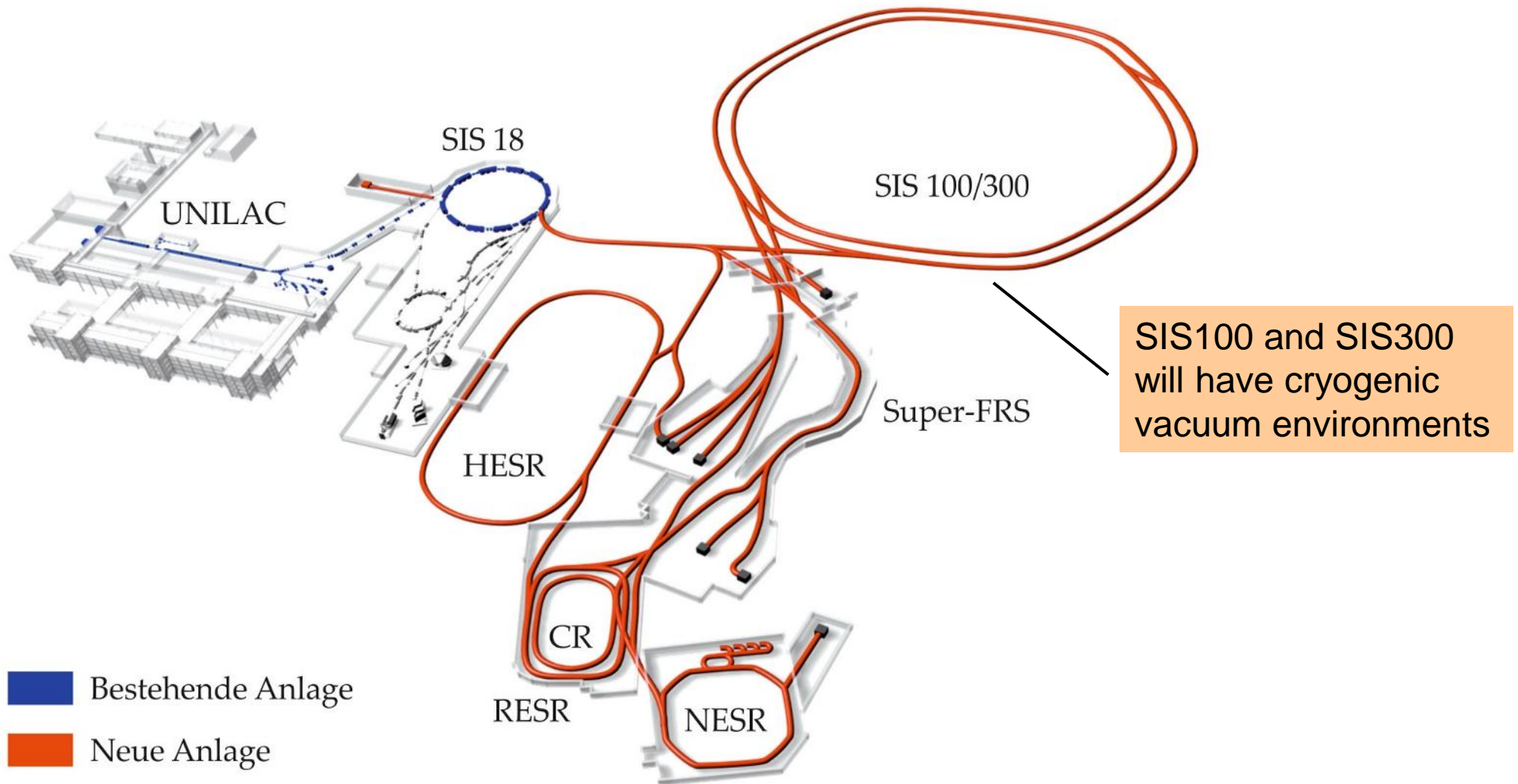


A Cold Extractor Type Ionization Gauge

Holger Kollmus / GSI Darmstadt

3rd ASPERA Technology Forum Industry meets Academia, May, 13. 2012

Facility for Antiproton and Ion Research

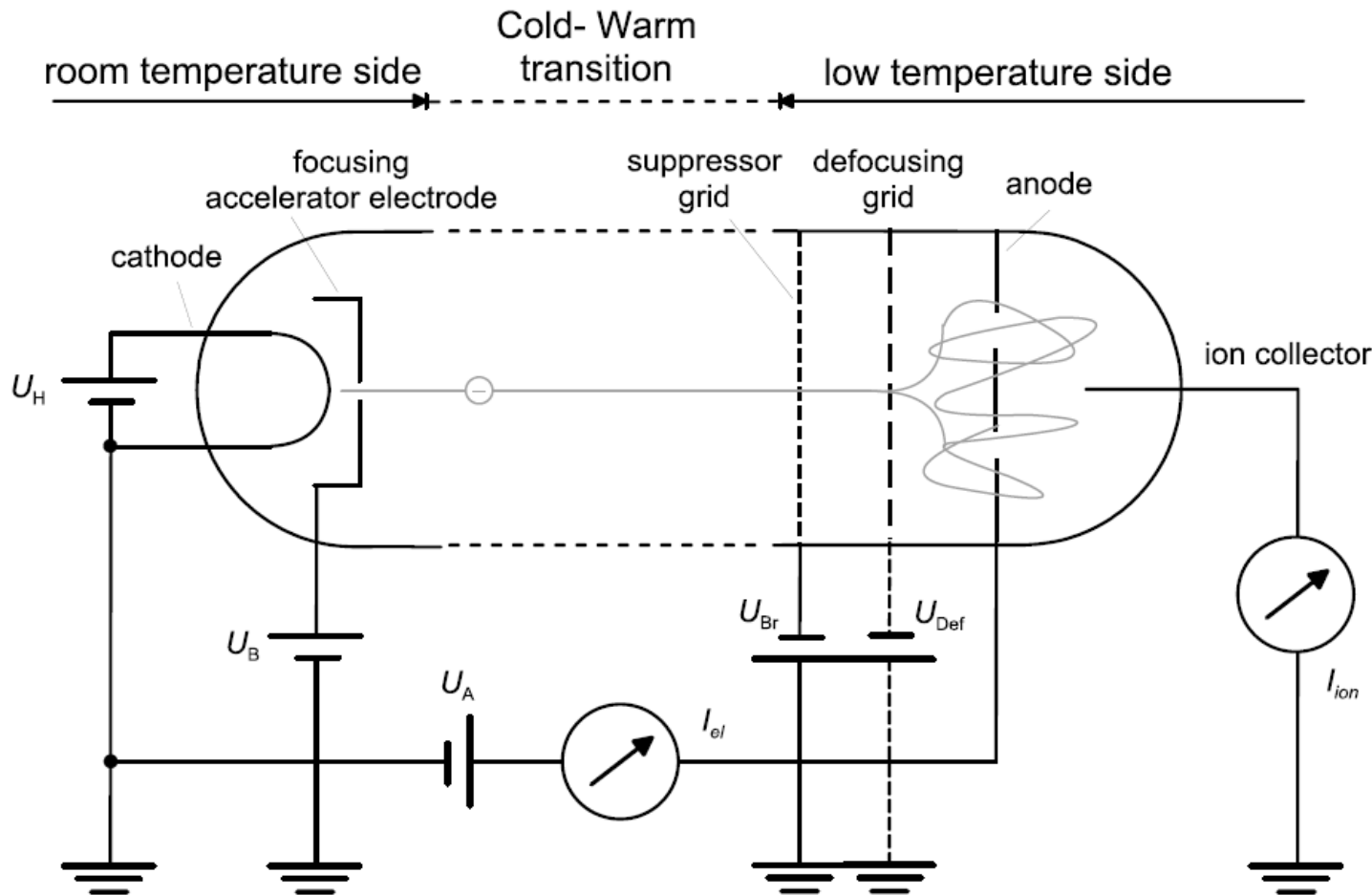


How to Measure Pressure in a Cold Vacuum Environment

- Hot cathode: heat load of filament to high
- Cold cathode: low pressure limit to high
- Beam life time: vessel model, cross sections for loss are energy dependent and not well known
- Hot cathode after CWT: might trigger interlock, but far away from reality

- Separation of electron production and ionization volume
- Usage of cold emitters

Separation of Electron Production and Measurement

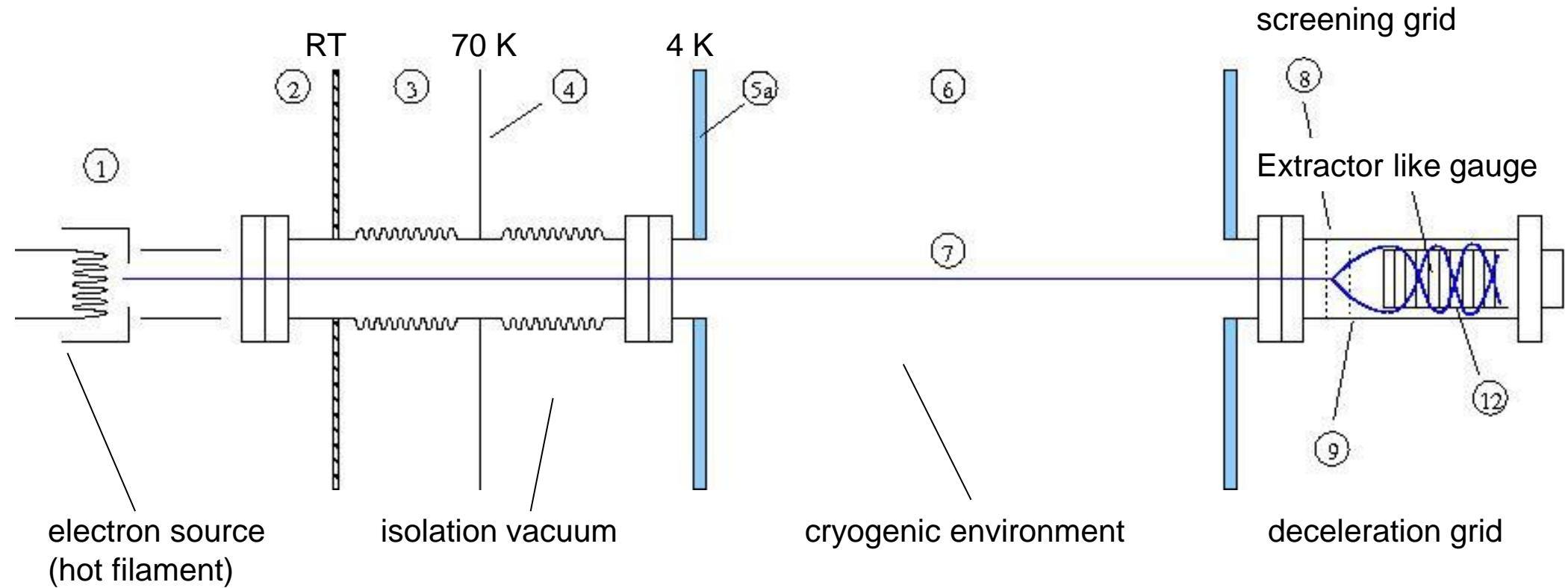


Electrical circuit for extractor gauge with decoupled electron source

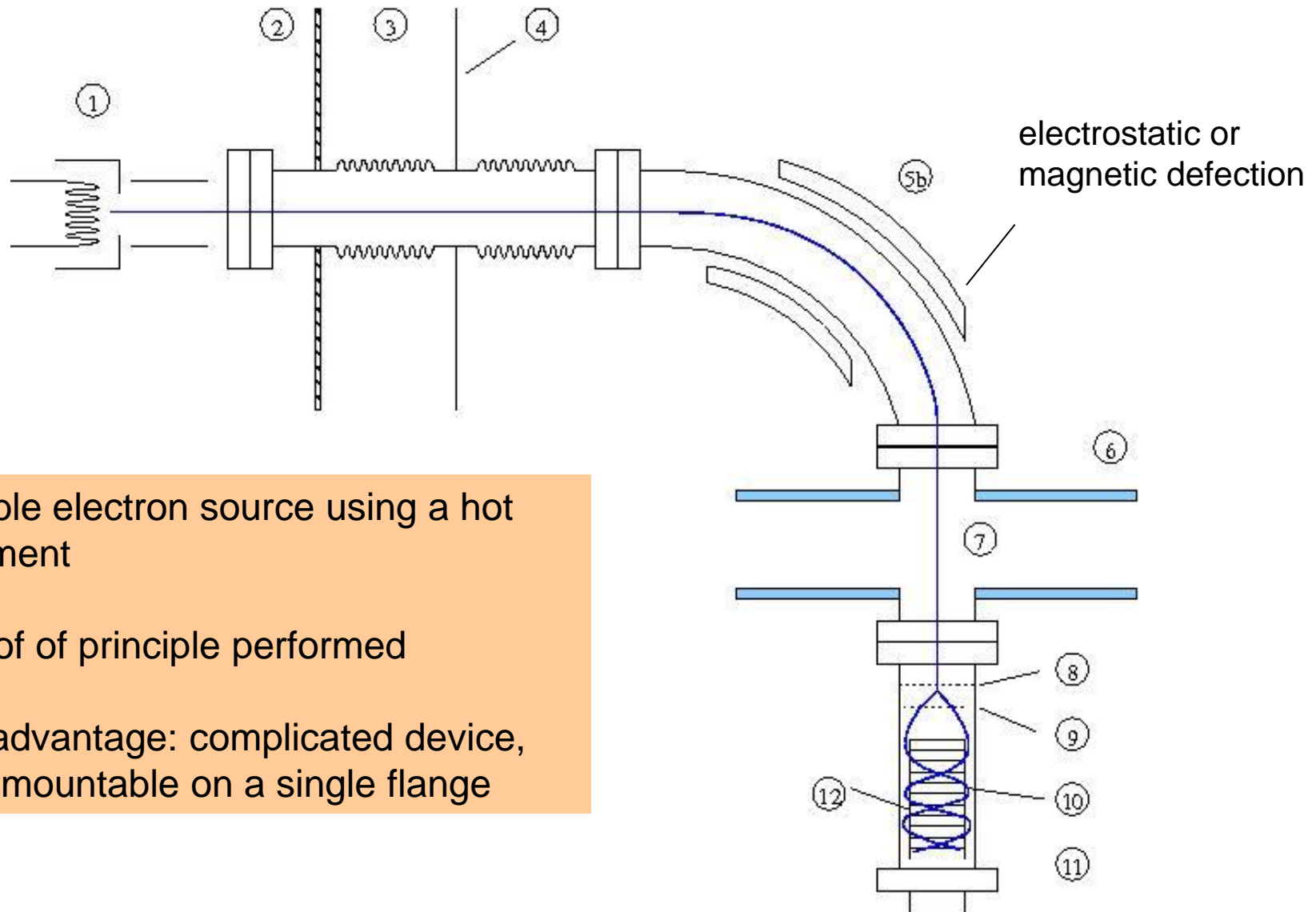
Realization I



cold-warm-transition (CWT)

