Electronic Supplementary Information for: Stoichiometric Network Analysis in Reaction Networks Yielding Spontaneous Mirror Symmetry Breaking in Prebiotic Atmosphere

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The extreme currents matrix E and the explicit extreme currents of KNS-LES, KNSCI and KNSCI-LES models

Extreme currents matrix $\mathbf{E}$ of KNS-LES model.

$$\mathbf{E} = \begin{pmatrix}
0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&1&0&0&0&1&0&1\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&1&1\\
0&0&1&0&0&1&0&0&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&1&0&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&1&0&0&0&1&0&1&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&1&1&0&0\\
0&1&0&0&1&0&0&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&1&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&1&0&0&1&1&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&1&1&0&0&0&0&0&0\\
1&0&0&1&0&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&1&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&1&1&1&0&0&0&0&0&0&0&0&0\\
1&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0
\end{pmatrix},$$

here, the columns are the extreme currents E_p $(p = 1, \ldots, 24)$, from left to right, and the rows denote the reactions R_j $(j = 1, \ldots, 14)$ from top to bottom. We verified that $\nu\mathbf{E} = \mathbf{0}$ $(\Leftrightarrow \nu\mathbf{v} = \mathbf{0})$. The explicit extreme currents of the stoichiometric network of KNS-LES model are in Table S1.

Table S1. Extreme currents of KNS - LES model.

E_i	Subnetwork	Reactions
E_1	$INH + HCN + L\text{-}CN \rightharpoonup L\text{-}CN + D\text{-}CN$, $D\text{-}CN \rightharpoonup D\text{-}AA + NH_3$	R_{11}, R_{14}
E_2	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN$, $D\text{-}CN \rightharpoonup D\text{-}AA + NH_3$	R_7, R_{14}
E_3	$INH + HCN \rightharpoonup D\text{-}CN$, $D\text{-}CN \rightharpoonup D\text{-}AA + NH_3$	R_3, R_{14}
E_4	$INH + HCN + L\text{-}CN \rightharpoonup L\text{-}CN + D\text{-}CN$, $L\text{-}CN + D\text{-}CN \rightharpoonup INH + HCN + L\text{-}CN$	R_{11}, R_{12}
E_5	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN$, $D\text{-}CN + L\text{-}CN \rightharpoonup L\text{-}CN + INH + HCN$	R_7, R_{12}
E_6	$INH + HCN \rightharpoonup D\text{-}CN$, $D\text{-}CN + L\text{-}CN \rightharpoonup L\text{-}CN + INH + HCN$	R_3, R_{12}
E_7	$INH + HCN + L\text{-}CN \rightharpoonup L\text{-}CN + D\text{-}CN$, $2D\text{-}CN \rightharpoonup INH + HCN + D\text{-}CN$	R_{11}, R_8
E_8	$INH + HCN + L\text{-}CN \rightharpoonup L\text{-}CN + D\text{-}CN$, $D\text{-}CN \rightharpoonup INH + HCN$	R_{11}, R_4
E_9	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN$, $2D\text{-}CN \rightharpoonup INH + HCN + D\text{-}CN$	R_7, R_8
E_{10}	$INH + HCN \rightharpoonup D\text{-}CN$, $2D\text{-}CN \rightharpoonup INH + HCN + D\text{-}CN$	R_3, R_8
E_{11}	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN$, $D\text{-}CN \rightharpoonup INH + HCN$	R_7, R_4
E_{12}	$INH + HCN \rightharpoonup D\text{-}CN$, $D\text{-}CN \rightharpoonup INH + HCN$	R_3, R_4
E_{13}	$INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN$, $L\text{-}CN \rightharpoonup L\text{-}AA + NH_3$	R_9, R_{13}
E_{14}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN$, $L\text{-}CN \rightharpoonup L\text{-}AA + NH_3$	R_5, R_{13}
E_{15}	$INH + HCN \rightharpoonup L\text{-}CN$, $L\text{-}CN \rightharpoonup L\text{-}AA + NH_3$	R_1, R_{13}
E_{16}	$INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN$, $D\text{-}CN + L\text{-}CN \rightharpoonup INH + HCN + D\text{-}CN$	R_9, R_{10}
E_{17}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN$, $L\text{-}CN + D\text{-}CN \rightharpoonup D\text{-}CN + INH + HCN$	R_5, R_{10}
E_{18}	$INH + HCN \rightharpoonup L\text{-}CN$, $L\text{-}CN + D\text{-}CN \rightharpoonup D\text{-}CN + INH + HCN$	R_1, R_{10}
E_{19}	$INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN$, $2L\text{-}CN \rightharpoonup INH + HCN + L\text{-}CN$	R_9, R_6
E_{20}	$INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN$, $L\text{-}CN \rightharpoonup INH + HCN$	R_9, R_2
E_{21}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN$, $2L\text{-}CN \rightharpoonup INH + HCN + L\text{-}CN$	R_5, R_6
E_{22}	$INH + HCN \rightharpoonup L\text{-}CN$, $2L\text{-}CN \rightharpoonup INH + HCN + L\text{-}CN$	R_1, R_6
E_{23}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN$, $L\text{-}CN \rightharpoonup INH + HCN$	R_5, R_2
E_{24}	$INH + HCN \rightharpoonup L\text{-}CN$, $L\text{-}CN \rightharpoonup INH + HCN$	R_1, R_2

