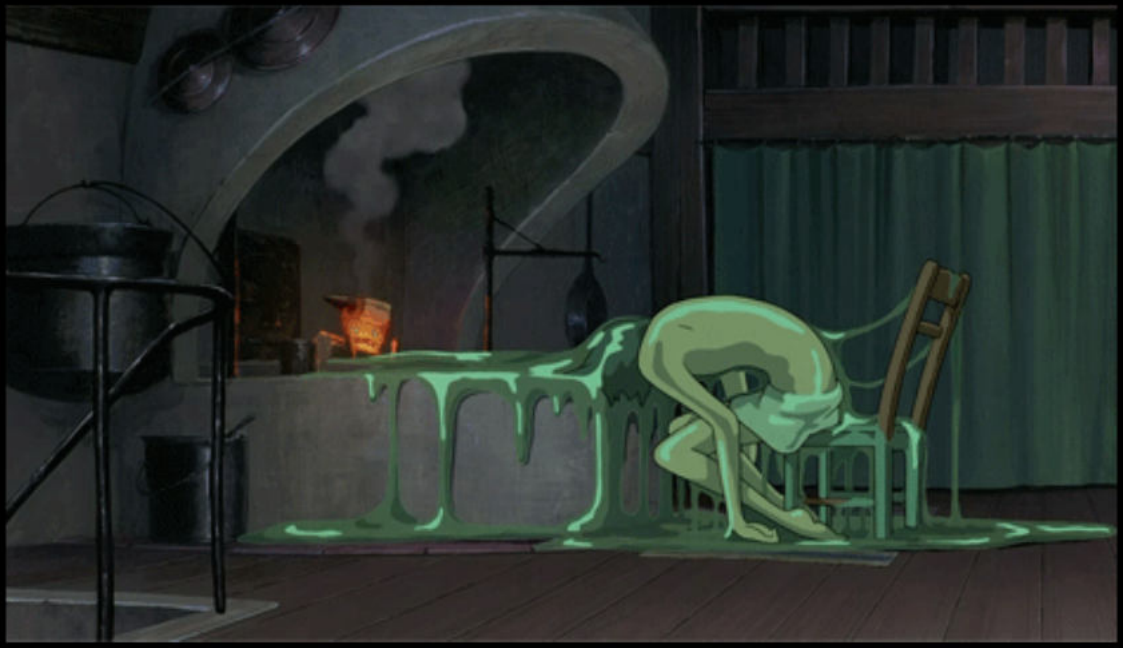
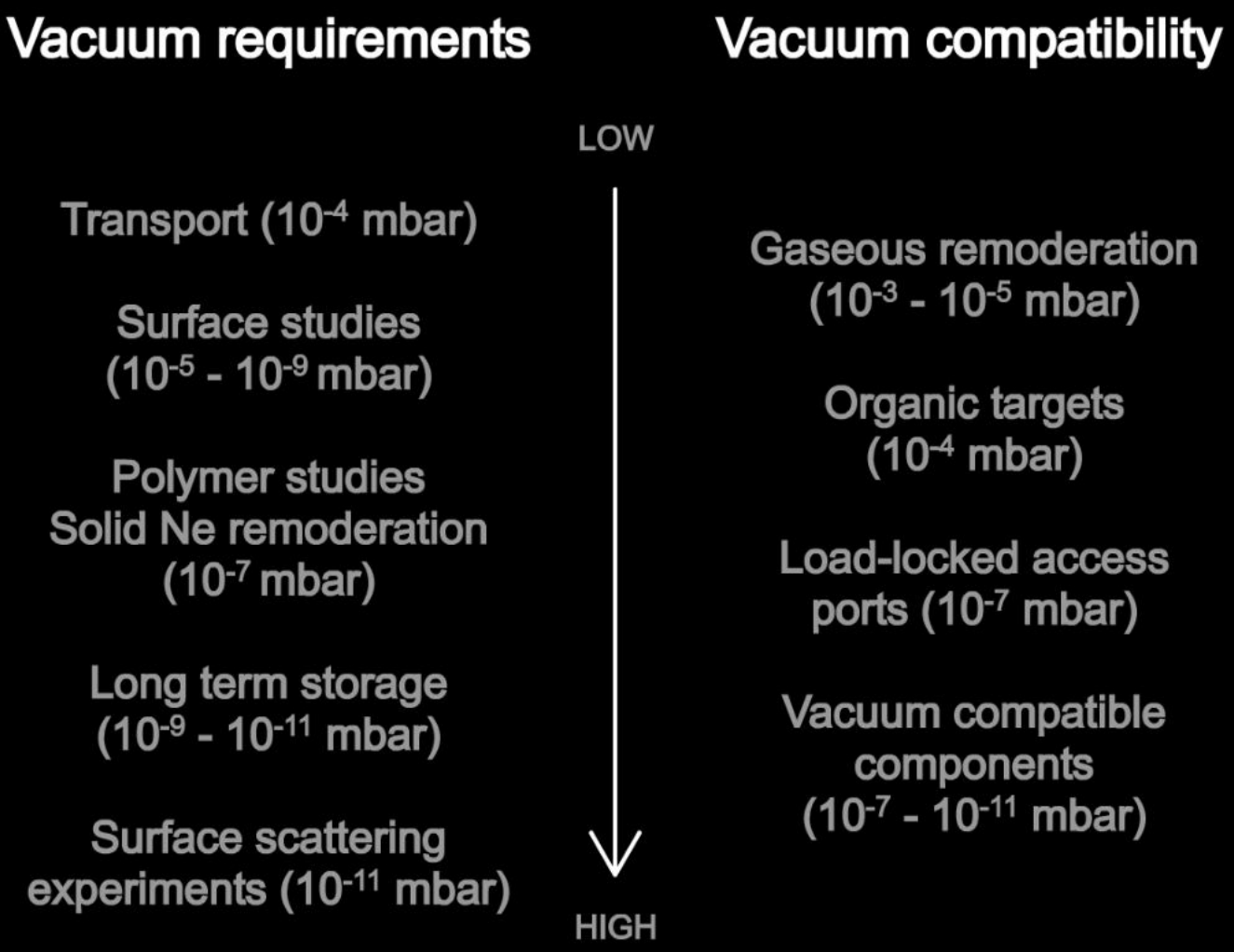
[…]

