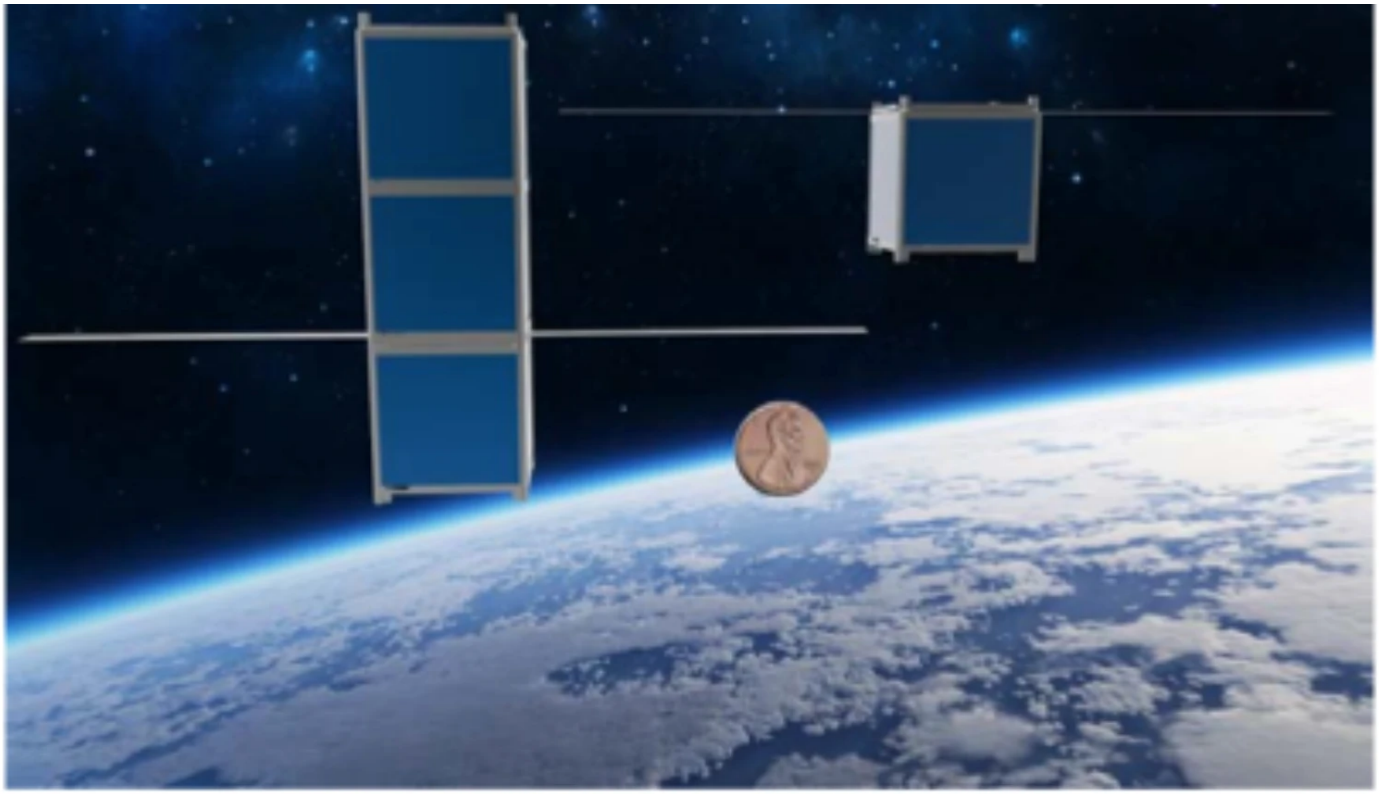


MOTHERBOARD
TECH BY VICE

Space Becomes Affordable If Your Spacecraft Is 3 Centimetres Small

Arizona State University's "SunCubes" are under 100g, making a launch affordable even for hobbyists.

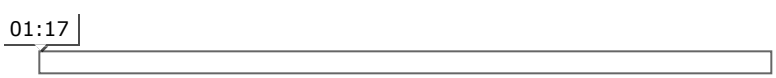
By **Victoria Turk**

Apr 7 2016, 7:30am

IMAGE: SUNCUBE DESIGN SPECS DOCUMENT

SunCube miniature satellites

from **ASU Now**



As technology advances, it often gets smaller. These darling little teensy-tiny baby satellites are following the miniaturisation trend, with the aim of making space exploration affordable even to hobbyists.

