x	term variable
α	type variable
T	type constructor
c	coercion variable
i	index metavariable

t	::=		term
	$\vert$	x	variable
	$\vert$	$\lambda(x : \tau) \Rightarrow t$	abstraction
	$\vert$	$\lambda\{\alpha\} \Rightarrow t$	type abstraction
	$\vert$	$\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow t$	coercion abstraction
	$\vert$	$t_1\, t_2$	application
	$\vert$	$t\ [\tau]$	type application
	$\vert$	$t\ {\sim}[\gamma]$	coercion application
	$\vert$	$t \blacktriangleright \gamma$	coercion
τ	::=		type
	$\vert$	α	type variable
	$\vert$	T	type constructor
	$\vert$	$\tau_1 \rightarrow \tau_2$	arrow
	$\vert$	$\{\tau_1 \sim \tau_2\} \rightarrow \tau_3$	coercion arrow
	$\vert$	$\forall\, \alpha, \tau$	universal quantification
γ	::=		coercion proof term
	$\vert$	c	variable
	$\vert$	$\mathbf{refl}\, \tau$	reflexivity
	$\vert$	$\mathbf{sym}\, \gamma$	symmetry
	$\vert$	$\gamma_1 \circ \gamma_2$	composition
	$\vert$	$\gamma_1 \rightarrow \gamma_2$	arrow introduction
	$\vert$	$\{\gamma_1 \sim \gamma_2\} \rightarrow \gamma_3$	coercion arrow introduction
	$\vert$	$\forall\, \alpha, \gamma$	universal quantification introduction
	$\vert$	$\gamma\ @\ \tau$	instantiation (quantification elimination)
	$\vert$	$\mathbf{elim}_{\mathrm{i}}\, \gamma$	generalized elimination
Γ	::=		typing environment
	$\vert$	$\emptyset$	empty
	$\vert$	$\Gamma, x : \tau$	variable
	$\vert$	Γ, T	type constructor
	$\vert$	Γ, α	type variable
	$\vert$	$\Gamma, c : \tau_1 \sim \tau_2$	coercion variable
tv	::=		typed value
	$\vert$	$\lambda(x : \tau) \Rightarrow t$	abstraction
	$\vert$	$\lambda\{\alpha\} \Rightarrow tv$	type abstraction
	$\vert$	$\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow tv$	coercion abstraction
	$\vert$	$tv\ [\tau]$	type application
	$\vert$	$tv\ {\sim}[\gamma]$	coercion application
	$\vert$	$tv \blacktriangleright \gamma$	coercion

v	::=		value
	|	$\lambda x \Rightarrow t$	abstraction

Initial environment: $\Gamma = \emptyset$

$\boxed{\Gamma \vdash t : \tau}$ Typing rules

$$\frac{x : \tau \in \Gamma}{\Gamma \vdash x : \tau} \quad \text{T\_VAR}$$

$$\frac{\Gamma, x : \tau_1 \vdash t : \tau_2 \qquad \Gamma \vdash \tau_1}{\Gamma \vdash (\lambda(x : \tau_1) \Rightarrow t) : \tau_1 \to \tau_2} \quad \text{T\_ABS}$$

$$\frac{\alpha \notin \Gamma \qquad \Gamma, \alpha \vdash t : \tau}{\Gamma \vdash (\lambda\{\alpha\} \Rightarrow t) : \forall\, \alpha, \tau} \quad \text{T\_TYABS}$$

$$\frac{\Gamma, c : \tau_1 \sim \tau_2 \vdash t : \tau_3 \qquad \Gamma \vdash \tau_1 \qquad \Gamma \vdash \tau_2}{\Gamma \vdash (\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow t) : \{\tau_1 \sim \tau_2\} \to \tau_3} \quad \text{T\_CABS}$$

$$\frac{\Gamma \vdash t_1 : \tau_2 \to \tau_1 \qquad \Gamma \vdash t_2 : \tau_2}{\Gamma \vdash t_1\ t_2 : \tau_1} \quad \text{T\_APP}$$

$$\frac{\Gamma \vdash t : \forall\, \alpha, \tau_2 \qquad \Gamma \vdash \tau_1 \qquad [\alpha \mapsto \tau_1]\tau_2 \rhd \tau_2'}{\Gamma \vdash t\ [\tau_1] : \tau_2'} \quad \text{T\_TYAPP}$$

$$\frac{\Gamma \vdash t : \{\tau_1 \sim \tau_2\} \to \tau_3 \qquad \Gamma \vdash \gamma : \tau_1 \sim \tau_2}{\Gamma \vdash t \sim\![\gamma] : \tau_3} \quad \text{T\_CAPP}$$

$$\frac{\Gamma \vdash \gamma : \tau_1 \sim \tau_2 \qquad \Gamma \vdash t : \tau_1}{\Gamma \vdash (t \blacktriangleright \gamma) : \tau_2} \quad \text{T\_COERCE}$$

$\boxed{\Gamma \vdash \gamma : \tau_1 \sim \tau_2}$ Coercion typing

$$\frac{c : \tau_1 \sim \tau_2 \in \Gamma}{\Gamma \vdash c : \tau_1 \sim \tau_2} \quad \text{C\_VAR}$$

$$\frac{\Gamma \vdash \tau}{\Gamma \vdash \mathbf{refl}\, \tau : \tau \sim \tau} \quad \text{C\_REFL}$$

$$\frac{\Gamma \vdash \gamma : \tau_2 \sim \tau_1}{\Gamma \vdash \mathbf{sym}\, \gamma : \tau_1 \sim \tau_2} \quad \text{C\_SYM}$$

$$\frac{\Gamma \vdash \gamma_1 : \tau_1 \sim \tau_2 \qquad \Gamma \vdash \gamma_2 : \tau_2 \sim \tau_3}{\Gamma \vdash \gamma_1 \circ \gamma_2 : \tau_1 \sim \tau_3} \quad \text{C\_COMP}$$

$$\frac{\Gamma \vdash \gamma_1 : \tau_1 \sim \tau_1' \qquad \Gamma \vdash \gamma_2 : \tau_2 \sim \tau_2' \qquad \Gamma \vdash \tau_1 \to \tau_2}{\Gamma \vdash (\gamma_1 \to \gamma_2) : (\tau_1 \to \tau_2) \sim (\tau_1' \to \tau_2')} \quad \text{C\_ARROW}$$

$$\frac{\begin{array}{c}\Gamma \vdash \gamma_1 : \tau_1 \sim \tau_1' \qquad \Gamma \vdash \gamma_2 : \tau_2 \sim \tau_2' \qquad \Gamma \vdash \gamma_3 : \tau_3 \sim \tau_3' \\ \Gamma \vdash \{\tau_1 \sim \tau_2\} \to \tau_3\end{array}}{\Gamma \vdash (\{\gamma_1 \sim \gamma_2\} \to \gamma_3) : (\{\tau_1 \sim \tau_2\} \to \tau_3) \sim (\{\tau_1' \sim \tau_2'\} \to \tau_3')} \quad \text{C\_CARROW}$$

$$\frac{\alpha \notin \Gamma \qquad \Gamma, \alpha \vdash \gamma : \tau_1 \sim \tau_2 \qquad \Gamma \vdash \forall\, \alpha, \tau_1}{\Gamma \vdash (\forall\, \alpha, \gamma) : (\forall\, \alpha, \tau_1) \sim (\forall\, \alpha, \tau_2)} \quad \text{C\_FORALL}$$

$$\frac{\Gamma \vdash \tau_1 \qquad \Gamma \vdash \gamma : (\forall\, \alpha_1, \tau_2) \sim (\forall\, \alpha_2, \tau_3) \qquad [\alpha_1 \mapsto \tau_1]\tau_2 \rhd \tau_2' \qquad [\alpha_2 \mapsto \tau_1]\tau_3 \rhd \tau_3'}{\Gamma \vdash \gamma\ @\ \tau_1 : \tau_2' \sim \tau_3'} \quad \text{C\_INST}$$

$$\frac{i\ \in \{1, 2\} \qquad \Gamma \vdash \gamma : (\tau_1 \to \tau_2) \sim (\tau_1' \to \tau_2')}{\Gamma \vdash \mathbf{elim}_{\mathrm{i}}\, \gamma : \tau_i \sim \tau_i'} \quad \text{C\_ELIMARROW}$$

$$\frac{i\ \in \{1, 2, 3\} \qquad \Gamma \vdash \gamma : (\{\tau_1 \sim \tau_2\} \to \tau_3) \sim (\{\tau_1' \sim \tau_2'\} \to \tau_3')}{\Gamma \vdash \mathbf{elim}_{\mathrm{i}}\, \gamma : \tau_i \sim \tau_i'} \quad \text{C\_ELIMCARROW}$$