The human body, as seen from an ultra-high vacuum specialist perspective



Howl's Moving Castle
Hayao Miyazaki - 2004


Vacuum requirements
Vacuum compatibility
LOW
HIGH
Transport (10^{-4} mbar)
Surface studies (10^{-5} - 10^{-9} mbar)
Polymer studies
Solid Ne remoderation (10^{-7} mbar)
Long term storage (10^{-9} - 10^{-11} mbar)
Surface scattering experiments (10^{-11} mbar)
Gaseous remoderation (10^{-3} - 10^{-5} mbar)
Organic targets (10^{-4} mbar)
Load-locked access ports (10^{-7} mbar)
Vacuum compatible components (10^{-7} - 10^{-11} mbar)

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Organic targets
(10^{-4} mbar)

Load-locked access ports (10^{-7} mbar)

Vacuum compatible components
(10^{-7} - 10^{-11} mbar)

What about electronics?

FRM II
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz

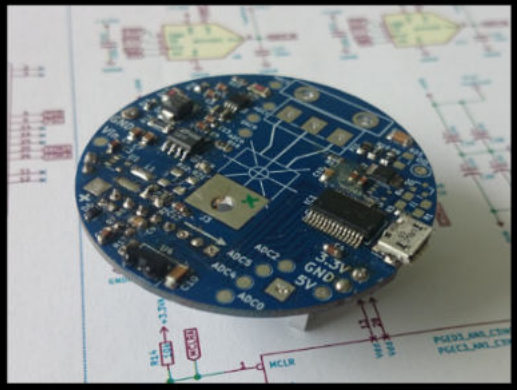
Technische
Universität
München

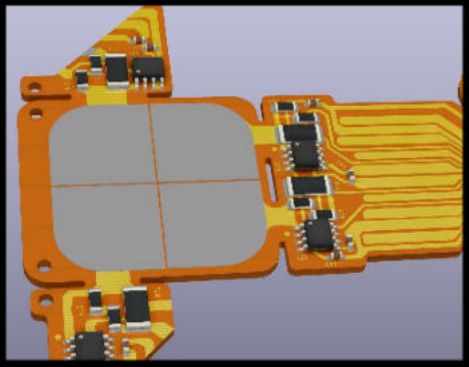
Bringing Electronics into Vacuum: Smarter Targets for Positron Physics

Francesco Guatieri
NEPOMUC

WHY ?

Avoid / Limit passthroughs
(e.g. when working with high voltages)

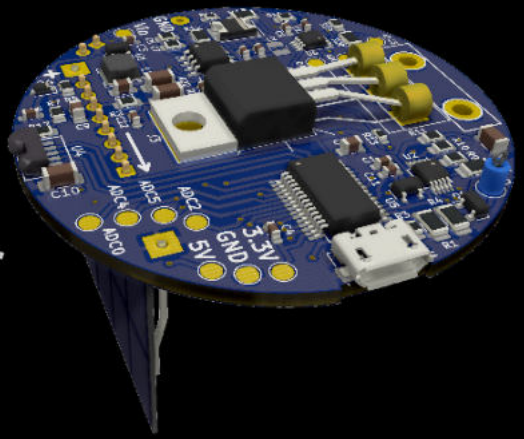




Local preamplification
(extremely low input signals)

Active Sample Holder

Bachelor thesis of Kilian Brenner

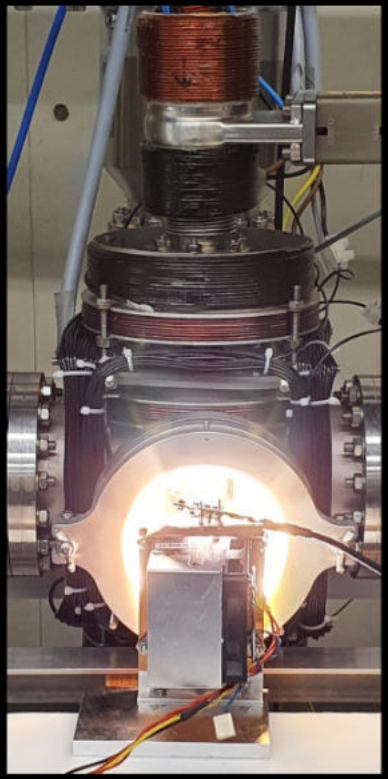


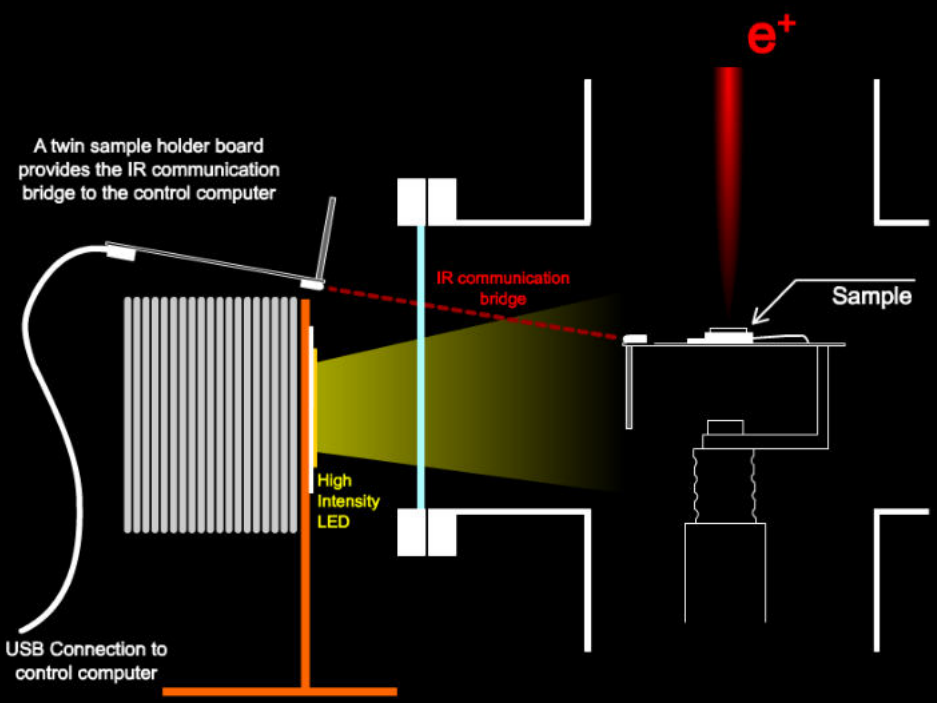
Galvanically-insulated microcomputer
that operates directly in vacuum

