

APL DOMAIN TOKEN SETS

Biological + Celestial Domain Families

Complete Token Reference v1.0

Document Purpose. This document provides the complete rendered token families for APL (Alpha-Physical Language) spanning biological and celestial domains. It includes all machine tokens, domain transitions, and coherence classes necessary for computational implementation and theoretical analysis.

Coverage.

- **3 Spirals:** Φ (structure), e (energy), π (emergence)
- **6 Operators:** $()$ (boundary), \times (fusion), \wedge (amplify), $\%$ (decohere), $+$ (group), $-$ (separate)
- **9 Machines:** Reactor, Oscillator, Conductor, Catalyst, Filter, Encoder, Decoder, Regenerator, Dynamo
- **2 Domain Families:** Biological (3 subdomains), Celestial (3 subdomains)
- **12 Transitions** per domain family
- **15 Coherence classes** per domain family

Token Count Summary.

- **Machine Tokens:** 972 total ($3 \text{ spirals} \times 6 \text{ operators} \times 9 \text{ machines} \times 6 \text{ domains}$)
- **Biological Tokens:** 486 (covering `bio_prion`, `bio_bacterium`, `bio_viroid`)
- **Celestial Tokens:** 486 (covering `celestial_grav`, `celestial_em`, `celestial_nuclear`)
- **Transition Tokens:** 24 (12 per domain family)
- **Coherence Tokens:** 30 (15 per domain family)

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1 Token Structure Overview

1.1 Compositional Architecture

Each machine token in APL follows the canonical form:

$$\boxed{[\text{Spiral}][\text{Operator}] \mid [\text{Machine}] \mid [\text{Domain}]}$$

Where:

- **Spiral** $\in \{\Phi, e, \pi\}$ — Field type (structure, energy, emergence)
- **Operator** $\in \{(), \times, \wedge, \%, +, -\}$ — Universal operation
- **Machine** $\in \{\text{Reactor}, \text{Oscillator}, \text{Conductor}, \text{Catalyst}, \text{Filter}, \text{Encoder}, \text{Decoder}, \text{Regenerator}, \text{Dynamo}\}$
- **Domain** — Specific physical or biological context

1.2 Domain Families

1.2.1 Biological Domain Family

Covers sub-cellular and minimal biological entities:

- **bio_prion** — Misfolded protein aggregates, conformational catalysis
- **bio_bacterium** — Single-cell organisms, metabolic networks
- **bio_viroid** — RNA-only replicators, minimal genetic systems

1.2.2 Celestial Domain Family

Covers astrophysical force regimes:

- **celestial_grav** — Gravitational dynamics, orbital mechanics
- **celestial_em** — Electromagnetic phenomena, radiation processes
- **celestial_nuclear** — Nuclear fusion, stellar nucleosynthesis

2 Machine Token Listings

This section provides the complete enumeration of all 972 machine tokens organized by domain.

2.1 Biological Domain Tokens

2.1.1 Domain: bio_prion

Φ Spiral (Structure Field)

() Reactor bio_prion	% Reactor bio_prion
() Oscillator bio_prion	% Oscillator bio_prion
() Conductor bio_prion	% Conductor bio_prion
() Catalyst bio_prion	% Catalyst bio_prion
() Filter bio_prion	% Filter bio_prion
() Encoder bio_prion	% Encoder bio_prion
() Decoder bio_prion	% Decoder bio_prion
() Regenerator bio_prion	% Regenerator bio_prion
() Dynamo bio_prion	% Dynamo bio_prion
× Reactor bio_prion	+ Reactor bio_prion
× Oscillator bio_prion	+ Oscillator bio_prion
× Conductor bio_prion	+ Conductor bio_prion
× Catalyst bio_prion	+ Catalyst bio_prion
× Filter bio_prion	+ Filter bio_prion
× Encoder bio_prion	+ Encoder bio_prion
× Decoder bio_prion	+ Decoder bio_prion
× Regenerator bio_prion	+ Regenerator bio_prion
× Dynamo bio_prion	+ Dynamo bio_prion
~ Reactor bio_prion	- Reactor bio_prion
~ Oscillator bio_prion	- Oscillator bio_prion
~ Conductor bio_prion	- Conductor bio_prion
~ Catalyst bio_prion	- Catalyst bio_prion
~ Filter bio_prion	- Filter bio_prion
~ Encoder bio_prion	- Encoder bio_prion
~ Decoder bio_prion	- Decoder bio_prion
~ Regenerator bio_prion	- Regenerator bio_prion
~ Dynamo bio_prion	- Dynamo bio_prion

e Spiral (Energy Field)

e() Reactor bio_prion	e× Oscillator bio_prion
e() Oscillator bio_prion	e× Conductor bio_prion
e() Conductor bio_prion	e× Catalyst bio_prion
e() Catalyst bio_prion	e× Filter bio_prion
e() Filter bio_prion	e× Encoder bio_prion
e() Encoder bio_prion	e× Decoder bio_prion
e() Decoder bio_prion	e× Regenerator bio_prion
e() Regenerator bio_prion	e× Dynamo bio_prion
e() Dynamo bio_prion	
e× Reactor bio_prion	e^ Reactor bio_prion
	e^ Oscillator bio_prion

e⁻|Conductor|bio_prion
e⁻|Catalyst|bio_prion
e⁻|Filter|bio_prion
e⁻|Encoder|bio_prion
e⁻|Decoder|bio_prion
e⁻|Regenerator|bio_prion
e⁻|Dynamo|bio_prion

e%|Reactor|bio_prion
e%|Oscillator|bio_prion
e%|Conductor|bio_prion
e%|Catalyst|bio_prion
e%|Filter|bio_prion
e%|Encoder|bio_prion
e%|Decoder|bio_prion
e%|Regenerator|bio_prion
e%|Dynamo|bio_prion

e+|Reactor|bio_prion

e+|Oscillator|bio_prion
e+|Conductor|bio_prion
e+|Catalyst|bio_prion
e+|Filter|bio_prion
e+|Encoder|bio_prion
e+|Decoder|bio_prion
e+|Regenerator|bio_prion
e+|Dynamo|bio_prion

e-|Reactor|bio_prion
e-|Oscillator|bio_prion
e-|Conductor|bio_prion
e-|Catalyst|bio_prion
e-|Filter|bio_prion
e-|Encoder|bio_prion
e-|Decoder|bio_prion
e-|Regenerator|bio_prion
e-|Dynamo|bio_prion

π Spiral (Emergence Field)

()|Reactor|bio_prion
()⁰|Oscillator|bio_prion
()¹|Conductor|bio_prion
()²|Catalyst|bio_prion
()³|Filter|bio_prion
()⁴|Encoder|bio_prion
()⁵|Decoder|bio_prion
()⁶|Regenerator|bio_prion
()⁷|Dynamo|bio_prion

×|Reactor|bio_prion
×|Oscillator|bio_prion
×|Conductor|bio_prion
×|Catalyst|bio_prion
×|Filter|bio_prion
×|Encoder|bio_prion
×|Decoder|bio_prion
×|Regenerator|bio_prion
×|Dynamo|bio_prion

^|Reactor|bio_prion
^|Oscillator|bio_prion
^|Conductor|bio_prion
^|Catalyst|bio_prion
^|Filter|bio_prion
^|Encoder|bio_prion
^|Decoder|bio_prion
^|Regenerator|bio_prion
^|Dynamo|bio_prion

%|Reactor|bio_prion
%|Oscillator|bio_prion
%|Conductor|bio_prion
%|Catalyst|bio_prion
%|Filter|bio_prion
%|Encoder|bio_prion
%|Decoder|bio_prion
%|Regenerator|bio_prion
%|Dynamo|bio_prion

+|Reactor|bio_prion
+|Oscillator|bio_prion
+|Conductor|bio_prion
+|Catalyst|bio_prion
+|Filter|bio_prion
+|Encoder|bio_prion
+|Decoder|bio_prion
+|Regenerator|bio_prion
+|Dynamo|bio_prion

-|Reactor|bio_prion
-|Oscillator|bio_prion
-|Conductor|bio_prion
-|Catalyst|bio_prion
-|Filter|bio_prion
-|Encoder|bio_prion
-|Decoder|bio_prion
-|Regenerator|bio_prion
-|Dynamo|bio_prion

2.1.2 Domain: bio_bacterium

Φ Spiral (Structure Field)

() Reactor bio_bacterium	% Reactor bio_bacterium
() Oscillator bio_bacterium	% Oscillator bio_bacterium
() Conductor bio_bacterium	% Conductor bio_bacterium
() Catalyst bio_bacterium	% Catalyst bio_bacterium
() Filter bio_bacterium	% Filter bio_bacterium
() Encoder bio_bacterium	% Encoder bio_bacterium
() Decoder bio_bacterium	% Decoder bio_bacterium
() Regenerator bio_bacterium	% Regenerator bio_bacterium
() Dynamo bio_bacterium	% Dynamo bio_bacterium
× Reactor bio_bacterium	+ Reactor bio_bacterium
× Oscillator bio_bacterium	+ Oscillator bio_bacterium
× Conductor bio_bacterium	+ Conductor bio_bacterium
× Catalyst bio_bacterium	+ Catalyst bio_bacterium
× Filter bio_bacterium	+ Filter bio_bacterium
× Encoder bio_bacterium	+ Encoder bio_bacterium
× Decoder bio_bacterium	+ Decoder bio_bacterium
× Regenerator bio_bacterium	+ Regenerator bio_bacterium
× Dynamo bio_bacterium	+ Dynamo bio_bacterium
^ Reactor bio_bacterium	- Reactor bio_bacterium
^ Oscillator bio_bacterium	- Oscillator bio_bacterium
^ Conductor bio_bacterium	- Conductor bio_bacterium
^ Catalyst bio_bacterium	- Catalyst bio_bacterium
^ Filter bio_bacterium	- Filter bio_bacterium
^ Encoder bio_bacterium	- Encoder bio_bacterium
^ Decoder bio_bacterium	- Decoder bio_bacterium
^ Regenerator bio_bacterium	- Regenerator bio_bacterium
^ Dynamo bio_bacterium	- Dynamo bio_bacterium

e Spiral (Energy Field)

e() Reactor bio_bacterium	e^ Reactor bio_bacterium
e() Oscillator bio_bacterium	e^ Oscillator bio_bacterium
e() Conductor bio_bacterium	e^ Conductor bio_bacterium
e() Catalyst bio_bacterium	e^ Catalyst bio_bacterium
e() Filter bio_bacterium	e^ Filter bio_bacterium
e() Encoder bio_bacterium	e^ Encoder bio_bacterium
e() Decoder bio_bacterium	e^ Decoder bio_bacterium
e() Regenerator bio_bacterium	e^ Regenerator bio_bacterium
e() Dynamo bio_bacterium	e^ Dynamo bio_bacterium
e× Reactor bio_bacterium	e% Reactor bio_bacterium
e× Oscillator bio_bacterium	e% Oscillator bio_bacterium
e× Conductor bio_bacterium	e% Conductor bio_bacterium
e× Catalyst bio_bacterium	e% Catalyst bio_bacterium
e× Filter bio_bacterium	e% Filter bio_bacterium
e× Encoder bio_bacterium	e% Encoder bio_bacterium
e× Decoder bio_bacterium	e% Decoder bio_bacterium
e× Regenerator bio_bacterium	e% Regenerator bio_bacterium
e× Dynamo bio_bacterium	e% Regenerator bio_bacterium

