Faraday cup study on ion beam for various electric propulsion technologies

IEPC 2019 – A – 803

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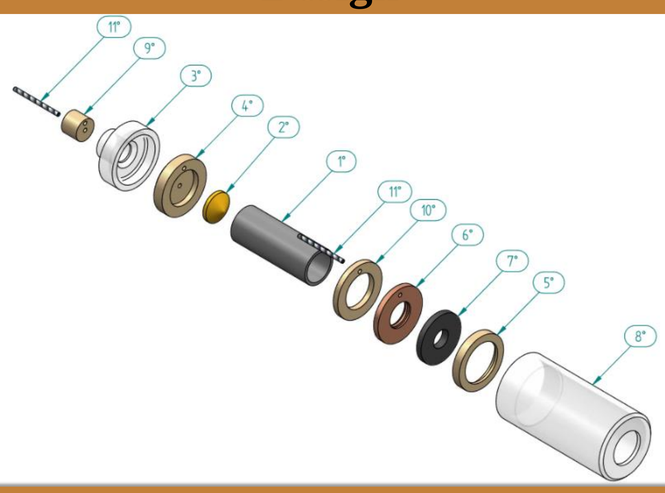
Design

Plume/Thruster performance parameters accessibility

- Complete scan of j_i profile
- Ion current : $I_i = \pi r^2 \int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} j_i(\varphi) \sin(\varphi)\, d\varphi$
  - Divergence half angle (θ)
  - Propellant utilisation (η)
  - Thrust, specific impulse



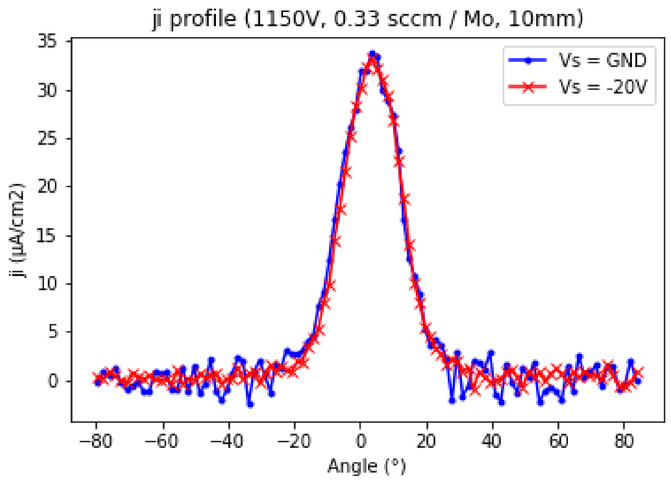
Related issues

- SEE
- CEX
- Material Pulverization
- Particle Deposition

FC Parameter impact

Collector (V_s) and Collimator (V_r) Potential

GIE: µ-RIT



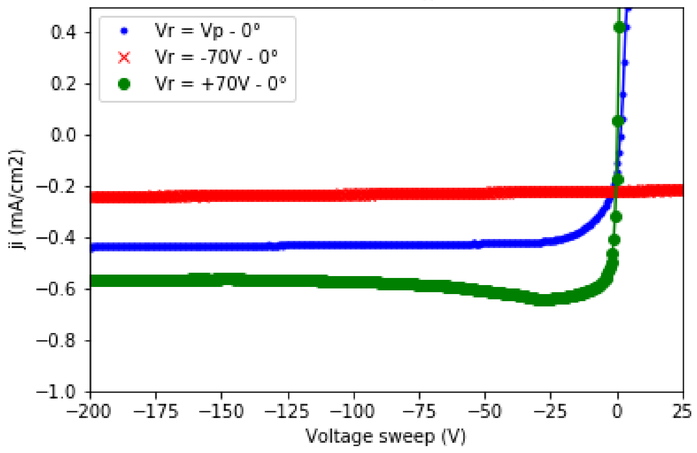
IV (200V, 9.5sccm // W, 5 mm)