Extreme currents matrix $\mathbf{E}$ of KNSCI model.

$$\mathbf{E}=\begin{pmatrix}
0&0&0&0&0&1&0&0&0&1&1&1\\
0&0&0&0&0&0&1&0&0&1&0&0\\
0&1&0&1&0&0&0&0&1&0&0&1\\
0&0&1&1&0&0&0&0&0&0&0&0\\
0&0&0&0&1&0&1&1&1&0&0&0\\
0&0&0&0&1&1&0&0&0&0&0&0\\
1&0&1&0&0&0&0&1&0&0&1&0\\
1&1&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&1&1&0&1&1
\end{pmatrix},$$

each extreme current E_p $(p=1,...,12)$ represents a column vector of the matrix **E**. The explicit extreme currents of KNSCI model are in Table S2.

Table S2. Extreme currents of KNSCI model.

E_i	Subnetwork	Reactions
E_1	$INH+HCN+D\text{-}CN \rightharpoonup 2D\text{-}CN \rightharpoonup INH+HCN+D\text{-}CN$	$R_7,\ R_8$
E_2	$INH+HCN \rightharpoonup D\text{-}CN \xrightharpoonup{D\text{-}CN} INH+HCN+D\text{-}CN$	$R_3,\ R_8$
E_3	$INH+HCN+D\text{-}CN \rightharpoonup 2D\text{-}CN \xrightharpoonup{\text{-}D\text{-}CN} INH+HCN$	$R_7,\ R_4$
E_4	$INH+HCN \rightharpoonup D\text{-}CN \rightharpoonup INH+HCN$	$R_3,\ R_4$
E_5	$INH+HCN+L\text{-}CN \rightharpoonup 2L\text{-}CN \rightharpoonup INH+HCN+L\text{-}CN$	$R_5,\ R_6$
E_6	$INH+HCN \rightharpoonup L\text{-}CN \xrightharpoonup{L\text{-}CN} INH+HCN+L\text{-}CN$	$R_1,\ R_6$
E_7	$INH+HCN+L\text{-}CN \rightharpoonup 2L\text{-}CN \xrightharpoonup{\text{-}L\text{-}CN} INH+HCN$	$R_5,\ R_2$
E_8	$INH+HCN+D\text{-}CN \rightharpoonup 2D\text{-}CN$ $\xrightharpoonup{\text{-}D\text{-}CN,\text{-}L\text{-}CN} D,L\text{-}ADCN+NH_3$ $INH+HCN+L\text{-}CN \rightharpoonup 2L\text{-}CN$	$R_5,\ R_7,\ R_9$
E_9	$INH+HCN \rightharpoonup D\text{-}CN$ $\xrightharpoonup{\text{-}L\text{-}CN} D,L\text{-}ADCN+NH_3$ $INH+HCN+L\text{-}CN \rightharpoonup 2L\text{-}CN$	$R_3,\ R_5,\ R_9$
E_{10}	$INH+HCN \rightharpoonup L\text{-}CN \rightharpoonup INH+HCN$	$R_1,\ R_2$
E_{11}	$INH+HCN \rightharpoonup L\text{-}CN$ $\xrightharpoonup{\text{-}D\text{-}CN} D,L\text{-}ADCN+NH_3$ $INH+HCN+D\text{-}CN \rightharpoonup 2D\text{-}CN$	$R_1,\ R_7,\ R_9$
E_{12}	$INH+HCN \rightharpoonup D\text{-}CN$ $\rightharpoonup D,L\text{-}ADCN+NH_3$ $INH+HCN \rightharpoonup L\text{-}CN$	$R_1,\ R_3,\ R_9$

Extreme currents matrix $\mathbf{E}$ of KNSCI-LES model.

$$\mathbf{E}=\begin{pmatrix}
0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&1&1&1&1\\
0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1&0&0&0\\
0&0&1&0&0&0&1&0&1&0&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1\\
0&0&0&0&1&0&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&1&1&1&1&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&1&1&0&0&0&0&0&0&0&0\\
0&1&0&0&0&1&0&1&0&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1&0\\
0&0&0&1&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&1&0&0&1&1&1&1&1&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&1&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
1&0&0&1&1&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1&0&0\\
1&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&1&1&0&0&0&1&1&1&0&1&1&1
\end{pmatrix},$$

each extreme current E_p $(p=1,...,27)$ represents a column vector of matrix **E**. The explicit extreme currents of KNSIC-LES model are in Table S3.

