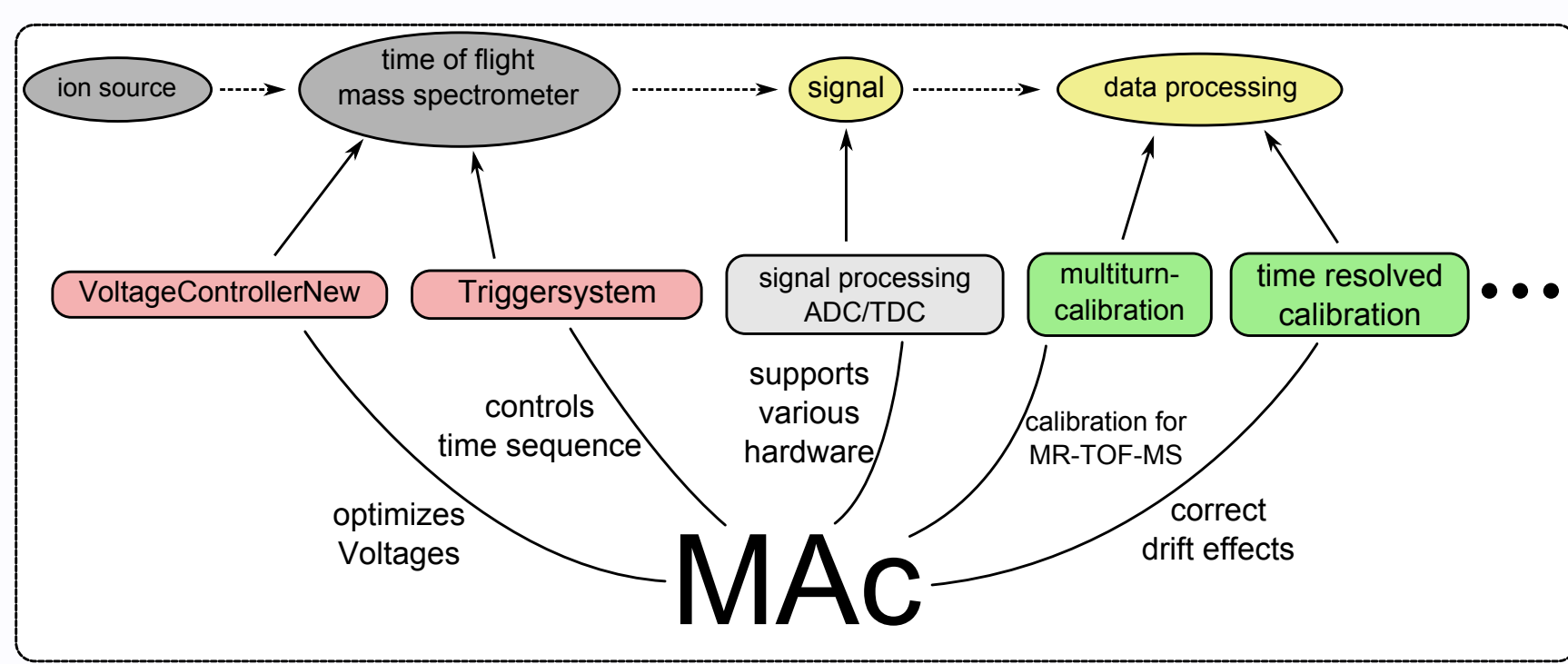


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1. MAC Software

- data acquisition
- data evaluation
- hardware control

Features:

- + ADC/TDC for large dynamic range
- + time sequence controller
- + multi-turn calibration
- + voltage optimizer
- + time resolved calibration
- + spectra accumulation
- + automatic peak detection
- + import/export various file formats
- + data operations (e.g. smoothing)

2. Enlarging Dynamic Range Using TDC and ADC Simultaneously.

TDC:

- + detection of single ions
- dead time effect

ADC:

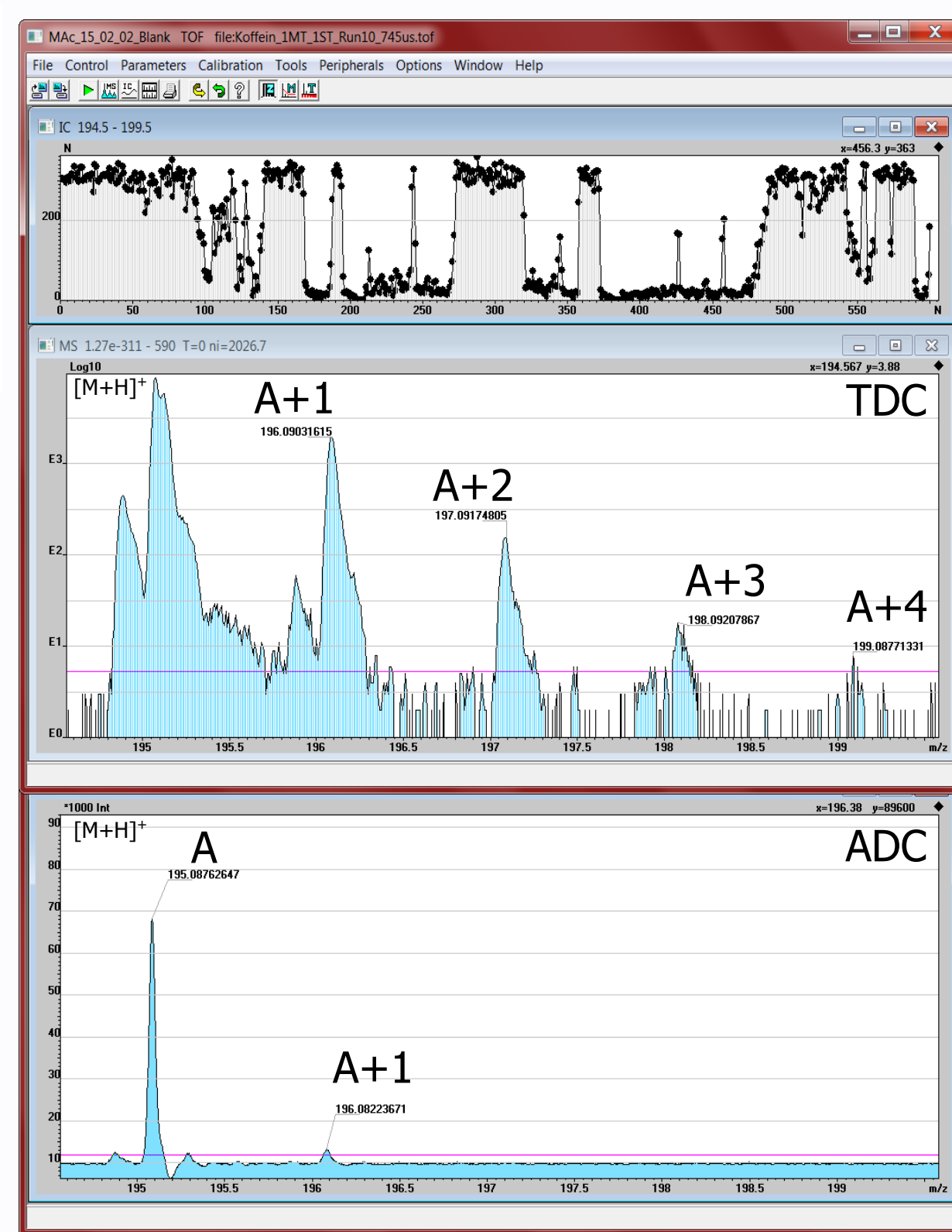
- + detection of high signal rates
- low intensity signals lost

Combined:

- + dynamic range > 4 orders of magnitude
- + detection of high and low signal rates

MAc:

- common user interface
- common calibration
- common file format and analysis tools



Example: Coffein (10^{-4} mol/l)

TDC (top):

- + A+1 to A+4

ADC (bottom):