- V_s: GND *vs* V_s: $-20V$
  - Damped instabilities at high angles

1150 V, 0.33 $sccm$ / Mo, 10mm			
V_r (V)	V_p	-10	-30
V_s (V)	GND	-20	-20
Deviation of I_i from I_+	4.08%	1.47%	1.29%

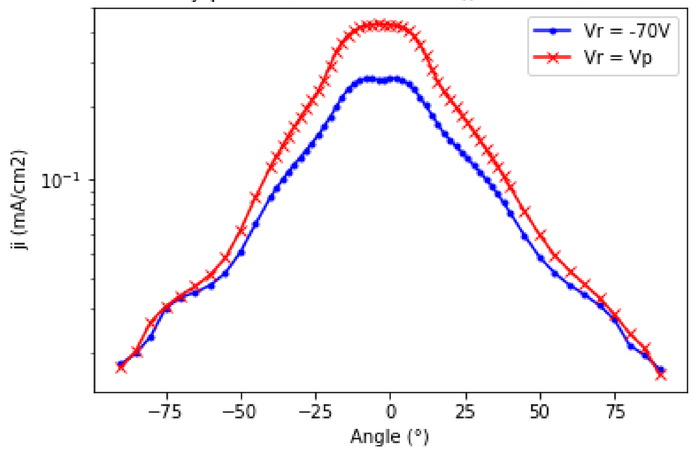
- $V_r < V_s$ *vs* $V_r > V_s$
  - Better determination of I_i

HT: ISCT200



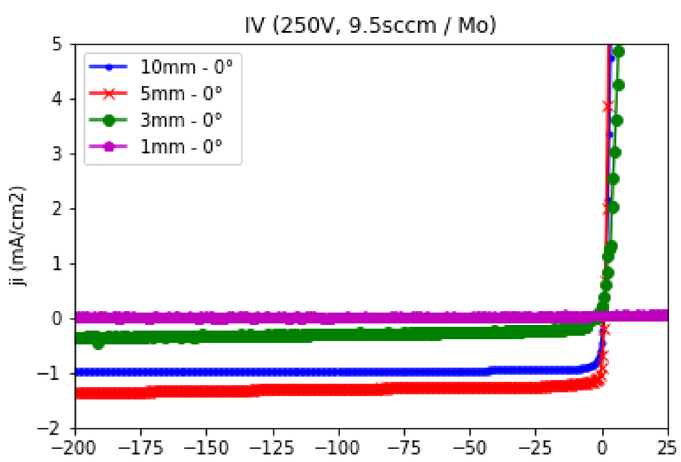
- V_r: $-70V$
  - Complete e^- screening
  - Loss of i^+ signal
- V_r: V_p
  - V_s< -25V e^- screening
- V_r: $+70V$
  - Signal over collected

ji profile (200V, 9.5 sccm // W, 5 mm)

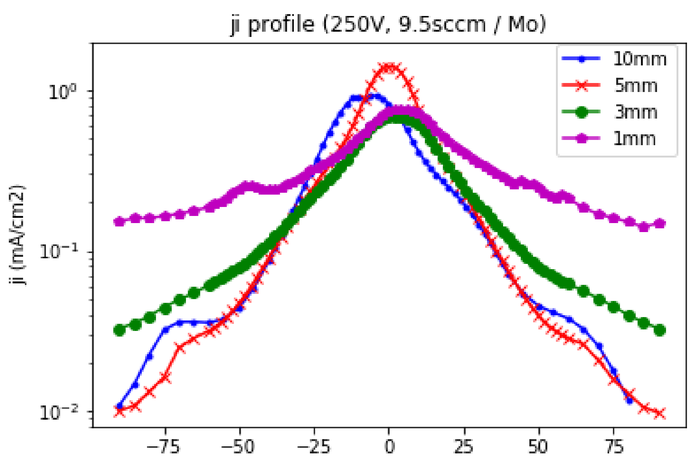


- V_r: V_p *vs* V_r: $-70V$
  - Weaker signal
  - → Low energetic ions not collected
  - → Better recollection of SEE
  - Narrower signal
  - → Sub-collection of low energetic ions at high angles ($E_i \ll V_s$)

