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WLP: Wet-Lab Protocol -- AI-to-Automation Instruction Schema v0
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Abstract

This document specifies WLP v0, the Wet-Lab Protocol for translating AI hypotheses (PACR records) into machine-executable wet-lab instructions. WLP is the longevity-research analogue of SCP (Science Context Protocol) from the photoresist automation domain. The protocol is royalty-free (Apache-2.0). Reference implementations in Rust (crates/wlp-conformance) and Python (agentcard_adapters.wlp_conformance) are provided.

Status of This Memo

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1. Introduction

WLP closes the loop between AI hypothesis generation and physical experimental execution without human translation. Each WLP-instruction carries a PACR provenance link and a lambda (energy) budget, enabling full cost accounting and falsifiability tracing.

Key design principles: (1) AI-to-Machine direct translation -- WLP-instructions are machine-executable; (2) PACR traceable -- every instruction has a pacr_record_id provenance link; (3) lambda budget constrained -- platforms MUST reject over-budget instructions; (4) Conformance verifiable -- any platform can run the Conformance Suite.

2. WLP-instruction Schema v0.1

```
{
  "wlp_version": "0.1",
  "instruction_id": "WLP-{gene}-{yyyymmdd}-{seq}",
  "target": {
    "gene": "FOXO3",
    "itt_l_id": "ITT-L-001",
    "h_itt_v2": 0.72
  },
  "intervention": {
    "type": "crispr_knockdown | compound | overexpression | sirna | small_molecule",
    "reagent": "sgRNA-FOXO3-001",
    "dose": {"value": 10, "unit": "nM | uM | mg/kg"},
    "window": {"start_day": 0, "end_day": 14}
  },
  "readout": {
    "primary": "S_T_delta",
    "secondary": ["lifespan_extension_pct", "healthspan_marker"],
    "model": "C_elegans | mouse | organoid | cell_line",
    "timepoint_days": [7, 14, 30]
  },
  "expected": {
    "S_T_delta": 0.05,
    "confidence": 0.65,
    "basis": "superlearner_dqn_v2"
  },
  "constraints": {
    "lambda_budget_j": 500,
    "max_duration_days": 30,
    "min_replicates": 3
  },
  "provenance": {
    "generated_by": "II:superlearner-meta-v1",
    "pacr_record_id": "pacr-discovery-v3:line-XXXXXX",
    "wlp_conformance": "v0.1"
  }
}
```

3. WLP-outcome Schema

```
{
  "instruction_id": "WLP-FOXO3-20260519-001",
  "executed_by": "wet-lab-node-001",
  "execution_date": "2026-05-26",
  "result": {
    "S_T_delta_observed": 0.048,
    "S_T_delta_expected": 0.050,
    "prediction_accuracy": 0.96,
    "replicates": 3,
    "p_value": 0.023
  },
  "lambda_actual_j": 420,
  "falsification_triggered": false,
  "notes": ""
}
```


4. AgentCard Extension

Wet-lab nodes MUST declare capability via AgentCard extension fields:


```
{
  "execution_capability": ["crispr-screen", "organoid-assay",
                           "model-organism", "compound-screen"],
  "wlp_version": "0.1",
  "throughput": {
    "assays_per_week": 10,
    "lambda_capacity_j_per_week": 5000
  }
}
```


5. Conformance Requirements

An implementation is conformant if it passes all 5 tests. Reference test vectors are in crates/wlp-conformance/src/lib.rs.

Test	Acceptance Criterion
schema_valid	WLP-instruction has all 8 required top-level fields
pacr_traceable	provenance.pacr_record_id is non-empty
lambda_bounded	lambda_actual_j <= lambda_budget_j
outcome_parseable	WLP-outcome has all 5 required fields
s_t_delta_range	S_T_delta_observed in [-1.0, 1.0]

Table 1

6. Execution Flow

```
Superlearner DQN
  -> generate WLP-instruction
  -> write to ~/.eon/bus/wlp-queue.jsonl
        |
        v
wlp_dispatcher.py
  -> match wet-lab-node AgentCard (execution_capability filter)
  -> send WLP-instruction to node
        |
        v
Automated wet-lab platform
  -> execute experiment
  -> return WLP-outcome.json
        |
        v
wlp_outcome_bridge.py
  -> convert to PACR record (domain="wet_lab")
  -> write to ~/.eon/pacr-wet-lab-v1.jsonl
```

7. Lambda Throughput Ratio

lambda_throughput_ratio = PACR_virtual_hypotheses / WLP_executed_instructions

Target (Day 90): filtered hypotheses (H_ITT_v2 >= 0.5) / WLP count >= 1000x

8. IANA Considerations

This document has no IANA actions.

9. Security Considerations

WLP-instructions carry lambda budgets that MUST be enforced by execution platforms to prevent resource exhaustion. PACR provenance links MUST be validated before execution.

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