Non-local solenoid compensation (update)

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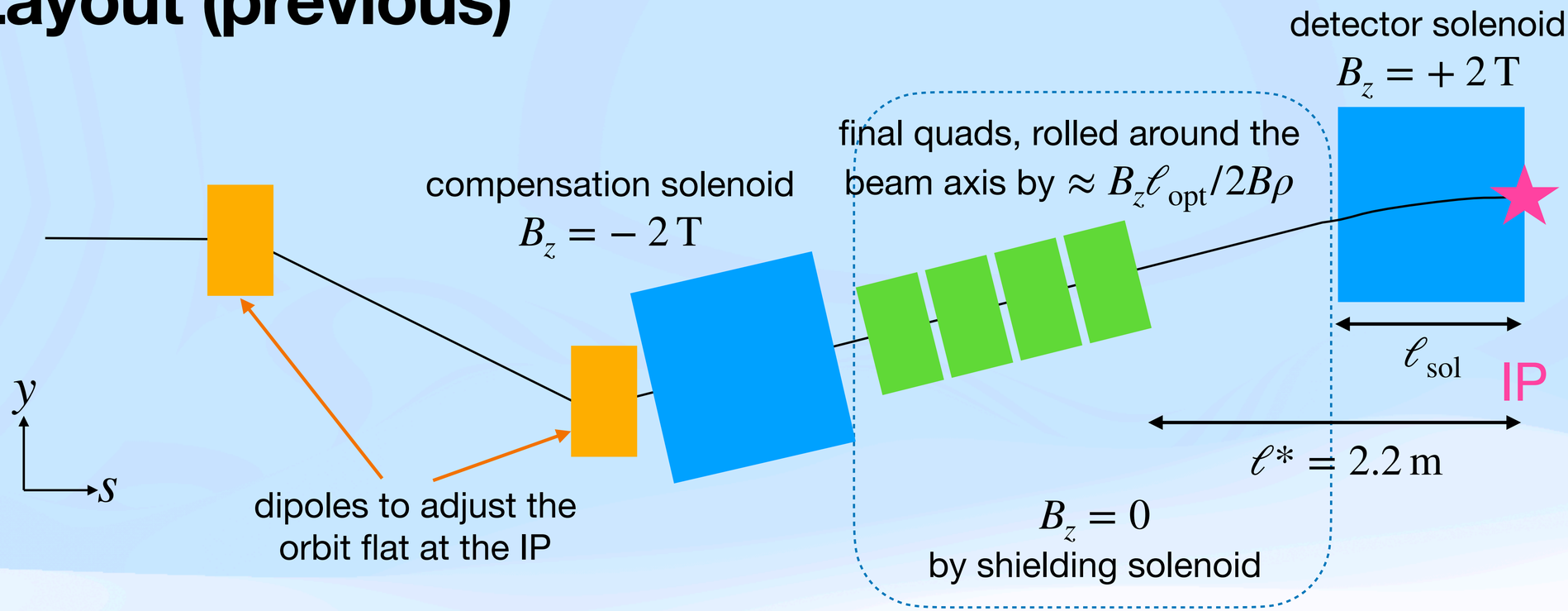
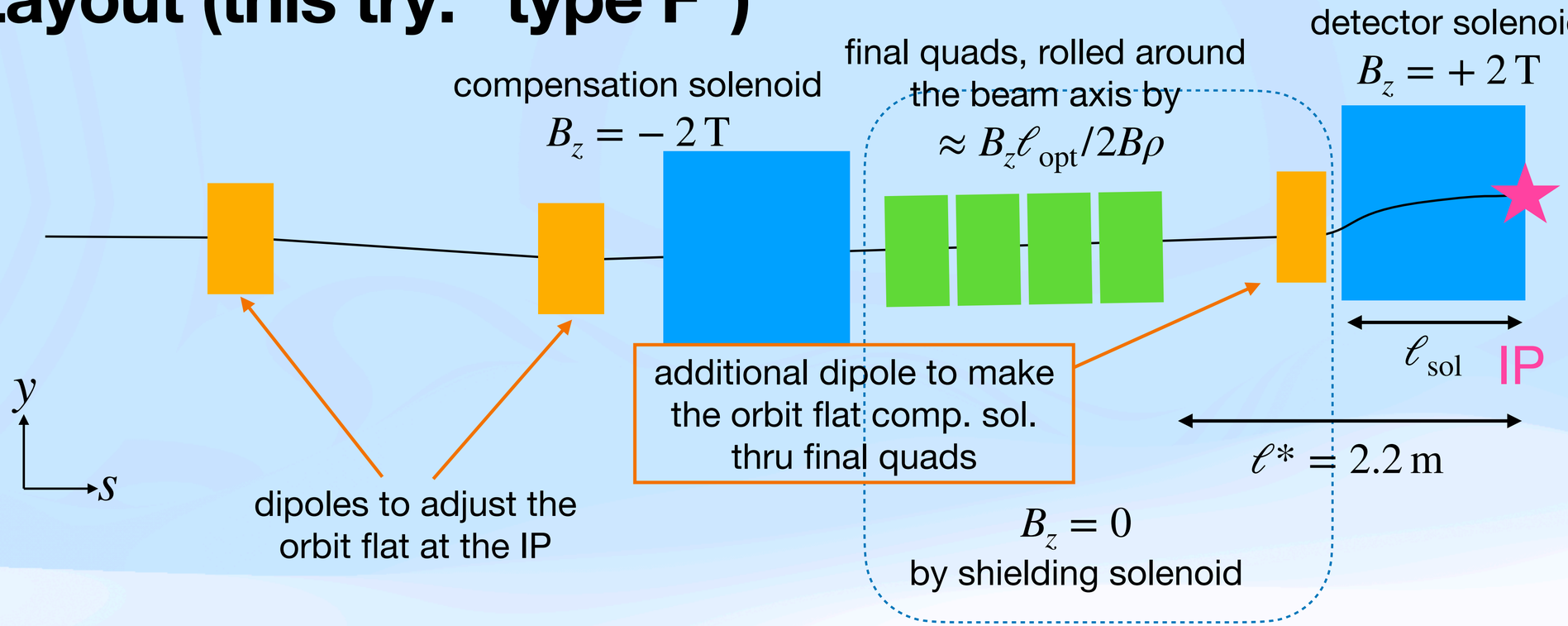
Layout (previous)



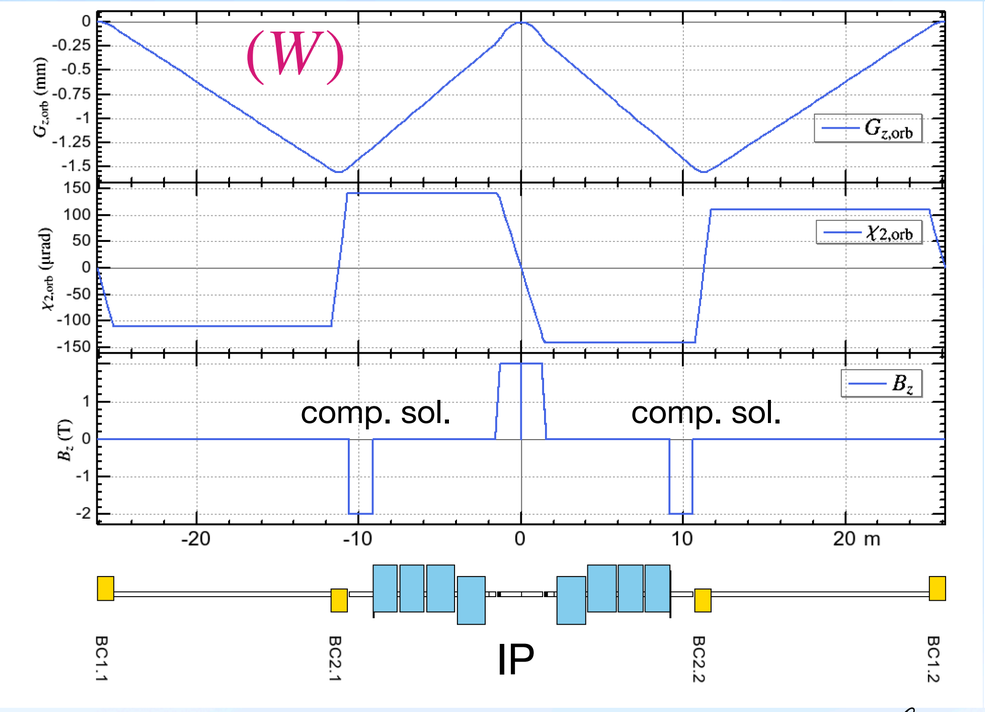
- The orbit is bent vertically by the detector solenoid.
- The final quads followed by the compensation solenoid are aligned along the beam axis.
  - This prevents additional orbit/dispersion deviation.
- Right after the detector solenoid region, the solenoid filed is completely shielded by the shielding solenoid, up to ℓ_{sol} from the IP.
  - The final quads sit in the field-free region.
- The vertical bend angle is corrected outside the compensation solenoid by two dipoles/side.

