

Realization of an Energy System-Informed Digital Twin of the KARA Accelerator at KIT in a Real-Time Simulation Environment: the ACCESS Project

M. Mohammad Zadeh, E. Bründermann, A.-S. Müller and G. De Carne

1. Project Target

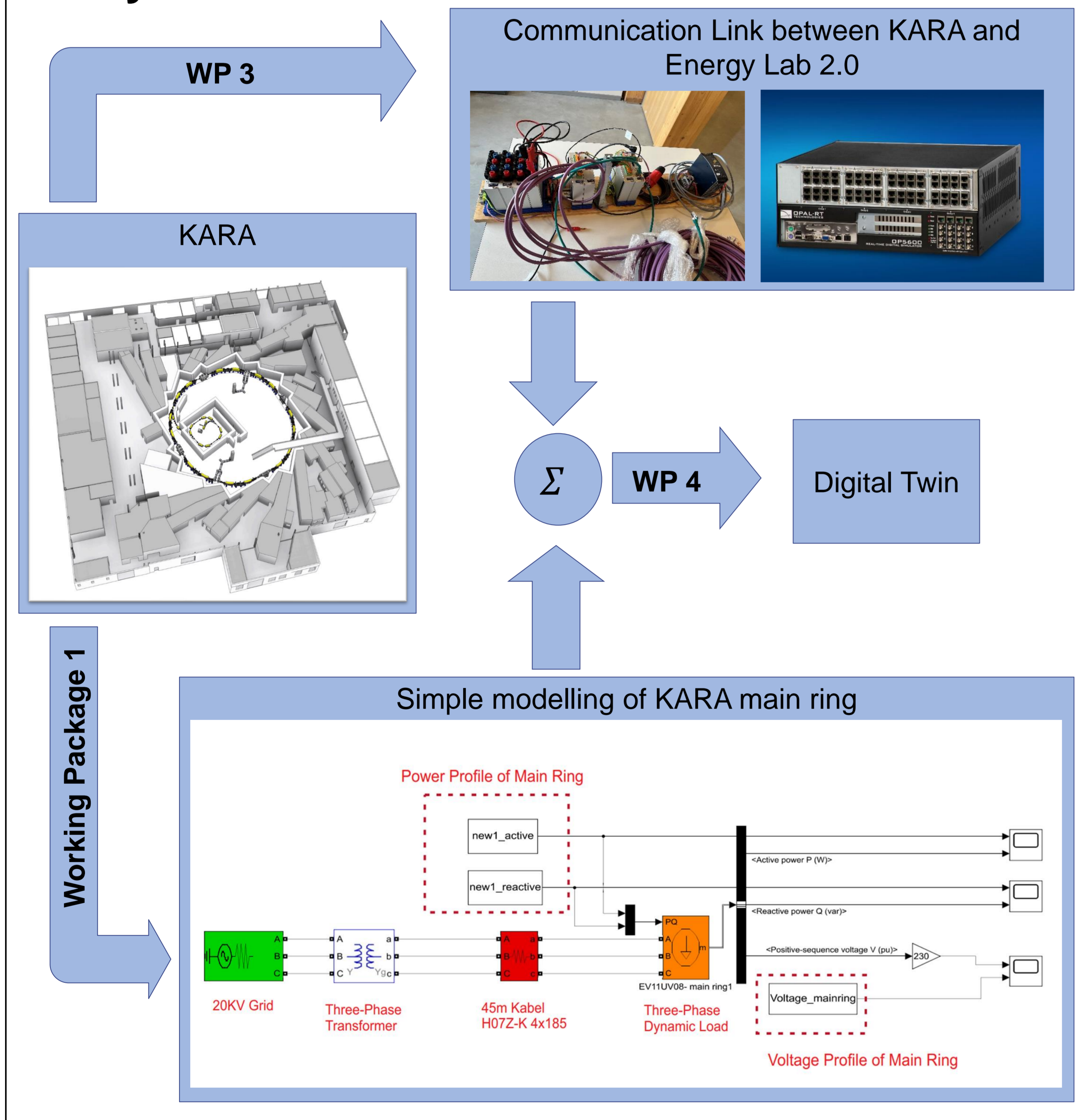
Motivation

- New energy solutions for energy-efficient and stable operation of Karlsruhe Research Accelerator (KARA).
- Can novel solutions be validated without disrupting research activities at the accelerator KARA?

