Research
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RESEARCH NOTES

Primes (part 05): Relationship between $\bar{n}$ and $\bar{n}\prime$

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Abstract

This notes gives a short overview over the relationship between $\bar{n}$ and $\bar{n}\prime$.

Content

$\bar{n}_1 = (2x_1+1)(2u_1+1) - 2\Delta_1$

$\bar{n}_1' = (2x_1'+1)(2u_1'+1) - 2\Delta_1'\Delta x_{1,2}$

$x_1 = x_1' + \Delta x_1'$

$u_1 = u_1' + \Delta u_1'$

$\mathcal{E} + \frac{1}{\Delta x_{1,2}}\Delta_1$ ⟶ $-2\Delta_1'\Delta x_{1,2}$

$= -2(\mathcal{E} + \frac{1}{\Delta x_{1,2}}\Delta x_{1,2}\Delta_1)$

$= \cancel{-2\mathcal{E}} - 2(\mathcal{E} + \Delta_1)$

$\Rightarrow$ $\cancel{(2x_1'+1}$

$(2(x_1'+\Delta x_1')+1)(2(u_1'+\Delta u_1')+1) - 2\Delta_1$

$= (2x_1'+1)(2u_1'+1) - 2\Delta x_{1,2}\Delta_1'$

$(2x_1'+1)(2(u_1'+\Delta u_1')+1) + 2\Delta x_1'(2(u_1'+\Delta u_1')+1) - 2\Delta_1$

$= (2x_1'+1)(2u_1'+1) - 2\Delta x_{1,2}\Delta_1'$

$\cancel{(2x_1'+1)(2u_1'+1)} + (2x_1'+1)(2\Delta u_1') + 2\Delta x_1'(2u_1'+1)$

$+ 2\Delta x_1'\cdot(2\Delta u_1') - 2\Delta_1$

$= \cancel{(2x_1'+1)(2u_1'+1)} - 2\Delta x_{1,2}\Delta_1'$

$x_1' = x_1 - \Delta x_1'$

$\Rightarrow x_1' = x_1 - \Delta_1 n_x \Delta x_{1,2}$

$u_1' = u_1 - \Delta u_1'$

$= u_1 - \Delta_1 n_u \Delta x_{1,2}$

$(2x_1'+1)(2\Delta u_1') + 2\Delta x_1'(2(u_1'+\Delta u_1')+1) - 2\Delta_1$

$= -2\Delta x_{1,2}\Delta_1'$

$\Delta u_1' = \Delta_1\cdot\Delta u_{1,\beta}'$

$= \Delta_1\cdot n_u\Delta x_{1,2}$

$\Delta x_1' = \Delta_1\cdot\Delta x_{1,\beta}'$

$= \Delta_1\cdot n_x\Delta x_{1,2}$

$$\Delta_1' = \frac{(2x_1'+1)(\cancel{2}\Delta u_1') + \cancel{2}\Delta x_1'(2(u_1'+\Delta u_1')+1) - \cancel{2}\Delta_1}{2\Delta x_{1,2}}$$

$$= \frac{(2x_1'+1)(\Delta u_1') + \Delta x_1'(2(u_1'+\Delta u_1')+1) - \Delta_1}{\Delta x_{1,2}}$$

$$= \Delta_1\frac{(2x_1'+1)(\Delta u_{1\beta}') + \Delta x_{1\beta}'(2(u_1'+\Delta u_{1\beta}')+1) - 1}{\Delta x_{1,2}}$$

Be $x_{1\beta} := \beta\cdot x_1$

$$= \Delta_1\frac{(2x_1'+1)(\Delta u_{1\beta}') + \Delta x_{1\beta}'(2u_1'+1) + \Delta x_{1\beta}'\Delta u_{1\beta}' 1 - 1}{\Delta x_{1,2}}$$

$$= \Delta_1\frac{(2x_1'+1)(n_u\Delta x_{1,2}) + (n_x\Delta x_{1,2})(2u_1'+1) + n_u\Delta x_{1,2}\cdot n_x\Delta x_{1,2} - 1}{\Delta x_{1,2}}$$

$\Delta x_{1\beta}'\Delta u_{1\beta}' - 1 = n\Delta x_{1,2}$

$\Delta x_{1\beta}' = \frac{n\cdot\Delta x_{1,2}+1}{\Delta u_{1\beta}'}$

~~Be $\Delta u_{1\beta}' = 1$~~

~~$\Rightarrow \Delta x_{1\beta}' = n\cdot\Delta x_{1,2}+1$~~

$\Delta_1' = \underbrace{\Delta_1[(2x_1'+1)n_u + n_x(2u_1'+1) + n_u n_x\Delta x_{1,2}]}_{=:\mathcal{E}}$

$-\underbrace{\frac{1}{\Delta x_{1,2}}}_{①}\cdot\Delta_1$ if $\Delta x_{1,2} > 1$ $\Rightarrow \lim_{\Delta x_{1,2}\to\infty} ① \to 0$

$$\Delta_1' = \Delta_1\left[(2x_1'+1)n_u + n_x(2u_1'+1) + n_u n_x \Delta x_{1/2}\right] - \Delta_1 \frac{1}{\Delta x_{1/2}}$$

$$\begin{aligned} &= \Delta_1\Big[(2(x_1 - \Delta_1 n_x \Delta x_{1/2}) + 1)n_u + \\ &\qquad + n_x(2(u_1' - \Delta_1 n_u \Delta x_{1/2}) + 1) + n_u n_x \Delta x_{1/2}\Big] - \Delta_1 \frac{1}{\Delta x_{1/2}} \end{aligned}$$

