Prompt vs direct J/ψ polarization

- Measuring *prompt* J/ψ polarization is insufficient for a *clear* solution of existing puzzles. Many prompt J/ψs are indirectly produced, their fraction increasing with p_T

- The feed-down from ψ' is well understood:
  - J/ψ from ψ' has approximately the same polarization as the ψ':
    BES and CLEO results for angular distributions of 2S-to-1S transitions (ψ and ϒ) show that the accompanying ππ system is predominantly in L=0 state
  - moreover, ψ' polarization should be similar to the direct-J/ψ polarization

  → *J/ψ from ψ' ≅ direct-J/ψ polarization*

- The "problem" is the *feed-down from* χ_c
  - CDF measured χ_c/ψ and χ_{c1}/χ_{c2} ratios averaged over p_T and y (i.e. small p_T, midrapidity)
  - they are unknown at the LHC, especially at high p_T (and fwd rapidity)
  - J/ψ from χ_c can have very different polarization wrt direct J/ψ
  - the relation between "spin-alignment" and shape of the dimuon angular distribution is totally different for χ_c and J/ψ

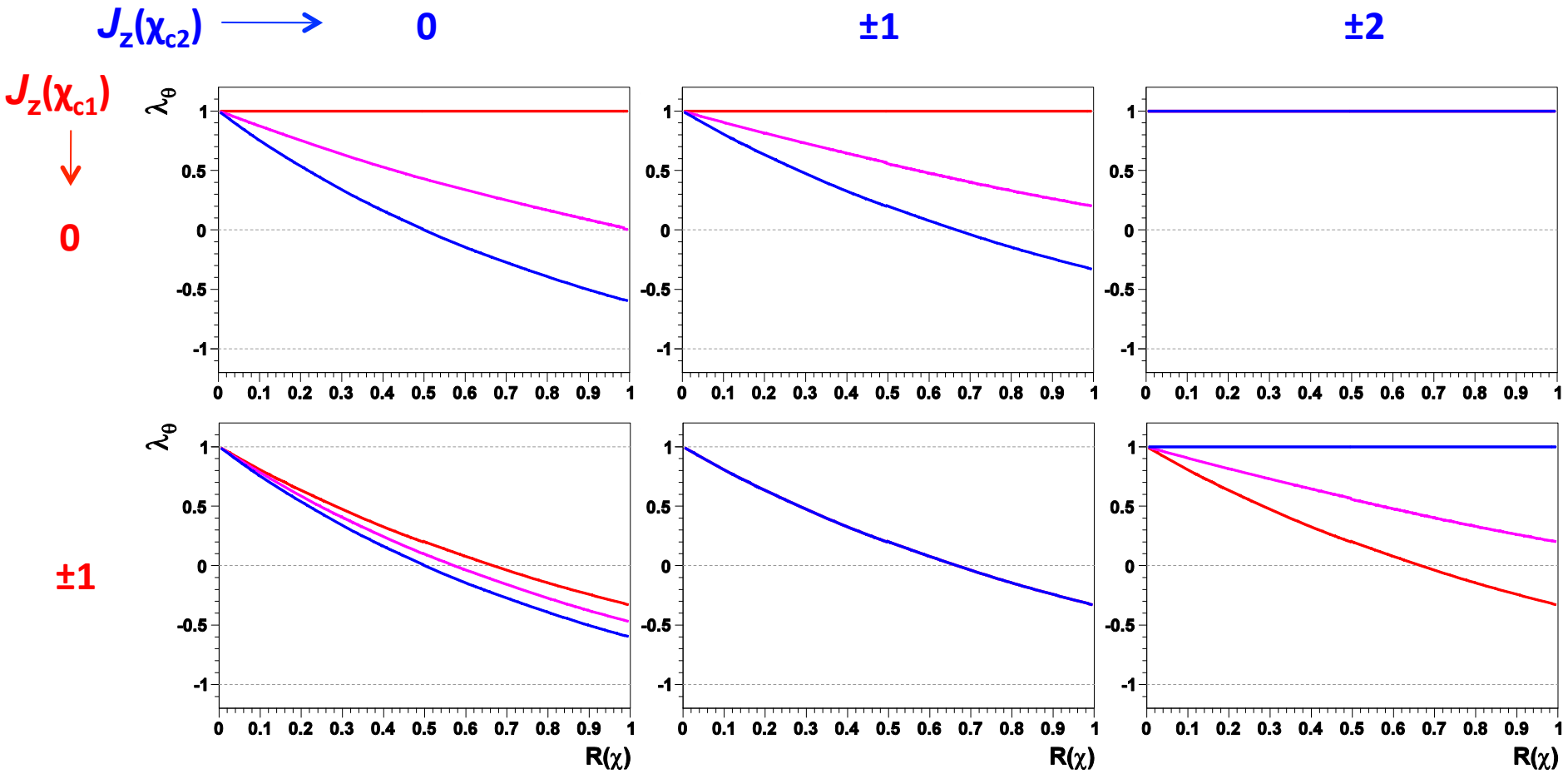
    e.g.: χ_{c1} and direct J/ψ both longitudinal (J_z=0): J/ψ from χ_{c1} → $1+\cos^2\vartheta$

    direct J/ψ → $1-\cos^2\vartheta$

- Even if the *direct* J/ψ would be fully polarized, the observed *prompt* J/ψ polarization is expected to be smeared by the χ_c feed-down contribution