Designed to perform active manipulation of samples

- Application/readout of voltages and currents
- Temperature measurements
- Strain measurements
- Operation of microactuators
- Completely operated through light

OPERATION THROUGH LIGHT





WHAT MAKES IT VACUUM COMPATIBLE?

Mainly choice of components.

THT Electrolytic Capacitor

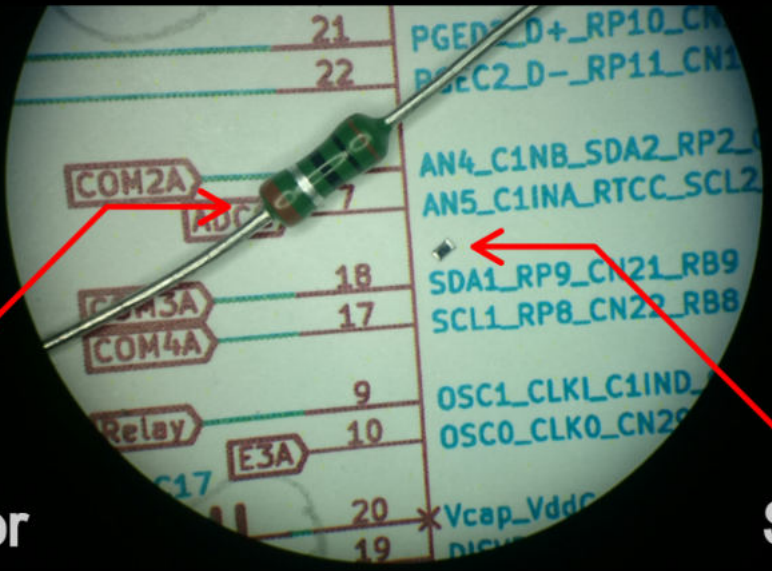
Aluminum body
Removable PET label
Liquid filled
Rubber plug on the bottom

SMD MLCC Capacitor

Hundreds of times smaller
Completely solid state
Full ceramic body
High temperature rated

WHAT MAKES IT VACUUM COMPATIBLE?

Mainly choice of components.



THT Resistor

Large body
Covered in enamel
Tin-coated terminals

SMD resistor

Hundreds times smaller
Ceramic and enamel body
High temperature rated

Also, complete removal of flux residuals.

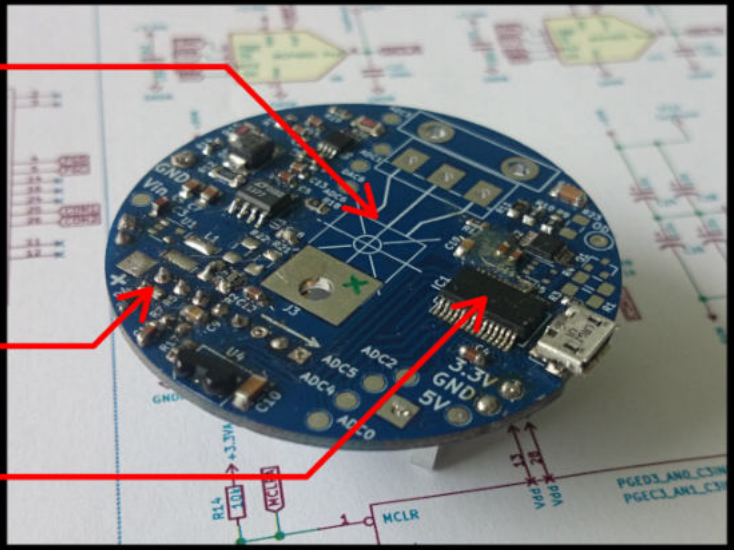
WHAT MAKES IT NOT VACUUM COMPATIBLE?

