

# The detumbler at Airbus Defence & Space : present and future products

In preparation for Active Debris Removal

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# The detumbler at Airbus DS : present and future products

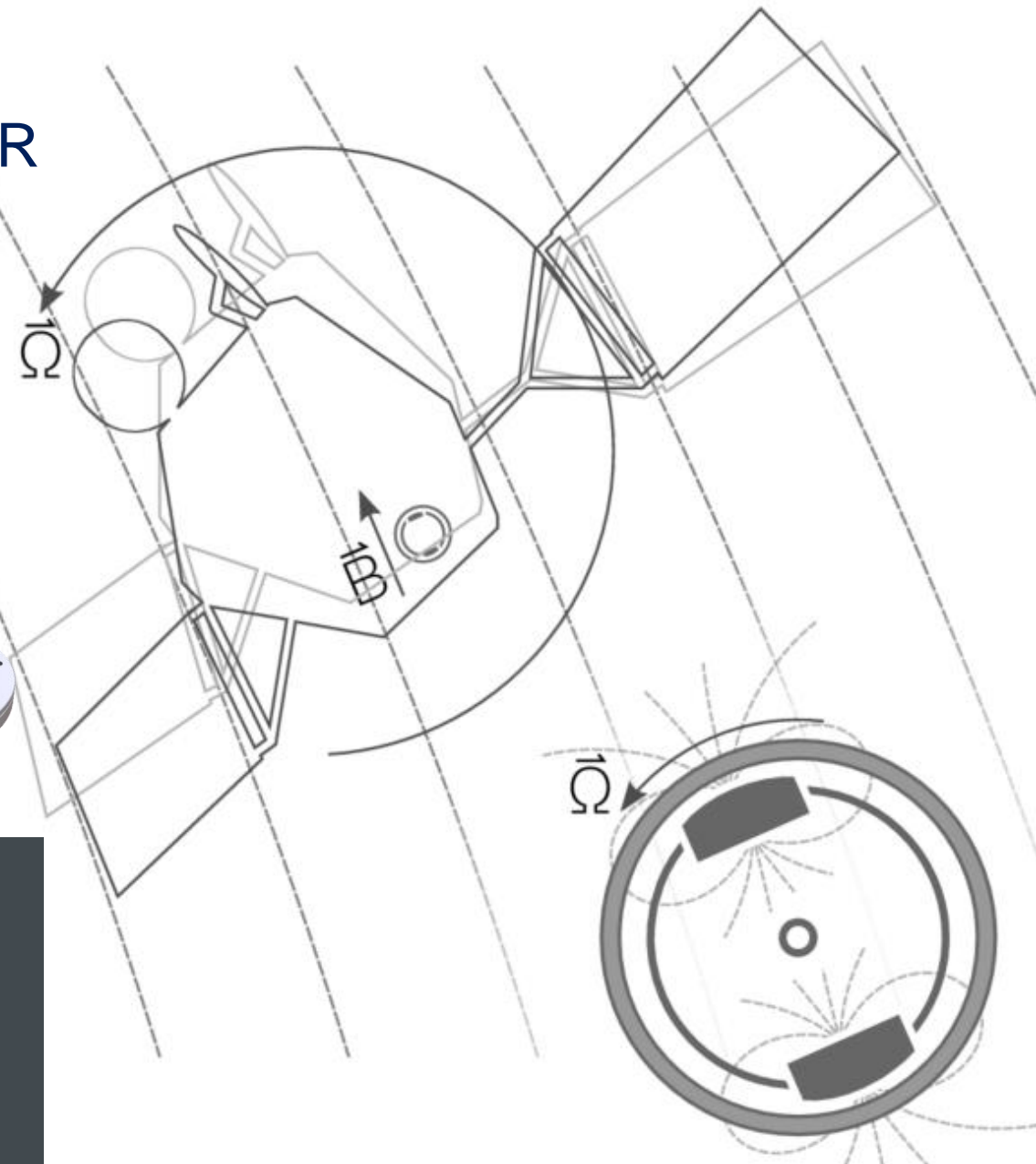
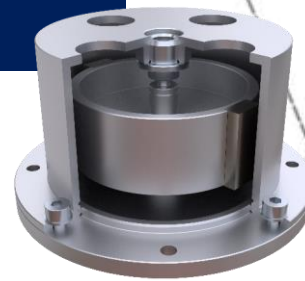
- **The detumbler-M : the workhorse product, space qualified with the support from CNES and available today**
- **The detumbler-L : in development with ESA, to extend the applicability to larger spacecraft or higher orbits (MEO)**
- **The IDEFIXS System Concept : fixing a detumbler to a derelict tumbling spacecraft already in orbit !**

# The DETUMBLER : A game-changer for ADR

We need a postmortem **detumbling** / **anti-tumbling** function :

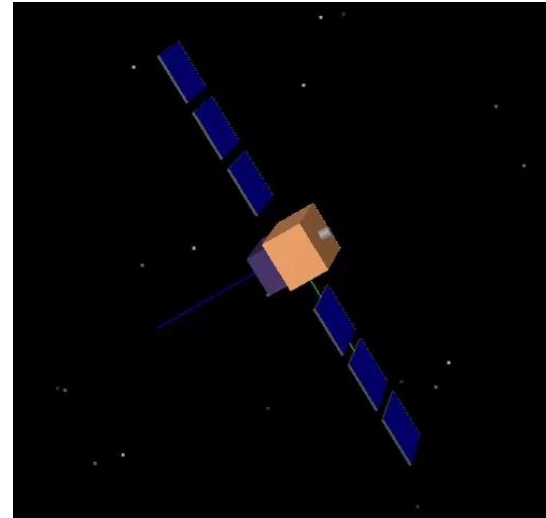
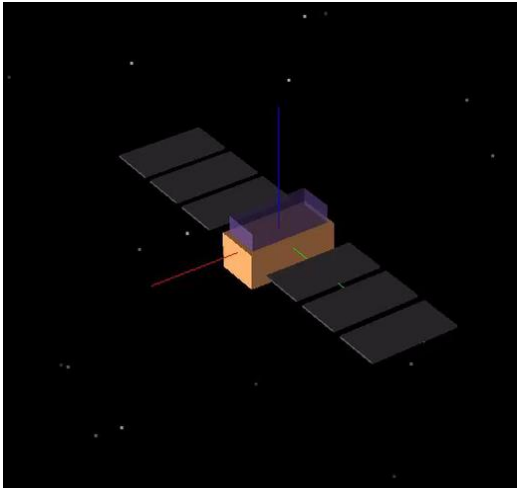
- to kill initial rates / to prevent spontaneous spin-up
- already imposed in ESA zero debris regulation / guidelines (ESA-OPS-SC-RD-2023-001 “Design for Removal : IRD for LEO missions”)
- Active debris removal becomes **much less challenging**  
smaller chaser, simpler grabbing system, smoother capture  
**safer proximity operations**

- Description of device
  - Fully passive mechanism
  - Rotor fitted with magnets
  - Rotor free to pivot inside aluminum housing (stator)
  - Stator is attached to the satellite structure
- Operating principle
  - rotor acts as a compass (wants to stay aligned with geomagnetic field)
  - if satellite is tumbling
    - differential rate between rotor and stator
    - rotor magnets moving near the conductive wall
      - eddy currents in the stator
      - resistive viscous torque slows down the rotation



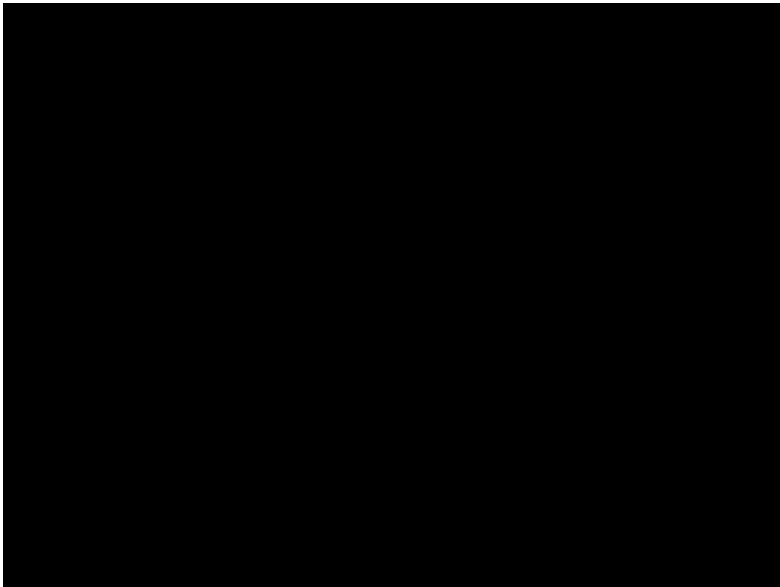
3D rendering, cutout view (true scale: diameter = 5 cm)

# The Detumbler-M in action

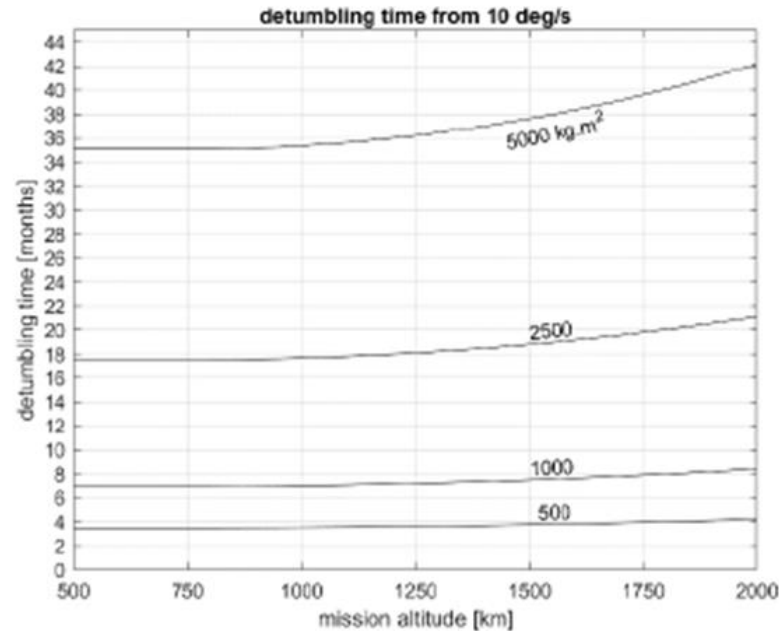


*tumbling at 3 deg/s (real-time) - for reference*

*after detumbling, 0.2 deg/s (real-time) - for comparison*



**On-ground proof-of-concept**



- key parameter = satellite inertia
- Detumbler-M design covers more than 95% of satellites in flight :

## LEO

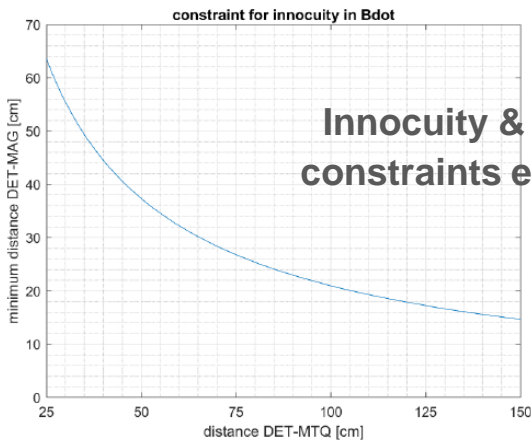
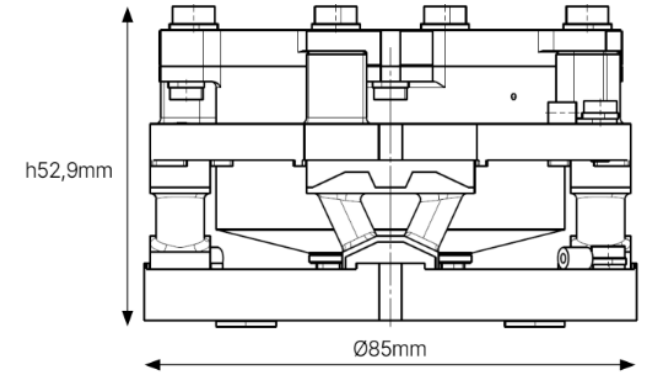
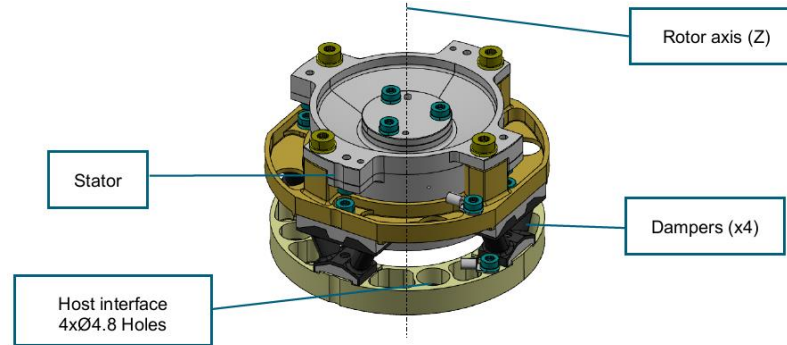
[50 – 5000 kg.m<sup>2</sup>]

satellites up to ~1.5 tons

# The detumbler-M : ready for flight, ready to order !

## Detumbler-M data sheet

Key Features & Performances	
mass	209 g (+/-5%)
size	h53mmØ85mm
orbit altitude	up to 2000 km
orbit inclination	all
satellite inertia range	50 - 5000 kg.m <sup>2</sup>
detumbling time	5 - 500 days
anti tumbling capability	up to 5 µNm avg. SRP
S/C rate after detumbling	< 0.2 deg/s
service life	up to 25 years (dependent to magnetorquers command)
temperature range	-90° C to + 80°C
power	0W (100% passive)
disturbance torque on S/C	< 50 µNm
units needed per S/C	1



### Developed by Airbus for next-generation debris mitigation solutions

- 2021 - 2025 CNES R&T and Airbus R&D
- ✓ funct. consolidation and performance
  - ✓ detumbling/ antitumbling simulations
  - ✓ detailed sizing tool
  - ✓ compatibility with AOCS
  - ✓ trade-off on technology alternatives
  - ✓ manufacturing of breadboards
  - ✓ vibration, shock, thermal and friction tests



- 2026 Product qualification
- ✓ Mechanical environment - passed
  - ✓ Thermal environment - passed
  - ✓ Life testing - passed
  - ✓ First flight models : 2026



- Patents
- 2016 - EP3538441B1 - Tourneur/Lagadec
  - 2021 - FR2110081 - Boyer/Lagadec
  - 2023 - WO2023047049 - Brault/Lagadec

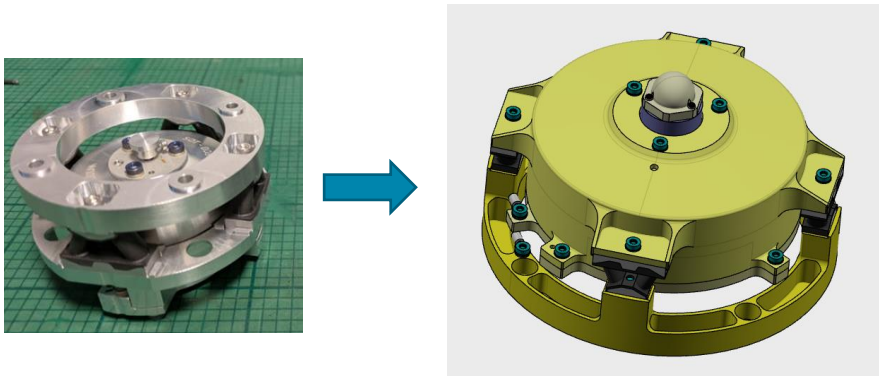
**Our motto : « No detumbler ?, No launch ! »**

# The detumbler-L : under development with ESA !

ESA Expro+ R&D Study “EoL Passive detumbling service for removal of not operative satellites in LEO/MEO/GEO orbits” : extending the detumbling capability to larger satellites, higher orbits :



→ Decision to prototype a larger detumbler



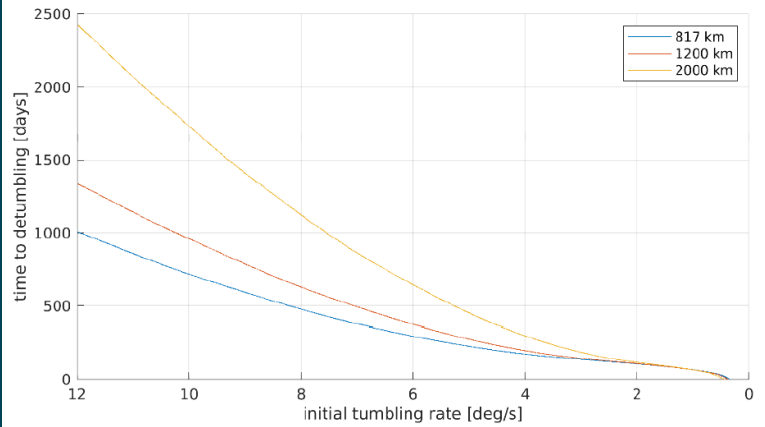
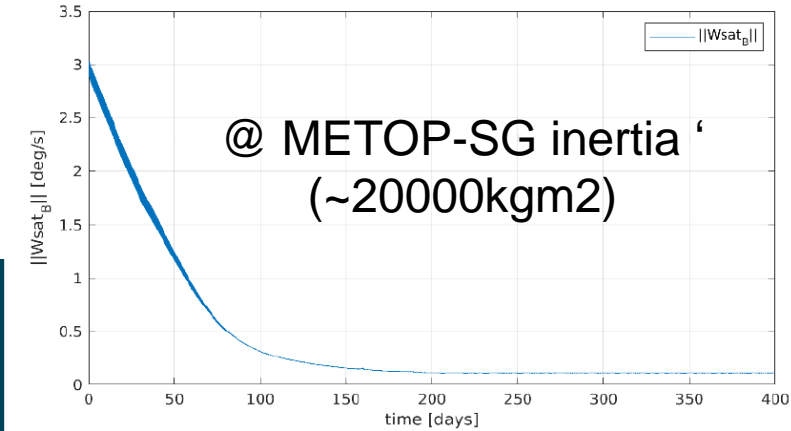
## Detumbler-L data sheet

**KEY DESIGN POINTS FOR DETUMBLER-L**

- mass target < 450 g
- size target: diameter < 120 mm
- magnetic dipole moment < 5 Am<sup>2</sup>
- target orbits: LEO & MEO (up to 8-10000 km)
- target range of S/C inertia
  - up to 25000 kg.m<sup>2</sup> in LEO
  - up to 5000 kg.m<sup>2</sup> in MEO
- performance targets
  - detumbling within 1 year
  - antitumbling against SRP torque up to 15 μNm
  - requires 5x more viscous dissipation
- versatile design
  - two versions (detumbling and antitumbling), same parts
  - adjustable viscous torque (x5) for antitumbling

esa

Ongoing R&D study for ESA



→ ENVISAT would be detumbled in ~2 years

→ Prototyping is on-going, qualification tests starting in 3T2026

→ Detumbler-L @TRL 5 by end 2026 !

# IDEFIXS Concept : In-orbit DEtumbler FIXing System

- ADS truly believes that the detumbler will be a game changer for facilitating future ADR missions of to-be-launched LEO spacecraft, but how to fix a detumbler to a derelict tumbling spacecraft already in orbit ?

*→ Our answer is the IDEFIXS System concept, a maneuvering Cubesat containing a detumbler, attached to a carrier / servicer (ADR) spacecraft, which will separate IDEFIXS at close proximity of its target. IDEFIXS will then fly autonomously towards its target and hooks on its deployed solar array edge (or any protruding flat panel edge) with a clamping mechanism*

- IDEFIXS in 2025 :
  - 6-month Phase 0 Feasibility study on ADS R&D and Innovation budget of 120k€ (~1100h)
  - Patent filed on 15/07/2025 : N° : FR 2507970, Title : « ENGIN SPATIAL ET PROCÉDÉ POUR LA STABILISATION EN ROTATION D'UN DÉBRIS SPATIAL À DÉSORBITER », Applicant : AIRBUS DEFENCE AND SPACE SAS, Inventors : Kristen Lagadec, Pascal Regnier



On-board IDEFIXS, towards ENVISAT (starting @30m, 0.1m/s, no synchronisation at the end, time accelerated x3)

# IDEFIXS System Concept Overview

Carry a detumbler-L

Passenger of an ADR  
servicer S/C with RPO  
and capture capabilities

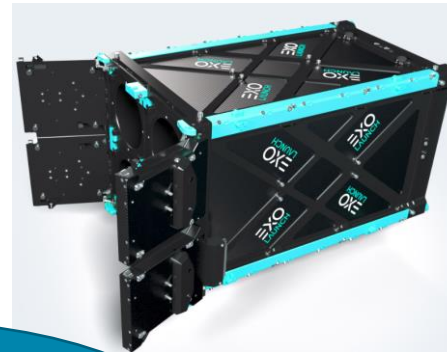
Servicer S/C in charge of :  
target observation, IDEFIXS  
ejection in adequate conditions,  
IDEFIXS mission observation,  
IDEFIXS retrieval in case of  
mission failure (no new debris)

Applicable targets :  
LEO/MEO spacecraft  
with salient deployed  
rigid solar array (>1m<sup>2</sup>)

## Main Mission Assumptions and Requirements

No on-board redundancy  
(IDEFIXS spare on passenger  
S/C), but FDIR shall prevent  
high velocity collision with  
target (no new debris)

Targets tumbling  
@~10°/s if capture point  
@5m from CoG, @5°/s  
if @20m (CGPS sizing)



Ensure innocuity to carrier  
S/C AOCs : detumbler  
neutralizers !

IDEFIXS mission duration  
while attached to its target  
(passive) : ~10 years

IDEFIXS shall use  
Cubesat technologies,  
fit within a 12U structure  
and a 16U dispenser

# IDEFIXS System Concept Overview

VCN-based GNC :  
trajectory in two parts : 1)  
free flight quasi-inertial  
approach, then 2)  
synchronization with  
target motion

Total mass budget : ~25kg  
Volume budget : ~12U internal, ~4U external

Cubesat Avionics : OBC,  
IMU, non-rechargeable  
battery, PCDU, I/F card, RF  
comms relay TBC

Major system and subsystem trade-  
offs and concepts

VCN : ADS METIS template  
model matching algorithms,  
then visual servoing on the  
solar array edge (structured  
light or 3D stereo extraction  
of SA edges, with LED  
illuminator)

Clamping mechanism concept :  
stowed outside 12U structure,  
deployed after separation,  
crossing-line LED sensor,  
spring-based fly swatter  
concept, with solimide foam  
and elastomer contact patches

Cold Gas Propulsion System  
: two 2l tanks, electronic PR,  
nine 3N-class thrusters (6dof)

# IDEFIXS Concept : conclusions and way forward for 2026 & beyond !

- Promising innovative system concept to fix a detumbler to a derelict tumbling spacecraft already in orbit, would drastically facilitate Active Debris Removal missions for target capture !
- Phase 0 feasibility study performed in 2025 @ADS exhibited no show-stopper but a few open questions to consolidate :
  - cold gas detent and temperature drop near mission's end,
  - 12U volume structure accommodation feasibility,
  - final visual servoing IP concept,
  - GNC performance at contact,
  - mechanism detailed design
- A military version of IDEFIXS could be envisaged, replacing the detumbler by...something else....
- Small ADS R&D / innovation study budget in 2026 to :
  - Contract a TBD Cubesat startup partner for mechanical configuration engineering and Cubesat avionics units pre-selection
  - System and subsystems co-engineering with the Cubesat startup to consolidate the mechanical configuration within a 12U structure
  - Lobbying and advocate IDEFIXS concept inside and outside Airbus DS to search for funding to raise TRL and envisage an in-orbit demonstration
- Consolidate an overall ADR mission / system concept with IDEFIXS and a TBD capture technology in response to ESA (ERASE) and CNES (MIREDO)

# Thank you

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