Reverse Telephoto Raytrace

Do a paraxial raytrace of the following thin lens system (this is called a reverse-telephoto lens configuration) to determine the system power and the locations of the rear cardinal points (F', P'). Check your answers with Gaussian Reduction. Sketch the result.

\[ f_1 = -63.6364 \]
\[ f_2 = 34.7222 \]
\[ t = 50 \]

Solution:

\[ f_1 = -63.6364 \text{mm} \quad \phi_1 = -0.015714 / \text{mm} \]
\[ f_2 = 34.7222 \text{mm} \quad \phi_2 = 0.0288 / \text{mm} \]
\[ t = 50 \text{mm} \]

Trace a ray parallel to the axis:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>-63.636400</td>
<td>34.722200</td>
<td></td>
</tr>
<tr>
<td>(-\phi)</td>
<td>0.015714</td>
<td>-0.028800</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>(\infty)</td>
<td>50</td>
<td>?</td>
</tr>
<tr>
<td>y</td>
<td>1</td>
<td>1.785714</td>
<td>0</td>
</tr>
<tr>
<td>u</td>
<td>0</td>
<td>0.015714</td>
<td>-0.035714</td>
</tr>
</tbody>
</table>

\[ BFD = 50.0 \quad u' = -0.035714 \]
\[ \phi = -u' / y_1 = 0.035714 / \text{mm} \]
\[ f_x = 28.0 \text{mm} \]
\[ f'_r = 28.0 \text{mm} \]
\[ d' = BFD - f'_r = 22.0 \text{mm} \]
Gaussian Reduction:

\[
\phi = \phi_1 + \phi_2 - \phi_1 \phi_2 t = 0.0357 / \text{mm}
\]

\[
f_E = f'_R = 28.0 \text{mm}
\]

\[
d' = -\frac{\phi_1}{\phi} t = 22.0 \text{mm}
\]

The Gaussian Reduction results match the ray tracing results.

Sketch: