

Optical emission spectroscopy of Xenon gridded ion thruster

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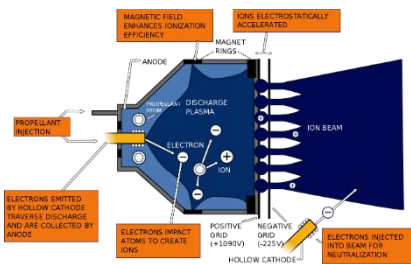
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1. Motivation

Modelling of grid erosion by using alternative propellants

– see companion paper, Ref. 1

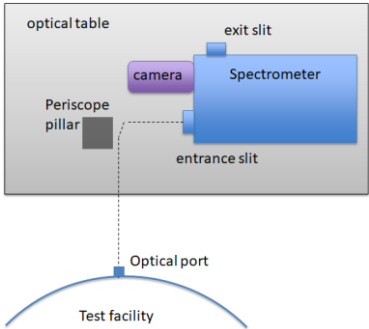


Credit: NASA

2. Experimental Set-up

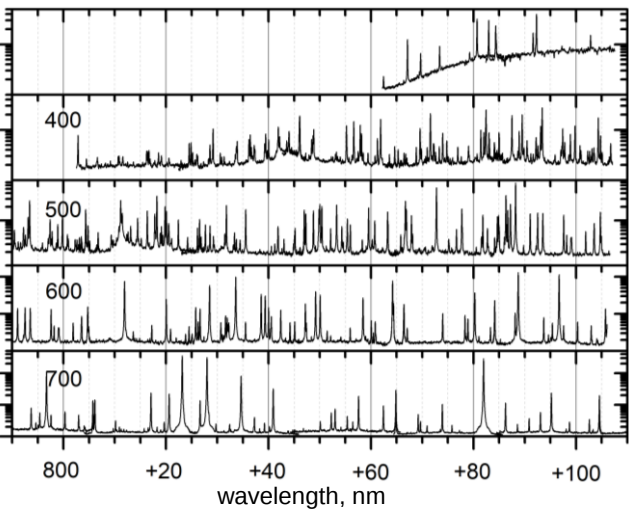
Optical emission spectroscopy (OES):

- Spectrometer 0.5 m, SpectraPro HRS-500, 1200 gr/mm
- Detector Andor iStar-CMOS with image intensifier
- Absolute calibration OL345R, Optronic laboratories

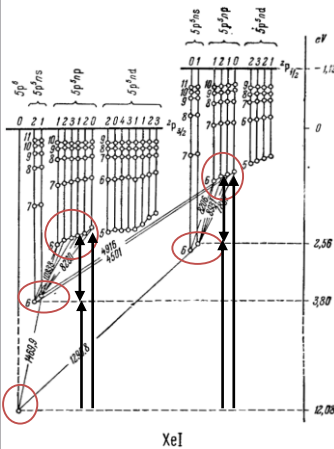


3. Measurements

Spectrum in 470 – 900 nm range

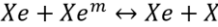
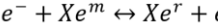
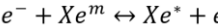
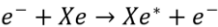


4. Model



Collisional-radiative model:

- Excitation and de-excitation by electrons, Ref. 2,3
- Direct and stepwise processes
- Intermixing metastable-resonant
- $5p^56s$, $5p^56p$, $5p^56s'$, $5p^56p'$
- Radiative transitions with known probabilities



$$M \cdot \vec{N} = \vec{D}$$

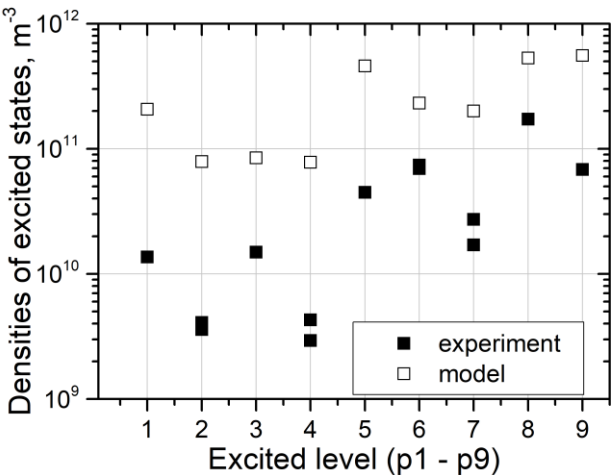
Transition matrix $\uparrow$ Direct excitations

Unknowns:

four 6s and ten 6p level densities

5. First results

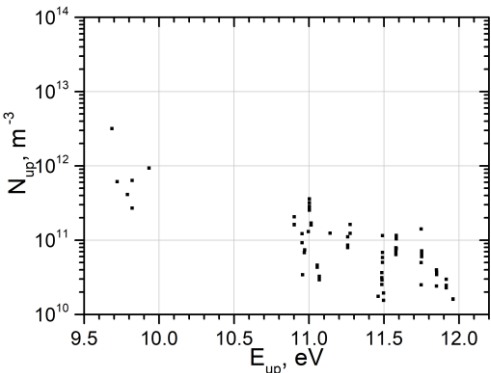
Comparison experiment – model:



6. Next steps / outlook

Incorporation of other excited states

- Densities of many other levels are measurable (see. Figure for results on other Xe-discharge)
- Probing of metastable densities by LAAS with lock-in measurements



7. References

1. Mallon, M., Kozakov, R., Smirnova, M., Spaedtke, P., Hartz-Behrend, K. and Schein, J., "Theoretical and Experimental Assessment of Ion Extraction Phenomena," *International Electric Propulsion Conference*, Vienna, Austria, 2019, IEPC-2019-804
2. Allan, M., Zatsarinny, O., and Bartschat, K., "Near-threshold absolute angle-differential cross sections for electron-impact excitation of argon and xenon" *Phys. Rev. A*, Vol. 74, 2006, 030701 (R).
3. Vriens L., and Smeets, A. H. M., "Cross-section and rate formulas for electron-impact ionization, excitation, deexcitation, and total depopulation of excited atoms" *Phys. Rev. A*, Vol. 22, 1980, pp. 940-951.