Proposed solution

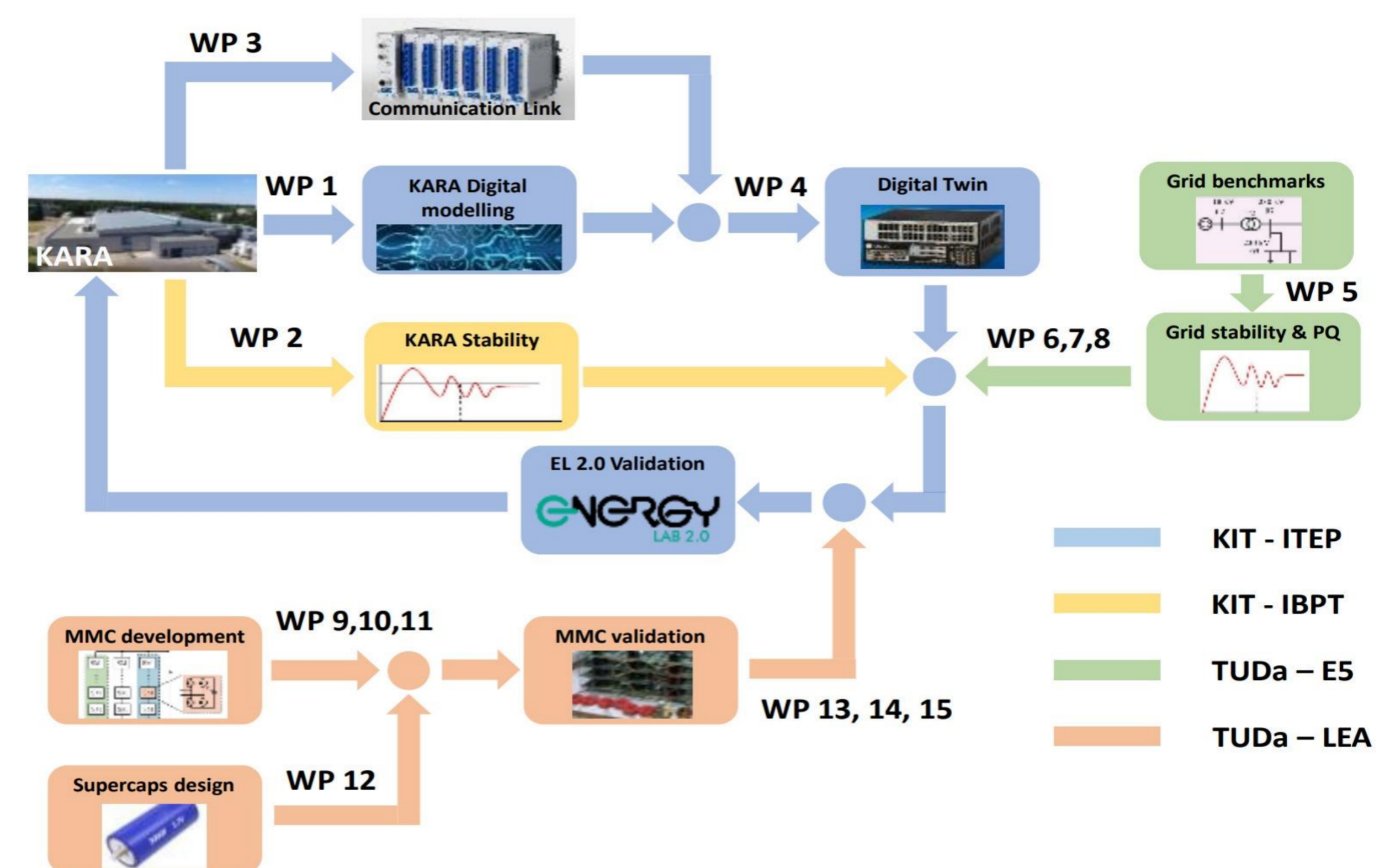
- The Digital Twin of the KARA at Energy Lab 2.0, realized in a real-time simulation environment with high accuracy.
- Developing strategies for reducing accelerator energy consumption and providing flexibility services to the grid via KARA Digital Twin.

