

Agilent Technologies Vacuum Products Division

Ion Pumps for GWT
Mauro Audi



Integrated vs External Ion pump

Weight & dimensions

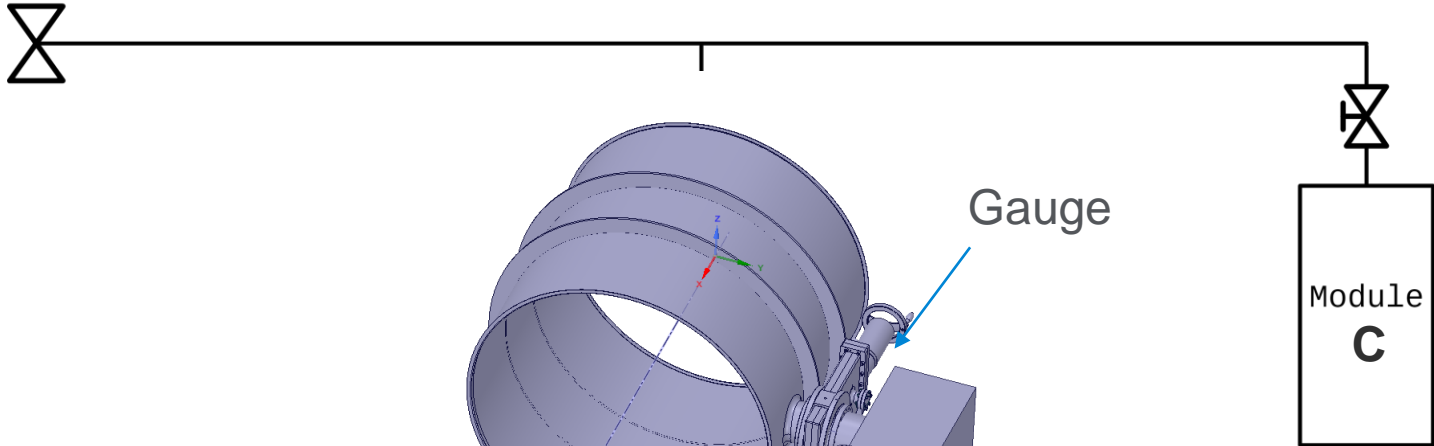
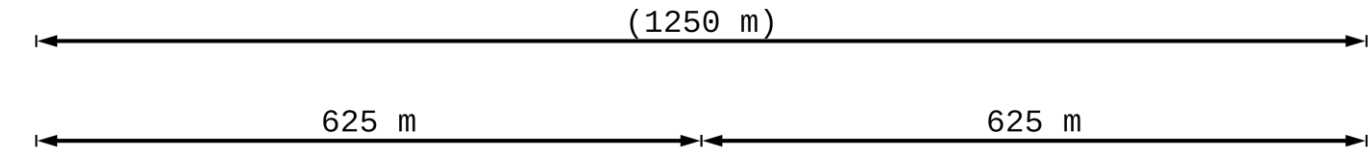
Particle emission

Pumping efficiency

Potential risks vs Costs

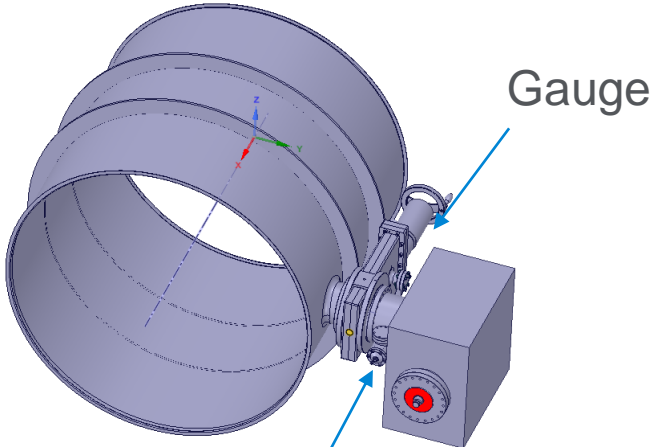
Control Units

HV pumping: vacuum layout



Module C

Will replace the module A mobile turbo
2000 ls⁻¹ NEG + 500 ls⁻¹ Ion Pump



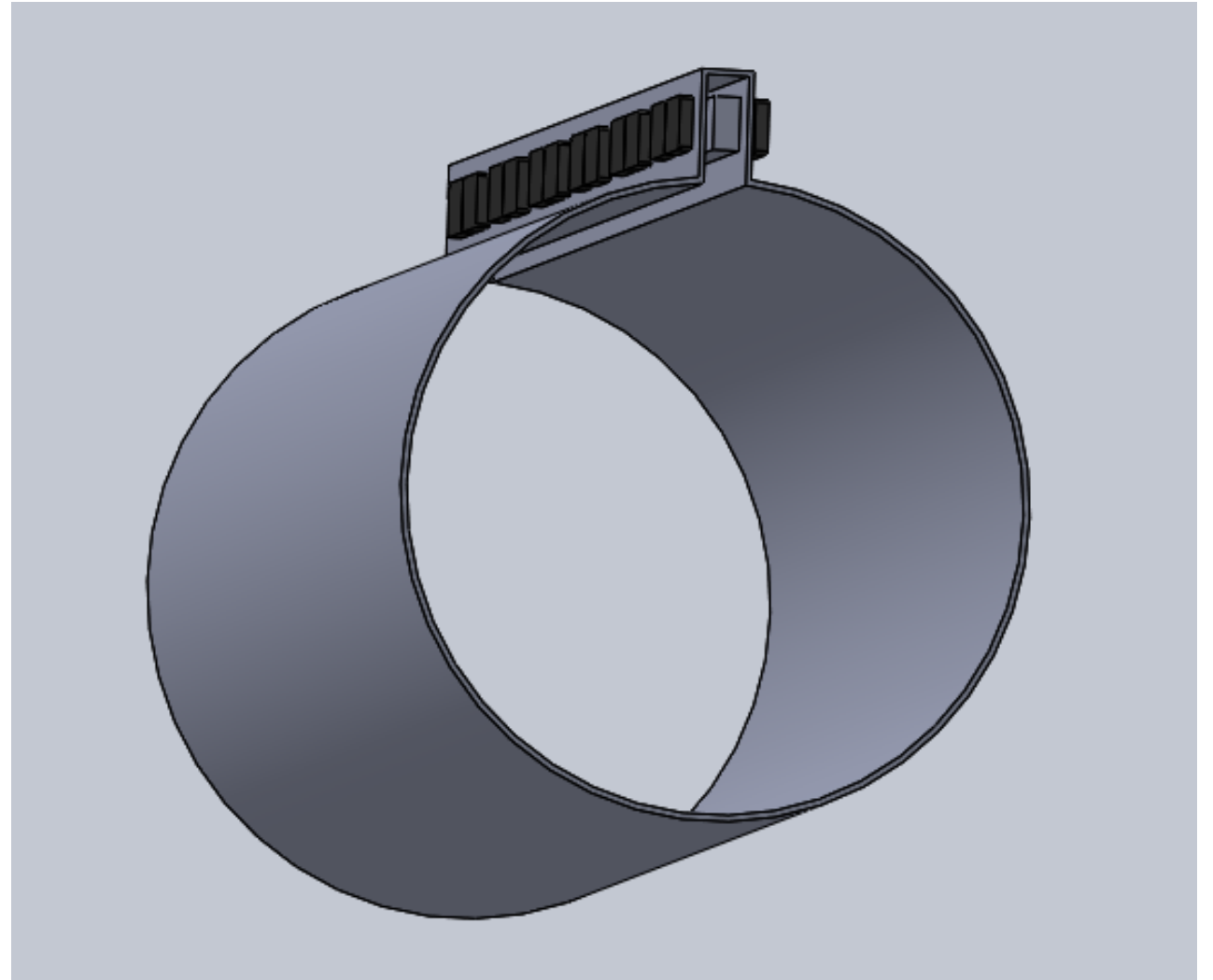
Integrated ion pumps 1

Slot dimensions *

160mm x 130 mm x ???

