Extraction Report: 01_scientific_paper

Property	Value
Domain	Scientific
Format	.pdf
Text length	93,613 chars
Sentences	411

Entities

Spacy NER: 135 entities (1016ms)

Entity	Label	Score
Sam Sammane	PERSON	
Roger Penrose	PERSON	
Busemeyer	PERSON	
Bruza	PERSON	
2012	DATE	
QHP	ORG	
Sammane	PERSON	
2025	DATE	
QHG	ORG	
QLang	ORG	
(	s_i\rangle\	GPE
\text{Relation}\rangle\	CARDINAL	
(r_i \in {1,	ORG	
Hilbert	PERSON	
first	ORDINAL	
(\hat{Q}\	PERSON	
19	CARDINAL	
812	CARDINAL	
15	CARDINAL	
five	CARDINAL	
four	CARDINAL	
OpenAI	ORG	
Microsoft	ORG	
Alibaba	GPE	

Gliner NER: 307 entities (1139ms)

Entity	Label	Score
Quantum Structure	data_structure	0.89
Human Reasoning	cognitive_concept	0.47
Quantum Hypergraph Paradigm	algorithm	0.85
Roger Penrose	role	0.37
human understanding	cognitive_concept	0.46
quantum-like coherence	requirement	0.51
decision-making	cognitive_concept	0.58
classical probability	cognitive_concept	0.67
quantum probability amplitudes	algorithm	0.90
QHP	algorithm	0.34
formal computational framework	architecture_pattern	0.48

Entity	Label	Score
cycle	temporal_concept	0.52
superposition	cognitive_concept	0.89
parallel interpretations	cognitive_concept	0.87
coherence evaluation	cognitive_concept	0.96
intuition	cognitive_concept	0.56
projection	cognitive_concept	0.95
collapse into understanding	cognitive_concept	0.47
adaptation	cognitive_concept	0.93
collapse	cognitive_concept	0.40
QHG state	state	0.76
normalized quantum representation	data_structure	0.68
natural-language documents	data_structure	0.71
QLang	protocol	0.50
s_i	state	0.65
rangle	state	0.82
structured triple	data_structure	0.30
Actor	role	0.60

Stanza NER: 129 entities (5343ms)

Entity	Label	Score
Abstract		
Roger Penrose	PERSON	
Busemeyer	ORG	
Bruza	PERSON	
2012	DATE	
QHP	ORG	
Sammane	WORK_OF_ART	
2025	DATE	
QHG	ORG	
QLang	ORG	
96}\	QUANTITY	
19	CARDINAL	
Hilbert	FAC	
first	ORDINAL	
Hilbert	ORG	
812	CARDINAL	
15	CARDINAL	
five	CARDINAL	
four	CARDINAL	
OpenAI	ORG	
Microsoft	ORG	
Alibaba	ORG	
BAAI	ORG	
384	CARDINAL	
3072	CARDINAL	

Flair NER: 55 entities (463ms)

Entity	Label	Score
Quantum Hypergraph Paradigm	MISC	0.91
Sam Sammane	PER	1.00
Roger Penrose	PER	1.00
Busemeyer	PER	1.00
Bruza	PER	1.00
Sammane	PER	1.00
QLang	MISC	1.00
Hilbert	MISC	0.95
QHP	ORG	1.00
OpenAI	ORG	1.00
Microsoft	ORG	1.00
Alibaba	ORG	1.00
BAAI	ORG	1.00
Cohen	PER	1.00
QHG	ORG	0.94
Penrose	PER	1.00
Quantum Cognition Thesis	MISC	0.93
Penrose	ORG	0.91
The Emperor's New Mind	MISC	1.00
Shadows of the Mind	MISC	1.00
Gödel	PER	1.00
Stuart Hameroff	PER	1.00

Relations (SRL)

132 SRL frames (272ms)

Verb	Agent	Patient
validate		Quantum Hypergraph Paradigm
Sam Samman		
argue	Empirical Evidence for Quantum Structure	that human understanding can not be r
reduce	human understanding	
involve		quantum - like coherence and collapse
demonstrate	Busemeyer and Bruza (2012)	that human decision - making
violates		
violate	human decision - making	
classical probability but aligns with qu		
synthesize	Quantum Hypergraph Paradigm	
(QHP ; Sa	insights	ARG2=into a formal computational fra
collapse	cognition as cycle of	
superposition (		ARG2=into understanding
learn		
introduce	We	QHG state — normalized quantum repr
extract		
be	Each QHG state (	s_i\rangle\ )
carry		definite graph - role eigenvalue (r_i \
project		state
(	s_i\rangle	semantic content vector obtained by pro
be	extraction itself	first
quantum operation : document — w		
exist	which	
measure	document — which exists as superposition	
collapse		it

Verb	Agent	Patient
be	states , not raw text	quantum objects
we study		
study	we	
test	We	QHP 's prediction that QHG states car
carry	QHG states	universal quantum signatures
extract		
use		five embedding models from four
organi		

Enriched Extraction (batch-enrich)

Single GPU call: 307 entities, 80 roles, 163 SRL frames (2459ms)

Latency Comparison

Method	Latency
Separate (GLiNER 1139ms + GLiClass 759ms + SRL 272ms)	**2170ms**
batch-enrich (unified)	**2459ms**
Speedup	**0.9x**

Per-Sentence Enriched Results (sample)

Sentence	Entities	Role
Empirical Evidence for Quantum Structure in Human Reasoning:	6	Evidence (0.98)
Busemeyer and Bruza (2012) demonstrated that human decision-	3	Probability (0.91
The Quantum Hypergraph Paradigm		
(QHP; Sammane, 2025) synthes	12	Concept (0.19)
We introduce the QHG state — a normalized quantum representa	4	State (0.70)
Each QHG state (	s_i\rangle) is a structured triple (\lan	12
The extraction itself is the first		
quantum operation: a docu	5	Measurement (0.
These states, not raw text, are the quantum objects		
we study	2	State (0.51)
We test QHP's prediction that QHG states carry universal qua	10	State (0.94)
The evidence spans three tiers: (1) all seven QHP constructs	10	Evidence (0.83)
We further demonstrate a GPU-accelerated composite implement	10	State (0.93)
The quantum structure is universal — it appears regardless o	5	State (0.91)
The common factor is the QHG representation itself: the norm	3	Concept (0.38)
We		
provide computational evidence supporting Penrose's quant	5	Evidence (0.93)

PART I: THEORY

1. \| 0 \| Hypothesis (0.46) \| 0 \| \| Introduction: The Quantum Cognition Thesis 1.1 Three Lines o \| 5 \| Hypothesis (0.19) \| 2 \|

Entity Type Distribution (enriched)

Label	Count
algorithm	87
cognitive_concept	80
data_structure	29
state	24
temporal_concept	20
system_component	14
process	10
event_type	9
role	8
architecture_pattern	8
action	5
metric	4
memory_type	4
requirement	3
protocol	1
constraint	1

Role Distribution (enriched)

Role	Count
State (State)	17
Condition (State)	10
Concept (Core)	8
Evidence (Discourse)	5
Probability (Scientific)	5
Event (Event)	4
Function (Programming)	4
Measurement (Scientific)	3
Hypothesis (Scientific)	3
Effect (Event)	3
Type (Programming)	3
Actor (Core)	2
Enabler (Causal)	2
Entity (Core)	2
State Change (Other)	2

QLang Sentences

Gliclass: 60 classifications (759ms)

Causal (2)

- [Enabler] (0.43) He concludes that conscious reasoning is not fully algorithmic — it must rely on...
- [Enabler] (0.16) Computational: We demonstrate a GPU-accelerated composite implementation of the ...

Core (9)

- [Concept] (0.19) The Quantum Hypergraph Paradigm (QHP; Sammane, 2025) synthesizes these insights ...
- [Actor] (0.48) Each QHG state (|s_i\rangle) is a structured triple (\langle\text{Actor} : \t...
- [Concept] (0.38) The common factor is the QHG representation itself: the normalized quantum form ...
- [Concept] (0.93) In their framework, superposition represents the coexistence of incompatible tho...
- [Entity] (0.12) Stephen Wolfram's A Project to Find the Fundamental Theory of Physics (2020) pro...
- [Concept] (0.22) Two central ideas follow: 1....
- [Actor] (0.55) Each QHG state is a structured triple (\langle\text{Actor} : \text{Role} : \tex...
- [Concept] (0.93) This distinction — between the quantum representation and the Hilbert space it i...

Discourse (5)

- [Evidence] (0.98) Empirical Evidence for Quantum Structure in Human Reasoning: Validating the Quan...
- [Evidence] (0.83) The evidence spans three tiers: (1) all seven QHP constructs are validated — coh...
- [Evidence] (0.93) We provide computational evidence supporting Penrose's quantum consciousness the...
- [Evidence] (0.90) Because the theoretical paper (Sammane, 2025) is not yet published in a peer-rev...
- [Evidence] (0.90) Across 19 experiments, three tiers of evidence, and five embedding models from f...

