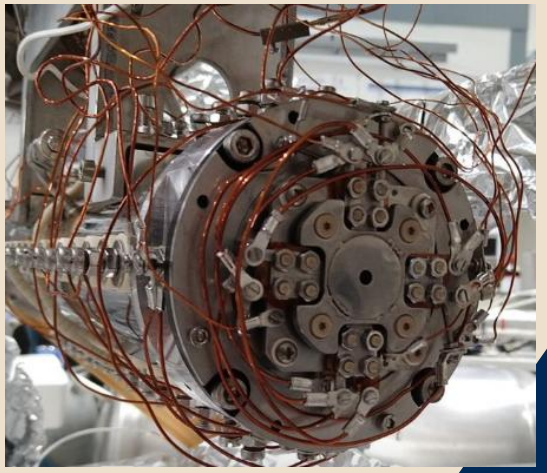


JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

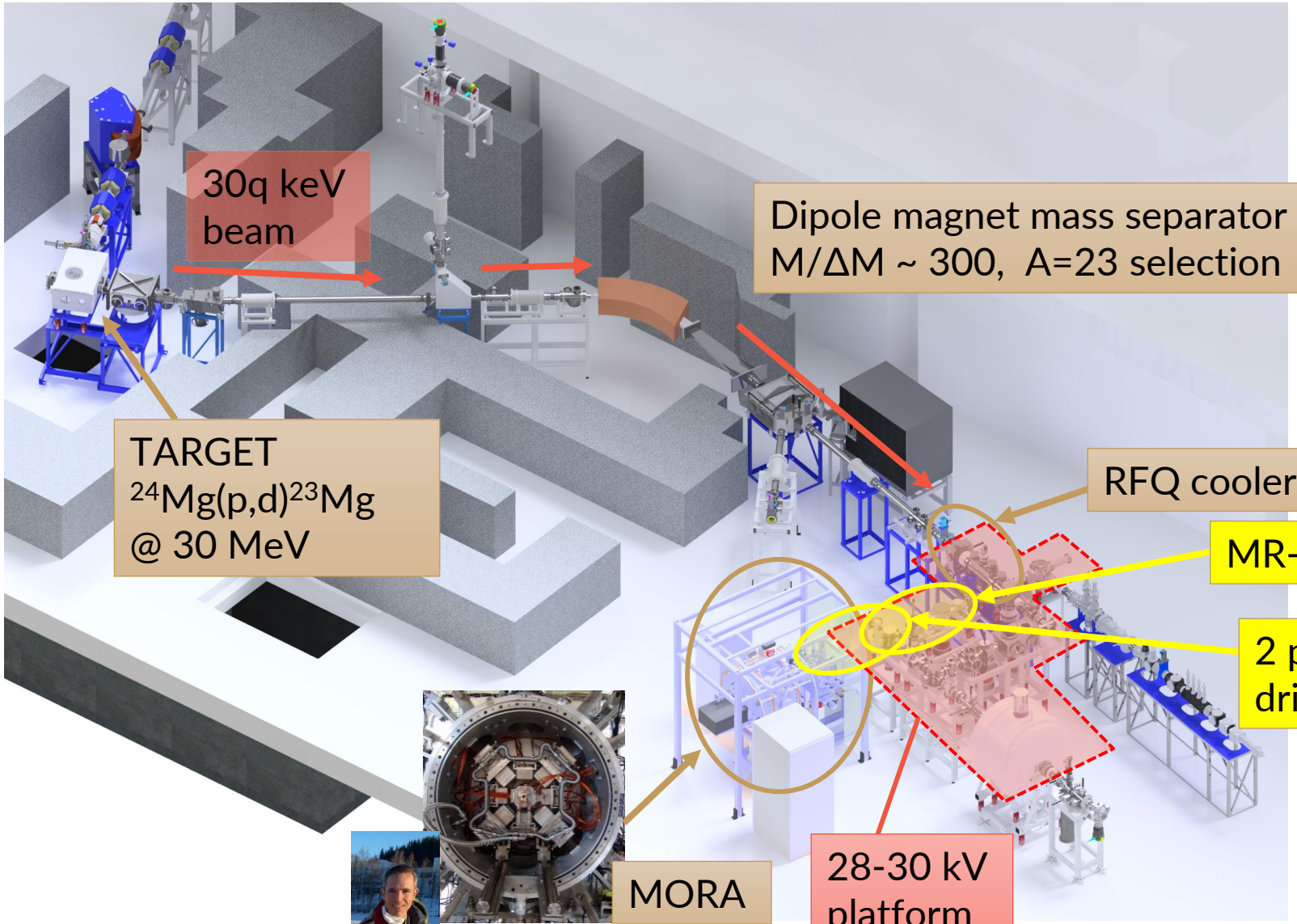
Minibuncher performance at IGISOL

Tommi Eronen

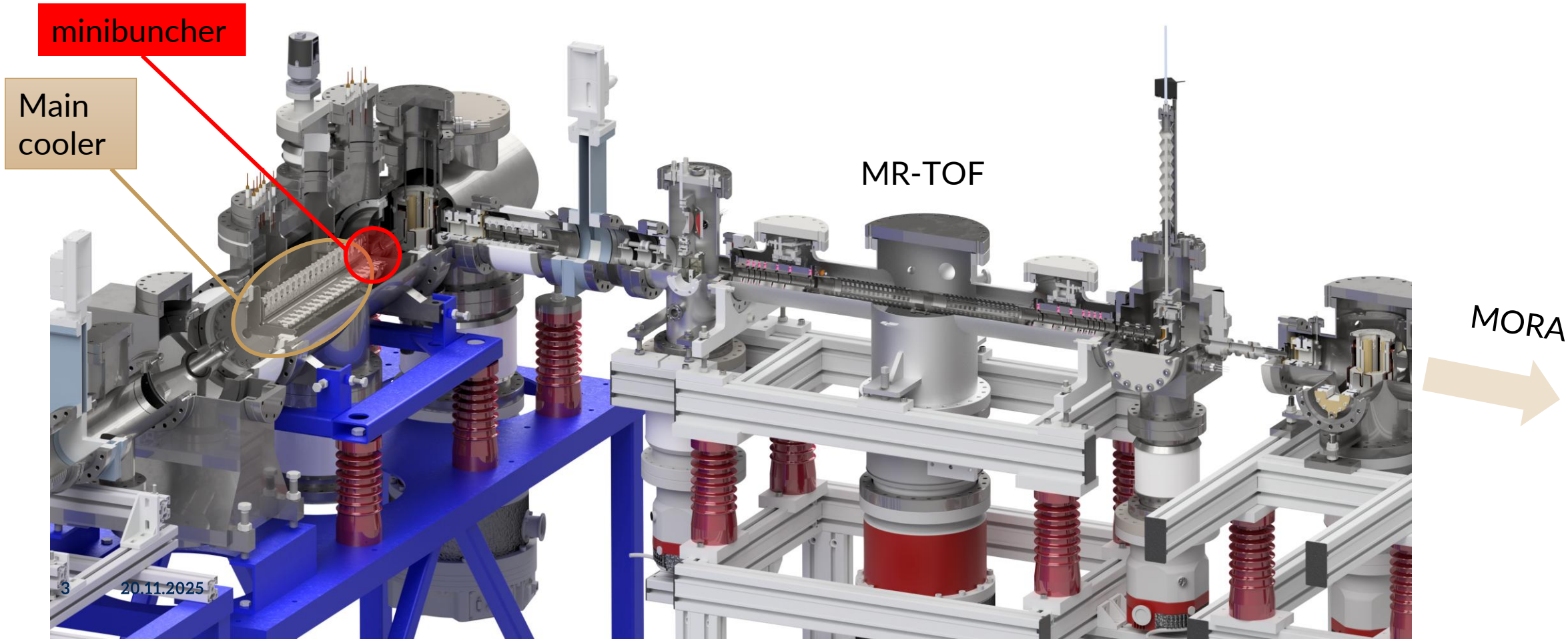
with material contribution and most of the work by **Ville Virtanen**

Miniaturised cooler-buncher for reduction of longitudinal emittance at IGISOL
V.A. Virtanen et al. NIMA 1072 (2025) 170186.

MORA @ IGISOL facility

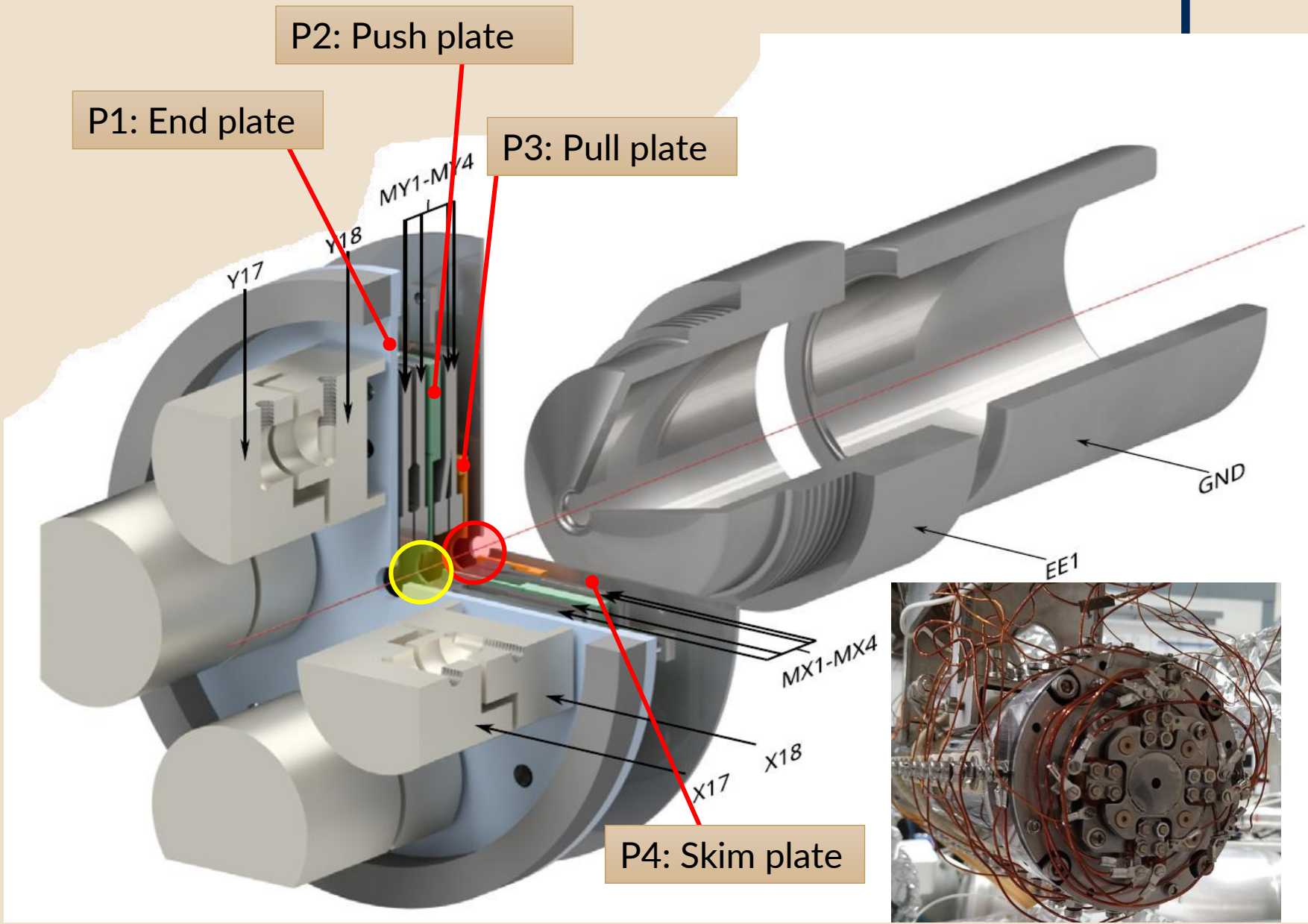


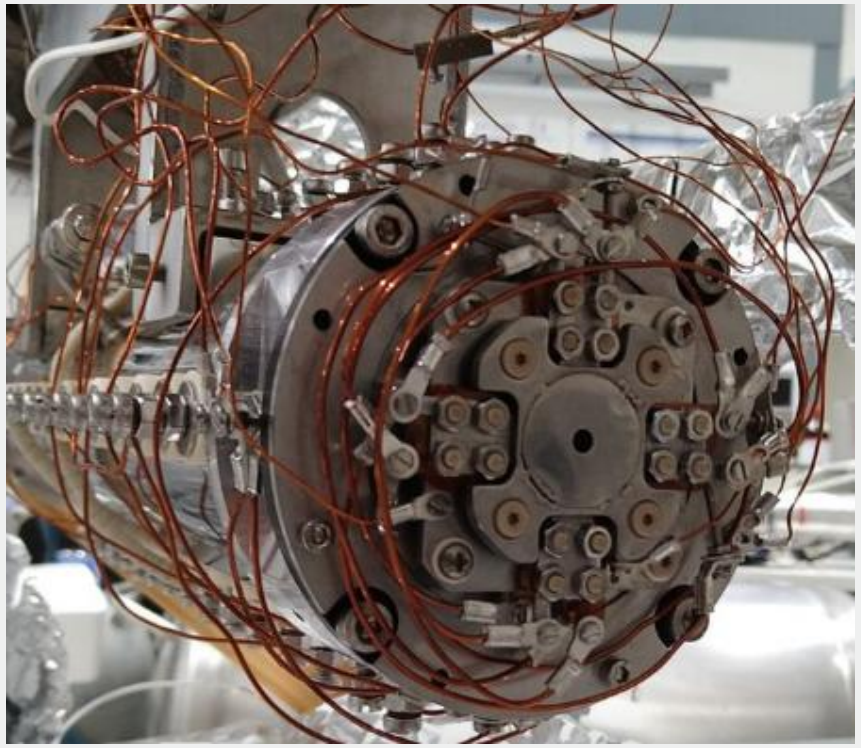
RFQ cooler-buncher + MR-TOF