160 mm Diameter increase

Overall dimensions, including
magnets & Pole pieces



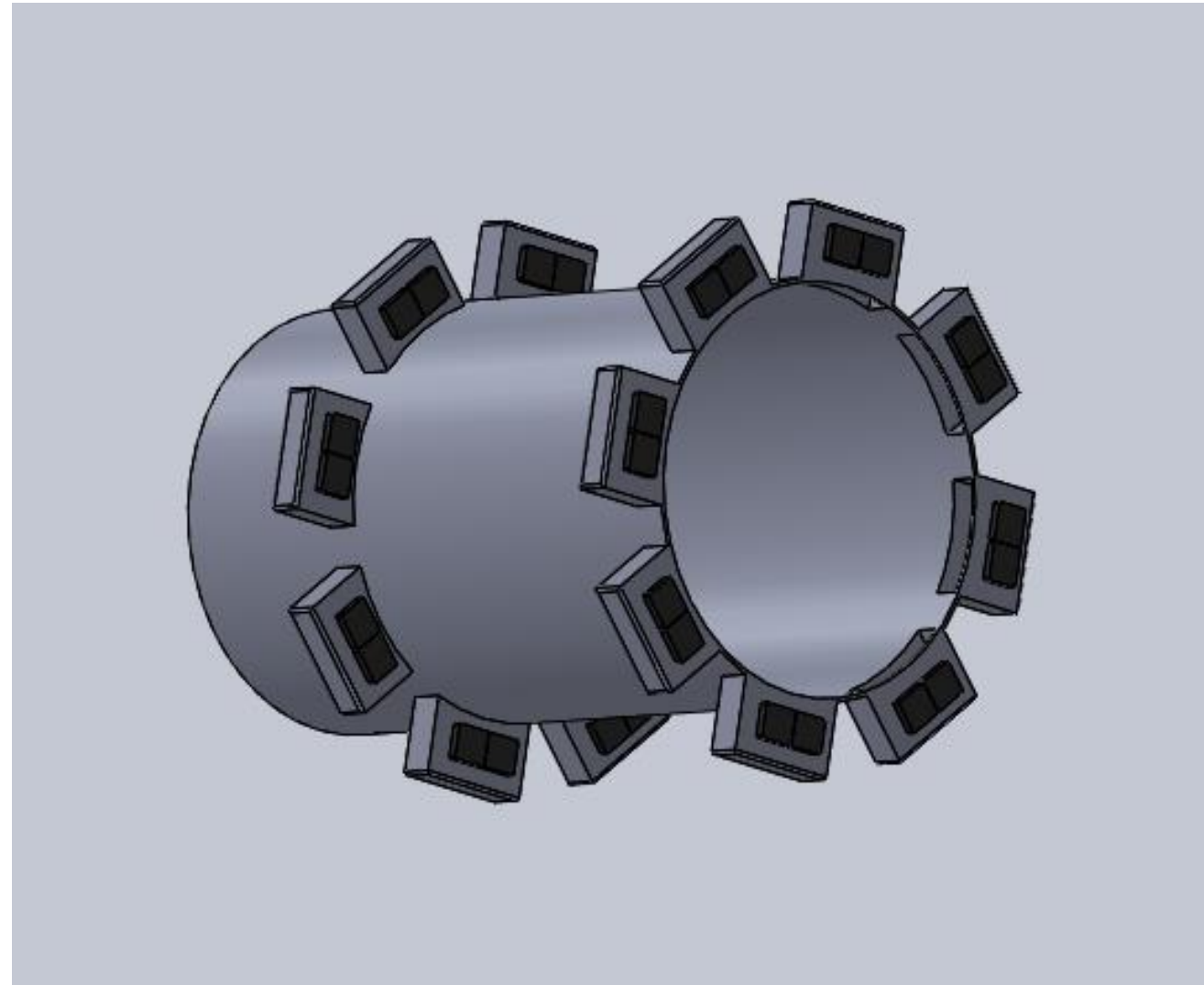
Integrated ion pumps 2

Slot dimensions *

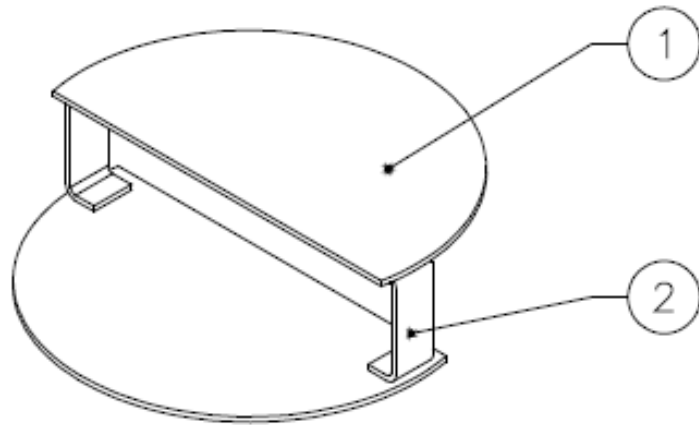
160 x 130 X 300 mm

160 mm diameter increase

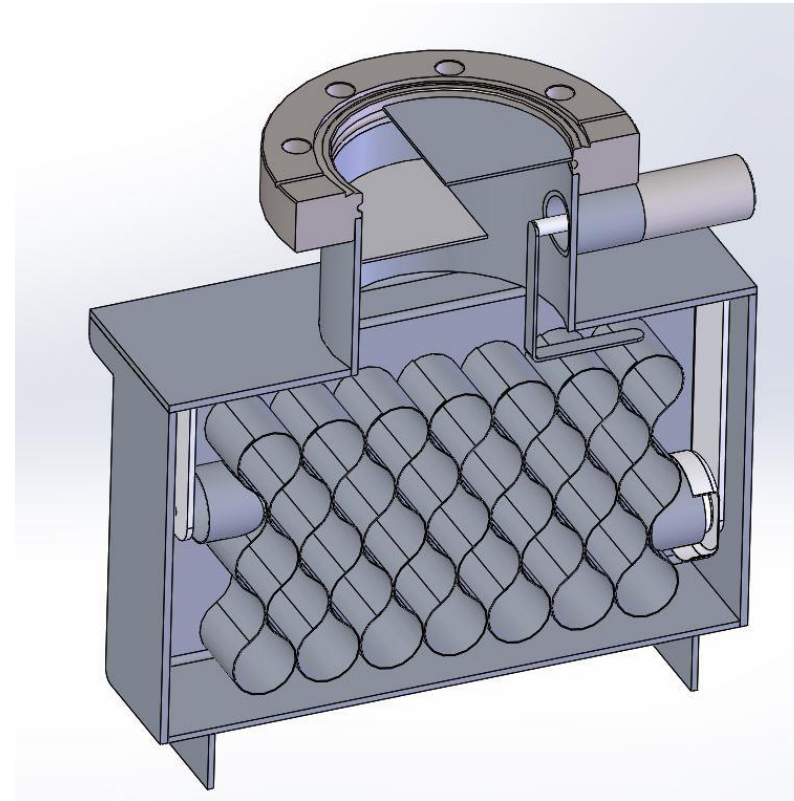
Overall dimensions, including magnets & Pole pieces



Particle Emissions Optical Shields 1



Effective to shield particle emission but
huge conductance limitations !



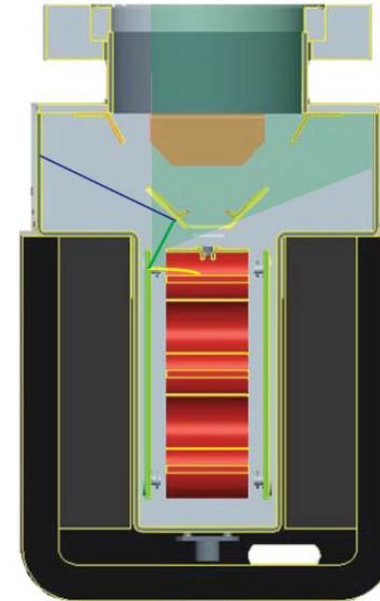
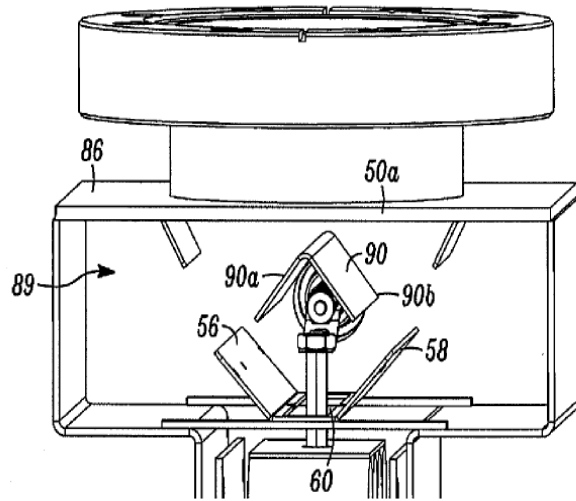
Optical shield 2

(12) **United States Patent**
Clough et al.

