Supplementary Information

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1 Simulation details

Table 1 Simulation details for results shown in Figure 2 of main text. The table lists the x-value, the actual number of beads in each arm of the ABC molecule, the resulting morphology, the box size of the simulation, the value of the cohesion width and finally the packing fraction assuming beads of diameter σ.

x	Beads	Result	Box	w_c	Pf
0.17	6:6:1	[LAM]	22	1.4	0.41
0.20	5:5:1	[LAM]	22	1.4	0.41
0.25	4:4:1	[LAM]	20	1.4	0.43
0.17	12:12:2	[DIA]	30	1.6	0.47
0.18	11:11:2	[DIA]	30	1.6	0.48
0.20	10:10:2	[DIA]	35	1.2	0.45
0.22	9:9:2	[DIA]	32	1.2	0.44
0.25	8:8:2	[HAR]	25	1.2	0.38
0.33	3:3:1	[8.8.4]	20	1.4	0.42
0.33	6:6:2	[8.8.4]	25	1.2	0.40
0.4	5:5:2	[8.8.4]	20	1.2	0.42
0.5	4:4:2	[8.8.4]	20	1.6	0.43
0.5	6:6:3	[8.8.4]	20	1.6	0.42
0.66	3:3:2	[8.8.4]	20	1.2	0.41
1	2:2:2	[6.6.6]	20	1.4	0.41
1	3:3:3	[6.6.6]	25	1.2	0.34
1.33	3:3:4	[6.6.6]	20	1.4	0.40
1.5	2:2:3	[6.6.6]	20	1.0	0.42
1.66	3:3:5	[8.6.4;8.6.6]	20	1.4	0.39
2	2:2:4	[8.6.4;10.6.4]	20	1.2	0.47
2.33	3:3:7	[10.6.4;10.6.6]	20	1.6	0.41
2.5	2:2:5	[10.6.4;10.6.6]	20	1.6	0.38
3.5	2:2:7	[12.6.4]	20	1.4	0.42
4	2:2:8	[14.6.4;14.4.4]	26	1.4	0.39
4.5	2:2:9	[CYL]	25	1.6	0.42
5	2:2:10	[CYL]	25	1.6	0.43
5.5	2:2:11	[CYL]	25	1.6	0.43
6	2:2:12	[LAM_2]	25	1.4	0.40

2 An example of a script for Surface Evolver

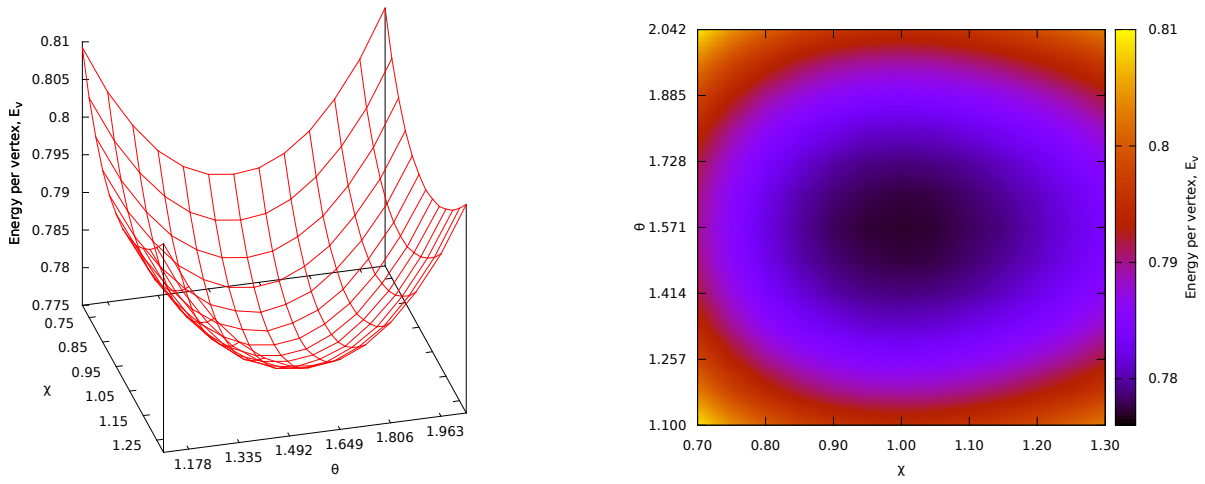
Using the following script in conjunction with Surface Evolver will lead to the minimisations outlined in the paper - in this case for the [8.8.4] pattern:

```
// String model initialization
space_dimension 2
string

// Properties of the unit cell
parameter AspectRatio = 1.0
parameter Angle = pi/2.0

// Considerations on the area of the pattern
parameter ValueOfX = 0.8
parameter Area1 = ValueOfX / (2.0 + ValueOfX)
parameter Area2 = (1.0 - Area1) / 2.0
parameter Area3 = (1.0 - Area1) / 2.0

// Derivation of the properties of the unit cell
parameter TotalArea = Area1 + Area2 + Area3
parameter CoordinateB = sqrt(TotalArea / (AspectRatio * sin(Angle)))
parameter CoordinateA = AspectRatio * CoordinateB

// Declaration of the unit cell
torus_filled
periods
CoordinateA             0
CoordinateB*cos(Angle)  CoordinateB*sin(Angle)

// Declaration of the vertices in the unit cell
vertices
1   0.05*CoordinateA 0.31*CoordinateB
2   0.16*CoordinateA 0.55*CoordinateB
3   0.39*CoordinateA 0.75*CoordinateB
4   0.62*CoordinateA 0.73*CoordinateB
5   0.81*CoordinateA 0.49*CoordinateB
6   0.98*CoordinateA 0.33*CoordinateB
7   0.71*CoordinateA 0.22*CoordinateB
8   0.52*CoordinateA 0.09*CoordinateB

// Characterization of the pattern via the connections of the unit cell
edges
1   1 2 * *
2   2 3 * *
3   3 4 * *
4   4 5 * *
5   5 6 * *
6   6 7 * *
7   7 8 * *
8   8 1 * *
9   3 8 * +
10  4 7 * +
```

```
11  5 2 + *
12  6 1 + *

// Declaration of the various domains
faces
1   -8 -7 -6 -5 -4 -3 -2 -1 color red
2   3 10 7 -9 color green
3   5 12 1 -11 color green
4   8 -12 6 -10 4 11 2 9 color blue

// Implementation of the area-constraints
bodies
1   1  volume Area2
2   2  volume Area1/2.0
3   3  volume Area1/2.0
4   4  volume Area3

// Rendering of the unit cell
read

show_bounding_box

show facets where 1

q
```

3 An example of an energy landscape as derived by Surface Evolver

The results of one analysis for a given x. We observe smooth energy surfaces leading to easily interpretable results - in this case, the optimal configuration of the [8.8.4] pattern at $x = 0.8$ yields a value for E_v of 0.777.



(a) (b)

Fig. 1 The energy landscape corresponding to the [8.8.4] pattern with $x = 0.8$ derived by the Surface Evolver computations. Each point in (a) represents a minimisation with the given pair of χ and θ. Likewise, (b) is a heat map of the same data; however, interpolation (by Gnuplot) between the points has been employed here. Notice, how $\theta = \pi/2$ and $\chi = 1$ yields the optimal energy-wise conditions for the pattern.

4 Barycentric embeddings of tiling patterns

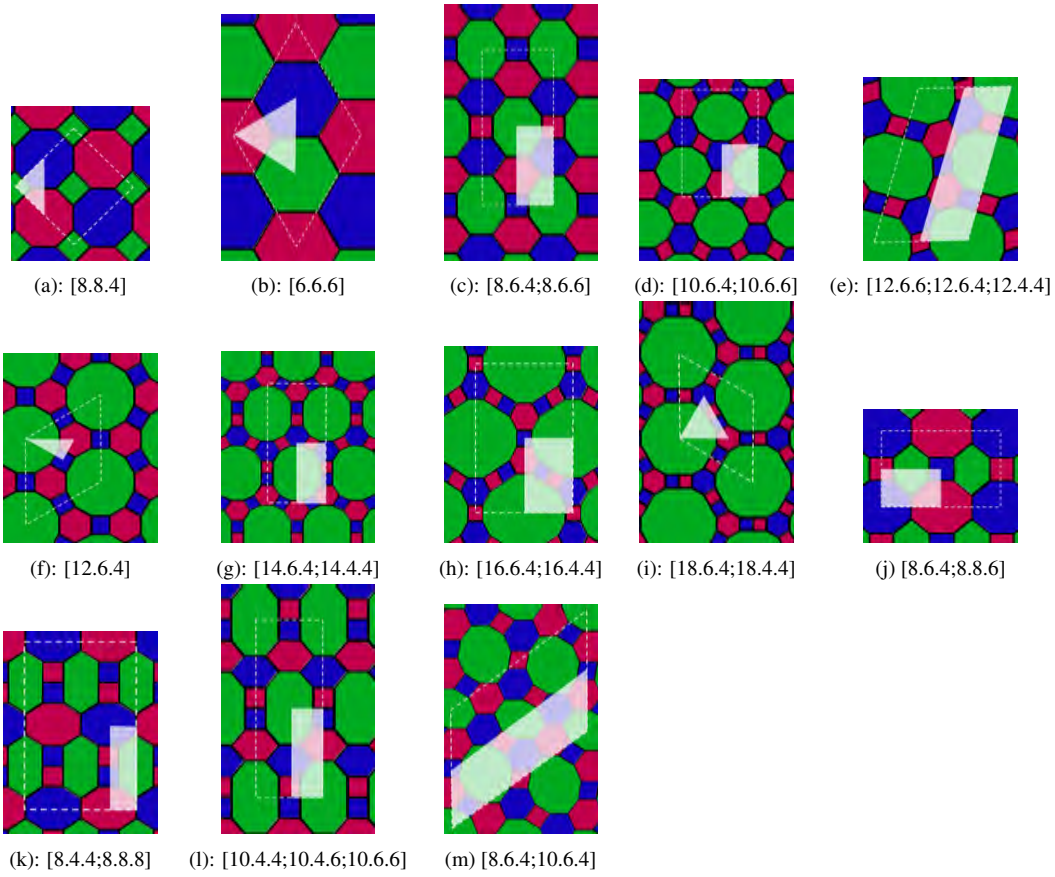


Fig. 2 Three-coloured barycentric embeddings of planar patterns formed by decorating discs with various spoke arrangements, *cf.* main text. Unit cells of the coloured patterns are marked by dashed white quadrilaterals; asymmetric domains of the planar tessellations by opaque white polygons.