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Work-Package PrIO Preparation of ITER Operation

Towards Tokamak operations Conversational AI Interface Using Multimodal Large Language Models

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Contexte and Motivation

Operational Challenges

Complexity: Managing numerous parameters and subsystems (pressure, temperature, magnetic fields.etc)
Data Overload: Interpreting huge amounts of real-time data
Anomalies detections: Predicting and mitigating disruptions& equipment failures
Response Time: Making rapid and informed decisions during anomalies

Role of AI in Tokamak Operations

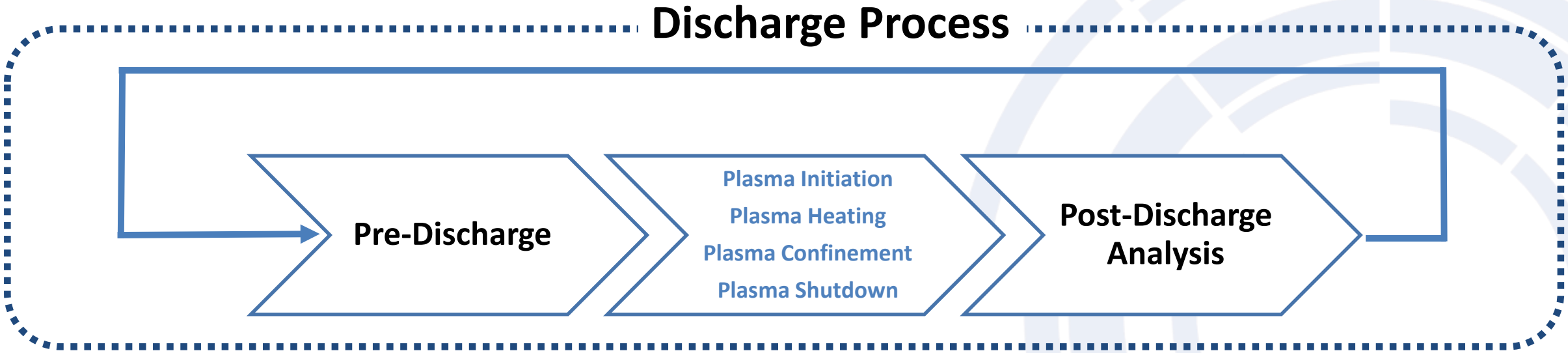
Advanced data analysis
Conversational interfaces
Build models that understand and generate text, images, and other data formats

Our proposal

Building AI conversational tool optimized for operations dialogue using **Large Language Models (LLMs)**
Aims to support and help tokamak operators with:

- Plasma discharge configuration
- Data interaction
- Provide advanced analysis to optimize control room operations

Which stage in the Tokamak operation would benefit most from conversational AI tools?

