



MAX IV

MAX IV AI Development



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Organizational Landscape and Technical Contributions

Organizational Overview of AI at MAX IV

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Introduction

- An overview of how AI is being developed and integrated across MAX IV, from strategic planning to hands-on technical implementations.

Scope:

- Organizational initiatives and roadmap alignment
- Divisional engagements and tailored AI applications
- Technical Division's role and project examples

AI in MAX IV's Strategic Planning

AI as a Strategic Enabler

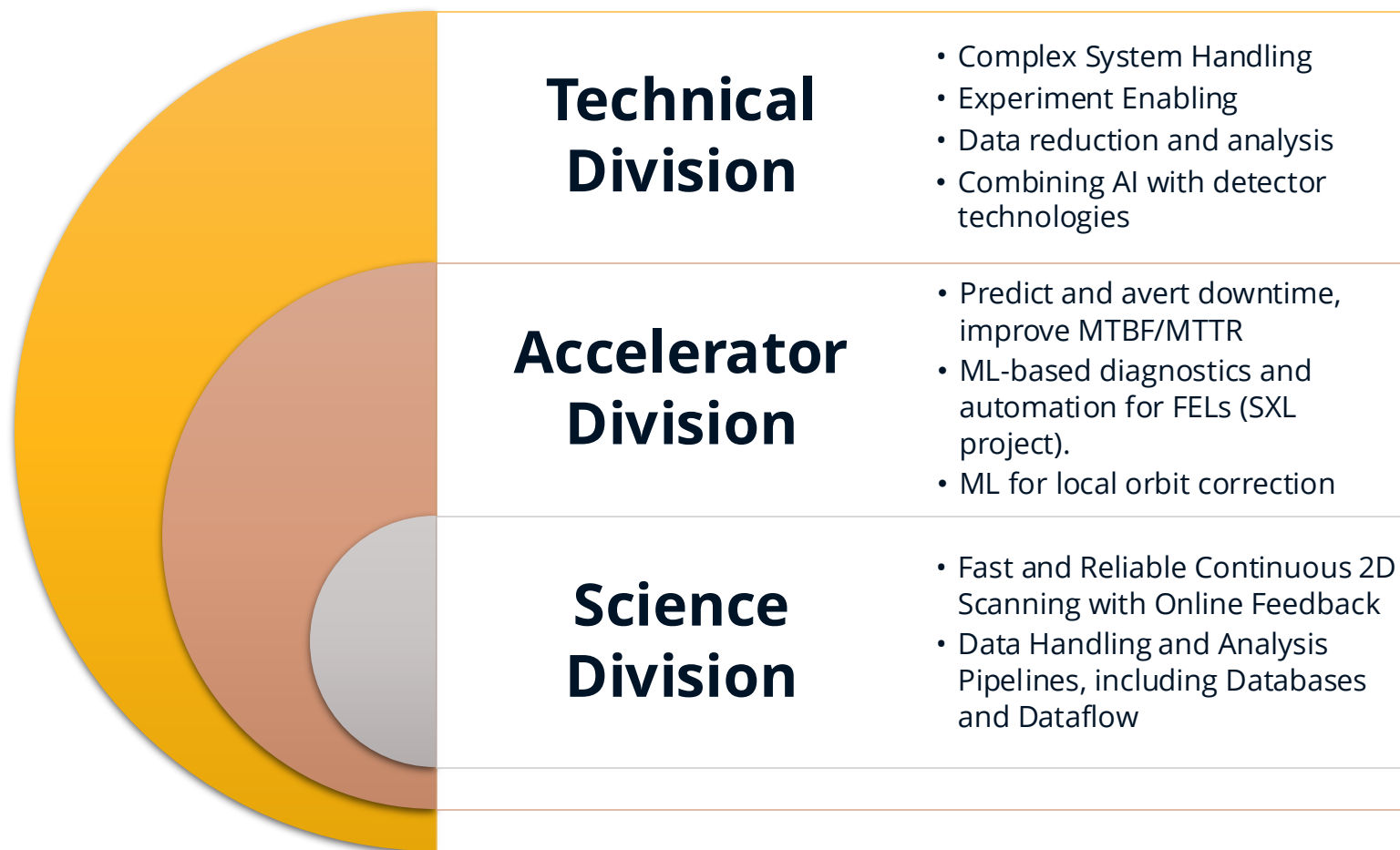
- Supports automation, diagnostics, and data analysis
- Enhances scientific capabilities and operational resilience

