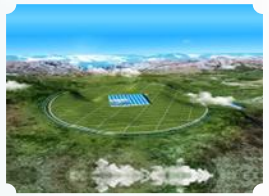
AI赋能大科学装置
——智能体和新型基础设施前沿

张正德
中国科学院高能物理研究所
国家高能物理科学数据中心

2026.05.17

国科大物理科学学院青年教师线上论坛



高能物理大科学装置与设施

建设

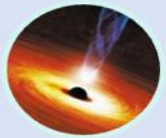
运行

退役

国家高能物理科学数据中心

具有重要国际影响力的国家级数据中心。

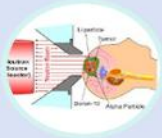
5大重要应用场景



基础研究
粒子物理研究
中微子研究
宇宙线研究
空间科学研究

产业创新
特种材料研究
超导技术
微电子技术

人工智能
科学大模型
数据供给



生物医学
医学诊断
射线治疗

国际合作
国内外大科学装置与计划

6类数据加工与服务方式

- >24.3亿条 文件记录数
- 9个 典型数据库
- 62PB 数据资源
- >10种 软件工具
- >1.5亿人次 访问总量
- >700PB 数据访问量/年

4种科学数据汇交模式

- 科技项目汇交
- 文章关联数据汇交
- 大科学装置数据汇交
- 国际科学数据镜像

8类数据来源

粒子物理

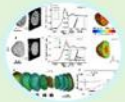
天体物理

空间科学卫星

光子科学

中子科学

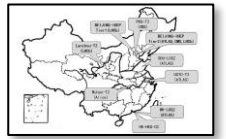
国际合作大科学实验


重大科研项目

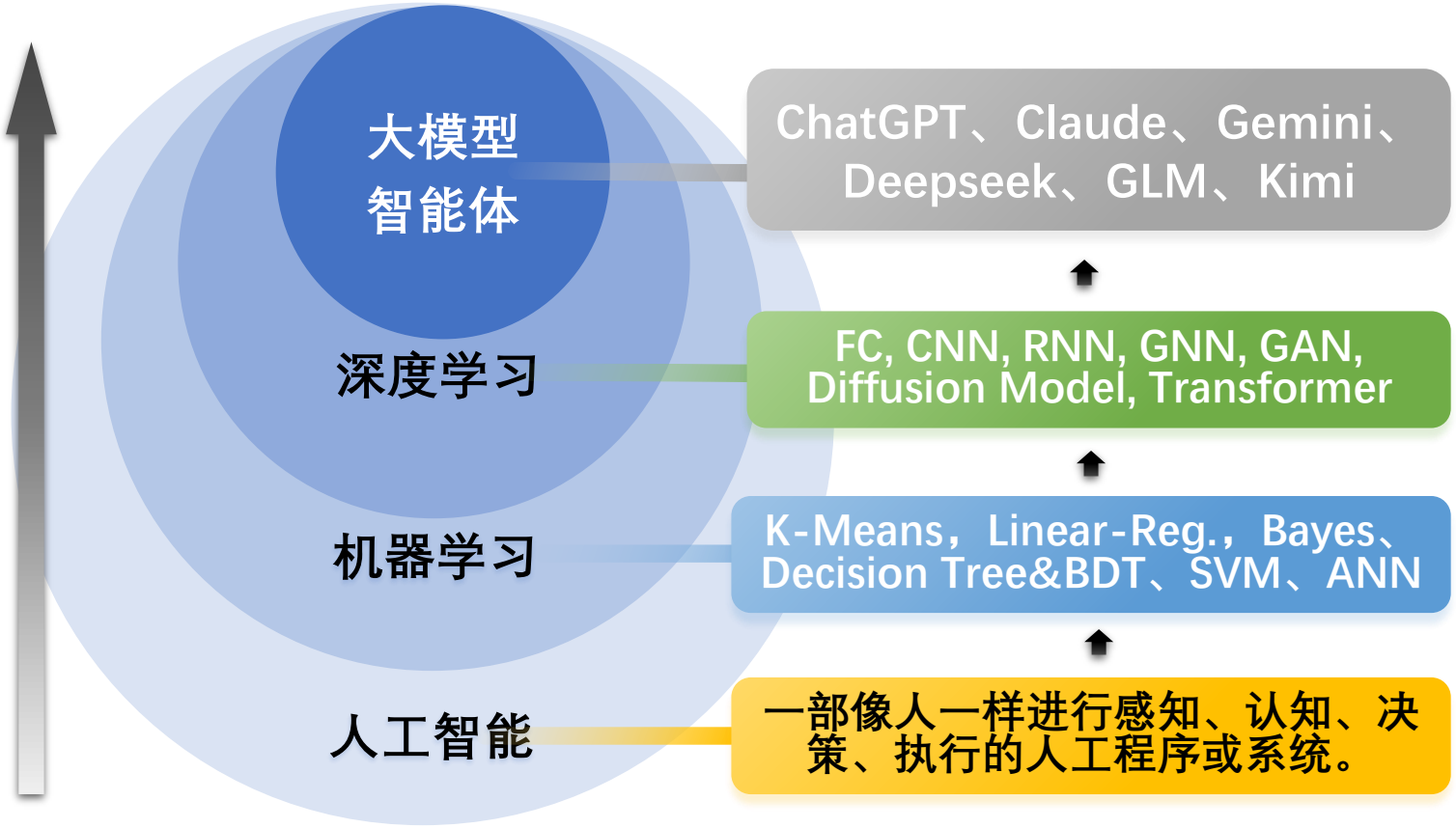
文章数据汇交

5家数据资源分中心

2024 年，运行国际网格一级站点（亚洲唯一），开启国际合作新局面。



人工智能



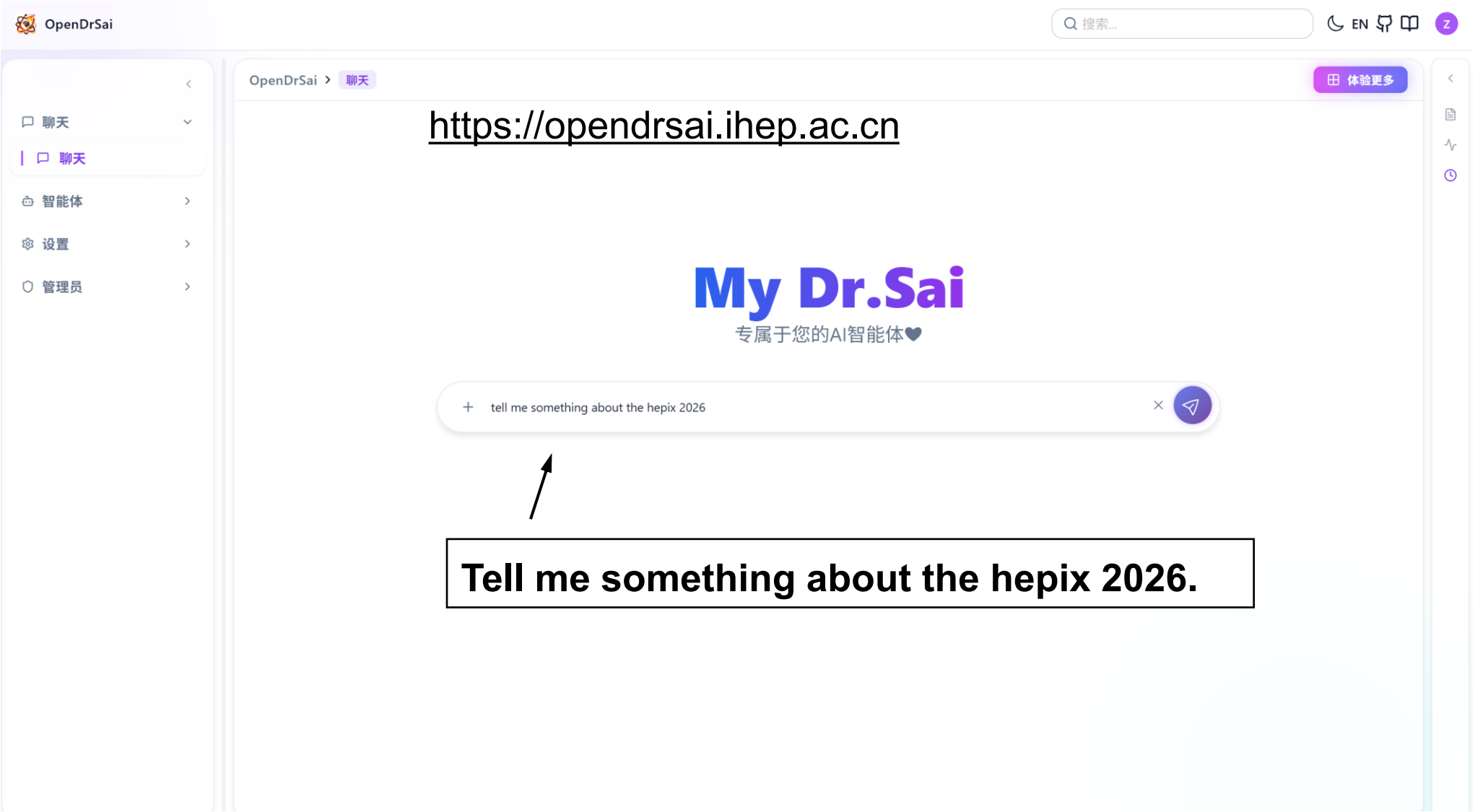
逐步发展，

包含关系

- **高能物理AI现状：**
  - **从以Bayes、BDT等机器学习算法应用居多。**
  - **近年来基于GNN、GAN等深度学习的算法逐渐增多。新算法研发以Cern为主（ParticleNet, ParticleTransorformer etc.）**
  - **近三年基于大模型的智能体应用处于前沿。**

注：算法不一定越新越好，需要考虑具体科学场景，但新算法可反映创新、引领能力。

Example of AI Agent (My Dr.Sai)



https://opendrsai.ihep.ac.cn

Tell me something about the hepix 2026.

聊天

聊天

智能体

设置

管理员

Here's the information about **HEPiX 2026**:

🔬 HEPiX Spring 2026 Workshop

📌 What is HEPiX?

HEPiX (High Energy Physics Unix/User Group) is an international forum that brings together IT professionals from high energy physics and nuclear physics laboratories worldwide. It was established in 1991.

📅 Latest Conference Details

Item	Details
Conference	HEPiX Spring 2026 Workshop
Date	**April 20-24, 2026**
Venue	ISCTE - Instituto Universitário de Lisboa
Location	Lisbon, Portugal
Hosts	LIP & CNCA
Website	https://indico.cern.ch/event/1598655/

⏰ Important Dates

Event	Date
Abstract Submission	Jan 22 - Apr 5, 2026
Early Bird Registration	Jan 22 - Mar 16, 2026
Late Registration	Mar 17 - Apr 10, 2026
Workshop	Apr 20-24, 2026

Type your message here...

文件空间 | 运行概览 | 历史会话

LogExecution

2026/4/23 11:45:24 INFO Assistant tools

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name='run_grep')]
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physics computing conference", "page_size": 5}',
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```

共 2 条日志条目

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OpenDrSai

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My Dr.Sai hepai/minimax-m2.7-highspeed

新建会话

体验更多

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Result from web search, memory retrieval (MCP, Skills), information synthesis, and generation (LLM)

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体验更多

Here's the information about HEPiX 2

HEPiX Spring 2026 W

What is HE

HEPiX (High Energy

from high energy p

Realized by OpenDrSAI Agent Harness we proposed

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Type your message here...

Powered by the minimax-m2.7 model, which is open-source and deployed locally.

文件空间

运行概览

历史会话

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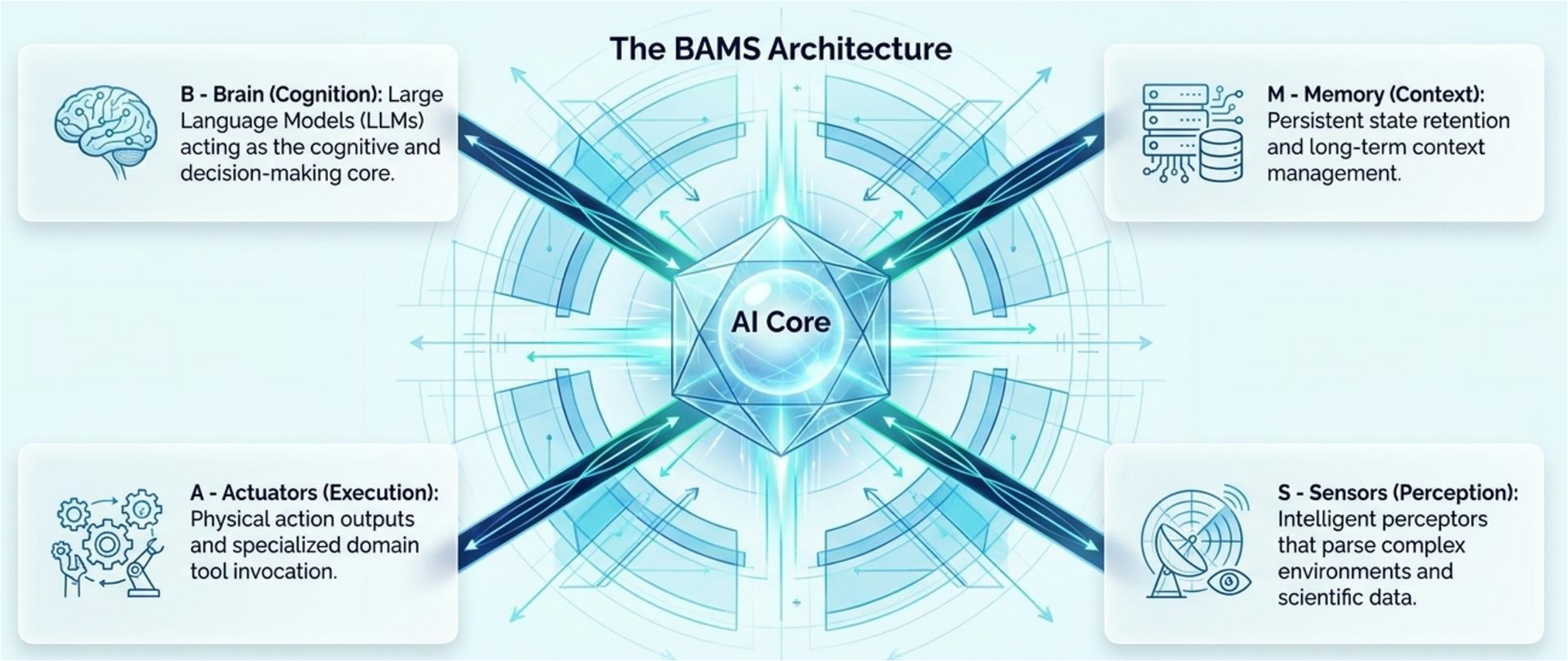
自动滚动到底部

Introducing OpenDRSAI Framework

A decentralized, open-source multi-agent framework designed specifically for large scientific facilities.



https://github.com/hepai-lab/drsai

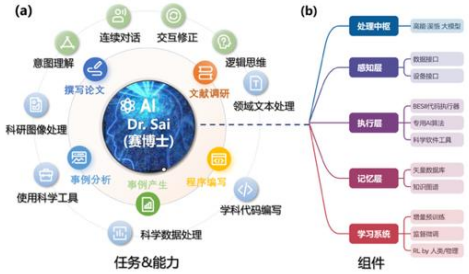
The Dr.Sai Agent Matrix

Dr.Sai Dora

DORA

AI agent for AI-Ready data.

Dr.Sai BESIII



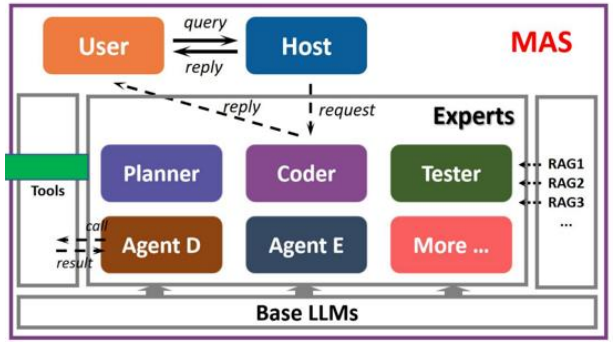
For particle physics analysis.

Dr.Sai Rongzai

RZERA

For neutron data processing.

OpenDrSai



AI agent framework for scientific research on large facilities.

Claude Code (external)

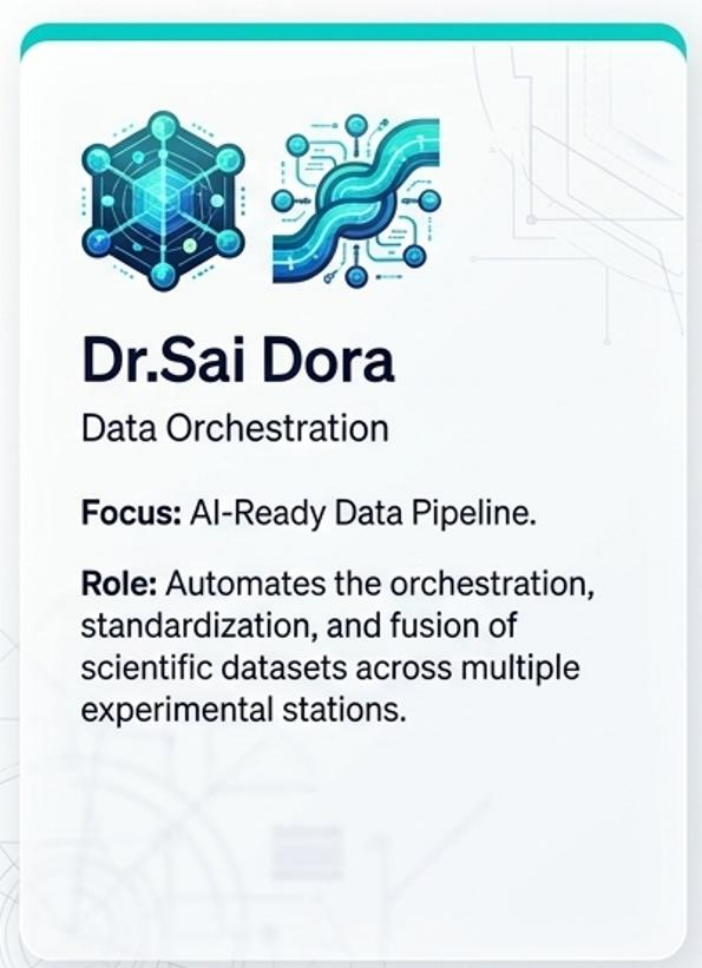
OpenClaw (external)

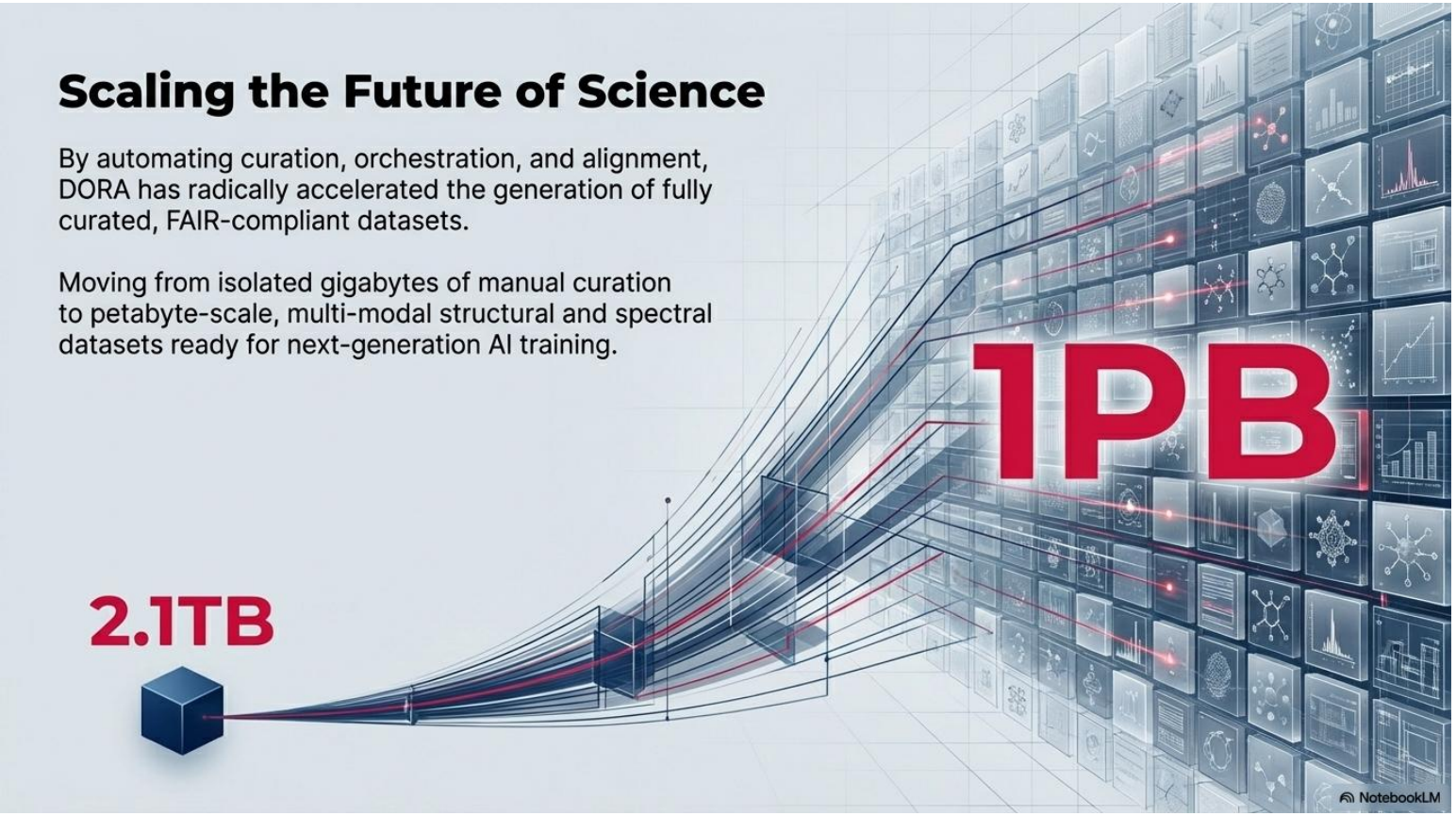
Hermes (external)

and more..

Dr.Sai Dora

- **DORA(Data ORchestration Agent) for AI-Ready data**

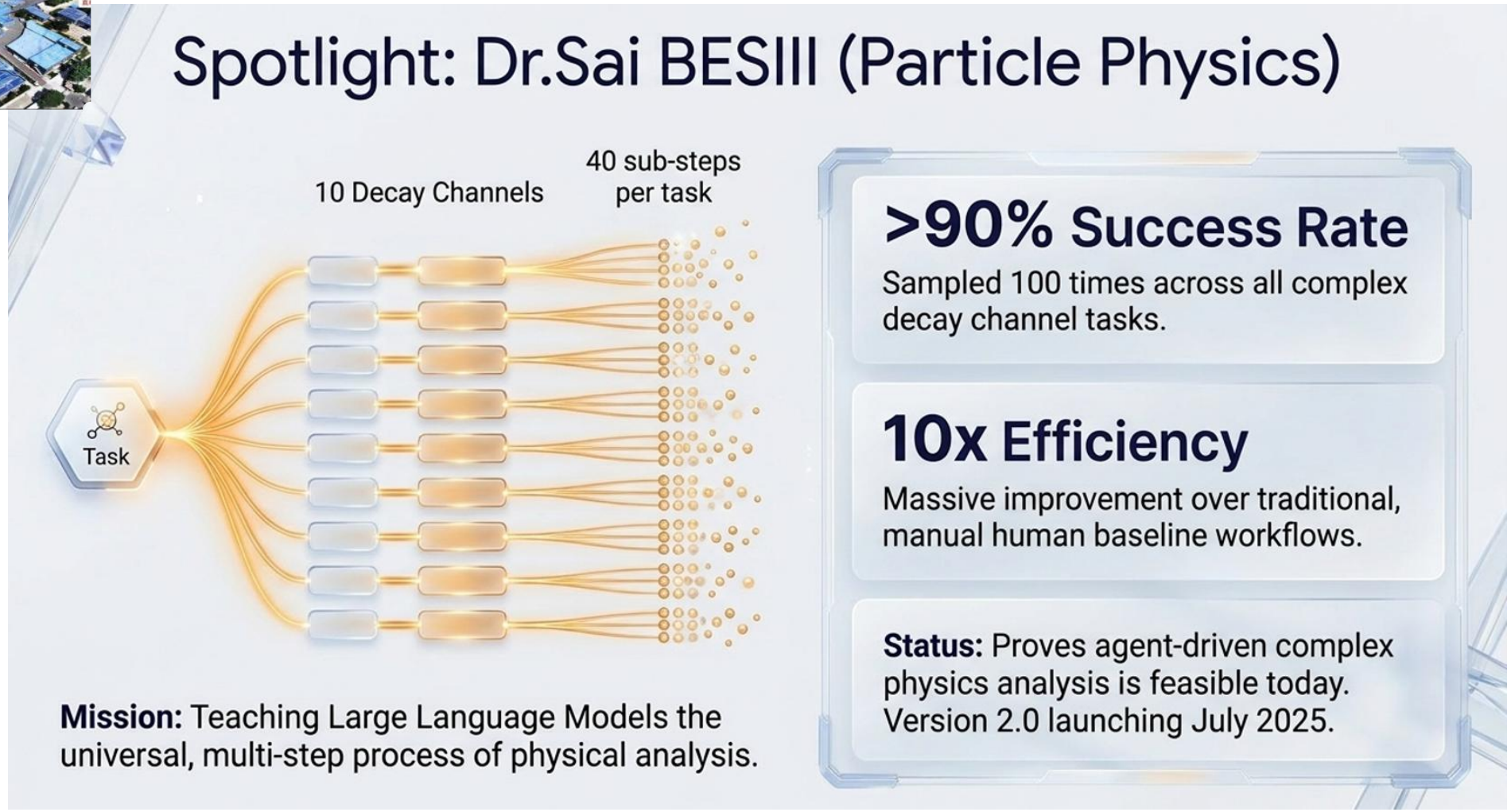




DORA Demo（Metadata Completion）： https://ihepbox.ihep.ac.cn/ihepbox/index.php/s/FlqkFP4m8IfturH

Dr.Sai BESIII v2

For BEPC (Beijing Electron Positron Collider) & BESIII Experiment

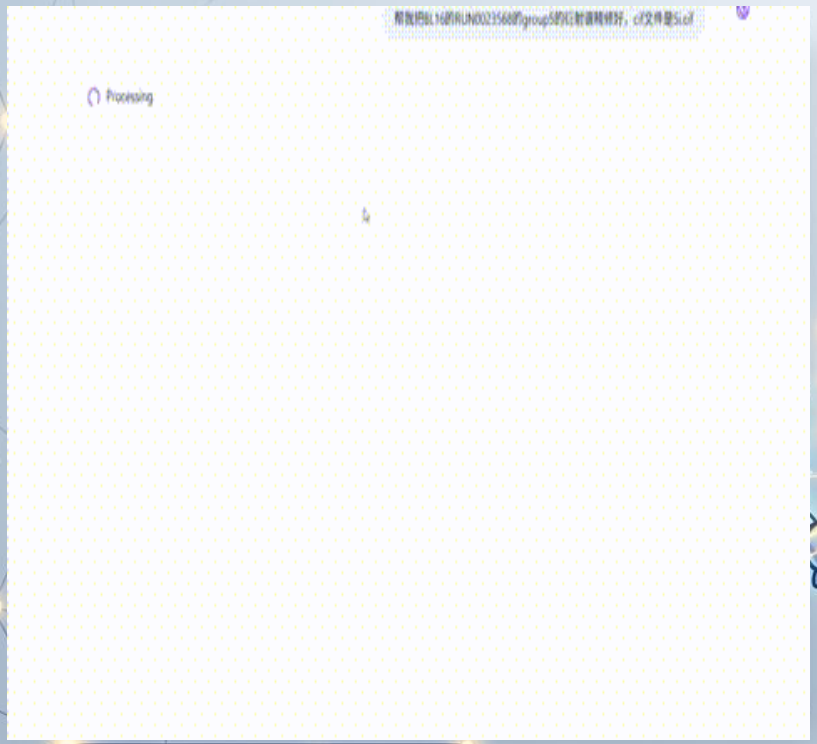


- You can alse found **Dr.Sai BESIII v1** on ICHEP2024 (PRAGUE): ://indico.cern.ch/event/1291157/contributions/5889603/
- **Dr.Sai BESIII v3.0** will be released in the summer 2026.