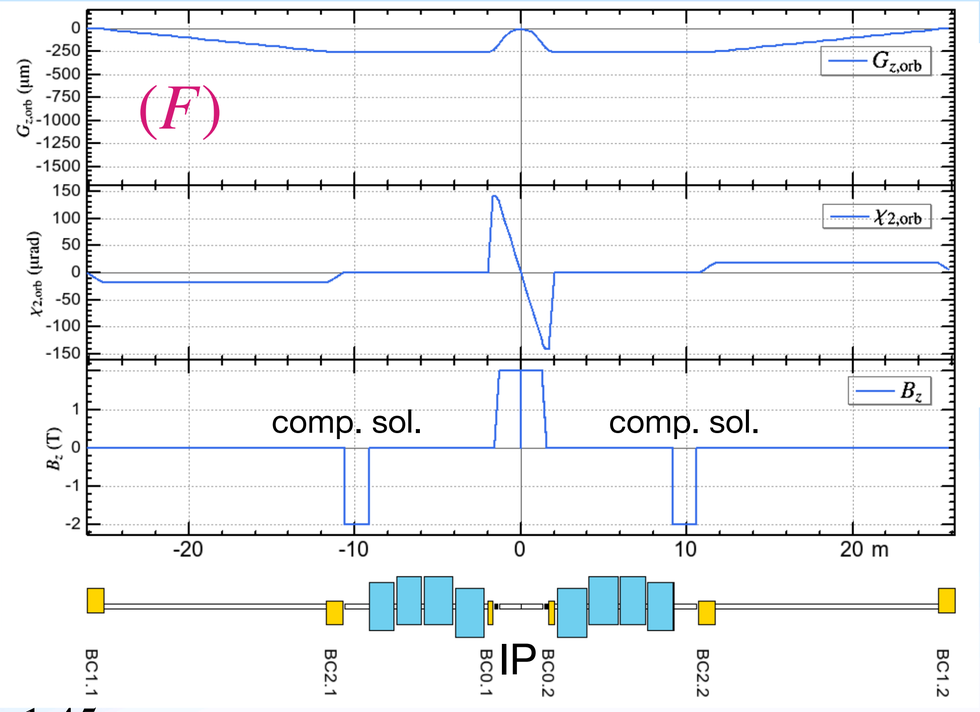
Layout (this try: “type F”)

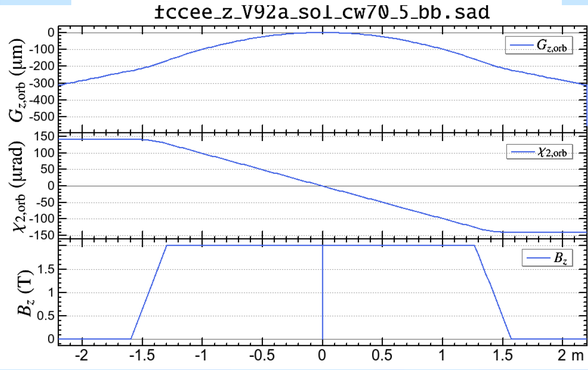


- Learnt from the design by Burkhardt/Ciarma (eg., MDI meeting #58), an additional dipole between the final quad and the detector solenoid region can make the orbit flat from the final quad through the compensation solenoid.
- Let us try this scheme and see the results.

Basic layout: two types of the vertical bump







IP

$\ell_{sol} \approx 1.45$ m

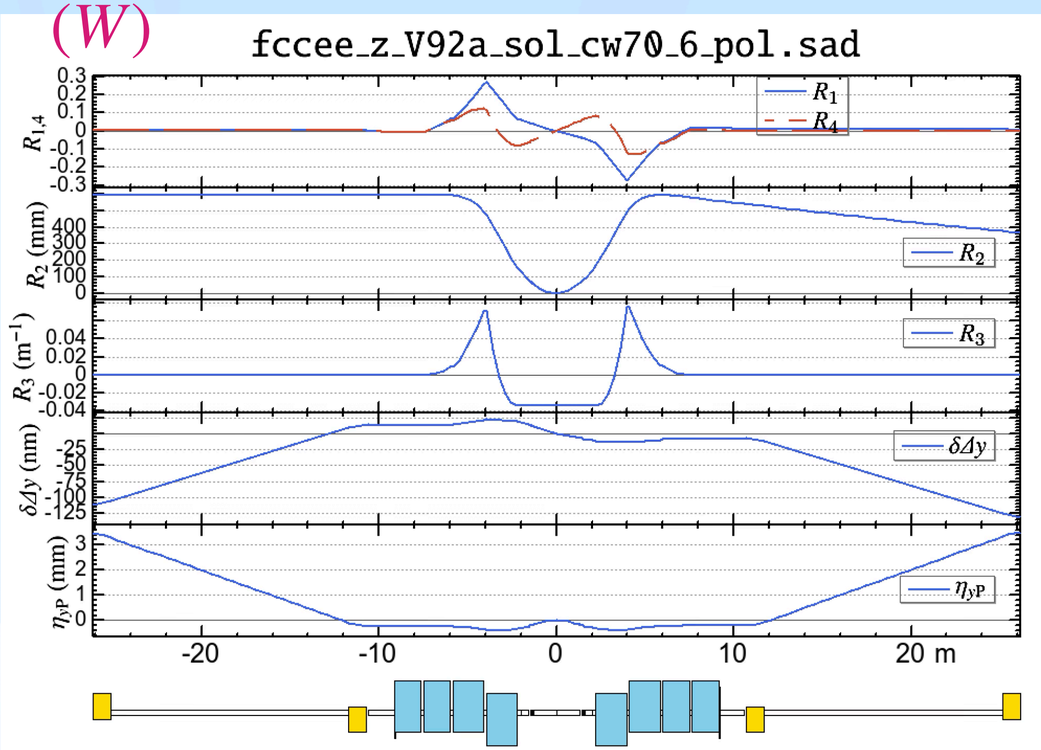
$\ell_{edge} \approx 0.3$ m

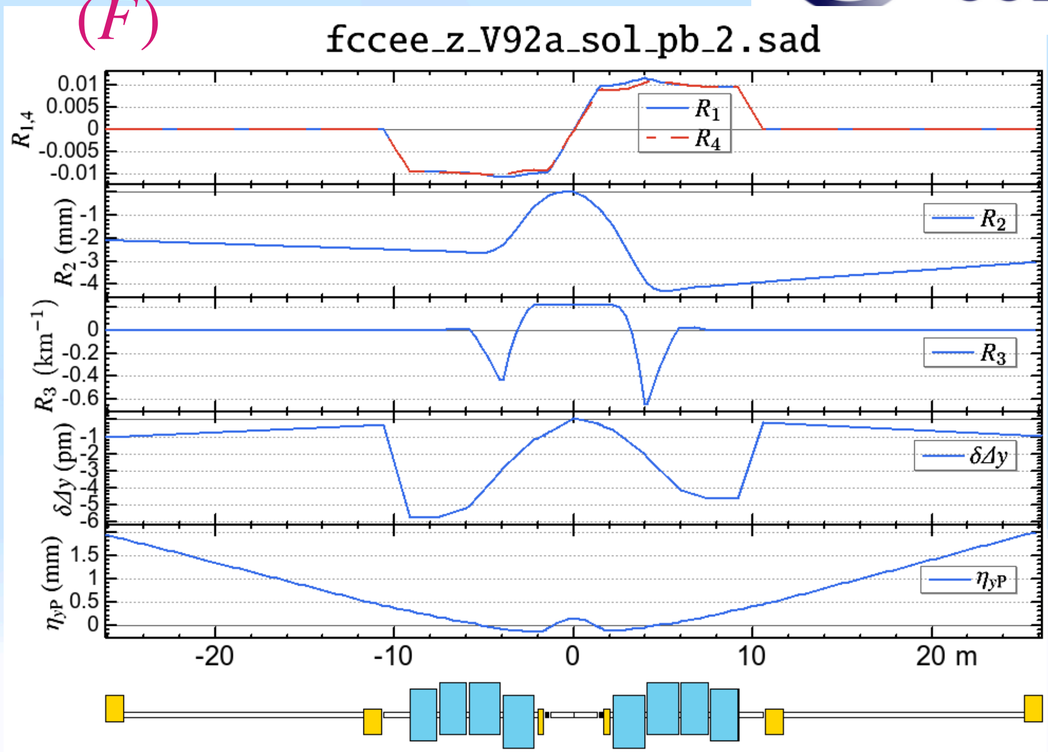
$\ell_{sol} = 1.45$ m

- The type F (right) with the additional dipole “BC0” indeed makes the vertical offset of the orbit flat and small.
  - alignment of the finale quads and compensation solenoids will be much simpler.
- The resulting vertical emittance becomes 2/3 of type W.
  - still larger than Burkhurdt/Ciarma’s.