Roadmap Integration

- AI/ML mentioned across multiple domains:
 - Data reduction for pixel-based detectors
 - Accelerator operations and downtime mitigation
 - Photon source control and orbit correction

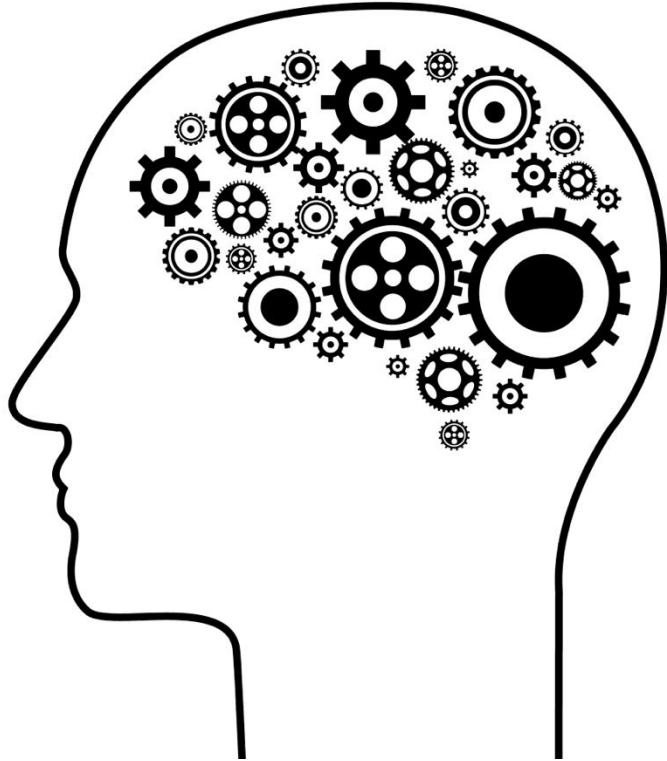
International Collaboration

- AI development aligned with European light source ecosystem
- Shared goals in control systems, data management, and experimental design



AI Across MAX IV Systems and Divisions

- AI and ML are considered in multiple layers of MAX IV's future planning—from beamline design to operational stability.
- The main focus of Technical Division is to enable science with the best possible standards for AI and ML development.
- Science Division does not explicitly address AI/ML, but has clear intersection areas.



MAX IV AI/ML Work Group– Building a Shared Platform

- **Main Objective**

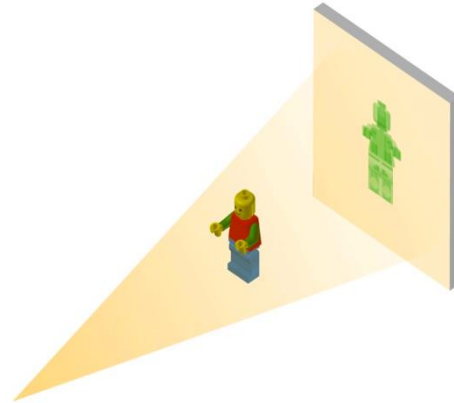
Establish a unified AI/ML platform at MAX IV to support scalable, maintainable, and collaborative development across divisions.