(10) **Patent No.:** US 7,850,432 B2
(45) **Date of Patent:** Dec. 14, 2010

(54) **ION PUMP HAVING EMISSION
CONTAINMENT**

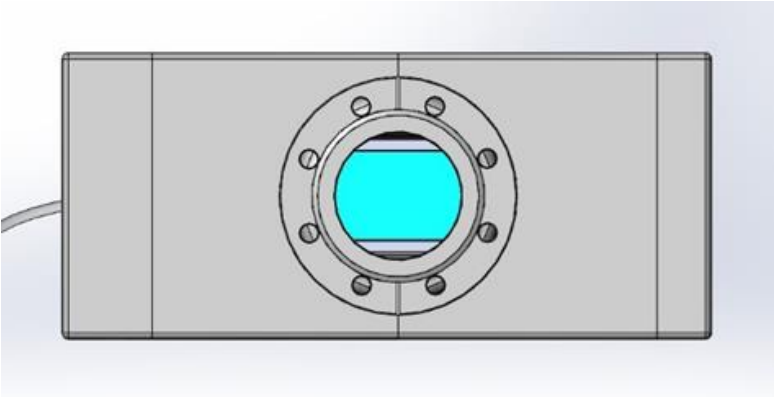
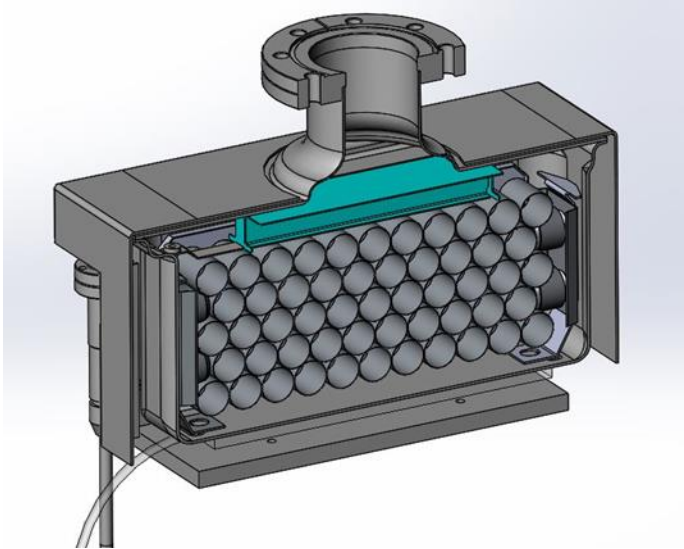
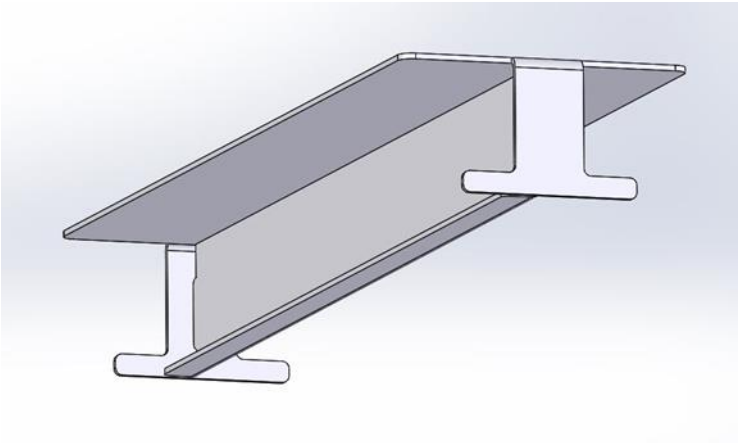
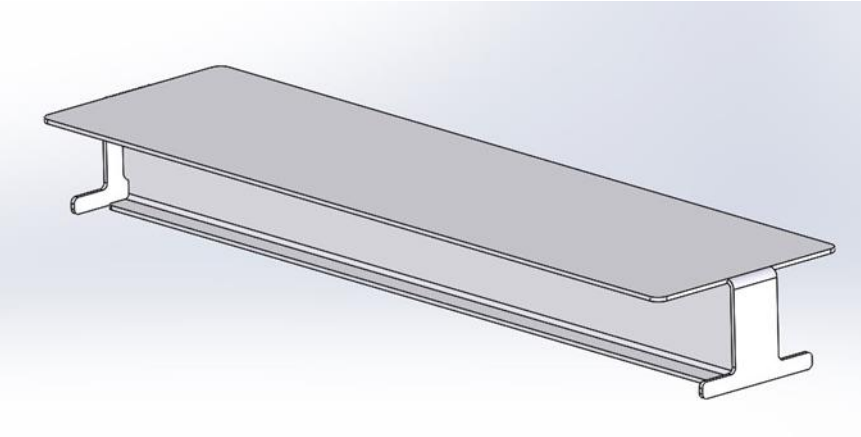
5,727,929 A * 3/1998 Nagai et al. 417/49
6,220,821 B1 4/2001 Kern et al.



Effective to shield particle emission but
huge conductance limitations !

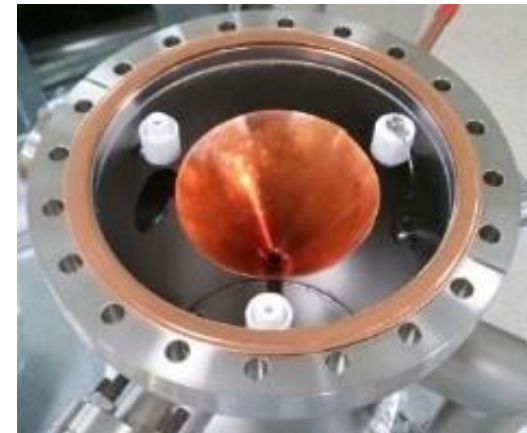
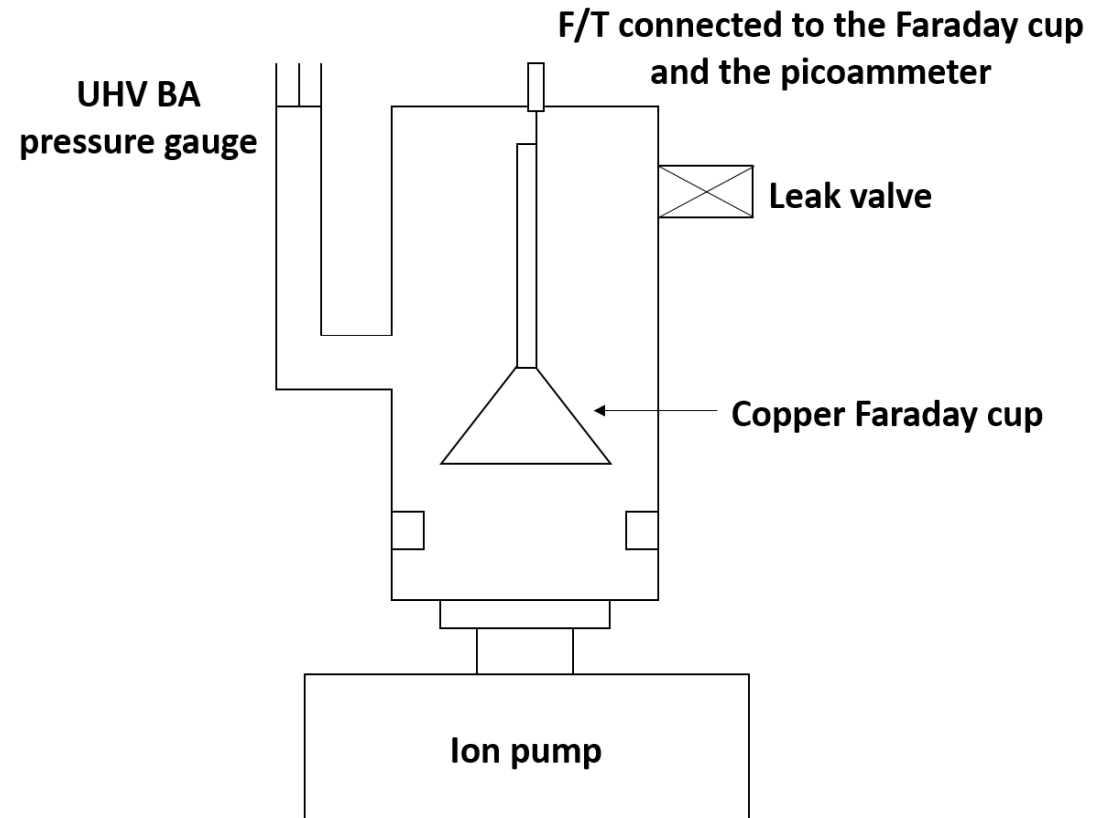
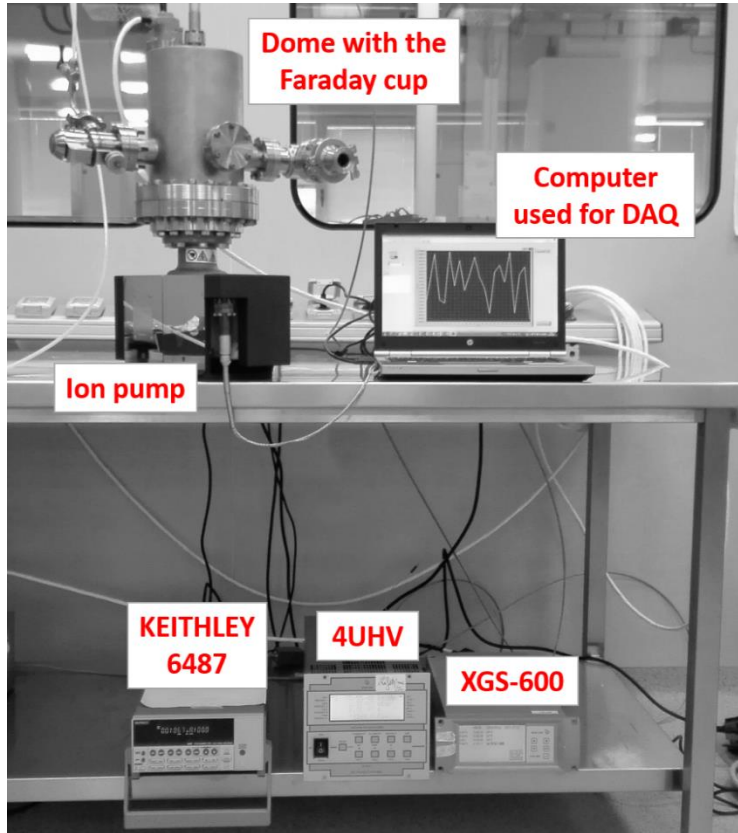
New Shield design