Dr.Sai Rongzai

For CSNS (China Spallation Neutron Source)

Spotlight: Dr.Sai Rongzai (Neutron Data)



The Mission:
Fully unsupervised processing of complex material samples (e.g., Silicon standards, Zeolites).

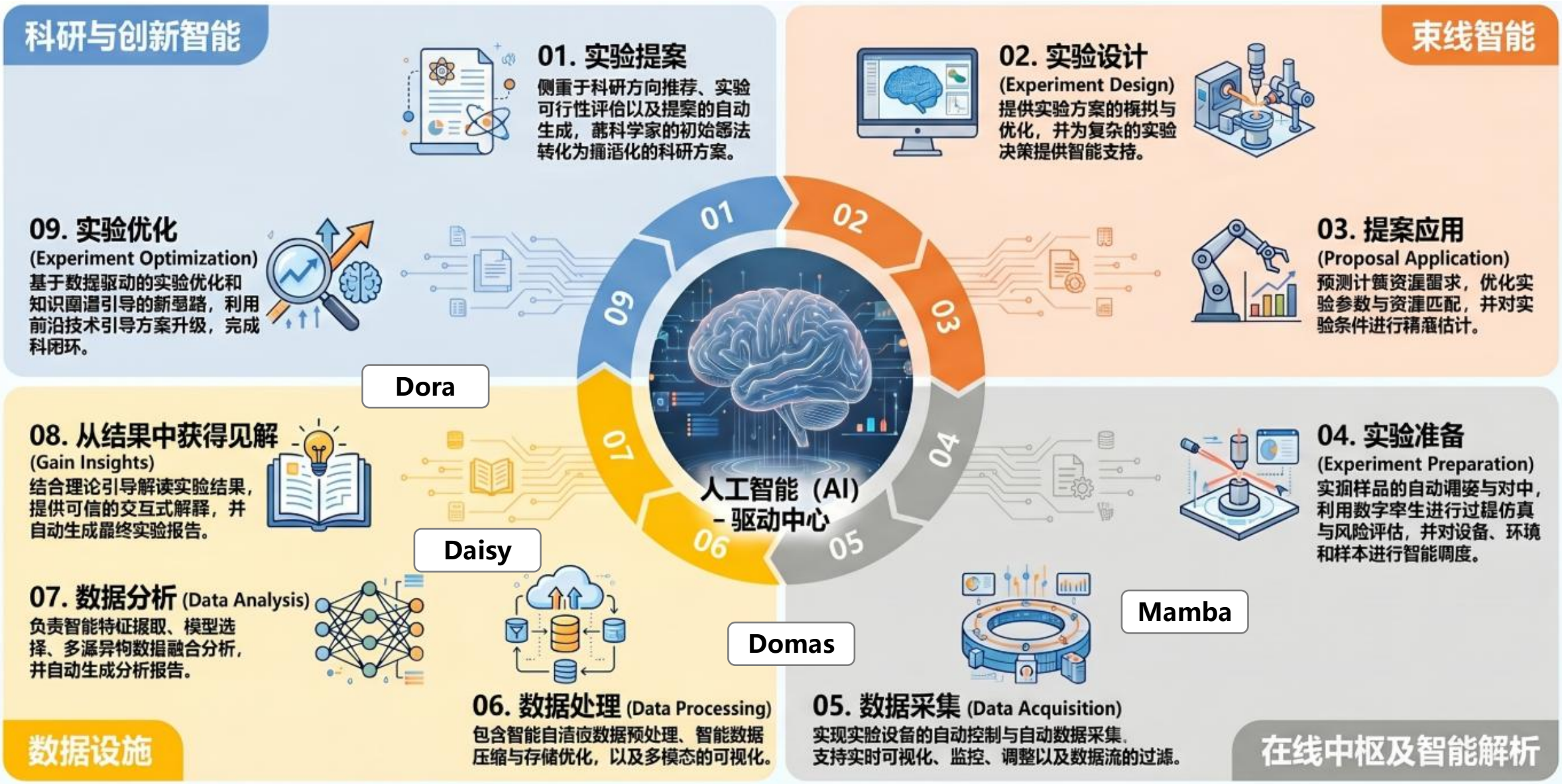
The Benchmark:
Consistently refines data to an R_{wp} (weighted profile R-factor) of < 5%, successfully matching human–expert levels entirely autonomously.

Deployment Status:
Launched January 2026. Actively deployed for LHAASO and Rongzai facility workflows.

NotebookLM

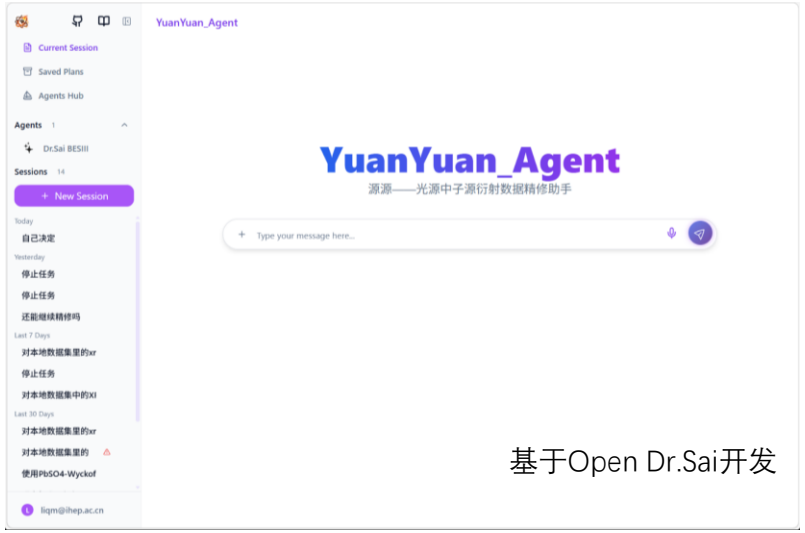
The first automatic refinement reached the level of human experts, with a speed six times faster!

AI赋能智慧光源&中子源



光源中子源联合分析AI智能体

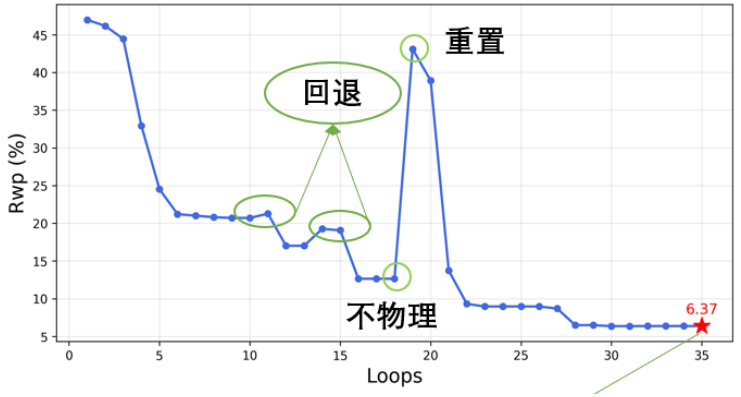
集成可调用的数据分析工具、分析用户自然语言任务、构建专家知识库并指导规划决策执行。

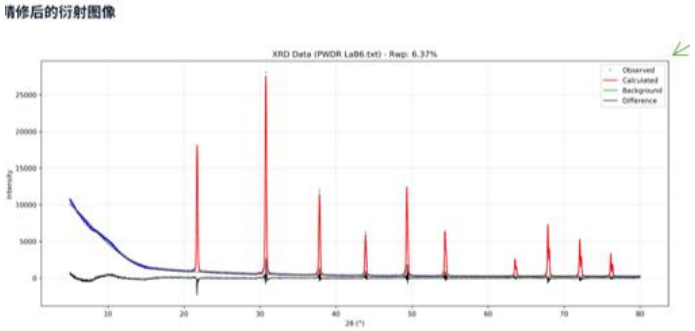


1. **数据感知器**开发:包括X射线衍射(XRD)、中子粉末衍射(NPD)、对分布函数(PDF)数据等。

2. **数据执行器**开发: 包括XRD/NPD数据模拟工具、基于GSAS-II的衍射数据联合精修工具、基于Diffpy的PDF数据精修工具等。

3. 基于数据集训练的**AI模型**作为执行器加入智能体。





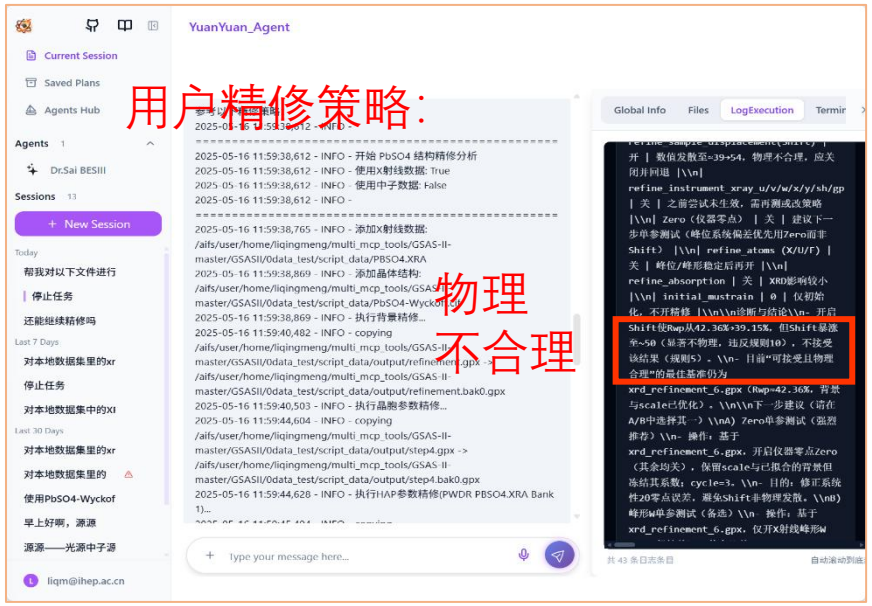
人类专家级精修结果:

```
Histogram: PWDR LaB6.txt histogram Id: 0
=========================================
PWDR histogram weight factor = 1.000
Final refinement wR = 7.78% on 3344 observa
Other residuals: R = 5.64%, R-bkg = 6.65%,
Instrument type: Bragg-Brentano
```

