

Langmuir Probe Studies of Laser Induced Ruby ($\text{Al}_2\text{O}_3:\text{Cr}^{3+}$) Plasma



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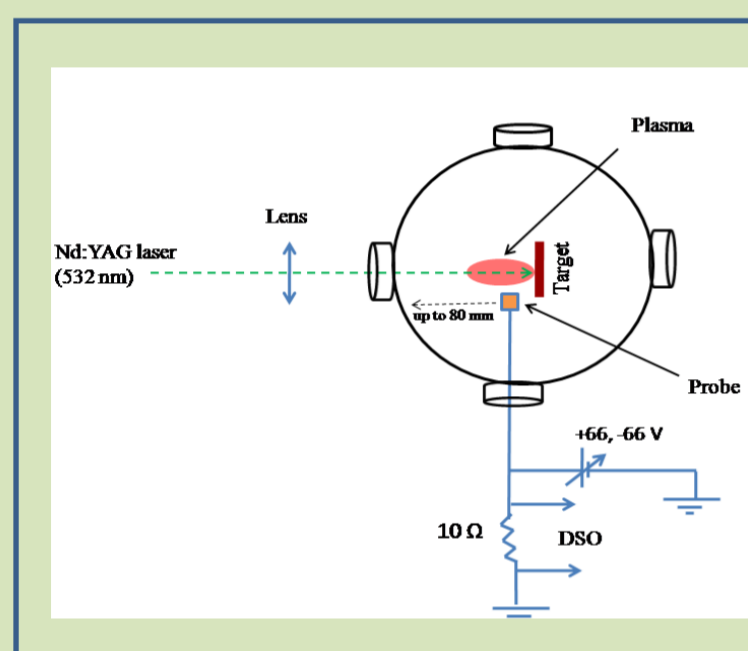
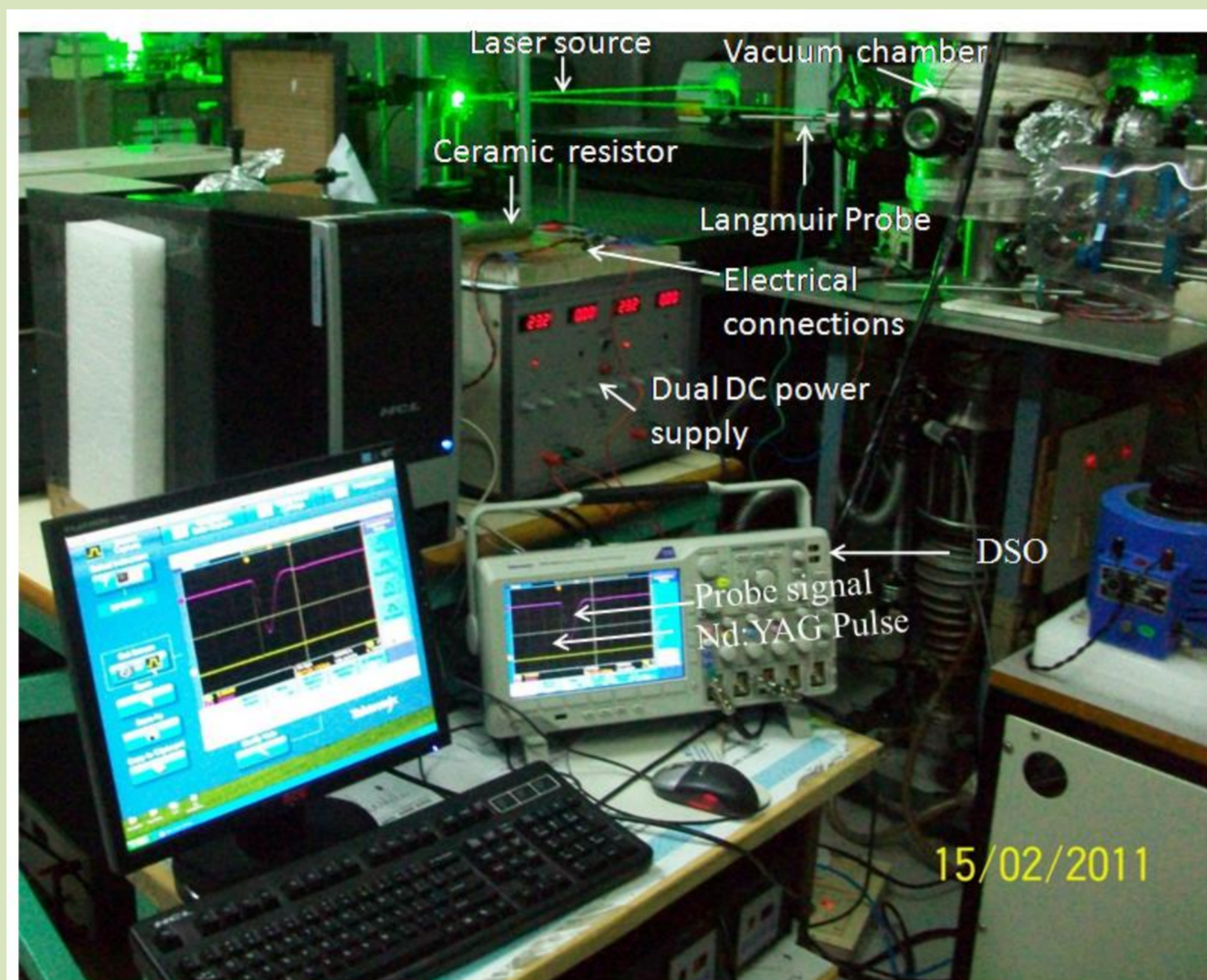
Objective