Solder resist layer

Solar cell

Solder

Plastic body of ICs

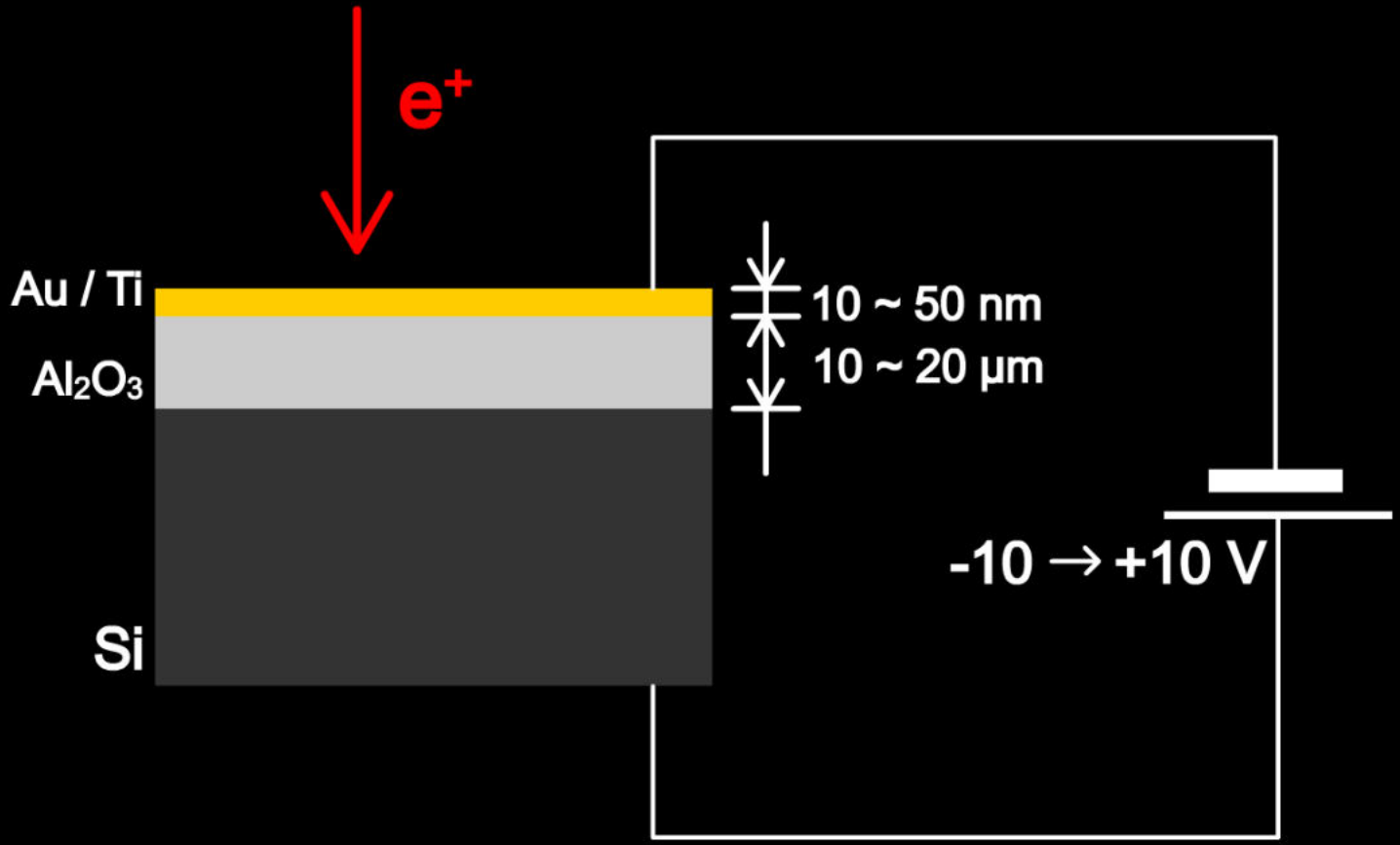


Despite that, in our apparatus

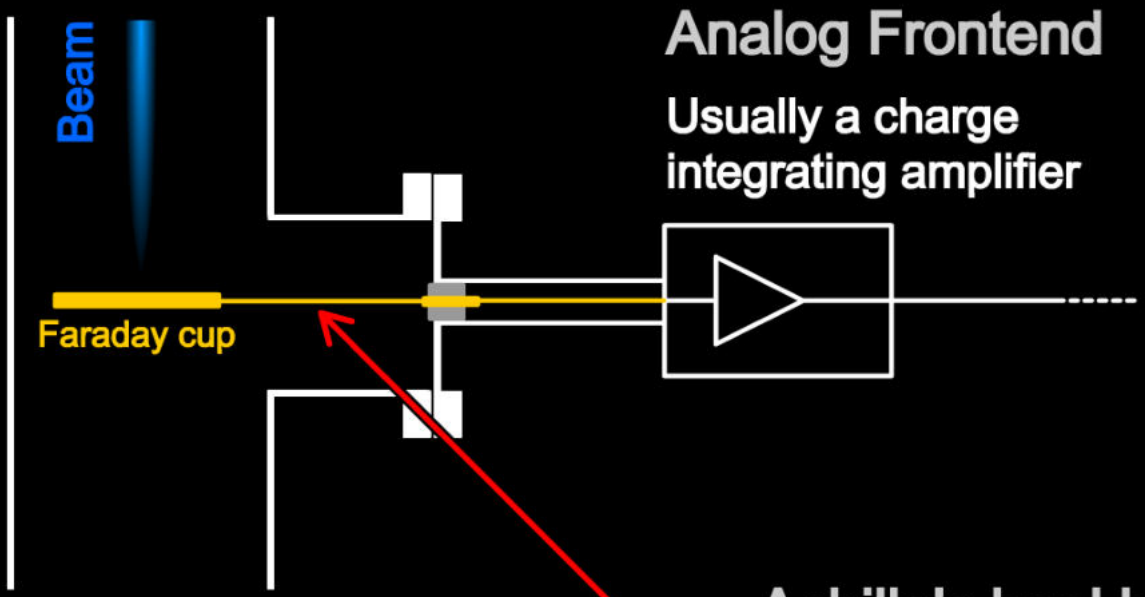
