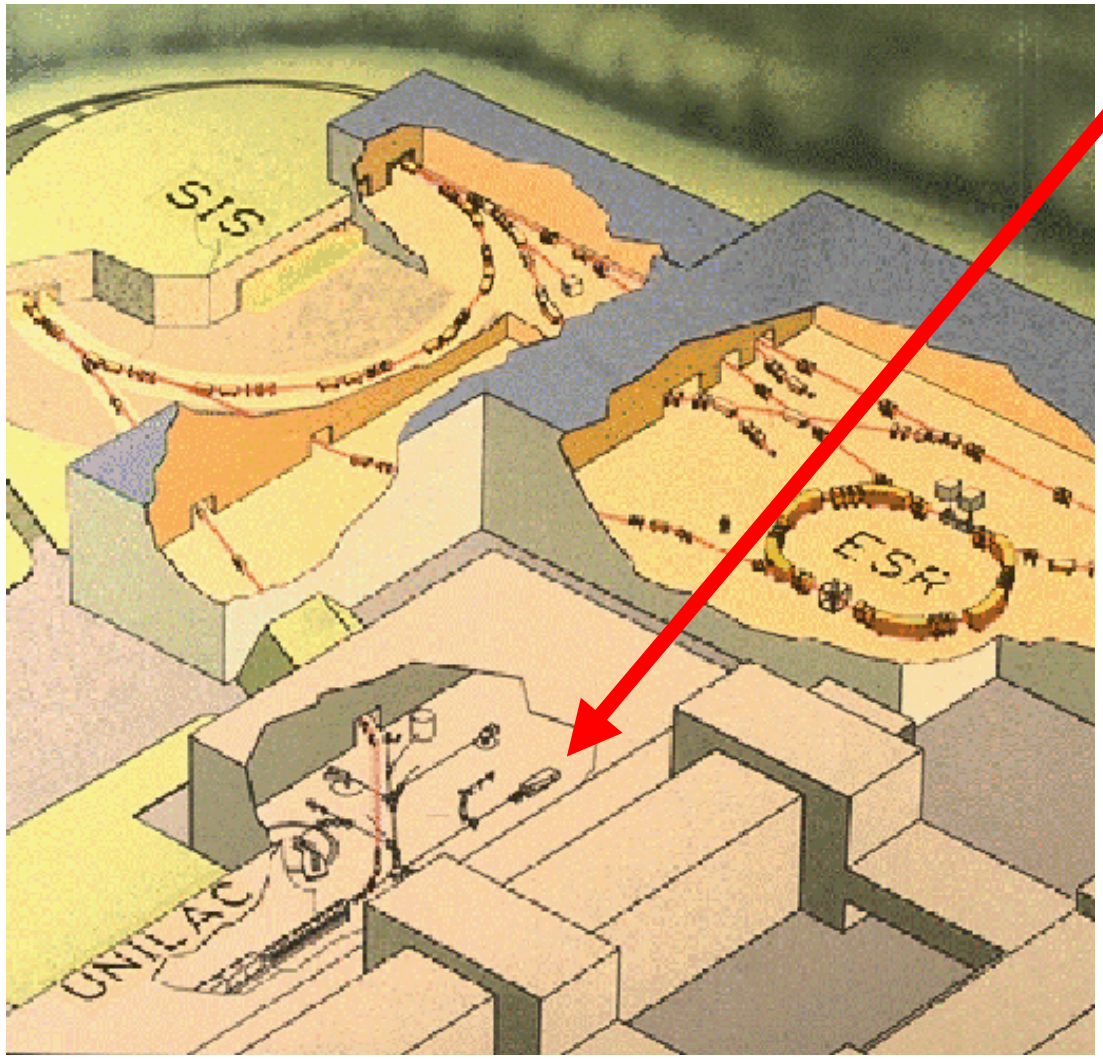
FT-ICR: A NON-DESTRUCTIVE DETECTION TECHNIQUE FOR HEAVY RADIONUCLIDES AT SHIPTRAP