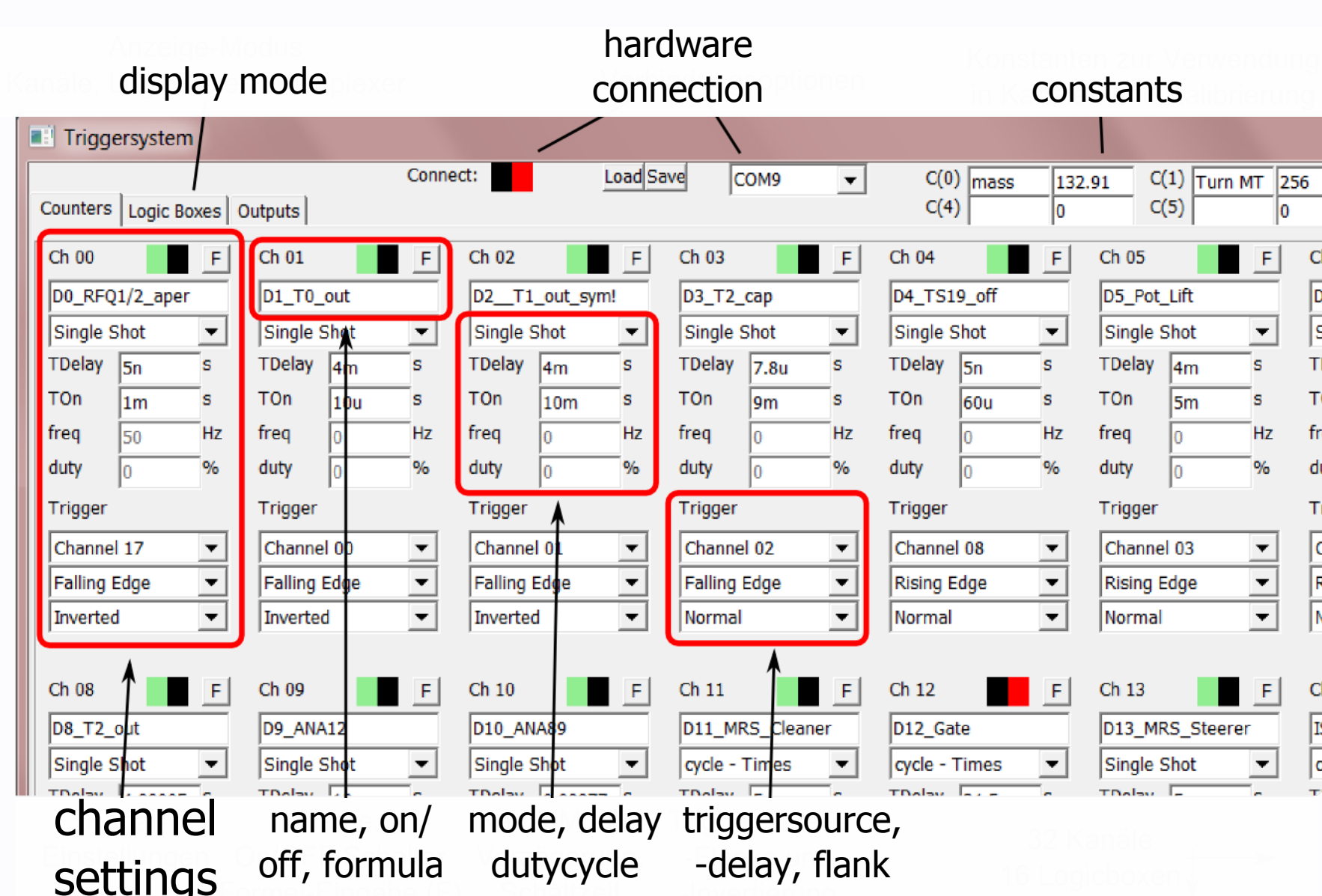
- + A and A+1

Device	Isotope	MAc	Literature	Rel. Deviation
ADC	m195 / m196	9,374 79	9,457 79	0,008 78
	m196 / m197	11,759 99	11,751 5	$7,1480 \cdot 10^{-4}$
TDC	m197 / m198	5,629 95	19,110 4	0,705 40
	m198 / m199	3,404 73	33,768	0,899 17

excellent isotope distribution
deviations from literature values due to unresolved isobars

3. Time Sequence Controller

- controls time sequences for RF ion traps, analyzer electrodes etc.
- multiple modes to set delays and duty cycles