Patented



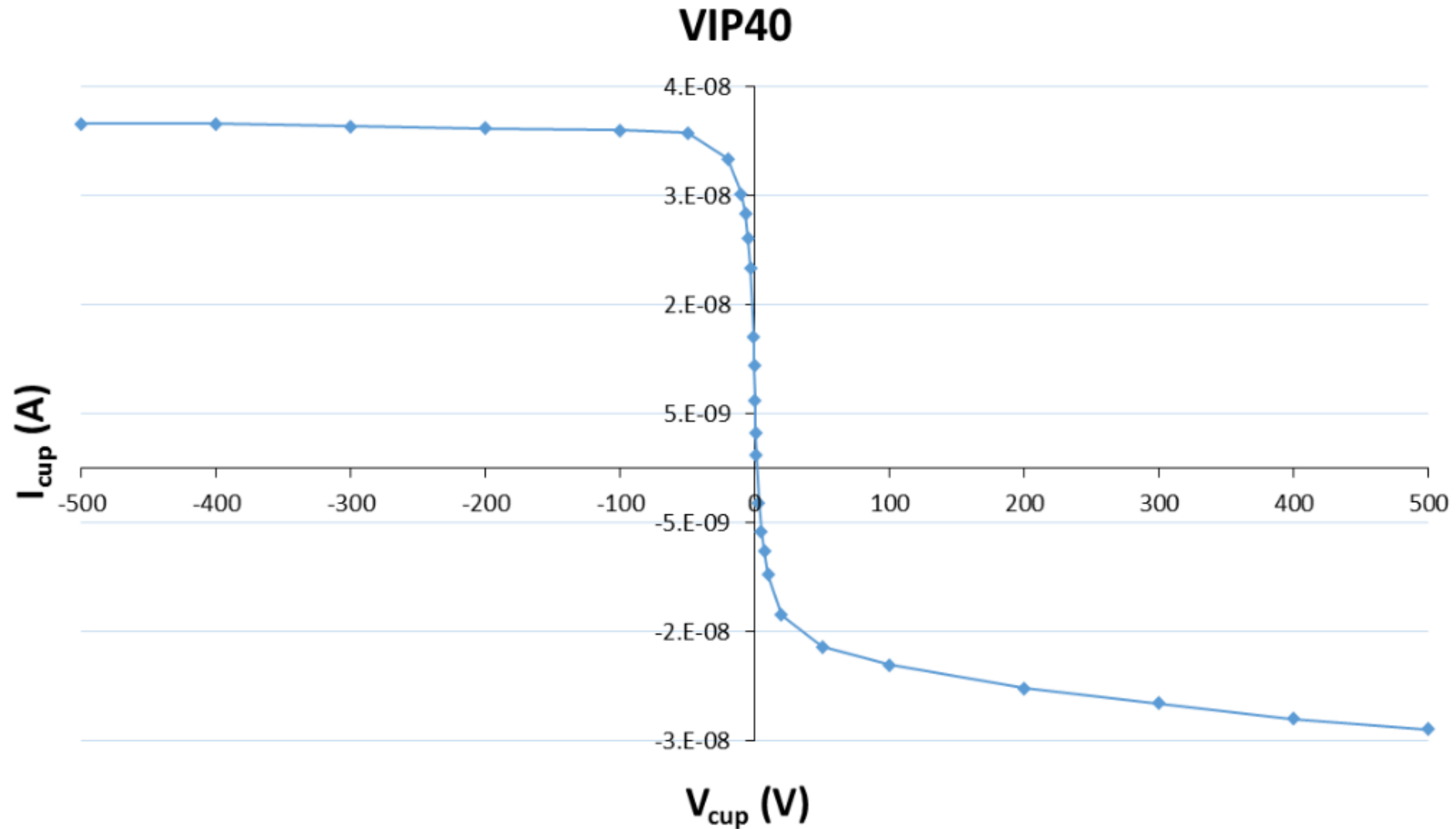
Experimental setup

Particle Emission

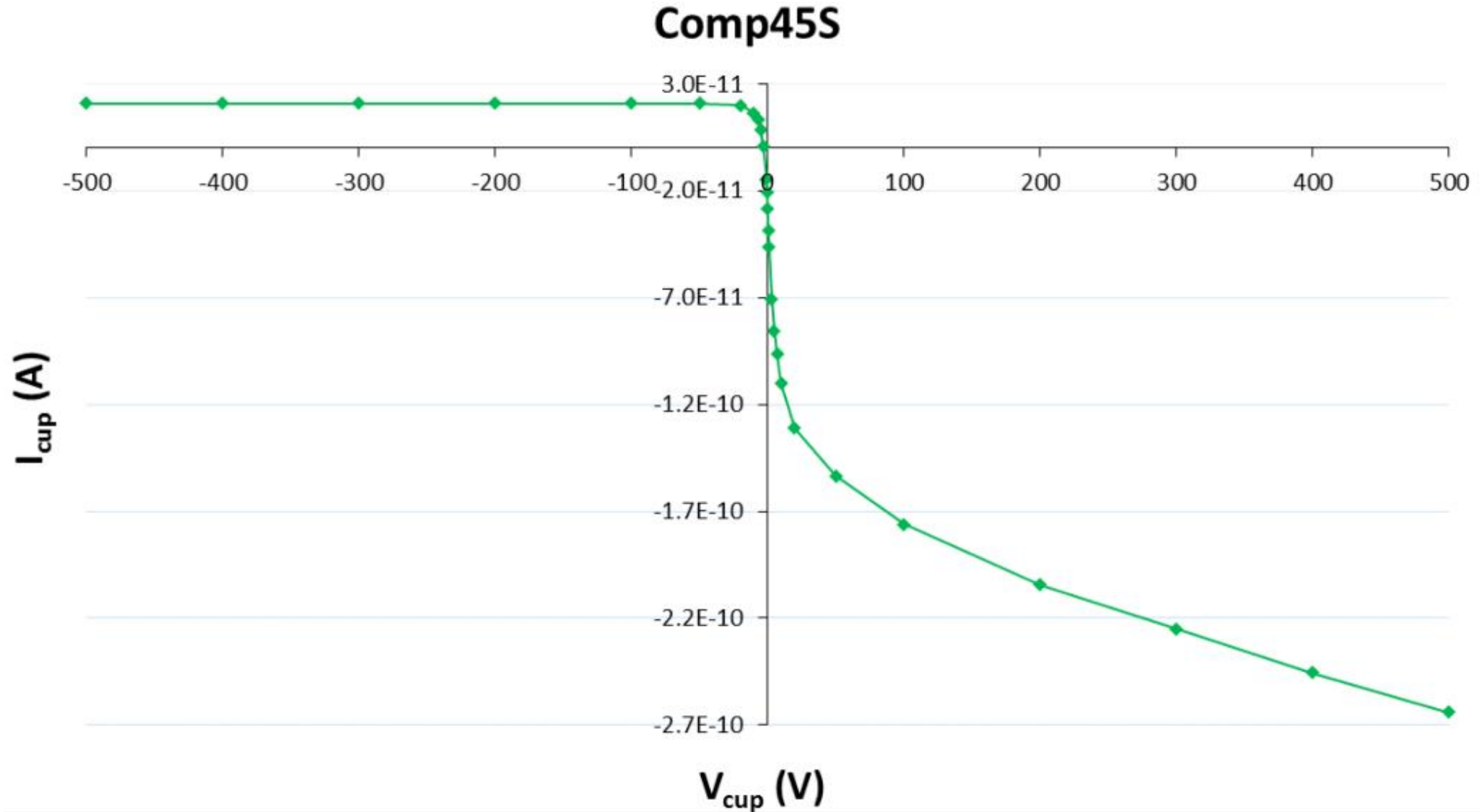


Tests at $P = 5 \text{ E-7 mbar}$ and $V = 5\text{KV}$ unless otherwise specified