Table S3. Extreme currents of KNSIC-LES model.

E_i	**Subnetwork**	**Reactions**
E_1	$INH + HCN + L\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN \rightharpoonup INH + HCN + L\text{-}CN$	R_{11}, R_{12}
E_2	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN \xrightarrow[\text{-}D\text{-}CN]{L\text{-}CN} INH + HCN + L\text{-}CN$	R_7, R_{12}
E_3	$INH + HCN \rightharpoonup D\text{-}CN \xrightarrow{L\text{-}CN} INH + HCN + L\text{-}CN$	R_3, R_{13}
E_4	$INH + HCN + L\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN \xrightarrow[\text{-}L\text{-}CN]{D\text{-}CN} INH + HCN + D\text{-}CN$	R_8, R_{11}
E_5	$INH + HCN + L\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN \xrightarrow{\text{-}L\text{-}CN} INH + HCN$	R_4, R_{11}
E_6	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN \rightharpoonup INH + HCN + D\text{-}CN$	R_7, R_8
E_7	$INH + HCN \rightharpoonup D\text{-}CN \xrightarrow{D\text{-}CN} INH + HCN + D\text{-}CN$	R_3, R_8
E_8	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN \xrightarrow{\text{-}D\text{-}CN} INH + HCN$	R_7, R_4
E_9	$INH + HCN \rightharpoonup D\text{-}CN \rightharpoonup INH + HCN$	R_3, R_4
E_{10}	$INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN \rightharpoonup INH + HCN + D\text{-}CN$	R_9, R_{10}
E_{11}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN \xrightarrow[\text{-}L\text{-}CN]{D\text{-}CN} INH + HCN + D\text{-}CN$	R_5, R_{10}
E_{12}	$INH + HCN \rightharpoonup L\text{-}CN \xrightarrow{D\text{-}CN} INH + HCN + D\text{-}CN$	R_1, R_{10}
E_{13}	$INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN \xrightarrow[\text{-}D\text{-}CN]{L\text{-}CN} INH + HCN + L\text{-}CN$	R_9, R_6
E_{14}	$INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN \xrightarrow{\text{-}D\text{-}CN} INH + HCN$	R_4, R_{11}
E_{15}	$INH + HCN + D\text{-}CN \rightharpoonup L\text{-}CN + D\text{-}CN$ $\xrightarrow[\text{-}L\text{-}CN]{\text{-}D\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + L\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN$	R_9, R_{11}, R_{13}
E_{16}	$INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN$ $\xrightarrow{\text{-}2D\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN$	R_7, R_9, R_{13}
E_{17}	$INH + HCN \rightharpoonup D\text{-}CN$ $\xrightarrow{\text{-}D\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + D\text{-}CN \rightharpoonup D\text{-}CN + L\text{-}CN$	R_3, R_9, R_{13}
E_{18}	$INH + HCN + D\text{-}CN \rightharpoonup 2L\text{-}CN \rightharpoonup INH + HCN + L\text{-}CN$	R_5, R_6
E_{19}	$INH + HCN \rightharpoonup L\text{-}CN \xrightarrow{L\text{-}CN} INH + HCN + L\text{-}CN$	R_1, R_6
E_{20}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN \xrightarrow{\text{-}L\text{-}CN} INH + HCN$	R_5, R_2
E_{21}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN$ $\xrightarrow{\text{-}2L\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + L\text{-}CN \rightharpoonup L\text{-}CN + D\text{-}CN$	R_5, R_{11}, R_{13}
E_{22}	$INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN$ $\xrightarrow[\text{-}L\text{-}CN]{\text{-}D\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN$	R_5, R_7, R_{13}
E_{23}	$INH + HCN \rightharpoonup D\text{-}CN$ $\xrightarrow{\text{-}L\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + L\text{-}CN \rightharpoonup 2L\text{-}CN$	R_3, R_5, R_{13}
E_{24}	$INH + HCN \rightharpoonup L\text{-}CN \rightharpoonup INH + HCN$	R_1, R_2
E_{25}	$INH + HCN \rightharpoonup L\text{-}CN$ $\xrightarrow{\text{-}L\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + L\text{-}CN \rightharpoonup L\text{-}CN + D\text{-}CN$	R_1, R_{11}, R_{13}
E_{26}	$INH + HCN \rightharpoonup L\text{-}CN$ $\xrightarrow{\text{-}D\text{-}CN} D, L\text{-}ADCN$ $INH + HCN + D\text{-}CN \rightharpoonup 2D\text{-}CN$	R_1, R_7, R_{13}
E_{27}	$INH + HCN \rightharpoonup L\text{-}CN$ $\longrightarrow D, L\text{-}ADCN$ $INH + HCN \rightharpoonup D\text{-}CN$	R_1, R_3, R_{13}