Type	W	F
ℓ_{sol}(m)	1.45	
ℓ_{edge} (m)	0.3	
ε_y (pm)	0.36	0.24
$\varepsilon_{y,BB}$ (pm)	1.4	-
τ (s)	16000	-
p(%)	0.99±0.05	0.95±0.05

X-y coupling and vertical dispersion

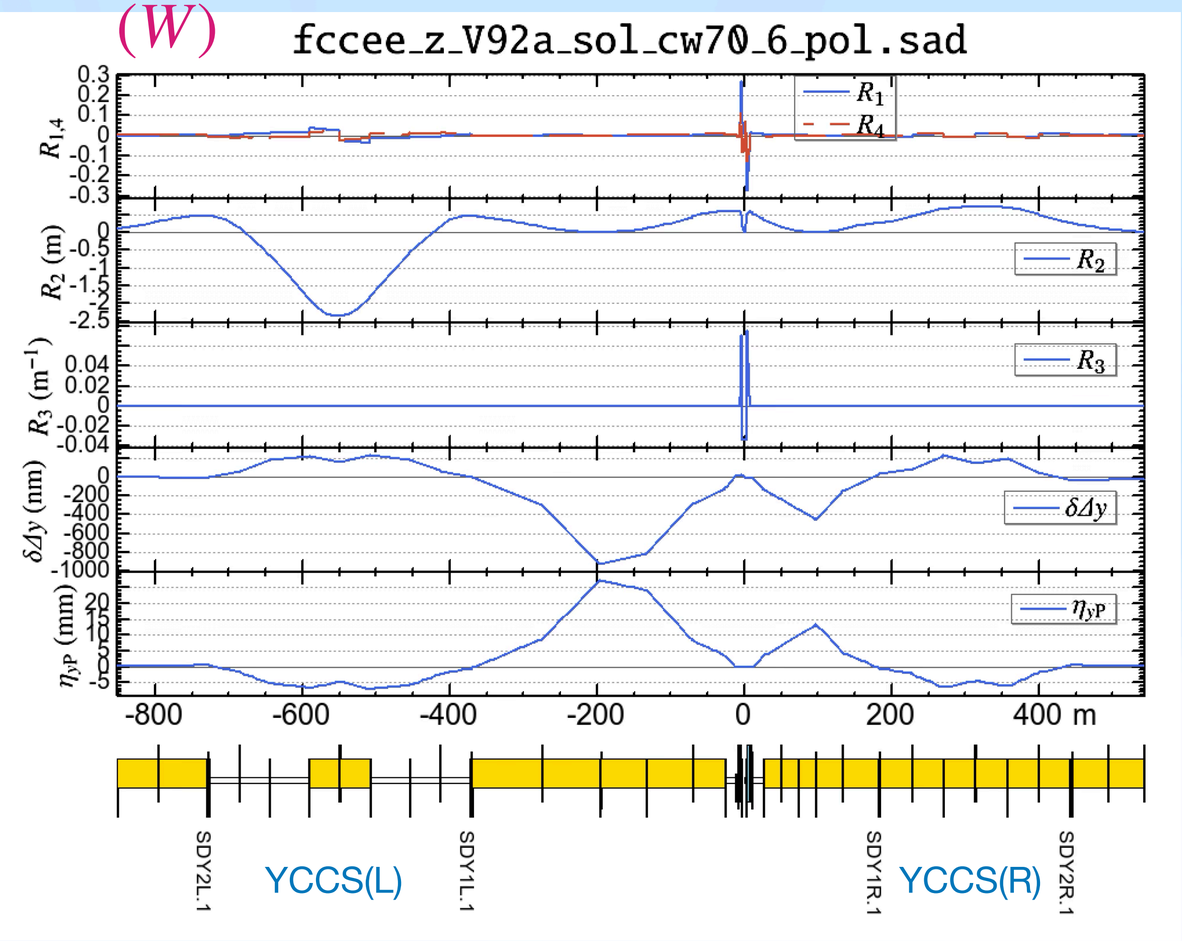


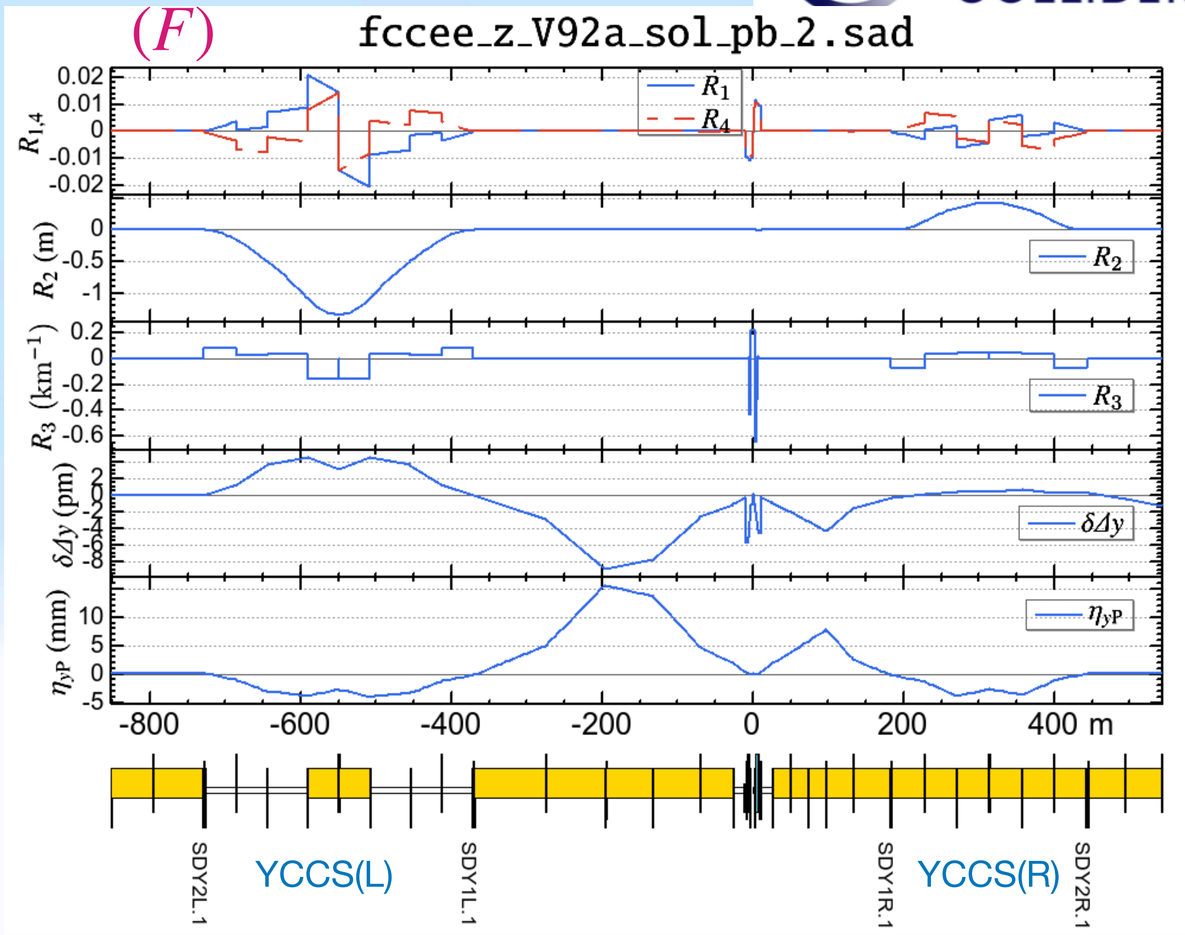


- The x-y coupling parameters $R_{1,2,3,4}$ are well confined within the compensation solenoid region as shown above.
- However, the vertical dispersion leaks toward outside.
- The profile of $R_{1,2,3,4}$ looks different for W and F. W has better symmetry around the IP.

