BEYOND XMMASIST

Agentic AI for Science Operations Centres

From proposal preparation to catalogue exploration

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CORE IDEA **Let Agentic AI (LLMs + RAG + Agents + MCP) orchestrate existing scientific services through natural language, while keeping trusted scientific tools at the core of the workflow.**

01 THE CHALLENGE

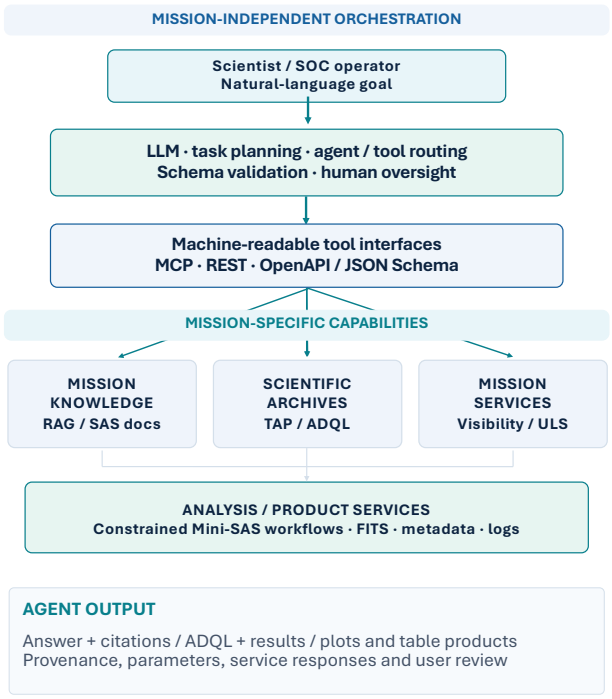
Modern observatories provide a rich ecosystem of scientific tools, archives interfaces and technical documentation. However, effectively using these resources requires considerable mission-specific expertise, particularly during proposal preparation.
Agentic AI offers a new approach: rather than replacing established tools, assistants such as **XMMASIST** can orchestrate existing services and make their capabilities accessible through natural-language interactions.

02 XMM-NEWTON AGENTS & TOOLS

For XMM-Newton, we have developed **XMMASIST**, an agentic AI assistant that combines Large Language Models (LLMs), Retrieval-Augmented Generation (RAG) over mission documentation, and specialised AI agents that interact with existing scientific and operational services through the Model Context Protocol (MCP).

- Mission documentation: RAG over SAS data processing manuals and technical documentation, Pipeline products manuals and technical resources
- Observation planning: target visibility (**ObjObsSAP**)
- Target name to coordinate conversion (SIMBAD)
- Archive exploration: **XSA TAP / natural language → ADQL**
- Science services: Upper Limit Server, long-term light curves, count-rate conversion and pile-up estimates

03 ARCHITECTURE: FROM CHAT TO VERIFIED TOOLS



AGENT OUTPUT

Answer + citations / ADQL + results / plots and table products
Provenance, parameters, service responses and user review

04 SCIENTIFIC DISCOVERY WORKFLOW

EXAMPLE USER GOAL

"Find candidate transient X-ray sources, inspect detections and upper limits, then assess whether a new observation is feasible."

AGENTIC WORKFLOW

1. Discover catalogue schema and construct ADQL.
2. Query XSA TAP and identify candidate observations.
3. Retrieve detections, upper limits and light curves.
4. Check target visibility and proposal constraints.
5. Return evidence, products and provenance.

EXAMPLE USER GOAL

"I would like to observe a particular X-ray source with XMM-Newton. Has it been observed before, is it currently visible, and what count rate should I expect?"

AGENTIC WORKFLOW

1. Resolve the target name and coordinates using SIMBAD.
2. Query the XSA via TAP/ADQL to identify observations.
3. Retrieve available flux measurements and long-term light curves using HILIGT.
4. Estimate EPIC count rates and potential pile-up using dedicated scientific services.
5. Check target visibility and return the results to support observation planning.

05 REUSE ACROSS different missions in a Science Operation Centre

XMMASIST provides a first step towards a reusable Agentic AI architecture for Science Operations Centres. By decoupling LLM reasoning and agent orchestration from mission-specific knowledge and services, the same AI infrastructure could support multiple missions, including XMM-Newton, Solar Orbiter, PLATO, INTEGRAL and LISA.