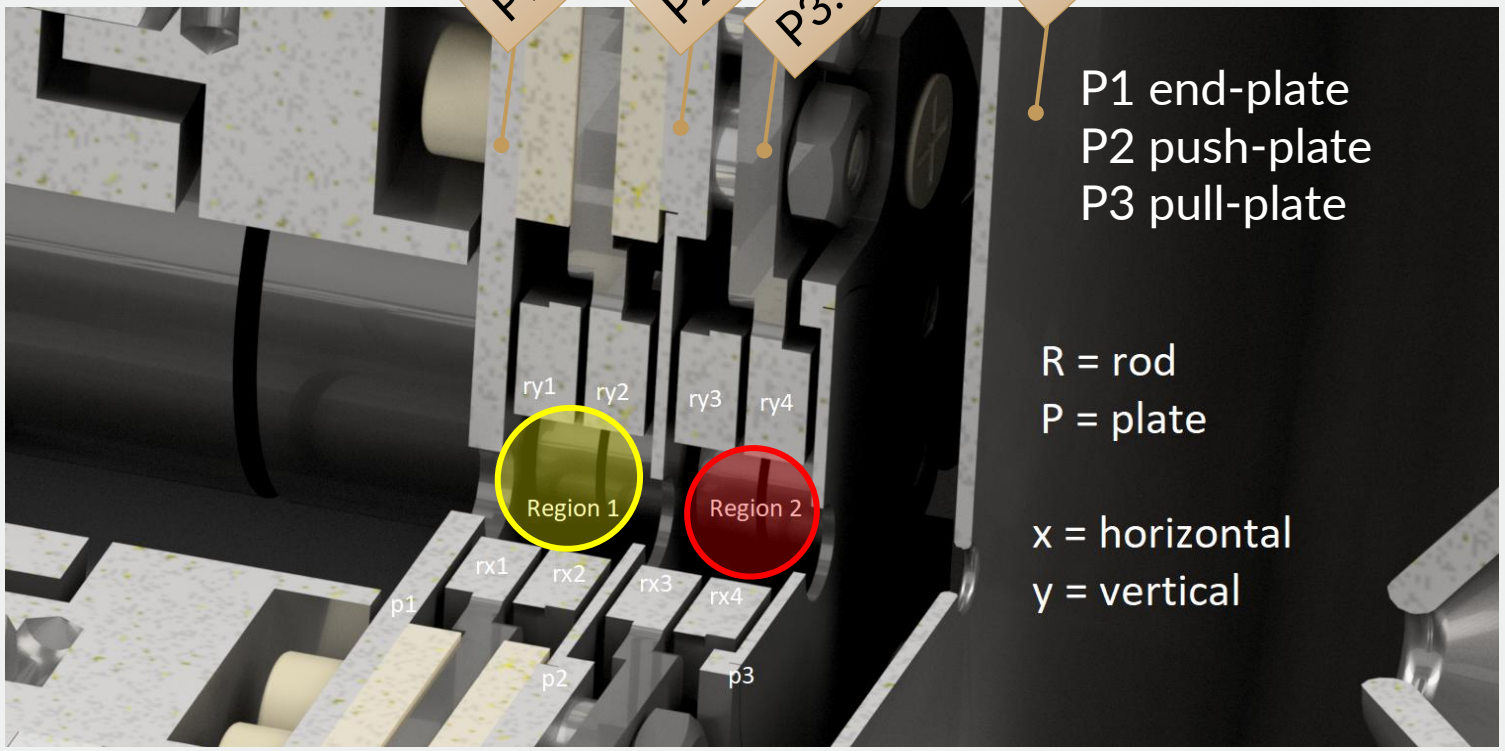


Minibuncher section

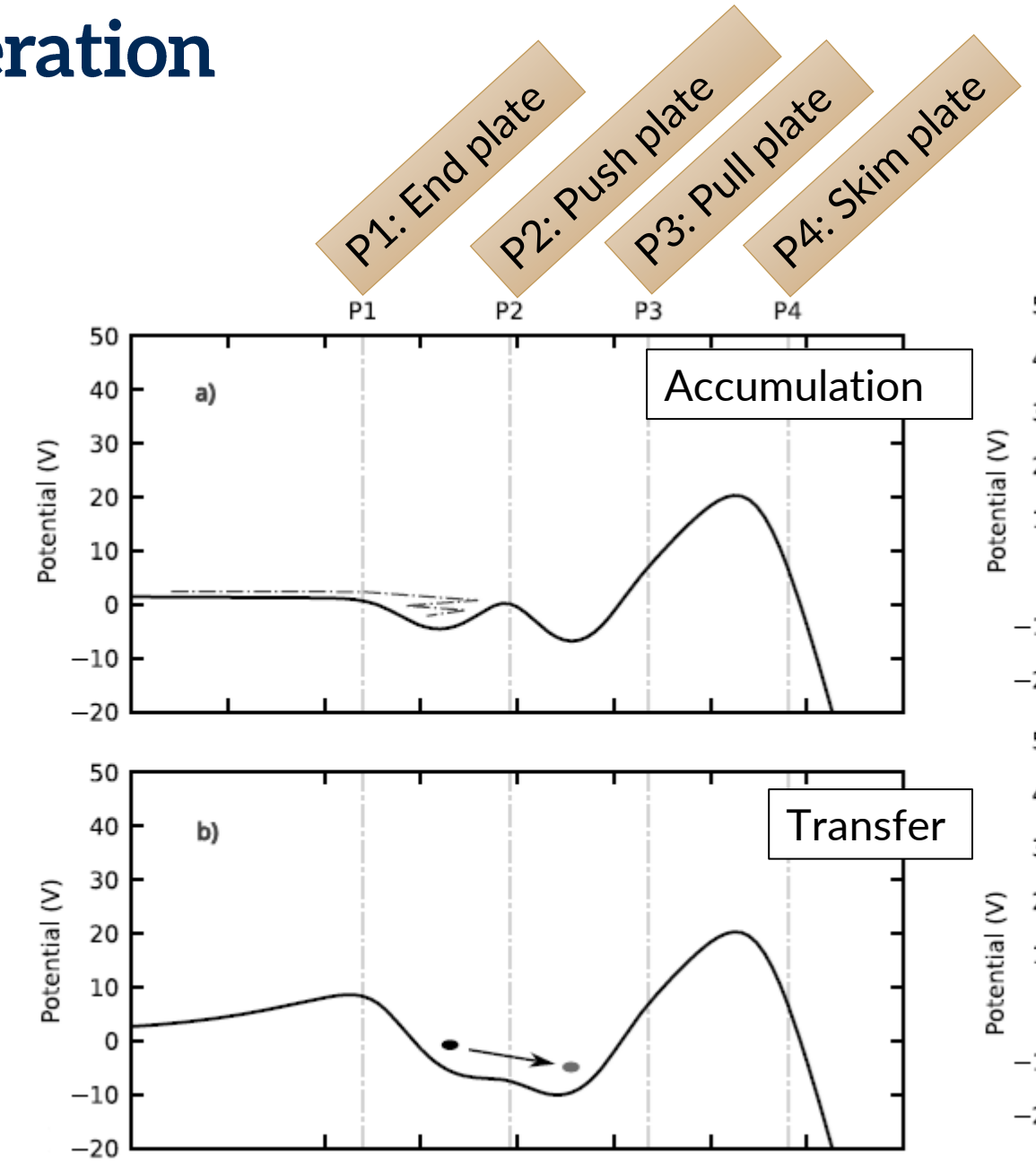
- Collection to pre-trap
- Push-pull extraction