$\boxed{\Gamma \vdash \tau}$ Type τ is well formed

$$\frac{\alpha\ \in \Gamma}{\Gamma \vdash \alpha} \quad \text{K\_VAR}$$

$$\frac{T\ \in \Gamma}{\Gamma \vdash T} \quad \text{K\_TYPECONSTR}$$

$$\frac{\Gamma \vdash \tau_1 \qquad \Gamma \vdash \tau_2}{\Gamma \vdash \tau_1 \to \tau_2} \quad \text{K\_ARROW}$$

$$\frac{\Gamma \vdash \tau_1 \qquad \Gamma \vdash \tau_2 \qquad \Gamma \vdash \tau_3}{\Gamma \vdash \{\tau_1 \sim \tau_2\} \to \tau_3} \quad \text{K\_CARROW}$$

$$\frac{\alpha\ \notin \Gamma \qquad \Gamma, \alpha \vdash \tau}{\Gamma \vdash \forall\, \alpha, \tau} \quad \text{K\_FORALL}$$

$\boxed{t \longrightarrow tv}$ Operational semantics

$$\frac{t_2 \longrightarrow tv_2 \qquad t_1\ tv_2 \longrightarrow tv_3}{t_1\ t_2 \longrightarrow tv_3} \quad \text{E\_APP1}$$

$$\frac{t \longrightarrow tv_1 \qquad tv_1\ tv_2 \longrightarrow tv_3}{t\ tv_2 \longrightarrow tv_3} \quad \text{E\_APP2}$$

$$\frac{[x \mapsto tv_1]t \rhd t' \qquad t' \longrightarrow tv_2}{(\lambda(x : \tau) \Rightarrow t)\ tv_1 \longrightarrow tv_2} \quad \text{E\_APPABS}$$

$$\frac{t \longrightarrow tv}{(\lambda\{\alpha\} \Rightarrow t) \longrightarrow (\lambda\{\alpha\} \Rightarrow tv)} \quad \text{E\_TABS}$$

$$\frac{t \longrightarrow tv}{(\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow t) \longrightarrow (\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow tv)} \quad \text{E\_CABS}$$

$$\frac{t \longrightarrow tv}{t\ [\tau] \longrightarrow tv\ [\tau]} \quad \text{E\_TAPP}$$

$$\frac{[\alpha \mapsto \tau]t \rhd t' \qquad t' \longrightarrow tv}{(\lambda\{\alpha\} \Rightarrow t)\ [\tau] \longrightarrow tv} \quad \text{E\_TAPPABS}$$

$$\frac{t \longrightarrow tv}{t\ {\sim}[\gamma] \longrightarrow tv\ {\sim}[\gamma]} \quad \text{E\_CAPP}$$

$$\frac{[c \mapsto \gamma]t \rhd t' \qquad t' \longrightarrow tv}{(\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow t)\ {\sim}[\gamma] \longrightarrow tv} \quad \text{E\_CAPPABS}$$

$$\frac{t \longrightarrow tv}{(t \blacktriangleright \gamma) \longrightarrow (tv \blacktriangleright \gamma)} \quad \text{E\_COERCE}$$

