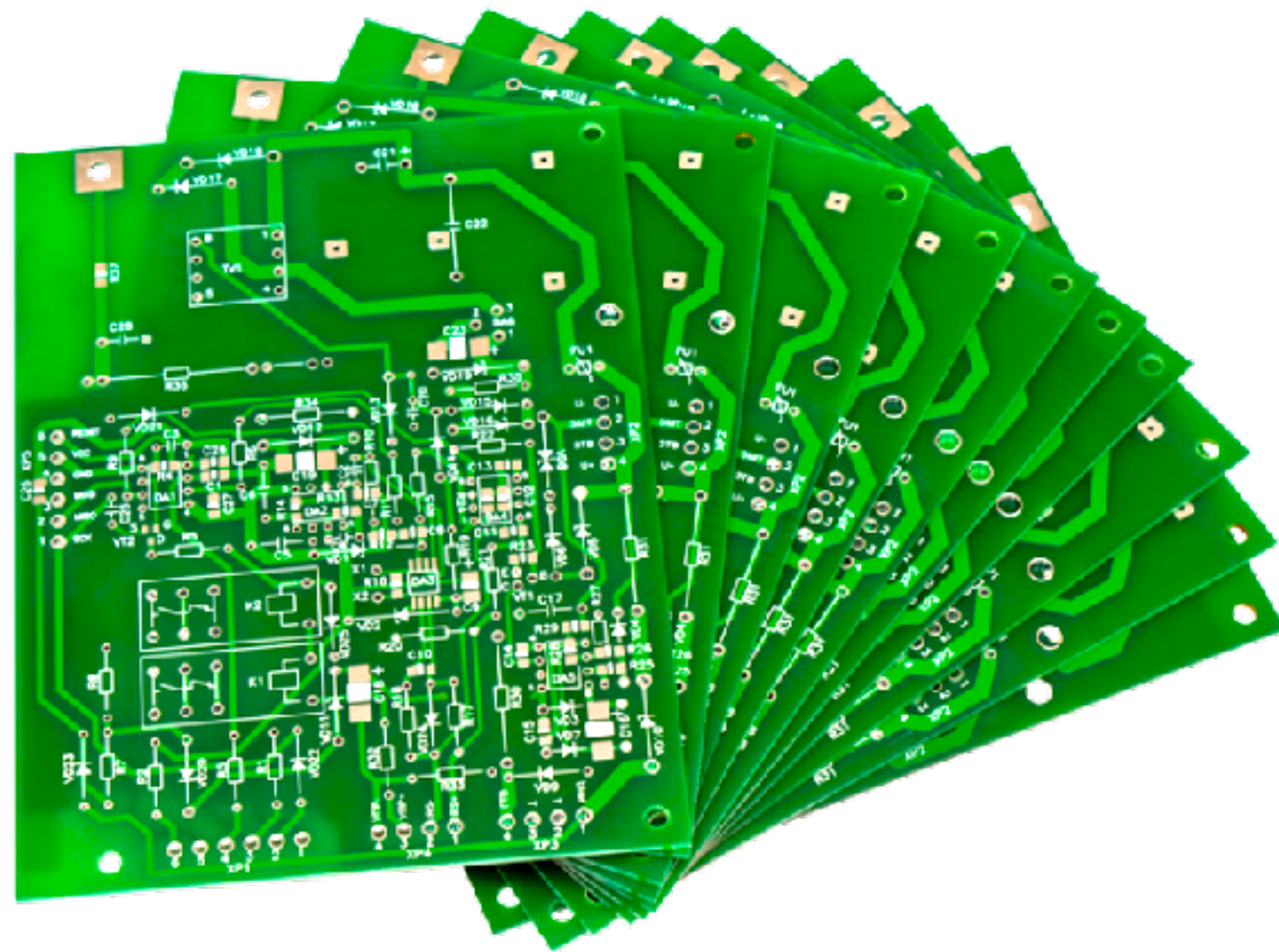


PCB anodes: High signal fidelity timing detectors for ions

Richard Wilhelm, Michael Kendler

TU Wien, Institute of Applied Physics

Regular PCBs



50 Ω impedance matched EMI
shielded transmission lines