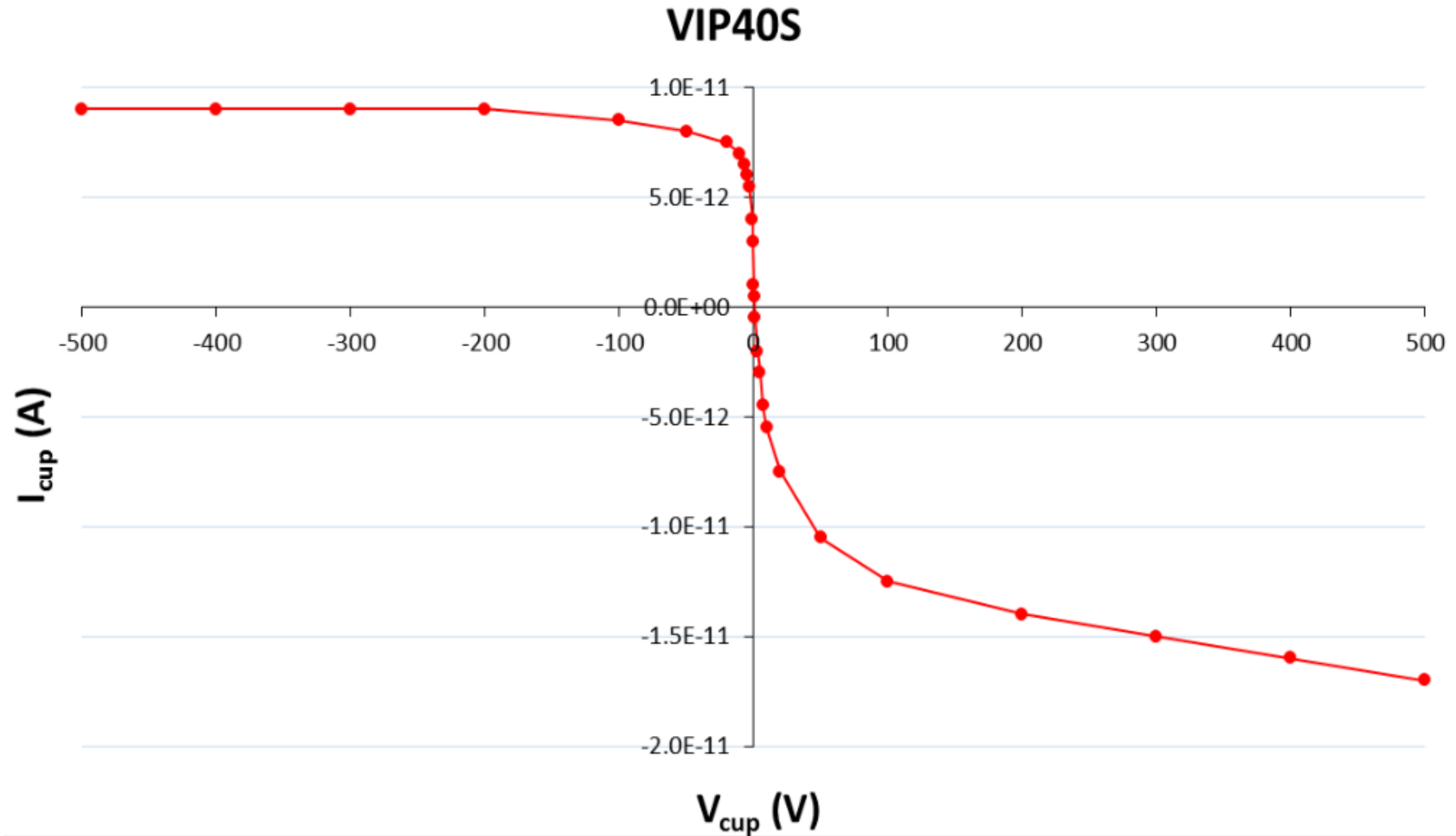
Standard pump , not shielded



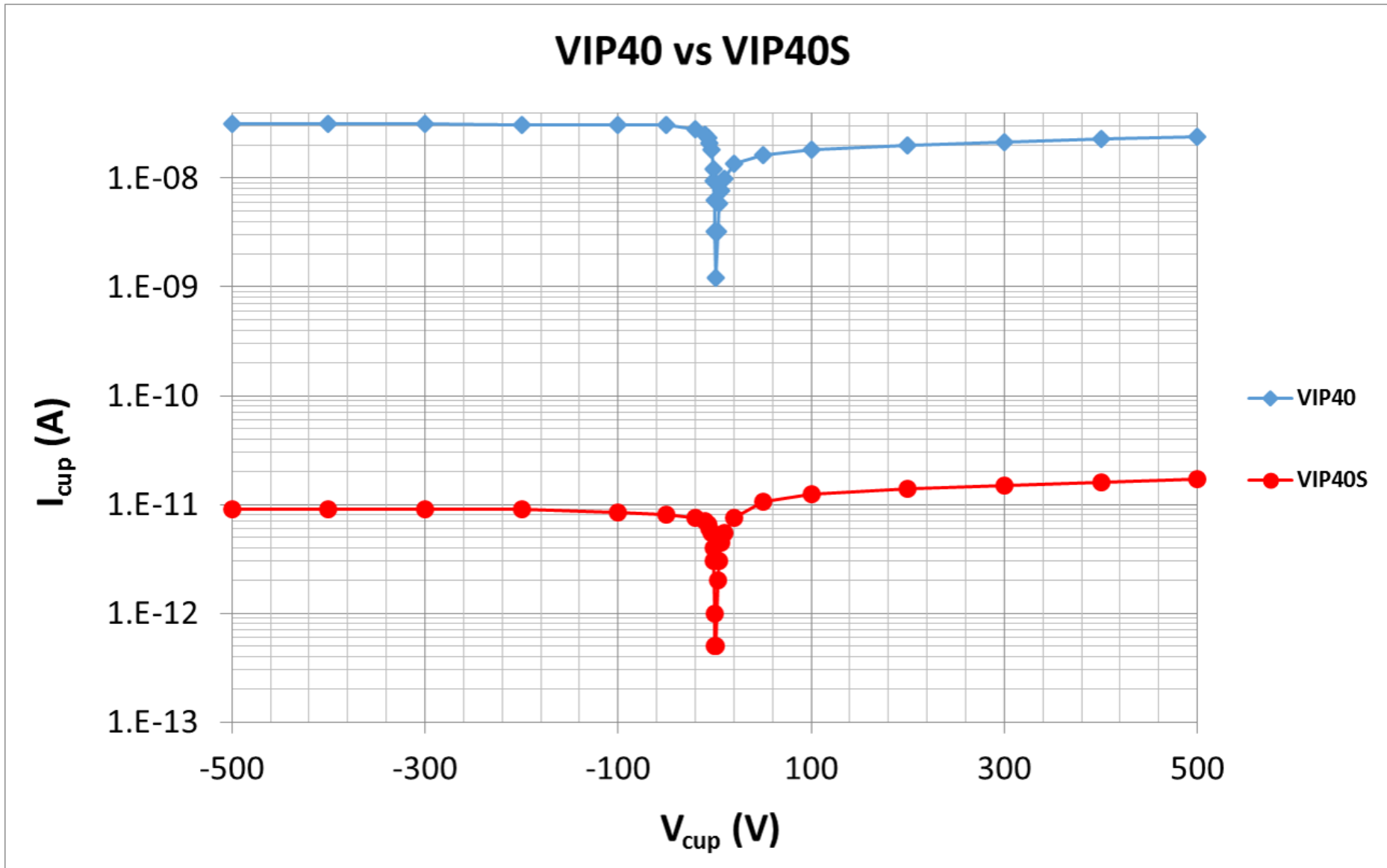
Conventional shielding



New proposed shielding

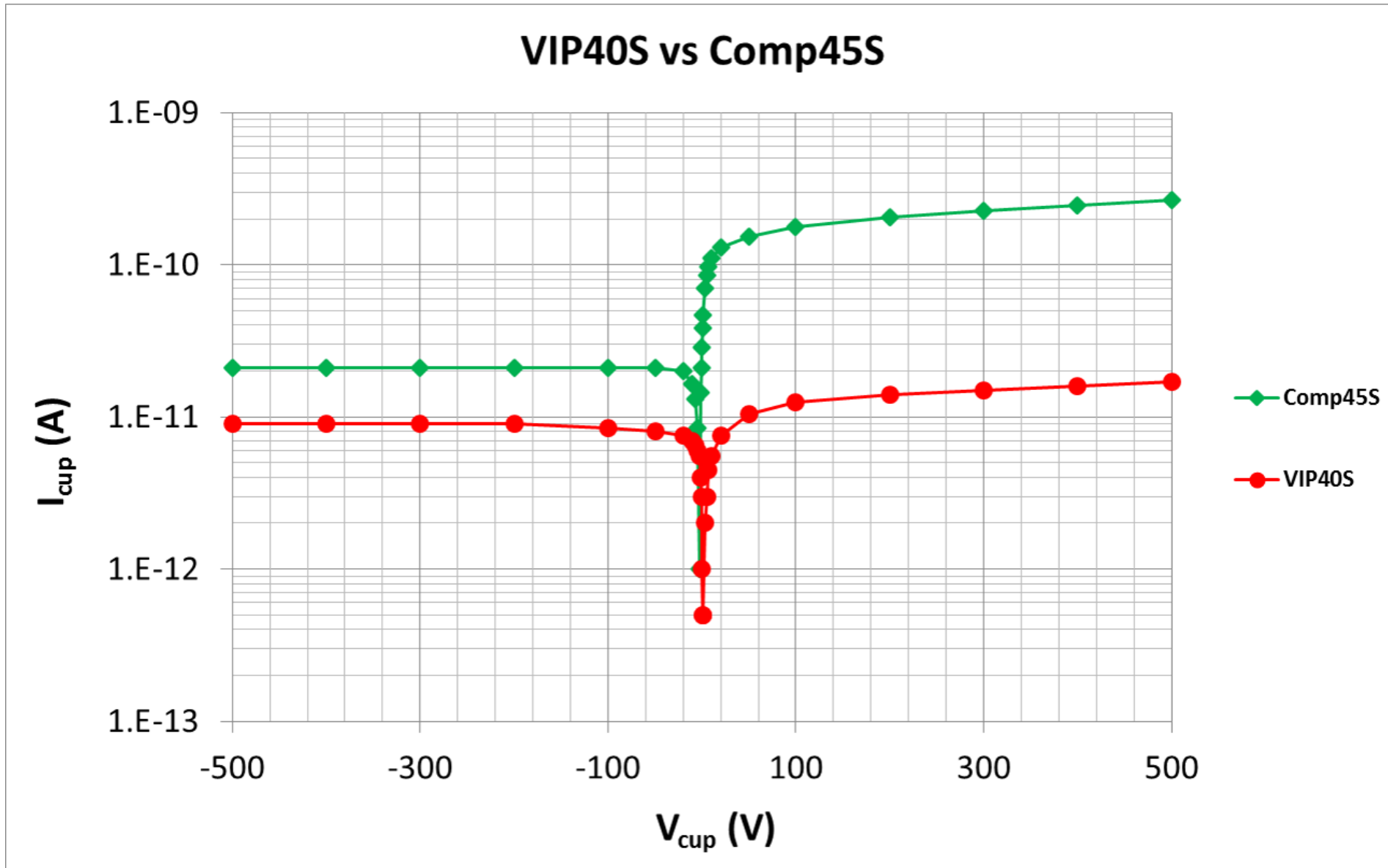


Not Shielded vs New Shield , DN 40 flange



More than three orders of magnitude particle reduction

Conventional vs New shielding , DN 40 flange



More than one order of magnitude particle reduction