~10^{-6} mbar initial pressure

1.8 10^{-7} mbar after conditioning

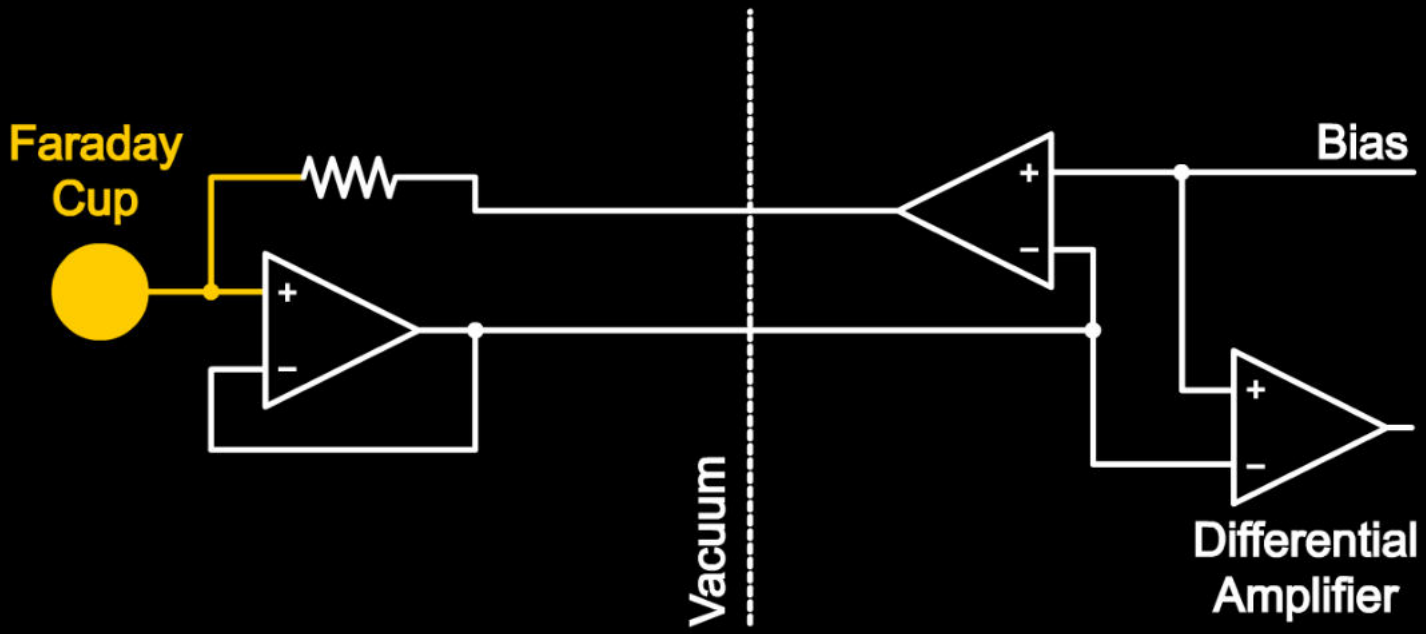
Development and commissioning is completed.
The first experiments are ongoing.



