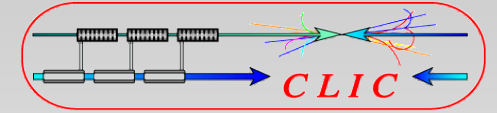


Gas outburst studies on copper

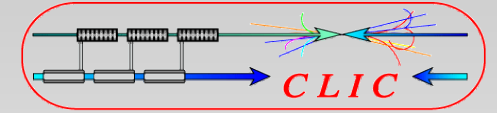
Yngve Inntjore Levinsen, Antoine Descoeurdes,
Sergio Calatroni, Mauro Taborelli

Outline



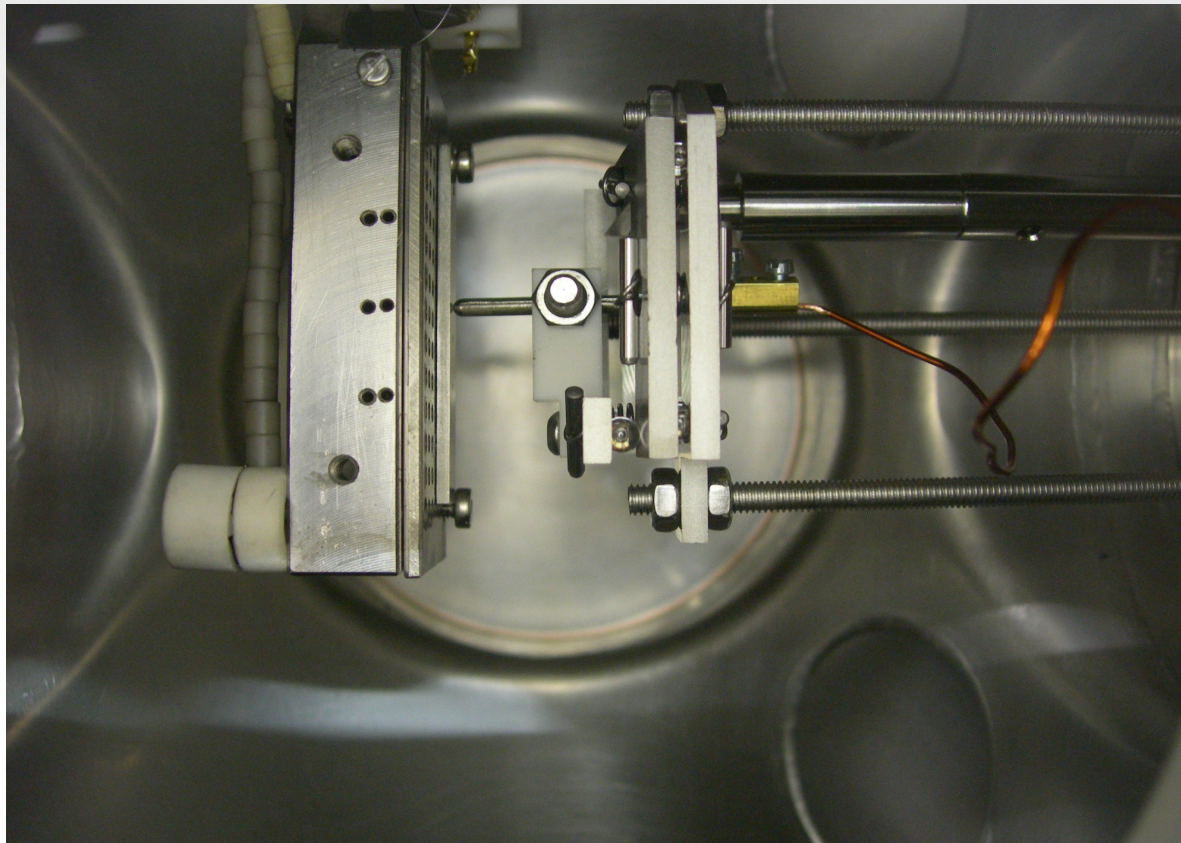
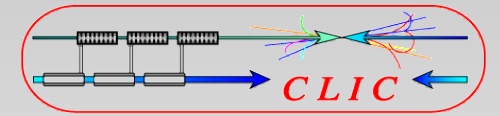
- New DC Spark Test System
- Gas outburst studies on copper electrodes

New DC Spark Test System ready

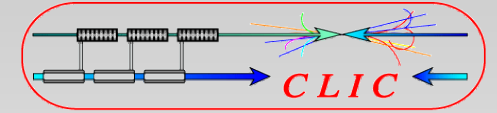


- 20kV electrode voltage tested (goal 30kV)
- Pressure $< 10^{-10}$ mbar achieved
- Combined field emission and breakdown measurement possible
- Additional equipment bays
- Free up one system to do time-consuming experiments (e.g. breakdown rate experiments)