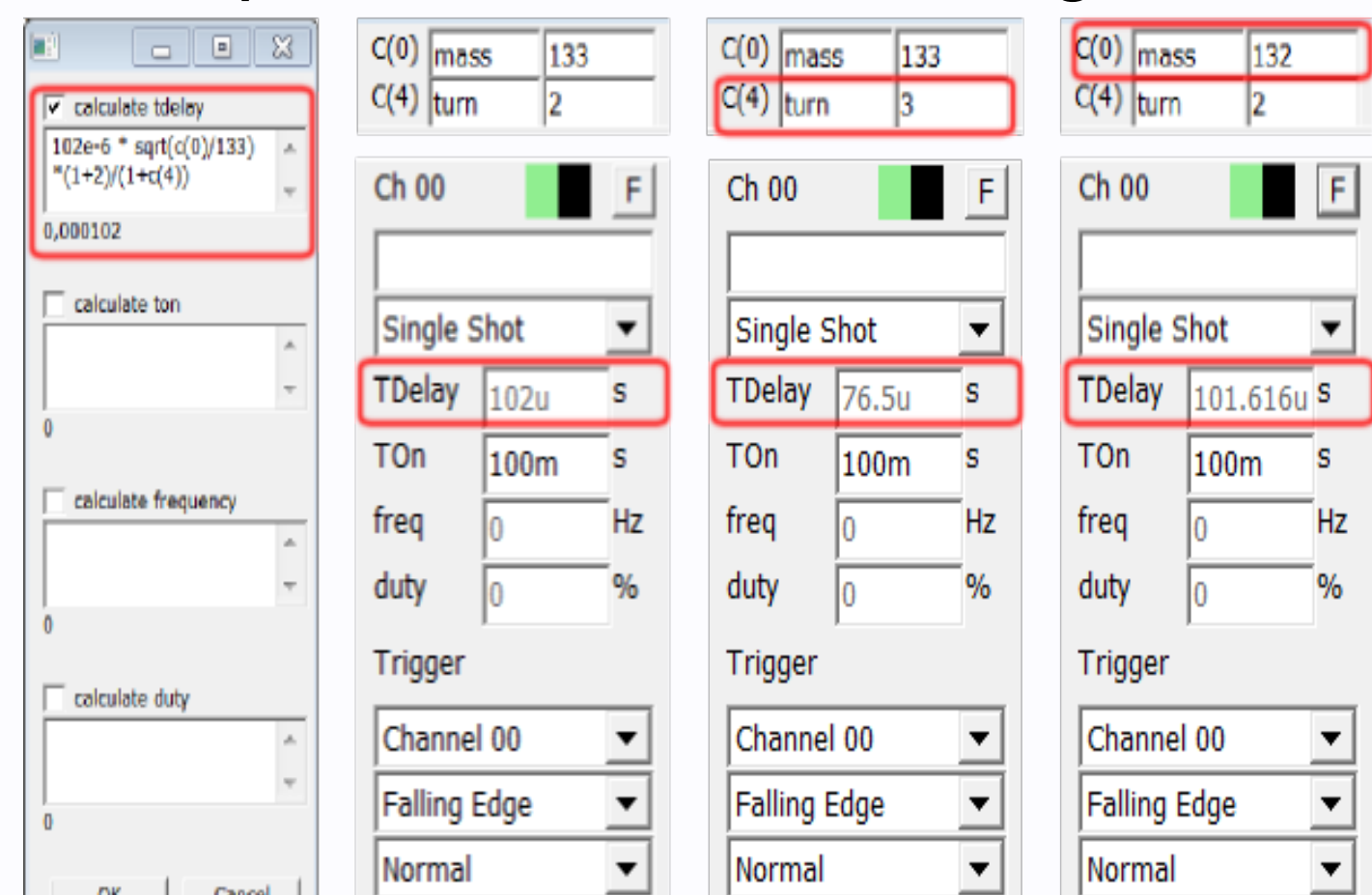
- + links triggers for 32 channels to each other or up to 16 logic channel combinations