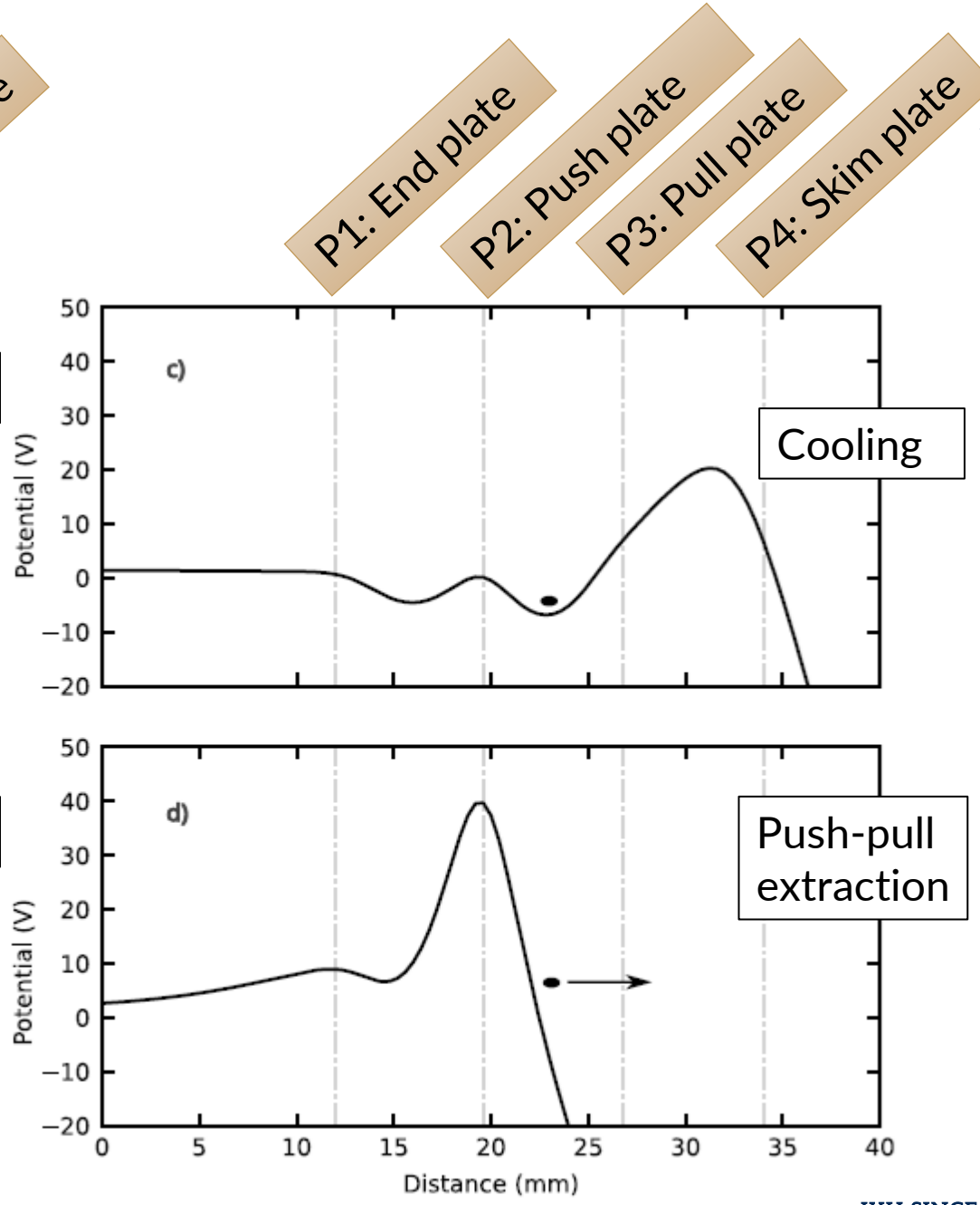





P1: End plate
P2: Push plate
P3: Pull plate
P4: Skim plate
P1 end-plate
P2 push-plate
P3 pull-plate
R = rod
P = plate
x = horizontal
y = vertical
ry1
ry2
ry3
ry4
Region 1
Region 2
rx1
rx2
rx3
rx4
p1
p2
p3

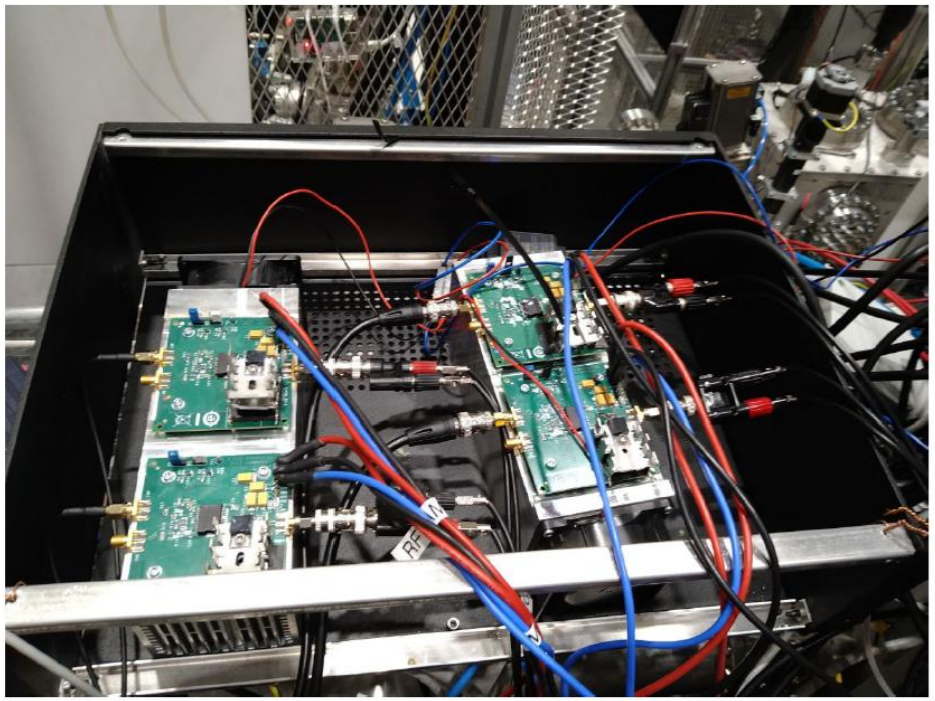
Operation

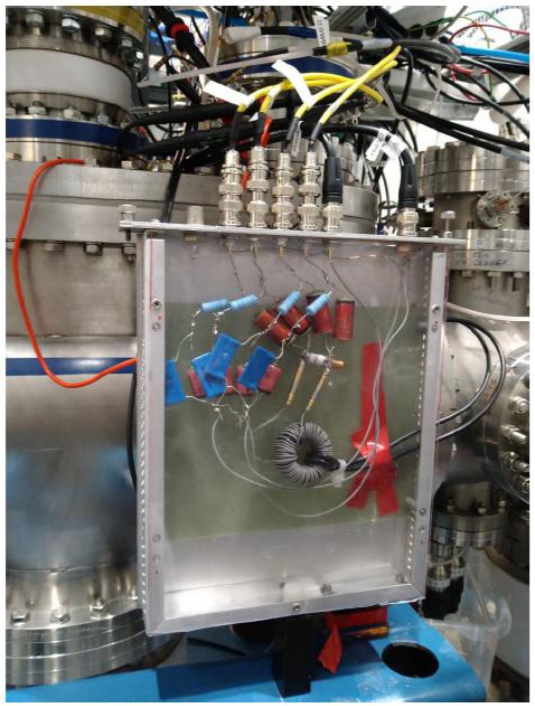

P1: End plate
P2: Push plate
P3: Pull plate
P4: Skim plate
P1
P2
P3
P4
a)
Accumulation
b)
Transfer
Potential (V)
50
40
30
20
10
0
−10
−20


P1: End plate
P2: Push plate
P3: Pull plate
P4: Skim plate
c)
Cooling
d)
Push-pull extraction
Potential (V)
Distance (mm)
50
40
30
20
10
0
−10
−20
0
5
10
15
20
25
30
35
40

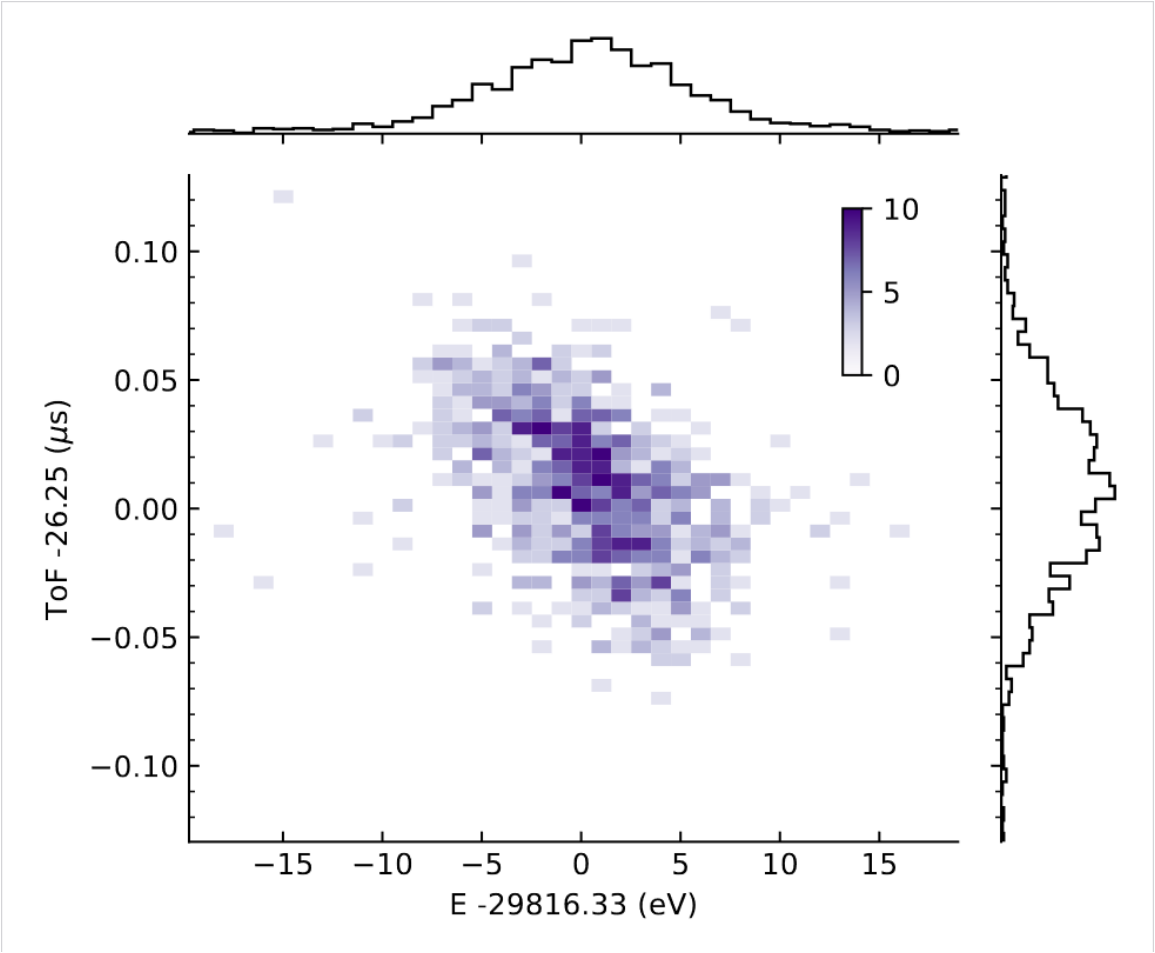
RF system

- Radial confinement with RF, 2 MHz, 1 kV (pp)
  - ADA4870 drivers + home-made resonant circuit
- Axial confinement with DC-only plates (P1-P4)
  - Easy to switch voltages





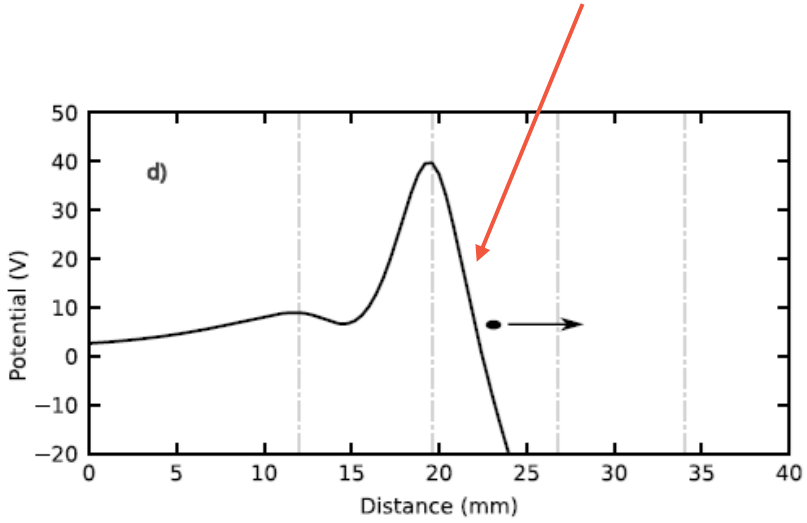
Using collinear laser spectroscopy for energy spread determination



