MAGDRIVE

Next generation spacecraft propulsion

The first high thrust, high efficiency propulsion system.
For urgent sustainable space and new business models in space.

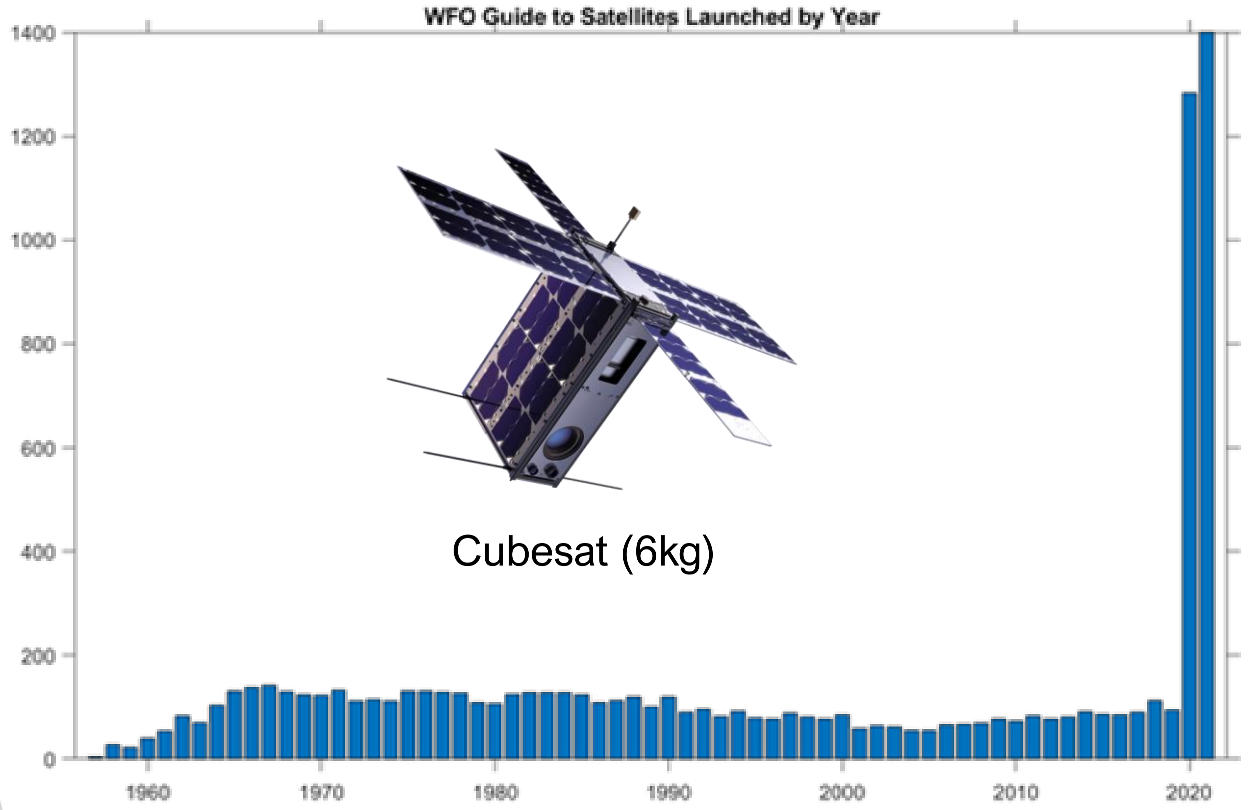
Spacecraft need propulsion when in space

Maintaining orbit
counteracting effects for atmospheric drag and other perturbations (e.g. Earth not a perfect sphere).

End of life de-orbiting
At end of life come down to upper atmosphere so they can slowly burn up, not contributing to space debris.

Collision avoidance
Avoiding collision with other spacecraft and space debris.

Number of spacecraft launched is **growing astronomically**



Cubesat (6kg)

Smallsat (150 kg)

Big satellite (>1000 kg)

Powerful and efficient propulsion system is urgently needed

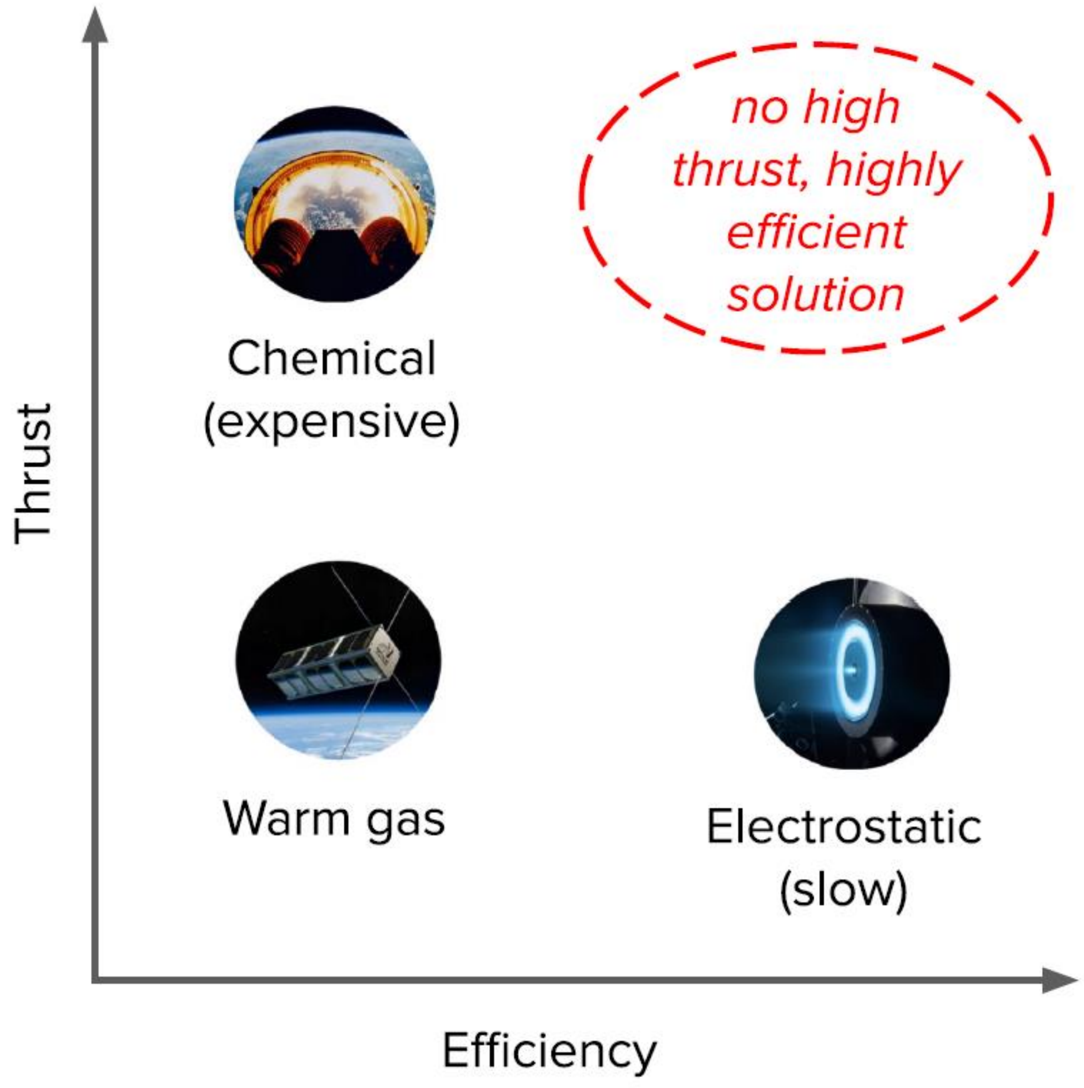
The number of **avoidance manoeuvres** will **increase tenfold** by 2025.

