Efficient de-orbiting of Micro- and Nano Satellites
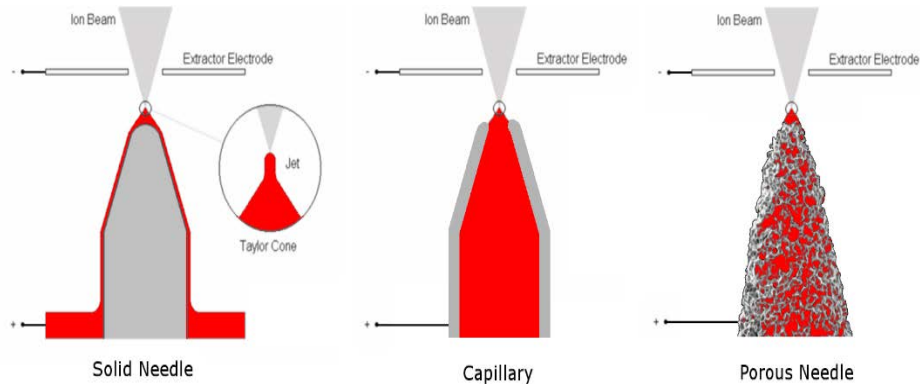
Using the IFM Nano Thruster

Robert-Jan Koopmans

# Liquid Metal Ion Source Technology

Emitter Types:

Building on 30 years of successful flight heritage of Liquid Metal Ion Sources, the department of Aerospace Engineering at FOTEC has developed LMIS for Field Emission Electric Propulsion (FEEP) applications. There are three different emitter technologies:

The Porous Tungsten Crown Emitter

Subheadline 18 Pt.

- 28 porous tungsten needles
- About 3 mm long
- 1 cm diameter

- Tips sharpended in dedicated etching procedure
- 1 – 5 µm tip radius

- Tested for more than 17000 h
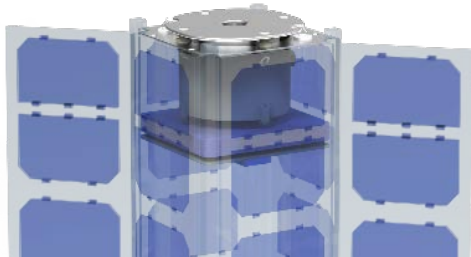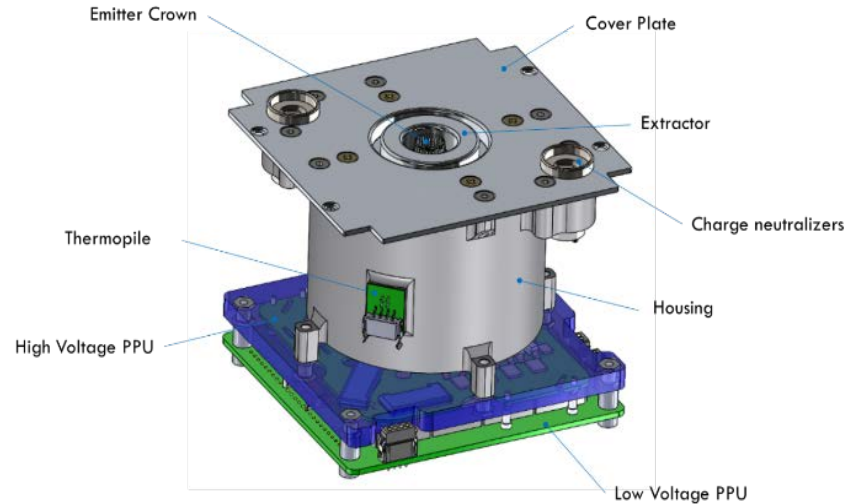- More than 100 emitters produced and characterized
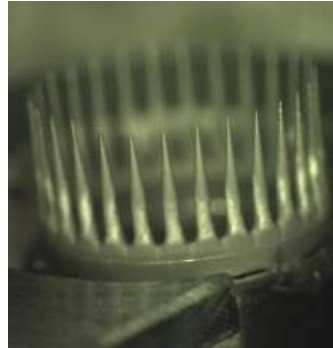
The IFM Nano thruster

Result of 25 years continuous developement

Indtroducing high delta-v to small satellites

- Volume below 1 CubeSat unit
- Thrust up to 400 µN
- More than 10 kNs of total impulse
- 900 g wet mass
- < 40 Watt input power

Simplified de-orbit model

Spherical earth with empirical altitude dependent density

$$\dot{r}(t) = -\frac{2r^2}{m\mu_E} * (D + T)\sqrt{\frac{\mu}{r}}$$
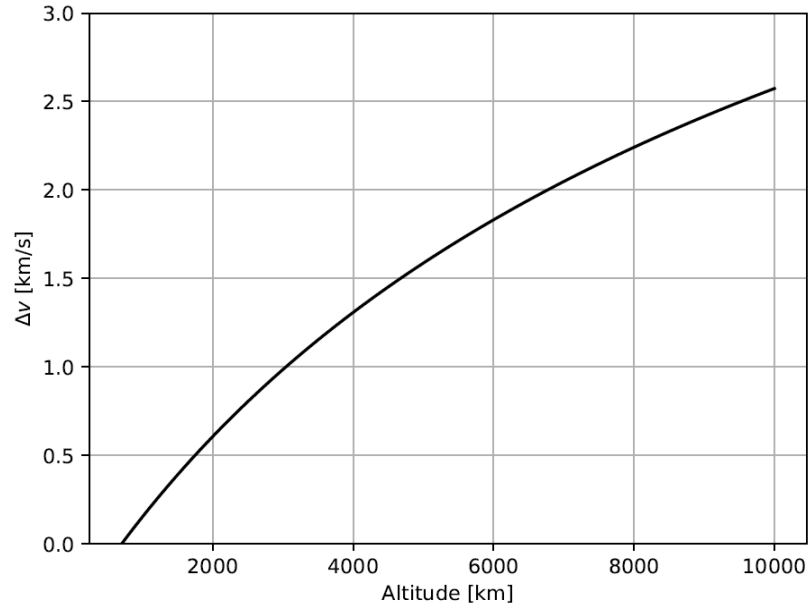
$$\rho(h) = 6 * 10^{10}\exp{(-\frac{h - 175}{H})}$$

H = N /m

N = 900 + 2.5 (F10.7 - 70) + 1.5*Ap

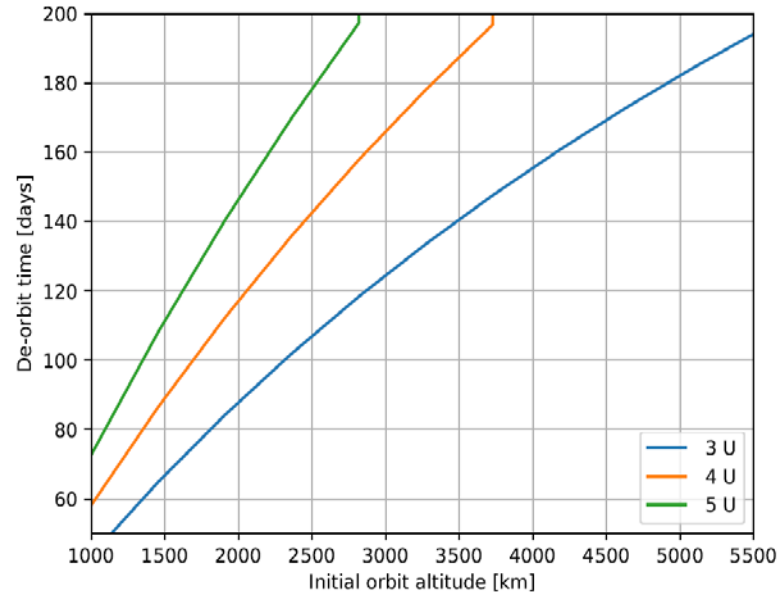m = 27- 0.012 (h - 200)

De-orbit to 700 km

Satellites above 700 km need a significant delta v capability in order to be transferred into an orbit that can cope with the 25 year requirement of satellite disposal

De-orbiting of CubeSats

Using the IFM Nano

CubeSats can be deorbited from relatively high altitudes within 100 to 200 days with a single thruster
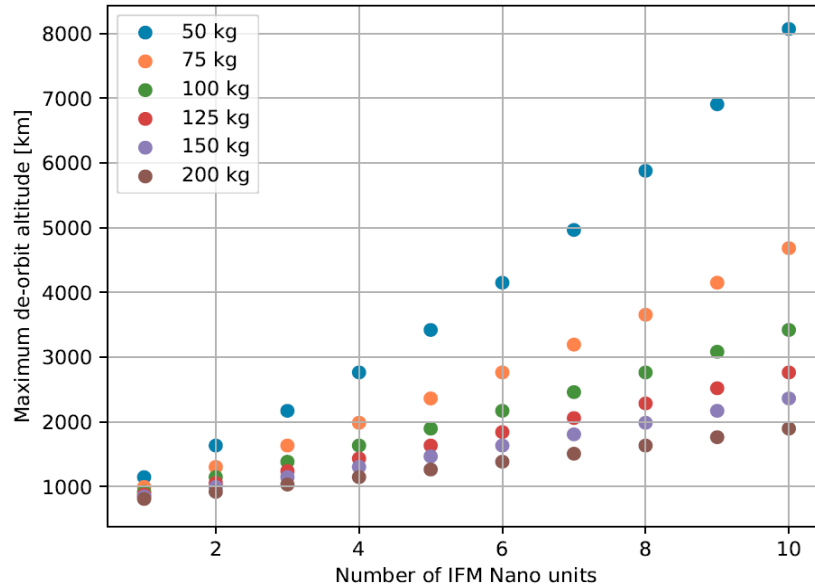
De-orbiting of Small Satellites
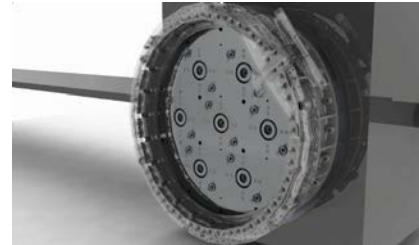
Using the IFM Nano

The modular approach of the IFM Nano Thruster allows for a clustering of the individual pre-qualified building blocks to provide custom solutions without added development times or costs.

Commercialisation

Available now!

- Spin-Off company was founded for series production and sale
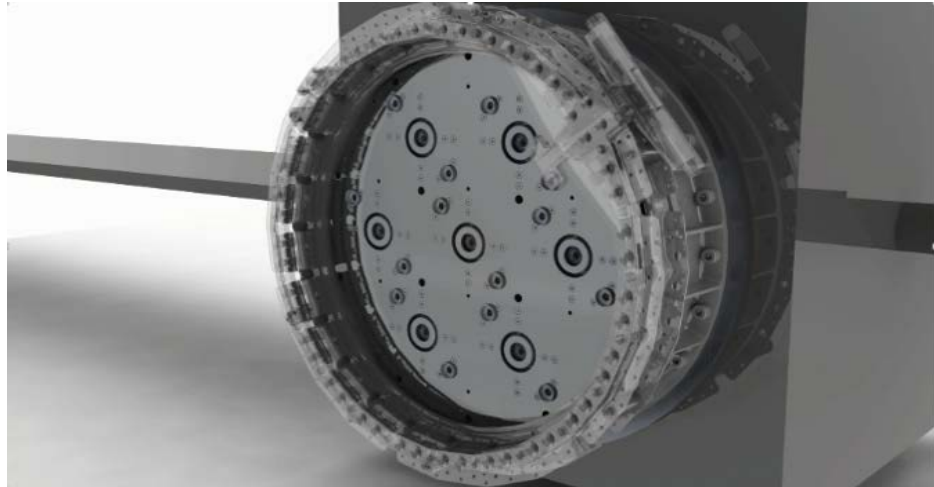- Already sold to several customers
- Web: ENPULSION.COM

CONCLUSION

- Option for deorbiting CubeSats and small satellites up to 200kg.
- Especially for LEO & MEO satellites: the high total impulse density is advantageous
- Drawback: the high power to thrust ratio is not considered to be as severe for deorbiting as for beginning of life orbit changes.

Thank you for your attention!