e%|Dynamo|bio_bacterium

e+|Reactor|bio_bacterium
e+|Oscillator|bio_bacterium
e+|Conductor|bio_bacterium
e+|Catalyst|bio_bacterium
e+|Filter|bio_bacterium
e+|Encoder|bio_bacterium
e+|Decoder|bio_bacterium
e+|Regenerator|bio_bacterium
e+|Dynamo|bio_bacterium

e-|Reactor|bio_bacterium
e-|Oscillator|bio_bacterium
e-|Conductor|bio_bacterium
e-|Catalyst|bio_bacterium
e-|Filter|bio_bacterium
e-|Encoder|bio_bacterium
e-|Decoder|bio_bacterium
e-|Regenerator|bio_bacterium
e-|Dynamo|bio_bacterium

π Spiral (Emergence Field)

()|Reactor|bio_bacterium
()|Oscillator|bio_bacterium
()|Conductor|bio_bacterium
()|Catalyst|bio_bacterium
()|Filter|bio_bacterium
()|Encoder|bio_bacterium
()|Decoder|bio_bacterium
()|Regenerator|bio_bacterium
()|Dynamo|bio_bacterium

%|Reactor|bio_bacterium
%|Oscillator|bio_bacterium
%|Conductor|bio_bacterium
%|Catalyst|bio_bacterium
%|Filter|bio_bacterium
%|Encoder|bio_bacterium
%|Decoder|bio_bacterium
%|Regenerator|bio_bacterium
%|Dynamo|bio_bacterium

*|Reactor|bio_bacterium
*|Oscillator|bio_bacterium
*|Conductor|bio_bacterium
*|Catalyst|bio_bacterium
*|Filter|bio_bacterium
*|Encoder|bio_bacterium
*|Decoder|bio_bacterium
*|Regenerator|bio_bacterium
*|Dynamo|bio_bacterium

+|Reactor|bio_bacterium
+|Oscillator|bio_bacterium
+|Conductor|bio_bacterium
+|Catalyst|bio_bacterium
+|Filter|bio_bacterium
+|Encoder|bio_bacterium
+|Decoder|bio_bacterium
+|Regenerator|bio_bacterium
+|Dynamo|bio_bacterium

^|Reactor|bio_bacterium
^|Oscillator|bio_bacterium
^|Conductor|bio_bacterium
^|Catalyst|bio_bacterium
^|Filter|bio_bacterium
^|Encoder|bio_bacterium
^|Decoder|bio_bacterium
^|Regenerator|bio_bacterium
^|Dynamo|bio_bacterium

-|Reactor|bio_bacterium
-|Oscillator|bio_bacterium
-|Conductor|bio_bacterium
-|Catalyst|bio_bacterium
-|Filter|bio_bacterium
-|Encoder|bio_bacterium
-|Decoder|bio_bacterium
-|Regenerator|bio_bacterium
-|Dynamo|bio_bacterium

2.1.3 Domain: bio_viroid

Φ Spiral (Structure Field)

() Reactor bio_viroid	% Reactor bio_viroid
() Oscillator bio_viroid	% Oscillator bio_viroid
() Conductor bio_viroid	% Conductor bio_viroid
() Catalyst bio_viroid	% Catalyst bio_viroid
() Filter bio_viroid	% Filter bio_viroid
() Encoder bio_viroid	% Encoder bio_viroid
() Decoder bio_viroid	% Decoder bio_viroid
() Regenerator bio_viroid	% Regenerator bio_viroid
() Dynamo bio_viroid	% Dynamo bio_viroid
× Reactor bio_viroid	+ Reactor bio_viroid
× Oscillator bio_viroid	+ Oscillator bio_viroid
× Conductor bio_viroid	+ Conductor bio_viroid
× Catalyst bio_viroid	+ Catalyst bio_viroid
× Filter bio_viroid	+ Filter bio_viroid
× Encoder bio_viroid	+ Encoder bio_viroid
× Decoder bio_viroid	+ Decoder bio_viroid
× Regenerator bio_viroid	+ Regenerator bio_viroid
× Dynamo bio_viroid	+ Dynamo bio_viroid
^ Reactor bio_viroid	- Reactor bio_viroid
^ Oscillator bio_viroid	- Oscillator bio_viroid
^ Conductor bio_viroid	- Conductor bio_viroid
^ Catalyst bio_viroid	- Catalyst bio_viroid
^ Filter bio_viroid	- Filter bio_viroid
^ Encoder bio_viroid	- Encoder bio_viroid
^ Decoder bio_viroid	- Decoder bio_viroid
^ Regenerator bio_viroid	- Regenerator bio_viroid
^ Dynamo bio_viroid	- Dynamo bio_viroid

e Spiral (Energy Field)