Satellites need to **efficiently de-orbit** at the end of their mission to **reduce space debris**.

Commercial operators are **severely restricted** by manoeuvrability and responsiveness in space.

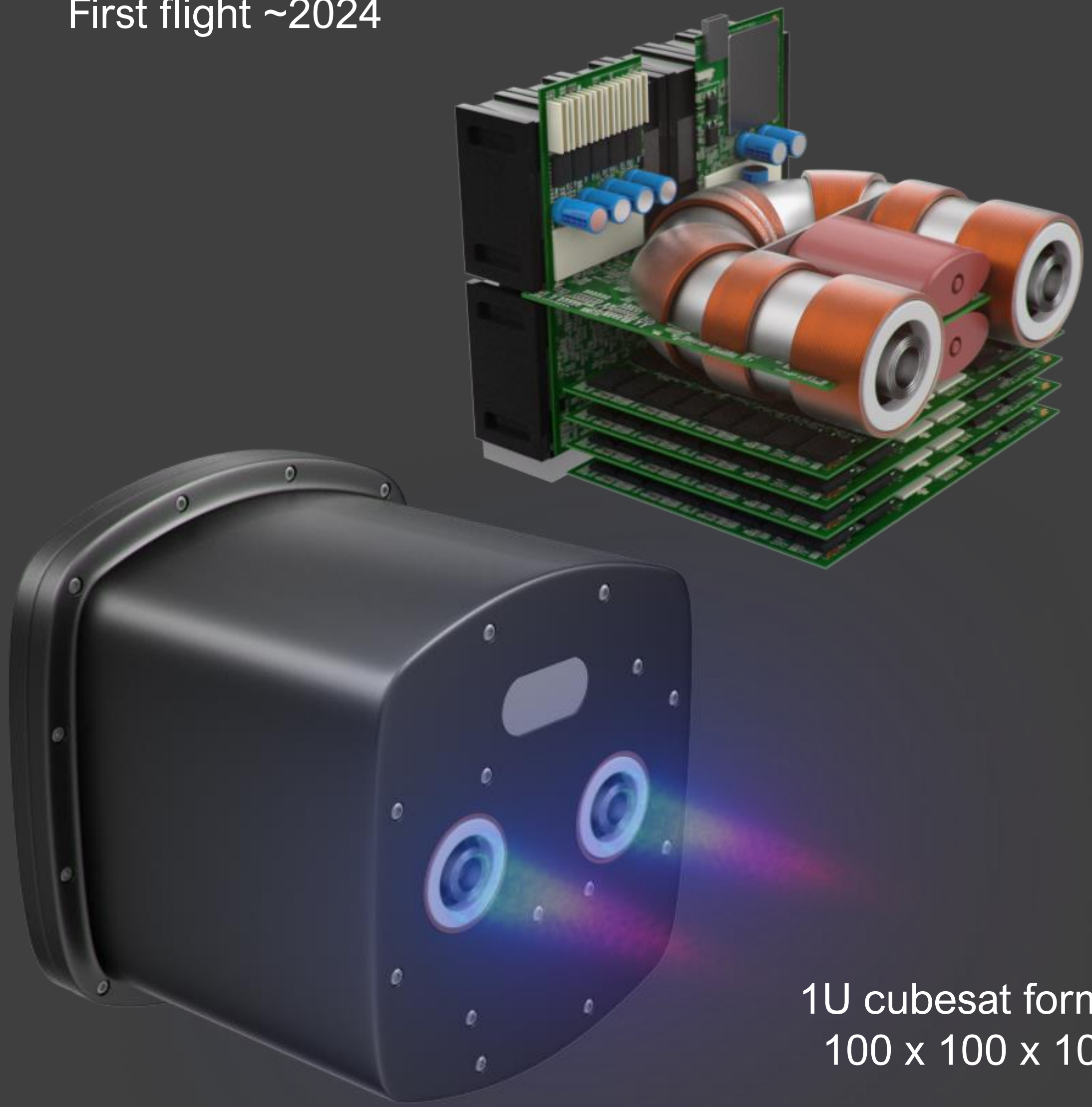
Chemical propulsion cannot meet the demands of Low Earth orbit over the next 10 years.