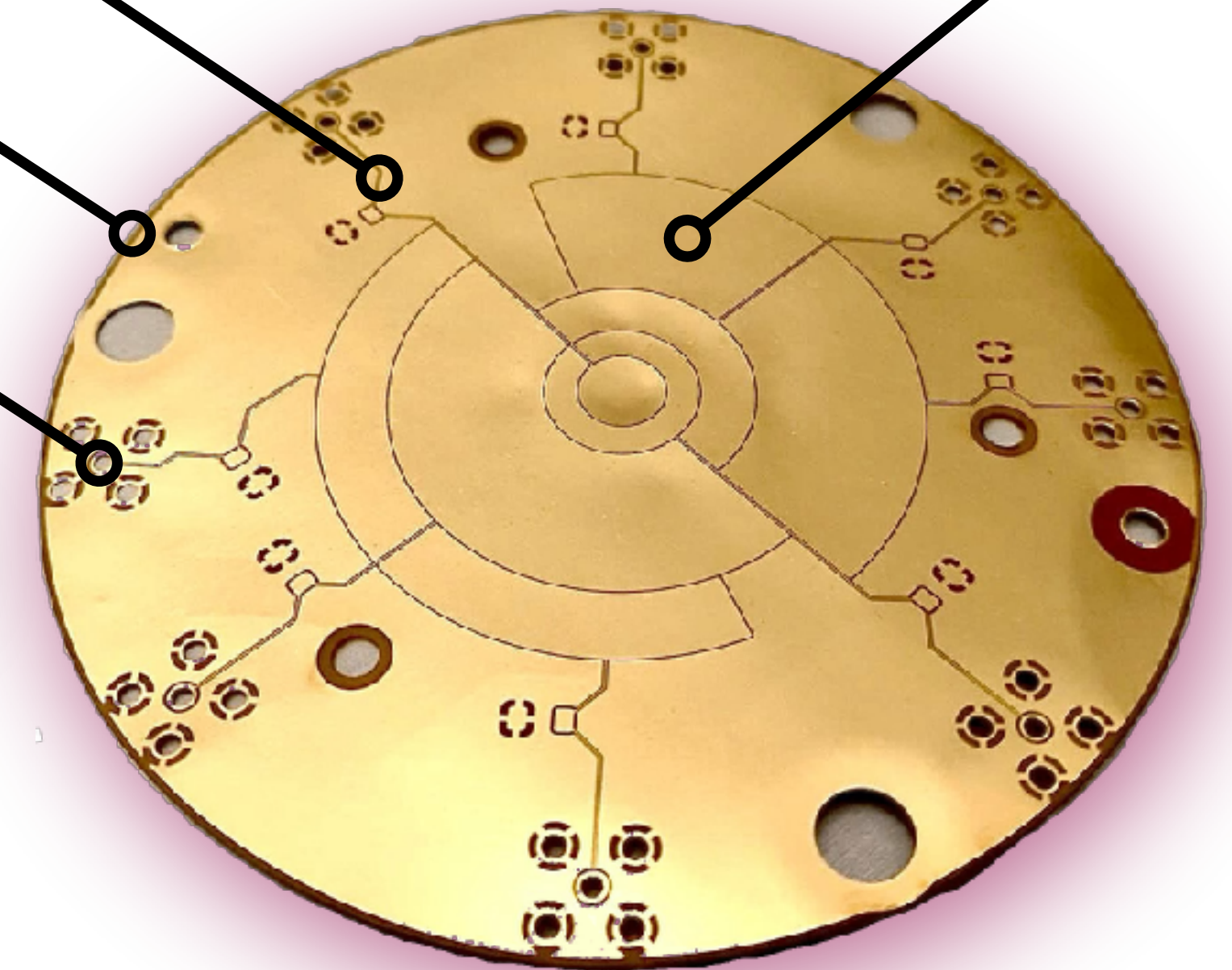
Embedded capacitor

High bandwidth
connector mounts

Polyimide laminates

arbitrarily shaped segmented
signal pickup patches

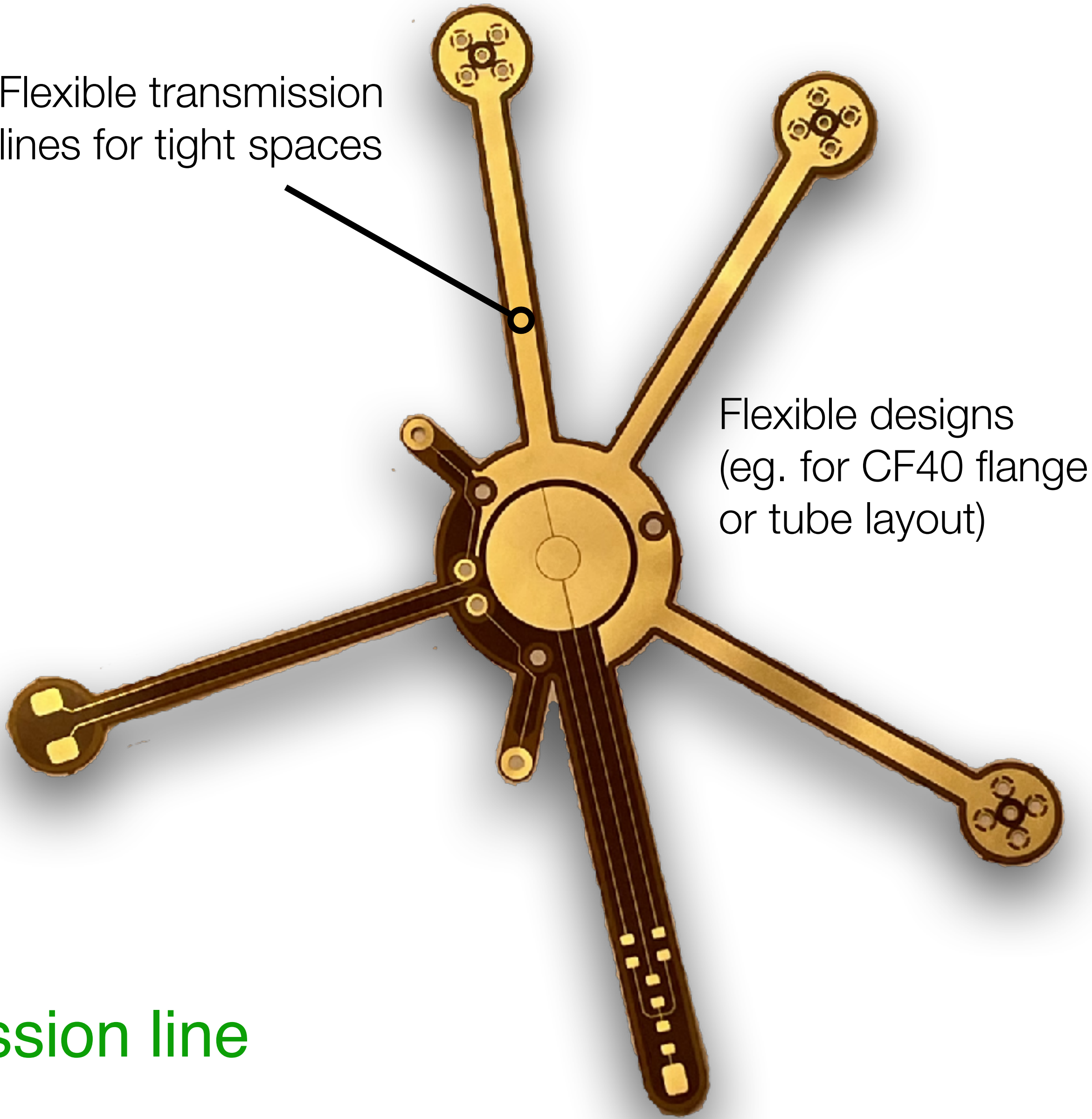
Our approach



- Outgassing of volatile components
- Not suitable for high frequency signals out-of-the-box
- Limited temperature range (no bake-out possible)

- ✓ No outgassing
- ✓ High breakdown voltage capacitor
- ✓ Uses high frequency compatible material
- ✓ Temperature tolerance for bake-out