TYPICAL FARADAY CUP DESIGN



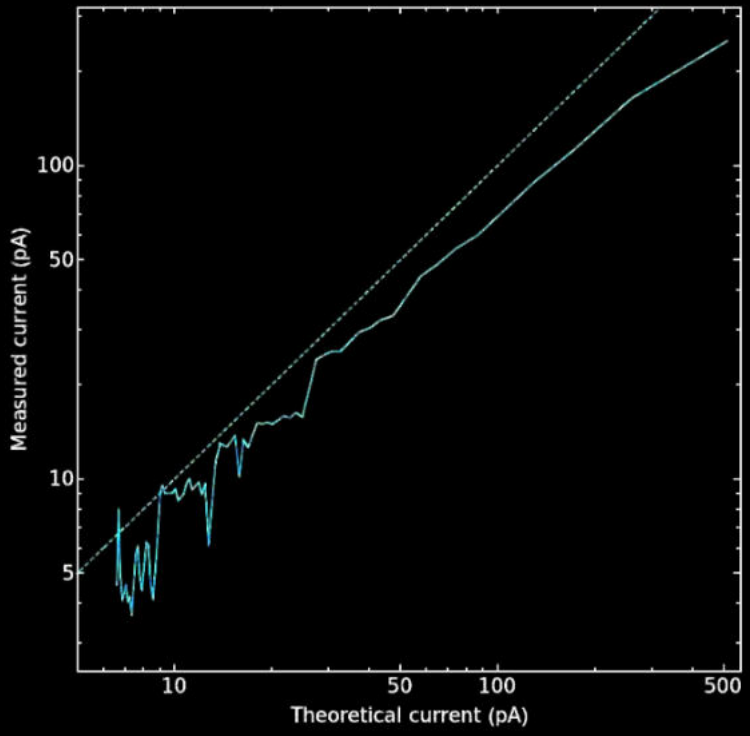
A DIFFERENT DESIGN



Preamplifier installed in vacuum
All connections to the outside are amplified

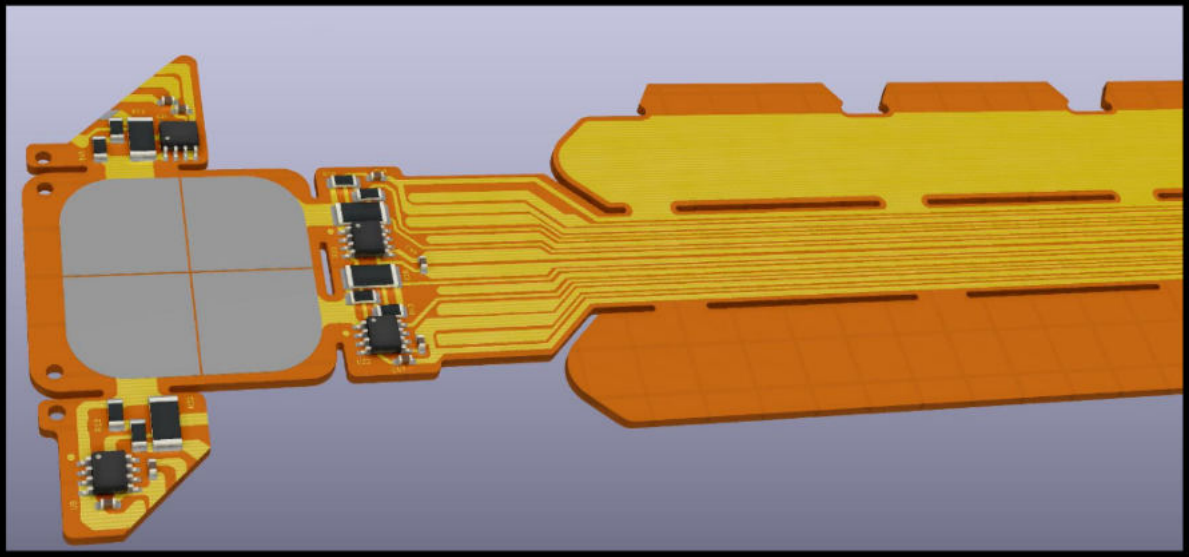
PRELIMINARY PERFORMANCE ASSESSMENT

(From the bachelor thesis of Michael Zimmermann)



Measurement time <1s

CURRENT DESIGN AIM



Four adjacent Farady Cup detectors

Sensitive to position and intensity of the beam

We aim at sub-second picoampere precision

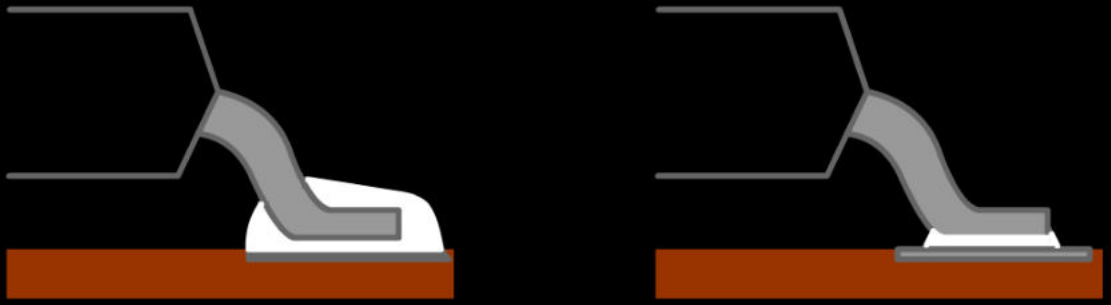
Suitable to perform live beam optimization

IMPROVING ON THE VACUUM COMPATIBILITY

Solder resist layer → Gold-on-Kapton PCB

~~Solar cell~~

Solder → Different soldering technique to reduce exposed solder