$\boxed{tv \longrightarrow v}$ type erasure

$$\frac{}{(\lambda (x : \tau) \Rightarrow t) \longrightarrow (\lambda x \Rightarrow t)} \quad \textsc{Erase\_Abs}$$

$$\frac{tv \longrightarrow v}{(\lambda \{\alpha\} \Rightarrow tv) \longrightarrow v} \quad \textsc{Erase\_TAbs}$$

$$\frac{tv \longrightarrow v}{(\lambda \{c : \tau_1 \sim \tau_2\} \Rightarrow tv) \longrightarrow v} \quad \textsc{Erase\_CAbs}$$

$$\frac{tv \longrightarrow v}{(tv\ [\tau]) \longrightarrow v} \quad \textsc{Erase\_TApp}$$

$$\frac{tv \longrightarrow v}{(tv\ {\sim}[\gamma]) \longrightarrow v} \quad \textsc{Erase\_CApp}$$

$$\frac{tv \longrightarrow v}{(tv \blacktriangleright \gamma) \longrightarrow v} \quad \textsc{Erase\_Coerce}$$

$\boxed{[\alpha \mapsto \tau_1]\tau_2 \rhd \tau_3}$ Type substitution

$$\frac{}{[\alpha \mapsto \tau]\alpha \rhd \tau} \quad \textsc{SubstT\_Var1}$$

$$\frac{\alpha_1 \neq \alpha_2}{[\alpha_1 \mapsto \tau]\alpha_2 \rhd \alpha_2} \quad \textsc{SubstT\_Var2}$$

$$\frac{}{[\alpha \mapsto \tau]T \rhd T} \quad \textsc{SubstT\_Type}$$

$$\frac{[\alpha \mapsto \tau_1]\tau_2 \rhd \tau_2' \qquad [\alpha \mapsto \tau_1]\tau_3 \rhd \tau_3'}{[\alpha \mapsto \tau_1](\tau_2 \to \tau_3) \rhd \tau_2' \to \tau_3'} \quad \textsc{SubstT\_Arrow}$$

$$\frac{[\alpha \mapsto \tau_1]\tau_2 \rhd \tau_2' \qquad [\alpha \mapsto \tau_1]\tau_3 \rhd \tau_3' \qquad [\alpha \mapsto \tau_1]\tau_4 \rhd \tau_4'}{[\alpha \mapsto \tau_1](\{\tau_2 \sim \tau_3\} \to \tau_4) \rhd (\{\tau_2' \sim \tau_3'\} \to \tau_4')} \quad \textsc{SubstT\_CArrow}$$

$$\frac{\alpha_1 \neq \alpha_2 \qquad [\alpha_1 \mapsto \tau_1]\tau_2 \rhd \tau_2'}{[\alpha_1 \mapsto \tau_1](\forall\, \alpha_2, \tau_2) \rhd (\forall\, \alpha_2, \tau_2')} \quad \textsc{SubstT\_Forall}$$

$\boxed{[x \mapsto tv]t_1 \rhd t_2}$ substitution

$$\frac{}{[x \mapsto tv]x \rhd tv} \quad \textsc{Subst\_Var1}$$

$$\frac{x_1 \neq x_2}{[x_1 \mapsto tv]x_2 \rhd x_2} \quad \textsc{Subst\_Var2}$$

$$\frac{}{[x \mapsto tv](\lambda (x : \tau) \Rightarrow t) \rhd (\lambda (x : \tau) \Rightarrow t)} \quad \textsc{Subst\_Abs1}$$

$$\frac{x_1 \neq x_2 \qquad [x_1 \mapsto tv]t_1 \rhd t_2}{[x_1 \mapsto tv](\lambda (x_2 : \tau) \Rightarrow t_1) \rhd (\lambda (x_2 : \tau) \Rightarrow t_2)} \quad \textsc{Subst\_Abs2}$$

$$\frac{[x \mapsto tv]t_1 \rhd t_2}{[x \mapsto tv](\lambda \{\alpha\} \Rightarrow t_1) \rhd (\lambda \{\alpha\} \Rightarrow t_2)} \quad \textsc{Subst\_TAbs}$$

$$\frac{[x \mapsto tv]t_1 \rhd t_2}{[x \mapsto tv](\lambda \{c : \tau_1 \sim \tau_2\} \Rightarrow t_1) \rhd (\lambda \{c : \tau_1 \sim \tau_2\} \Rightarrow t_2)} \quad \textsc{Subst\_CAbs}$$

$$\frac{[x \mapsto tv]t_1 \rhd t_1' \qquad [x \mapsto tv]t_2 \rhd t_2'}{[x \mapsto tv](t_1\ t_2) \rhd t_1'\ t_2'} \quad \textsc{Subst\_App}$$

$$\frac{[x \mapsto tv]t_1 \rhd t_2}{[x \mapsto tv](t_1\ [\tau]) \rhd (t_2\ [\tau])} \quad \textsc{Subst\_TApp}$$

$$\frac{[x \mapsto tv]t_1 \rhd t_2}{[x \mapsto tv](t_1 \sim[\gamma]) \rhd (t_2 \sim[\gamma])} \quad \textsc{Subst\_CApp}$$

$$\frac{[x \mapsto tv]t_1 \rhd t_2}{[x \mapsto tv](t_1 \blacktriangleright \gamma) \rhd (t_2 \blacktriangleright \gamma)} \quad \textsc{Subst\_Coerce}$$

$\boxed{[\alpha \mapsto \tau]t_1 \rhd t_2}$ substitution of type variable in term

$$\frac{}{[\alpha \mapsto \tau]x \rhd x} \quad \textsc{TtSubst\_Var}$$

$$\frac{[\alpha \mapsto \tau_1]\tau_2 \rhd \tau_2' \qquad [\alpha \mapsto \tau_1]t_1 \rhd t_2}{[\alpha \mapsto \tau_1](\lambda(x:\tau_2) \Rightarrow t_1) \rhd (\lambda(x:\tau_2') \Rightarrow t_2)} \quad \textsc{TtSubst\_Abs}$$

$$\frac{\alpha_1 \neq \alpha_2 \qquad [\alpha_1 \mapsto \tau]t_1 \rhd t_2}{[\alpha_1 \mapsto \tau](\lambda\{\alpha_2\} \Rightarrow t_1) \rhd (\lambda\{\alpha_2\} \Rightarrow t_2)} \quad \textsc{TtSubst\_TAbs}$$

$$\frac{[\alpha \mapsto \tau_1]\tau_2 \rhd \tau_2' \qquad [\alpha \mapsto \tau_1]\tau_3 \rhd \tau_3' \qquad [\alpha \mapsto \tau_1]t_1 \rhd t_2}{[\alpha \mapsto \tau_1](\lambda\{c:\tau_2 \sim \tau_3\} \Rightarrow t_1) \rhd (\lambda\{c:\tau_2' \sim \tau_3'\} \Rightarrow t_2)} \quad \textsc{TtSubst\_CAbs}$$

$$\frac{[\alpha \mapsto \tau]t_1 \rhd t_1' \qquad [\alpha \mapsto \tau]t_2 \rhd t_2'}{[\alpha \mapsto \tau](t_1\ t_2) \rhd t_1'\ t_2'} \quad \textsc{TtSubst\_App}$$

$$\frac{[\alpha \mapsto \tau_1]t_1 \rhd t_2 \qquad [\alpha \mapsto \tau_1]\tau_2 \rhd \tau_2'}{[\alpha \mapsto \tau_1](t_1\ [\tau_2]) \rhd (t_2\ [\tau_2'])} \quad \textsc{TtSubst\_TApp}$$

$$\frac{[\alpha \mapsto \tau]t_1 \rhd t_2 \qquad [\alpha \mapsto \tau]\gamma_1 \rhd \gamma_2}{[\alpha \mapsto \tau](t_1 \sim[\gamma_1]) \rhd (t_2 \sim[\gamma_2])} \quad \textsc{TtSubst\_CApp}$$

$$\frac{[\alpha \mapsto \tau]t_1 \rhd t_2 \qquad [\alpha \mapsto \tau]\gamma_1 \rhd \gamma_2}{[\alpha \mapsto \tau](t_1 \blacktriangleright \gamma_1) \rhd (t_2 \blacktriangleright \gamma_2)} \quad \textsc{TtSubst\_Coerce}$$

