KMI · Nagoya University

Dark Matter
International Research Center

DarMa 暗黒物質国際研究センター

Kobayashi-Maskawa Institute, Nagoya University

Hiroyasu Tajima

KMI Symposium, November 9, 2026



First eye · 2025

Why a Dark Matter Center at KMI?

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KMI (2010–): bridging particles × universe, theory × experiment

Two central questions

- **Missing antimatter, which is handled by the Flavor Physics International Research Center (FlaP).**
- **Dark matter and dark energy, which is now handled by DarMa.**
  - **Dark matter is certain to exist; its nature is unknown.**
  - **It implies physics beyond the Standard Model and demands particle theory, cosmology, astroparticle physics and collider physics, together.**

02 · The Name

Why "DarMa"?

DarMa

Dark Matter International Research Center

暗黒物質国際研究センター

DarMa = Dark Matter · echo of *dharma*

Sanskrit · dhṛ

"to hold, to support": dark matter holds galaxies together

Buddhism · dharma

the law and order of the Universe: what parcle & astrophysics, cosmology look for

Bodhidharma · 達磨

nine years facing the wall (面壁九年) — patience, too



DMnet 2020–2024

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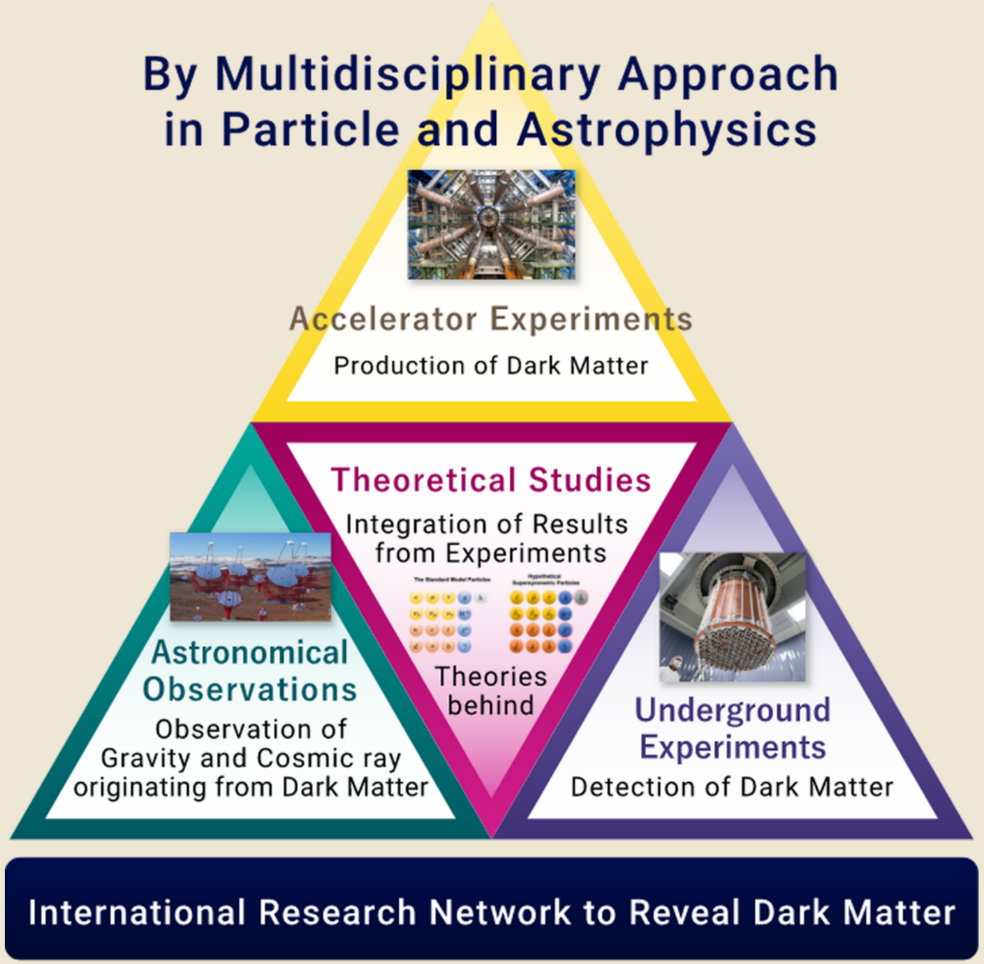
JSPS Core-to-Core: an international hub across four fields