光源中子源联合分析AI智能体

■ 精修过程纠错能力

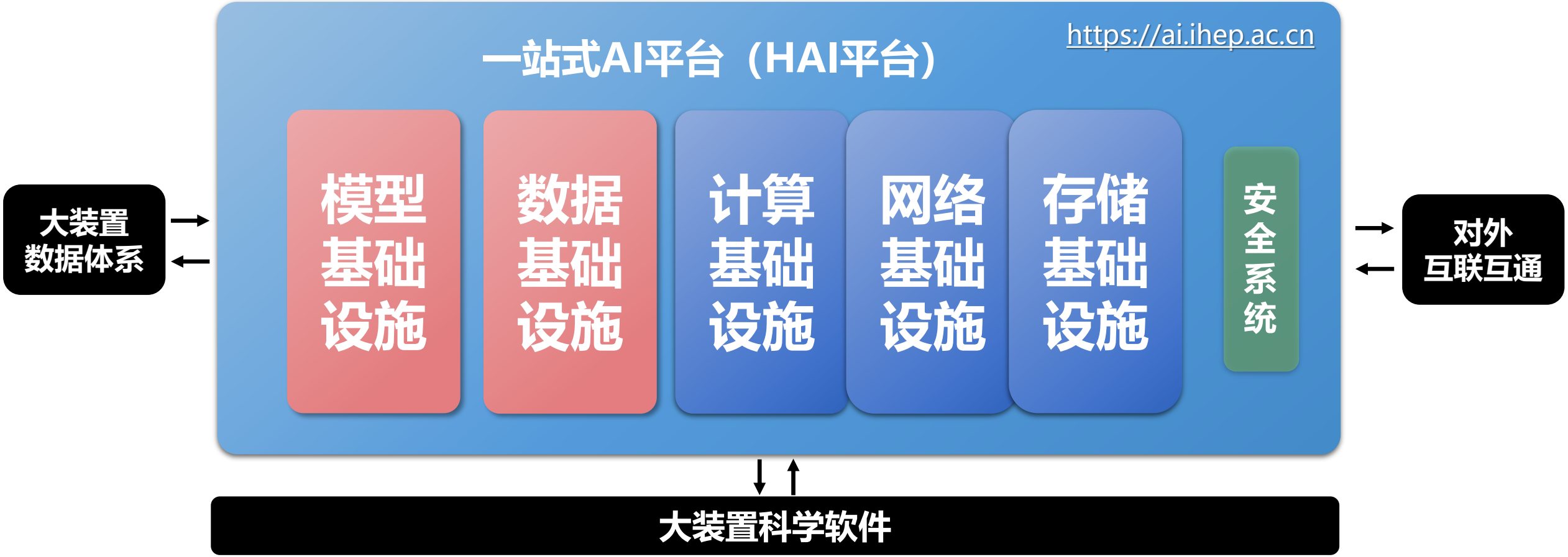
人为加入干扰因素（提供错误的仪器参数、CIF文件等），智能体能自动发现纠错。



How can we enable and support the above AI agents?

新型AI领域基础设施

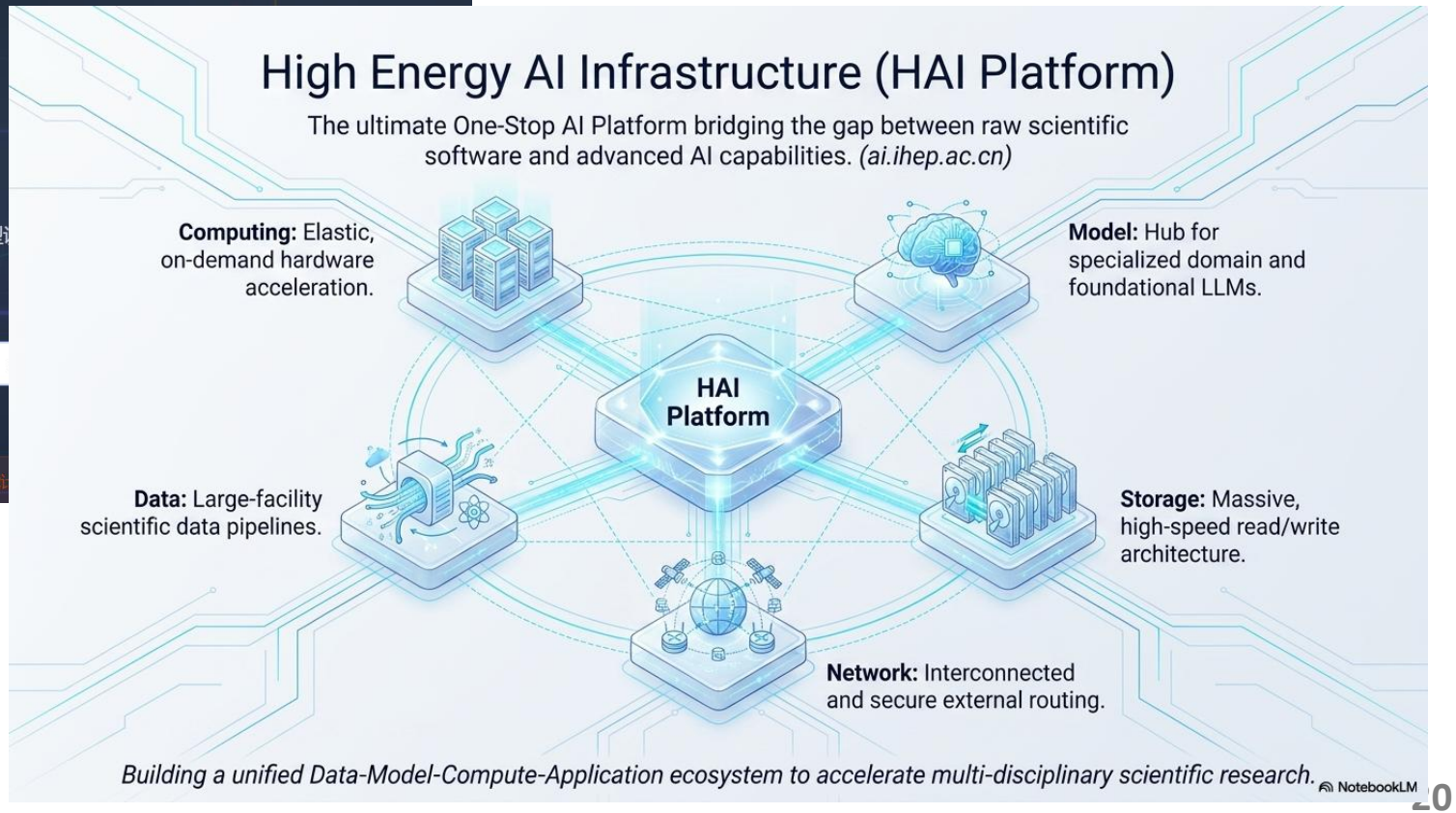
目标：满足人工智能+科学场景中**长时间运行、高交互性和强隔离性**特征的新型AI基础设施。