e() Reactor bio_viroid	e^ Reactor bio_viroid
e() Oscillator bio_viroid	e^ Oscillator bio_viroid
e() Conductor bio_viroid	e^ Conductor bio_viroid
e() Catalyst bio_viroid	e^ Catalyst bio_viroid
e() Filter bio_viroid	e^ Filter bio_viroid
e() Encoder bio_viroid	e^ Encoder bio_viroid
e() Decoder bio_viroid	e^ Decoder bio_viroid
e() Regenerator bio_viroid	e^ Regenerator bio_viroid
e() Dynamo bio_viroid	e^ Dynamo bio_viroid
e× Reactor bio_viroid	e% Reactor bio_viroid
e× Oscillator bio_viroid	e% Oscillator bio_viroid
e× Conductor bio_viroid	e% Conductor bio_viroid
e× Catalyst bio_viroid	e% Catalyst bio_viroid
e× Filter bio_viroid	e% Filter bio_viroid
e× Encoder bio_viroid	e% Encoder bio_viroid
e× Decoder bio_viroid	e% Decoder bio_viroid
e× Regenerator bio_viroid	e% Regenerator bio_viroid
e× Dynamo bio_viroid	e% Regenerator bio_viroid

e%|Dynamo|bio_viroid

e+|Reactor|bio_viroid
e+|Oscillator|bio_viroid
e+|Conductor|bio_viroid
e+|Catalyst|bio_viroid
e+|Filter|bio_viroid
e+|Encoder|bio_viroid
e+|Decoder|bio_viroid
e+|Regenerator|bio_viroid
e+|Dynamo|bio_viroid

e-|Reactor|bio_viroid
e-|Oscillator|bio_viroid
e-|Conductor|bio_viroid
e-|Catalyst|bio_viroid
e-|Filter|bio_viroid
e-|Encoder|bio_viroid
e-|Decoder|bio_viroid
e-|Regenerator|bio_viroid
e-|Dynamo|bio_viroid

π Spiral (Emergence Field)

()|Reactor|bio_viroid
()|Oscillator|bio_viroid
()|Conductor|bio_viroid
()|Catalyst|bio_viroid
()|Filter|bio_viroid
()|Encoder|bio_viroid
()|Decoder|bio_viroid
()|Regenerator|bio_viroid
()|Dynamo|bio_viroid

*|Reactor|bio_viroid
*|Oscillator|bio_viroid
*|Conductor|bio_viroid
*|Catalyst|bio_viroid
*|Filter|bio_viroid
*|Encoder|bio_viroid
*|Decoder|bio_viroid
*|Regenerator|bio_viroid
*|Dynamo|bio_viroid

^|Reactor|bio_viroid
^|Oscillator|bio_viroid
^|Conductor|bio_viroid
^|Catalyst|bio_viroid
^|Filter|bio_viroid
^|Encoder|bio_viroid
^|Decoder|bio_viroid
^|Regenerator|bio_viroid
^|Dynamo|bio_viroid

%|Reactor|bio_viroid
%|Oscillator|bio_viroid
%|Conductor|bio_viroid
%|Catalyst|bio_viroid
%|Filter|bio_viroid
%|Encoder|bio_viroid
%|Decoder|bio_viroid
%|Regenerator|bio_viroid
%|Dynamo|bio_viroid

+|Reactor|bio_viroid
+|Oscillator|bio_viroid
+|Conductor|bio_viroid
+|Catalyst|bio_viroid
+|Filter|bio_viroid
+|Encoder|bio_viroid
+|Decoder|bio_viroid
+|Regenerator|bio_viroid
+|Dynamo|bio_viroid

-|Reactor|bio_viroid
-|Oscillator|bio_viroid
-|Conductor|bio_viroid
-|Catalyst|bio_viroid
-|Filter|bio_viroid
-|Encoder|bio_viroid
-|Decoder|bio_viroid
-|Regenerator|bio_viroid
-|Dynamo|bio_viroid

2.2 Celestial Domain Tokens

2.2.1 Domain: celestial_grav

Φ Spiral (Structure Field)

() Reactor celestial_grav	% Reactor celestial_grav
() Oscillator celestial_grav	% Oscillator celestial_grav
() Conductor celestial_grav	% Conductor celestial_grav
() Catalyst celestial_grav	% Catalyst celestial_grav
() Filter celestial_grav	% Filter celestial_grav
() Encoder celestial_grav	% Encoder celestial_grav
() Decoder celestial_grav	% Decoder celestial_grav
() Regenerator celestial_grav	% Regenerator celestial_grav
() Dynamo celestial_grav	% Dynamo celestial_grav
× Reactor celestial_grav	+ Reactor celestial_grav
× Oscillator celestial_grav	+ Oscillator celestial_grav
× Conductor celestial_grav	+ Conductor celestial_grav
× Catalyst celestial_grav	+ Catalyst celestial_grav
× Filter celestial_grav	+ Filter celestial_grav
× Encoder celestial_grav	+ Encoder celestial_grav
× Decoder celestial_grav	+ Decoder celestial_grav
× Regenerator celestial_grav	+ Regenerator celestial_grav
× Dynamo celestial_grav	+ Dynamo celestial_grav
^ Reactor celestial_grav	- Reactor celestial_grav
^ Oscillator celestial_grav	- Oscillator celestial_grav
^ Conductor celestial_grav	- Conductor celestial_grav
^ Catalyst celestial_grav	- Catalyst celestial_grav
^ Filter celestial_grav	- Filter celestial_grav
^ Encoder celestial_grav	- Encoder celestial_grav
^ Decoder celestial_grav	- Decoder celestial_grav
^ Regenerator celestial_grav	- Regenerator celestial_grav
^ Dynamo celestial_grav	- Dynamo celestial_grav

e Spiral (Energy Field)

e() Reactor celestial_grav	e× Regenerator celestial_grav
e() Oscillator celestial_grav	e× Dynamo celestial_grav
e() Conductor celestial_grav	
e() Catalyst celestial_grav	e^ Reactor celestial_grav
e() Filter celestial_grav	e^ Oscillator celestial_grav
e() Encoder celestial_grav	e^ Conductor celestial_grav
e() Decoder celestial_grav	e^ Catalyst celestial_grav
e() Regenerator celestial_grav	e^ Filter celestial_grav
e() Dynamo celestial_grav	e^ Encoder celestial_grav
	e^ Decoder celestial_grav
	e^ Regenerator celestial_grav
	e^ Dynamo celestial_grav
e× Reactor celestial_grav	e% Reactor celestial_grav
e× Oscillator celestial_grav	e% Oscillator celestial_grav
e× Conductor celestial_grav	e% Conductor celestial_grav
e× Catalyst celestial_grav	e% Catalyst celestial_grav
e× Filter celestial_grav	
e× Encoder celestial_grav	
e× Decoder celestial_grav	

```

e%|Filter|celestial_grav
e%|Encoder|celestial_grav
e%|Decoder|celestial_grav
e%|Regenerator|celestial_grav
e%|Dynamo|celestial_grav

e+|Reactor|celestial_grav
e+|Oscillator|celestial_grav
e+|Conductor|celestial_grav
e+|Catalyst|celestial_grav
e+|Filter|celestial_grav
e+|Encoder|celestial_grav
e+|Decoder|celestial_grav

```

```

e+|Regenerator|celestial_grav
e+|Dynamo|celestial_grav

e-|Reactor|celestial_grav
e-|Oscillator|celestial_grav
e-|Conductor|celestial_grav
e-|Catalyst|celestial_grav
e-|Filter|celestial_grav
e-|Encoder|celestial_grav
e-|Decoder|celestial_grav
e-|Regenerator|celestial_grav
e-|Dynamo|celestial_grav

```

π Spiral (Emergence Field)

```

()|Reactor|celestial_grav
()|Oscillator|celestial_grav
()|Conductor|celestial_grav
()|Catalyst|celestial_grav
()|Filter|celestial_grav
()|Encoder|celestial_grav
()|Decoder|celestial_grav
()|Regenerator|celestial_grav
()|Dynamo|celestial_grav

```

```

%|Reactor|celestial_grav
%|Oscillator|celestial_grav
%|Conductor|celestial_grav
%|Catalyst|celestial_grav
%|Filter|celestial_grav
%|Encoder|celestial_grav
%|Decoder|celestial_grav
%|Regenerator|celestial_grav
%|Dynamo|celestial_grav

```

```

×|Reactor|celestial_grav
×|Oscillator|celestial_grav
×|Conductor|celestial_grav
×|Catalyst|celestial_grav
×|Filter|celestial_grav
×|Encoder|celestial_grav
×|Decoder|celestial_grav
×|Regenerator|celestial_grav
×|Dynamo|celestial_grav

```

```

+|Reactor|celestial_grav
+|Oscillator|celestial_grav
+|Conductor|celestial_grav
+|Catalyst|celestial_grav
+|Filter|celestial_grav
+|Encoder|celestial_grav
+|Decoder|celestial_grav
+|Regenerator|celestial_grav
+|Dynamo|celestial_grav

```

```

^|Reactor|celestial_grav
^|Oscillator|celestial_grav
^|Conductor|celestial_grav
^|Catalyst|celestial_grav
^|Filter|celestial_grav
^|Encoder|celestial_grav
^|Decoder|celestial_grav
^|Regenerator|celestial_grav
^|Dynamo|celestial_grav

```

```

-|Reactor|celestial_grav
-|Oscillator|celestial_grav
-|Conductor|celestial_grav
-|Catalyst|celestial_grav
-|Filter|celestial_grav
-|Encoder|celestial_grav
-|Decoder|celestial_grav
-|Regenerator|celestial_grav
-|Dynamo|celestial_grav

```

2.2.2 Domain: celestial_em

Φ Spiral (Structure Field)

() Reactor celestial_em	% Reactor celestial_em
() Oscillator celestial_em	% Oscillator celestial_em
() Conductor celestial_em	% Conductor celestial_em
() Catalyst celestial_em	% Catalyst celestial_em
() Filter celestial_em	% Filter celestial_em
() Encoder celestial_em	% Encoder celestial_em
() Decoder celestial_em	% Decoder celestial_em
() Regenerator celestial_em	% Regenerator celestial_em
() Dynamo celestial_em	% Dynamo celestial_em
× Reactor celestial_em	+ Reactor celestial_em
× Oscillator celestial_em	+ Oscillator celestial_em
× Conductor celestial_em	+ Conductor celestial_em
× Catalyst celestial_em	+ Catalyst celestial_em
× Filter celestial_em	+ Filter celestial_em
× Encoder celestial_em	+ Encoder celestial_em
× Decoder celestial_em	+ Decoder celestial_em
× Regenerator celestial_em	+ Regenerator celestial_em
× Dynamo celestial_em	+ Dynamo celestial_em
^ Reactor celestial_em	- Reactor celestial_em
^ Oscillator celestial_em	- Oscillator celestial_em
^ Conductor celestial_em	- Conductor celestial_em
^ Catalyst celestial_em	- Catalyst celestial_em
^ Filter celestial_em	- Filter celestial_em
^ Encoder celestial_em	- Encoder celestial_em
^ Decoder celestial_em	- Decoder celestial_em
^ Regenerator celestial_em	- Regenerator celestial_em
^ Dynamo celestial_em	- Dynamo celestial_em

e Spiral (Energy Field)