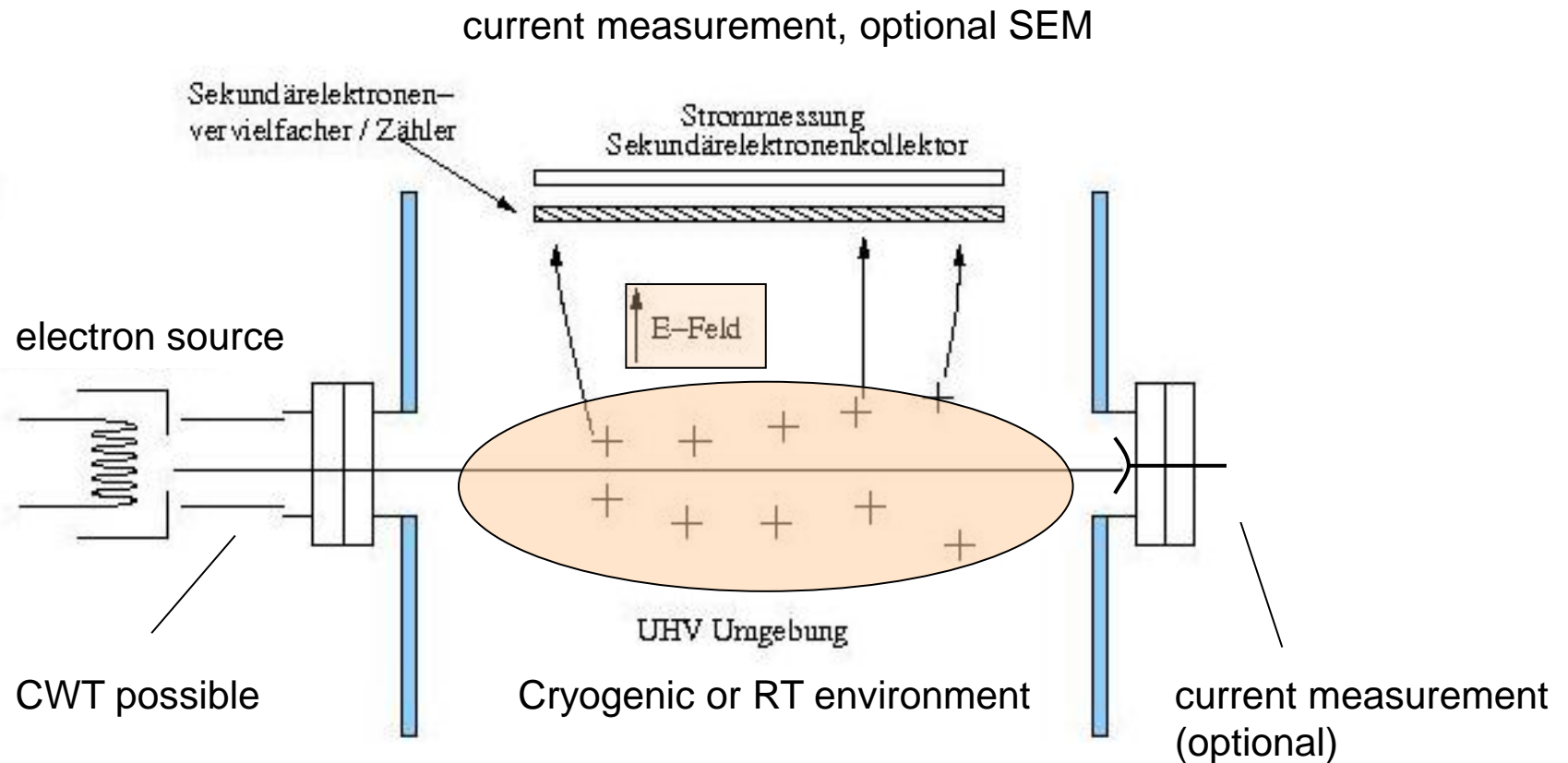


Realization II



- Stable electron source using a hot filament
- Proof of principle performed
- Disadvantage: complicated device, not mountable on a single flange

Realization III



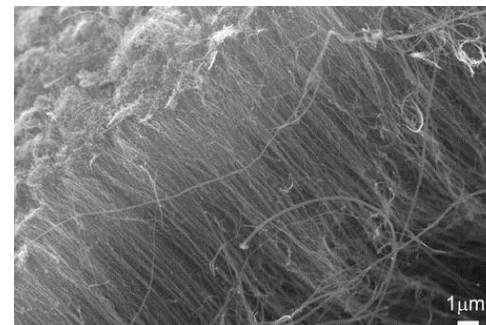
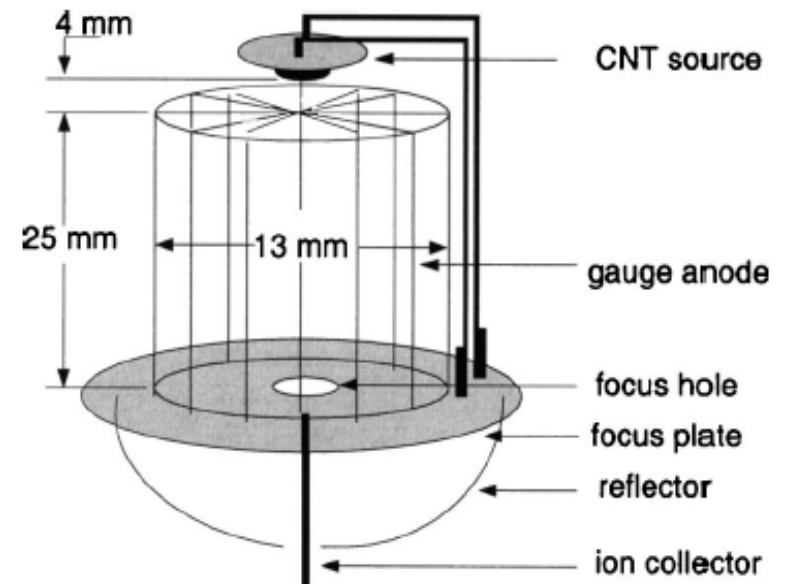
- Large ionization volume possible
- Counting of single electrons possible
- Highest sensitivity

Usage of Cold Emitters

- Ionization gauges with cold electron sources are recently described in literature and most of them work properly
- Advantage of an extractor gauge equipped with a cold electron source: compact design, can be realized on a CF 40 flange
- Frequently used field emission electron sources: CNT (Carbon Nano Tubes) cathodes
- Possible problems: low electron current, missing long term stability (overall life time), not investigated so far: cold behavior while freezing out residual gas

CNT-based extractor gauge after Dong and Myneni

Appl Phys Letters 84 (2004), 5443



SEM micrograph of a typical CNT structure

Conclusion

- Two new cold ionization gauges were presented
- The proof of principle was performed for both
- Both have *pros* and *cons*
- Both should be realized as specific solutions for different applications
- Counting the recoil ions from electron impact ionization was proposed to measure the pressure in cryogenic and RT environments