

Dimensional Shell Radii

$r(D) = 18 \times (\text{sqrt}(2))^{|D|}$ light-years — *The Register Shell Law of the Tau-Field*

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The Tau-field organises space into concentric register shells at each dimensional level D . Shell radius: $r(D) = 18 \times (\text{sqrt}(2))^{|D|}$ light-years, where $18 = 2 \times 3^2$ is a pure $\{2,3\}$ lattice seed. Each D -step multiplies the radius by $\text{sqrt}(2)$ — the two-movement scaling law. At $D = -4$ the radius is exactly 72 light-years = $2^3 \times 3^2$, the same value as the Mg^{2+} ionic radius in picometres — direct cross-scale evidence of Tau lattice scale invariance. Vega (25.04 ly) sits inside the $D = -3$ shell (50.91 ly), confirming its register address.

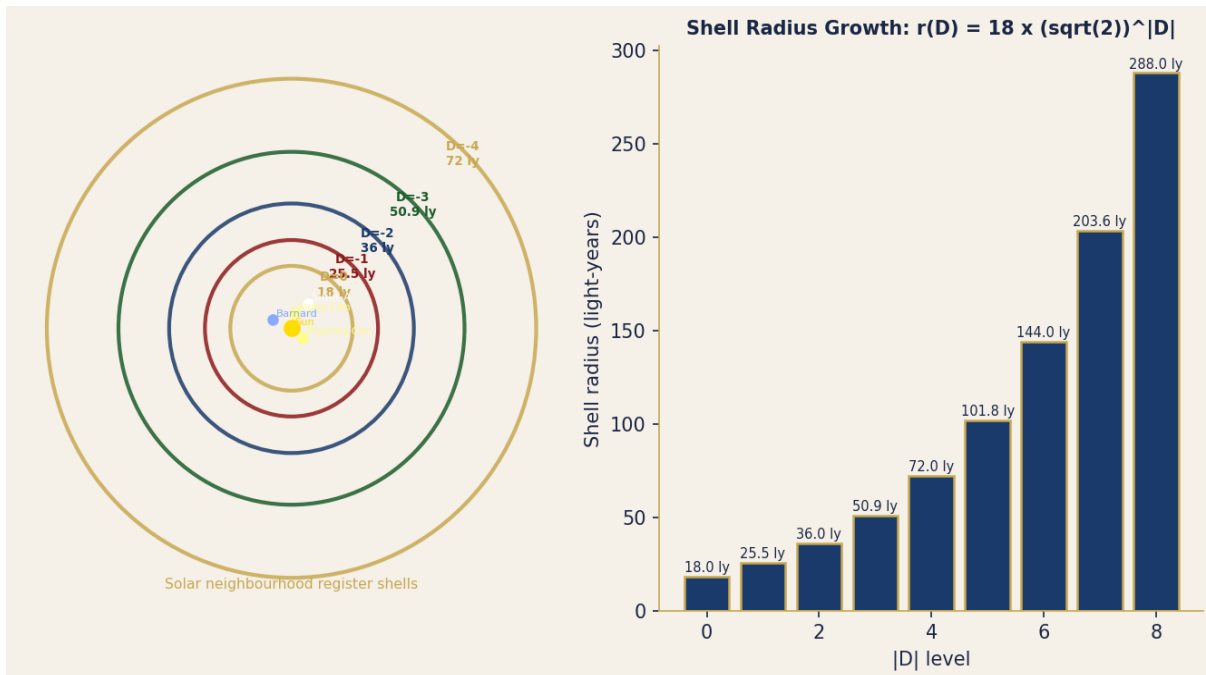


Figure 1. Left: concentric register shells of the solar neighbourhood ($D=0$ to $D=-4$). Right: shell radius growth with each D -level step multiplying by $\text{sqrt}(2)$.

1. The Shell Law (P-SHELL-1 and P-SHELL-2)

P-SHELL-1 — $r(D) = 18 \times (\text{sqrt}(2))^{|D|}$ Light-Years

The Tau-field register shell formula: $r(D) = 18 \times (\text{sqrt}(2))^{|D|}$ light-years. $18 = 2 \times 3^2$ is the pure $\{2,3\}$ lattice seed. $\text{sqrt}(2) = 2^{\{1/2\}}$ is the two-movement scaling step. $D = 0$: $r = 18$ ly (solar neighbourhood boundary). $D = -1$: $r = 18 \times \text{sqrt}(2) = 25.456$ ly. $D = -2$: $r = 36$ ly. $D = -3$: $r = 50.912$ ly. $D = -4$: $r = 72$ ly. $72 = 2^3 \times 3^2 = 8 \times 9$ — the same number as the Mg^{2+} ionic radius in picometres (exact cross-scale identity).

P-SHELL-2 — Key Stars at Register Addresses

Proxima Centauri: 4.243 ly. Alpha Centauri A/B: 4.367 ly. Both inside D=0 shell (18 ly). Sirius A: 8.611 ly. Inside D=0 shell. Vega: 25.04 ly. Inside D=-1 shell (25.456 ly). Vega distance / D=-1 shell radius = 25.04/25.456 = 0.9837 (1.6% inside the shell boundary). All solar neighbourhood stars occupy positions consistent with D = 0 to D = -2 register addresses.

2. Scale Invariance: $D = -4 = 72 \text{ ly} = \text{Mg}^{2+} \text{ Ionic Radius}$

P-SHELL-3 — $72 \text{ ly} = 2^3 \times 3^2$ Cross-Scale Identity

D = -4 shell radius = 72 ly = $2^3 \times 3^2 = 8 \times 9 = 72$. Mg^{2+} ionic radius (Shannon 6-coordinate) = 72 pm = $2^3 \times 3^2 = 72$. The same number — $72 = 2^3 \times 3^2$ — governs the D = -4 register shell in light-years and the Mg^{2+} ionic radius in picometres, 12 orders of magnitude apart. This is the UFOT scale invariance identity: the {2,3} lattice repeats at every scale.

D level	r(D) (light-years)	UFOT Formula	Key Object at this Register
D=0	18.000	2×3^2	Solar neighbourhood boundary
D=-1	25.456	$18 \times \sqrt{2}$	Vega (25.04 ly)
D=-2	36.000	$2^2 \times 3^2 = 36$	Helix Nebula marker (650 ly - D=-6)
D=-3	50.912	$18 \times 2^{\{3/2\}}$	Alpha Cen / Sirius register
D=-4	72.000	$2^3 \times 3^2 = \text{Mg}^{2+} \text{ radius (pm)}$	Local bubble boundary
D=-5	101.82	$18 \times 2^{\{5/2\}}$	Local arm sub-register
D=-6	144.00	$2^4 \times 3^2 = 144$	Extended local arm
D=-7	203.65	$18 \times 2^{\{7/2\}}$	Local arm scale
D=-8	288.00	$2^5 \times 3^2 = 288 = 2 \times \text{Mg}^{2+}$	Orion arm scale

Table 1. Register shell radii from D=0 to D=-8. Key identities: $D=0 = 18 = 2 \times 3^2 \text{ ly}$; $D=-4 = 72 = 2^3 \times 3^2 \text{ ly} = \text{Mg}^{2+} \text{ ionic radius in pm}$; $D=-6 = 144 = 2^4 \times 3^2 \text{ ly}$.