Science & Technology Facilities Council
ASTeC

Cryogenic SEY measurement Facility at Daresbury

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EuroCirCol
A key to New Physics

Science & Technology Facilities Council

Motivation

- LASE is the baseline for FCC-hh e-cloud mitigation

- My PhD project is part of EuroCirCol WP4
  - Optimising LASE surfaces on Cu with various lasers and parameters to create surfaces with SEY < 1
  - Testing these surfaces at room temperatures
  - Testing the best surfaces at cryogenic temperatures with and without cryosorbed gasses

Sample Production

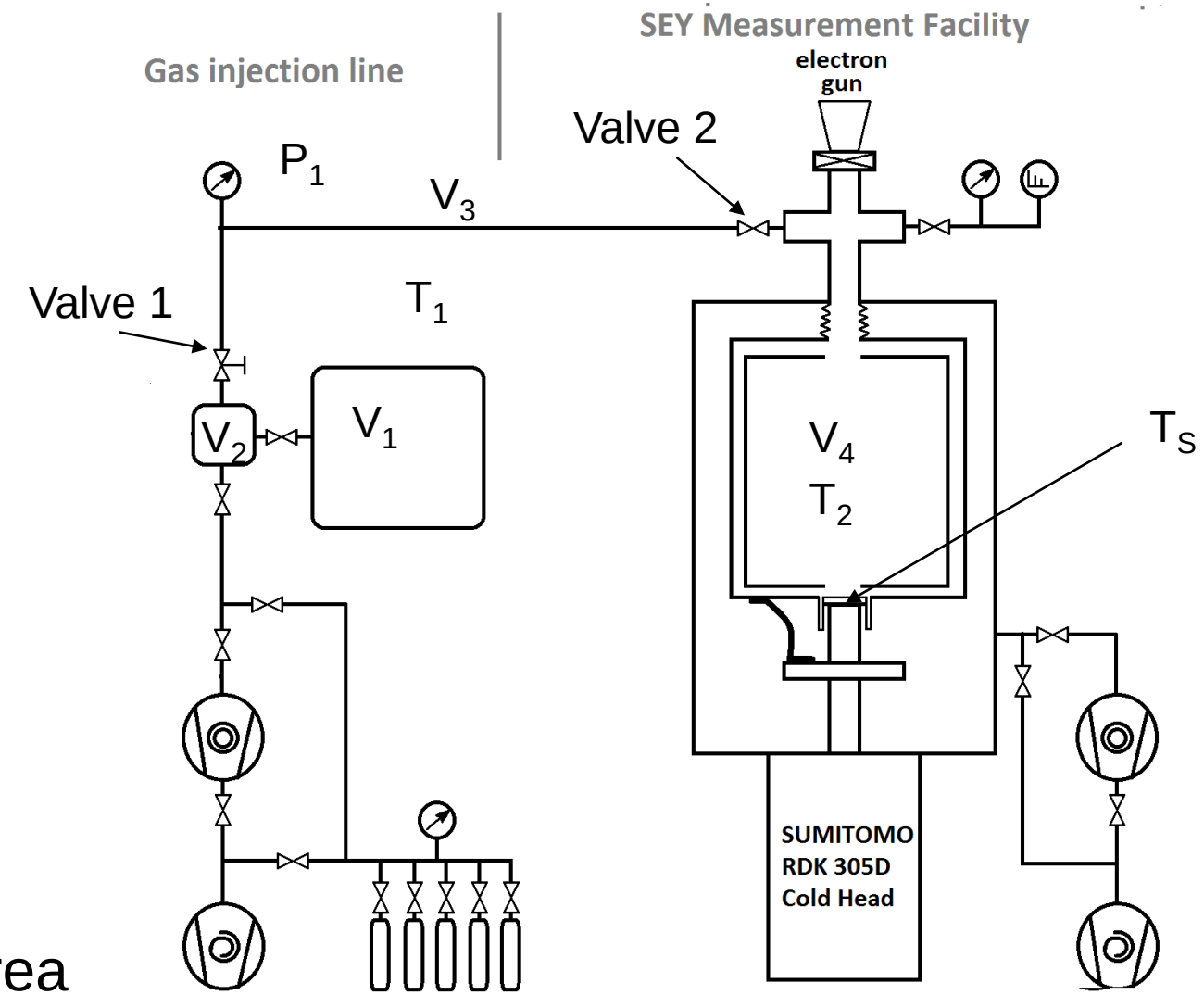
- Produced and tested more than 100 different LASE samples
  - With different laser parameters treated with the following lasers:
    - Nanosecond 355 nm
    - Nanosecond 1064 nm
    - Picosecond 355 nm
    - Picosecond 1064 nm
  - In different atmospheres:
    - Air
    - Ar
    - CH_4
- More than 40 samples have $SEY_{max}<1$
  - More in talk my R. Valizadeh
- What about cryogenic temperature and condensed gas?