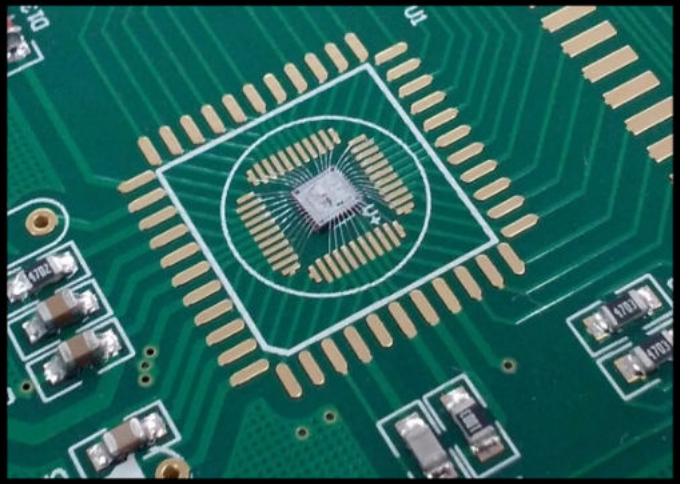


Plastic body of ICs

Still a problem?

A POTENTIAL SOLUTION TO REMOVE IC CASING

Direct to PCB wire bonding



Requires specialized external manufacturing
so we would like to test whether it is necessary

WE WON'T STOP HERE

There are several direction in which
we can expand our approach

Union of the two technologies
(i.e. Faraday Cups on active sample holders)

More complex manipulation

Custom integrated electronics

Multipixel detectors

What electronics would you like install in your experiment's vacuum if you could?

What electronics would you like install in your experiment's vacuum if you could?

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Thanks for your attention