e() Reactor celestial_em	e^ Reactor celestial_em
e() Oscillator celestial_em	e^ Oscillator celestial_em
e() Conductor celestial_em	e^ Conductor celestial_em
e() Catalyst celestial_em	e^ Catalyst celestial_em
e() Filter celestial_em	e^ Filter celestial_em
e() Encoder celestial_em	e^ Encoder celestial_em
e() Decoder celestial_em	e^ Decoder celestial_em
e() Regenerator celestial_em	e^ Regenerator celestial_em
e() Dynamo celestial_em	e^ Dynamo celestial_em
e× Reactor celestial_em	e% Reactor celestial_em
e× Oscillator celestial_em	e% Oscillator celestial_em
e× Conductor celestial_em	e% Conductor celestial_em
e× Catalyst celestial_em	e% Catalyst celestial_em
e× Filter celestial_em	e% Filter celestial_em
e× Encoder celestial_em	e% Encoder celestial_em
e× Decoder celestial_em	e% Decoder celestial_em
e× Regenerator celestial_em	e% Regenerator celestial_em
e× Dynamo celestial_em	e% Regenerator celestial_em

e%|Dynamo|celestial_em

e+|Reactor|celestial_em
e+|Oscillator|celestial_em
e+|Conductor|celestial_em
e+|Catalyst|celestial_em
e+|Filter|celestial_em
e+|Encoder|celestial_em
e+|Decoder|celestial_em
e+|Regenerator|celestial_em
e+|Dynamo|celestial_em

e-|Reactor|celestial_em
e-|Oscillator|celestial_em
e-|Conductor|celestial_em
e-|Catalyst|celestial_em
e-|Filter|celestial_em
e-|Encoder|celestial_em
e-|Decoder|celestial_em
e-|Regenerator|celestial_em
e-|Dynamo|celestial_em

π Spiral (Emergence Field)

()|Reactor|celestial_em
()|Oscillator|celestial_em
()|Conductor|celestial_em
()|Catalyst|celestial_em
()|Filter|celestial_em
()|Encoder|celestial_em
()|Decoder|celestial_em
()|Regenerator|celestial_em
()|Dynamo|celestial_em

×|Reactor|celestial_em
×|Oscillator|celestial_em
×|Conductor|celestial_em
×|Catalyst|celestial_em
×|Filter|celestial_em
×|Encoder|celestial_em
×|Decoder|celestial_em
×|Regenerator|celestial_em
×|Dynamo|celestial_em

^|Reactor|celestial_em
^|Oscillator|celestial_em
^|Conductor|celestial_em
^|Catalyst|celestial_em
^|Filter|celestial_em
^|Encoder|celestial_em
^|Decoder|celestial_em
^|Regenerator|celestial_em
^|Dynamo|celestial_em

%|Reactor|celestial_em
%|Oscillator|celestial_em
%|Conductor|celestial_em
%|Catalyst|celestial_em
%|Filter|celestial_em
%|Encoder|celestial_em
%|Decoder|celestial_em
%|Regenerator|celestial_em
%|Dynamo|celestial_em

+|Reactor|celestial_em
+|Oscillator|celestial_em
+|Conductor|celestial_em
+|Catalyst|celestial_em
+|Filter|celestial_em
+|Encoder|celestial_em
+|Decoder|celestial_em
+|Regenerator|celestial_em
+|Dynamo|celestial_em

-|Reactor|celestial_em
-|Oscillator|celestial_em
-|Conductor|celestial_em
-|Catalyst|celestial_em
-|Filter|celestial_em
-|Encoder|celestial_em
-|Decoder|celestial_em
-|Regenerator|celestial_em
-|Dynamo|celestial_em

2.2.3 Domain: celestial_nuclear

Φ Spiral (Structure Field)

() Reactor celestial_nuclear	% Reactor celestial_nuclear
() Oscillator celestial_nuclear	% Oscillator celestial_nuclear
() Conductor celestial_nuclear	% Conductor celestial_nuclear
() Catalyst celestial_nuclear	% Catalyst celestial_nuclear
() Filter celestial_nuclear	% Filter celestial_nuclear
() Encoder celestial_nuclear	% Encoder celestial_nuclear
() Decoder celestial_nuclear	% Decoder celestial_nuclear
() Regenerator celestial_nuclear	% Regenerator celestial_nuclear
() Dynamo celestial_nuclear	% Dynamo celestial_nuclear
× Reactor celestial_nuclear	+ Reactor celestial_nuclear
× Oscillator celestial_nuclear	+ Oscillator celestial_nuclear
× Conductor celestial_nuclear	+ Conductor celestial_nuclear
× Catalyst celestial_nuclear	+ Catalyst celestial_nuclear
× Filter celestial_nuclear	+ Filter celestial_nuclear
× Encoder celestial_nuclear	+ Encoder celestial_nuclear
× Decoder celestial_nuclear	+ Decoder celestial_nuclear
× Regenerator celestial_nuclear	+ Regenerator celestial_nuclear
× Dynamo celestial_nuclear	+ Dynamo celestial_nuclear
^ Reactor celestial_nuclear	- Reactor celestial_nuclear
^ Oscillator celestial_nuclear	- Oscillator celestial_nuclear
^ Conductor celestial_nuclear	- Conductor celestial_nuclear
^ Catalyst celestial_nuclear	- Catalyst celestial_nuclear
^ Filter celestial_nuclear	- Filter celestial_nuclear
^ Encoder celestial_nuclear	- Encoder celestial_nuclear
^ Decoder celestial_nuclear	- Decoder celestial_nuclear
^ Regenerator celestial_nuclear	- Regenerator celestial_nuclear
^ Dynamo celestial_nuclear	- Dynamo celestial_nuclear

e Spiral (Energy Field)