Event (6)

- [Effect] (0.15) Penrose and quantum consciousness....
- [Event] (0.45) Penrose proposes that quantum state-vector reduction (collapse) is an objective ...
- [Event] (0.94) Together with Stuart Hameroff, Penrose extended this to the biological domain: q...
- [Object] (0.16) This is Orchestrated Objective Reduction (Orch-OR)....
- [Event] (0.51) Instead of continuous spacetime or differential equations, the universe is a vas...
- [Effect] (0.36) Theoretical:...

Other (3)

- [Time Condition] (0.37) This is Objective Reduction (OR), with collapse time approximated by: [\tau \ap...
- [State Change] (0.61) 2. Multiway Evolution — when multiple rewrites are possible simultaneously, the ...
- [State Change] (0.58) A key philosophical consequence is computational irreducibility: even though the...

Programming (4)

- [Invariant] (0.94) Causal Invariance — the global causal network is invariant under different order...
- [Function] (0.19) Wolfram provides the substrate but not the cognitive operators....
- [Function] (0.17) What was missing was a synthesis: a formal model where reasoning is explicitly d...
- [Type] (0.93) We present the Quantum Hypergraph Paradigm (QHP) in full — a framework that mode...

Scientific (12)

- [Probability] (0.91) Busemeyer and Bruza (2012) demonstrated that human decision-making violates clas...
- [Measurement] (0.75) The extraction itself is the first quantum operation: a document — which exists ...
- [Hypothesis] (0.46) --- PART I: THEORY

1....

- [Hypothesis] (0.19) Introduction: The Quantum Cognition Thesis 1.1 Three Lines of Convergence Three ...
- [Observation] (0.64) In The Emperor's New Mind (1989) and Shadows of the Mind (1994), Roger Penrose u...
- [Probability] (0.83) Cognitive scientists have long noted that human decision-making violates classic...
- [Probability] (0.98) Busemeyer and Bruza (2012) showed that these violations align precisely with qua...
- [Probability] (0.97) The multiway graph encodes interference and probabilistic structure....

State (19)

- [State] (0.70) We introduce the QHG state — a normalized quantum representation of a single ide...
- [State] (0.51) These states, not raw text, are the quantum objects we study....
- [State] (0.94) We test QHP's prediction that QHG states carry universal quantum signatures in a...
- [State] (0.93) We further demonstrate a GPU-accelerated composite implementation of the QHP alg...
- [State] (0.91) The quantum structure is universal — it appears regardless of which model projec...
- [State] (0.70) He relates the moment of collapse to gravitational self-energy: when two quantum...
- [State] (0.28) In Penrose's view, each collapse constitutes a moment of proto-conscious experie...
- [State] (0.68) Whether or not the biological details are correct, Penrose's core insight — that...

Qualtron: 8 classifications (19503ms)

Core (6)

- [Concept] (0.95) Empirical Evidence for Quantum Structure in Human Reasoning: Validating the Quan...
- [Concept] (0.95) The quantum structure is universal — it appears regardless of which model projec...
- [Concept] (0.95) Penrose and quantum consciousness....

- [Concept] (0.95) This is Objective Reduction (OR), with collapse time approximated by: [\tau \ap...
- [Concept] (0.95) Busemeyer and quantum cognition....
- [Concept] (0.95) The multiway graph encodes interference and probabilistic structure....

Event (1)

- [Action] (0.95) The extraction itself is the first quantum operation: a document — which exists ...

Project (1)

- [Project] (0.95) Stephen Wolfram's A Project to Find the Fundamental Theory of Physics (2020) pro...

QHG Process Models

FSM (1677ms)

Could not parse structured output

```
None
```

BPMN (1769ms)

Could not parse structured output

```
None
```

DFG (14551ms)

Could not parse structured output

````
```json
{
  "nodes": [
    {
      "id": "n1",
      "name": "Roger Penrose",
      "type": "source",
      "inputs": [],
      "outputs": [
        {
          "id": "n2",
          "name": "Quantum Consciousness Thesis",
          "type": "operation",
          "inputs": [
            {
````

KnowledgeState (5800ms)

3 states, 2 transitions

- KS: **Classical Computation Limitation** (3 facts)
- KS: **Quantum Hypergraph Paradigm (QHP)** (6 facts)
- KS: **Empirical Validation of QHP** (6 facts)

CNL / QNR2 Rules

14 rule patterns detected
````

Conditional (2)

- `If information can entangle, then the Quantum Hypergraph is not merely a theory of cognition - it is a map of`
- `If this is a real cognitive phenomenon, then sentences sharing a`

Obligation (7)

- `must involve`
- `must rely on physical phenomena that allow new information to emerge beyond deterministic computation.`
- `must be`
- `shall maintain confidentiality of all proprietary`
- `must appear across fundamentally different embedding architectures.`

Permission (1)

- `may represent different dimensions of experience - perceptual and emotional, linguistic and`