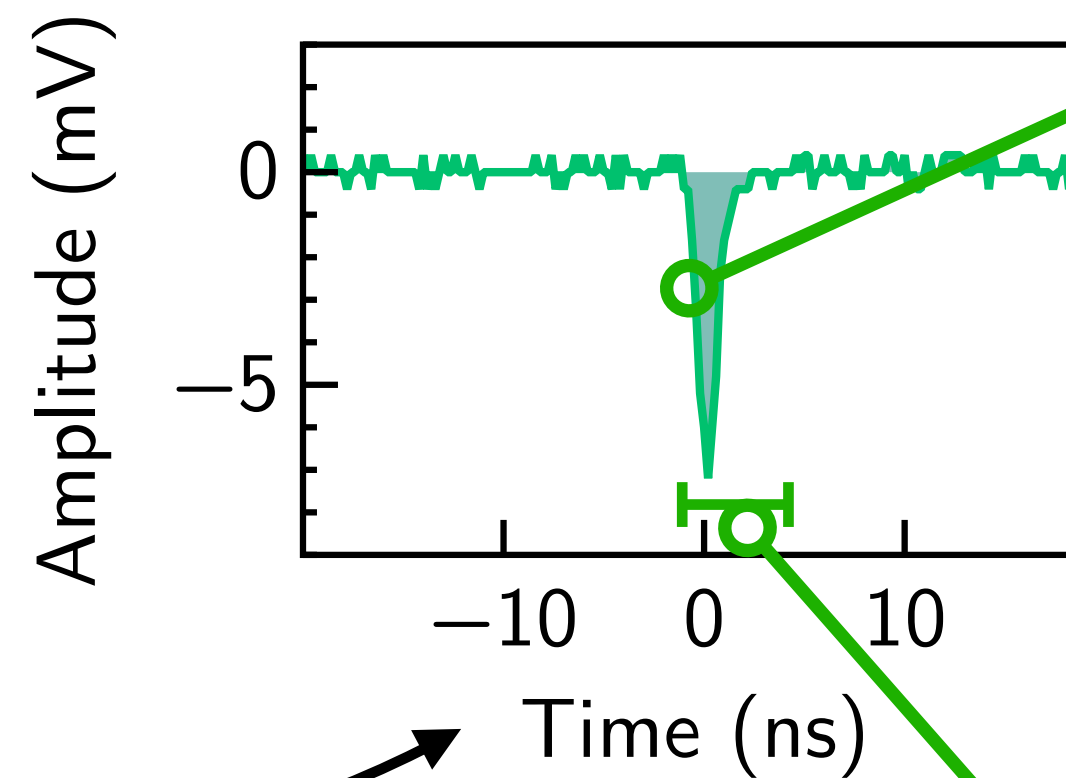
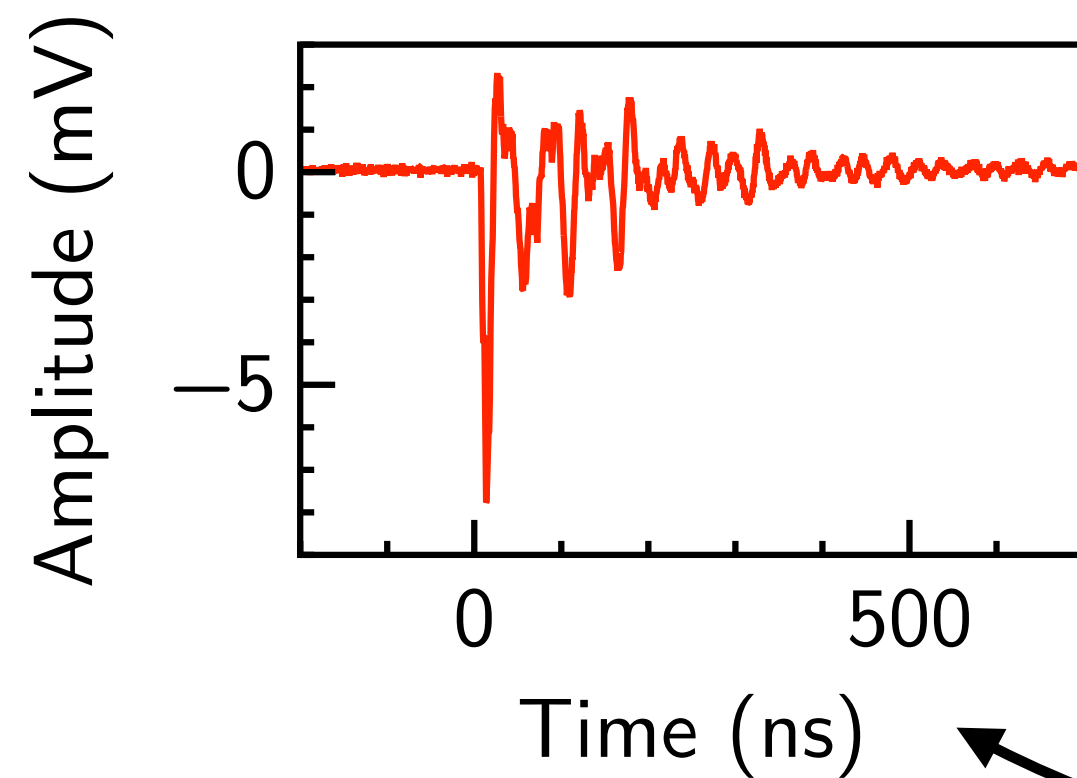
UHV / high voltage / HF challenges	Our solution
Stiff and brittle insulation materials e.g. ceramics (unreliable mounting in tight spaces)	Flexible laminates, high voltage capacitive out-coupling included (flexible for different applications)
Unshielded UHV wires not suitable for HF signal transmission (high AC noise floor)	Printed 2D transmission lines with 50Ω impedance (ultralow signal noise)
Discontinuous transmission line impedance due to non-standard cable connections (signal ringing)	On board SMA connectors with 2GHz coaxial cables for constant 50Ω impedance matching (no signal ringing)
HV feedthroughs typically not high bandwidth compatible (damping)	HV capacitive out-coupling embedded in the design (high signal amplitudes)



- Higher bandwidth signal read-out
 - Lower noise floor on the transmission line
 - Higher signal-to-noise ratio

Standard timing anode

Our solution



note the different
time bases

500ns per pulse!