Network at a glance

33 institutions in 4 countries

28 researchers abroad / year (post-COVID)

Core partners

INFN Padova · MPIK · Edinburgh · IBS

Symposia hosted

MPIK (2022) · INFN Padova (2023) · IBS (2024)

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DMunit 2022–2026

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Liquid xenon, instruments and a Nagoya B-1 research unit

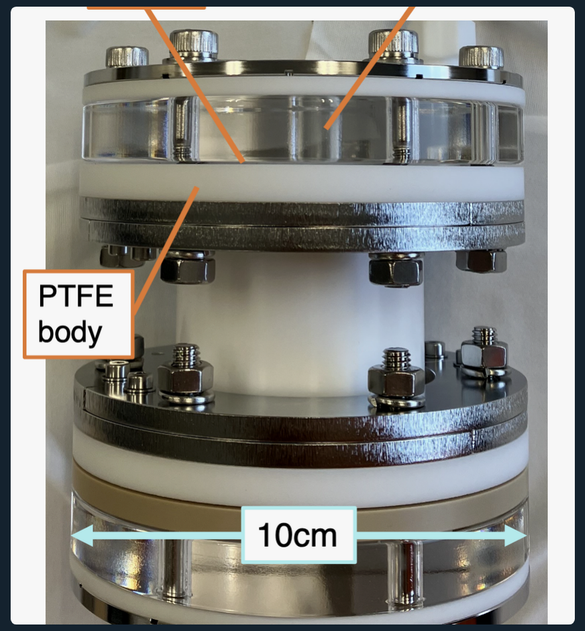
What DMunit delivered

XENONnT analysis core in Japan
3 press releases; contributions central

Dedicated LXe facility in Nagoya
Hermetic TPC · low-BG VUV sensors

R&D toward ~50 t detector
Pathway to DARWIN / XLZD

Joint with KMI · ISEE · Freiburg
Extended through 2026 by partner request



Workshops
Nagoya Workshop on Technology in Future Liquid Noble Gas Detectors (2024)

- Liquid-noble-gas
- DM–neutrino physics
- theory × experiment

05 · Launched April 1, 2025

DarMa finds its place inside KMI

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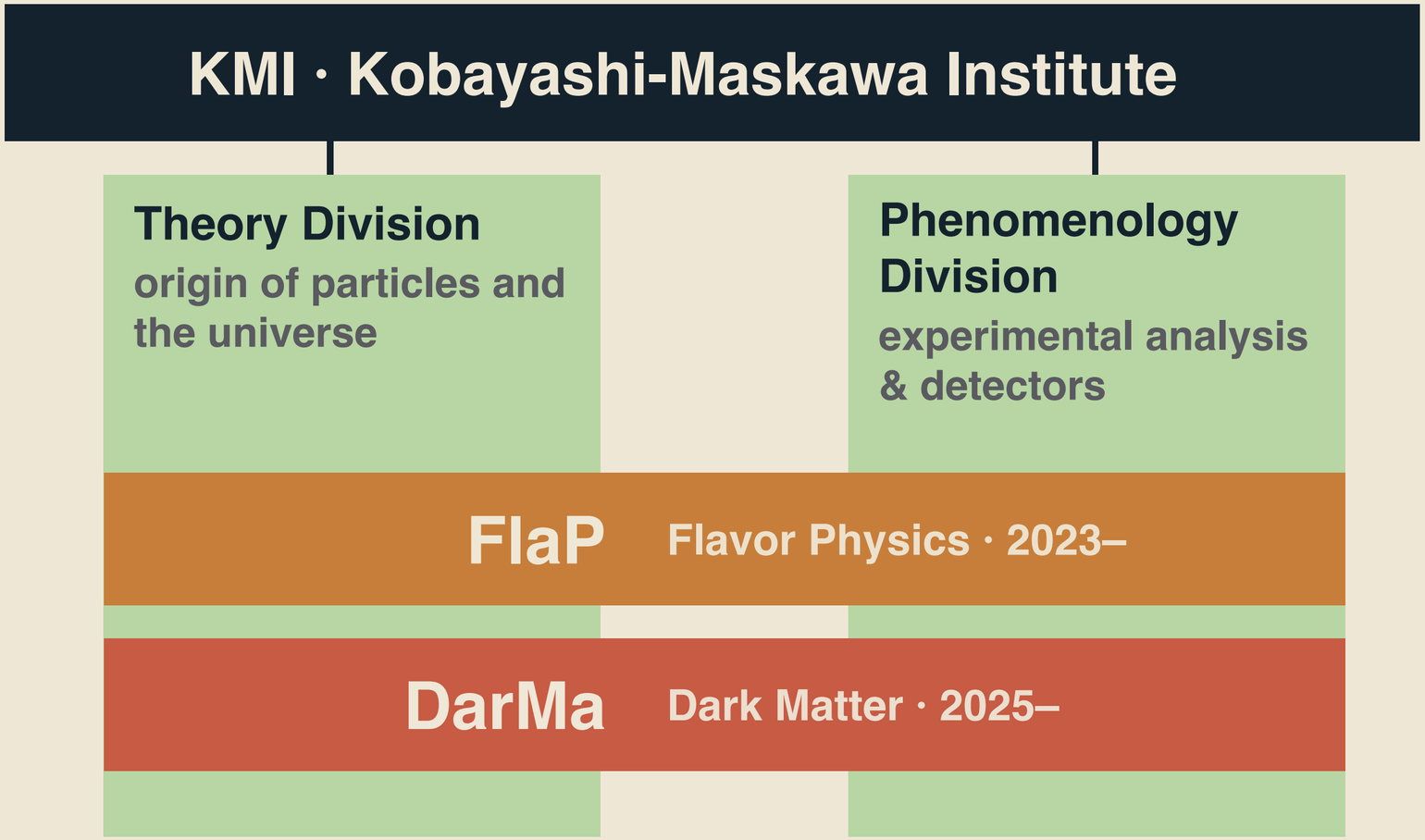
A cross-cutting center, sitting beside its sibling FlaP.



Inside the university

Graduate School of Science

ISEE

Graduate School of Mathematics

IMaSS

National collaborators

KEK · NAOJ · ICRR

cross-appointments · visiting positions

What DarMa is for

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Five objectives

01

International research hub

cross-field workshops, seminars, schools

02

People

exchange young researchers · expand cross-appointments

03

Shared infrastructure

LXe + VUV facility, detector R&D, machine learning

04

Sustain the network

33-institution DMnet
Freiburg partnership

05

Stable funding

Win MEXT support (概算要求) for permanent operations.

Until then — pursue external funding actively; every activity here builds the case.

An all-direction approach

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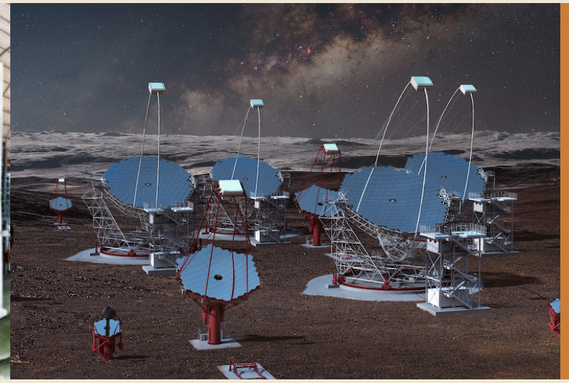
Theory at the center, four channels of evidence around it

DM Scattering

XENONnT → XLZD

scattering off nuclei
×10 statistics





DM Annihilation

MAGIC → CTAO

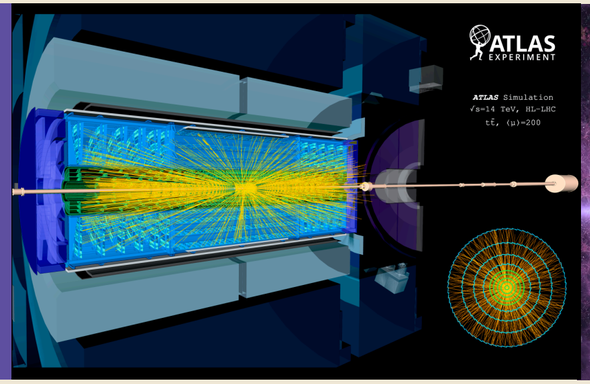
annihilation gamma rays
×10 statistics, GeV/TeV

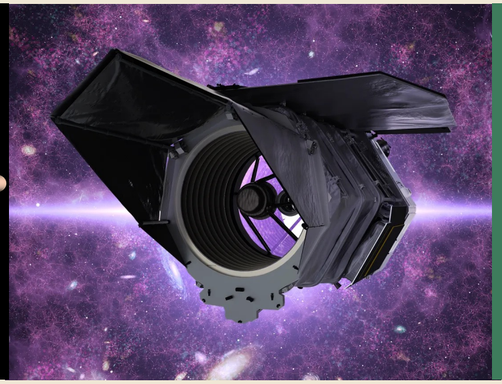
Theory SUSY / wino · axions · dark photons · primordial black holes