Requirement (4)

- `requires quantum-like reduction events - moments where a diffuse field of`
- `requires joint measurement.`
- `requires zero training - it is a direct computation from Hilbert space geometry.`
- `requires computing the full N×N similarity matrix.`

Heuristic Facts & Rules

35 facts, 44 rules

Facts (sample)

- \cos^2\theta) achieves 56–88% zero-shot accuracy on every model with no training; (3) a Bell-type test shows...
- Postulate 2 (Evolution). A closed quantum system evolves according to (|\psi(t+1)\rangle = U|\psi(t)\rangle where...
- experiment validates this — the Born rule achieves 56–88% zero-shot accuracy across all five models....
- | Role match | 38.3% | 1.6% | 23.7× |...
- | Category match | 55.3% | 5.6% | 10.0× |...
- | Collapse stability | 89.4% | — | — |...
- and the collapse is 89% stable under perturbation. This is the computational analogue of Penrose's "aha moment":...
- Cognitive interpretation: Most sentences are "particle-like" — they belong clearly to one category (90.6% of...

Rules (sample)

- [obligation] Roger Penrose argued that human understanding cannot be reduced to classical computation and must involve...
- [obligation] must rely on physical phenomena that allow new information to emerge beyond deterministic computation....
- [conditional] random or observer-dependent event. He relates the moment of collapse to gravitational self-energy: when two...
- [conditional] 2. Multiway Evolution — when multiple rewrites are possible simultaneously, the system branches into a...
- [conditional] 3. Empirical: We test QHP's prediction that QHG states carry universal quantum signatures when projected into any...

- [conditional] | 5. Observation/Collapse | Resolution | When a query or constraint demands closure, the most coherent...
- [conditional] conjecture: Intelligence emerges when symbolic rewrites are governed by coherence constraints and...
- [obligation, conditional] When a query or constraint demands closure, the system cannot remain in superposition. One configuration must be...

Topics (Gensim LDA)

- **Topic 0**: {'word': 'qhg', 'weight': 0.016}, {'word': 'qhp', 'weight': 0.0154}, {'word': 'text', 'weight': 0.0152}, {'word': 'entanglement', 'weight': 0.0121}, {'word': 'classical', 'weight': 0.0111}, {'word': 'states', 'weight': 0.011}, {'word': 'rule', 'weight': 0.0109}, {'word': 'model', 'weight': 0.0109}
- **Topic 1**: {'word': 'rule', 'weight': 0.0111}, {'word': 'gpu', 'weight': 0.01}, {'word': 'real', 'weight': 0.0095}, {'word': 'coherence', 'weight': 0.009}, {'word': 'classical', 'weight': 0.0077}, {'word': 'cupy', 'weight': 0.007}, {'word': 'qhp', 'weight': 0.0069}, {'word': 'qra', 'weight': 0.0068}
- **Topic 2**: {'word': 'that', 'weight': 0.012}, {'word': 'coherence', 'weight': 0.0103}, {'word': 'collapse', 'weight': 0.0102}, {'word': 'qhp', 'weight': 0.0099}, {'word': 'cognitive', 'weight': 0.0093}, {'word': 'entanglement', 'weight': 0.0087}, {'word': 'this', 'weight': 0.0086}, {'word': 'reasoning', 'weight': 0.0067}
- **Topic 3**: {'word': 'rangle', 'weight': 0.017}, {'word': 'text', 'weight': 0.0169}, {'word': 'qhg', 'weight': 0.0152}, {'word': 'state', 'weight': 0.0152}, {'word': 'role', 'weight': 0.0099}, {'word': 'space', 'weight': 0.0088}, {'word': 'embedding', 'weight': 0.0072}, {'word': 'human', 'weight': 0.0069}
- **Topic 4**: {'word': 'embedding', 'weight': 0.0187}, {'word': 'space', 'weight': 0.0149}, {'word': 'that', 'weight': 0.0135}, {'word': 'rangle', 'weight': 0.0132}, {'word': 'states', 'weight': 0.0099}, {'word': 'text', 'weight': 0.0088}, {'word': 'state', 'weight': 0.0087}, {'word': 'psi', 'weight': 0.0086}

Summary (Sumy LexRank)

The Quantum Hypergraph Paradigm (QHP; Sammane, 2025) synthesizes these insights into a formal computational framework: cognition as a cycle of superposition (generation of parallel interpretations), coherence evaluation (intuition), projection (collapse into understanding), and adaptation (learning from the collapse). Each reasoning episode is a discrete quantum step through four operators: [\mathbf{F}(\text{Flow}) \rightarrow \mathbf{C}(\text{Coherence}) \rightarrow \boldsymbol{\Pi}(\text{Proj