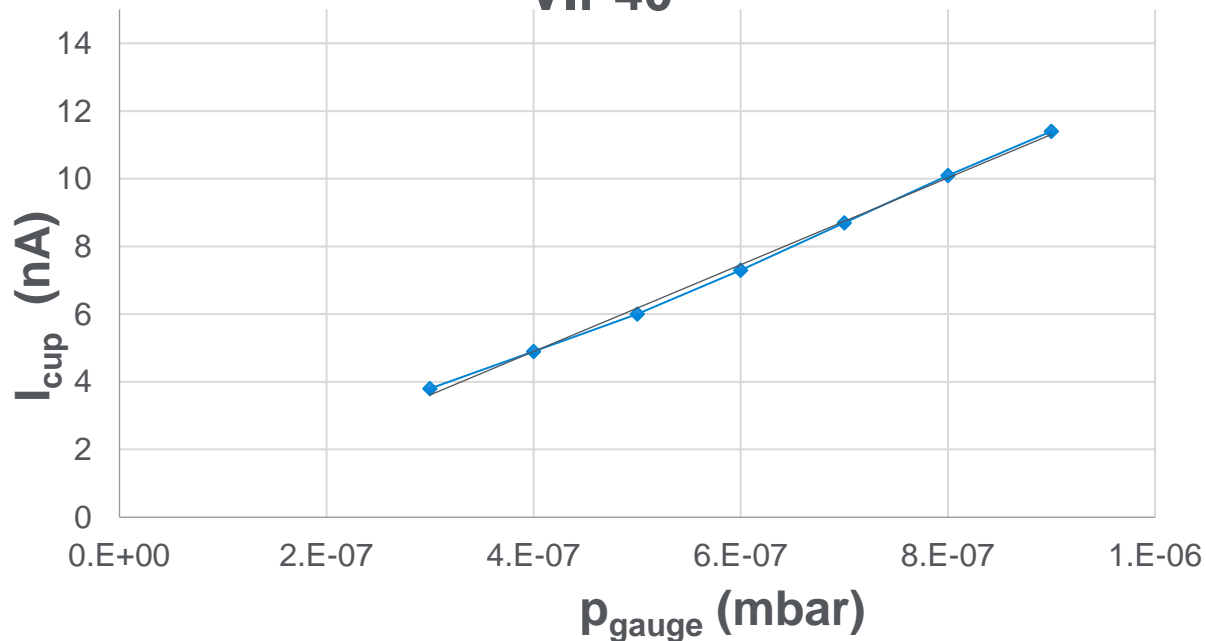
Particle emissions vs Pressure

V = 5KV

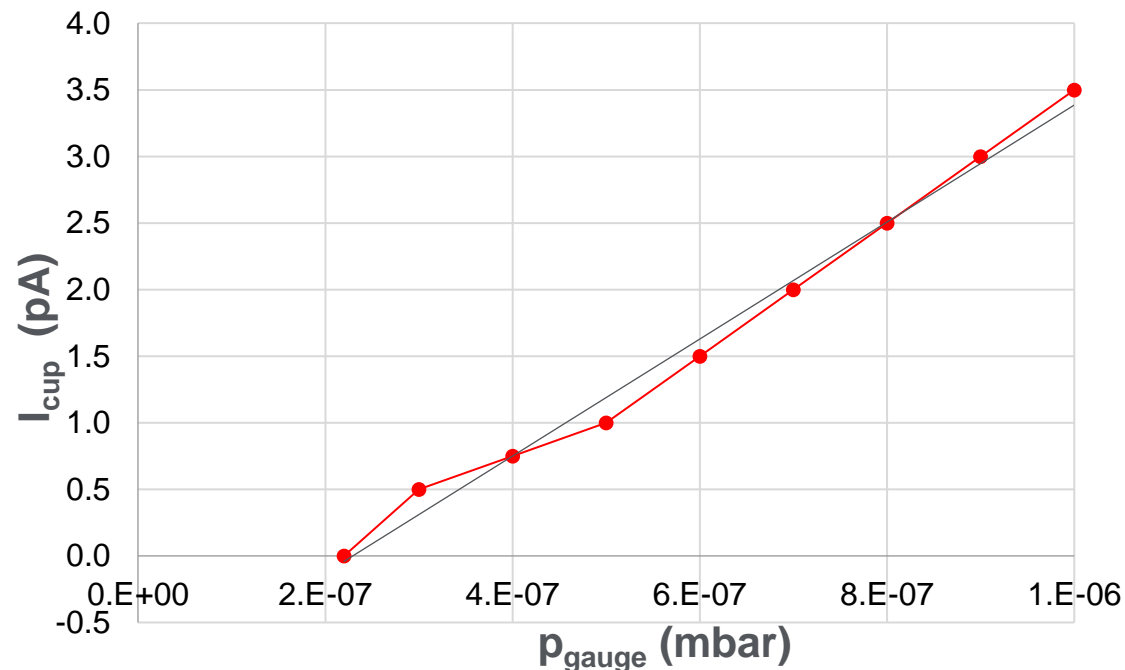
Emission roughly proportional to pressure

Emission in the -10mbar range 3 orders of magnitude lower

VIP40



VIP40S



Pumping Methane

Methane «behaves» like a Noble Gas

Main pumping mechanism is CH₄ ions bombarding the cathode , and then either implanted there (unstable pumping) or being neutralized and reflected , and embedded into the anode and covered by sputtered cathode material (stable pumping)

StarCell performance best for CH₄ , highest reflection rate

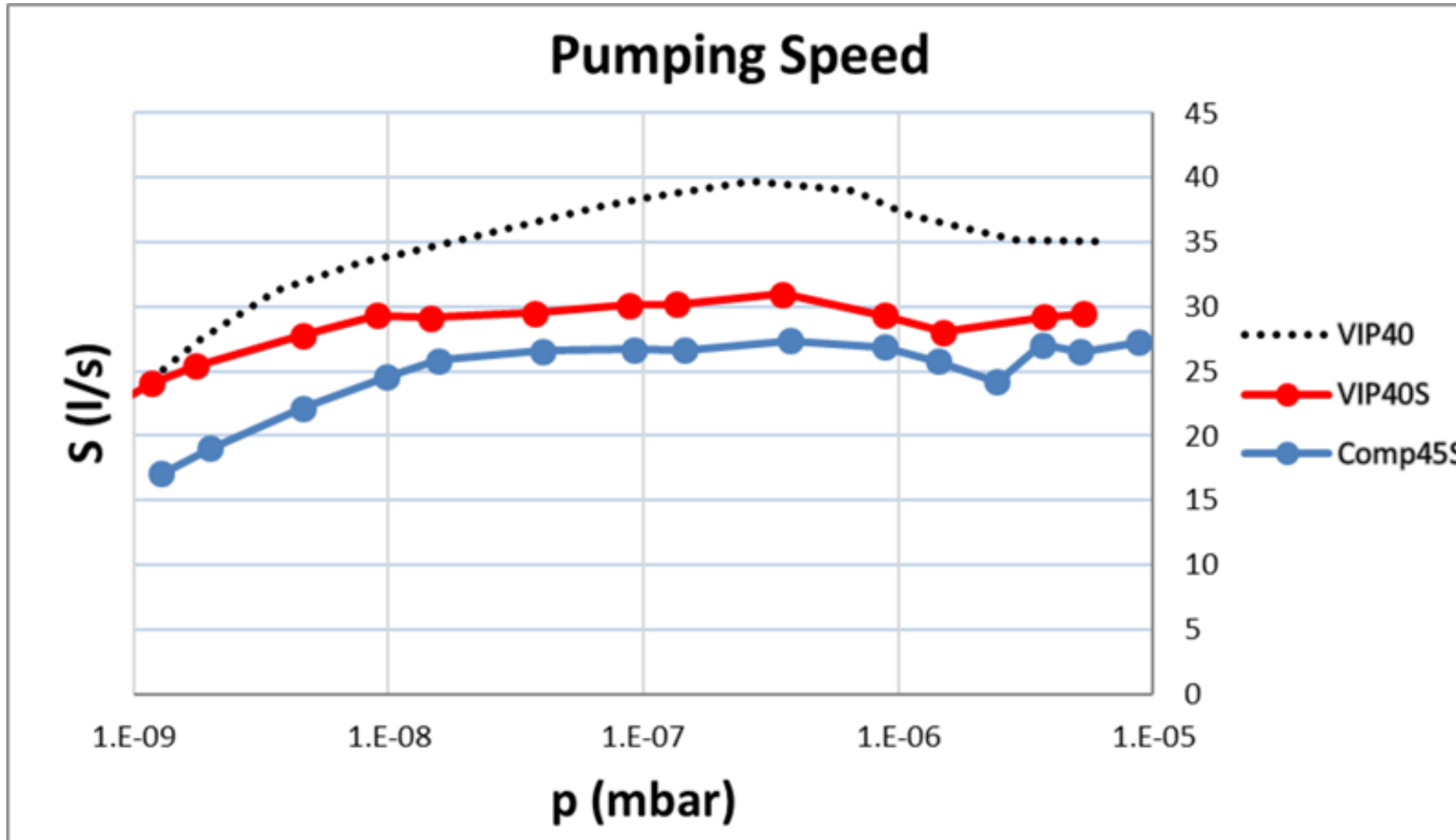
Phisycal burying , not chemical reaction

Ion pumps do crack Methane and Hydrogen and CH_x are pumped as «getterable» gases

Overall efficiency almost comparable to the one for Nitrogen

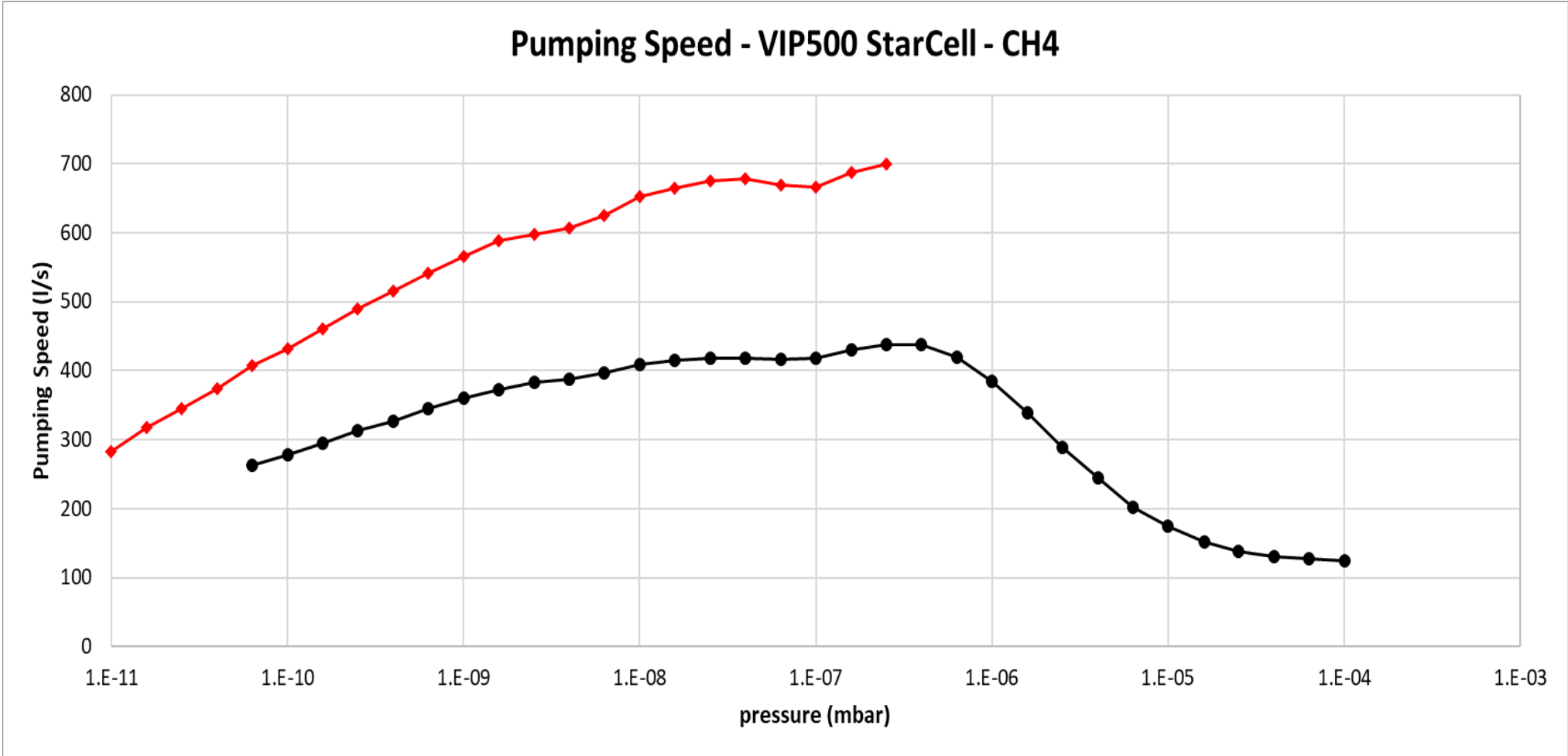
VIP40 – VIP40S – Comp45S (DN40)

Gas: N₂, saturated pump, V = 7kV



New shield allows better conductance than conventional shields

Methane pumping speed , before and after saturation



Pumping efficiency

Intrinsic speed (N₂) of a single element approx 85 L/S (10⁻⁷ mbar)

Net speed of a 500 L/S (8 elements) : 480 to 500 L/S

8 elements directly mounted in the chamber : 680 L/S

With particle emission shield : 60 L/S per element , 480 L/S Total

Risks vs cost

Marginal risks of pump failure (HV Feedthrough)

Only two reasons for failures are mechanical shock and corrosion

No need for expensive valves

(Valves may not actually be needed even for external pumps)

Corrosion free ION Pumps HV Feedthrough

Corrosion free feedthrough

HV feedthrough and connector are subjected to corrosion

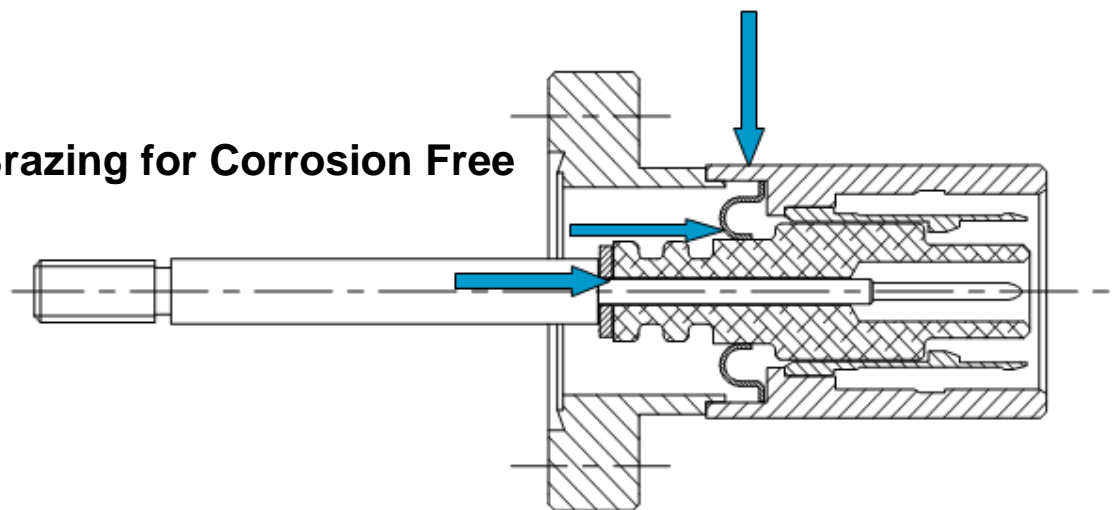
Transition metal to Kovar (or similar) to ceramic is critical

Temperature cycling , humidity , high electric field gradient may cause corrosion

Water vapor trapped in between the connector and the feedthrough may cause oxidation

Specific design to minimize air trapping and critical surface exposed to air (vacuum side brazing)

Vacuum Side Brazing for Corrosion Free



ION Pumps – Safety Interlock

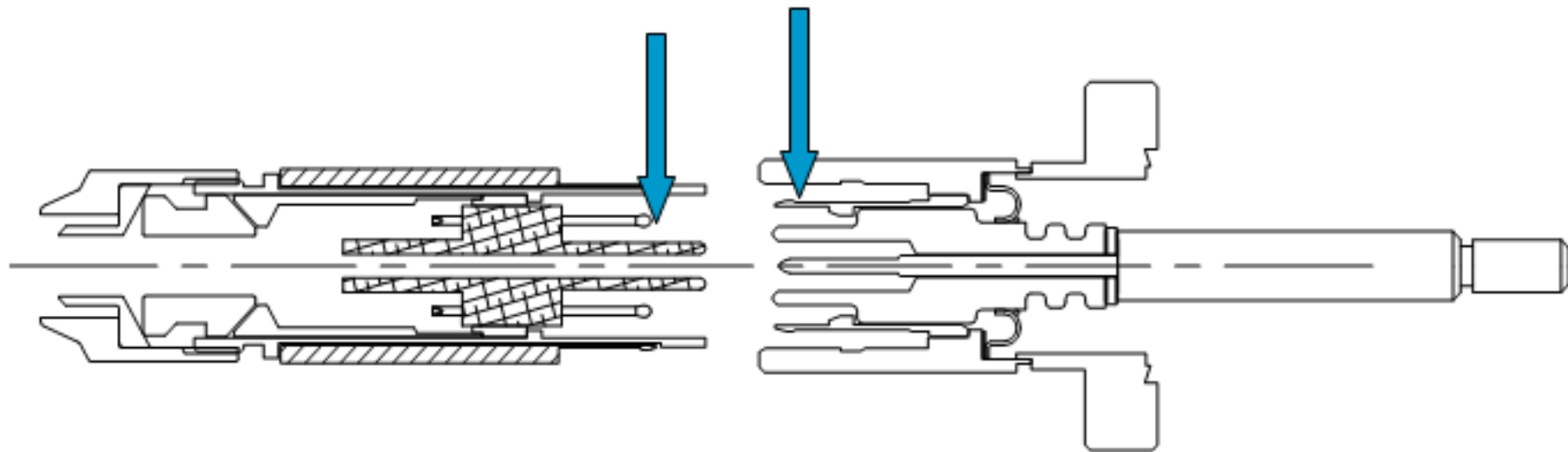
From passive to active safety

Passive Safety

- The control unit and HV cable connector must be intrinsically safe
- No live parts can be touched

Active Safety

- Interlock on HV connection to ensure that HV is switched off whenever the HV cable is disconnected, either from the pump or from the controller



Ion Pump Controllers

4UHV – Multichannel Ion Pump controller

Ion Pump controller maximizes IP performances in the entire operating range
Variable voltage maximizes pumping speed
Variable voltage allows reliable pressure reading at low pressures
Multiple ion pumps independent operation (up to 4 pumps connected)
4UHV State of the art Ion Pump controller incorporate all these functions in a compact and light design

Up to 4 x 80 W independent Channel



IPCMini – Single Channel Control Unit

Touch panel Display with innovative design
Variable STEP voltage function
New iSTEP voltage function
High current resolution & Low ripple noise
Fast I/O response time (<10 msec)

1 x 40 W Channel