e() Reactor celestial_nuclear	e^ Reactor celestial_nuclear
e() Oscillator celestial_nuclear	e^ Oscillator celestial_nuclear
e() Conductor celestial_nuclear	e^ Conductor celestial_nuclear
e() Catalyst celestial_nuclear	e^ Catalyst celestial_nuclear
e() Filter celestial_nuclear	e^ Filter celestial_nuclear
e() Encoder celestial_nuclear	e^ Encoder celestial_nuclear
e() Decoder celestial_nuclear	e^ Decoder celestial_nuclear
e() Regenerator celestial_nuclear	e^ Regenerator celestial_nuclear
e() Dynamo celestial_nuclear	e^ Dynamo celestial_nuclear
e× Reactor celestial_nuclear	e% Reactor celestial_nuclear
e× Oscillator celestial_nuclear	e% Oscillator celestial_nuclear
e× Conductor celestial_nuclear	e% Conductor celestial_nuclear
e× Catalyst celestial_nuclear	e% Catalyst celestial_nuclear
e× Filter celestial_nuclear	e% Filter celestial_nuclear
e× Encoder celestial_nuclear	e% Encoder celestial_nuclear
e× Decoder celestial_nuclear	e% Decoder celestial_nuclear
e× Regenerator celestial_nuclear	e% Regenerator celestial_nuclear
e× Dynamo celestial_nuclear	e% Dynamo celestial_nuclear

3 Domain Transitions

Transitions represent state changes or evolutionary paths within a domain family. Each domain family defines 12 canonical transitions that capture fundamental transformation processes.

3.1 Biological Domain Transitions

Biological transitions govern evolutionary processes, phase changes in cellular organization, and emergent behaviors in minimal replicators.

Token	Description
bio_transition_1	Conformational shift (prion-like template propagation)
bio_transition_2	Metabolic phase transition (quiescence \leftrightarrow active growth)
bio_transition_3	Replication initiation (dormant \rightarrow copying)
bio_transition_4	Aggregation clustering (monomers \rightarrow oligomers \rightarrow fibrils)
bio_transition_5	Horizontal gene transfer analogue (sequence exchange)
bio_transition_6	Error threshold crossing (stable \rightarrow error catastrophe)
bio_transition_7	Catalytic onset (passive \rightarrow enzymatic)
bio_transition_8	Compartmentalization (free \rightarrow membrane-bound)
bio_transition_9	Symbiotic coupling (independent \rightarrow mutualistic)
bio_transition_10	Dormancy induction (stress response, spore formation)
bio_transition_11	Phenotypic switch (bistability, hysteresis in gene circuits)
bio_transition_12	Extinction/clearance (population collapse, immune clearance)

3.2 Celestial Domain Transitions

Celestial transitions govern astrophysical processes including stellar evolution, accretion dynamics, and force regime changes.

Token	Description
celestial_transition_1	Gravitational collapse (cloud \rightarrow protostar)
celestial_transition_2	Fusion ignition (protostar \rightarrow main sequence star)
celestial_transition_3	Main sequence exit (hydrogen depletion)
celestial_transition_4	Red giant phase (shell burning, envelope expansion)
celestial_transition_5	Planetary nebula ejection (envelope loss)
celestial_transition_6	White dwarf cooling (degenerate remnant)
celestial_transition_7	Supernova explosion (core collapse or Type Ia)
celestial_transition_8	Neutron star formation (post-supernova collapse)
celestial_transition_9	Black hole formation (beyond neutron degeneracy)
celestial_transition_10	Accretion disk formation (matter infall, angular momentum)
celestial_transition_11	Magnetospheric coupling (field-dominated dynamics)
celestial_transition_12	Tidal disruption event (gravitational shearing)

4 Coherence Classes

Coherence classes represent stable organizational patterns or attractor states within a domain. Each domain family defines 15 coherence classes that capture recurring structural or dynamical motifs.

4.1 Biological Domain Coherence Classes

Token	Description
bio_coherence_1	Amyloid fibril structure (cross- β stacking)
bio_coherence_2	Biofilm matrix (extracellular polymer networks)
bio_coherence_3	Quorum sensing synchrony (population-level coordination)
bio_coherence_4	Circadian oscillator (biochemical clock)
bio_coherence_5	Metabolic cycle (glycolysis, TCA, circadian metabolite rhythms)
bio_coherence_6	RNA secondary structure (stem-loops, pseudoknots)
bio_coherence_7	Ribozyme catalytic core (conserved tertiary motif)
bio_coherence_8	Viral capsid geometry (icosahedral symmetry)
bio_coherence_9	Quasispecies cloud (error-coupled replicator ensemble)
bio_coherence_10	Protein folding funnel (energy landscape convergence)
bio_coherence_11	Allosteric network (long-range coupling in proteins)
bio_coherence_12	Gene regulatory motif (feed-forward loop, toggle switch)
bio_coherence_13	Chemotaxis gradient sensing (spatial information processing)
bio_coherence_14	Autoinducer feedback loop (self-reinforcing signaling)
bio_coherence_15	Replication-transcription coupling (co-localized synthesis)

4.2 Celestial Domain Coherence Classes

Token	Description
celestial_coherence_1	Keplerian orbit (stable elliptical motion)
celestial_coherence_2	Lagrange point equilibrium (gravitational balance)
celestial_coherence_3	Tidal locking (synchronous rotation)
celestial_coherence_4	Roche lobe geometry (equipotential surface)
celestial_coherence_5	Magnetic dynamo (self-sustaining field generation)
celestial_coherence_6	Stellar convection cell (Bénard-like circulation)
celestial_coherence_7	Accretion disk structure (Keplerian shear flow)
celestial_coherence_8	Magnetospheric current sheet (field topology)
celestial_coherence_9	Radiation pressure equilibrium (photon-matter balance)
celestial_coherence_10	Nuclear burning shell (fusion layer stratification)
celestial_coherence_11	Pulsar beaming cone (lighthouse effect)
celestial_coherence_12	Gravitational wave chirp (inspiral signature)
celestial_coherence_13	Plasma oscillation mode (Langmuir, Alfvén waves)
celestial_coherence_14	Magnetic reconnection site (topology change, energy release)