Cryogenic Experiment Schematic

- Known amount of gas injected $Q=P_{1*}\,(V_1 + V_2 + V_3)$
- All volumes are known
- After opening valve 2 while $T_s = T_2$:

$$Q=P_1\,(V_1 + V_2 + V_3 + V_4\sqrt{\frac{T_2}{T_1}})$$

- Then sample temperature is reduced to $4.2\ K < T_s < 80\ K$ to cryosorb the gas.
- Surface coverage is:
  $s = \frac{Q}{A}$, where A is the sample area

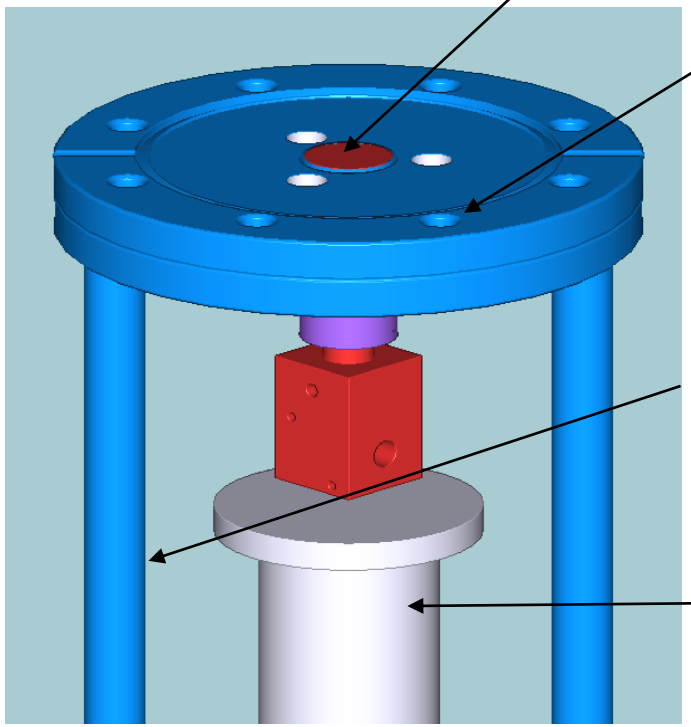


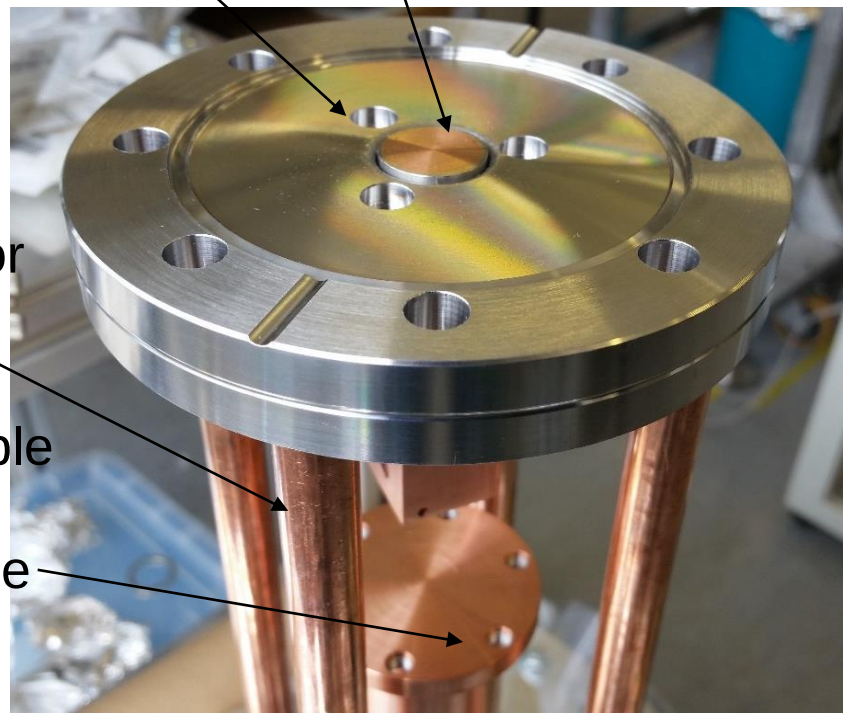
Sample Holder

- 1 mm gap between the flange and sample to reduce lost gas

- Thin stainless steel tubes used to reduce conductance to sample
- Holes near the sample holder for the supports for the Farraday cup

