Few basic (personal) considerations on final focus systems.

1) Bends are bad (that's way people build linear colliders).

   They generate synch-rad that hurts more and more at higher energies.

   An ideal FF system should have no bends.
   A FF with n bends is n steps far from the ideal

2) Sextupoles are bad.

   They generate background and ruin the emittance, a particle 10-sigmas off is kicked 100 times more than a particle 1-sigma off.

   An ideal FF system should have no sexts.
   A FF with n sexts is n steps far from the ideal

3) Quads are bad.

   They ruin the model and randomly kick the beams.

   An ideal FF system should have no quads.
   A FF with n quads is n steps far from the ideal
The systems build so far (SLC-FF and FFTB) have shown few of the problems related to (1), (2) and (3), so they have never performed near-optimum.

The problems become more acute with higher energies and smaller emittances, and most likely more problems will show up...

Eventually new schemes have to be developed that at some stage will be the ONLY ones (Irwin/Chen or some other bright guy that invents a strong lens).

(However I find risky to build a Irwin/Chen FF for a 1 TeV linear collider before testing them at lower energies)

It looks like a FF for a 1-TeV collider could still work with some more experienced scheme, but Irwin did show that it will be last one...
Keeping (1) (2) and (3) in mind we could add or remove more requirements for a "conventional" FF.

0) The FF should do just what we need.
   
a) The FF should be chromatically correct in the IP-phase.
   
b) The FF, in the Y plane, should be 100 times better than in the X plane.
   
c) Bends generate energy spread, so the chromaticity should be corrected downstream the bends.
   
d) The chromaticity is generated by the final doublet, so it will be nice if it could be corrected at the final doublet. (This also will make the FF chromatically correct at higher orders too).
   
e) If the FF has more than 2 sextupoles, than he has "interleaved" sextupoles (according to my definition). It is a different story if we call "un-interleaved sextupoles' sextupoles that do not generate third order aberrations at the IP.
   
f) The FF should be tunable, flexible and with enough diagnostic.
   
g) The FF should not generate background, and at his best decrease it.
A system that satisfies all the requirements could be:

I) A beta-matching section with 6 normal quads to match alfa, beta and phase in both planes.
   In this section also, 3 skew quads for coupling correction and 4 "wire scanners" can be easily included.
II) A final telescope made of two doublets to provide the desired de-magnification at the IP.
III) A chromatic correction made of:
   - A bend in between (I) and (II) to generate dispersion across the final doublet (but not at the IP).
   - Two C-sextupoles across the final doublet to compensate its chromaticity.
   - Two G-sextupoles upstream the bend and in phase with the previous ones, to compensated for their geometric aberrations.
   - One more quad between (I) and (II) is needed to make the G-sextupoles unaffected by the beta-matching.
More constrains come from second and third order terms cancellations:

However the system has still a lot of degrees of freedom to satisfy them all.

There are still some degrees of freedom left for later (during the run) changes....

I order geom observations independently canceled:

\[ M_D = \begin{pmatrix} D & 0 & 0 & 0 \\ D & 0 & 0 & 0 \\ 0 & 0 & D & 0 \\ 0 & 0 & 0 & D \end{pmatrix} \quad M_F = \begin{pmatrix} F_1 & 0 & 0 \\ F_1 & 0 & 0 \\ 0 & F_2 & 0 \\ 0 & F_3 & F \end{pmatrix} \]

II order geom observations canceled:

\[ U_{12} = C_{12} = -2K_F K_D \left[ (\frac{P_{D_{F_{12}}}}{P_{D_{F_{12}}}} - \frac{P_{D_{F_{12}}}}{P_{D_{F_{12}}}}) R_{F_{11}}^2 R_{F_{34}}^2 + P_{F_{34}}^2 P_{D_{12}} \right] \]
\[ -4(P_{D_{F_{34}}} D_{34} - P_{F_{34}} R_{D_{44}}) R_{F_{11}} R_{F_{34}} R_{F_{11}} R_{F_{34}} = 0 \]

\[ U_{34} = 4K_F K_D \left[ (\frac{P_{D_{F_{12}}}}{P_{D_{F_{12}}}} - \frac{P_{D_{F_{12}}}}{P_{D_{F_{12}}}}) R_{F_{11}}^2 R_{F_{34}}^2 \right] \]
\[ U_{12} = 4K_F K_D \left[ (\frac{P_{D_{F_{12}}}}{P_{D_{F_{12}}}} - \frac{P_{D_{F_{12}}}}{P_{D_{F_{12}}}}) R_{F_{11}}^2 R_{F_{12}} \right] \]
\[
C_X = K q F \xi_{12}^2 (\delta X_1^1 \eta_0^2) + K s F R_{12}^3 (2X_1^1 \eta_0^2 + \eta_0^2 \eta_0^2) + \eta_{12}^1 \delta \eta
\]

From last quad

\[
\Rightarrow \left\{ \begin{array}{l}
K q F \xi_{12}^2 + \frac{1}{2} \eta_{12}^1 + 2K s F R_{12}^3 \eta_0^2 = 0 \\
K q F \xi_{12}^2 + K s F R_{12}^3 \eta_0^2 = 0 \\
K s F R_{12}^3 \eta_0^2 = -K q 
\end{array} \right.
\]

From start

\[
\Rightarrow \left\{ \begin{array}{l}
T_{12c} = 0 \\
T_{34c} = 0 \\
\eta_{12}^1 = \text{B-match very chromatic in } \gamma \end{array} \right.
\]

\[
\delta Y = K q d \xi_{34}^2 \delta \gamma_0^1 + \frac{1}{2} \gamma_0^1 \gamma_0^1 - 2K s d R_{34}^3 \gamma_0^1 \gamma_0^1
\]

\[
\Rightarrow \left\{ \begin{array}{l}
K q d \xi_{34}^2 + \frac{1}{2} \gamma_0^1 = 2K s d R_{34}^3 \gamma_0^1 \\
T_{34c} = 0
\end{array} \right.
\]
The IP tuning is very similar to the standard:

Beta matching and incoming coupling as usual.

Horizontal G sextupoles moves will move the waists. Vertical G sextupoles moves will change the X'Y coupling. Horizontal C sextupoles moves will move waists and horizontal dispersion. Vertical C sextupoles moves will change X'Y coupling and vertical dispersion.

About background:

I like the active-collimation scheme. with strategically placed octupoles we could make such as that any particle that enters the FF, never crosses the final doublet more that 20 sigmas off... (true only in X for now)