New DC Spark Test System ready

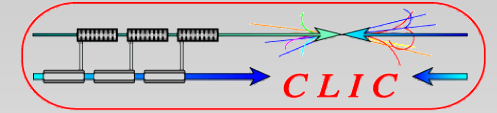


New DC Spark Test System ready



- Breakdown resistance measurement on SLAC test piece underway
- Stainless steel piece ready for breakdown rate measurement

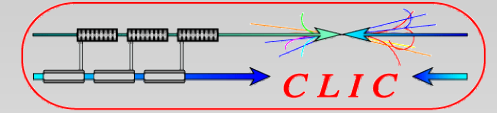
Outgassing studies



Goals:

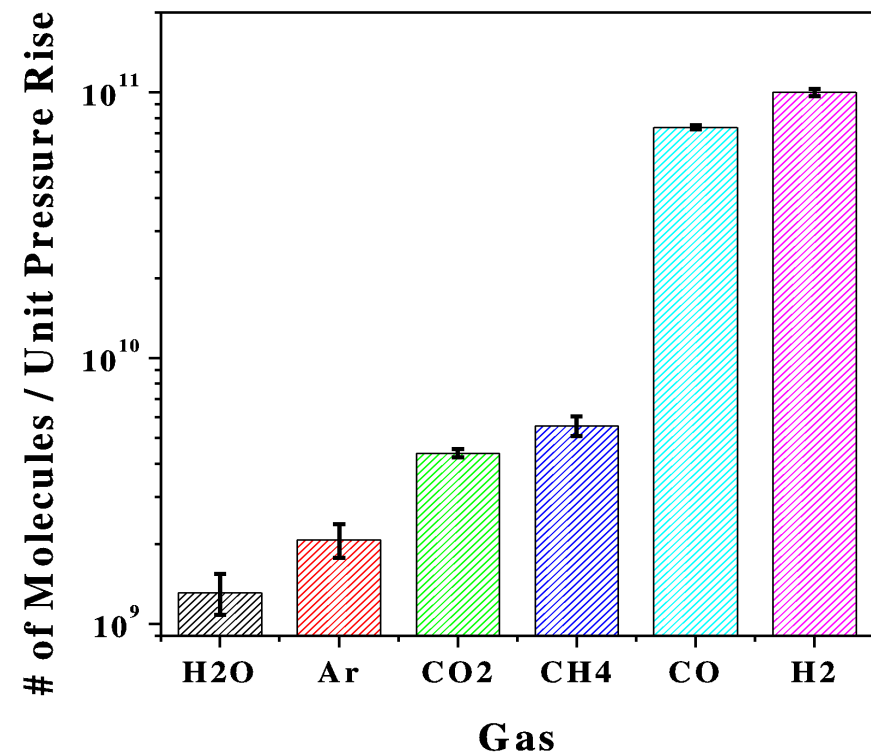
- Provide quantitative input data for vacuum quality simulations
- Further understand how the vacuum quality affects breakdown resistance

Outgassing studies

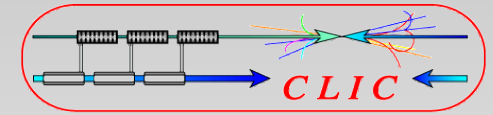


Already done for molybdenum (by Trond Ramsvik):

