- CCC with strong graded monad
- Strong Graded Monad Laws:
  - Unitor Law

$$\begin{array}{ccc} \mathtt{1} \times T_\epsilon A & \xrightarrow{\mathtt{t}_{\epsilon,\mathtt{1},A}} & T_\epsilon(\mathtt{1} \times A) \\ & \searrow^{\lambda_{T_\epsilon A}} & \downarrow{\scriptstyle T_\epsilon(\lambda_A)} \\ & & T_\epsilon A \end{array}$$

  - left-right unit

$$\begin{array}{ccc} T_\epsilon A & \xrightarrow{T_\epsilon \eta_A} & T_\epsilon T_{\mathtt{1}} A \\ & \searrow^{\mathtt{Id}_{T_\epsilon A}} & \downarrow{\scriptstyle \mu_{\epsilon,\mathtt{1},A}} \\ & & T_\epsilon A \end{array}$$

$$\begin{array}{ccc} T_\epsilon A & \xrightarrow{\eta_{T_\epsilon A}} & T_{\mathtt{1}} T_{\mathtt{1}} A \\ & \searrow^{\mathtt{Id}_{T_\epsilon A}} & \downarrow{\scriptstyle \mu_{\mathtt{1},\epsilon,A}} \\ & & T_\epsilon A \end{array}$$

  - mu

$$\begin{array}{ccc} T_{\epsilon_1} T_{\epsilon_2} T_{\epsilon_3} A & \xrightarrow{\mu_{\epsilon_1,\epsilon_2,T_{\epsilon_3}A}} & T_{\epsilon_1 \cdot \epsilon_2} T_{\epsilon_3} A \\ \downarrow{\scriptstyle T_{\epsilon_1}\mu_{\epsilon_2,\epsilon_3,A}} & & \downarrow{\scriptstyle \mu_{\epsilon_1\cdot\epsilon_2,\epsilon_3,A}} \\ T_{\epsilon_1} T_{\epsilon_2\cdot\epsilon_3} A & \xrightarrow{\mu_{\epsilon_1,\epsilon_2\cdot\epsilon_3,A}} & T_{\epsilon_1\cdot\epsilon_2\cdot\epsilon_3} A \end{array}$$

  - t and mu

$$\begin{array}{ccccc} A \times T_{\epsilon_1} T_{\epsilon_2} B & \xrightarrow{\mathtt{t}_{\epsilon_1,A,T_{\epsilon_2}B}} & T_{\epsilon_1}(A \times T_{\epsilon_2} B) & \xrightarrow{T_{\epsilon_1}\mathtt{t}_{\epsilon_2,A,B}} & T_{\epsilon_1} T_{\epsilon_2}(A \times B) \\ & \searrow^{\mathtt{Id}_A \times \mu_{\epsilon_1,\epsilon_2,B}} & & & \downarrow{\scriptstyle \mu_{\epsilon_1,\epsilon_2,A\times B}} \\ & & A \times T_{\epsilon_1\cdot\epsilon_2} B & \xrightarrow{\mathtt{t}_{\epsilon_1\cdot\epsilon_2,A,B}} & T_{\epsilon_1\cdot\epsilon_2}(A \times B) \end{array}$$

  - t and sub-effecting

$$\begin{array}{ccc} A \times T_{\epsilon_1} B & \xrightarrow{\mathtt{Id}_A \times [\![\epsilon_1 \le \epsilon_2]\!]_{\mathtt{M},B}} & A \times T_{\epsilon_2} B \\ \downarrow{\scriptstyle \mathtt{t}_{\epsilon_1,A,B}} & & \downarrow{\scriptstyle \mathtt{t}_{\epsilon_2,A,B}} \\ T_{\epsilon_1}(A \times B) & \xrightarrow{[\![\epsilon_1 \le \epsilon_2]\!]_{\mathtt{M},A\times B}} & T_{\epsilon_2}(A \times B) \end{array}$$

  - t and id times f

$$\begin{array}{ccc} A \times T_\epsilon B & \xrightarrow{\mathtt{Id}_A \times T_\epsilon f} & A \times T_\epsilon B' \\ \downarrow{\scriptstyle \mathtt{t}_{\epsilon,A,B}} & & \downarrow{\scriptstyle \mathtt{t}_{\epsilon,A,B'}} \\ T_\epsilon(A \times B) & \xrightarrow{T_\epsilon(\mathtt{Id}_A \times f)} & T_\epsilon(A \times B') \end{array}$$

$$\begin{array}{ccc} A \times T_\epsilon B & \xrightarrow{f \times \mathtt{Id}_{T_\epsilon B}} & A' \times T_\epsilon B \\ \downarrow{\scriptstyle \mathtt{t}_{\epsilon,A,B}} & & \downarrow{\scriptstyle \mathtt{t}_{\epsilon,A',B}} \\ T_\epsilon(A \times B) & \xrightarrow{T_\epsilon(f \times \mathtt{Id}_B)} & T_\epsilon(A' \times B) \end{array}$$