Easy to design but
It took 8 months to manufacture this piece (and delayed the research programme)

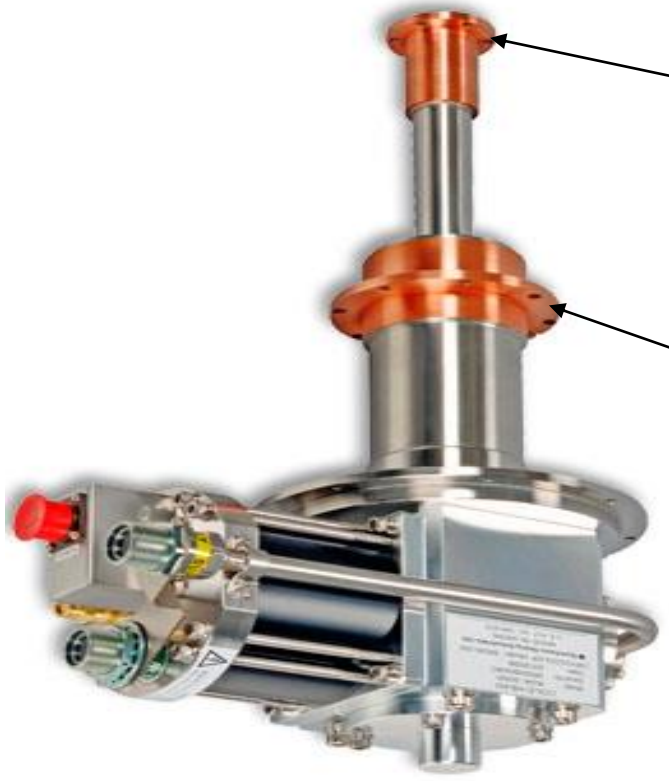




Initial Design

Electron Gun, Gauge, RGA, Pumping, Gas injection

RDK-305D 4K Cryocooler (RDK-305D Cold Head with CNA-31C/D Compressor)