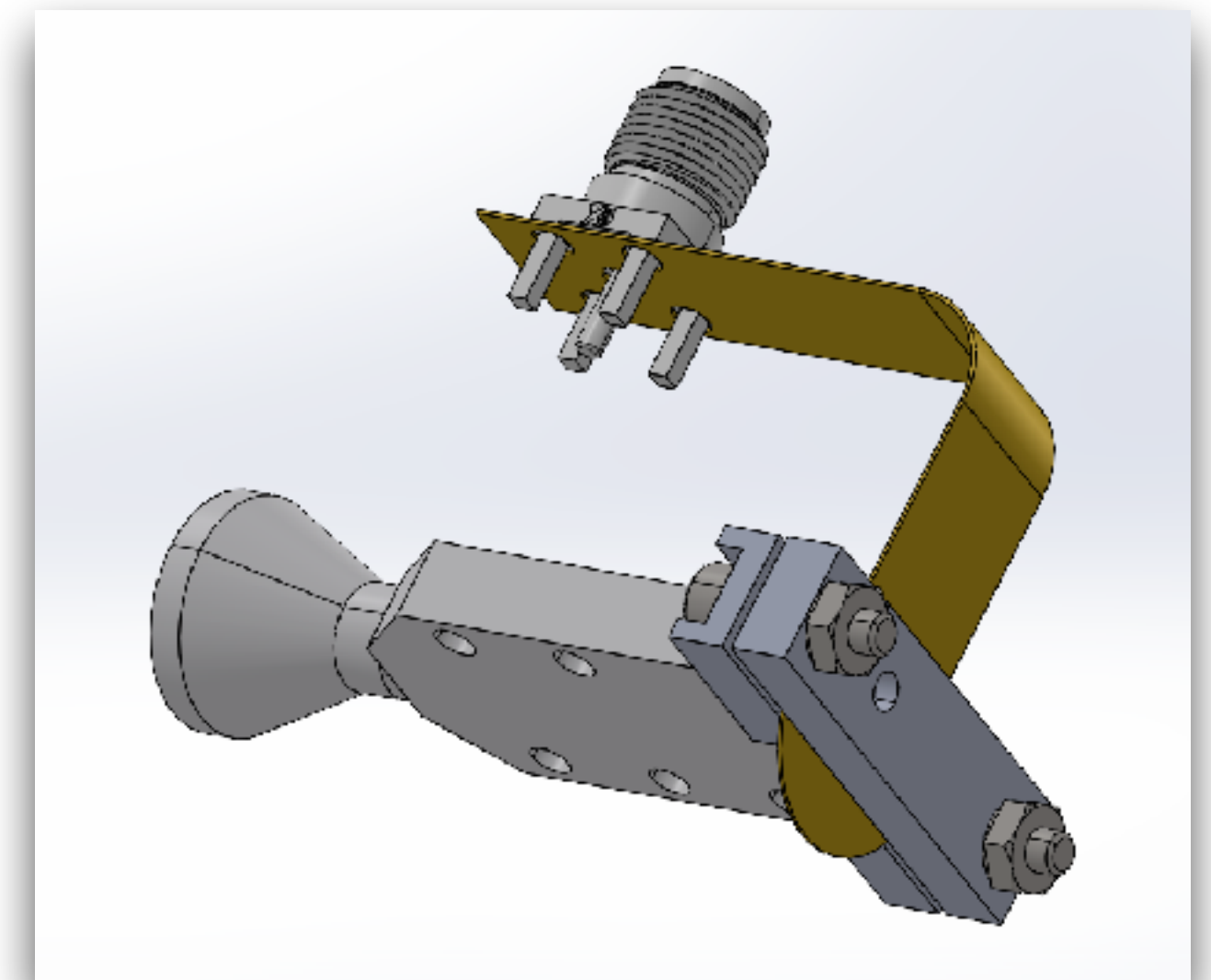
Keep count rate $\ll 1$ MHz
to avoid overlap/pile-up

5ns per pulse!

Count rate > 1 MHz
easily possible

Faster measurement,
real-time process control with RGA!