- To study the Pulsed laser ablated Ruby plasma in vacuum.
- Spatial distribution of ions density in ablated plume .
- Estimation of plasma temperature as a function of distance from target .

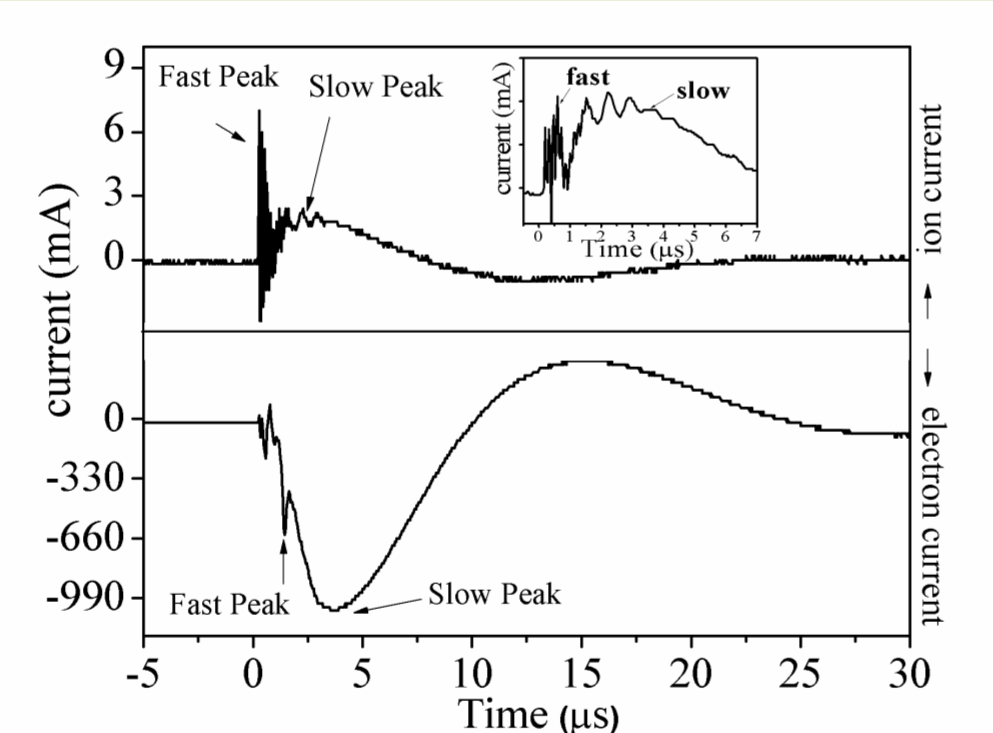
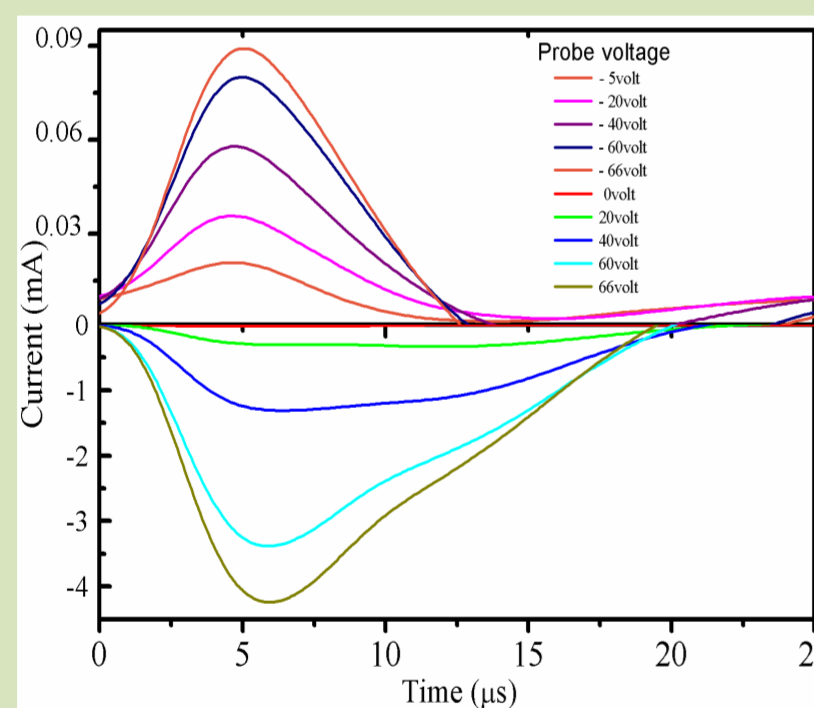
Experimental Setup

Experimental Details

Laser Source : Nd:YAG ; 2nd Harmonic (532 nm)
Laser fluence : 60 J/cm²
working pressure : 10⁻⁵ mbar
Langmuir Probe : flat copper probe 4 mm x 4 mm;
Resistor : 10 Ω
Bias Voltage : +66 to -66 volt.



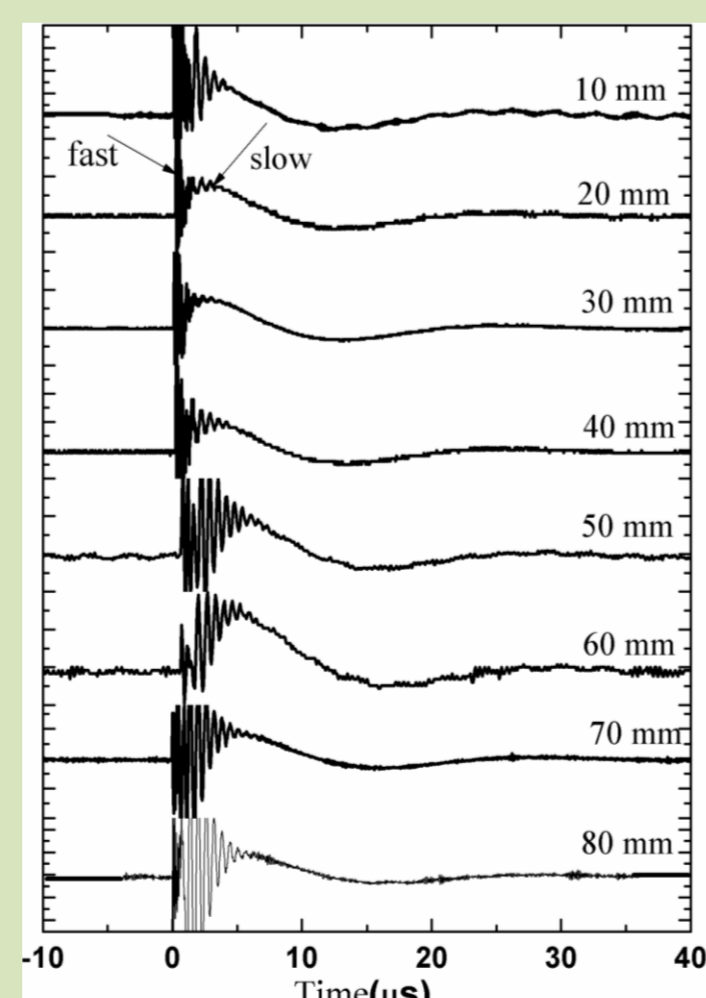
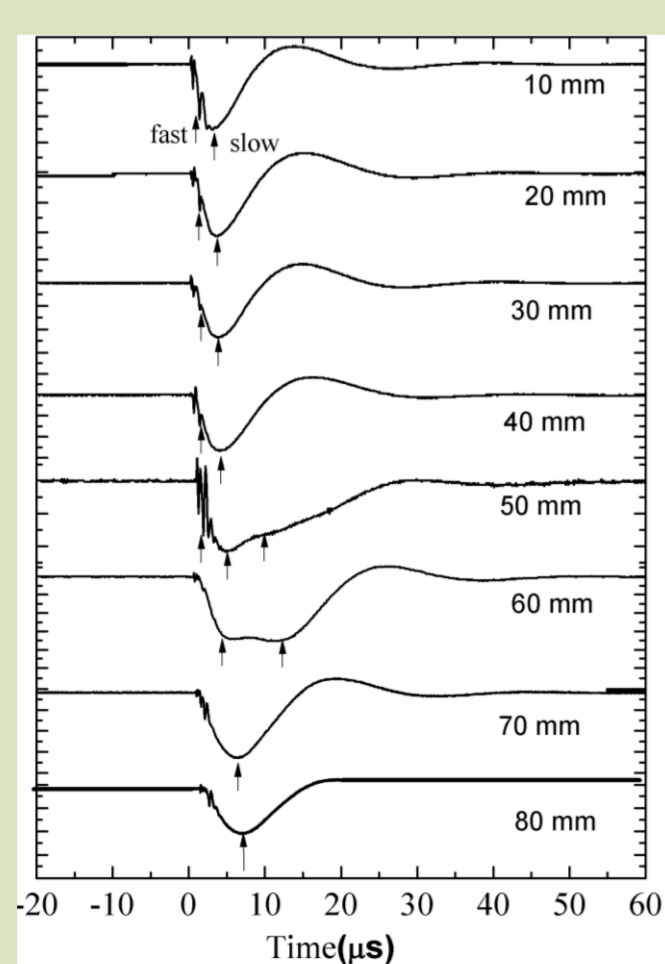
Ion and Electron Time Of Flight (TOF) Signals as a function of bias voltage



TOF ion and electron signals at various bias voltage ranging from +66 to -66 volt.
Target-Probe distance : 60 mm

Twin peak distribution in electron and ion TOF signal at 20 mm probe distance (at bias voltage +66 volt).

