Unproven conjectures required (directly or indirectly) to prove _psi_t_var_formula

proveit.core_expr_types.conditionals.satisfied_condition_reduction

$$\forall_{a, Q~|~Q}~\left(\{a \textrm{ if } Q~.~ = a\right)$$

proveit.core_expr_types.lambda_maps.general_lambda_substitution

$$\forall_{i \in \mathbb{N}^+}~\left[\forall_{f, g, Q}~\left(\begin{array}{c} \left[\forall_{a_{1}, a_{2}, \ldots, a_{i}~|~Q\left(a_{1}, a_{2}, \ldots, a_{i}\right)}~\left(f\left(a_{1}, a_{2}, \ldots, a_{i}\right) = g\left(a_{1}, a_{2}, \ldots, a_{i}\right)\right)\right] \Rightarrow \\ \left(\begin{array}{c} \left[\left(b_{1}, b_{2}, \ldots, b_{i}\right) \mapsto \left\{f\left(b_{1}, b_{2}, \ldots, b_{i}\right) \textrm{ if } Q\left(b_{1}, b_{2}, \ldots, b_{i}\right)~.\right.\right] = \\ \left[\left(c_{1}, c_{2}, \ldots, c_{i}\right) \mapsto \left\{g\left(c_{1}, c_{2}, \ldots, c_{i}\right) \textrm{ if } Q\left(c_{1}, c_{2}, \ldots, c_{i}\right)~.\right.\right] \end{array}\right) \end{array}\right)\right]$$

proveit.core_expr_types.operations.operands_substitution_via_tuple

$$\forall_{n \in \mathbb{N}}~\left[\forall_{f, x_{1}, x_{2}, \ldots, x_{n}, y_{1}, y_{2}, \ldots, y_{n}~|~\left(x_{1}, x_{2}, \ldots, x_{n}\right) = \left(y_{1}, y_{2}, \ldots, y_{n}\right)}~\left(\begin{array}{c} f\left(x_{1}, x_{2}, \ldots, x_{n}\right) = \\ f\left(y_{1}, y_{2}, \ldots, y_{n}\right) \end{array}\right)\right]$$

proveit.core_expr_types.tuples.extended_range_from1_len_typical_eq

$$\forall_{f, x}~\left[\forall_{i \in \mathbb{N}}~\left(|\left(f\left(1\right), f\left(2\right), \ldots, f\left(i\right), x\right)| = |\left(1, 2, \ldots, \left(i + 1\right)\right)|\right)\right]$$

proveit.core_expr_types.tuples.general_len

$$\forall_{n \in \mathbb{N}^+}~\left[\begin{array}{l} \forall_{f_{1}, f_{2}, \ldots, f_{n}, i_{1}, i_{2}, \ldots, i_{n}, j_{1}, j_{2}, \ldots, j_{n}~|~\left(\left(j_{1} - i_{1} + 1\right) \in \mathbb{N}\right), \left(\left(j_{2} - i_{2} + 1\right) \in \mathbb{N}\right), \ldots, \left(\left(j_{n} - i_{n} + 1\right) \in \mathbb{N}\right)} \\ \left(\begin{array}{l} |\left(f_{1}\left(i_{1}\right), f_{1}\left(i_{1} + 1\right), \ldots, f_{1}\left(j_{1}\right), f_{2}\left(i_{2}\right), f_{2}\left(i_{2} + 1\right), \ldots, f_{2}\left(j_{2}\right), \ldots\ldots, f_{n}\left(i_{n}\right), f_{n}\left(i_{n} + 1\right), \ldots, f_{n}\left(j_{n}\right)\right)| \\ = \left(\left(j_{1} - i_{1} + 1\right) + \left(j_{2} - i_{2} + 1\right) + \ldots + \left(j_{n} - i_{n} + 1\right)\right) \end{array}\right) \end{array}\right]$$

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Axioms required (directly or indirectly) to prove _psi_t_var_formula

proveit.core_expr_types.lambda_maps.lambda_substitution

$$\forall_{i \in \mathbb{N}^+}~\left[\forall_{f, g}~\left(\begin{array}{c} \left[\forall_{a_{1}, a_{2}, \ldots, a_{i}}~\left(f\left(a_{1}, a_{2}, \ldots, a_{i}\right) = g\left(a_{1}, a_{2}, \ldots, a_{i}\right)\right)\right] \Rightarrow \\ \left(\begin{array}{c} \left[\left(b_{1}, b_{2}, \ldots, b_{i}\right) \mapsto f\left(b_{1}, b_{2}, \ldots, b_{i}\right)\right] = \\ \left[\left(c_{1}, c_{2}, \ldots, c_{i}\right) \mapsto g\left(c_{1}, c_{2}, \ldots, c_{i}\right)\right] \end{array}\right) \end{array}\right)\right]$$

proveit.core_expr_types.operations.operands_substitution

$$\forall_{n \in \mathbb{N}}~\left[\forall_{f, x_{1}, x_{2}, \ldots, x_{n}, y_{1}, y_{2}, \ldots, y_{n}~|~\left(x_{1} = y_{1}\right), \left(x_{2} = y_{2}\right), \ldots, \left(x_{n} = y_{n}\right)}~\left(\begin{array}{c} f\left(x_{1}, x_{2}, \ldots, x_{n}\right) = \\ f\left(y_{1}, y_{2}, \ldots, y_{n}\right) \end{array}\right)\right]$$

proveit.core_expr_types.tuples.empty_range_def

$$\forall_{f, i, j~|~\left(j + 1\right) = i}~\left(\left(f\left(i\right), f\left(i + 1\right), \ldots, f\left(j\right)\right) = \left(\right)\right)$$

proveit.core_expr_types.tuples.range_extension_def

$$\forall_{f, i, j~|~|\left(f\left(i\right), f\left(i + 1\right), \ldots, f\left(j\right)\right)| \in \mathbb{N}}~\left(\begin{array}{c} \left(f\left(i\right), f\left(i + 1\right), \ldots, f\left(j + 1\right)\right) = \\ \left(f\left(i\right), f\left(i + 1\right), \ldots, f\left(j\right), f\left(j + 1\right)\right) \end{array}\right)$$

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Conservative definitions used (but not logically required) to prove _psi_t_var_formula

proveit.physics.quantum.QPE._psi_t_def

$$\forall_{t \in \mathbb{N}^+}~\left(\lvert \psi_{t} \rangle = \left(\left(\frac{1}{\sqrt{2}} \cdot \left(\lvert 0 \rangle + \left(\mathsf{e}^{2 \cdot \pi \cdot \mathsf{i} \cdot 2^{t - 1} \cdot \varphi} \cdot \lvert 1 \rangle\right)\right)\right) {\otimes} \left(\frac{1}{\sqrt{2}} \cdot \left(\lvert 0 \rangle + \left(\mathsf{e}^{2 \cdot \pi \cdot \mathsf{i} \cdot 2^{t - 2} \cdot \varphi} \cdot \lvert 1 \rangle\right)\right)\right) {\otimes} \ldots {\otimes} \left(\frac{1}{\sqrt{2}} \cdot \left(\lvert 0 \rangle + \left(\mathsf{e}^{2 \cdot \pi \cdot \mathsf{i} \cdot 2^{0} \cdot \varphi} \cdot \lvert 1 \rangle\right)\right)\right)\right)\right)$$

Theorems/conjectures that depend directly on _psi_t_var_formula

proveit.physics.quantum.QPE._alpha_m_evaluation

$$\forall_{m \in \{0~..~2^{t} - 1\}}~\left(\alpha_{m} = \left(\frac{1}{2^{t}} \cdot \left(\sum_{k=0}^{2^{t} - 1} \left(\mathsf{e}^{-\frac{2 \cdot \pi \cdot \mathsf{i} \cdot k \cdot m}{2^{t}}} \cdot \mathsf{e}^{2 \cdot \pi \cdot \mathsf{i} \cdot \varphi \cdot k}\right)\right)\right)\right)$$