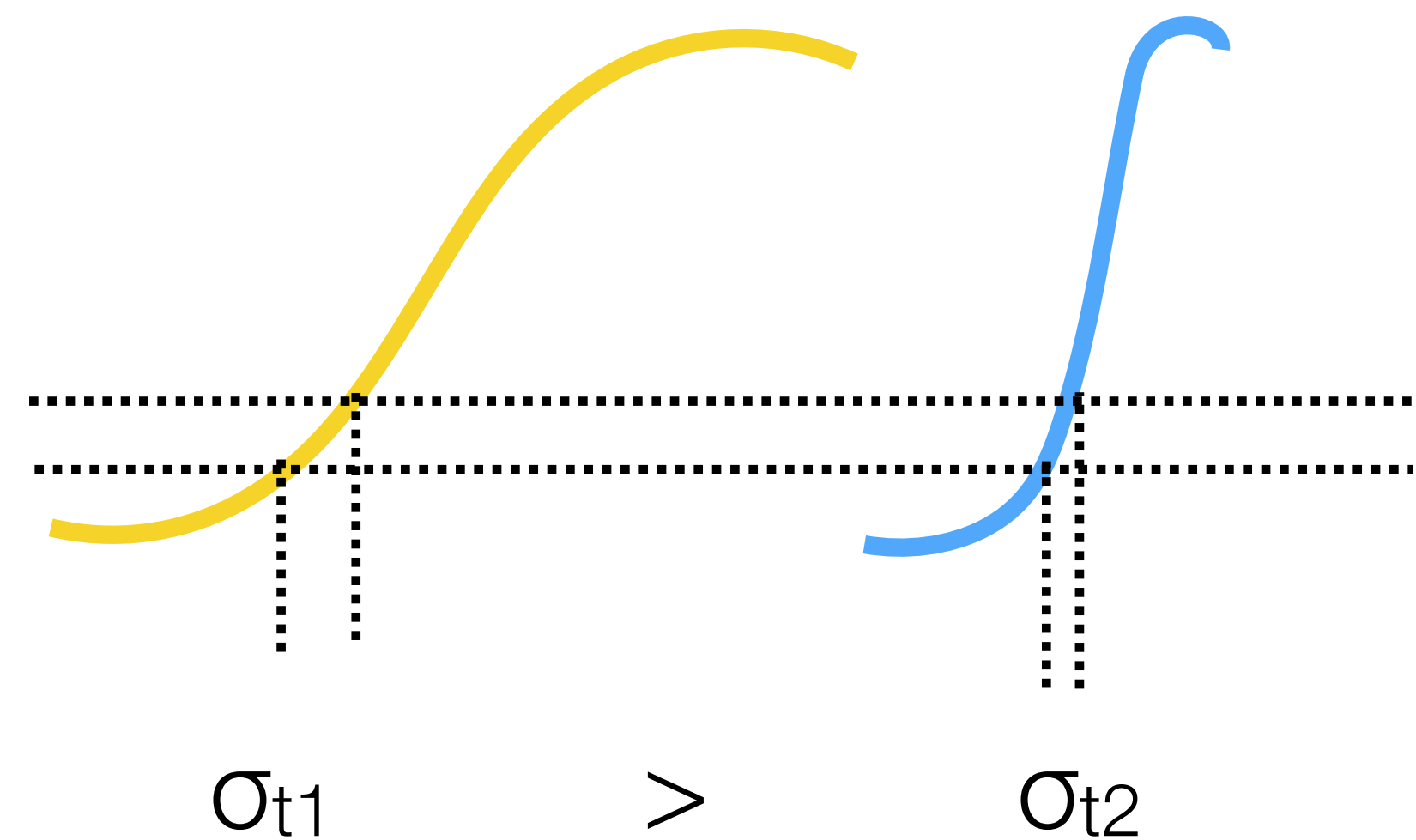
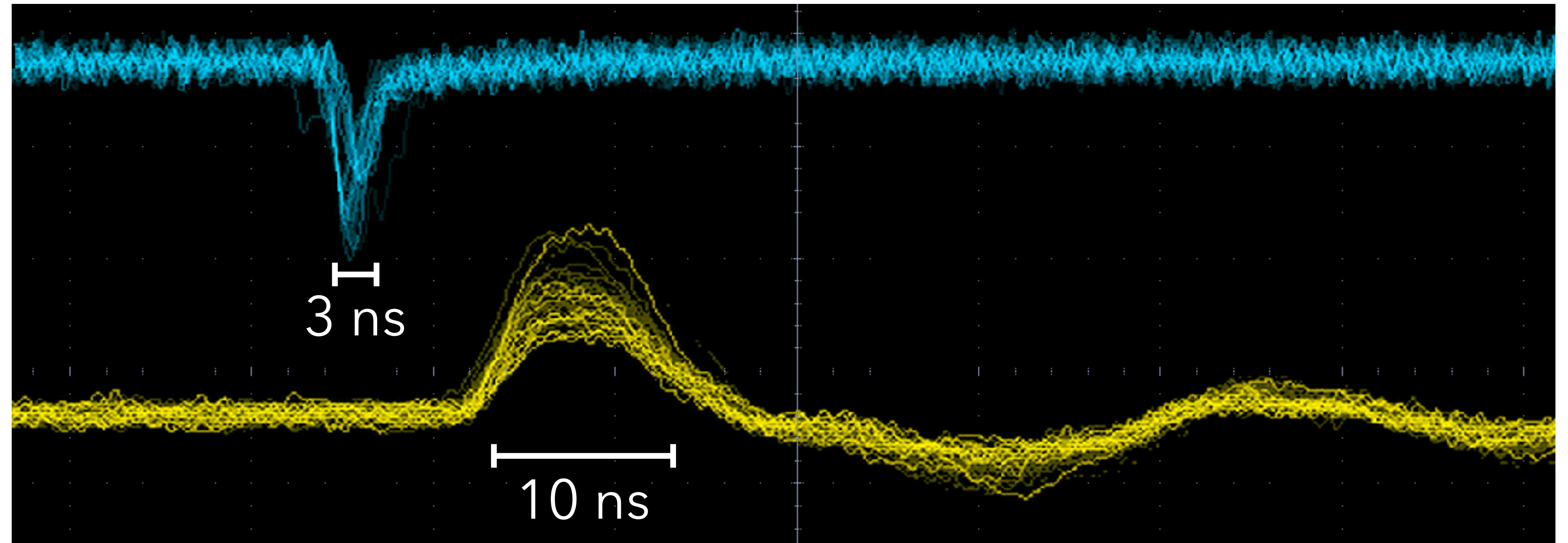
Signal rise time $\ll 1$ ns
Signal jitter < 100 ps
**TOF stop time resolution:
80 – 100 ps (world record)**



Fits also a
channeltron!
1st test successful!