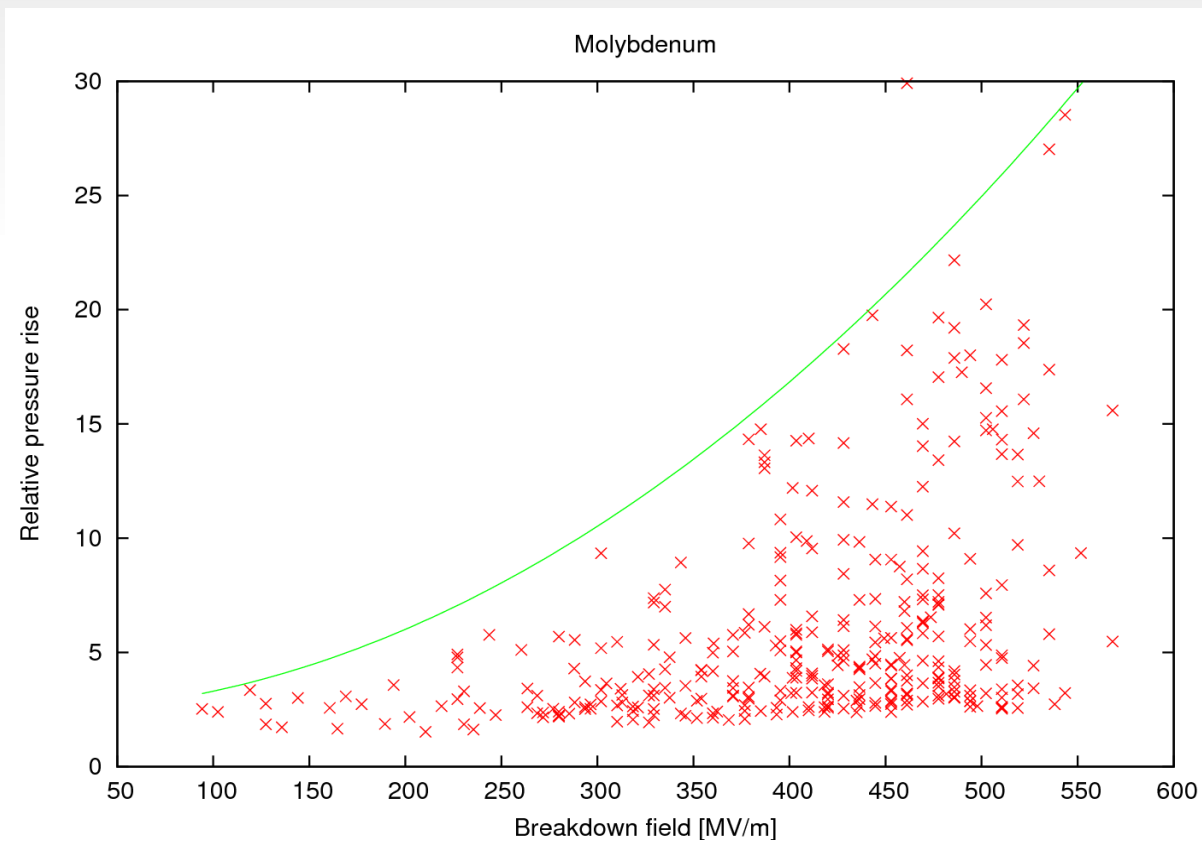
- # molecules scales linearly with pressure rise
- Relative pressure rise varies from ~2 to ~16
- Pumping speed 0.3 l/s for H₂



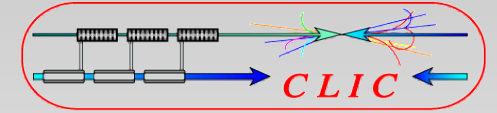
Outgassing studies



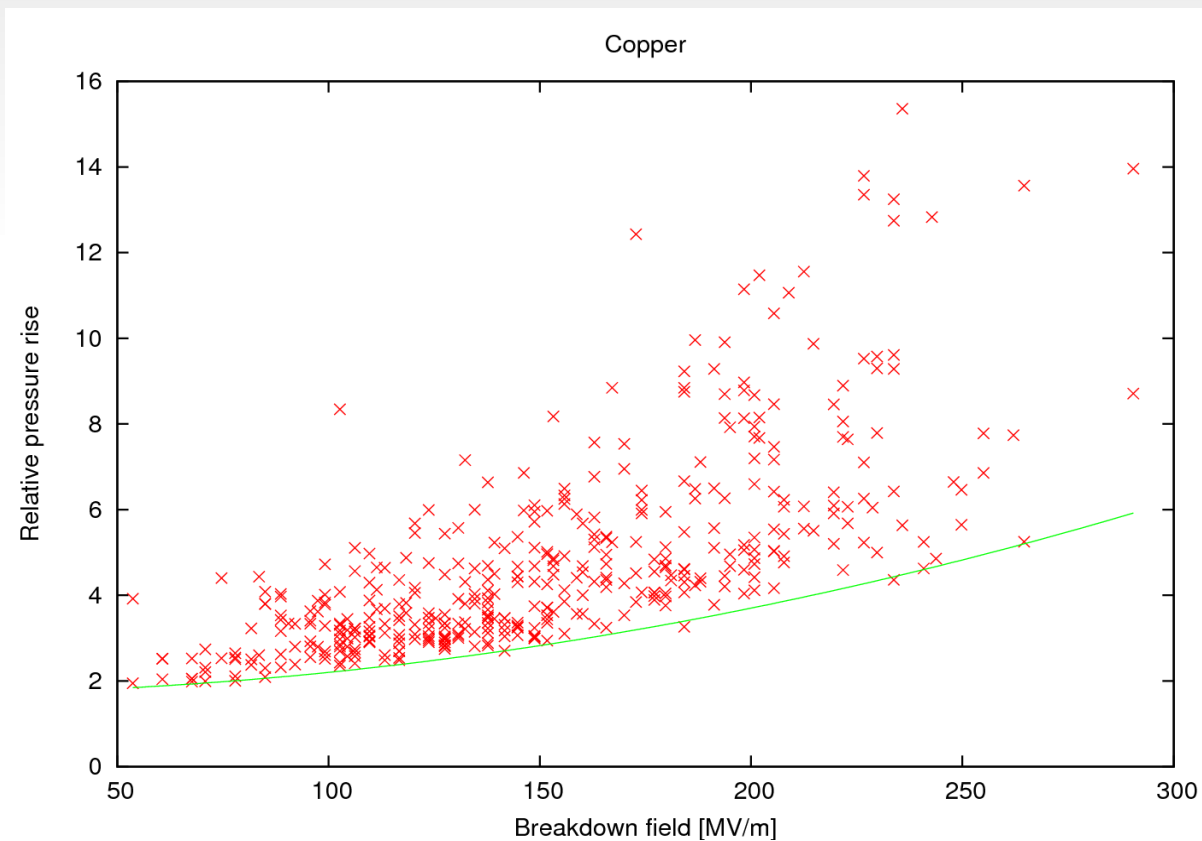
Spark cycle => field and pressure variations