Prompt J/ψ polarization vs R(χ_c)

$J_z(J/\psi_{dir}) = \pm 1$ fully transverse direct J/ψ (plots valid for p > 5 GeV/c)



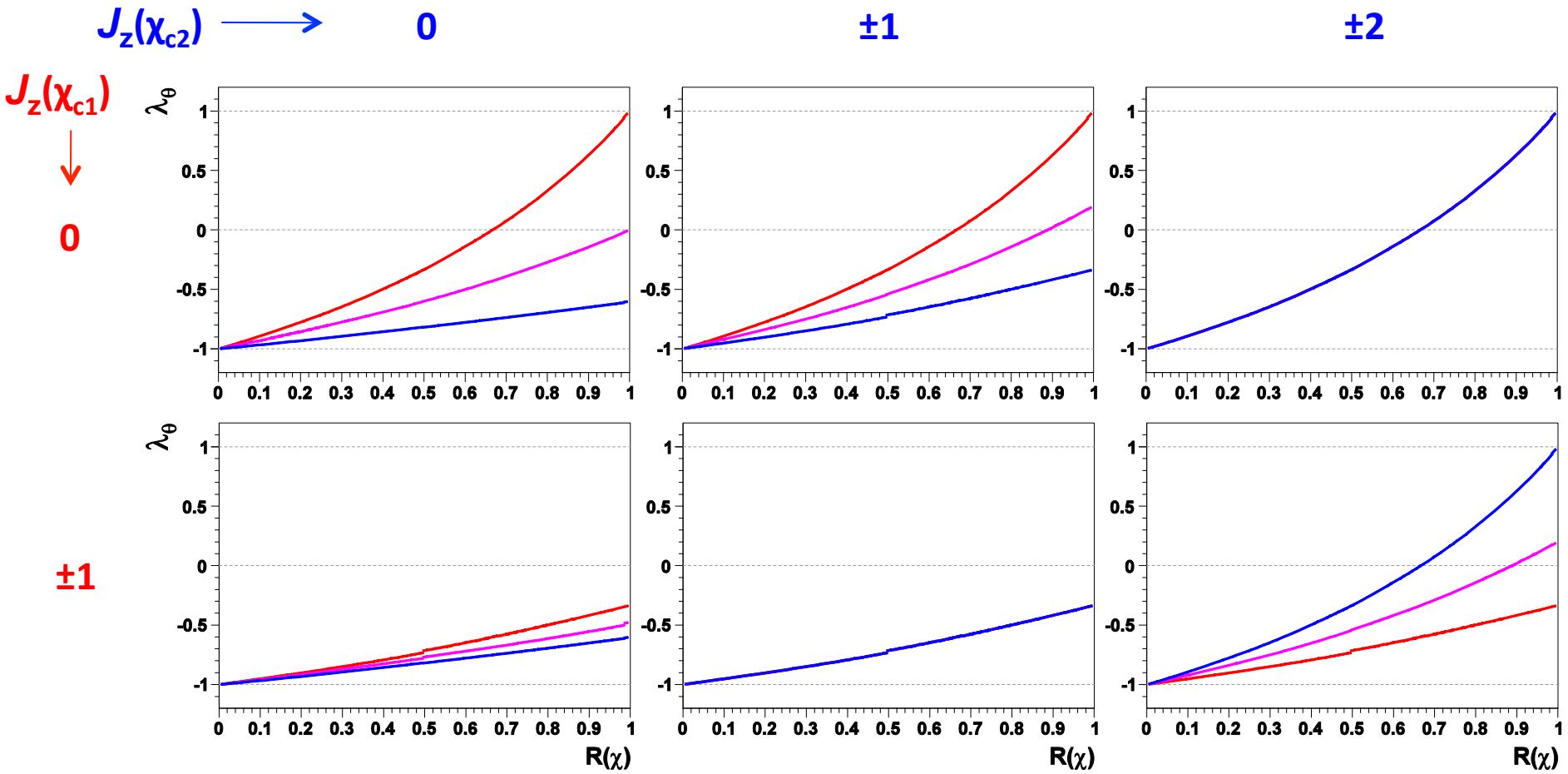
J/ψ's from χ_{c1} dominate over J/ψ's from χ_{c2}

same number of J/ψ's from χ_{c1} and J/ψ's from χ_{c2}

J/ψ's from χ_{c2} dominate over J/ψ's from χ_{c1}

Prompt J/ψ polarization vs R(χ_c)

$J_z(J/\psi_{dir}) = 0$ fully longitudinal direct J/ψ (plots valid for p > 5 GeV/c)



J/ψ's from χ_{c1} dominate over J/ψ's from χ_{c2}

same number of J/ψ's from χ_{c1} and J/ψ's from χ_{c2}

J/ψ's from χ_{c2} dominate over J/ψ's from χ_{c1}