- + uses formulas to calculate delay and duty cycles

- + link to other channel's times

- + use up to 8 constants

Example of automatic scaling



- + set times can be used in other MAc parts
- calibration

4. Multiturn Calibration

Calibration Formula

$$m = a \frac{(t - t_0)^2}{(1 + b \cdot N)^2}$$

$$a = \frac{2q \cdot U}{I_{detec}^2} \quad b = \frac{L_{turn}}{I_{detec}}$$

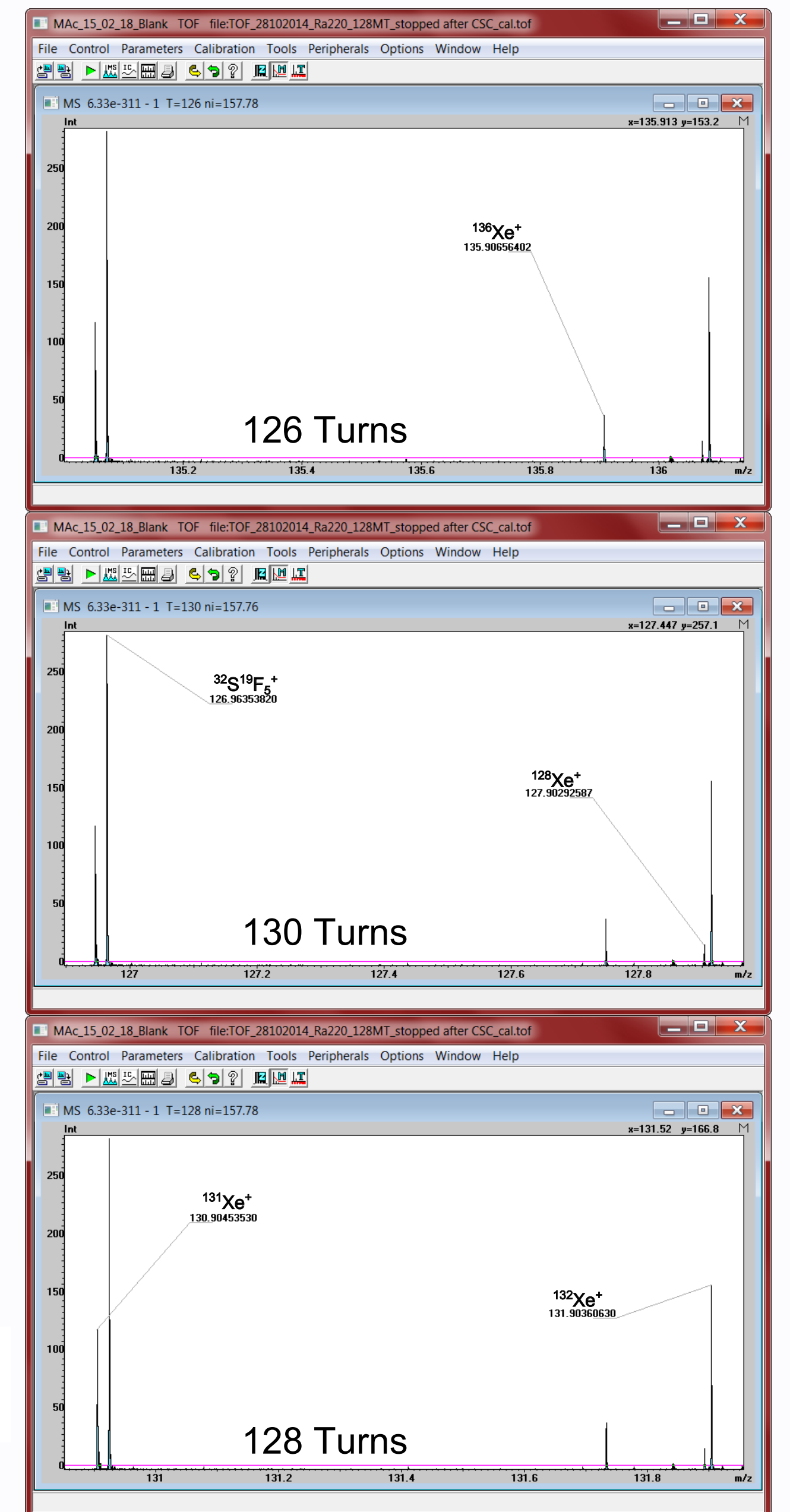
t_0 : electronic delay time

- + ≤3 calibrants → analytical solution
- + >3 calibrants → least square deviation minimizer
- + uses time sequence controller for trap extraction time
- + use and display for different turns in multiturn calibration
- + mass range greatly increased