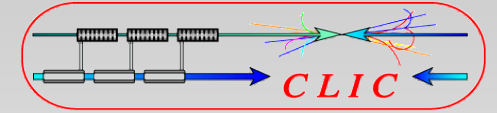
Outgassing studies



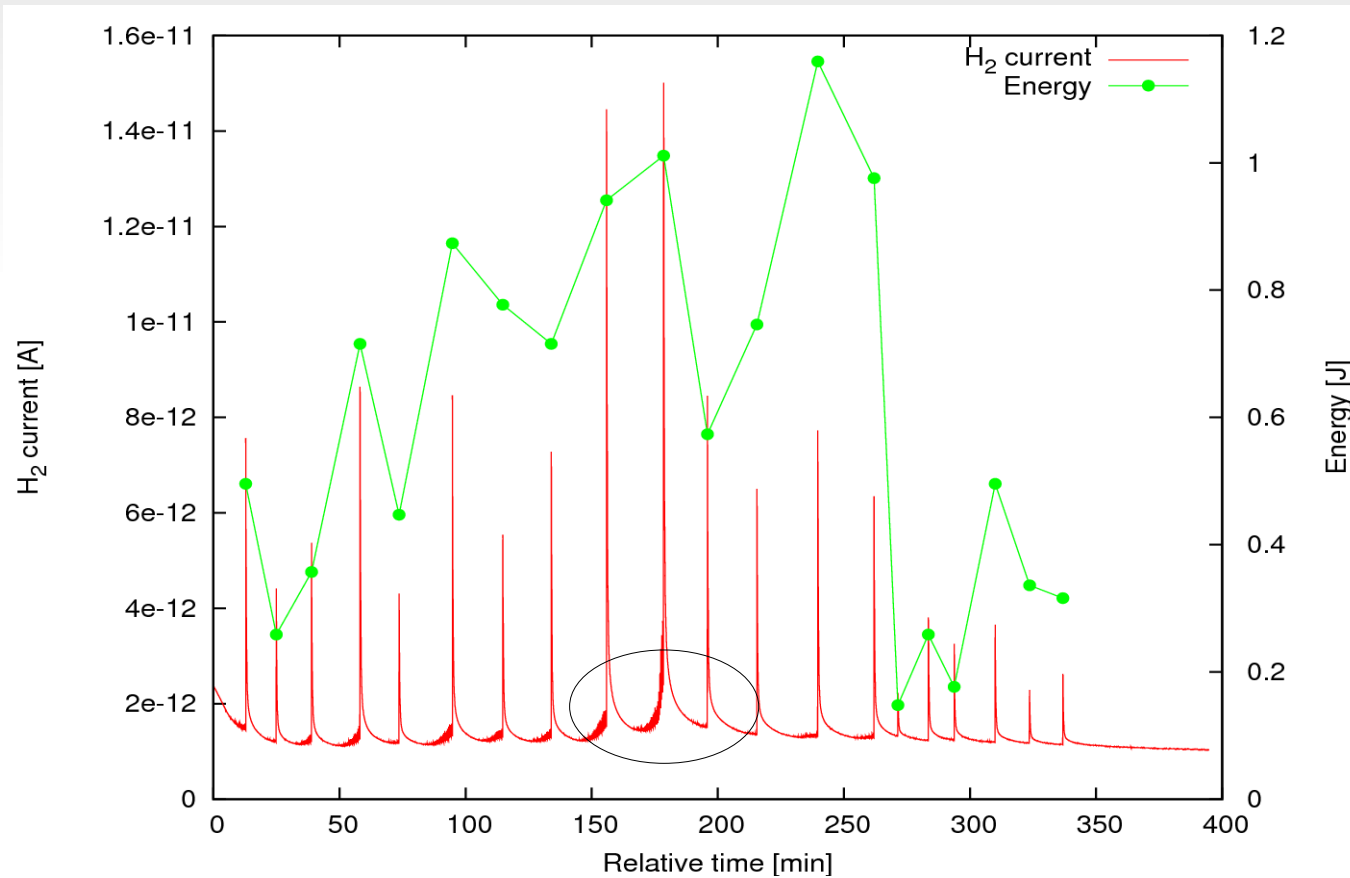
For copper: A lower limit for pressure rise also appears!



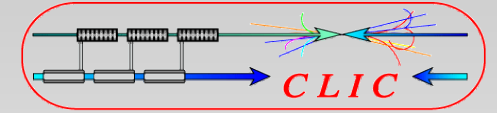
Outgassing studies



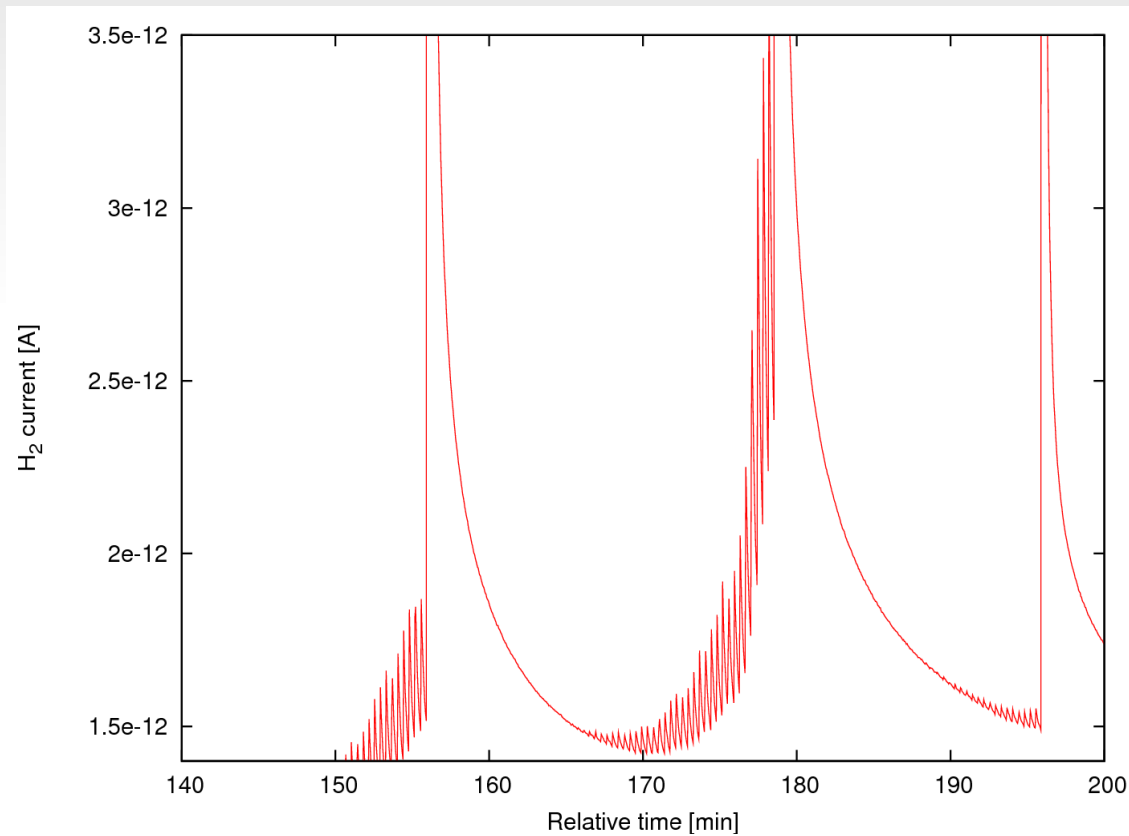
Hydrogen outgassing and the energy through the spark:



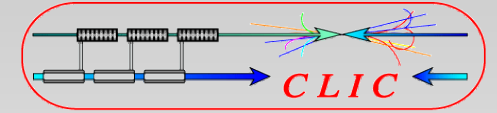
Outgassing studies



Detailed view: Field emission outgassing

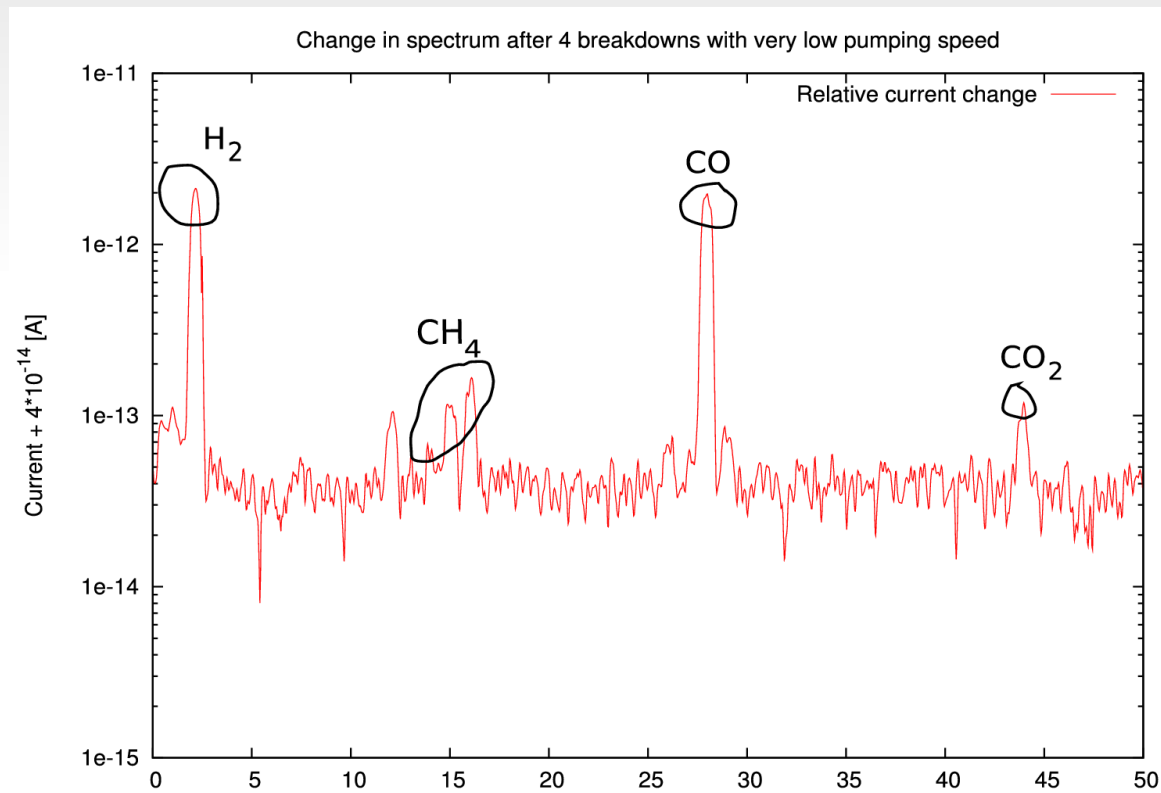
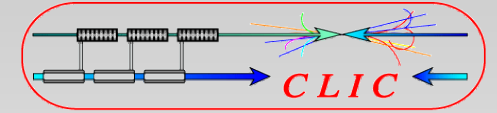


Outgassing studies

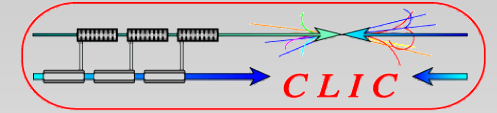


- Average relative pressure rise: 3.0
- Average energy: 0.6 J
- Average field: 210 MV/m
- Pumping speed: ~ 0.02 l/s for N_2

Outgassing studies

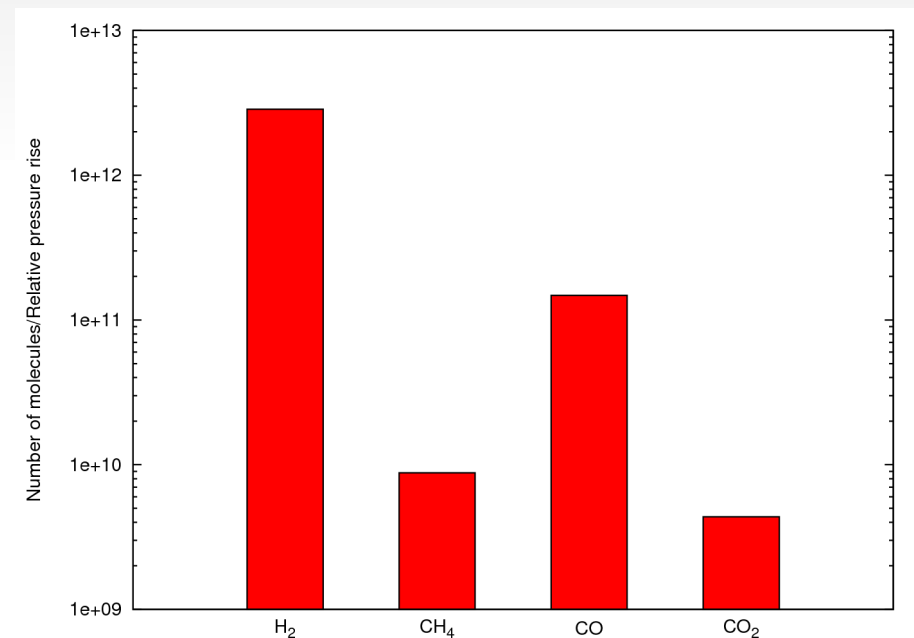


Outgassing studies

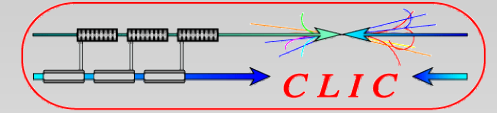


Results from copper outgassing experiment:

- Hydrogen most prominent, followed by CO, CH₄ and CO₂
- No water found
- No argon
- Higher uncertainty on CO levels than for the other gases
- Multiply by 3 to get # of molecules

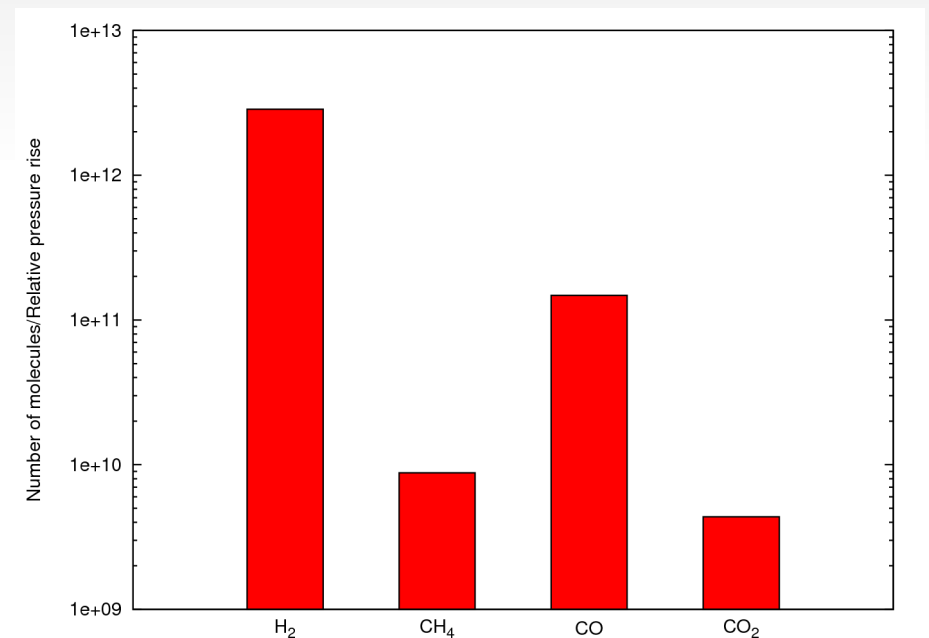


Outgassing studies

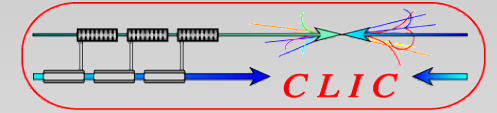


Results from copper outgassing experiment:

- H_2 ~ 30 times more than for Mo (!)
- CO ~ 70-80% more
- CH_4 ~ 60% more
- CO_2 ~ 10-20% less
- Rough error estimation ~30%

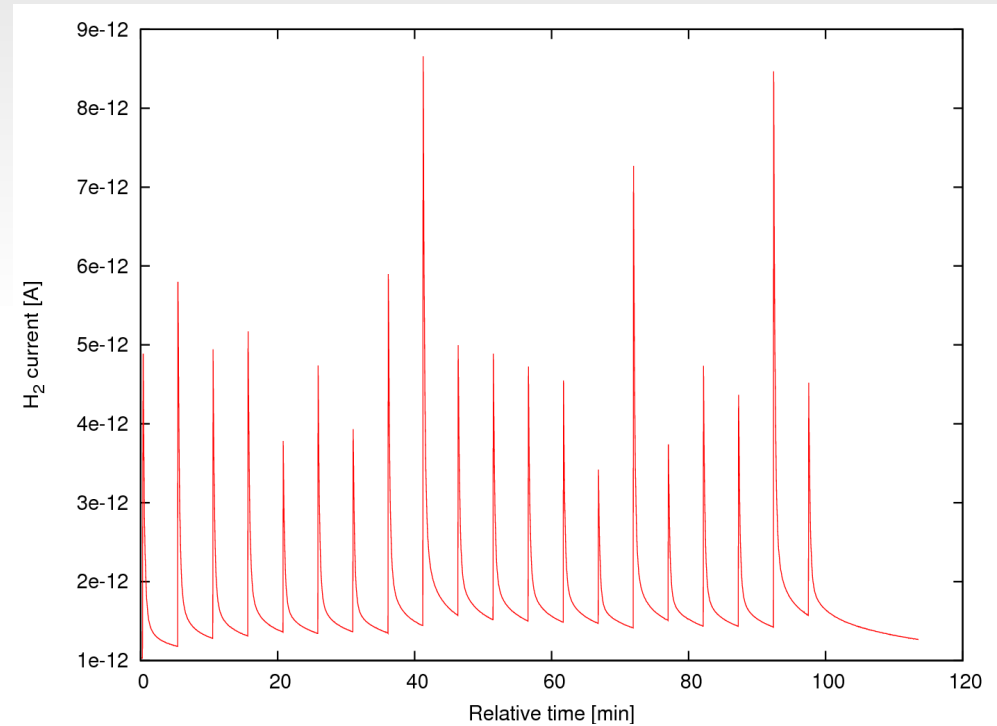


Outgassing studies

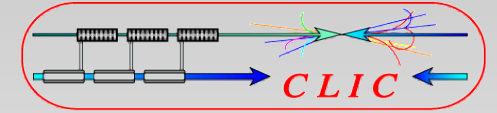


Another way find the gas released:

- Fixed energy 0.85 J (~ 250 MV/m)
- Breakdown rate 1
- Not normalized with pressure

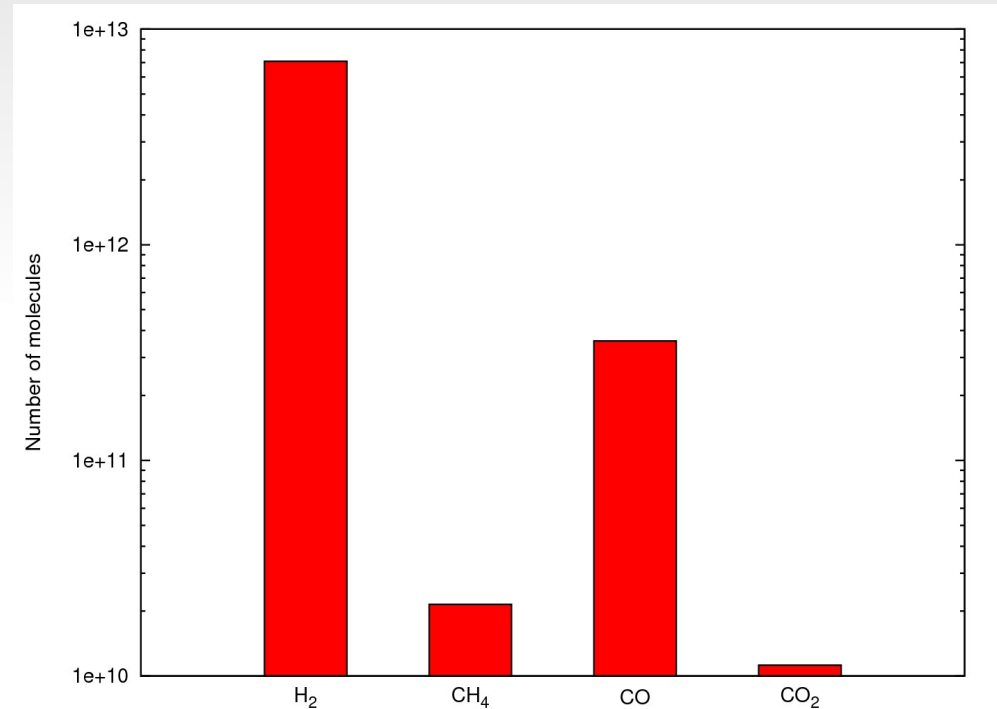


Outgassing studies

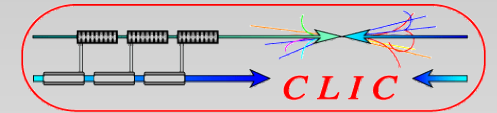


Compared to the other experiment on copper:

- Energy ~ 40% higher
- Amount down by ~ 15-20%
- No particles from field emission



Summary



- New DC Spark Test System now ready to provide new kinds of experimental data
- Outgassing studies on copper show same "ranking" as for molybdenum, different ratios
- Total error estimated ~ 30%
- Questions/comments?