A FACILITY TO STUDY TRANSURANIUM ISOTOPES

GSI

universität mainz

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

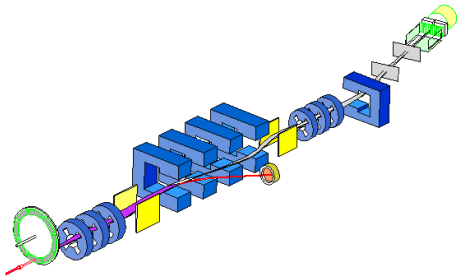
EXO TRAPS

SHIPTRAP

MOTIVATION

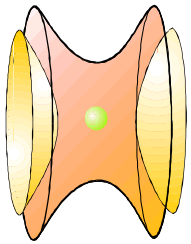
GSI

SHIP



- Radionuclide-production facility
- Transuranium elements

Ion Trap



- Small phase space
- Long storage time
- High mass selectivity

SHIPTRAP

High-precision experiments

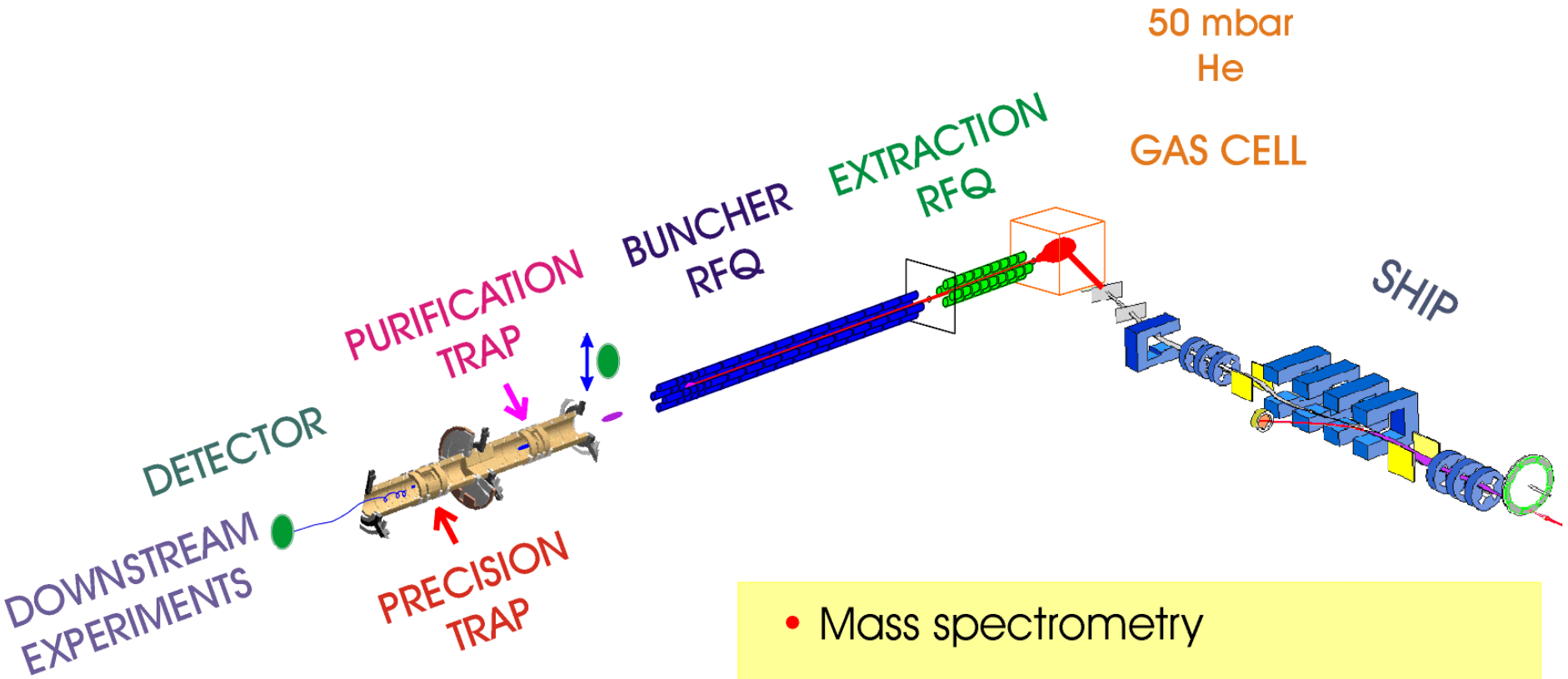
Experiments within the trap

Extraction of a well defined ion sample

SHIPTRAP

SET-UP & SCIENTIFIC PROGRAMM

GSI

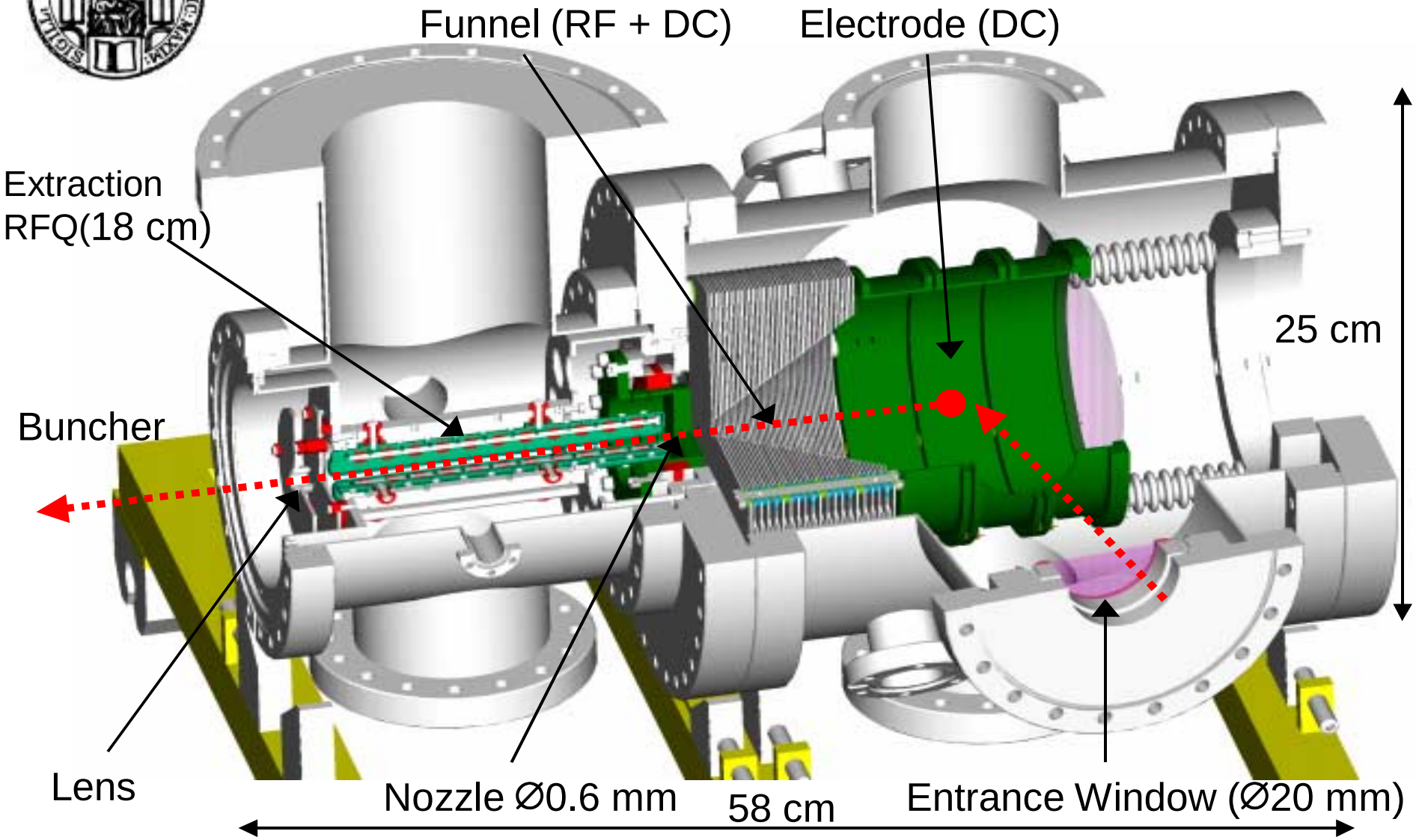


- Mass spectrometry
- Nuclear decay studies
- Laser spectroscopy
- Chemistry of superheavy elements

