"Production of negative ions in an helicon hydrogen plasma in front of a HOPG sample"

"Role of double capture and sputtering"

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Arches 2008 Marseille

Summary

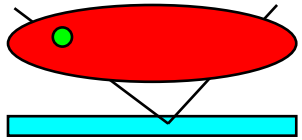
Motivation

Experimental set-up « PHISIS »

IDF measurement

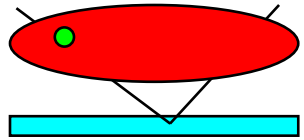
- H- production (Volume and surface)
- H- produced at surface
  - Energy deposit and isotopic effect
  - Sample temperature measurements
  - Coverage, sputtering and double capture
- Temporal behaviour

Conclusion

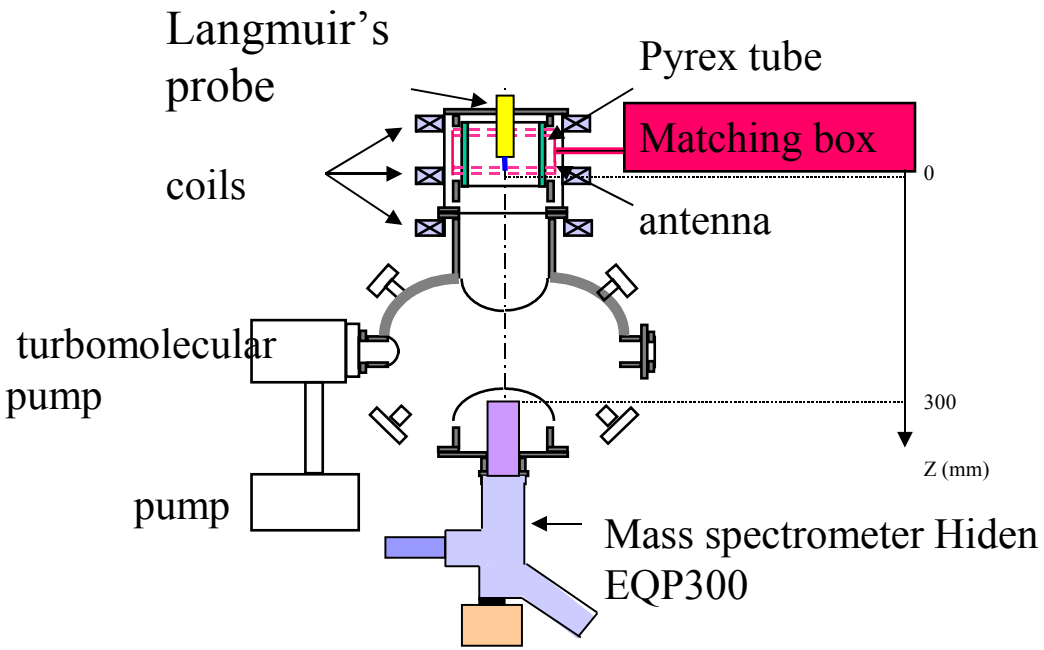


Motivation

- Improve neutral beam injection (ITER)
- Negative ion production (thruster)
- Stability of plasma source
- Dust chemistry (sheath behavior)
- Improvement? of H- production with a small additional argon (10%)



Plasma Helicon to Irradiate Surface In-Situ



« PHISIS »

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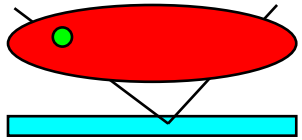
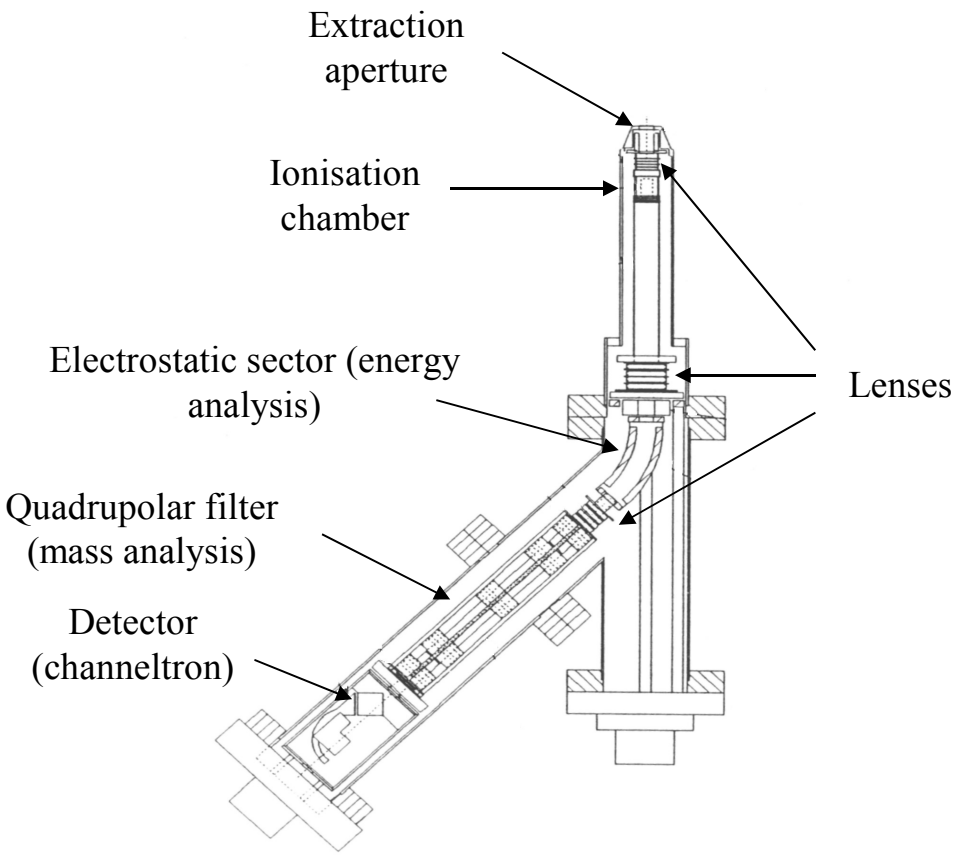
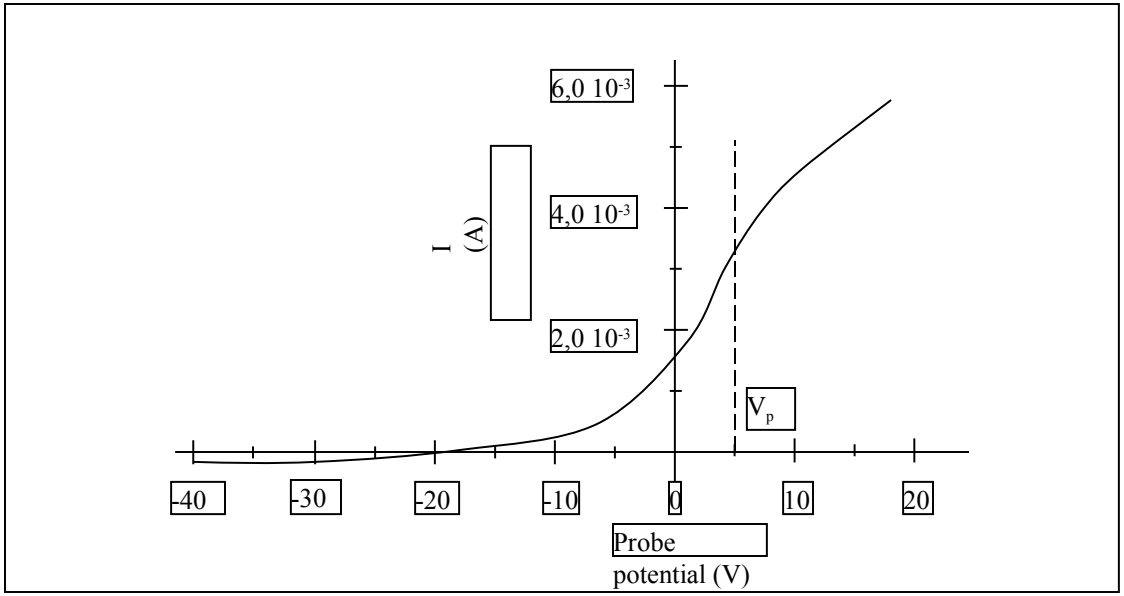
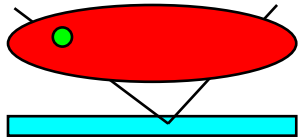



Extraction aperture
Ionisation chamber
Electrostatic sector (energy analysis)
Quadrupolar filter (mass analysis)
Detector (channeltron)
Lenses

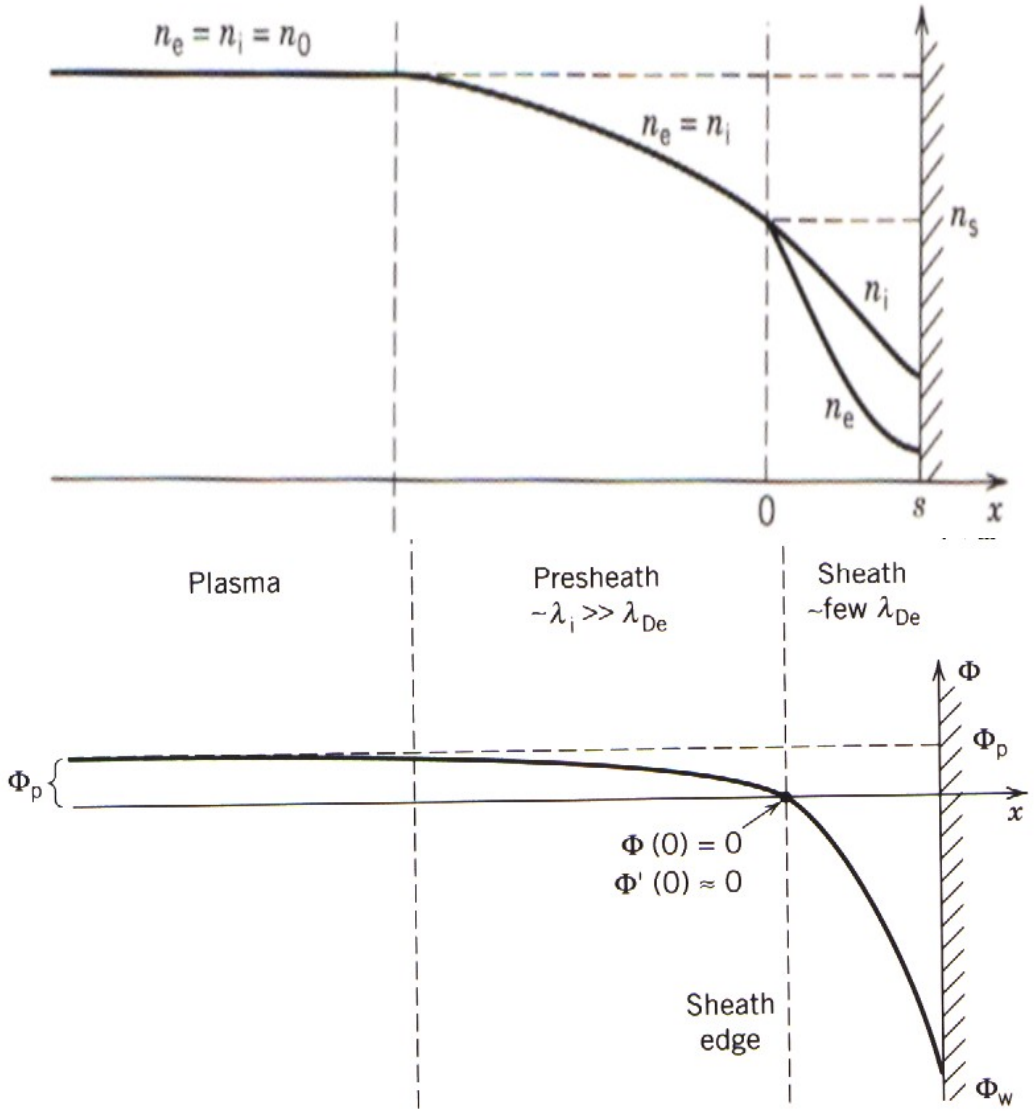
The langmuir probe

Scientific systems





sheath

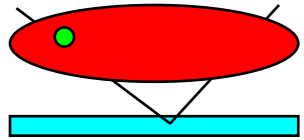


Negative

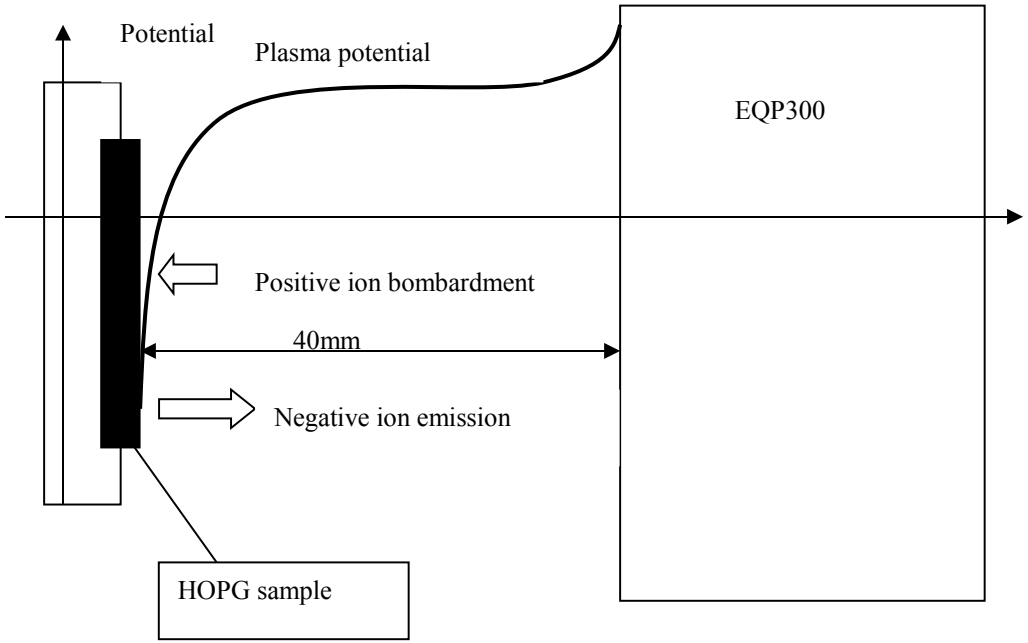
or

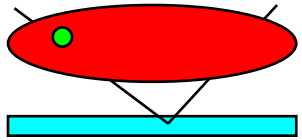
positive

sheath

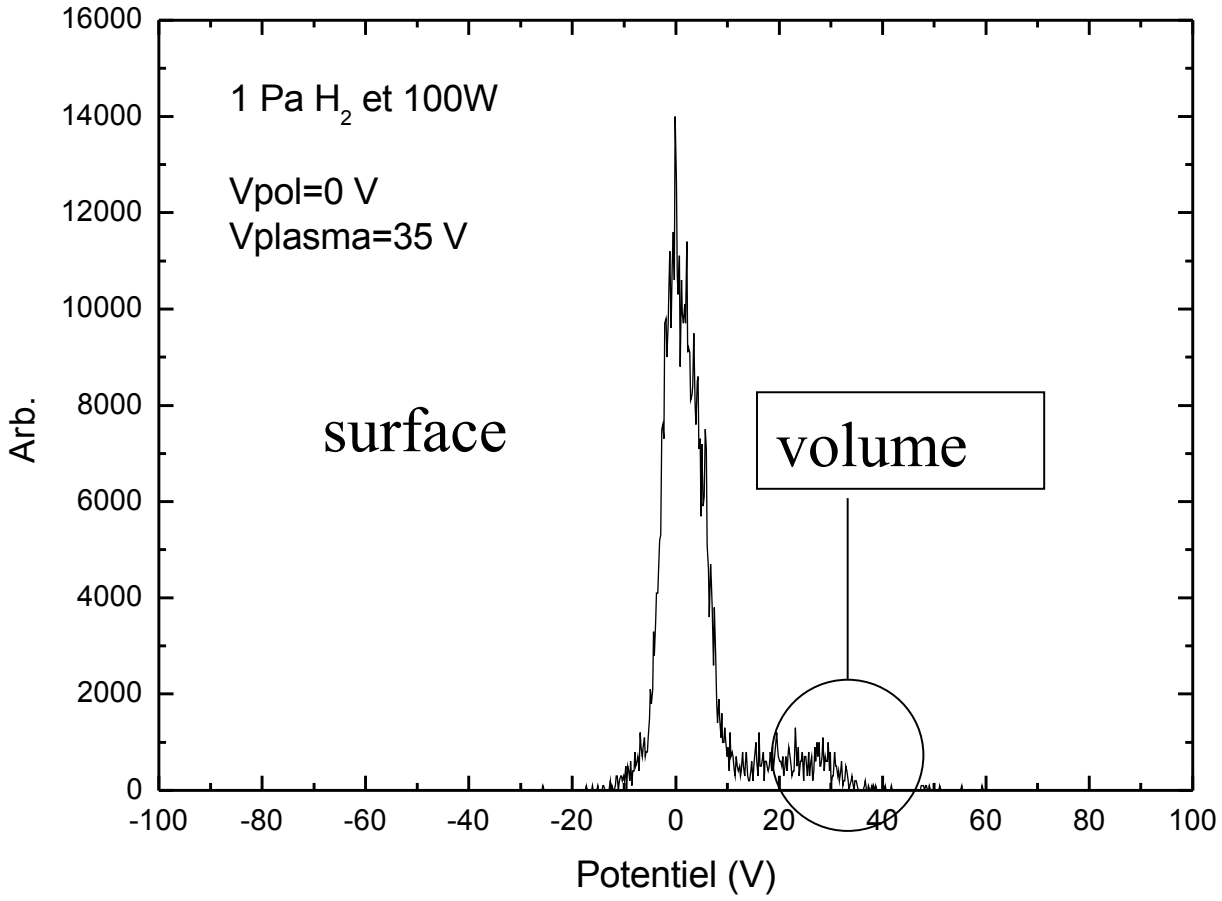


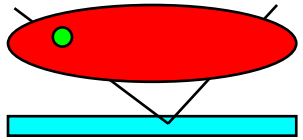
Sketch of our setup negative ion detection





H- IDF (surface and volume)





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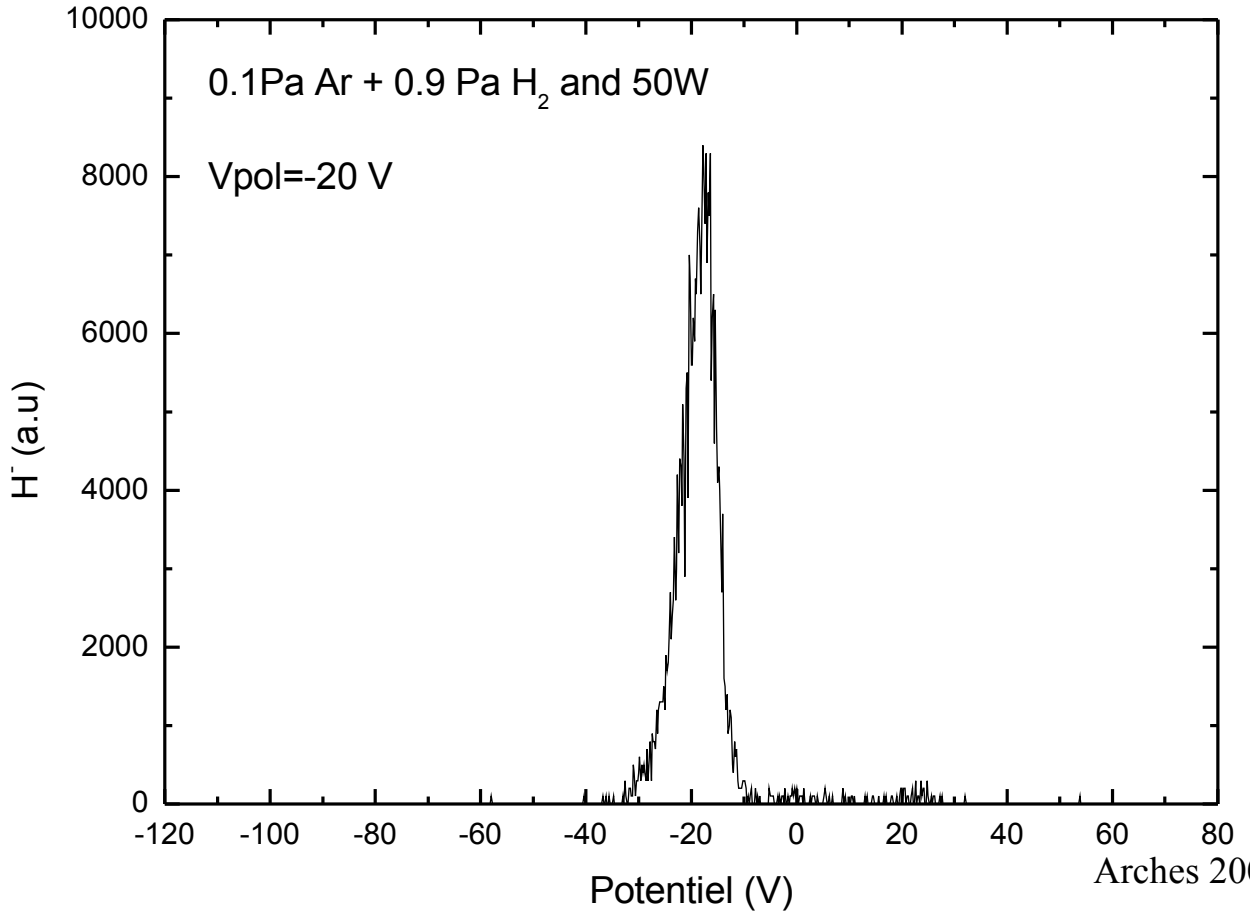
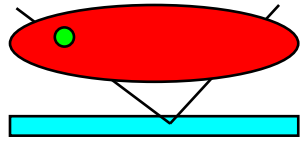
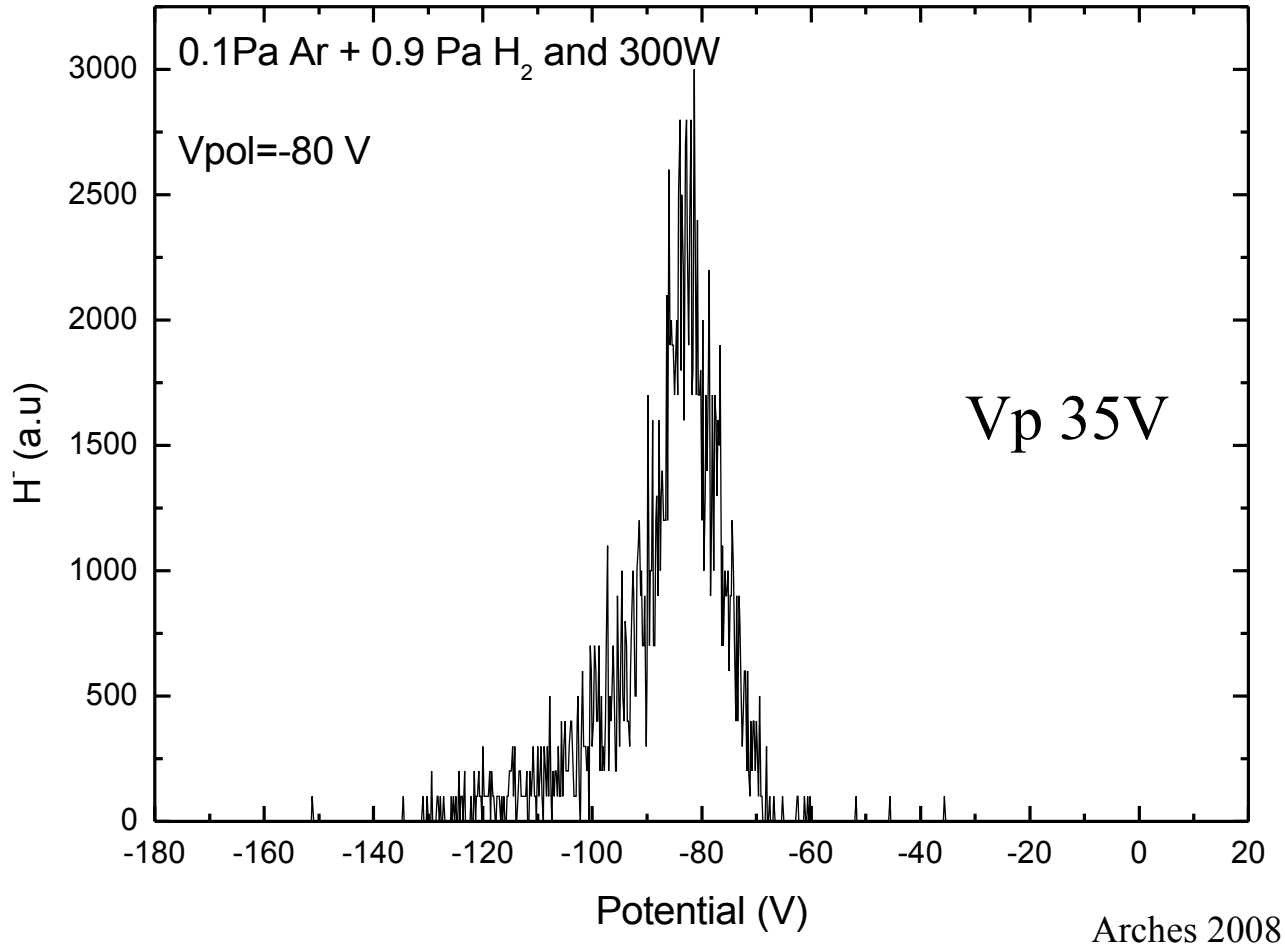
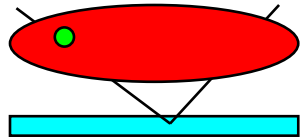




H- IEDF


0.1Pa Ar + 0.9 Pa H2 and 300W
Vpol=-80 V
Vp 35V
H- (a.u)
Potential (V)
3000
2500
2000
1500
1000
500
0
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20



$$H + H \xrightarrow{Surf} H_2^*$$

$$H_2^* + e^- \rightarrow H^-$$ ← Volume

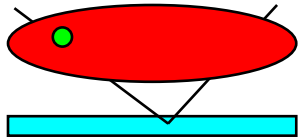
Highest reaction rates

$$H^+ \xrightarrow{Surf} H^-$$ ← 2 e- capture

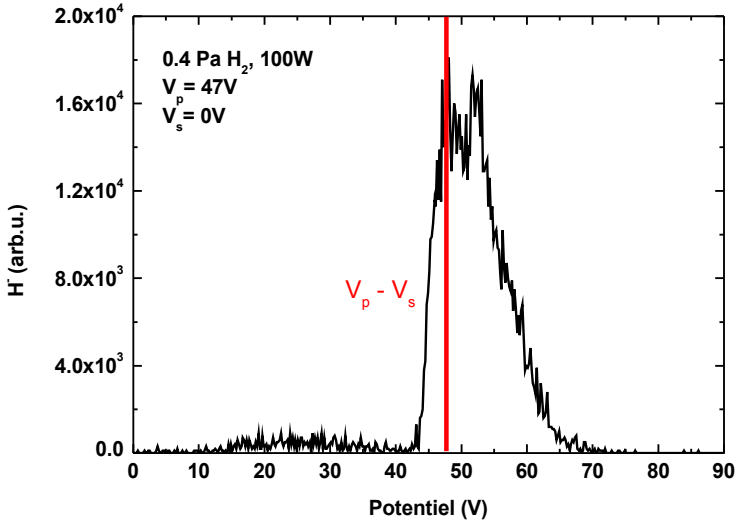
$$H_2^+ \xrightarrow{Surf} H^- + H$$

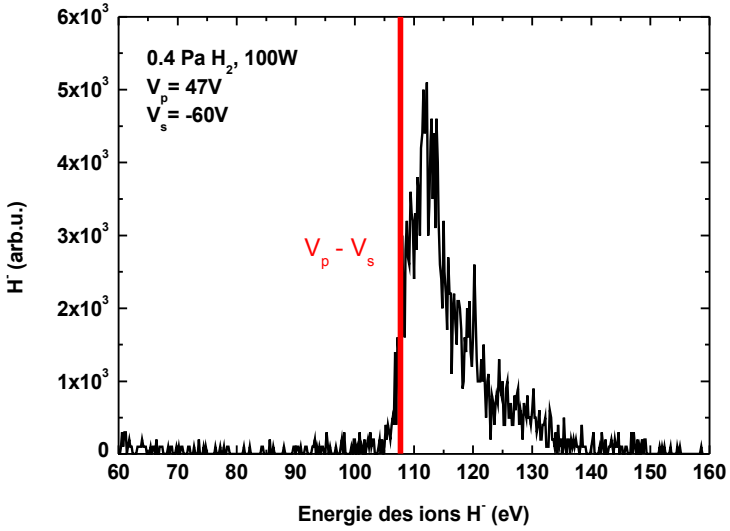
$$H_3^+ \xrightarrow{Surf} H^- + 2H$$

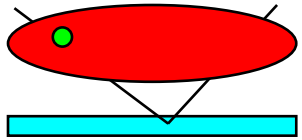
$$ArH^+ \xrightarrow{Surf} Ar + H^- \ ?$$



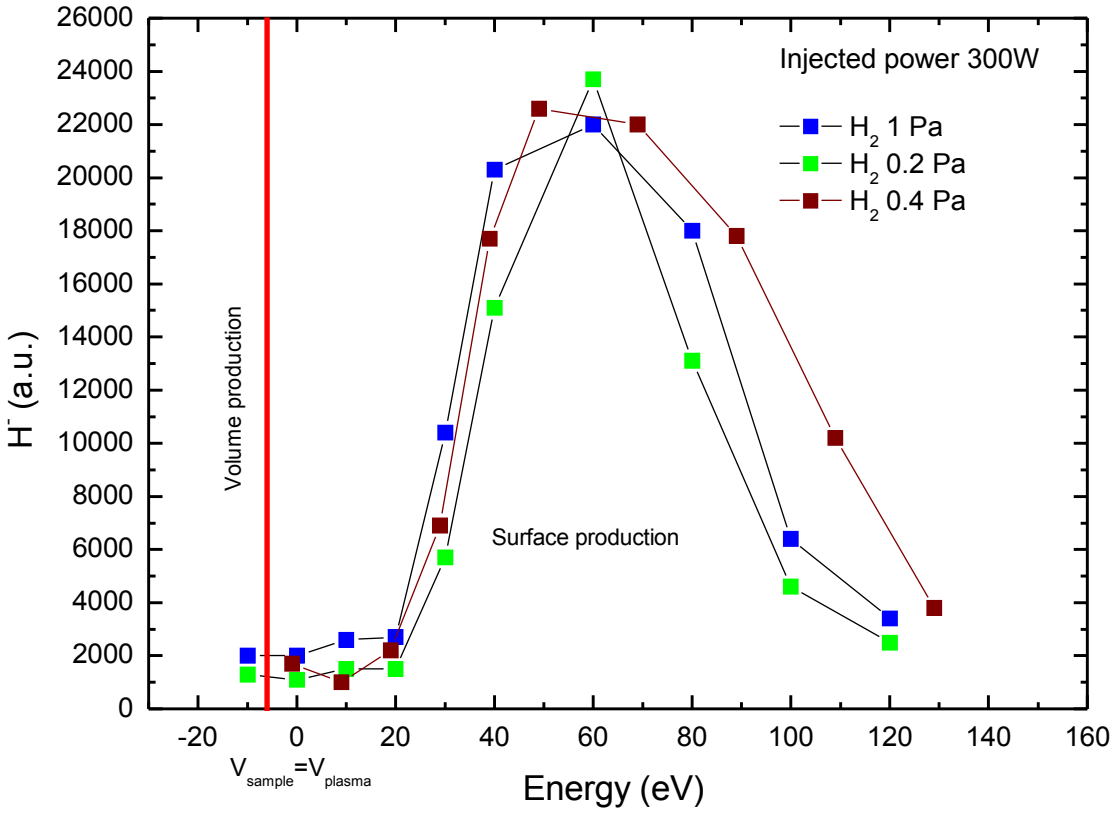
IDF of negative ions (surface)

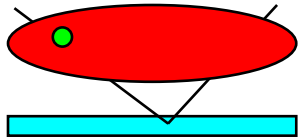




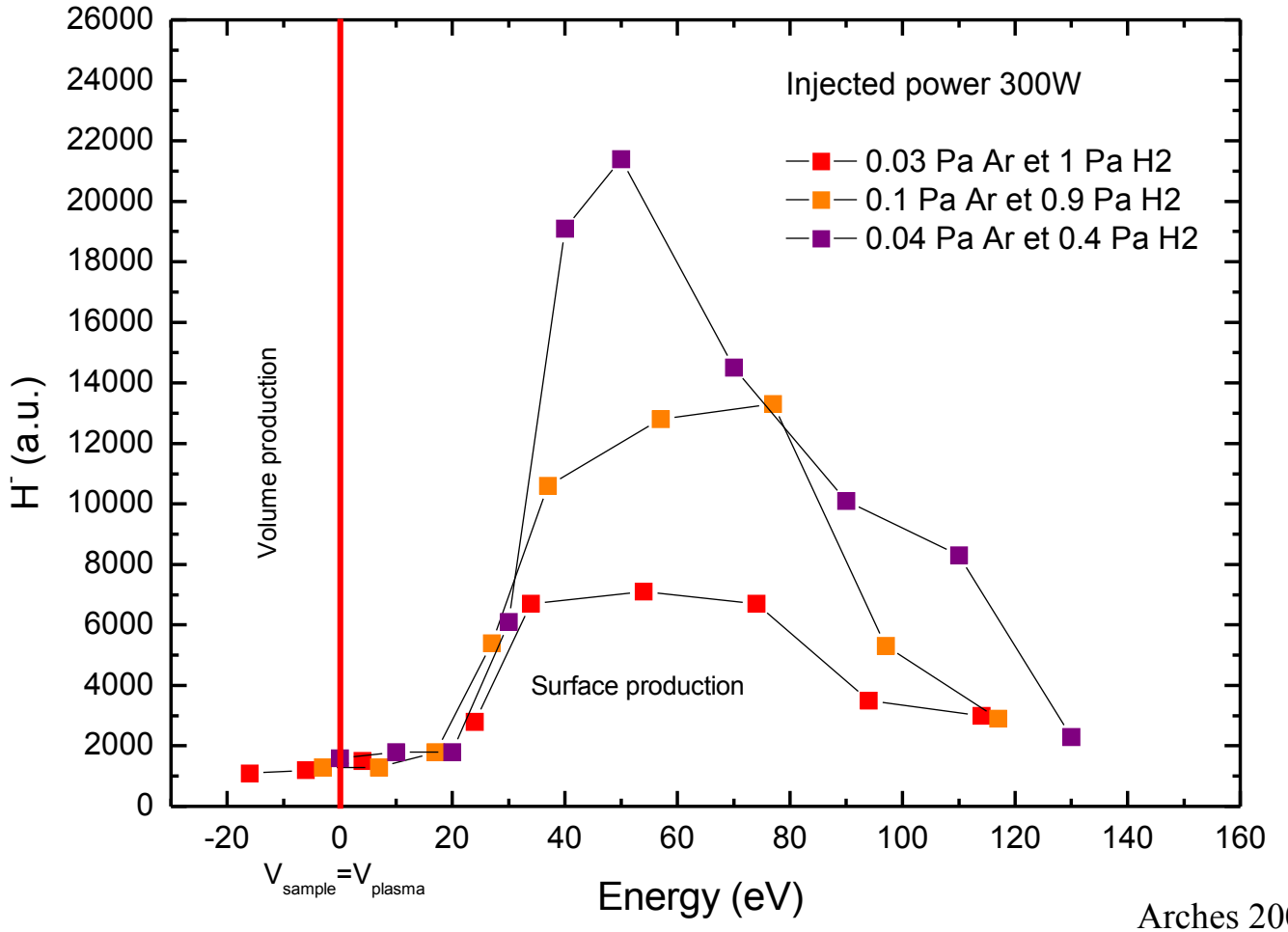


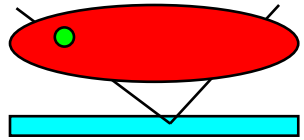
H- versus ion energy



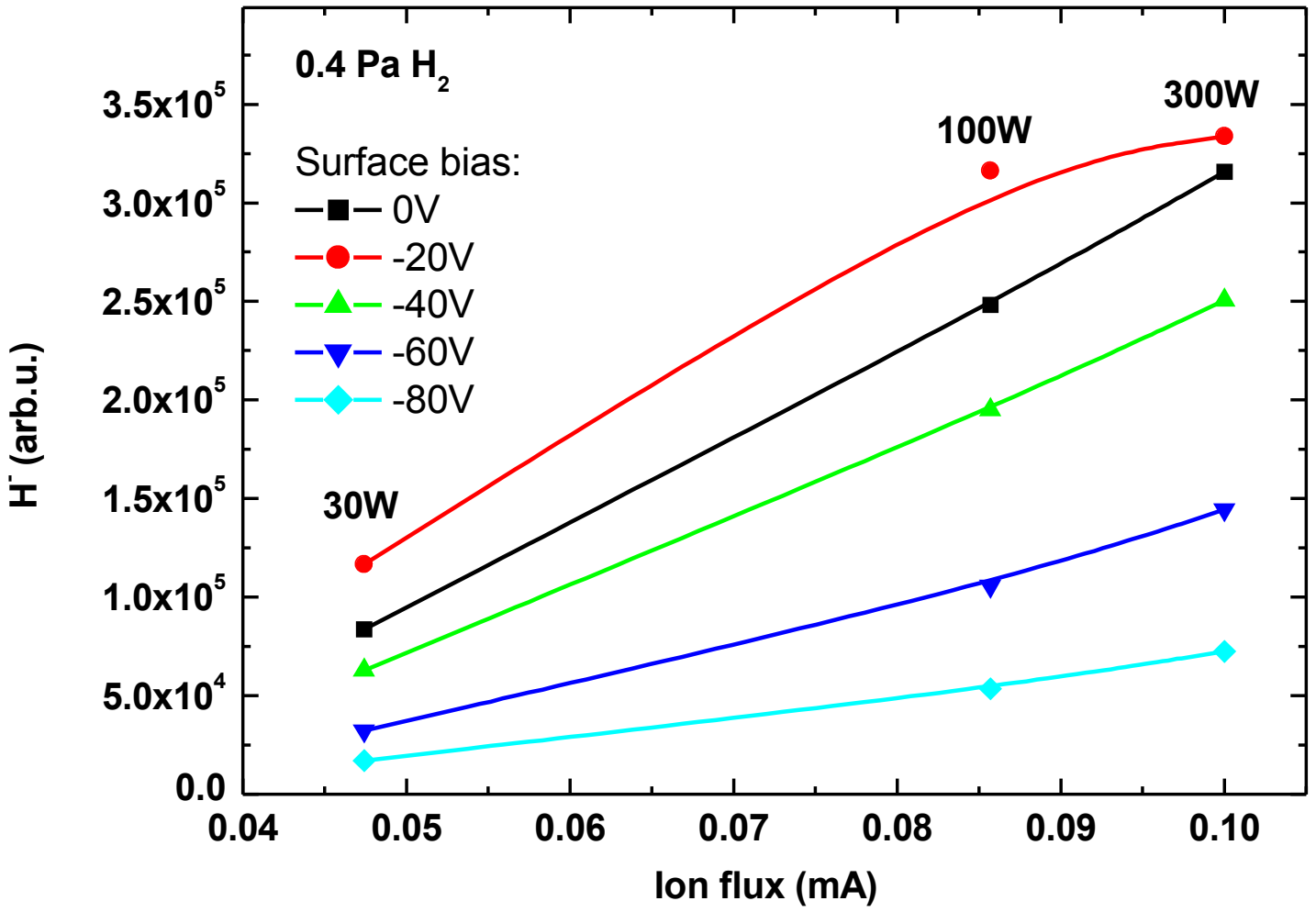


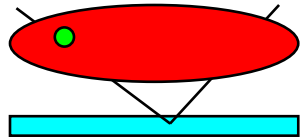
H- (Ar-H2)versus ion energy



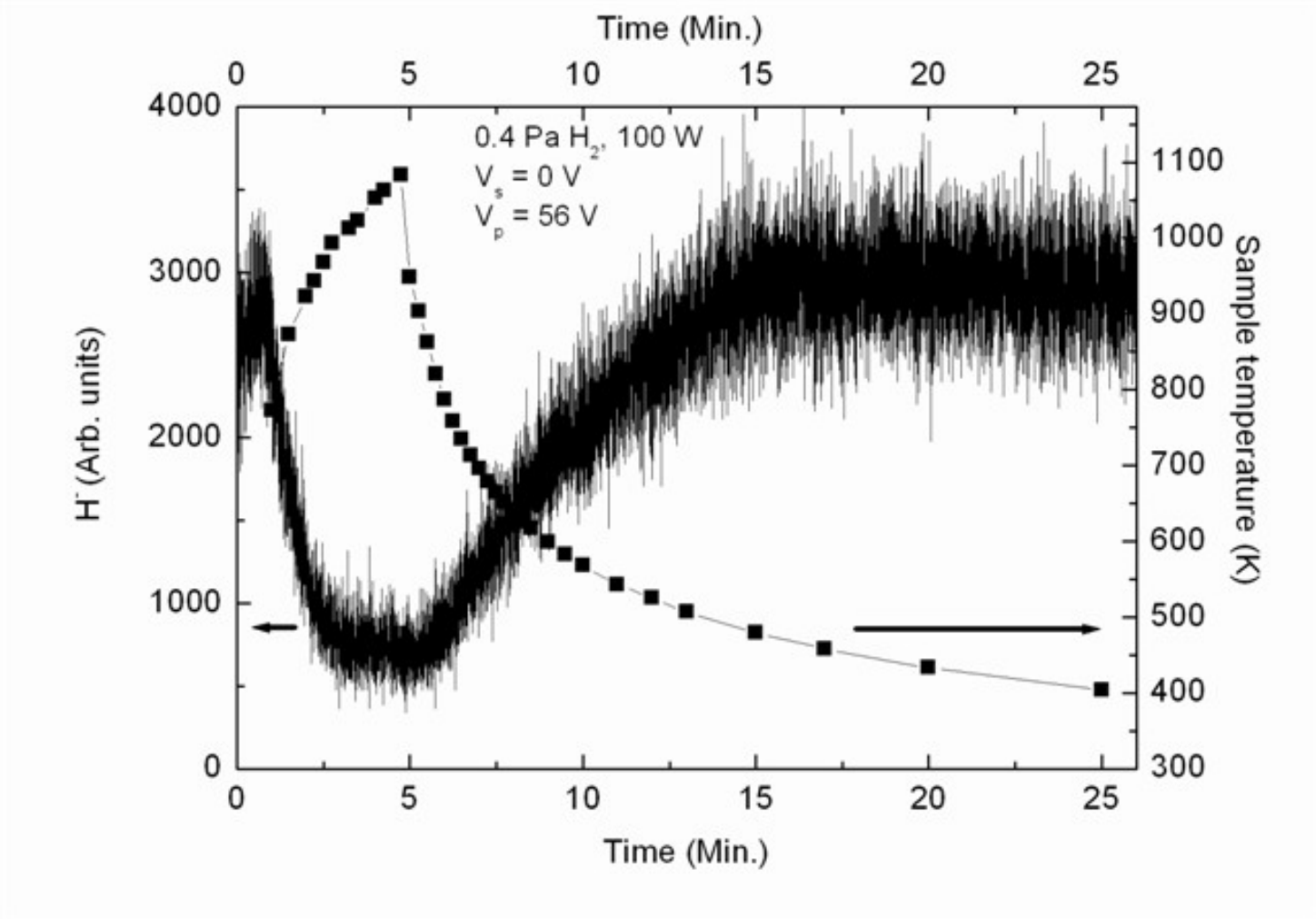


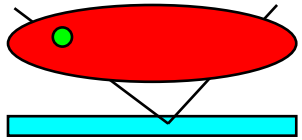
H- versus incoming proton



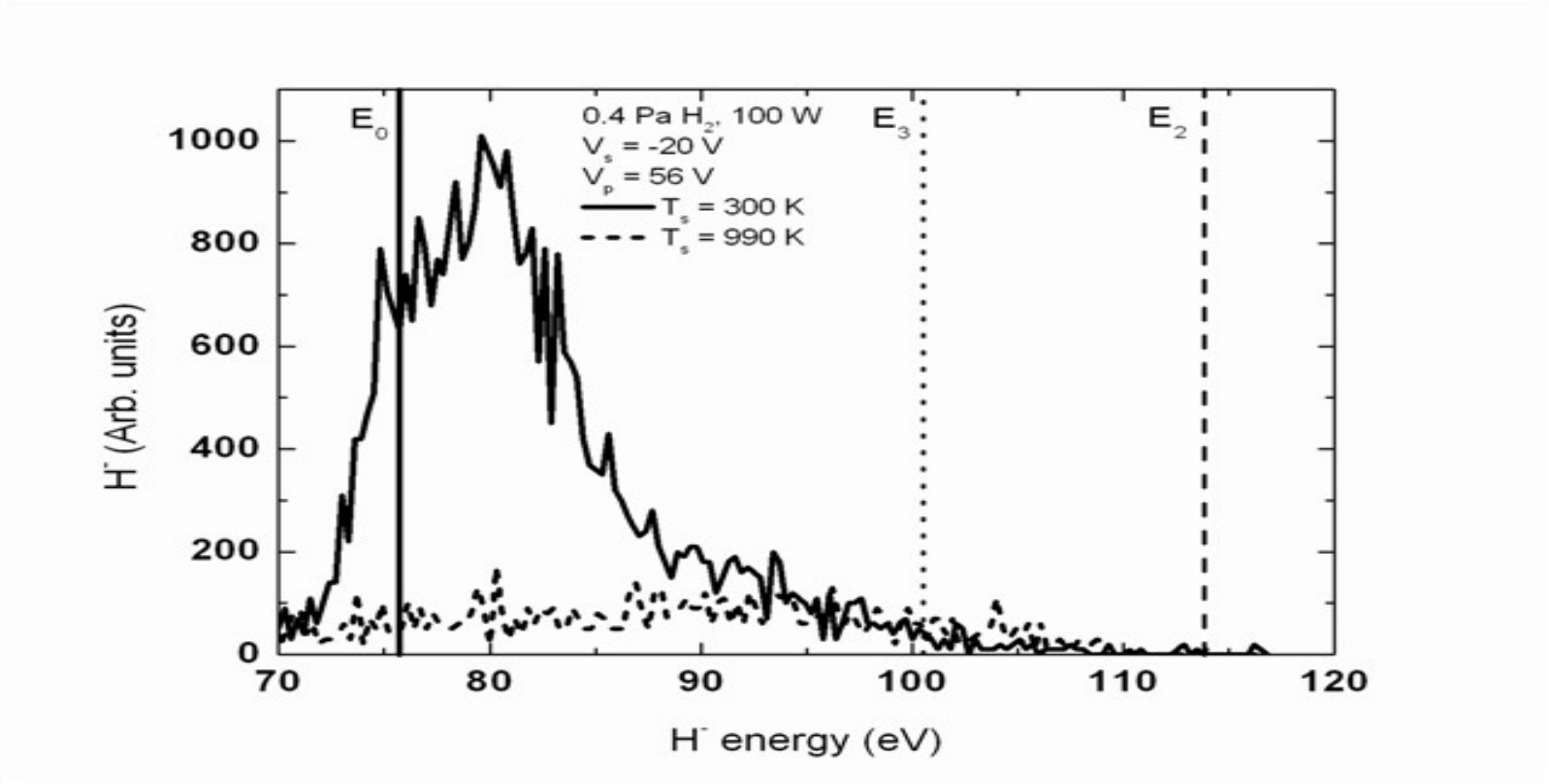


Sample temperature behavior

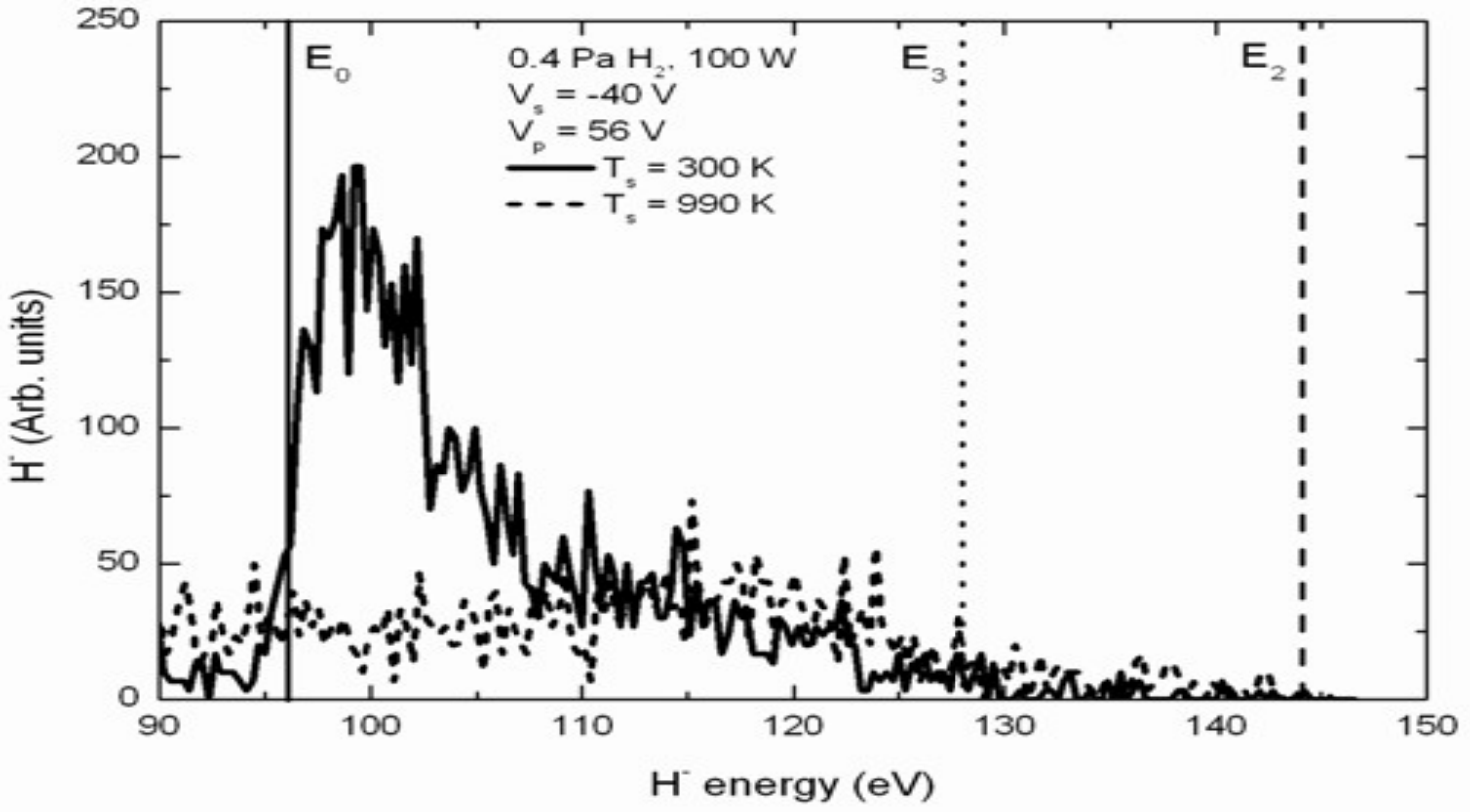




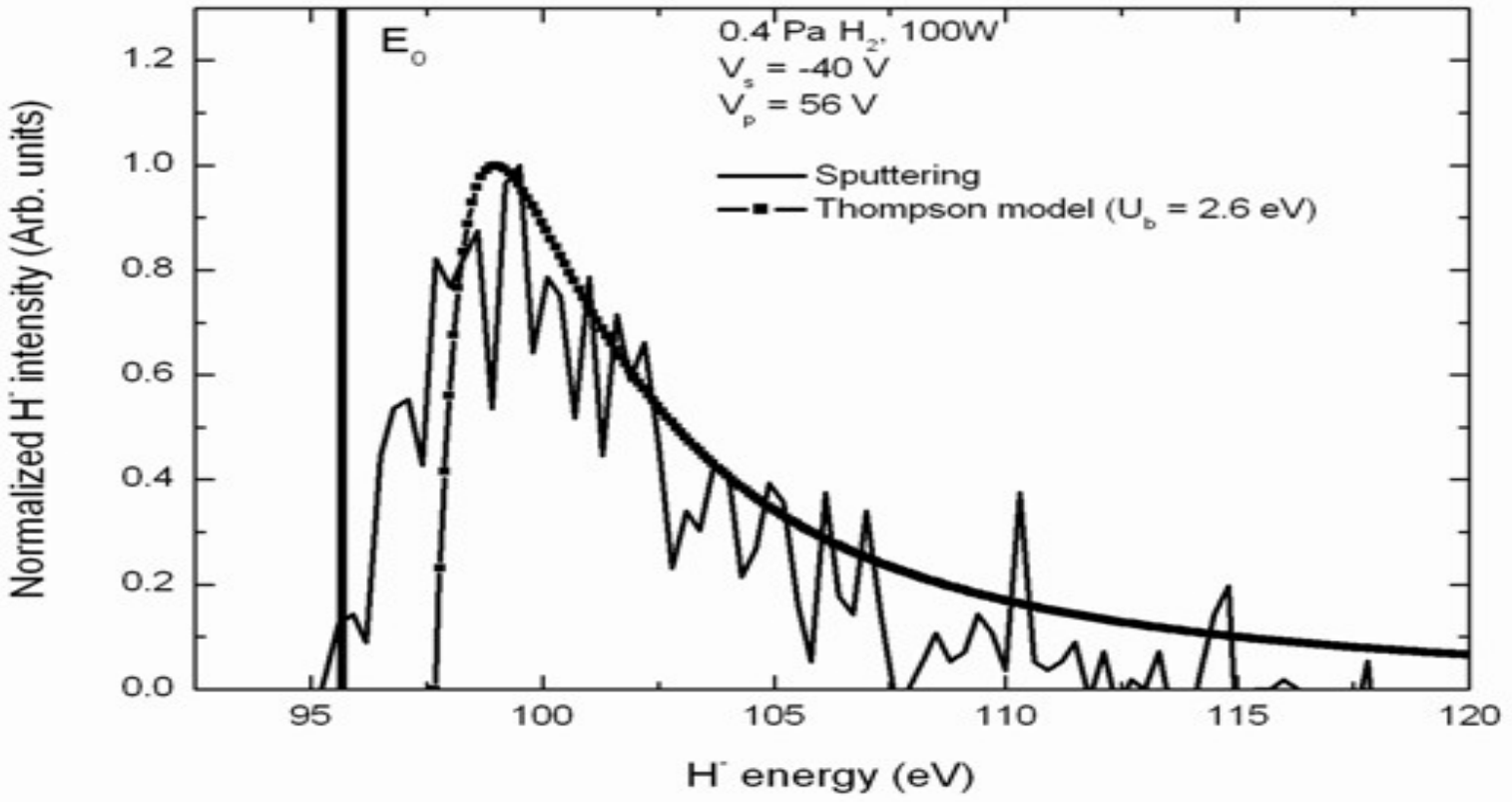
Double electron capture



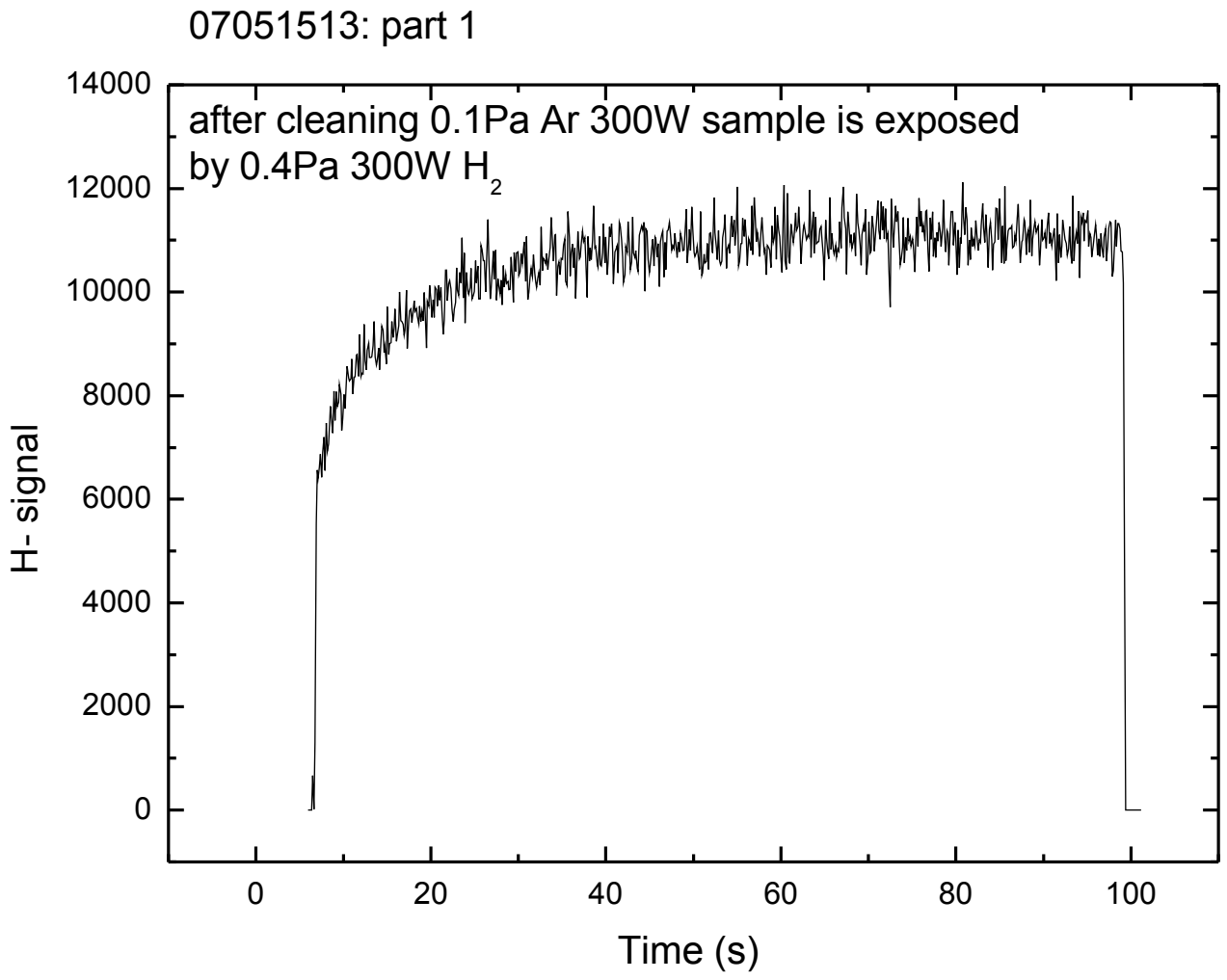