Our PCB anode:

Standard metal
anodes:

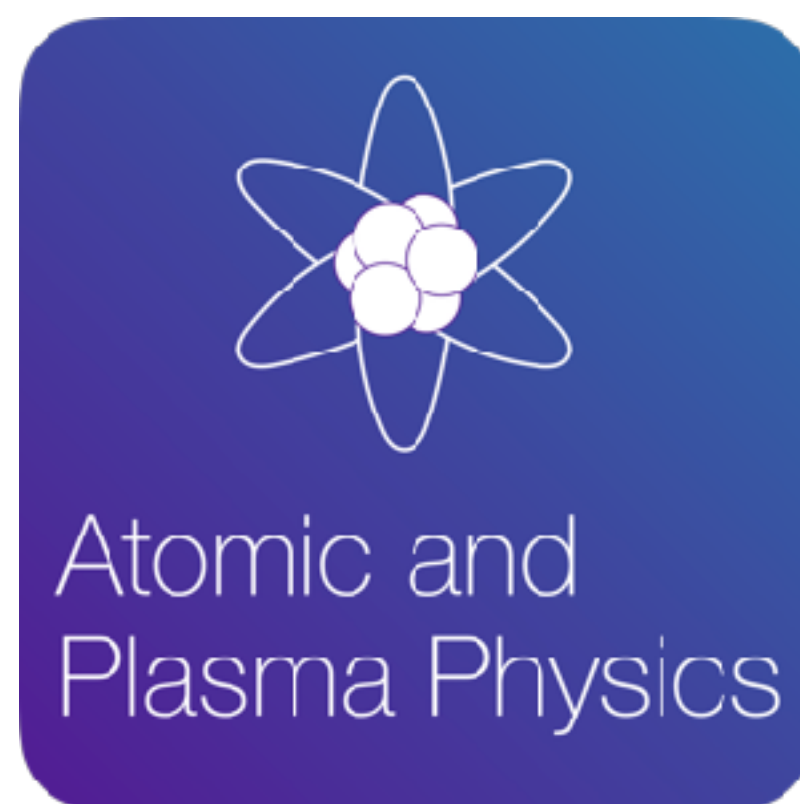
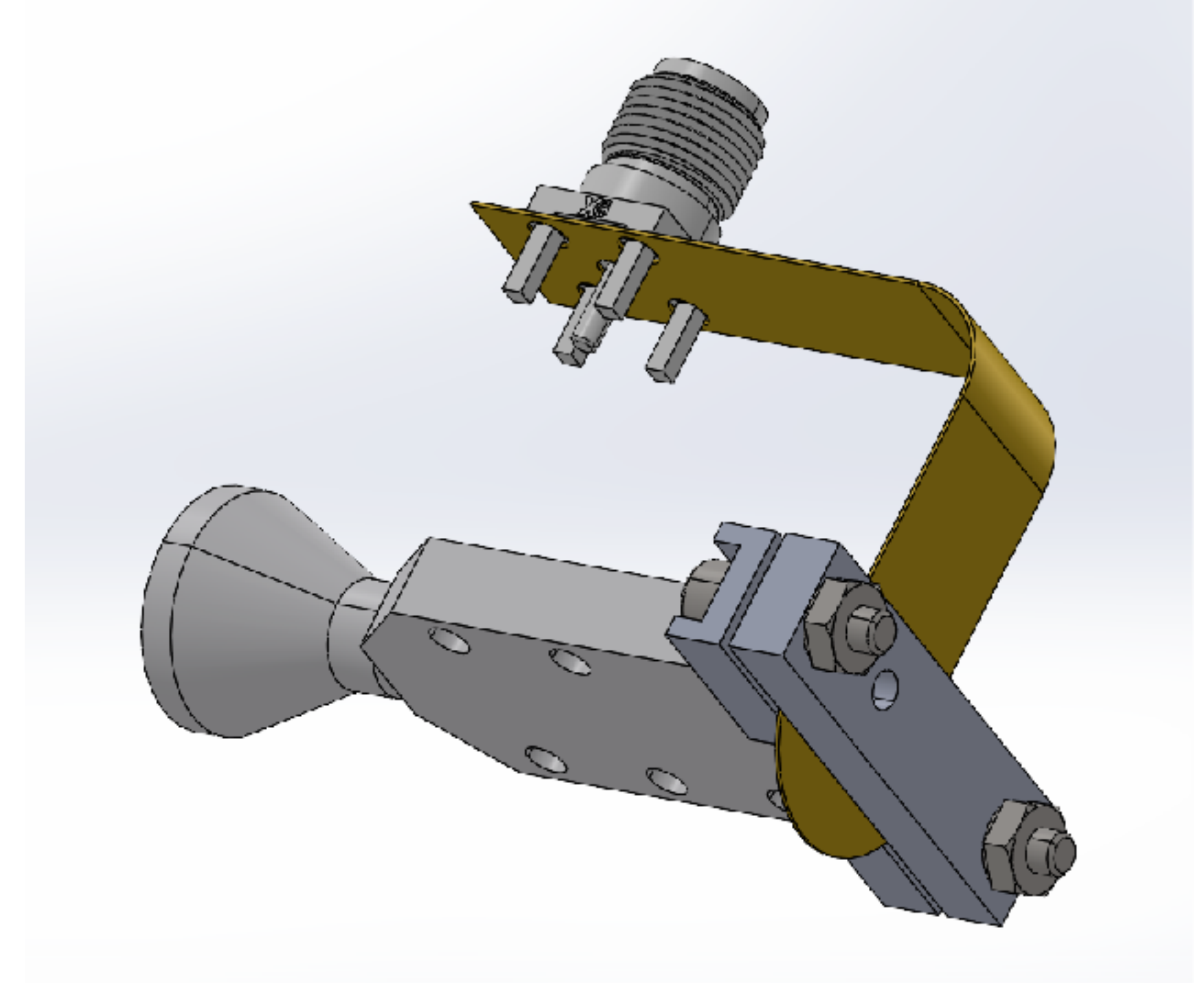
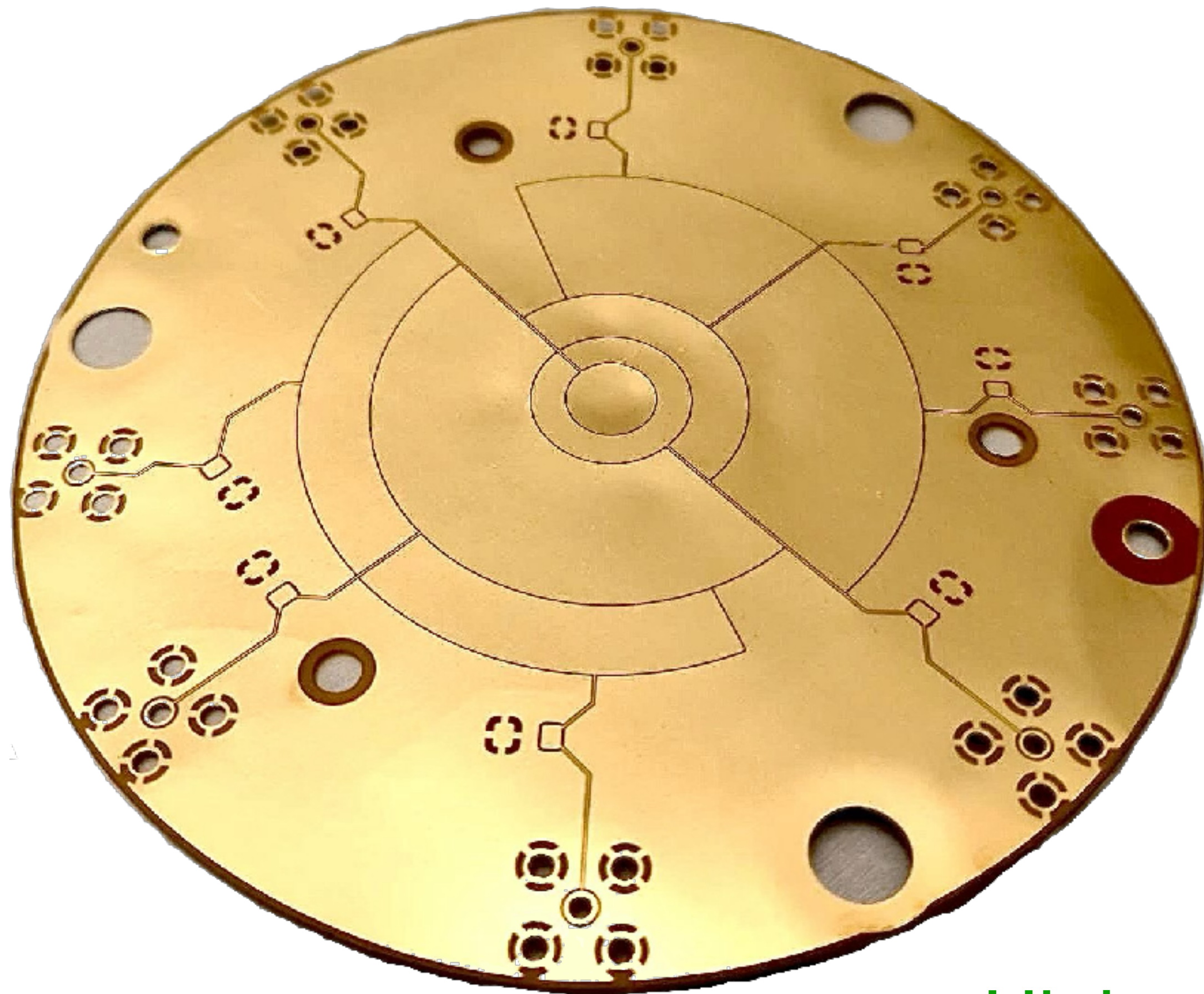


Discriminator
triggering range

Target resolution: $m/\Delta m \sim 200$

Especially for small atomic masses
and
short TOF chambers

σ_t has to be $< 1\text{ ns}$



- ▶ Higher TOF resolution - higher mass resolution
- ▶ Higher count rates - faster spectrum acquisition
- ▶ Higher sensitivity - detect trace amounts
- ▶ Segmented MCP anode - measure faster in parallel
- ▶ Fits a channeltron, fits tight spaces