- **Key Goals**

- **Identify facility-wide needs and gaps** in infrastructure, tooling, and workflows (*e.g., missing components, integration challenges, retraining strategies*)
- Promote **cross-divisional collaboration** and knowledge sharing
- Support **strategic alignment** with the **MAX IV Roadmap**

Independent AI/ML Projects Across Divisions

- These initiatives are driven by specific scientific and operational goals
- They are often developed independently, outside centralized coordination
- This is a reflex of the diversity of possible use cases for AI applications across MAX IV.

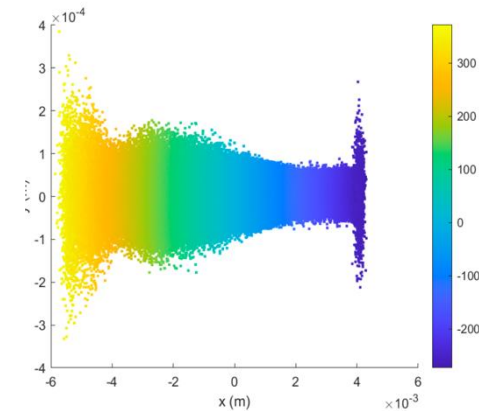


Science Division – DanMAX

- Plans to implement **AI-based tomography reconstruction**
- Inspired by existing solutions, adapted to DanMAX's experimental needs
- Midterm implementation and requires funding.

Accelerator Division

- **TDC prediction** using non-invasive beam diagnostics
- Predicts pulse format at the end of the linac without interrupting SPF delivery
- Addresses operational needs with minimal disruption



Technical Division – Enabling and Driving AI Solutions

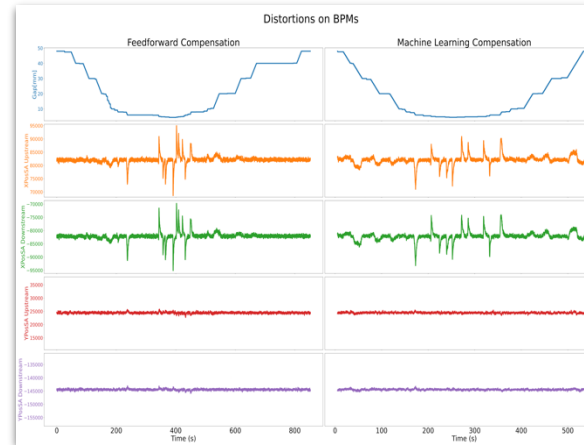
- **Key Contributions**

- Infrastructure and tooling (e.g., MLFlow on OKD, Jupyter Hub)
- Scalable and maintainable AI pipelines
- Integration with control systems and monitoring tools

- **Positioning**

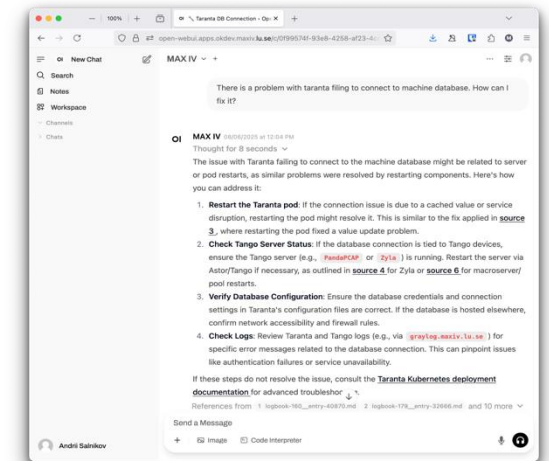
- Acts as a **bridge** between scientific needs and technical implementation
- Focused on **robustness, reusability, and long-term maintainability**

Centralized and Collaborative projects



- Initiated by other divisions, supported through joint effort
- *Example: ID ML project with the Insertion Device and Software teams*