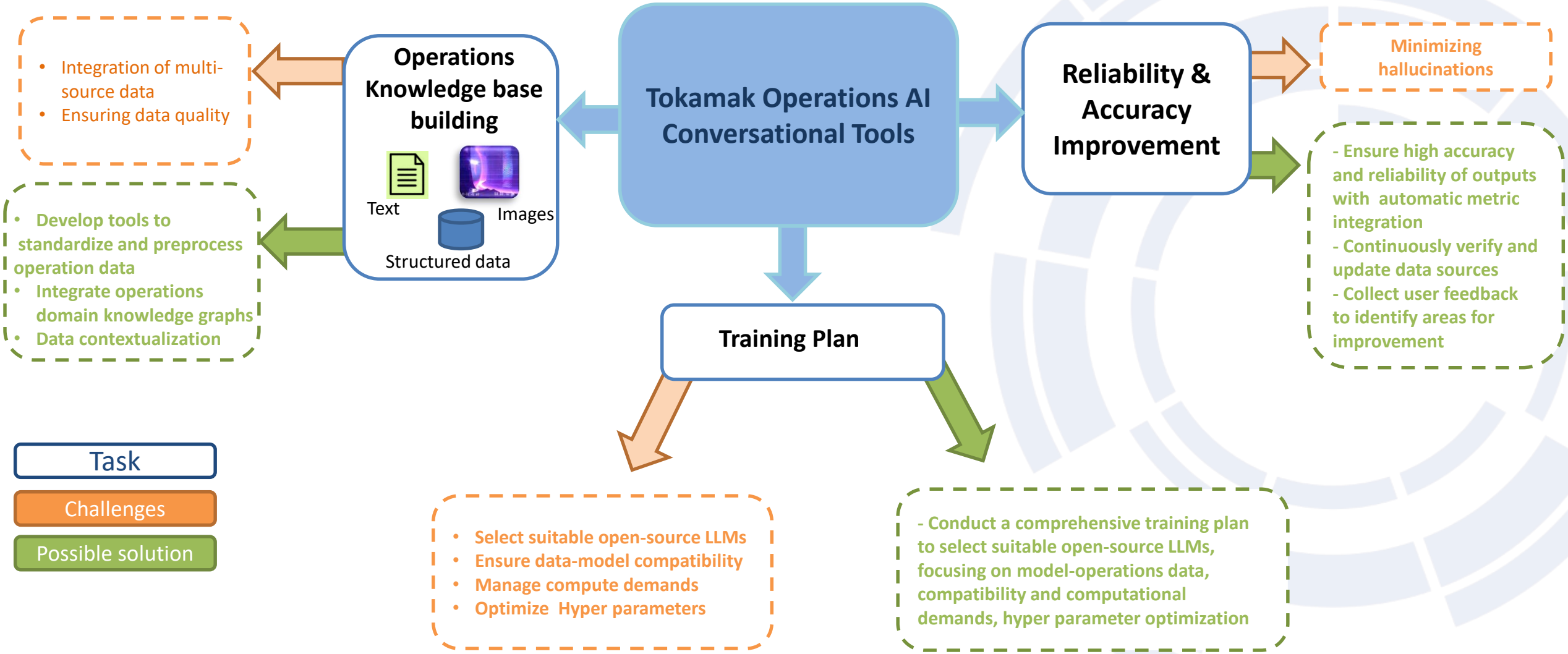


How the Conversational AI Tool can position

- ❖ Help in Discharge Configuration and Operation Planning
- ❖ Assisting in verification
- ❖ Knowledge Acquisition

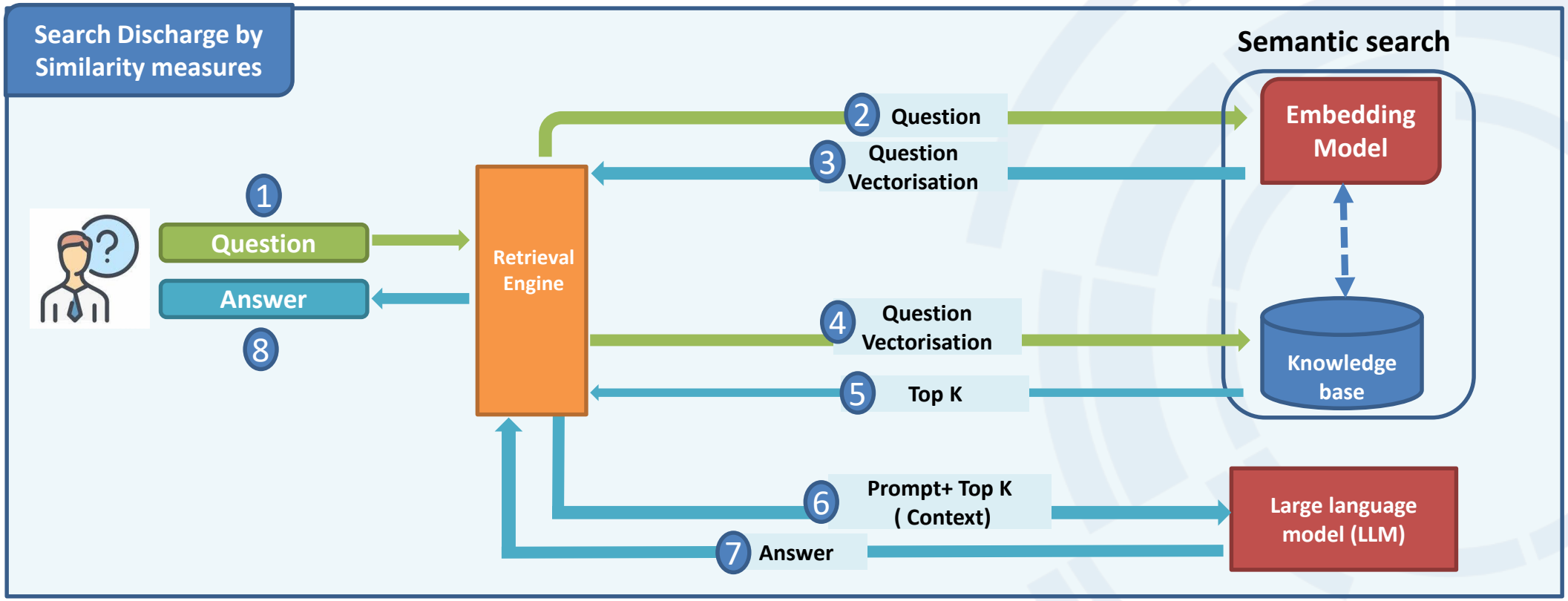
- ❖ Advanced analysis
- ❖ Help in next discharge preperation
- ❖ Help in anomaly detection