Huge new markets, in-orbit manufacturing and missions in VLEO, require a magnitude improvement in propulsion.



Magdrive Nano
Thruster for the New Space Age

First flight ~2024



1U cubesat form factor
100 x 100 x 100 mm

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Targeting spacecraft between 6 and 300 kg
(can be tessellated in a grid for larger spacecraft)

Sports mode

Thrust / Isp	100 mN at 2000 s
Impulse per propellant	20 Ns/g
Impulse per burn	300 mNs

Eco mode

Thrust / Isp	40 mN at 5000 s
Impulse per propellant	50 Ns/g
Impulse per burn	120 mNs

Characteristics

Dimensions	100x100x100 mm
Dry mass	1.0 kg
Communication	RS-422 serial
Total impulse	> 50,000 Ns
Thrust vectoring	> 15^{o}
Charge time	30 s at 200 W
	5 mins at 20 W

*predicted performance

Breakthrough in propulsion enables new mission scenarios

High thrust-to-weight ratio
an order of magnitude higher than other electric systems.

Solid metal propellant
non-toxic, no cryogenics, no pressurisation.

Variable specific impulse
increase efficiency or thrust for all missions.

Directional thrust
propulsion and attitude control with no moving parts.

Simple integration and operation
software-defined system removes complexity.

Pulsed burns increase versatility
Charge slowly, store energy and discharge rapidly when needed.

In-orbit updates
software updates for performance enhancement in space.

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Avoidance Manoeuvres

End of Life Deorbiting

Satellite Servicing

Sustained Operation in VLEO

No comparable propulsion solutions

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	Specific impulse [s]	Thrust [mN]	Mass [kg]	Vectoring
MAGDRIVE	5000	100	1	yes
exotrail	800	1.8	~1	no
ENPULSION	6000	0.4	1.4	limited
PHASEFOUR	1400	10	8.4	no
THRUSTME	2400	1.1	1.2	no

No other propulsion provides the high thrust and specific impulse for frequent avoidance manoeuvres and new missions such as orbital servicing and manufacturing.

MAGDRIVE

An unprecedented combination of skills in the space industry

Mark Stokes
CEO

Mechanical & Machine Learning Engineer Imperial College London.

8+ years commercial experience at start-ups and Fortune 500 companies.

Dr Thomas Clayson
CTO

Plasma astrophysicist, nuclear fusion scientist Imperial College London.

Designed and built largest pulsed power machine in Europe for nuclear fusion experiments.

Dr Savva Theocharous
Experimental Physics

James Bass
Mechanical Eng.

Sundeep Patel
Mechanical Eng.

David Salmon
Electrical Eng.

Dr Christos Stavrou
Numerical Physics

Chuong Van Dang
Operations

Charlie Clark
Flight Eng.

Patrick Mabin
Electrical Eng.

Advisors

Dr Simon Bland
Plasma Physics
Imperial College

Dr Aaron Knoll
Spacecraft Engineering
Imperial College

Mike Curtis-Rouse
Manufacturing for Space
Satellite AC

Dr Chris Hobbs
Commercial Development
Satellite AC

esa business incubation centre UK

Imperial College London

Internationally supported

MAGDRIVE

International venture capital backing
$2M raised in December 2020
Led by Founders Fund (investors in SpaceX)

Working with future customers
Collaborative grants and mission studies
Mentored by Thales Alenia Space UK

Funding supported by government
$3M raised in equity free grants to date
Alumni of ESA business incubator

Strong links with academia
Collaborative grants and masters projects
Source of interns and employees

International recognition and press coverage

Magdrive's First Flight

Magdrive's first space mission
Launching in October 2022 aboard SpaceX Transporter 6
Hosted payload about a 6U Endurosat spacecraft