$\boxed{[\alpha \mapsto \tau]\gamma_1 \rhd \gamma_2}$ substitution of type variable in coercion term

$$\frac{}{[\alpha \mapsto \tau]c \rhd c} \quad \textsc{aCSubst\_Var}$$

$$\frac{[\alpha \mapsto \tau_1]\tau_2 \rhd \tau_2'}{[\alpha \mapsto \tau_1](\mathbf{refl}\,\tau_2) \rhd \mathbf{refl}\,\tau_2'} \quad \textsc{aCSubst\_Refl}$$

$$\frac{[\alpha \mapsto \tau]\gamma_1 \rhd \gamma_2}{[\alpha \mapsto \tau](\mathbf{sym}\,\gamma_1) \rhd \mathbf{sym}\,\gamma_2} \quad \textsc{aCSubst\_Sym}$$

$$\frac{[\alpha \mapsto \tau]\gamma_1 \rhd \gamma_1' \qquad [\alpha \mapsto \tau]\gamma_2 \rhd \gamma_2'}{[\alpha \mapsto \tau](\gamma_1 \circ \gamma_2) \rhd \gamma_1' \circ \gamma_2'} \quad \textsc{aCSubst\_Comp}$$

$$\frac{[\alpha \mapsto \tau]\gamma_1 \rhd \gamma_1' \qquad [\alpha \mapsto \tau]\gamma_2 \rhd \gamma_2'}{[\alpha \mapsto \tau](\gamma_1 \to \gamma_2) \rhd \gamma_1' \to \gamma_2'} \quad \textsc{aCSubst\_Arrow}$$

$$\frac{[\alpha \mapsto \tau]\gamma_1 \rhd \gamma_1' \qquad [\alpha \mapsto \tau]\gamma_2 \rhd \gamma_2' \qquad [\alpha \mapsto \tau]\gamma_3 \rhd \gamma_3'}{[\alpha \mapsto \tau](\{\gamma_1 \sim \gamma_2\} \to \gamma_3) \rhd (\{\gamma_1' \sim \gamma_2'\} \to \gamma_3')} \quad \textsc{aCSubst\_CArrow}$$

$$\frac{\alpha_1 \neq \alpha_2 \qquad [\alpha_1 \mapsto \tau]\gamma_1 \rhd \gamma_2}{[\alpha_1 \mapsto \tau](\forall\,\alpha_2, \gamma_1) \rhd (\forall\,\alpha_2, \gamma_2)} \quad \textsc{aCSubst\_Forall}$$

$$\frac{[\alpha \mapsto \tau_1]\gamma_1 \rhd \gamma_2 \qquad [\alpha \mapsto \tau_1]\tau_2 \rhd \tau_3}{[\alpha \mapsto \tau_1](\gamma_1 \mathbin{@} \tau_2) \rhd \gamma_2 \mathbin{@} \tau_3} \quad \textsc{aCSubst\_Inst}$$

$$\frac{[\alpha \mapsto \tau]\gamma_1 \rhd \gamma_2}{[\alpha \mapsto \tau](\mathbf{elim}_{\mathrm{i}}\,\gamma_1) \rhd \mathbf{elim}_{\mathrm{i}}\,\gamma_2} \quad \textsc{aCSubst\_Elim}$$

$\boxed{[c \mapsto \gamma]t_1 \rhd t_2}$ substitution of coercion variable in term

$$\frac{}{[c \mapsto \gamma]x \rhd x} \quad \textsc{CtSubst\_Var}$$

$$\frac{[c \mapsto \gamma]t_1 \rhd t_2}{[c \mapsto \gamma](\lambda(x : \tau) \Rightarrow t_1) \rhd (\lambda(x : \tau) \Rightarrow t_2)} \quad \textsc{CtSubst\_Abs}$$

$$\frac{[c \mapsto \gamma]t_1 \rhd t_2}{[c \mapsto \gamma](\lambda\{\alpha\} \Rightarrow t_1) \rhd (\lambda\{\alpha\} \Rightarrow t_2)} \quad \textsc{CtSubst\_TAbs}$$

$$\frac{}{[c \mapsto \gamma](\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow t) \rhd (\lambda\{c : \tau_1 \sim \tau_2\} \Rightarrow t)} \quad \textsc{CtSubst\_CAbs1}$$

$$\frac{c_1 \neq c_2 \qquad [c_1 \mapsto \gamma]t_1 \rhd t_2}{[c_1 \mapsto \gamma](\lambda\{c_2 : \tau_1 \sim \tau_2\} \Rightarrow t_1) \rhd (\lambda\{c_2 : \tau_1 \sim \tau_2\} \Rightarrow t_2)} \quad \textsc{CtSubst\_CAbs2}$$

$$\frac{[c \mapsto \gamma]t_1 \rhd t_1' \qquad [c \mapsto \gamma]t_2 \rhd t_2'}{[c \mapsto \gamma](t_1\ t_2) \rhd t_1'\ t_2'} \quad \textsc{CtSubst\_App}$$

$$\frac{[c \mapsto \gamma]t_1 \rhd t_2}{[c \mapsto \gamma](t_1\ [\tau]) \rhd (t_2\ [\tau])} \quad \textsc{CtSubst\_TApp}$$

$$\frac{[c \mapsto \gamma_1]t_1 \rhd t_2 \qquad [c \mapsto \gamma_1]\gamma_2 \rhd \gamma_2'}{[c \mapsto \gamma_1](t_1 \sim[\gamma_2]) \rhd (t_2 \sim[\gamma_2'])} \quad \textsc{CtSubst\_CApp}$$

$$\frac{[c \mapsto \gamma_1]t_1 \rhd t_2 \qquad [c \mapsto \gamma_1]\gamma_2 \rhd \gamma_2'}{[c \mapsto \gamma_1](t_1 \blacktriangleright \gamma_2) \rhd (t_2 \blacktriangleright \gamma_2')} \quad \textsc{CtSubst\_Coerce}$$

$\boxed{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_3}$ substitution of coercion variable in coercion term

$$\frac{}{[c \mapsto \gamma]c \rhd \gamma} \quad \textsc{CCSubst\_Var1}$$

$$\frac{c_1 \neq c_2}{[c_1 \mapsto \gamma]c_2 \rhd c_2} \quad \textsc{CCSubst\_Var2}$$

$$\frac{}{[c \mapsto \gamma](\mathbf{refl}\,\tau) \rhd \mathbf{refl}\,\tau} \quad \textsc{CCSubst\_Refl}$$

$$\frac{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_3}{[c \mapsto \gamma_1](\mathbf{sym}\,\gamma_2) \rhd \mathbf{sym}\,\gamma_3} \quad \textsc{CCSubst\_Sym}$$

$$\frac{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_2' \qquad [c \mapsto \gamma_1]\gamma_3 \rhd \gamma_3'}{[c \mapsto \gamma_1](\gamma_2 \circ \gamma_3) \rhd \gamma_2' \circ \gamma_3'} \quad \textsc{CCSubst\_Comp}$$

$$\frac{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_2' \qquad [c \mapsto \gamma_1]\gamma_3 \rhd \gamma_3'}{[c \mapsto \gamma_1](\gamma_2 \to \gamma_3) \rhd \gamma_2' \to \gamma_3'} \quad \textsc{CCSubst\_Arrow}$$

$$\frac{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_2' \qquad [c \mapsto \gamma_1]\gamma_3 \rhd \gamma_3' \qquad [c \mapsto \gamma_1]\gamma_4 \rhd \gamma_4'}{[c \mapsto \gamma_1](\{\gamma_2 \sim \gamma_3\} \to \gamma_4) \rhd (\{\gamma_2' \sim \gamma_3'\} \to \gamma_4')} \quad \textsc{CCSubst\_CArrow}$$

$$\frac{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_3}{[c \mapsto \gamma_1](\forall\,\alpha, \gamma_2) \rhd (\forall\,\alpha, \gamma_3)} \quad \textsc{CCSubst\_Forall}$$

$$\frac{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_3}{[c \mapsto \gamma_1](\gamma_2 \ @\ \tau) \rhd \gamma_3 \ @\ \tau} \quad \textsc{CCSubst\_Inst}$$

$$\frac{[c \mapsto \gamma_1]\gamma_2 \rhd \gamma_3}{[c \mapsto \gamma_1](\mathbf{elim}_{\mathrm{i}}\, \gamma_2) \rhd \mathbf{elim}_{\mathrm{i}}\, \gamma_3} \quad \textsc{CCSubst\_Elim}$$

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Definition rules:        91 good    0 bad
Definition rule clauses: 174 good    0 bad
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