Collimator dimensions

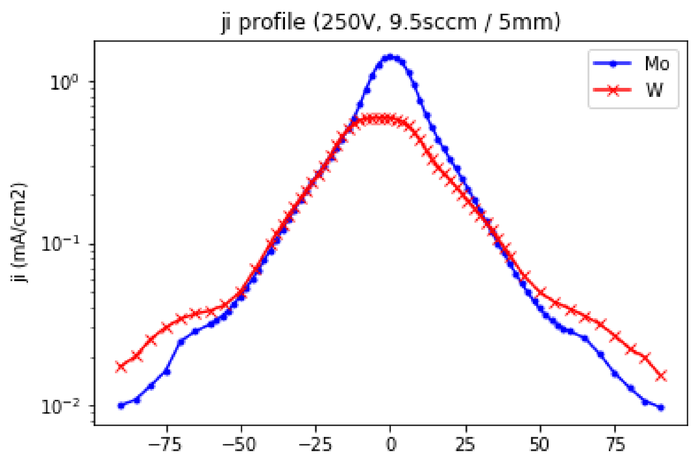


- IV : $d \leq 3mm$ *vs* $d \geq 5mm$
  - Underestimation of the ion properties
  - → Poor collection of ions' thermal branch



- J_i profile: $d \leq 3mm$ *vs* $d \geq 5mm$
  - Flattening of the profile
  - → Over collection of sputtering particles due to excessive exposure of the collimator

Collector Material

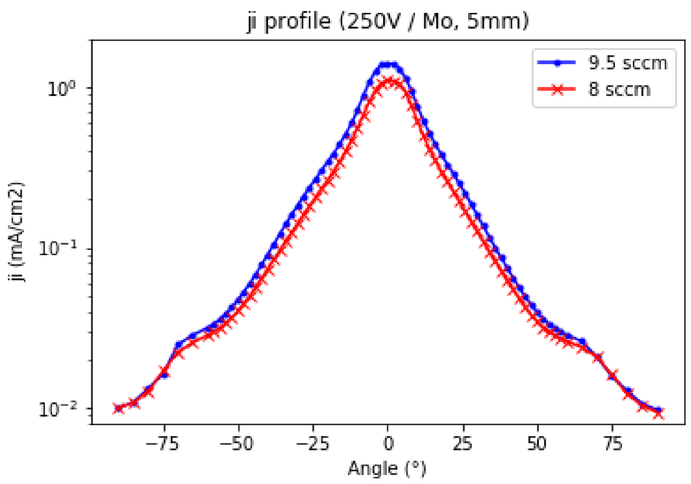


- *Mo vs W*
  - Weaker signal collected
  - → Reduction of SEE

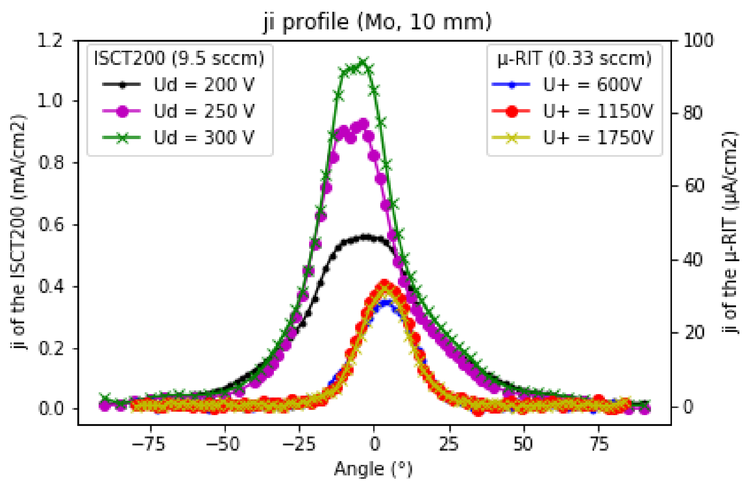
Thruster parameter impact

Mass flow rate ($\dot{m}$)

- High *vs* Low $\dot{m}$
  - Weaker signal collected
  - → Better SEE recollection due to less energetic particle collisions
  - → Fewer production of high density ions



Emission parameters (U_d, I_d / U_+, I_+)



- High *vs* Low E_i
  - SEE/CEX management issues
- High *vs* Low current density
  - Signal collection management issues
- Wide *vs* Narrow Beam