Magdrive Hardware and firmware completed
Integration with Endurosat flatsat successful

Test of power system, the heart of the Magdrive
Unique charging, energy storage and discharging system
0.5U 500 g payload on 6U spacecraft
Cathode arc thruster from University of Southampton

First flight heritage, first step to customer missions
Magdrive Nano first flight aiming for 2024

Operation Get It Up

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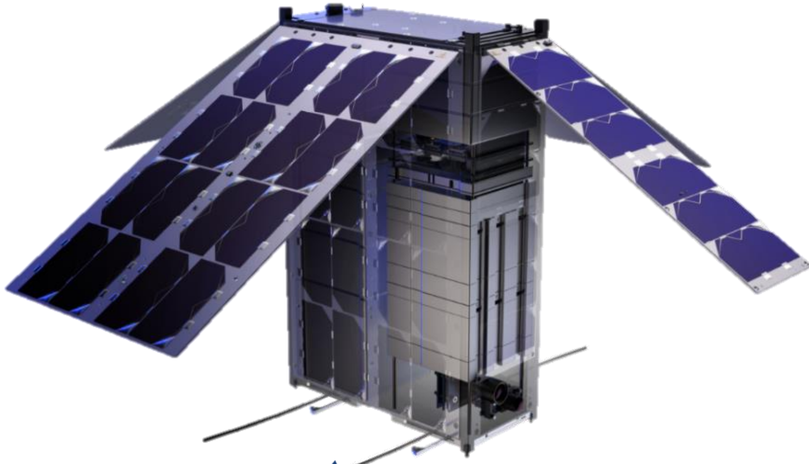
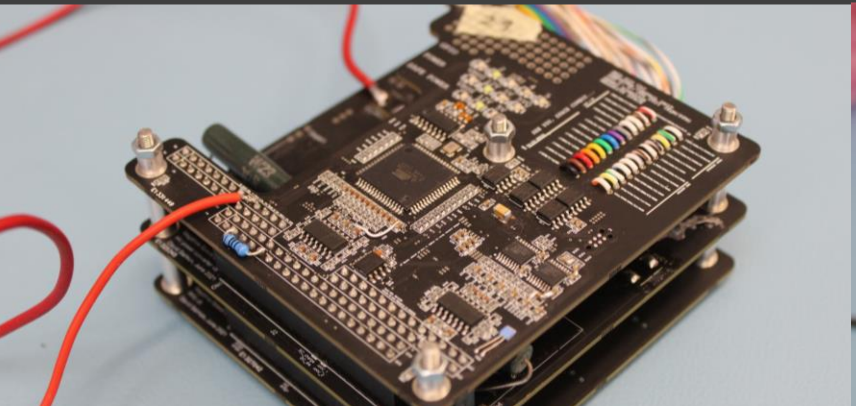
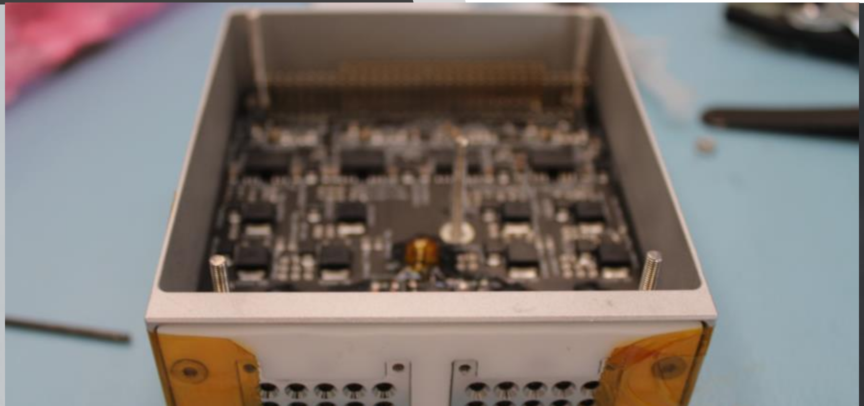