Double electron capture



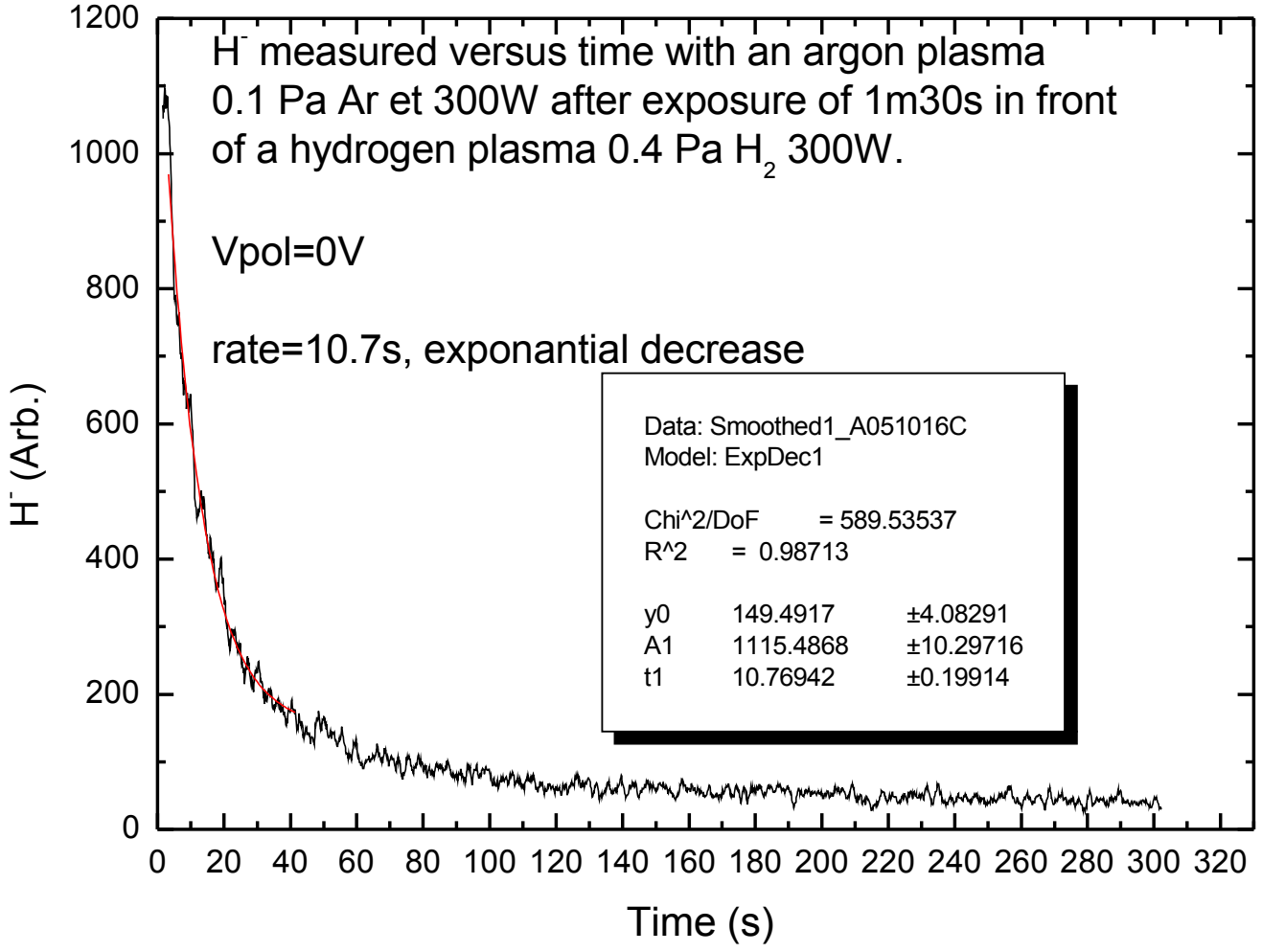
Sputtering component of H- surface production

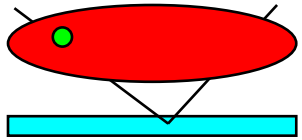


Temporal behavior



Temporal behavior





Conclusion

IDF show volume and surface contributions

H- Behaviour with energy of incoming ions

H- Behaviour versus temperature shows

Double electron and sputtering components

Temporal study clearly show a contribution of coverage?

Theory of sputtering with defects and dangling bonds?

Implantation of ions at low energy? Electron capture?

Stability of the sheath (width of the peak)?