SHIPTRAP

GAS CELL & EXTRACTION

GSI



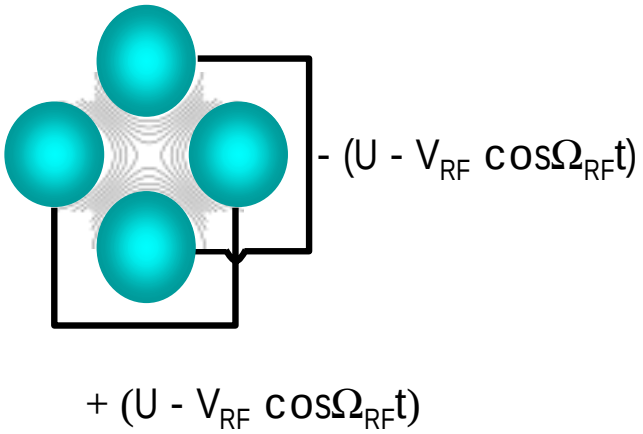
SHIPTRAP

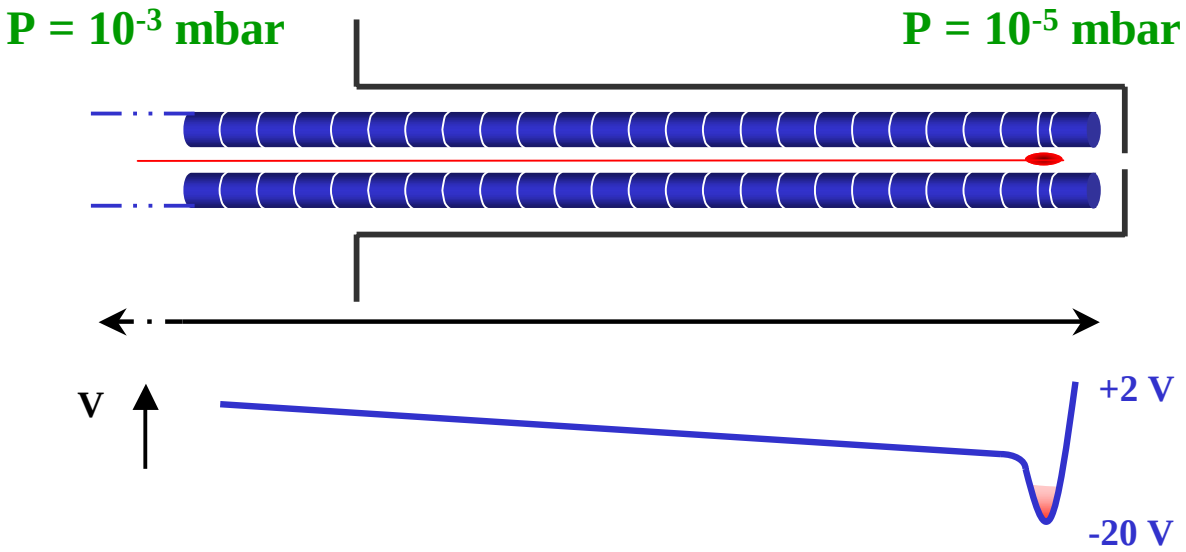
BUNCHER-RFQ

GSI

In: continuous beam

Out: cooled , bunched beam





- Length of RFQ: L = 1 m
- Segmented electrodes: l = 40 or 25 mm, l_{trap} = 4 mm
- ø = 9 mm
- r_o = 3.9 mm
- V_{RF} = 140 V, Ω_{RF} = 2 π 1 MHz

