HAK-GAL Project Status Report

From Neuro-Symbolic Suite to an Epistemic Operating System

Status as of 11 Juli 2025

Executive Summary

The HAK-GAL project began as an ambitious attempt to build a transparent, verifiable AI system. Originally conceived as a neuro-symbolic suite for translating natural language into formal logic, it has evolved into a revolutionary concept: **ArchonOS**—the first operating system for epistemic and causal resources.

1 Vision and Project Goals

1.1 Original Vision

- Translate natural language into verifiable logic (NLP2Logic)
- Orchestrate multiple reasoning engines (portfolio management)
- Deliver transparent, traceable answers
- Inject scientific rigour into AI systems

1.2 Extended Goals with ArchonOS

- **Epistemic resource management**: treat facts, beliefs and proofs as first-class system objects
- **Responsibility assignment**: cryptographically bind AI actions to human consent
- **Kernel-level governance**: non-bypassable security policies in the OS core
- **Dynamic belief revision**: AGM-compliant knowledge evolution

2 Technical Milestones

Component	Status	Key Functionality
NLP2Logic Engine		Translates natural language into first-order logic
Multi-Prover Portfolio		Integration of Z3, Prolog, Wolfram Alpha
Relevance Filter System		Structural, Semantic, Learned and Distributed filters
Governance Framework		Three-branch design (legislative, judicial, executive)
Belief Revision Engine		AGM-compliant epistemic updates

3 Scientific Advances

3.1 Self-Learning Pattern Extraction

The system autonomously derives new logical patterns from successful translations—an emergent capability not explicitly programmed.

3.2 Hybrid Relevance Orchestration

The orchestrator unifies four relevance-filter strategies and chooses adaptively based on query analysis and history.

3.3 Physical Responsibility Coupling

The Responsibility Assignment Subsystem (RAS) cryptographically couples AI decisions to human consent tokens.

4 ArchonOS—The New Architecture

ArchonOS no longer manages CPU or RAM first; it manages epistemic resources (knowledge, beliefs, proofs). The HAK-GAL suite becomes a privileged user-space application.

Core Sub-systems

Subsystem	Function	Problem Addressed
VeritasKernel	Immutable OS core	Single trust anchor
Epistemic State Manager	Knowledge "file system"	Eliminates inconsistent KB states
Causal Scheduler	AI-agent orchestration	Removes prover bottlenecks
Governance Microkernel	Constitution enforcement	Blocks security bypasses
Responsibility Assignment	Human-consent interface	Prevents unaccountable AI

5 Code Example: System Call in ArchonOS

```
# HAK-GAL shell issues a system call
result = kernel.syscall_handler(
    "VERIFY",
    query="CapitalOf(Germany, x)"
)
# 1. Causal Scheduler analyses the query
# 2. Governance microkernel runs safety checks
# 3. Wolfram agent is executed
# 4. Epistemic State Manager updates the KB
# 5. Result "Berlin" is returned
```

6 Roadmap and Next Steps

Phase 1 (Q1 2025) ArchonOS kernel: full subsystem implementation, initial security audits.

Phase 2 (Q2 2025) Real-world testing, human-consent tokens, performance profiling.

Phase 3 (Q3 2025) Scientific publication, open-source release, community building.

This document reflects the project status as of 11 Juli 2025. All numeric performance metrics have been intentionally removed pending empirical validation.