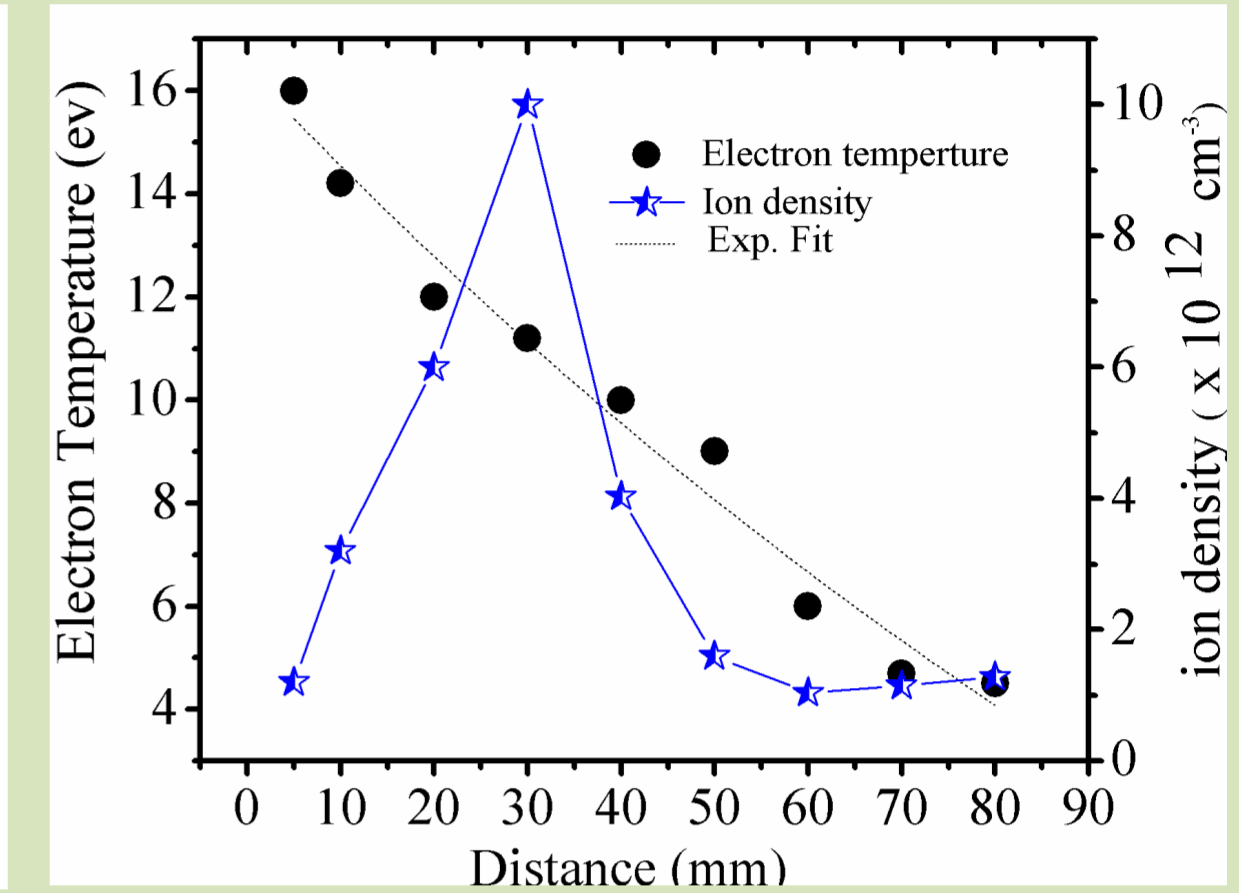
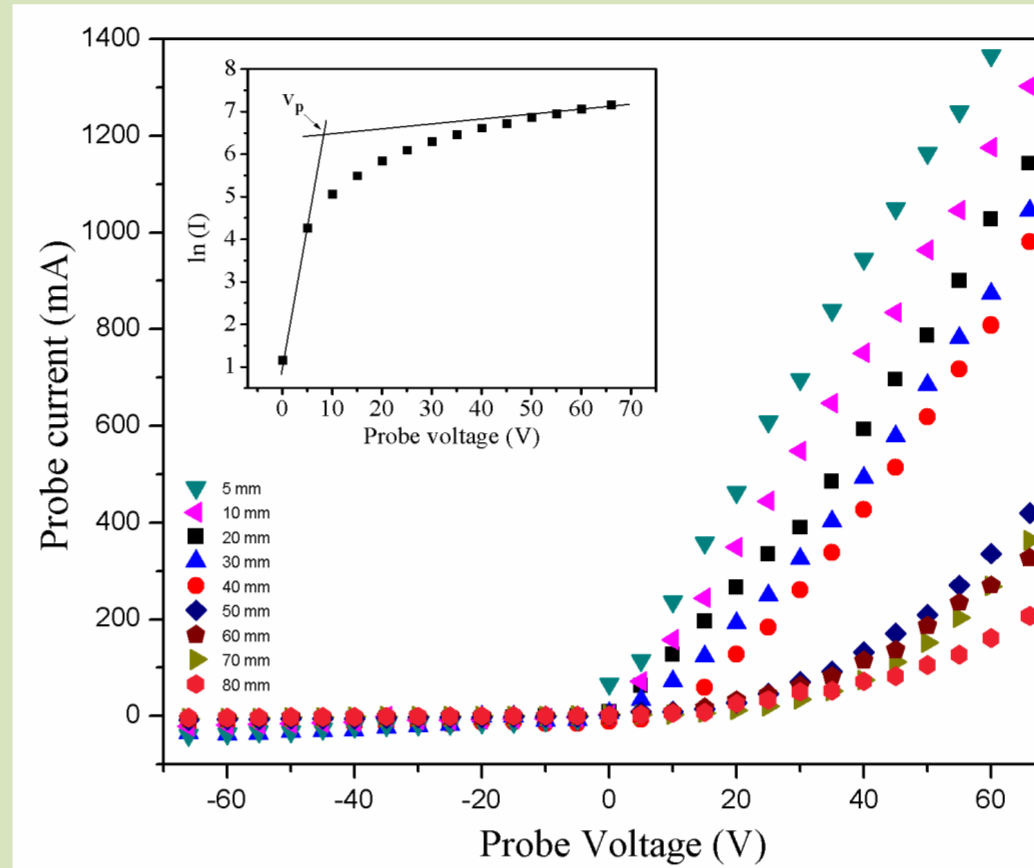
Electron & ion TOF signal as a function of distance at bias voltage 66 volt