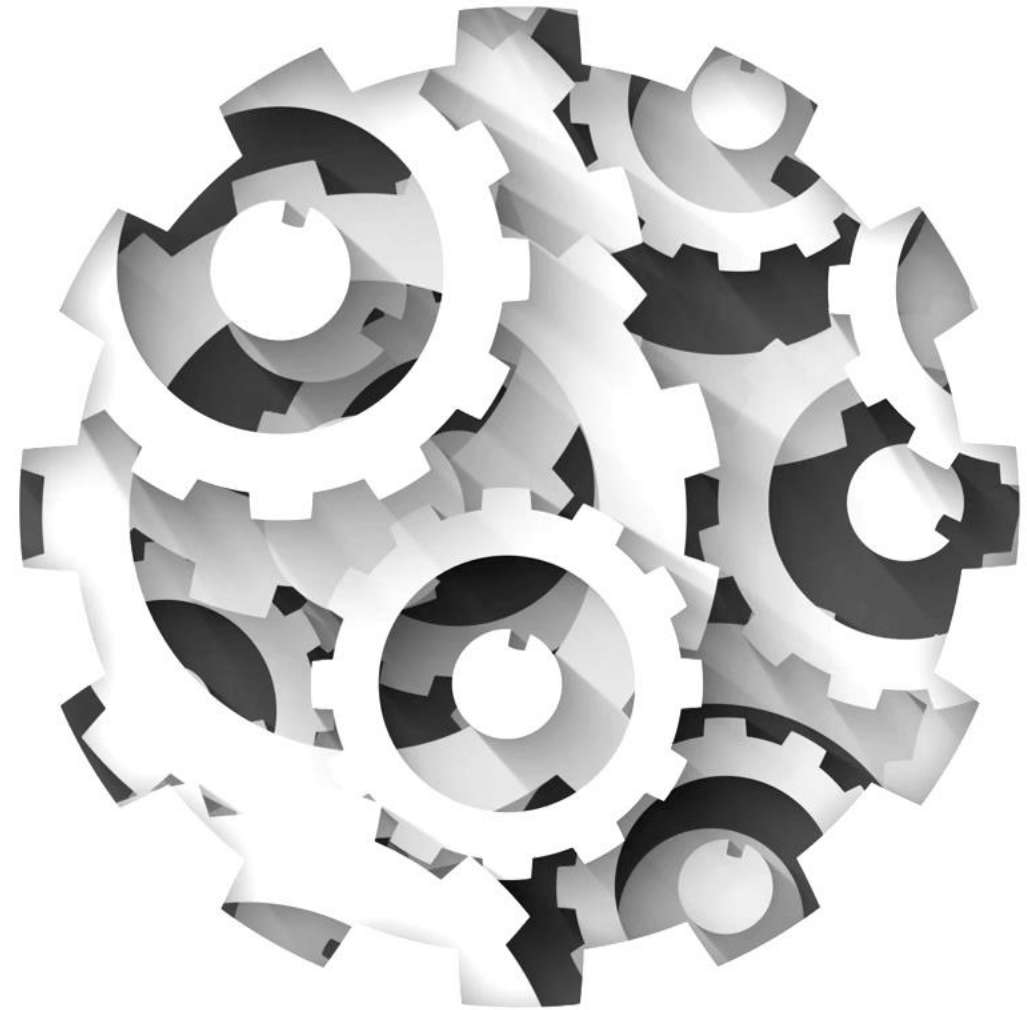
Internally initiated projects



- Driven by curiosity, innovation, or identified needs
- *Example: Open WebUI*

AI/ML at MAX IV – From Individual Efforts to Organizational Strategy

- AI/ML is still a **relatively new topic** at MAX IV on an organizational level
- Most initiatives have been **driven by individual efforts** and local needs
- This is **starting to change**:
 - AI is now part of the **MAX IV Roadmap**
 - Management is actively working to **coordinate and support** development
 - A shared platform is being planned to **enable collaboration and scalability**



Technical Contributions

- **Infrastructure Open WebUI** – internally initiated tool for operational support
- **ID ML Project** – collaborative effort for ID distortion compensation using ML