$$\begin{aligned} &= \Delta_1\Big[(2x_1+1)n_u - 2\Delta_1 n_x n_u \Delta x_{1/2} \\ &\qquad + (2u_1+1)n_x - 2\Delta_1 n_x n_u \Delta x_{1/2} + n_u n_x \Delta x_{1/2}\Big] - \Delta_1 \frac{1}{\Delta x_{1/2}} \end{aligned}$$

$$\begin{aligned} \Delta_1' &= \Delta_1\Big[(2x_1+1)n_u + (2u_1+1)n_x - 4\Delta_1 n_x n_u \Delta x_{1/2} \\ &\qquad + n_x n_u \Delta x_{1/2}\Big] - \Delta_1 \frac{1}{\Delta x_{1/2}} \end{aligned}$$

$$\bar{n}_1' = (2x_1'+1)(2u_1'+1) - 2\Delta_1' \Delta x_{1/2}$$

(with $n_x = 1 = n_u$)

$$\begin{aligned} \Rightarrow \bar{n}_1' &= (2x_1'+1)(2u_1'+1) \\ &\quad - 2\left\{\Delta_1\left[(2x_1'+1)n_u + (2u_1'+1)n_x + \cancel{\Delta x_{1/2}}^{\,n_u n_x \Delta x_{1/2}}\right] - \frac{\Delta_1}{\Delta x_{1/2}}\right\}\Delta x_{1/2} \\ &= (2x_1'+1)(2u_1'+1) \\ &\quad - \left\{2\Delta_1\left[(2x_1'+1)n_u + (2u_1'+1)n_x + n_u n_x \Delta x_{1/2}\right]\right\}\Delta x_{1/2} \\ &\quad - \left\{2 \cdot \frac{\Delta_1}{\Delta x_{1/2}}\right\}\Delta x_{1/2} \end{aligned}$$

$$\begin{aligned} \bar{n}_1' &= (2x_1'+1)(2u_1'+1) \\ &\quad - 2\Delta_1 \Delta x_{1/2}\left[(2x_1'+1)n_u + (2u_1'+1)n_x + n_u n_x \Delta x_{1/2}\right] \\ &\quad - 2\Delta_1 \end{aligned}$$

$$\begin{aligned} (2x_1'+1)(2u_1'+1) &= (2(x_1 - \Delta_1 n_x \Delta x_{1/2}) + 1)(2(u_1 - \Delta_1 n_u \Delta x_{1/2}) + 1) \\ &= (2x_1+1)(2(u_1 - \Delta_1 n_u \Delta x_{1/2}) + 1) \\ &\quad - (2\Delta_1 n_x \Delta x_{1/2})(2(u_1 - \Delta_1 n_u \Delta x_{1/2}) + 1) \\ &= (2x_1+1)(2u_1+1) - (2x_1+1)(2\Delta_1 n_u \Delta x_{1/2}) \\ &\quad - (2\Delta_1 n_x \Delta x_{1/2})(2u_1+1) \\ &\quad + (2\Delta_1 n_x \Delta x_{1/2})(2\Delta_1 n_u \Delta x_{1/2}) \end{aligned}$$

$$\begin{aligned}\bar{n}_1' = {} & (2x_1+1)(2u_1+1) \\ & - (2x_1+1)(2\Delta_1 n_u \Delta x_{1/2}) \\ & - (2\Delta_1 n_x \Delta x_{1/2})(2(u_1 - \Delta_1 n_u \Delta x_{1/2})+1) \\ & - 2\Delta_1 \Delta x_{1/2}\Big[(2(x_1 - \Delta_1 n_x \Delta x_{1/2})+1) n_u \\ & \qquad + (2(u_1 - \Delta_1 n_u \Delta x_{1/2})+1) \quad + n_u n_x \Delta x_{1/2}\Big] \\ & - 2\Delta_1\end{aligned}$$

$$\begin{aligned}\bar{n}_1' = {} & (2x_1+1)(2u_1+1) \\ & - (2x_1+1)(2\Delta_1 n_u \Delta x_{1/2}) \quad \checkmark \\ & - (2\Delta_1 n_x \Delta x_{1/2})(2(u_1 - \Delta_1 n_u \Delta x_{1/2})+1) \quad \checkmark \\ & - (2\Delta_1 \Delta x_{1/2})(2x_1+1) n_u \quad \checkmark \\ & + (2\Delta_1 \Delta x_{1/2})(2\Delta_1 n_x \Delta x_{1/2} n_u) \quad \checkmark \\ & - (2\Delta_1 \Delta x_{1/2})(2(u_1 - \Delta_1 n_u \Delta x_{1/2})+1) \quad \checkmark \\ & - (2\Delta_1 \Delta x_{1/2})(n_u n_x \Delta x_{1/2}) \\ & - 2\Delta_1\end{aligned}$$

$$\boxed{\begin{aligned}\bar{n}_1' = {} & (2x_1+1)(2u_1+1) \\ & - (2x_1+1)(2\Delta_1 \Delta x_{1/2})(2n_u) \\ & - (2\Delta_1 n_x \Delta x_{1/2})(2u_1+1) \\ & + (2\Delta_1 n_x \Delta x_{1/2})(2\Delta_1 n_u \Delta x_{1/2}) \\ & + (2\Delta_1 \Delta x_{1/2})(2\Delta_1 n_x \Delta x_{1/2} n_u) \\ & - (2\Delta_1 \Delta x_{1/2})(2u_1+1) \\ & + (2\Delta_1 \Delta x_{1/2})(2\Delta_1 n_u \Delta x_{1/2}) \\ & - (2\Delta_1 \Delta x_{1/2})(n_u n_x \Delta x_{1/2}) \\ & - 2\Delta_1\end{aligned}}$$

$\boxed{n_x, n_u \in \mathbb{Z}}$