$$\mathrm{R} = \begin{pmatrix} \mu\mathrm{I} & \mathrm{Jr}^T\mathrm{J} \\ \mathrm{r} & \mu\mathrm{I} \end{pmatrix} = \begin{pmatrix} \mu & . & -\mathrm{R4} & \mathrm{R2} \\ . & \mu & \mathrm{R3} & -\mathrm{R1} \\ \mathrm{R1} & \mathrm{R2} & \mu & . \\ \mathrm{R3} & \mathrm{R4} & . & \mu \end{pmatrix}$$

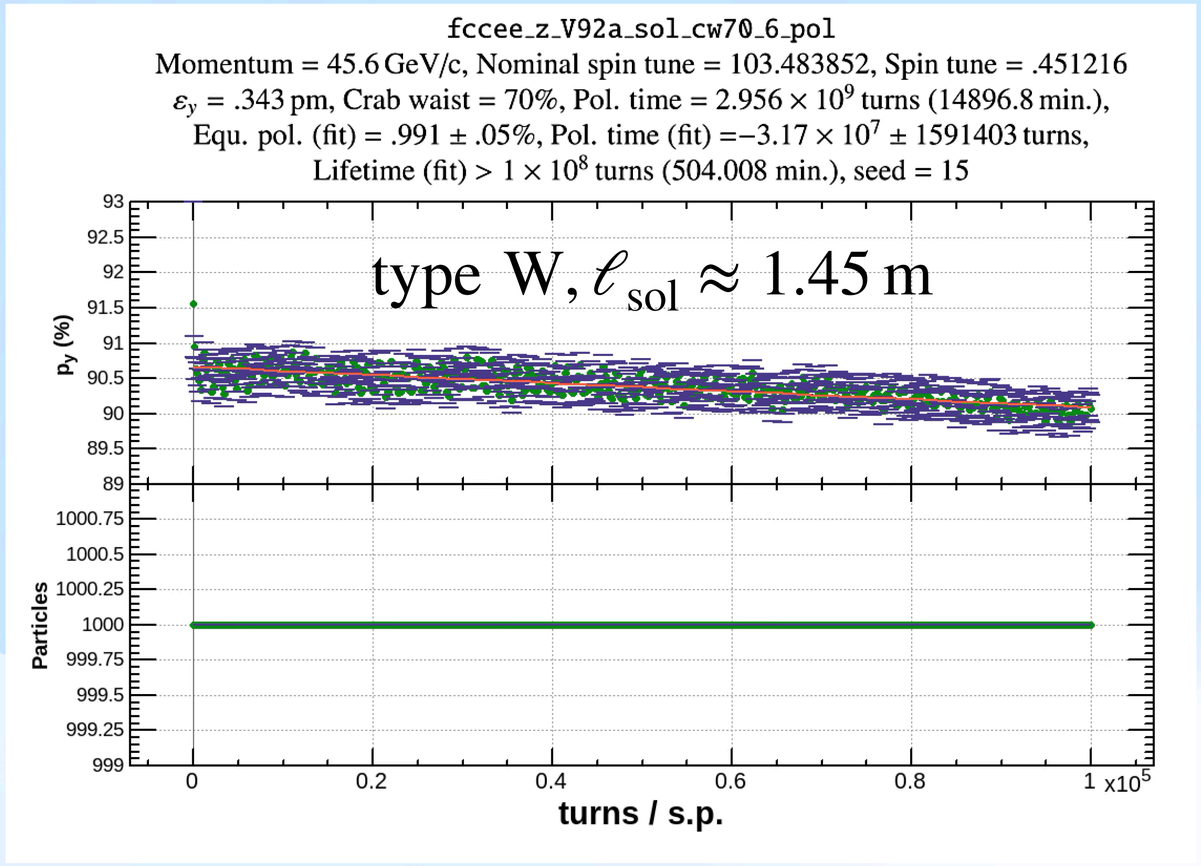
X-y coupling and vertical dispersion

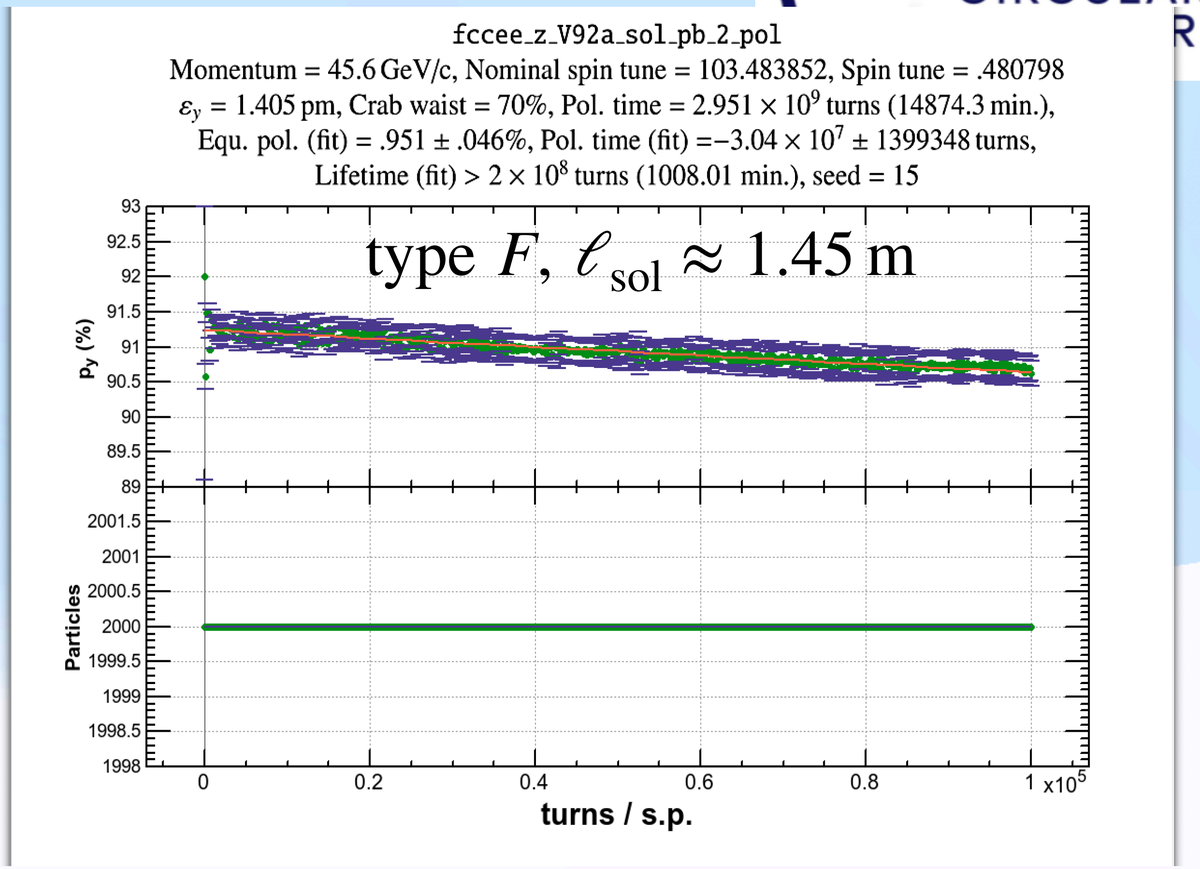




- The leak of the vertical dispersion toward outside the comp. solenoid has got smaller for type F (right) than type W (left).
  - This leads to the smaller vertical emittance.

Polarization





- The spin tracking shows a significant depolarization for type W (left), and type Λ (right), both $\ell_{\mathrm{sol}} = 1.45$ m.
  - Tracking starts at Sokolov-Ternov polarization.
  - The equilibrium polarization may decay to around 1%, by assuming the observed depolarization speeds.No depolarization is seen for $B_z = 0$ (right low).
- Some polarization bump tunings will be necessary, if these results are true.

Summary (preliminary)

- Examined a non-local solenoid compensation scheme.
  - A new type of the orbit “type F” learnt from Burkhardt/Ciarma has been tried this time.

Type	W	F
$\ell_{\mathrm{sol}}(\mathrm{m})$	1.45	
$\ell_{\mathrm{edge}}(\mathrm{m})$	0.3	
$\varepsilon_y(\mathrm{pm})$	0.36	0.24
$\varepsilon_{y,\mathrm{BB}}(\mathrm{pm})$	1.4	-
$\tau(\mathrm{s})$	16000	-
$p(\%)$	0.99±0.05	0.95±0.05

- The vertical emittance of type F still looks larger than Burkhardt/Ciarma’s, but it is already enough small.
  - The recent required lattice vertical emittance is 1.0 pm.
- The type F with $\ell_{\mathrm{sol}} = 1.45\,\mathrm{m}$ seems usable, except for the polarization.
  - A polarization tuning such as vertical bump in the arc is necessary.