Bellows

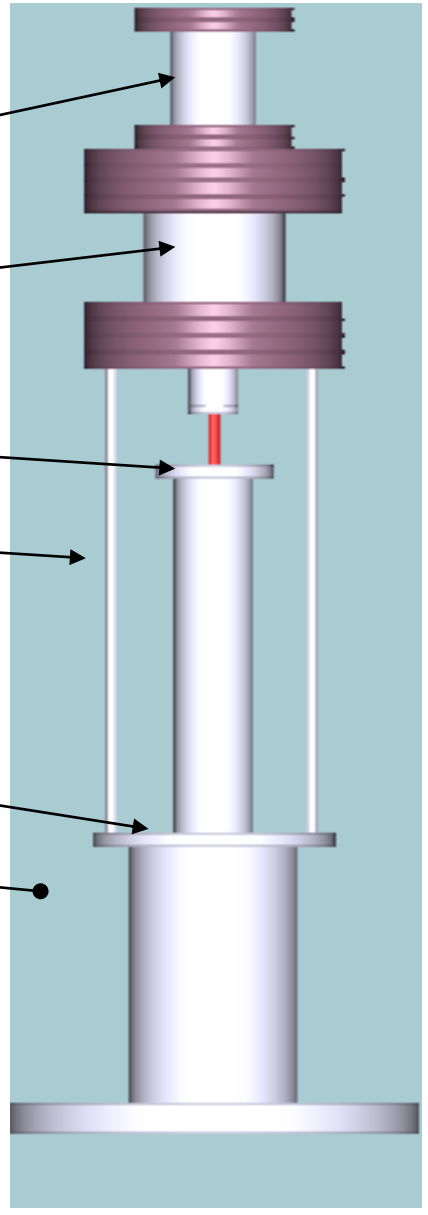
Test chamber

2nd stage

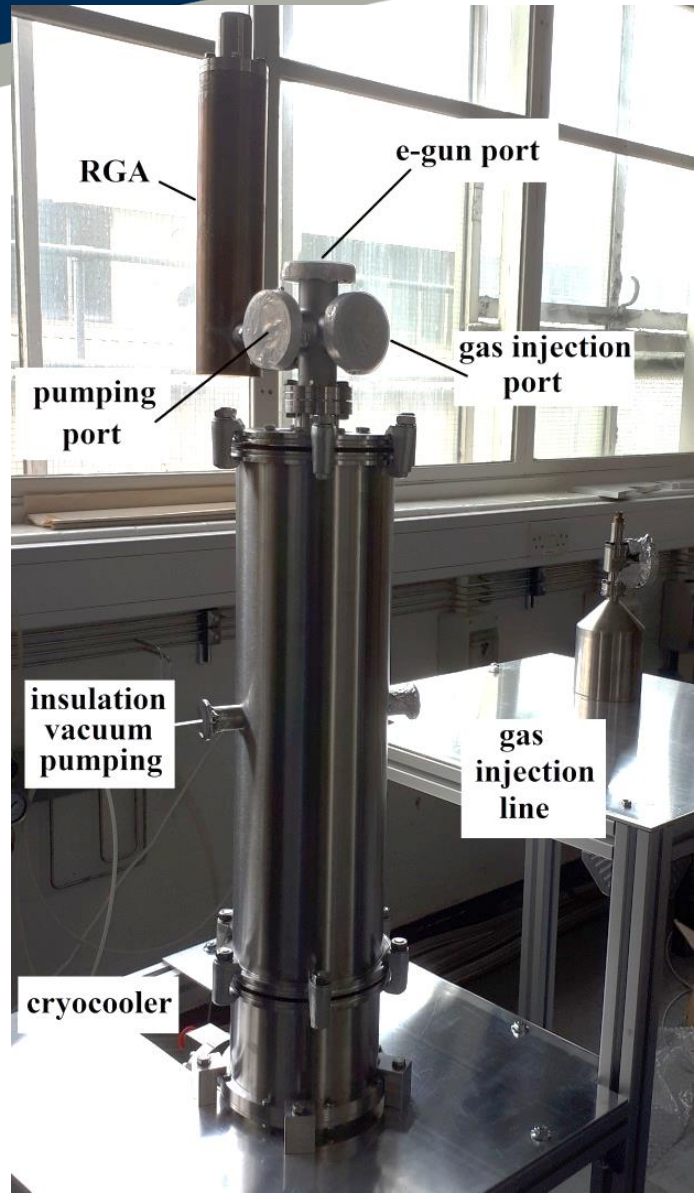
Conductor from 1st stage to heat shield

1st stage

Insulation vacuum



Current design



Bellows

Test chamber

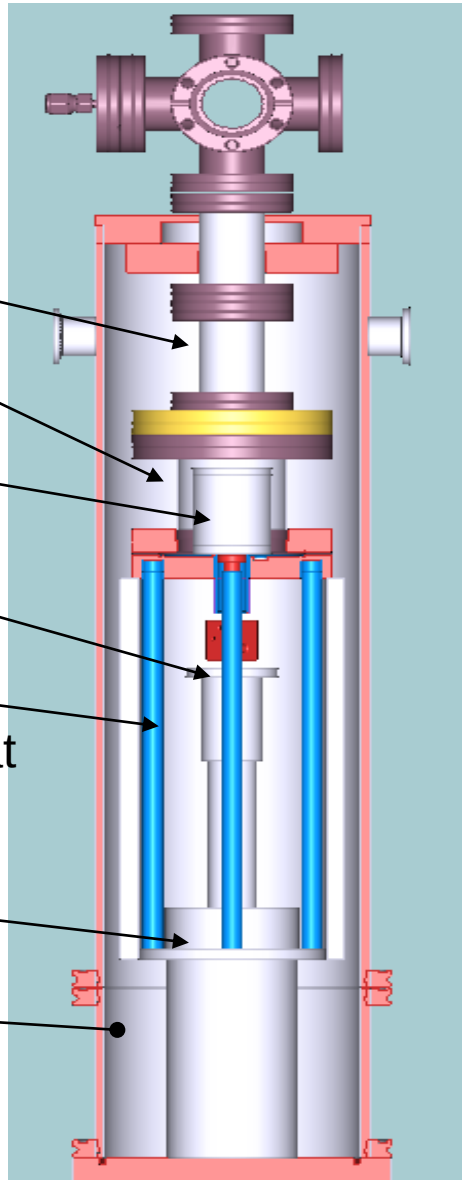
Faraday cup

2nd stage

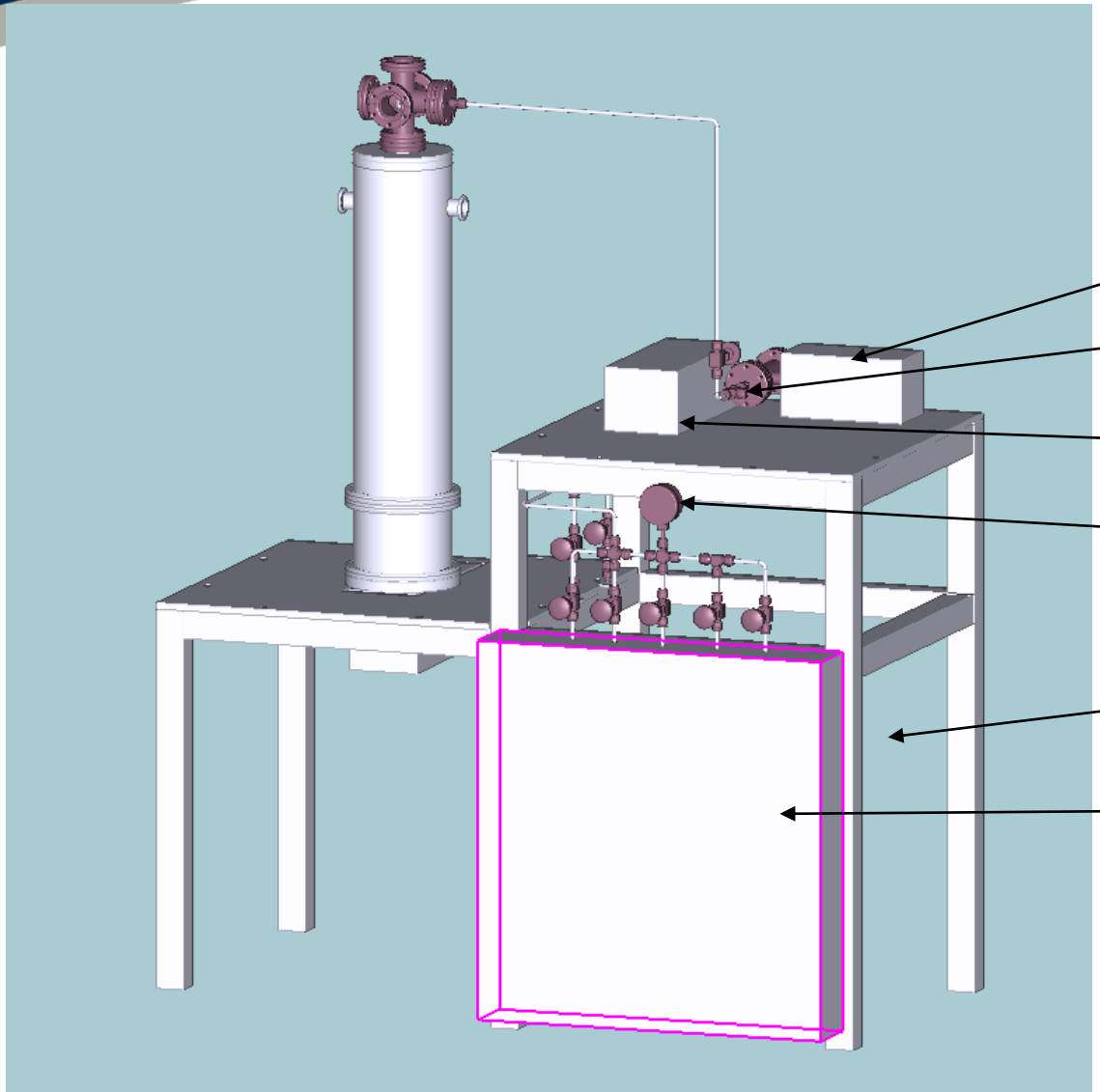
Conductor from 1st stage to heat shield

1st stage

Insulation vacuum



Injection line



Baratron

Small Volume

Large Volume

Gauge

Pumps

Gasses (CO, CO_2, CH_4, N_2, Ar and H_2)

Conclusions

- SEY < 1 has demonstrated on more than 40 samples produced with different lasers and various parameters
- A new facility for SEY studies will allow the measurement of LASE surfaces at cryogenic temperatures with and without cryosorbed gasses
- Facility will be tested shortly after this workshop