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PA 17551. *The Category of A_∞ -Bialgebras and Applications.*

We construct the free matron \mathcal{H}_∞ realized by acyclic polytopes $KK_{n,m} = KK_{m,n}$ of which $KK_{0,n}$ is the Stasheff polytope K_{n+1} . A map of matrons $\mathcal{H}_\infty \rightarrow \text{End}(TA)$ defines an A_∞ -bialgebra structure on A . We construct the free relative matron $\mathcal{J}\mathcal{J}_\infty$, which is an \mathcal{H}_∞ -bimodule realized by acyclic polytopes $\{JJ_{n,m} = JJ_{m,n}\}$ of which $JJ_{0,n}$ is the multiplihedron J_{n+1} . A map of relative matrons $\mathcal{J}\mathcal{J}_\infty \rightarrow \text{Hom}(TA, TB)$ defines a morphism of A_∞ -bialgebras $A \rightarrow B$. We prove that the homology of every DG bialgebra (and the integral loop space homology in particular) is an A_∞ -bialgebra.

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