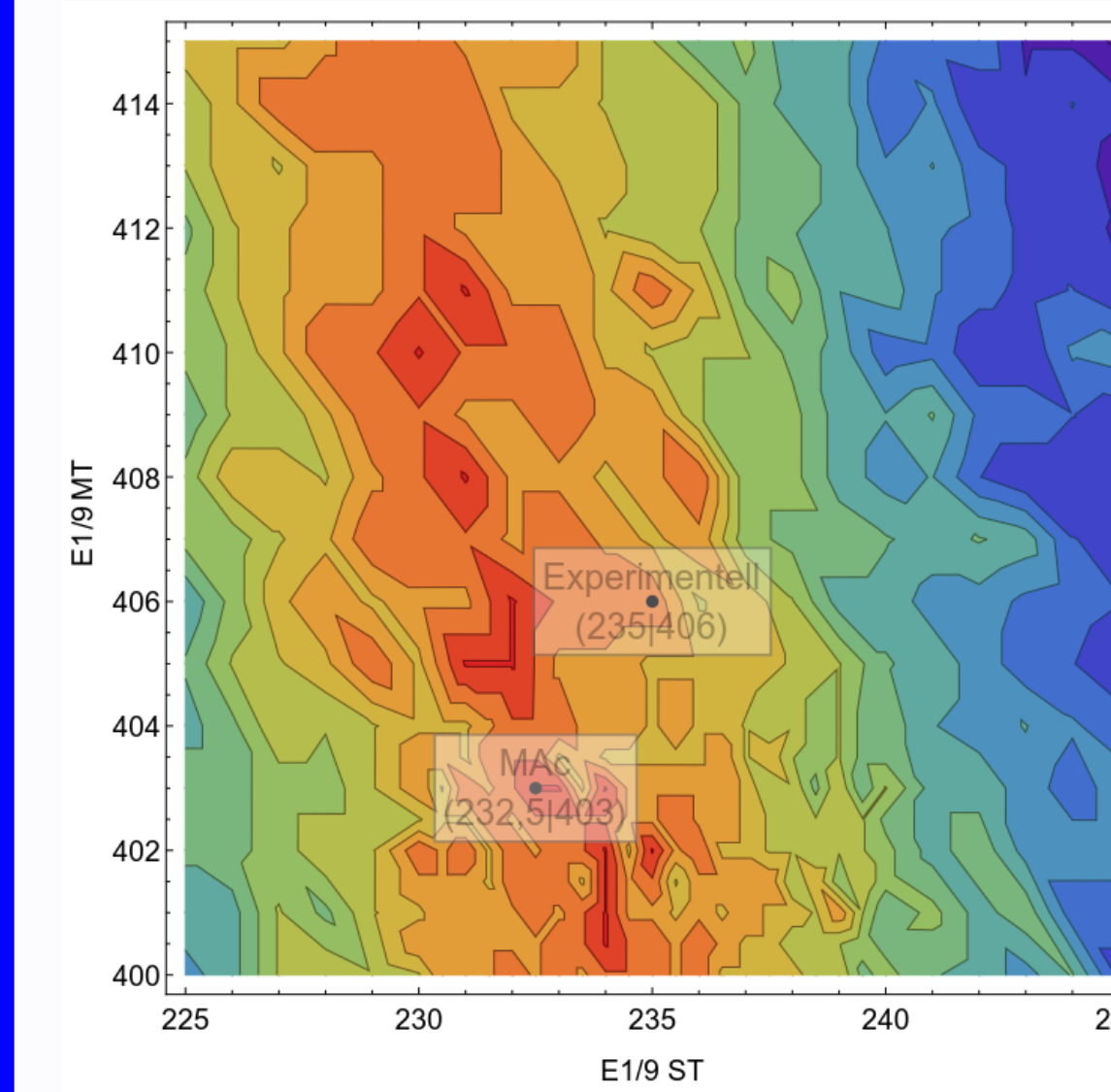
Example: Xe & SF6

- + between 126 and 130 turns
- + precision of online identified masses of $4 \cdot 10^{-7}$

Time (µs)	Turns	Mass MAc (u)	Mass Lit (u)	Lit-MAc Lit	Nuklid
49,3071469	130	127,9029259	127,9029822	$4,40 \cdot 10^{-7}$	$^{128}\text{Xe}^+$
46,5327600	126	135,906564	135,9066657	$7,48 \cdot 10^{-7}$	$^{136}\text{Xe}^+$



5. Voltage Optimizer



- connects to all available power supplies
- free choice for amount of channels
- from adjustable MIN to MAX all voltage combinations are scanned
- automatic measurement taken for each combination
- + up to 20 measurements per minute
- automatic optimization algorithms to be implemented

Conclusion:

Indispensable for preparing optimized off- and online measurements

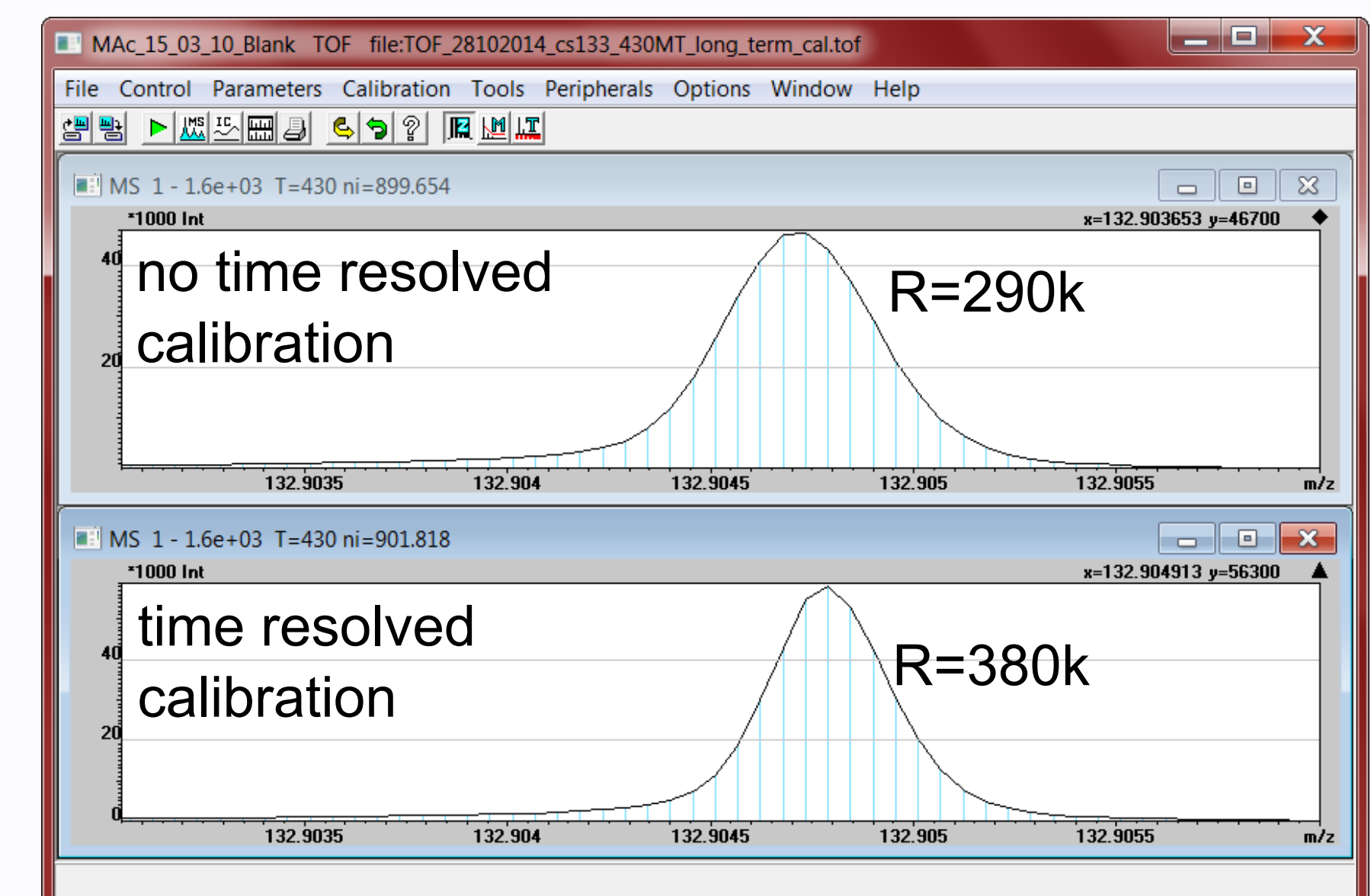
6. Time resolved calibration

Problem:

- voltages can vary during measurement
- thus flight length varies during turns
- mass lines shift in time

Solution:

- + each spectra gets calibrated → calibrant stays fixed in mass
- + automatic detection of calibrant
- + correction of 2000 spectra in under 1 second
- + recalibrated data can be displayed and used inside MAc
- + ideally suited for long term and high resolution measurements



Poster Information

Presentation at DPG Heidelberg 2015
Poster MS 6.3
Discussion: March 24, 17:00 until 19:00