A team from Arizona State University led by Jekan Thanga has developed the "SunCube," a type of femtosatellite (a satellite under 100g) that starts at just 3cm across but is still capable of carrying instruments such as a camera. On Thursday, they published a set of standards for the satellites that they hope will encourage people to design and fly their own.

"The purpose is to utilize the latest in miniaturized electronics, sensors and actuators towards developing truly affordable, fully functioning spacecraft that can be rapidly launch into space in a matter of month," the researchers write in their paper. "By reducing the launch costs, it is hoped a wider community of educators, researchers and hobbyists can develop their own spacecraft."

Space is expensive, and while small CubeSats—which are made of multiples of 10 cm cubes—have taken off amid claims of democratising exploration beyond Earth, the cost of assembling and launching one are still beyond most individuals' and low-level organisations' budgets as launching one costs in the tens to hundreds of thousands of dollars.

According to the researchers, a SunCube satellite's parts cost in the hundreds of dollars, and a launch to the ISS would start at $1,000, with a mission to low-Earth orbit $3,000. They detail two models: one is a diddy 3 cm cube, and the other is equivalent to three of the mini cubes on top of each other at 9 cm total length.

In a video introducing the SubCube design specs, Thanga described the SunCube as "the prototype of a fully-functioning spacecraft."

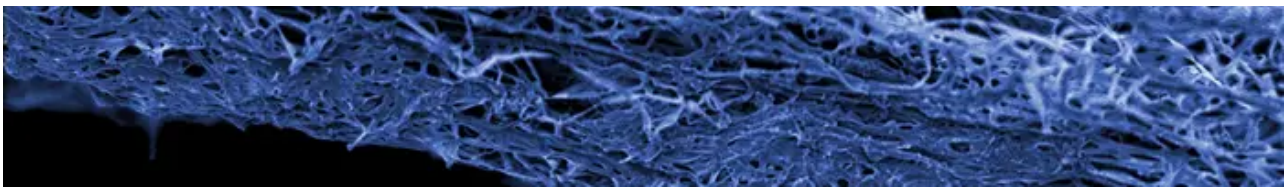
"Onboard you have cameras, you have power systems, you have computers, you have a fully-functioning radio that you can launch into lower-Earth orbit."

The femtosats would be deployed by a CubeSat unit, which could release up to 27 at a time.

Like CubeSats, one of the main ideas behind the even smaller satellites is the potential to use many of the devices in collaboration—ASU gives the example of a "swarm" of femtosats examining a damaged spacecraft.

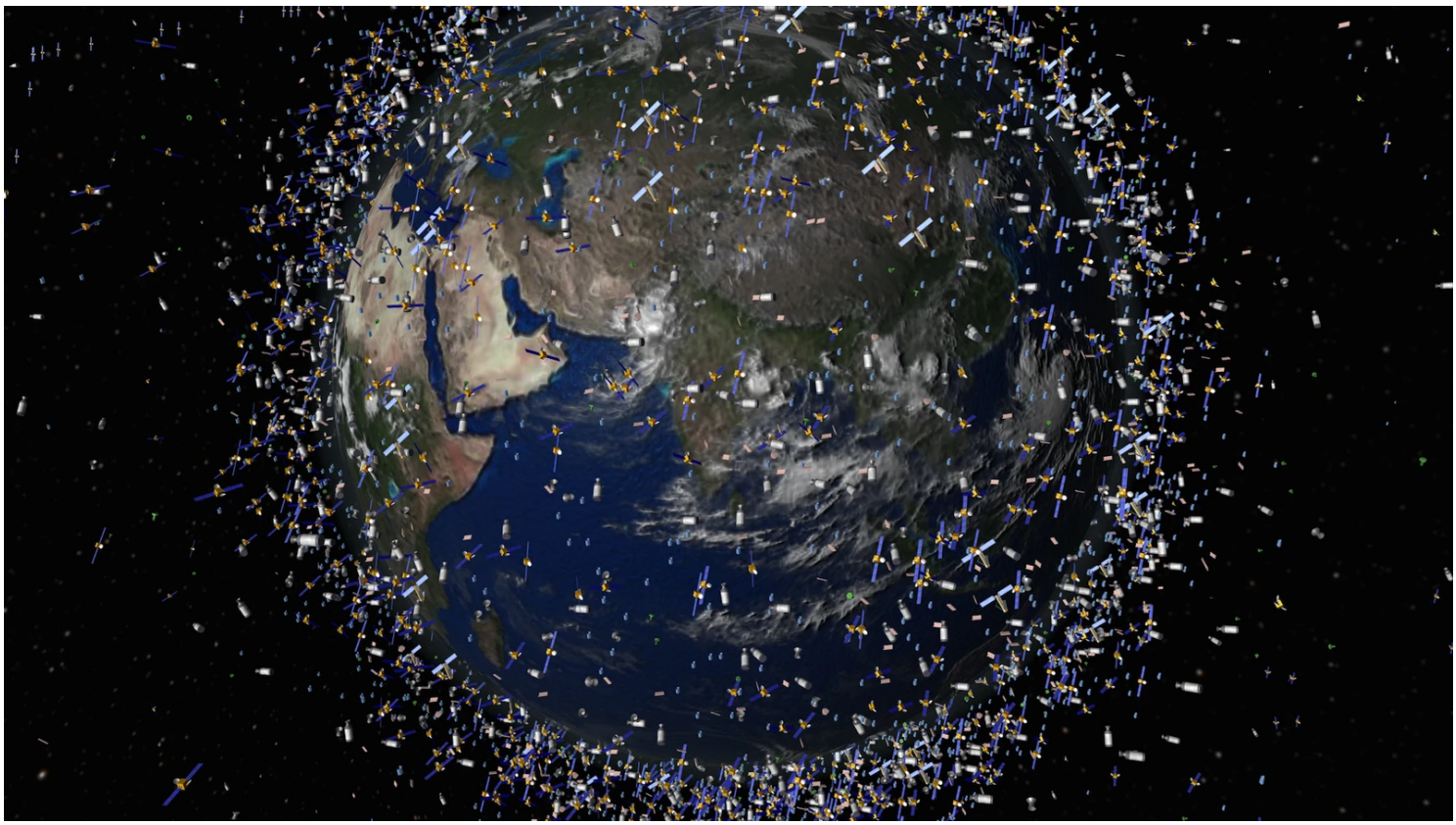
Thanga plans to get a prototype in space next year. If the SunCube lives up to its creators' hopes, the future could see thousands of tiny new satellites buzzing around in LEO—and thousands more reasons to address our space debris problem.

TAGGED: TECH, MOTHERBOARD, SATELLITES, ARIZONA STATE UNIVERSITY, MOTHERBOARD SHOW, CUBESATS, LOWER EARTH ORBIT, JEKAN THANGA, SUNCUBE, FEMTOSATELLITES



Clues To Life on Mars May Live in the Mine-Dwelling Devil Worm

FROM **DEAR FUTURE**



MOTHERBOARD
TECH BY VICE

We Need to Clear Up Space Debris to Make Way for the Small Satellite Boom

With the influx of CubeSats, lower Earth orbit is going to get very busy.

By **Victoria Turk**

Nov 25 2015, 6:20am

ARTIST'S IMPRESSION OF SPACE DEBRIS IN LOWER EARTH OBJECT (DEBRIS SIZE EXAGGERATED). IMAGE: ESA

CubeSats and other small-sized satellites promise to democratise space and open up the final frontier. But there's one big thing in their way—or rather hundreds of thousands of small things: space debris. And before we go launching more future-junk into space, we need to figure out what to do about it.

Lesley Jane Smith, a visiting professor of space law at the University of Strathclyde and a member of the London Institute of Space Policy and Law, explained some of the regulatory issues facing the small satellite revolution in a talk at London Space Week.

"Everything that's involved in space is dangerous and hazardous," she told Motherboard in an interview. "But the CubeSats, because of the particular orbit that they're going into—that is the orbit that has the greatest amount of debris already."

EXAMPLE OF A CUBESAT. MASAT-1 WAS LAUNCHED IN 2012. IMAGE: DÁVID CZIFRA/ESA

CubeSats are small satellites made of parts measuring around 10 cm cubed and weighing less than 1.33 kg. They're cheaper to build and launch than conventional satellites, offering the chance for more organisations (aside from nation states) to get into the satellite game. They boast a compelling array of potential applications, from telecommunications to Earth observation.