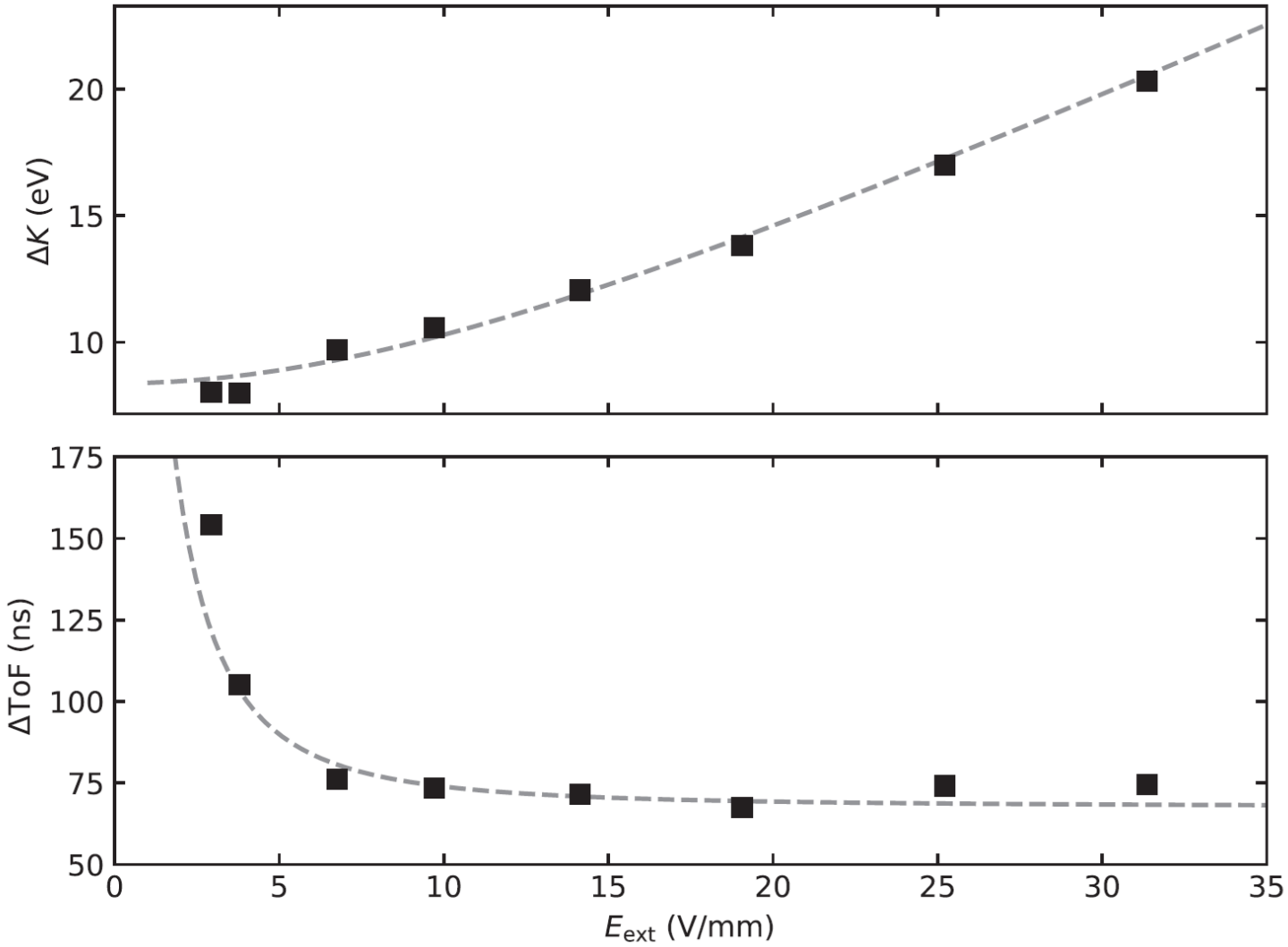
V.A. Virtanen et al. NIMA 1072 (2025) 170186.