Electron TOF signal as a function of distance along the plume expansion. Twin peak is observed upto 40 mm. At 50 mm & 60 mm triple peak is observed due to splitting of second peak.

Ion TOF signal also shows twin peak upto 40 mm. Beyond 40 mm only one peak is observed with reduction in peak intensity.

Plasma temperature & plasma density from I-V characteristics of Langmuir Probe at various distances



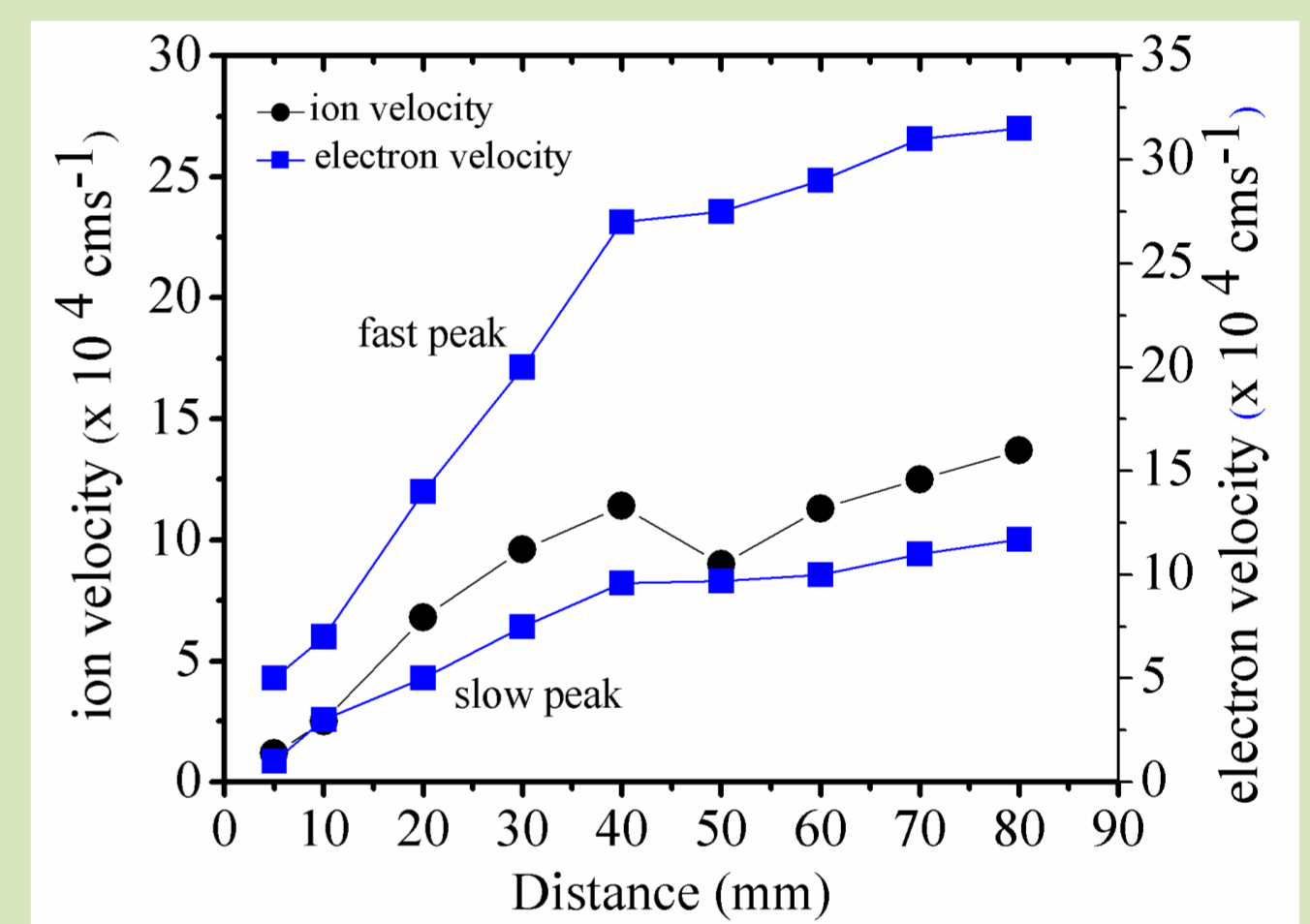
I-V characteristics at various distances for probe bias voltage ranging from +66 to -66 volt. Inset shows semi logarithmic plot of I-V curve at 40 mm distance for estimation of electron temperature.

Electron temperature and ion density as a function of distance. Electron temperature shows exponential decay with distance.

Electron & ion velocities estimated from TOF signals

Electron and ion flow velocity at various distances.

Kink in ion velocity profile is observed after 40 mm due to re-splitting of corresponding second peak.



Conclusion

- Ruby plasma is investigated using planar Langmuir probe.
- Spatial distribution of electron and ion TOF signal is studied. Electron TOF shows fast and slow component.
- Triple peak is observed in electron TOF signal at a distance of 50 mm & 60 mm due to re-splitting of slower component.
- Electron temperature was found to decay exponentially from 16 eV to 4.5 eV on increasing the distance from 5mm to 80 mm.
- Ion density was found to increase from $1.2 \times 10^{12} \text{ cm}^{-3}$ to $1.0 \times 10^{13} \text{ cm}^{-3}$ on increasing distance from 5mm to 30 mm. After 30mm it drops down to $1.6 \times 10^{12} \text{ cm}^{-3}$. Beyond 50 mm density shows steady behavior with distance.

Acknowledgement

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References

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