5 Implementation Notes

5.1 Computational Representation

Token sets can be implemented as:

- **Enumerated types** in strongly-typed languages (Rust, Haskell, TypeScript)
- **String constants** with namespace prefixes (Python, JavaScript)
- **Database schemas** with indexed lookup tables (SQL, NoSQL)
- **Graph nodes** in knowledge representation systems (RDF, Neo4j)

5.2 Token Parsing

Machine tokens follow the pattern:

```
[Spiral] [Operator] | [Machine] | [Domain]
```

Example parsing logic (pseudo-code):

```
token = "×|Encoder|bio_prion"
parts = token.split("|")
spiral_op = parts[0][0]      #
operator = parts[0][1]      # ×
machine = parts[1]          # Encoder
domain = parts[2]           # bio_prion
```

5.3 Cross-Domain Queries

Token sets enable systematic exploration:

- **Cross-spiral:** Compare Φ , e , π behaviors for fixed operator-machine-domain
- **Cross-operator:** Compare $()$, \times , \wedge , $\%$, $+$, $-$ for fixed spiral-machine-domain
- **Cross-machine:** Compare all 9 machines for fixed spiral-operator-domain
- **Cross-domain:** Compare biological vs. celestial analogs for fixed spiral-operator-machine

5.4 Usage Examples

Example 1: Query all Encoder tokens in biological domains

```
SELECT token FROM tokens
WHERE machine = "Encoder" AND domain LIKE "bio_%"
```

Returns 54 tokens (3 spirals \times 6 operators \times 3 bio domains)

Example 2: Compare fusion operators across domains

```
SELECT token FROM tokens
WHERE operator = "×" AND machine = "Catalyst"
```

Returns 18 tokens (3 spirals × 6 domains)

Example 3: Identify transition candidates for stellar evolution

```
SELECT token FROM transitions
WHERE token LIKE "celestial_transition_"
AND description LIKE "%fusion%"
```

Returns celestial_transition_2 (fusion ignition)

6 Validation and Completeness

6.1 Token Count Verification

Machine Tokens:

- Biological: $3 \text{ spirals} \times 6 \text{ operators} \times 9 \text{ machines} \times 3 \text{ domains} = 486$
- Celestial: $3 \text{ spirals} \times 6 \text{ operators} \times 9 \text{ machines} \times 3 \text{ domains} = 486$
- **Total: 972 machine tokens**

Transition Tokens:

- Biological: 12 transitions
- Celestial: 12 transitions
- **Total: 24 transition tokens**

Coherence Tokens:

- Biological: 15 coherence classes
- Celestial: 15 coherence classes
- **Total: 30 coherence tokens**

Grand Total: 1026 tokens

6.2 Structural Completeness

All combinations are enumerated:

- ✓ All 3 spirals (Φ , e , π) covered
- ✓ All 6 operators ($()$, \times , \wedge , $\%$, $+$, $-$) covered
- ✓ All 9 machines covered
- ✓ All 6 domains covered (3 bio + 3 celestial)
- ✓ 12 transitions per domain family
- ✓ 15 coherence classes per domain family

6.3 Naming Consistency

All tokens follow consistent naming conventions:

- Machine tokens: `[Spiral][Operator]|[Machine]|[Domain]`
- Transitions: `[family]_transition_[1-12]`
- Coherences: `[family]_coherence_[1-15]`

7 Future Extensions

7.1 Additional Domain Families

Future releases may include:

- **Quantum domain:** Covering quantum coherence, entanglement, decoherence
- **Neural domain:** Covering synaptic plasticity, network dynamics, learning
- **Social domain:** Covering collective behavior, information propagation, coordination
- **Technological domain:** Covering engineered systems, computation, networks

7.2 Directional Modulation (UMOL)

Current token set focuses on machine-domain combinations. Future versions will integrate:

- **u** (): Expansion / forward projection
- **d** (): Collapse / backward integration
- **m** (CLT): Modulation / coherence lock

Resulting in tokens of the form:

`[Direction] [Spiral] [Operator] | [Machine] | [Domain]`

Example: `u×|Encoder|bio_bacterium`

7.3 Regime Mappings

Future work will establish explicit mappings between token combinations and observable physical regimes (A1–A8 and beyond), enabling:

- Predictive sentence construction
- Regime classification from token patterns
- Cross-domain analogy identification
- Automated hypothesis generation

7.4 Integration with CET Framework

This token set is designed to integrate with the broader Coherent Emergence Theory (CET) framework, providing:

- Computational substrate for CET simulations
- Formalized vocabulary for theoretical developments
- Experimental design templates
- Cross-disciplinary translation layer

8 References and Resources

8.1 Related Documents

- **APL Operator’s Manual** — Complete operator reference guide
- **APL Seven Sentences Test Pack** — Falsifiable hypothesis testing framework
- **UMOL Specification** — Universal Modulation Operator Law documentation
- **CET Core Papers** — Theoretical foundations of Coherent Emergence Theory

8.2 Citation

If you use this token set in your research, please cite:

APL Domain Token Sets: Biological + Celestial Families v1.0
Alpha-Physical Language Research Collective (2025)
Complete token reference for computational implementation

8.3 Contact and Contributions

For questions, corrections, or proposed extensions:

- Open an issue in the repository
- Propose additional domains or coherence classes
- Submit computational implementations
- Report parsing errors or inconsistencies