SHIPTRAP

THE PENNING TRAP SYSTEM

GSI

B-field

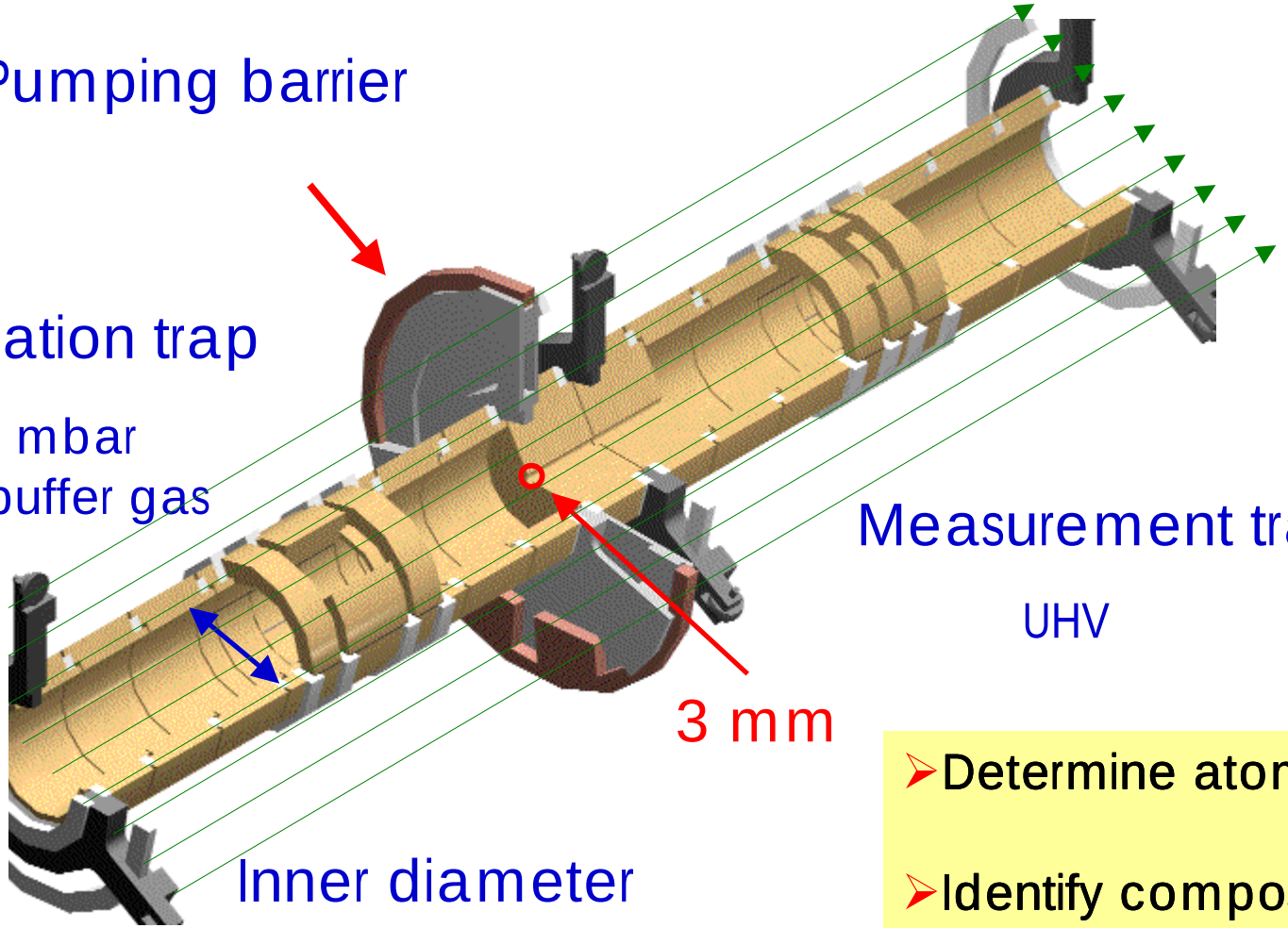
$$\nu_c = \frac{qB}{2\pi m}$$

Pumping barrier

Purification trap

P = 10^{-5} mbar

Helium buffer gas



Measurement trap

UHV

3 mm

Inner diameter

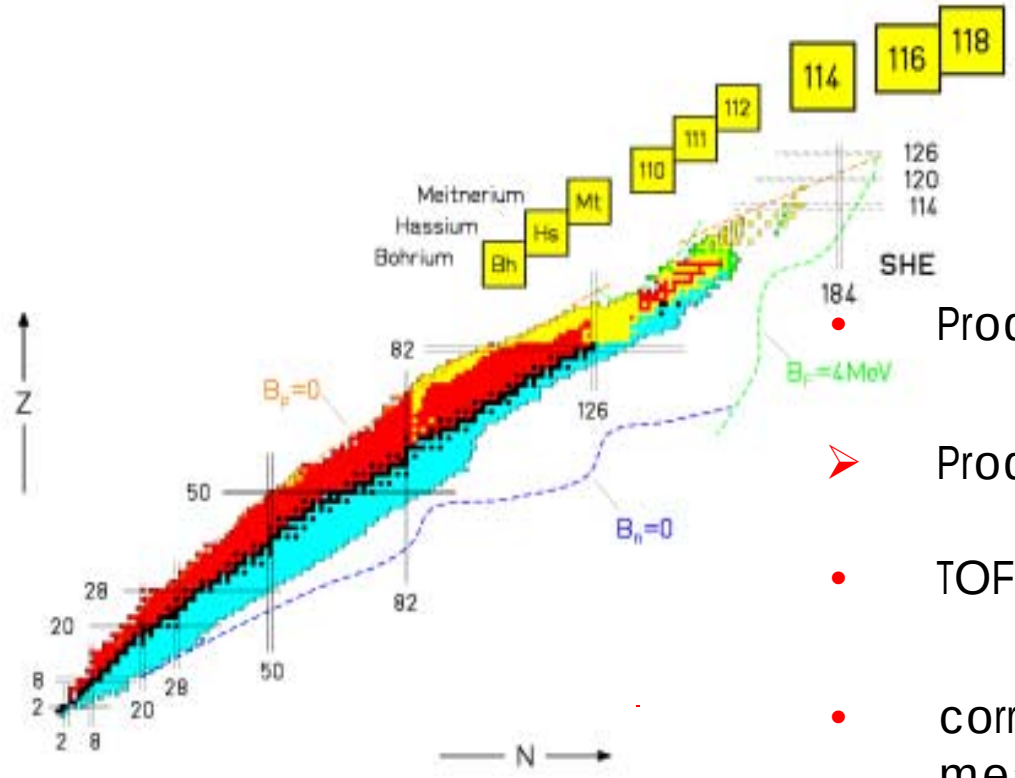
= 32 mm

- Determine atomic masses