Challenges


Tokamak Operations AI Conversational Tools
Operations Knowledge base building
Text
Images
Structured data
Integration of multi-source data
Ensuring data quality
Develop tools to standardize and preprocess operation data
Integrate operations domain knowledge graphs
Data contextualization
Reliability & Accuracy Improvement
Minimizing hallucinations
- Ensure high accuracy and reliability of outputs with automatic metric integration
- Continuously verify and update data sources
- Collect user feedback to identify areas for improvement
Training Plan
Select suitable open-source LLMs
Ensure data-model compatibility
Manage compute demands
Optimize Hyper parameters
- Conduct a comprehensive training plan to select suitable open-source LLMs, focusing on model-operations data, compatibility and computational demands, hyper parameter optimization
Task
Challenges
Possible solution

Use Cases

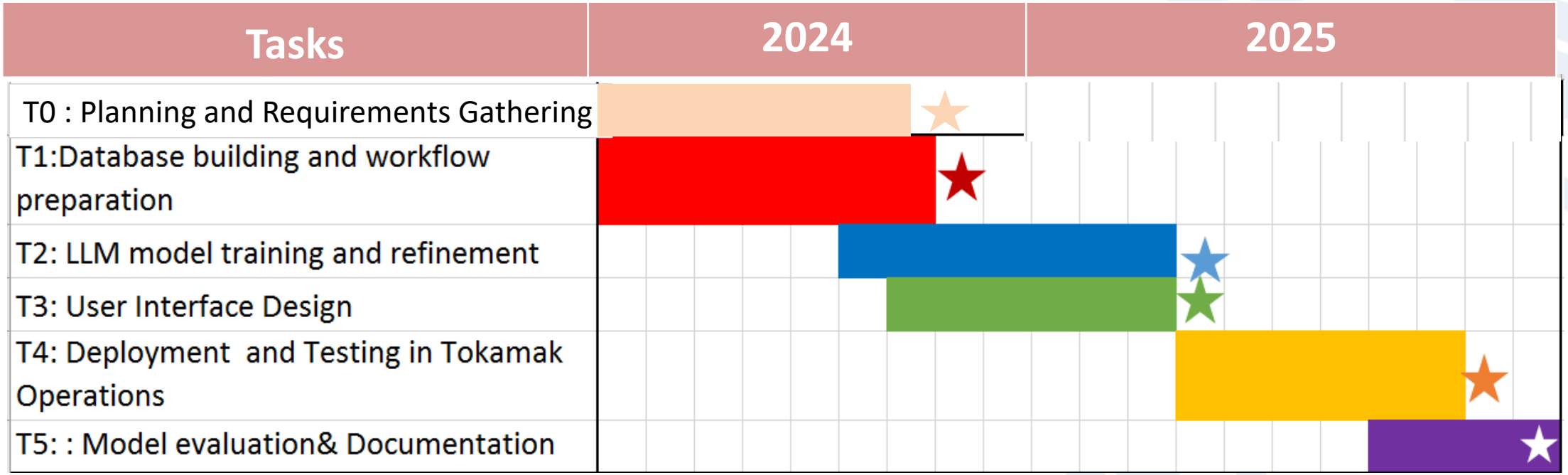
Example : Discharge Similarity retrieval & reporting



Potential use cases

- Discharge Classification
- Discharge Reporting Summaries insights from previous discharge data
- Question answering
- Events Prediction

Planning and deliverables



More details in « Towards Tokamak operations Conversational AI Interface Using Multimodal Large Language Models scientific proposal".pdf

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