3. System Overview



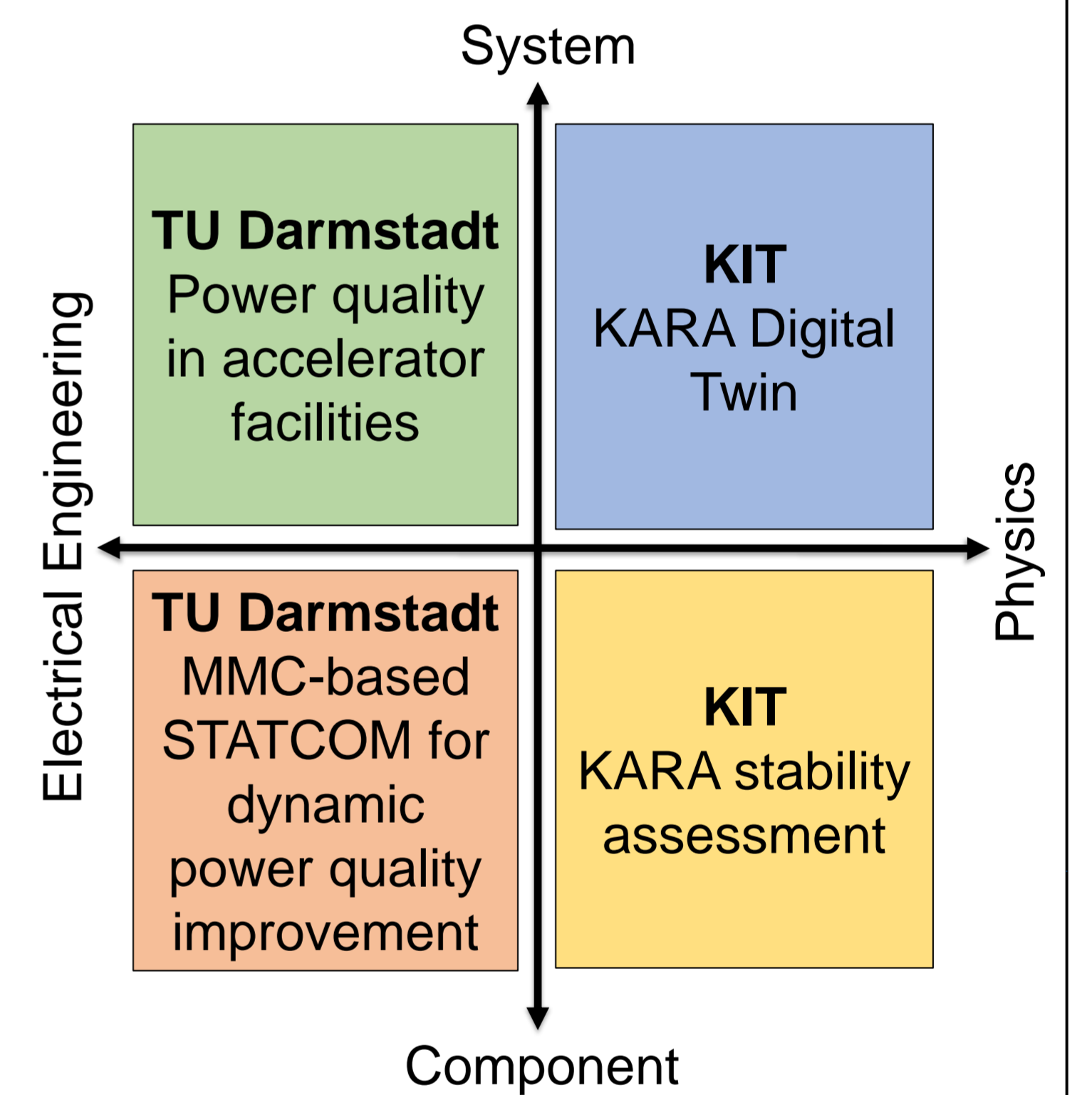
2. ACCESS Project

Cooperation strategy between KIT and TU Darmstadt:



Final Goal:

- Provision of a reliable power supply for large accelerator infrastructures under modified grid conditions based on the development of advanced power electronics, management and control approaches.



Outlook:

- Unique expertise in energy management and power quality for large accelerator infrastructures, with a focus on KARA, transferred to other facilities (e.g., BESSY II, PETRA III, GSI/FAIR) and potentially the market.
- New energy solutions for accelerators have not been validated using energy system-informed Digital Twins globally, making the collaboration between KARA and Energy Lab 2.0 unique due to their combined expertise and testing flexibility.

4. Results

Comparing the P, Q, and V values of the KARA main ring obtained from the Digital model to their real value:

