Any function \( M \) obeys the same \( \Gamma \) problem

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\int_{\Omega} \varphi = 0
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\int_{\Omega} \varphi = \int_{\Omega} \varphi
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K-P Z equation via dressing method

Let\( x = 1 \)

\( x \)
\[ m = -3 u + 3 \]

\[
\left( \frac{2x_0}{\partial x_2} - \frac{P_n}{\partial y} \right) = \frac{x_e}{x_e} - 6 u - 12 = \frac{x_e}{1 x_e} - 12 = m
\]

\[
\frac{x_e}{1 x_e} + \frac{x_e}{1 x_e} = \frac{x_0}{x_e} = \frac{2}{2}
\]

\[
\frac{x_n}{x_n} + \frac{x_e}{\partial x_e} + \frac{x_e}{\partial x_e} = \frac{x_0}{1 x_e}
\]

Hence \( L = 0 \)

Hence \( y = \) new

\[
L = -12 \quad \text{or} \quad \frac{x_e}{\partial x_e}
\]

\[
V = -6 u
\]

We demand \( L + \frac{x_e}{\partial x_e} \)

\[
\ldots + \frac{x_0}{x_0} + \frac{x_0}{x_0} + 1 = p
\]

\[ \boxed{3 \quad \text{is explained in the asymptotic series} \} \]
\[ 0 = \left( \frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2} + \frac{\partial^2 \varphi}{\partial z^2} \right) \frac{\partial \varphi}{\partial x} + \left( \frac{\partial \varphi}{\partial y} + \frac{\partial \varphi}{\partial z} \right) \frac{\partial \varphi}{\partial y} + \frac{\partial \varphi}{\partial z} \frac{\partial \varphi}{\partial z} \]

Using expressions for \( \psi \) we find

\[ 0 = \frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2} + \frac{\partial^2 \varphi}{\partial z^2} \frac{\partial \varphi}{\partial x} + \left( \frac{\partial \varphi}{\partial y} + \frac{\partial \varphi}{\partial z} \right) \frac{\partial \varphi}{\partial y} + \frac{\partial \varphi}{\partial z} \frac{\partial \varphi}{\partial z} \]

\[ A_i = -\frac{\partial \varphi}{\partial x}, \quad B_i = -\frac{\partial \varphi}{\partial y}, \quad C_i = -\frac{\partial \varphi}{\partial z} \]

After linearization of \( \psi \), \( A \), and \( \varphi \) we find \( A \) and \( \varphi \) such that

\[ A = \frac{\sqrt{A_x^2 + A_y^2 + A_z^2}}{A_x^2}, \quad \varphi = \frac{\sqrt{\varphi_x^2 + \varphi_y^2 + \varphi_z^2}}{\varphi_x^2} \]

Assume in the beginning that

\[ \frac{\sqrt{V_x^2 + V_y^2 + V_z^2}}{V_x^2} \]

Assume that

\[ A \varphi \]
\[ \frac{3}{\eta^2} \frac{\partial^2 \eta}{\partial x^2} = -3 \frac{\partial \eta}{\partial y} \]

This must replace \( \frac{\partial}{\partial y} \), thus

To go to the KP-\( F \) equation one

\[ \frac{\eta^2}{\eta} \left( \frac{\partial^2 \eta}{\partial x^2} - \frac{\partial \eta}{\partial y} \right) = 3 \left( \frac{\partial \eta}{\partial y} \right)^2 \]

\[ \frac{\partial}{\partial y} \left( \frac{\partial \eta}{\partial y} \right) = 0 \]

Now, calculating

\[ \frac{\partial}{\partial y} \left( \frac{\partial \eta}{\partial y} \right) = 0 \]

They are

\[ \frac{x}{\eta} \frac{\partial^2 \eta}{\partial x^2} = -3 \left( \frac{\partial \eta}{\partial y} \right)^2 \]

Conclusion on non-linear terms forms

\[ \frac{\partial}{\partial y} \left( \frac{\partial \eta}{\partial y} \right) = - \frac{\partial}{\partial y} \left( \frac{\partial \eta}{\partial y} \right) \]

Consider non-linear terms including \( y \) dependencies.
Transition to KdV equation

If \( \frac{\partial^2 u}{\partial y^2} = 0 \)

\[
\frac{\partial^2 u}{\partial t^2} - \frac{3}{2} u \frac{\partial u}{\partial x} - \frac{3}{8} u \frac{\partial^3 u}{\partial x^3} = 0 \\
(\frac{\partial}{\partial x} + (y^2 - x^2) \frac{\partial}{\partial y} + 4(y^3 - x^3) \frac{\partial}{\partial z} + (y^3 - x^3)) T(y, x) = 0
\]

How \( T(y, x) \) is not dependent on \( y \).

We can achieve this by assuming

\( T(y, x) = T(x) \delta(y - y_0) \)

We obtain following ODE problem

\[
\frac{\partial}{\partial x} = T(x) f(-x) \frac{\partial}{\partial x} - 2\lambda x - 8\lambda^3 + \\
\frac{\partial}{\partial x} = f(-x) T(x) \frac{\partial}{\partial x} - 2\lambda x - 8\lambda^3
\]

in the matrix case

\[
\frac{\partial}{\partial x} = f(-x) T(x) \frac{\partial}{\partial x}
\]