- **2025年2月模型基础设施正式上线服务。**
- **数据基础设施正在研发中。**

一站式AI平台

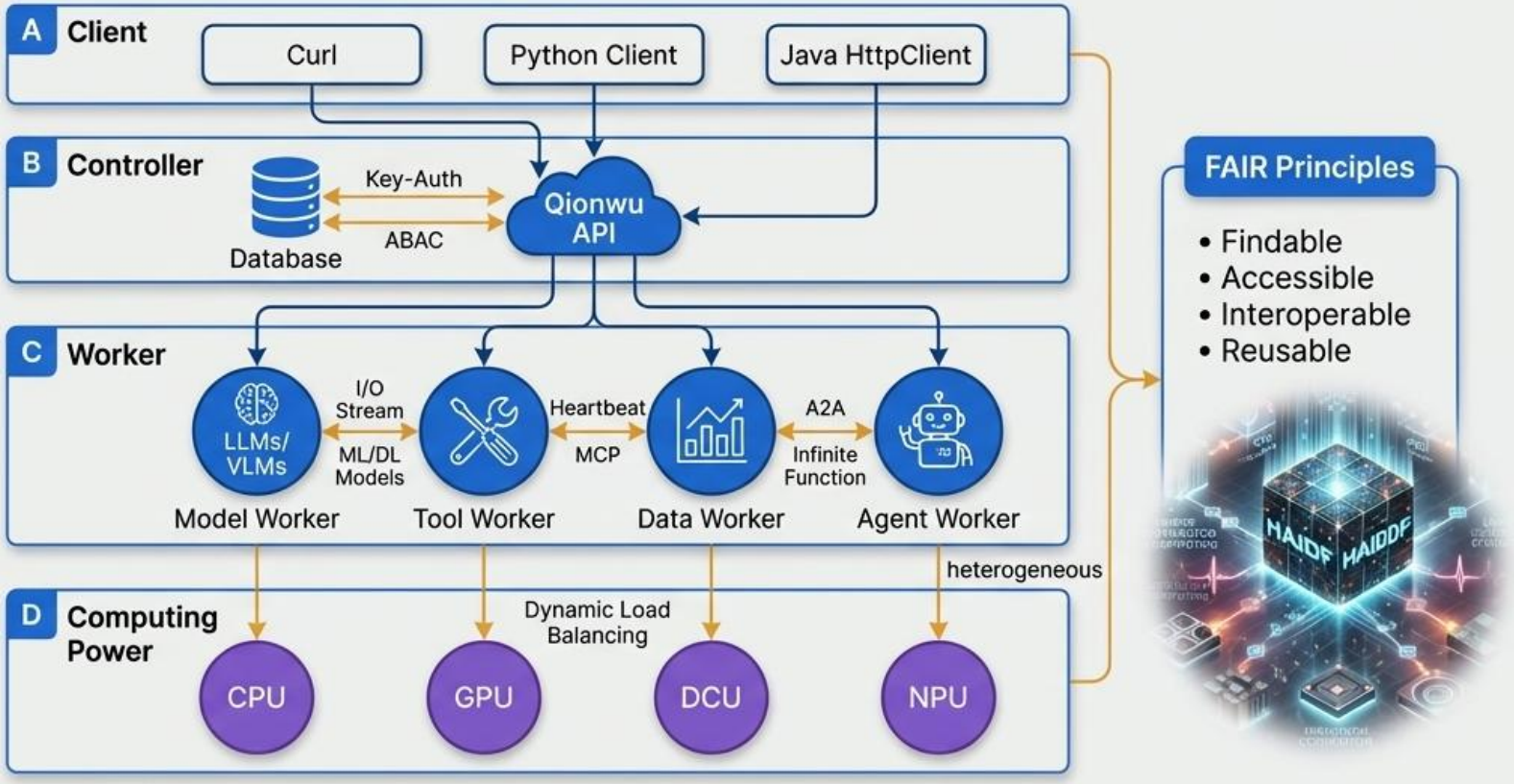
https://ai.ihep.ac.cn



Model Infrastructrue： Qionwu

Qionwu (HaiDDF): Breaking Information Islands

Transforms LLMs, scientiic tools, memory, and data into accessible resources, connecting dynamic Agent Workers to CPU/GPU/NPU clusters.



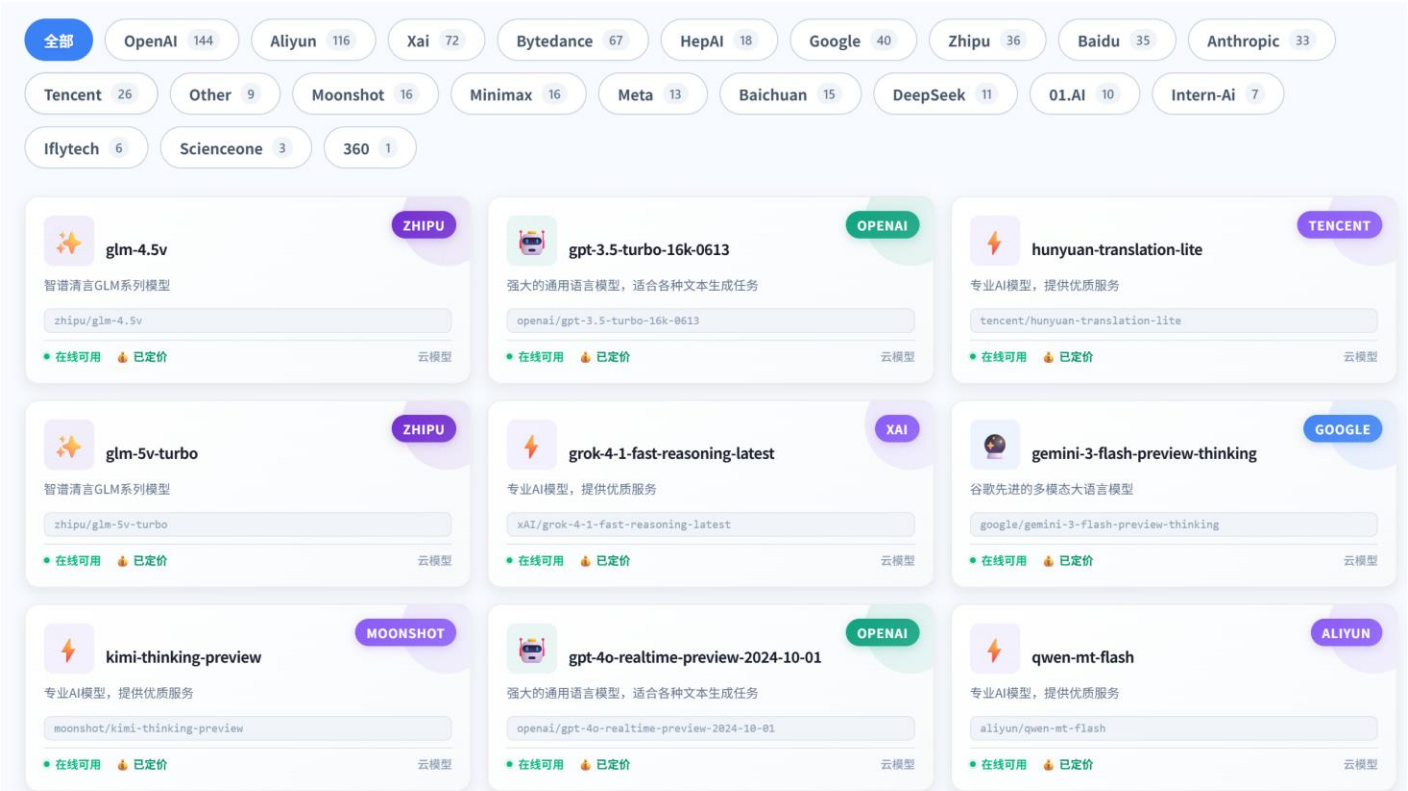
NotebookLM

Supported Models

- **Latest models (Local and External)**

- Local models (hepai serials)
  - hepai/deepseek-v4-flash/pro
  - hepai/minimax-m2.7
  - hepai/xiwu-70b
  - hepai/bge-m3:lastest
  - hepai/miner2_2B

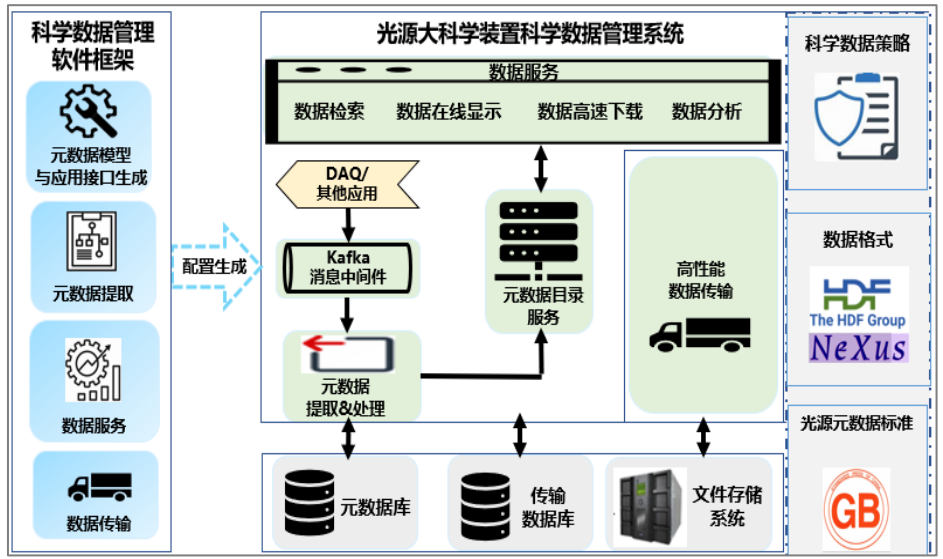
- Cloud models
  - OpenAI serials
  - Anthropic serials
  - Google serials
  - Deepseek serials
  - Minimax serials
  - Glm serials
  - Kimi serials
  - ScienceOne
  - Intern



- Base url: https://aiapi.ihep.ac.cn/apiv2
- API-KEY: get from https://ai.ihep.ac.cn
- API protocal: chat completion, responses, messages

Data Infrastructrue： Domas

A **large-scale facility data system** refers to the comprehensive framework and mechanisms for the collection, storage, processing, analysis, and utilization of data within large scientific facilities. It encompasses the entire lifecycle of data, from its generation to its final application, and ensures data quality, integrity, security, and availability.



Domas Architecture

Fusion Data for AI Scientist

Computing Infrasturcture

Providing AI elastic computing services on-demand to eliminate resource bottlenecks

Hardware Power:

22.6 PFlops Half-precision
Total AI Computing Power

104
Dedicated Acceleration Cards

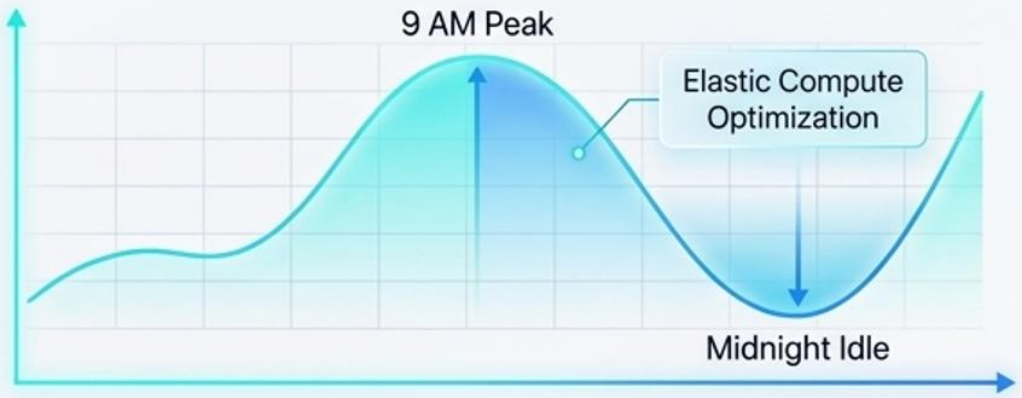
200 TB
High-Speed SSD Storage

Deployment Flexibility:

GPU:	Single-machine, single-card training and deployment.
DCU:	Large-scale model training.
NPU:	Efficient model deployment.