Each mission would expose its technical documentation, scientific archives and operational capabilities through standardised, agent-ready interfaces. This approach could reduce duplicated development efforts, facilitate cross-mission workflows and enable scientific tools to be shared across different observatories.

Towards a common, interoperable Agentic AI infrastructure for Science Operations Centres.

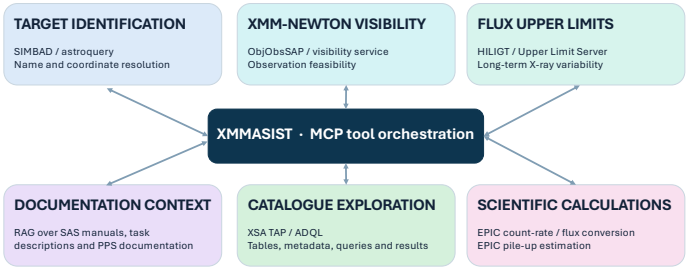
06 ENGINEERING PRINCIPLES

Integrating Agentic AI into Science Operations Centres requires a robust framework that ensures secure, controlled and traceable interactions with scientific and operational services, while preserving scientific reliability and human oversight.

- Explicit tool contracts and validated interfaces
- Constrained parameters and controlled execution
- Trusted scientific services as authoritative sources
- Authentication and role-based access control
- Audit logging and scientific provenance
- Reproducibility and traceability
- Human oversight of consequential actions

07 XMMASIST: CURRENT AGENTIC CAPABILITIES

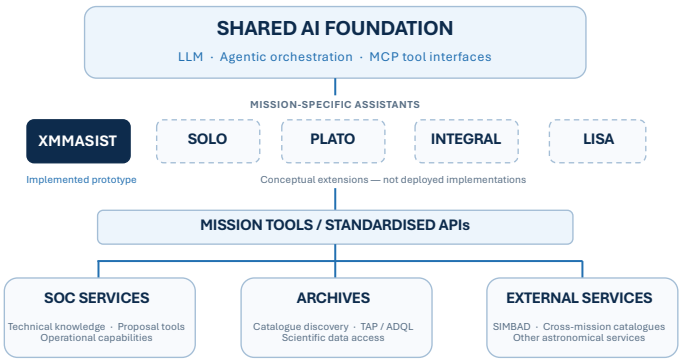
MCP-exposed tools connect the assistant to established astronomical services and local scientific calculations.



Available capabilities shown above. Product-generation workflows are future work, not currently available.

08 REUSABLE SOC ARCHITECTURE

A common AI orchestration layer, connected to mission-specific knowledge and trusted services



Reusable design: new missions plug in their own documentation, standards-based archives and validated services.
XMMASIST demonstrates the approach for XMM-Newton; reuse across missions is an architectural objective.

09 STATUS & NEXT STEPS

PROTOTYPE / CURRENT USE CASES

XMMASIST integrates RAG over mission documentation with agents for catalogue exploration (TAP/ADQL), target visibility, upper limits, long-term light curves, EPIC pile-up estimation and count-rate-to-flux conversion.

LLM DEPLOYMENT

XMMASIST combines Mistral models for reasoning-intensive tasks with a locally hosted Qwen model at ESAC for other agents. This hybrid approach demonstrates that useful agentic scientific services can be delivered with modest local computing infrastructure.

NEXT STEPS — AGENT-READY SCIENTIFIC SERVICES

Develop standardised API interfaces for generating scientific products, including spectra, images and light curves, through dedicated agent-ready Mini-SAS microservices. Each service will expose well-defined inputs and outputs, enabling reliable and reproducible scientific workflows. Building on existing IVOA standards and exploring new ones where needed, we aim to define common cross-mission service interfaces that facilitate interoperability, reuse and seamless integration with Agentic AI frameworks.

Multi-mission reuse is an architectural objective, not a claim of production deployment.

TAKE-HOME MESSAGE

One interface for proposal feasibility, catalogue discovery and trusted scientific products with the LLM as mediator and existing mission services as the source of truth.

ADASS 2026 · Featured Poster · Agentic AI as a tool for data discovery and data management

XMMGPT → XMMASIST