DM production&interaction

HL-LHC · Belle II

production at colliders
high-luminosity





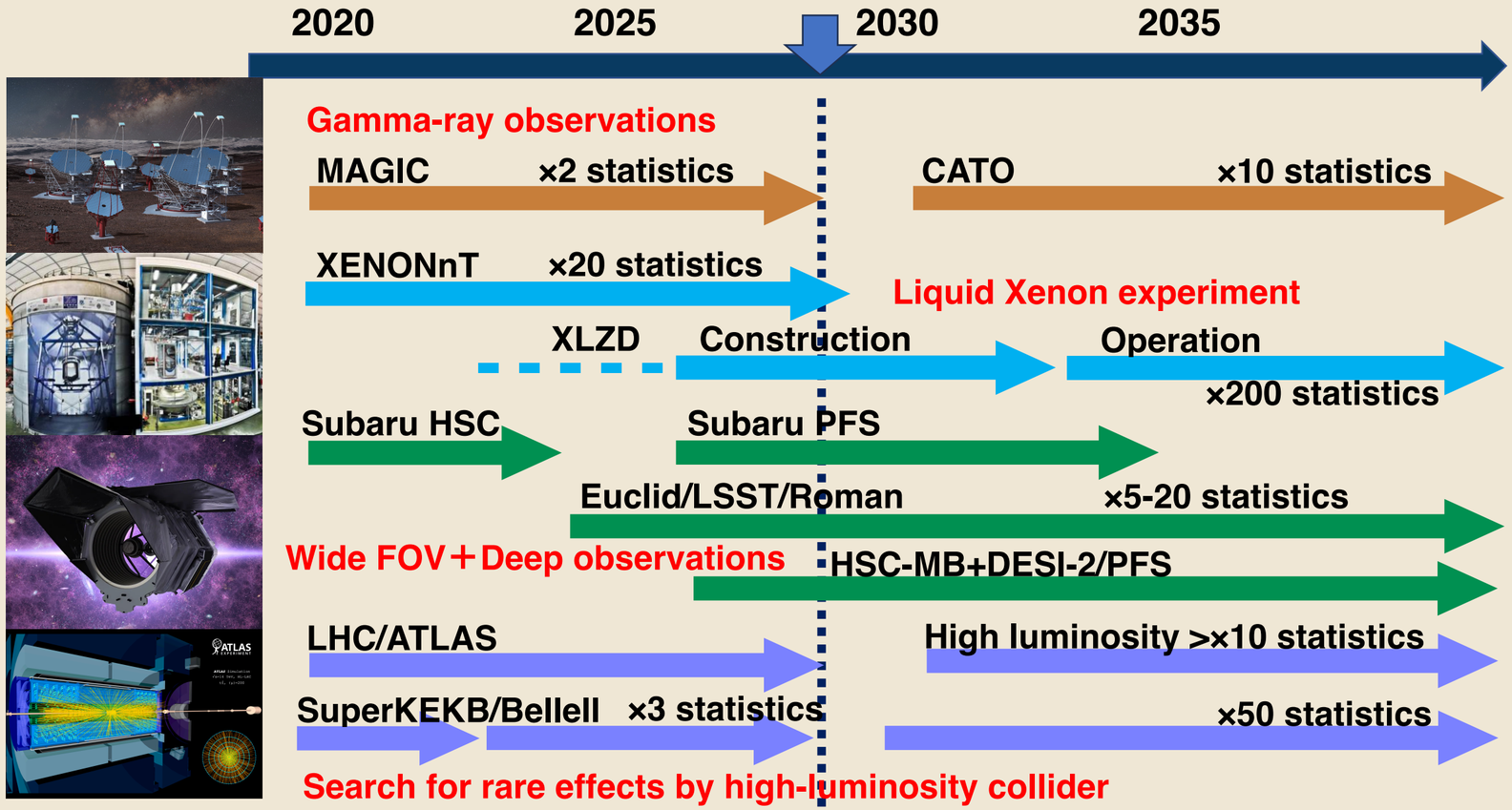
Cosmology

HSC · PFS · Euclid · Roman

surveys + spectroscopy
×5–20 statistics

Timeline, 2020 → 2035

From 2026, many experiments turn into a discovery window



Goal

Identity of dark matter — and the physics behind it

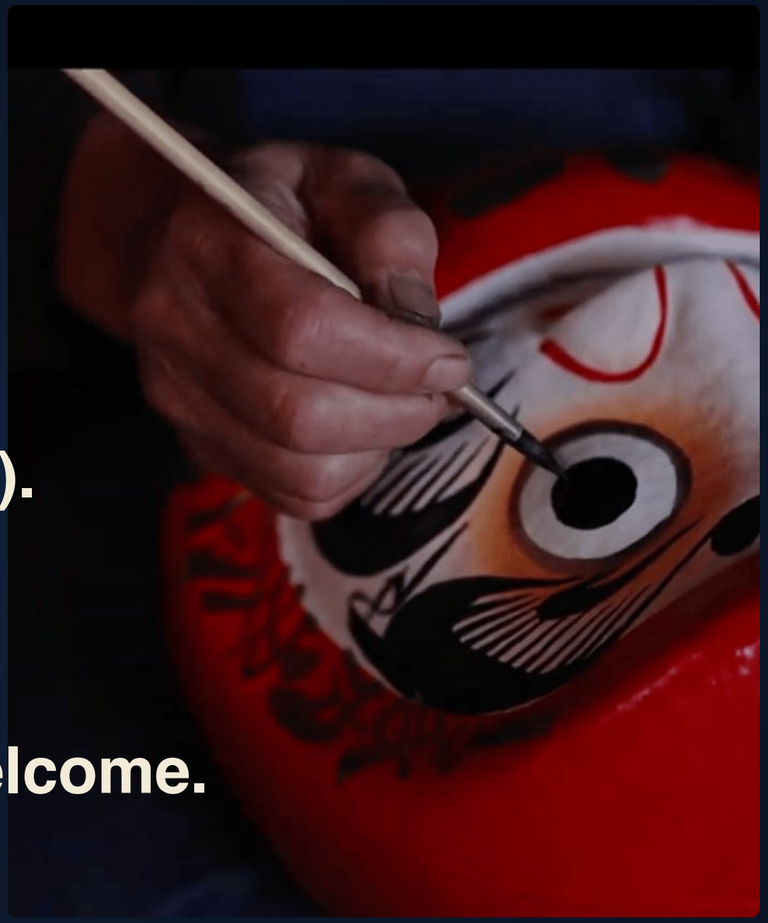
SUSY · wino · axions · dark photons · primordial black holes — all four must agree.

09 · Closing

DarMa

KMI's permanent home for the search for the dharma of the Universe

- Built on DMnet (network) and DMunit (technology).
- Timed for the milestones of 2026–2030.
- Join us: seminars · joint workshops · students welcome.



Closing

"We have painted the first eye of our Daruma."