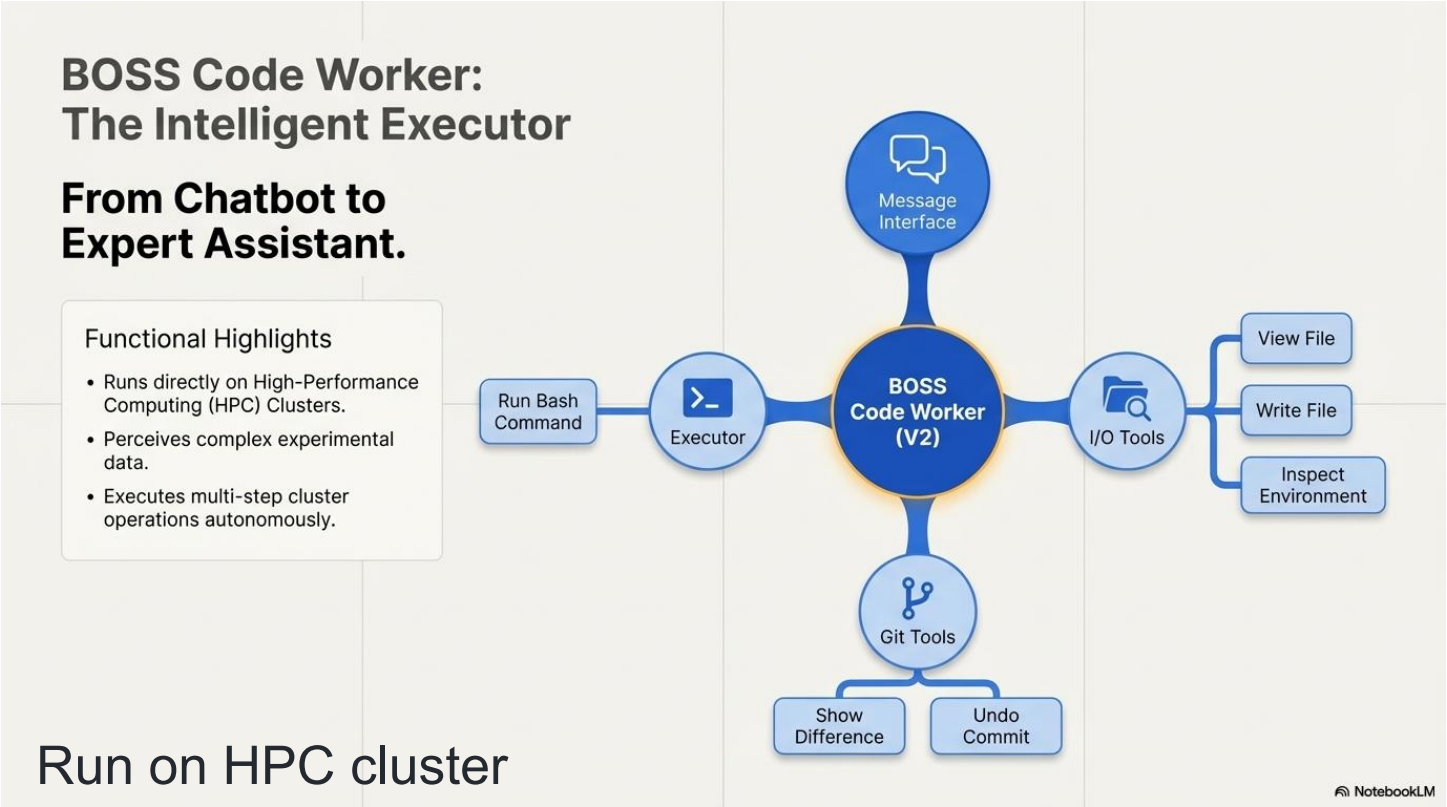
Supports diverse workflows: EShell, Jupyter, Online VSCode, and VNC.

Compute Utilization Over Time



Agent Senors and Actuators

How the Dr.Sai connect to experiment data and execute jobs tasks on HEP cluster



Qionwu Gateway

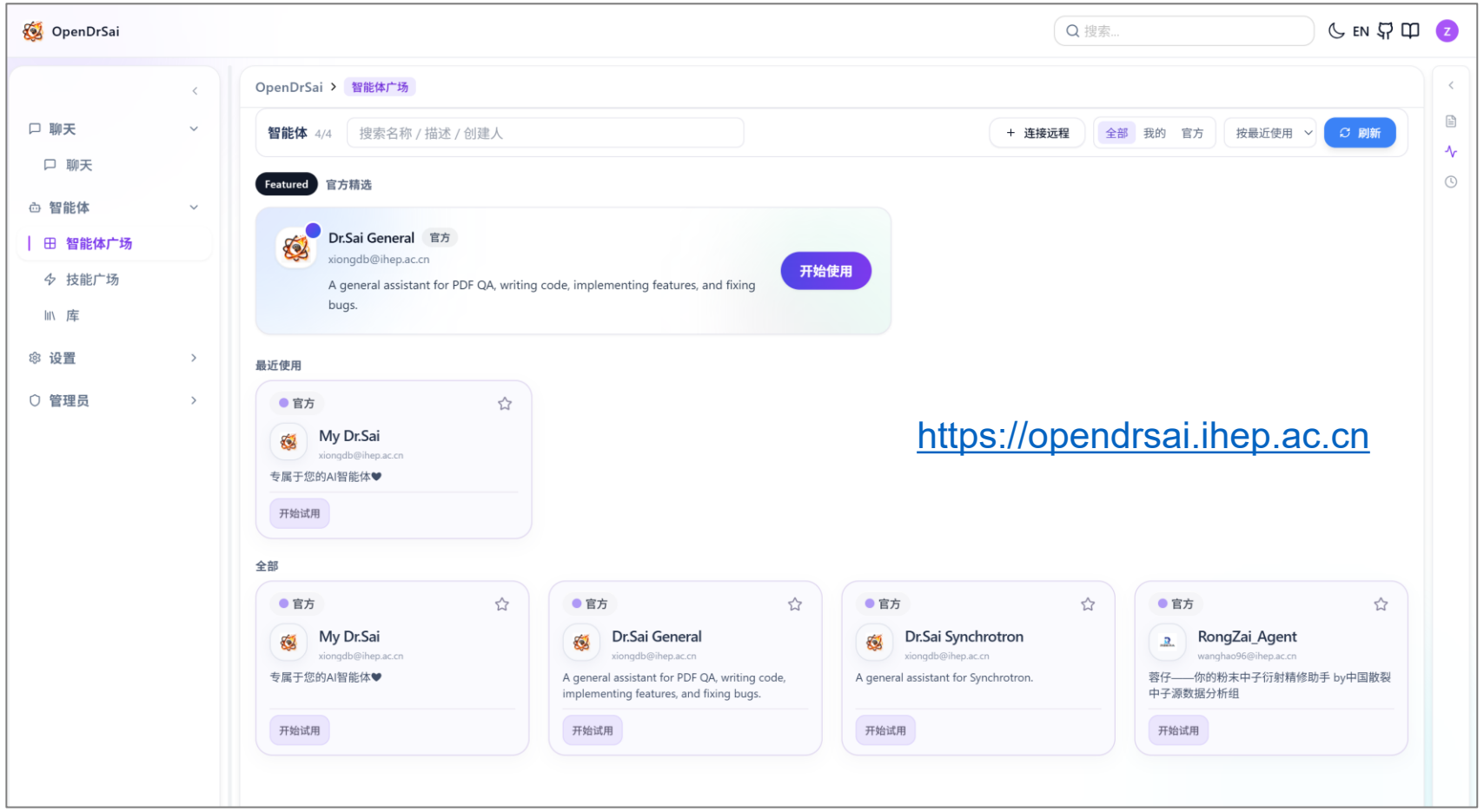
Dr.Sai

Support protocals: **IF(Infinite function, ours),** MCP, A2A

OpenDrSAI

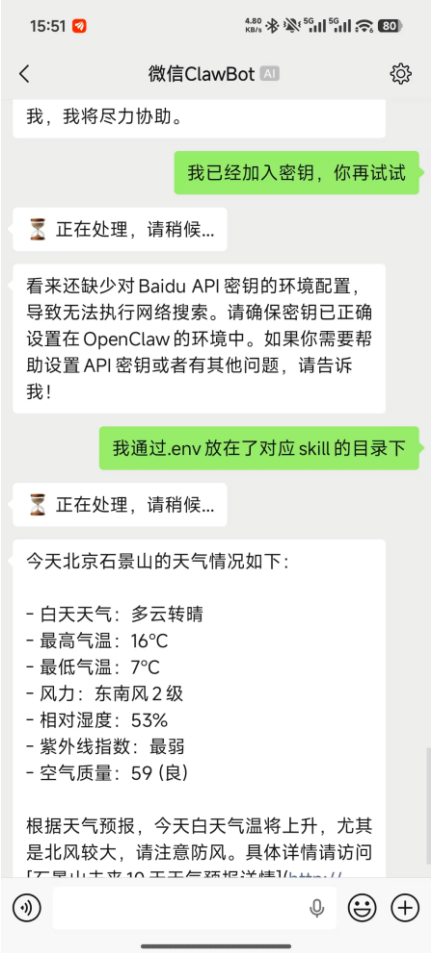
- 所内专属独立IP
- 基于容器的环境隔离
- 数据持久化
- 本地模型和云端模型无缝切换

http://10.5.8.xx:18789/



https://opendrsai.ihep.ac.cn

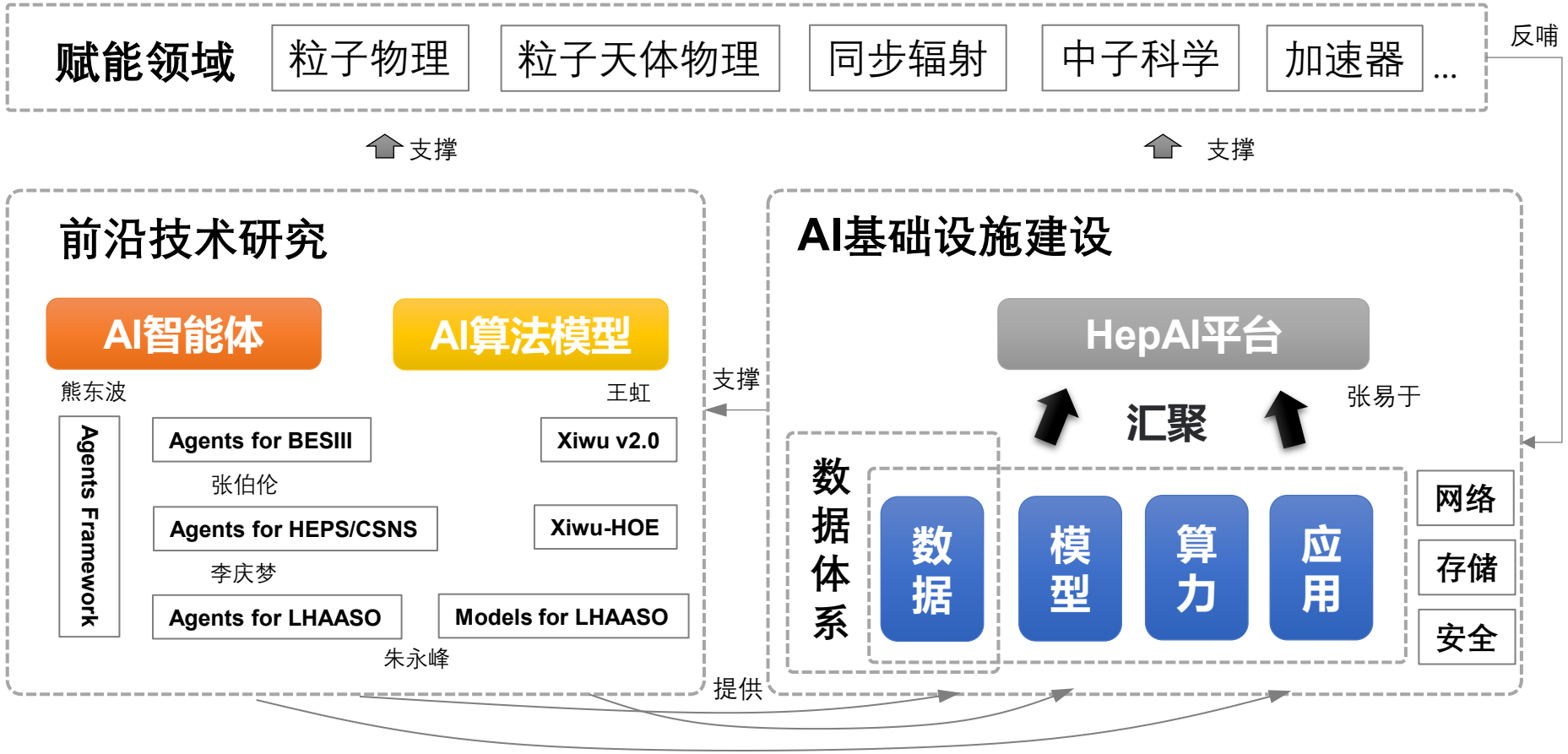
Dr.Sai Agent Platform



接入微信等app

总结

AI+大科学装置

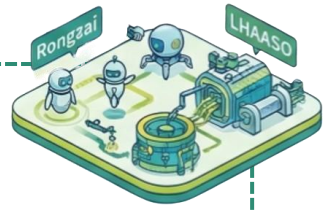

赋能领域
粒子物理
粒子天体物理
同步辐射
中子科学
加速器
...
反哺
支撑
支撑
前沿技术研究
AI智能体
AI算法模型
熊东波
王虹
Agents Framework
Agents for BESIII
Xiwu v2.0
张伯伦
Agents for HEPS/CSNS
Xiwu-HOE
李庆梦
Agents for LHAASO
Models for LHAASO
朱永峰
支撑
提供
AI基础设施建设
HepAI平台
张易于
汇聚
数据体系
数据
模型
算力
应用
网络
存储
安全

未来规划蓝图

推动3-5项重大基础物理或学科突破

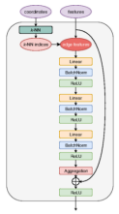
技术支撑

智能体与工具链



- **物理分析智能体**从“原型系统”走向“**率先实用**”
- **数据智能体**反哺数据体系
- 推动一批大装置智能体的落地应用（Rongzai、LHAASO等）
- 继续发展领域工具和Skills

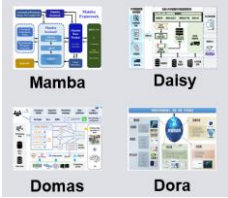
模型系统



- 继续推进针对特定任务的**专用AI模型**
- 研究**大小模型协同**新方法
- 探索理解科学数据、掌握物理规律的**科学(大)模型**

大装置数据体系

- 完善“3D”数据软件



- 推动数据专用光源线站建设
- 建成**PB级**AI就绪科学数据库/集

AI基础设施

- 优化**模型基础设施**
- 上线**数据基础设施**服务
- 与国家各规划基础设施实现联动和互联互通

运行支撑

提供模型

提供数据

运行支撑

运行支撑

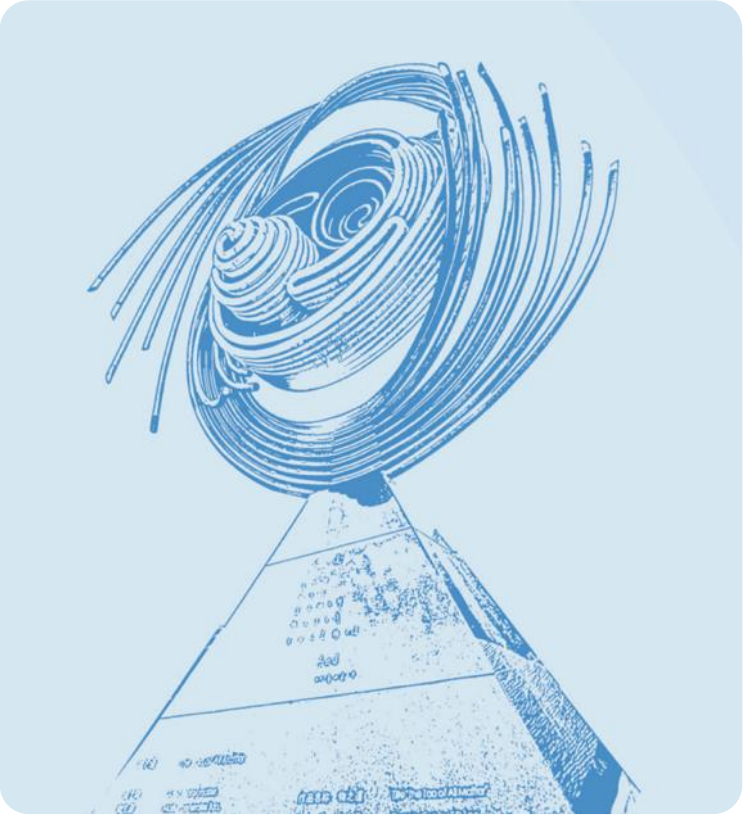
相关链接

- 高能人工智能（HAI）平台: https://ai.ihep.ac.cn
- Open Dr.Sai科研智能体框架： https://github.com/hepai-lab/drsai
- 开源工具包: https://github.com/hepai-lab/hepai
- 赛博士智能体: https://drsai.ihep.ac.cn
- 蓉仔智能体： https://rongzai.ihep.ac.cn
- HEP·Xiwu LLM: https://github.com/zhangzhengde0225/Xiwu

- **欢迎探讨AI for Science相关议题！**

  - 张正德，王虹，张易于，朱永峰，张伯伦，李庆梦，熊东波
  - 中国科学院高能物理研究所计算中心 数据与人工智能组
  - 国家高能物理科学数据中心
  - 邮箱：zdzhang@ihep.ac.cn

Backup



高能所团队在AI4S的关键技术研究取得重要进展

2024.07 Dr. Sai v1.0面向BESIII国际合作组发布；2025.07 Dr. Sai v2.0上线。https://drsai.ihep.ac.cn

Howie Lan (UC, Berkeley):
You are ahead.
Tanaka Junichi（Unv. of Tokyo）：
Very impressive

2024.07 第42届国际高能物理大会（ICHEP）　2025.03 国际网格会议（ISGC）　2025.04 中关村论坛