CubeSats and other small satellites are generally launched into lower Earth orbit (LEO) because of latency issues higher up. But

that means there are a lot of satellites all wanting a share of the same space—especially as the full potential of CubeSats lies in constellations of tens or even hundreds of the things.

Not only are these satellites trying to access an area already crowded with junk; they will create a lot of new space debris after their limited lifetime is up. And anyone who's seen *Gravity* knows how damaging that debris can be.

> **"The entire issue of debris has been brought to a head by the CubeSats"**

The diagram below from a UK Space Agency presentation shows the predicted probability of a collision in lower Earth orbit in 2070 compared to in 2001, though Smith suggested the 2070 prediction could come much earlier.

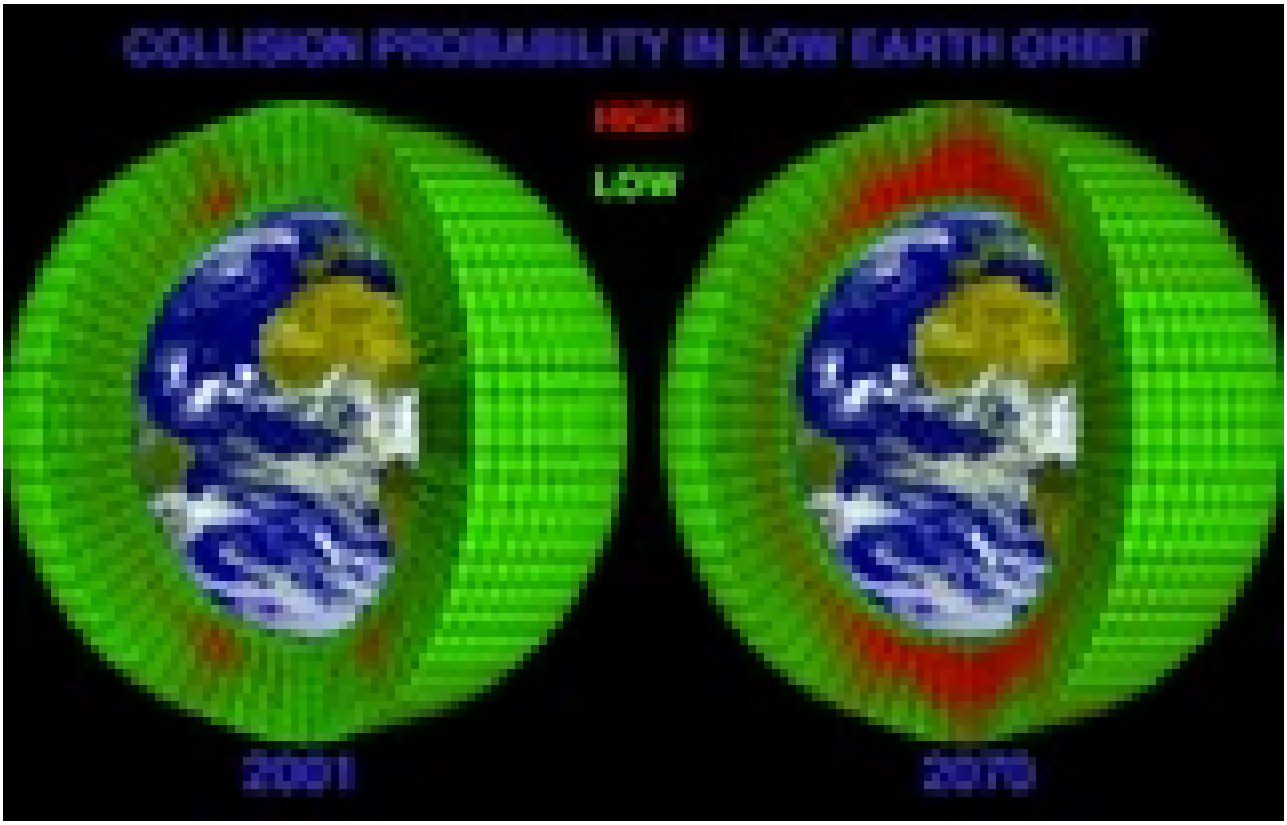


IMAGE: UKSA/UNOOSA

As a result, Smith said that "the entire issue of debris has been brought to a head by the CubeSats."

That's why, if the small satellite industry is going to be sustainable, regulations regarding space debris mitigation need to be discussed pronto.

The problem is, it seems mighty unjust to impose regulations on small satellites given the amount of junk that bigger players already dumped in the same orbital territory.

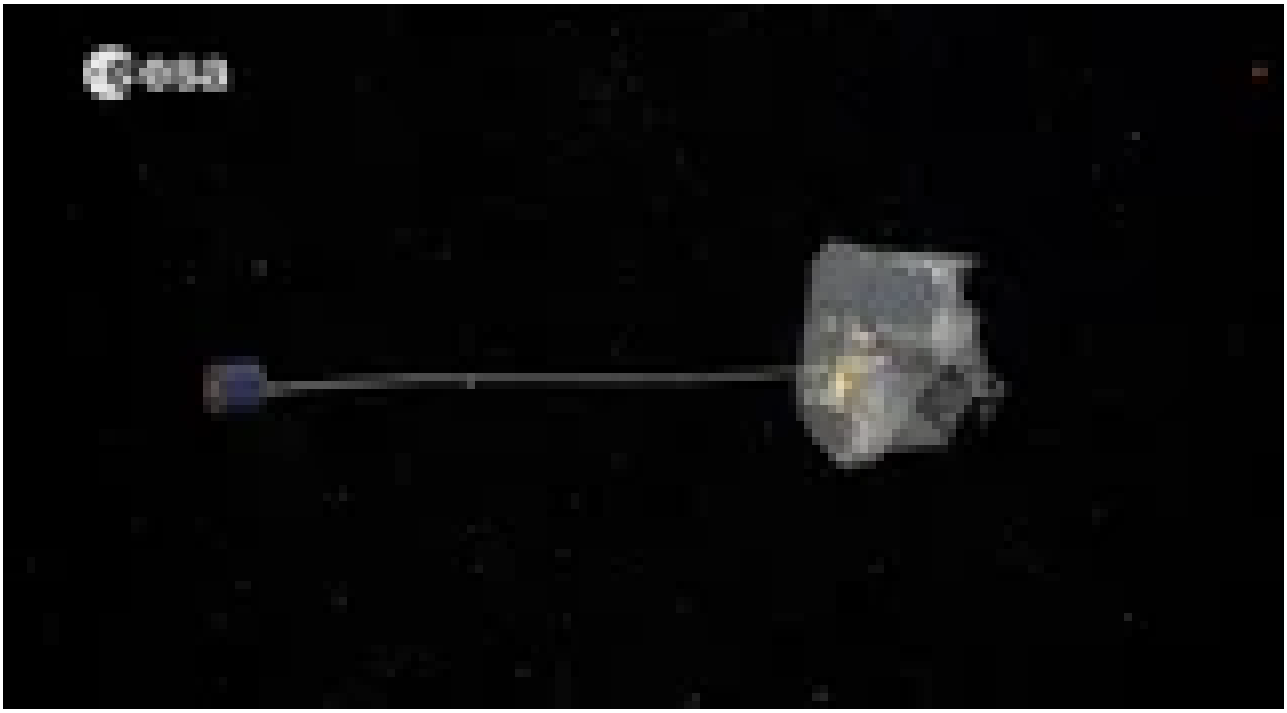
Smith reckons a state-backed programme such as the European Space Agency (ESA) should therefore lead the way and put up the money to clean up space before anything too bad happens—or

before commercial companies are put off the satellite industry due to the looming risk and cost.

> **"My feeling is that an agency like ESA should get involved"**

ESA is responsible for a particularly large piece of space junk in the form of its defunct Envisat satellite.

"If you want to be a team leader, then my feeling is that an agency like ESA should get involved, and bring down its own satellite, Envisat, to show that it can be done," said Smith. "Of course it's dangerous, but it will set a precedent that it can be done and states are responsible, liable, for their own satellites."



ESA'S SPACE DEBRIS-CATCHING NET CONCEPT. IMAGE: ESA

ESA has already started testing techniques to catch space debris such as using a giant high-tech fishing net. Another option would be commercial space debris salvage operations, where companies could collect space trash for a fee—but international space law doesn't allow for that at the moment, and changing it would require a fair amount of thought. "There's complicated issues if they remove a functioning satellite instead of a dysfunctional satellite—there are legal issues out there," said Smith, stressing the need for global understanding and consent.

One of the main regulatory issues for CubeSats is that most current rules don't recognise them as any different from other satellites, whether on the issue of debris and de-orbiting or other legal hurdles such as licensing and insurance. There is an argument that exceptions should be made, given smaller satellites' promise both to open up space and provide services to more people; Smith recognised that the technology has "fantastic potential."

"In a way we're talking about a transformative phase," she said in her talk.

Regulation was necessary, she explained, in order for the UK and other countries to keep their place in the current, evolving space industry.

And when it comes down to it, Smith pointed out, the industry and its regulatory system has never really been tested. "If two satellites collide, and they're functional, somebody's going to do something," she said.

TAGGED: TECH, MOTHERBOARD, SATELLITES, SPACE, LONDON, LAW, SPACE LAW, SPACE JUNK, ESA, SPACE DEBRIS, MOTHERBOARD SHOW, CUBESATS, LONDON SPACE WEEK, ENVISAT, LESLEY JANE SMITH, LONDON INSTITUTE OF SPACE POLICY AND LAW, LOWER EARTH ORBIT

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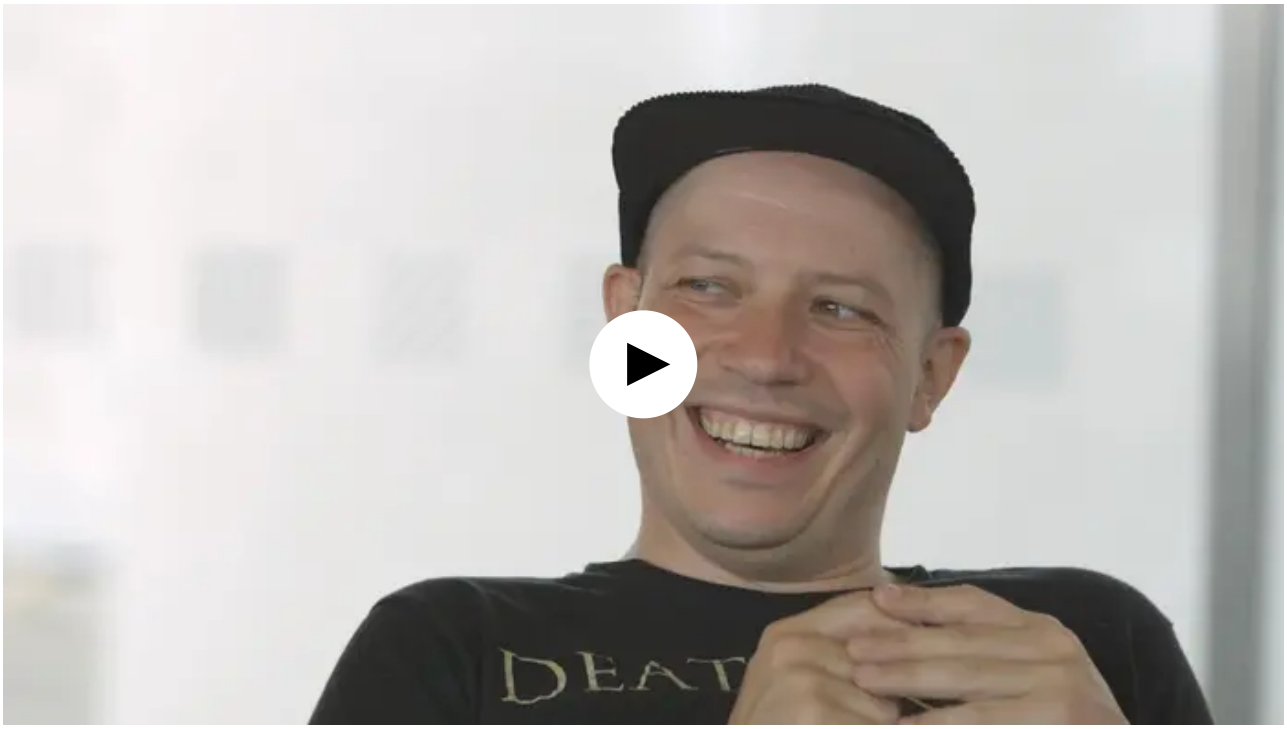

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