- Identify composition of stored ion sample

SHIPTRAP

LIMITATIONS TO MEASUREMENTS

GSI



- Production cross section at SHIP < nb

➢ Production rates < 10^{-3} ions/s

- TOF technique requires ~ 1000 ions

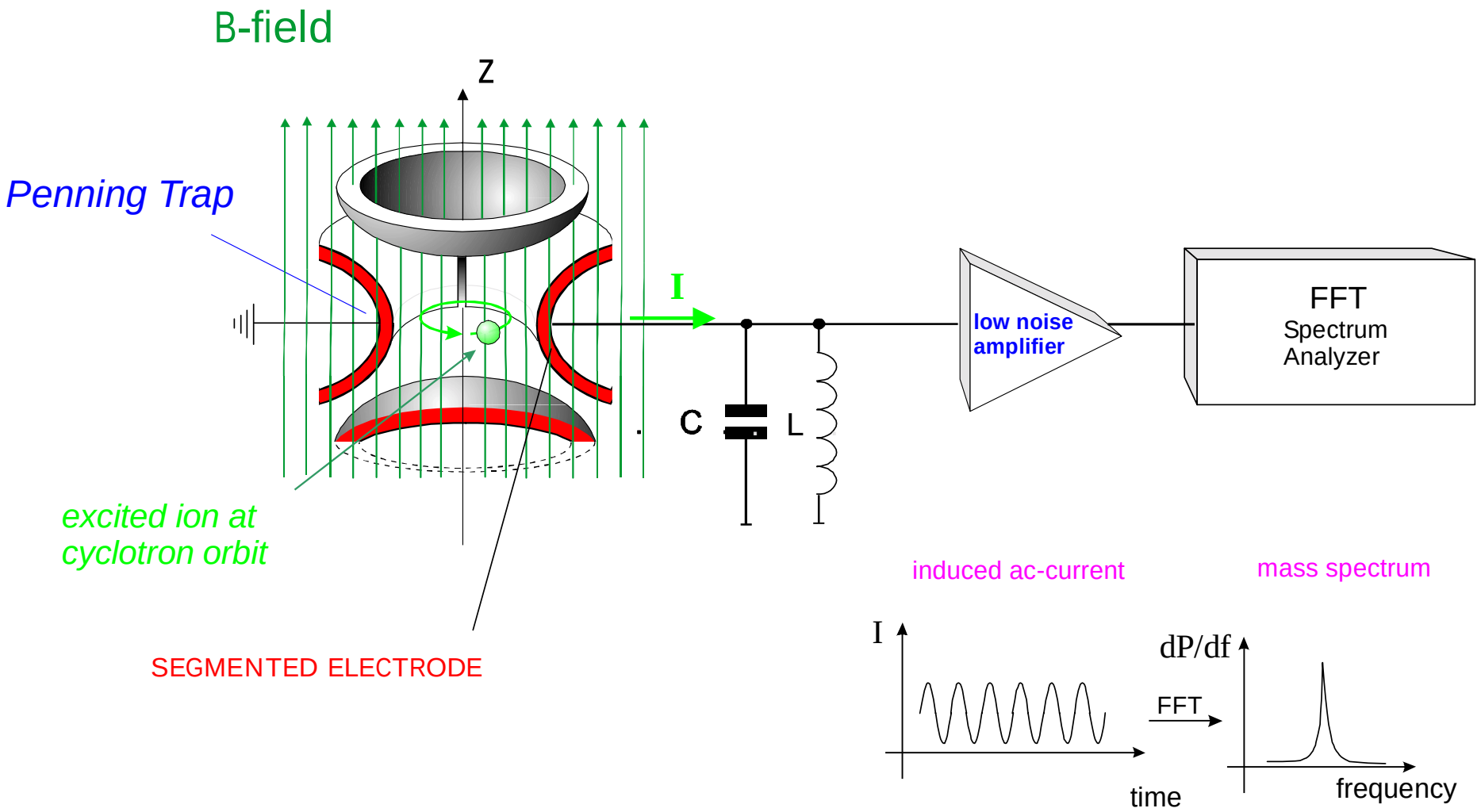
- corresponds to 10 days of measurement time

➢ FT- ICR : short integration time possible

- corresponds < 1 day of measurement time

SHIPTRAP

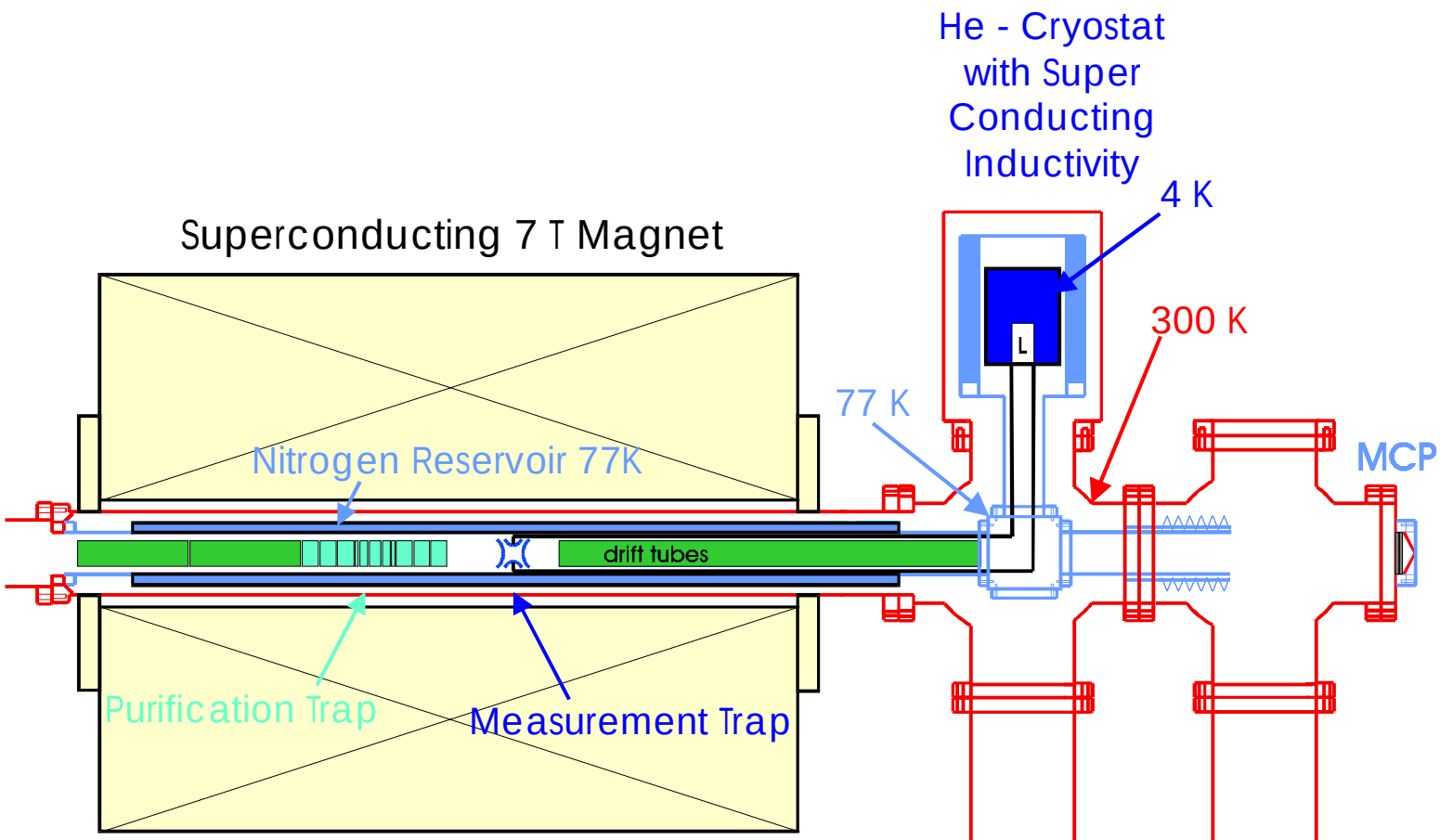
PRINCIPLE OF FT-ICR



SHIPTRAP

THE PLANNED CRYOGENIC SET-UP

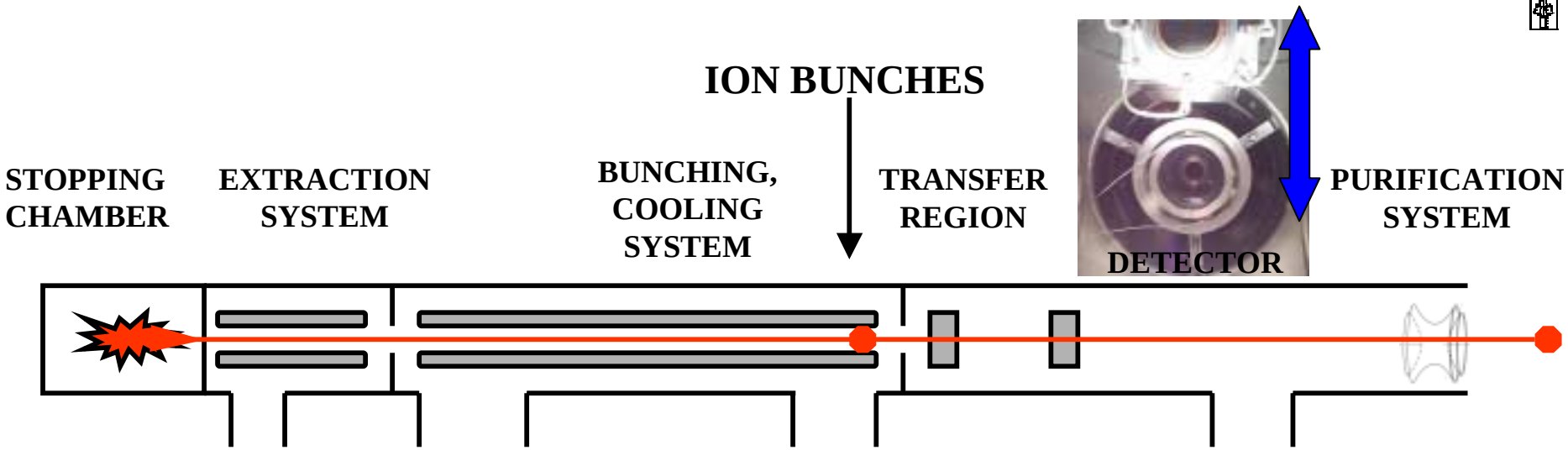
GSI



Single ion detection possible

SHIPTRAP

FIRST ON-LINE TESTS

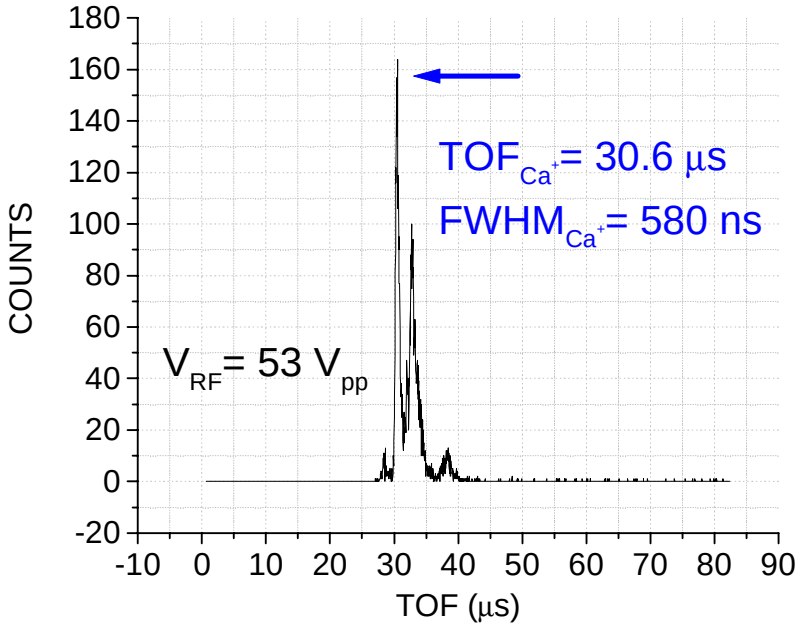


Beam Time (19.-20.12.01):

$^{40}Ca + {}^{140}Ce \rightarrow {}^{180}X$

Initial Beam energy: 4.9 MeV/u
Secondary beam: 250keV/u

Ions from SHIP extracted from gas-cell and detected behind the buncher

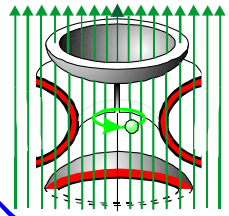


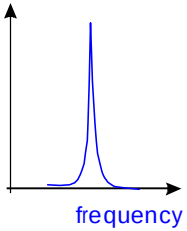
SHIPTRAP

CONCLUSION

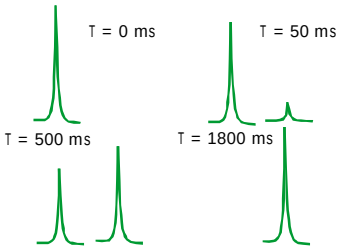
GSI

sensitive FT - mass spectroscopy



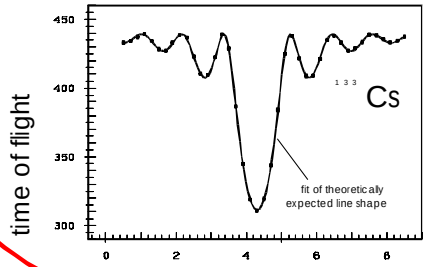


study of chemical reaction kinetics

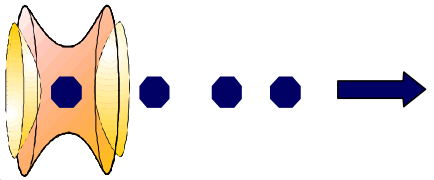


SHIPTRAP

TOF - mass spectroscopy



transfer to further experiments



SHIPTRAP

GSI