ToF and energy spread

- Scanned push-pull voltage gradient slope



- Detect ToF and energy spread



Space charge limits

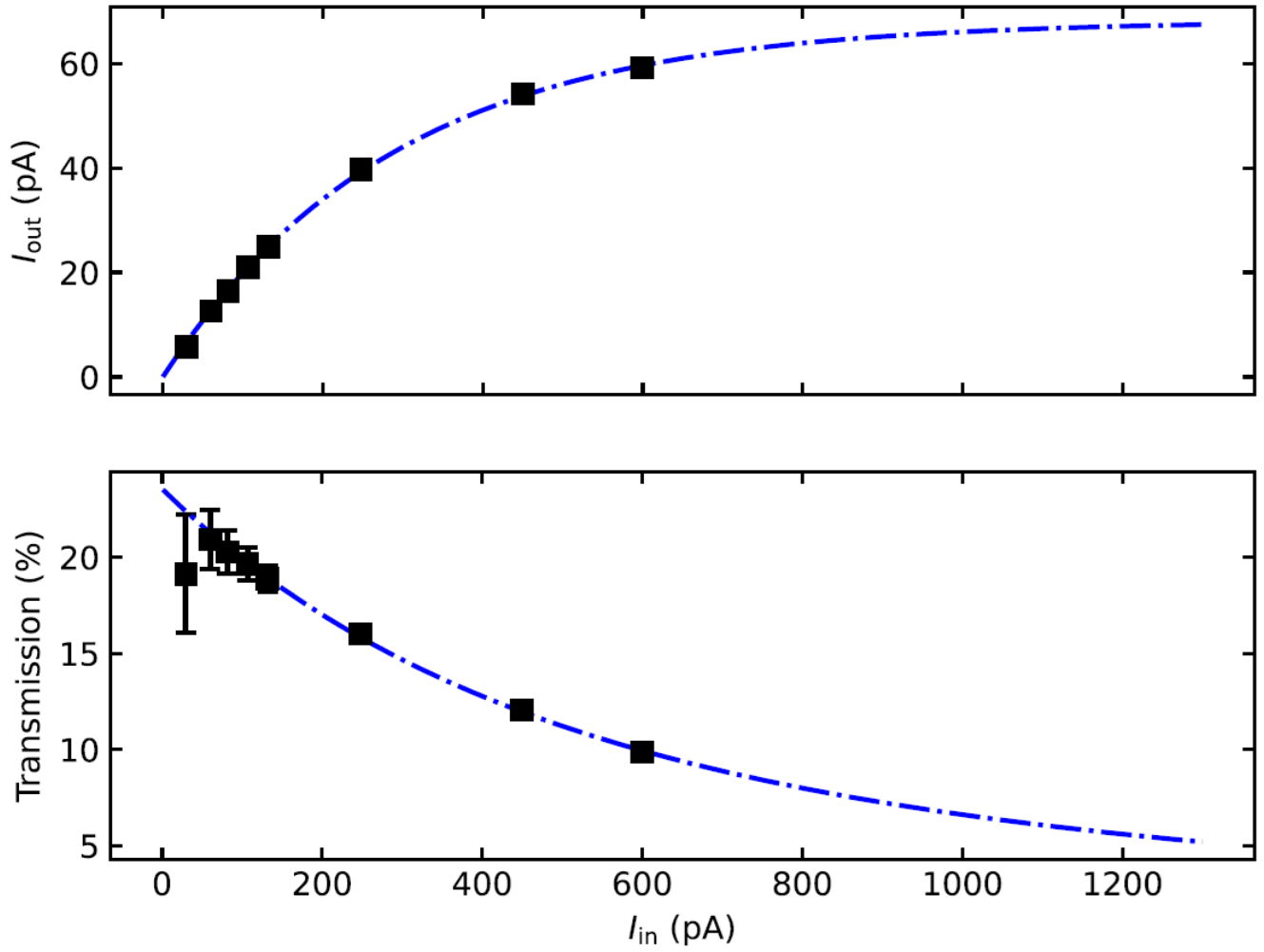
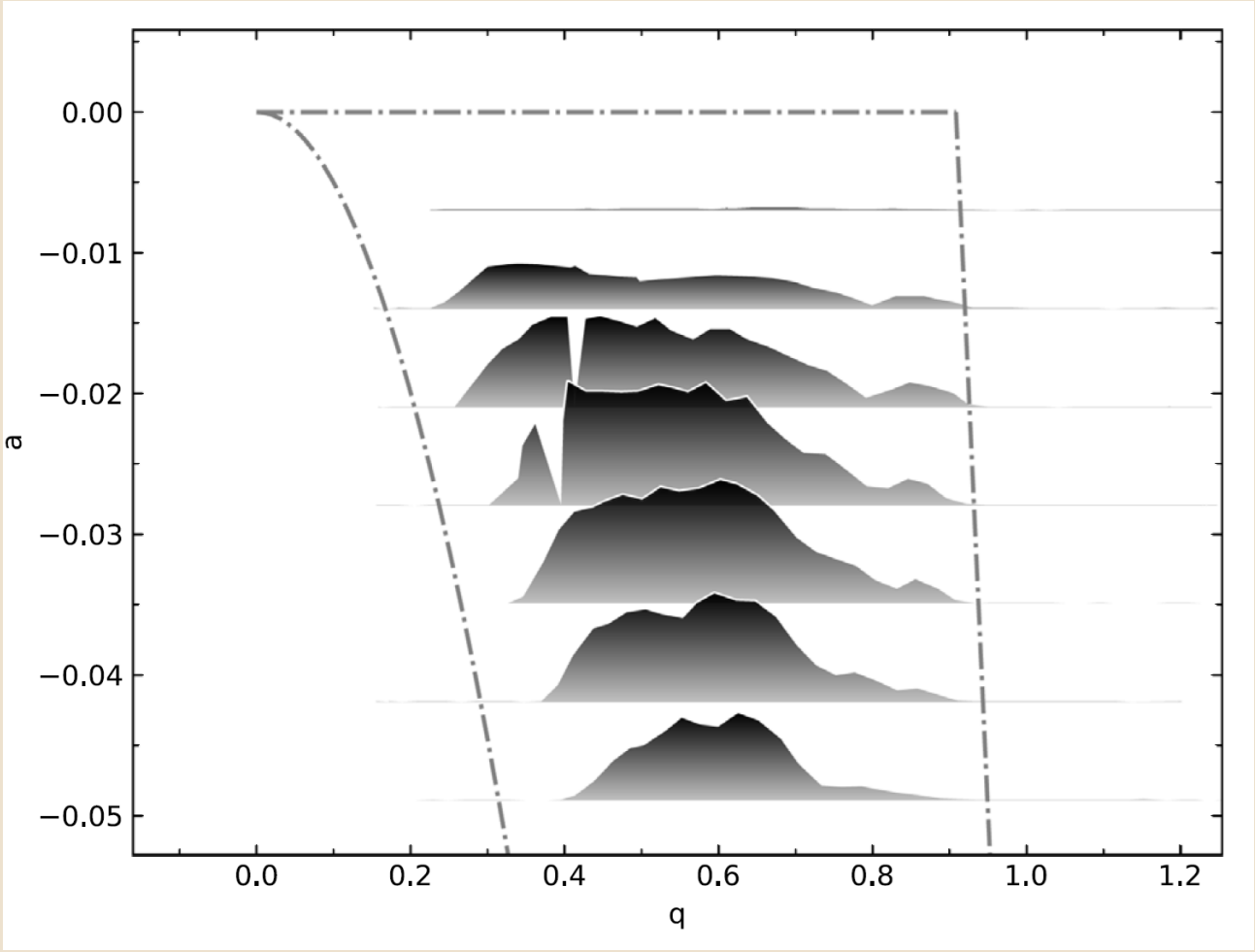


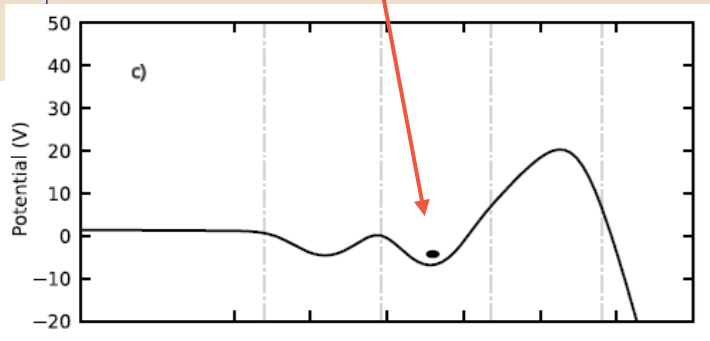
Fig. 8. Transmission of $^{85}Rb^{+}$ through the Mini-Buncher as a function of incoming current, with a fixed bunching cycle length of 3 ms. Top pane displays current, and bottom pane the estimated transmission efficiency. The blue lines are fits based on

- 3 ms cycle
- $10^5..10^6$ ions/bunch

Mathieu stability diagram mapping



- q: RF amplitude
- a: DC depth



MORA bunch considerations

- One shot – $10^5..10^6$ ions in it
- Cycle 10-20 s
- Desire to have only ^{23}Mg in it, but there is also stable ^{23}Na

Minibuncher outlook

- New amplifiers being designed: 5 MHz, 2 kV pp
  - Higher frequecy – more space charge capacity
  - Have x from one side and y the other side of the coil
  - In vacuum cabling updates at some point

- Overall nice performance, allows MR-ToF mass spectrometry with $M/\Delta M$ ~ few x 10^5

THANK YOU FOR YOUR ATTENTION TO THIS MATTER!