UNIVERSITY OF Southampton

ENDUROSAT





Scalable solution for the ambitious future missions

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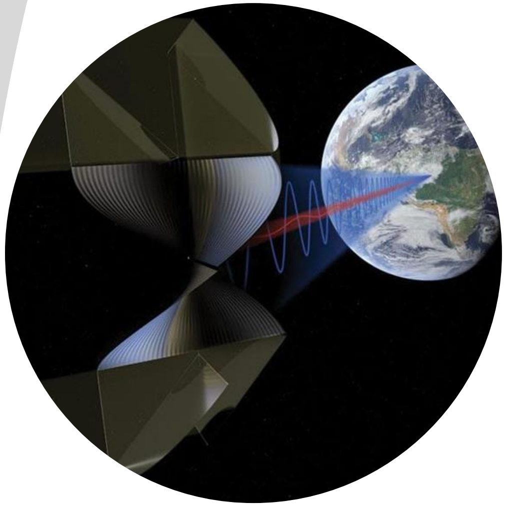
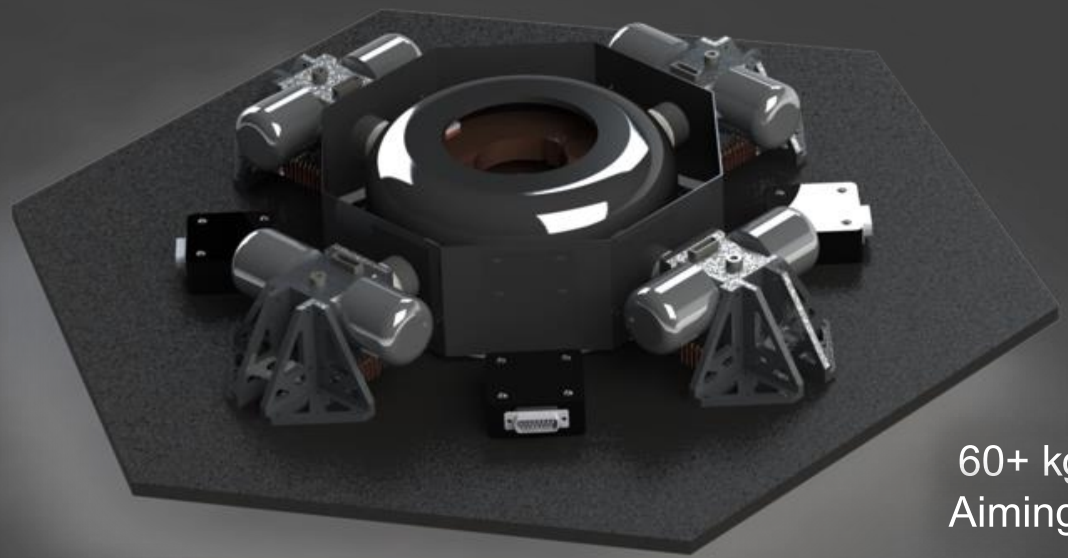
Future space ambitions require larger spacecraft with a breakthrough in propulsion technology

Luna economy GEO Asteroid mining

Leverage high temperature superconducting magnets to enable higher thrust to weight and improved efficiency





60+ kg >10 N
Aiming for ~2028

Space Energy Initiative

Future megastructures for solar energy require high power propulsions solutions. Magdrive are members of the SEI.

Future space nuclear reactors require a scalable high power propulsion solutions.

UK space agency funded work to investigate superconducting magnetic coils for Magdrive.

UK SPACE AGENCY

tokamak energy

Rocket Engineering and Space Propulsion

Astroscale

MAGDRIVE

Magdrive Nano
Thruster for the New Space Age

Efficient electric propulsion system with
unparalleled power-to-mass ratio

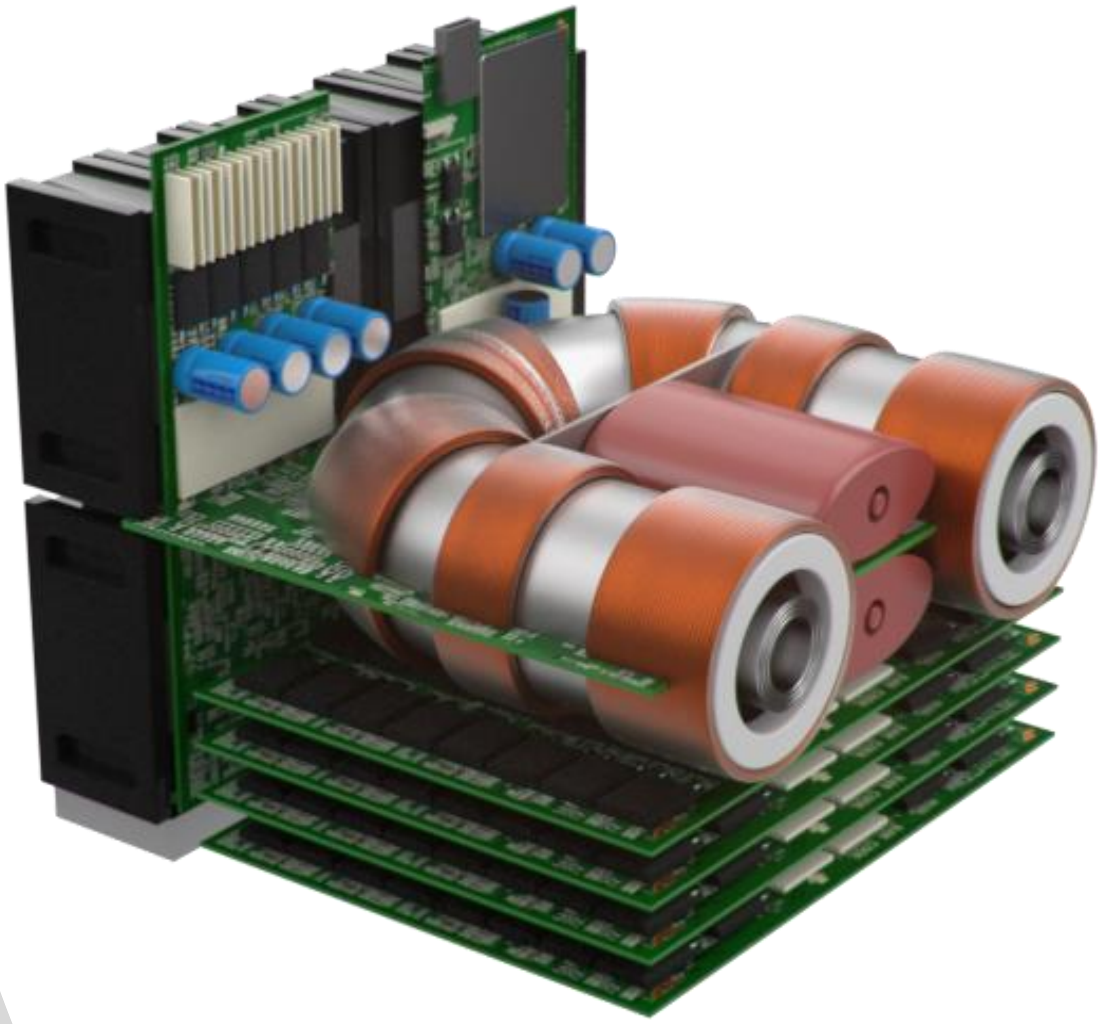
Provides both high thrust and high efficiency
for all satellite missions and growing debris avoidance

New capabilities enable entirely new missions
and business models uncapped in value

Supported by top venture capital firms,
space agencies and academia

Scalable solution for ambitious future missions
from Luna and asteroid mining

First prototype mission launching October 2022
First Magdrive Nano flight aiming for 2024



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