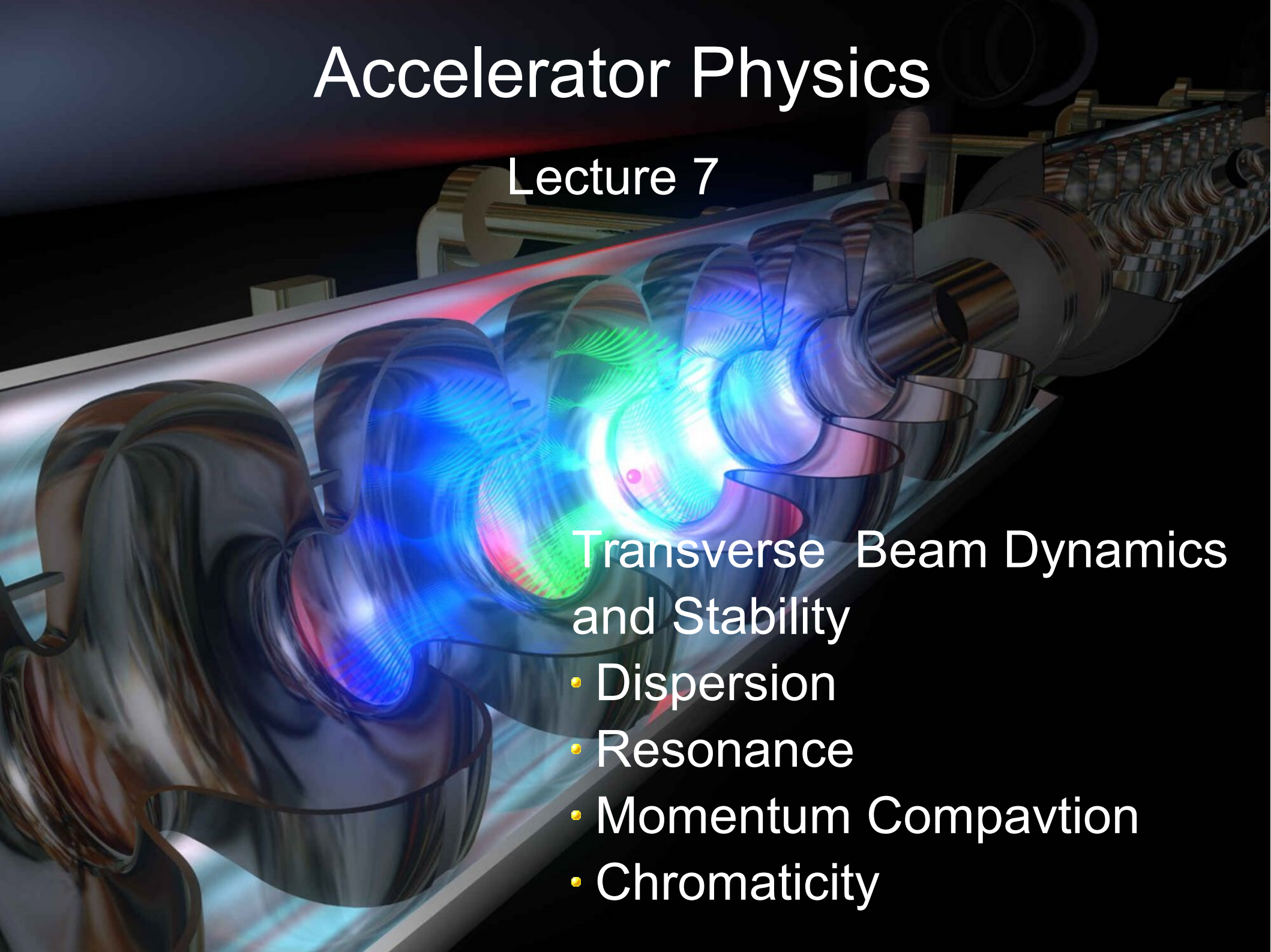


# Accelerator Physics

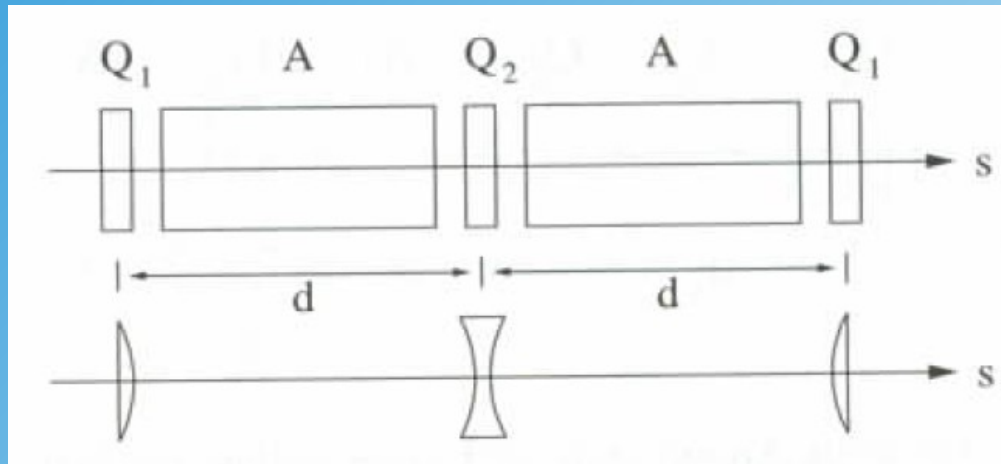
## Lecture 7

### Transverse Beam Dynamics and Stability

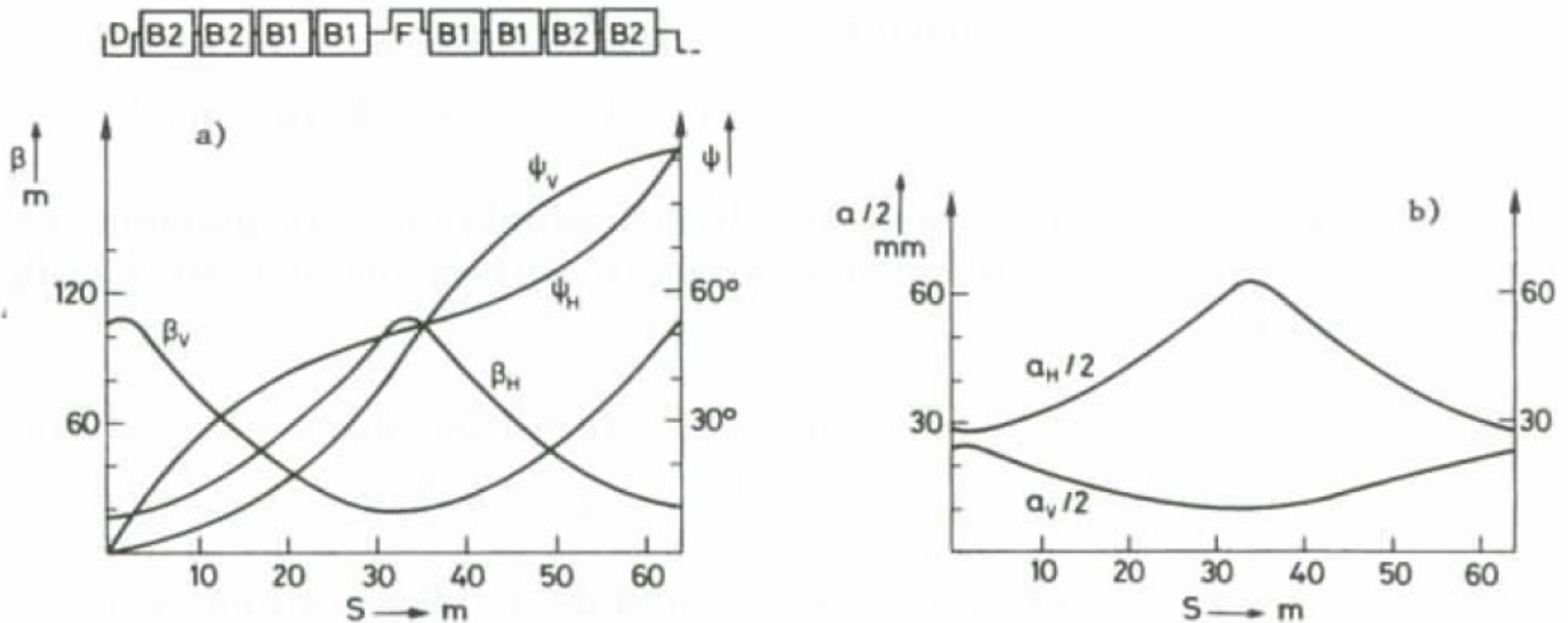
- Dispersion
- Resonance
- Momentum Compaction
- Chromaticity



# FODO element



# SPS (CERN) FODO structure



**Abb. 6.11.** SPS-Einheit zelle: Horizontale und vertikale Betatronfunktion  $\beta_x = \beta_H$  und  $\beta_y = \beta_V$ , Betatronphasen  $\psi_x = \phi_H$  und  $\psi_y = \phi_V$  und Enveloppen  $a_H/2 = \sqrt{\beta_x \epsilon_x}$ ,  $a_V/2 = \sqrt{\beta_y \epsilon_y}$ . Aus [Wi85] entnommen

SPS: 108 unit cells;  $d=32\text{m}$ ;  $\mu=91.8620^\circ$

focus:  $\beta_F=112.7\text{ m}$

maximum:  $\beta_D=17.6\text{ m}$

# SPS (CERN) FODO structure

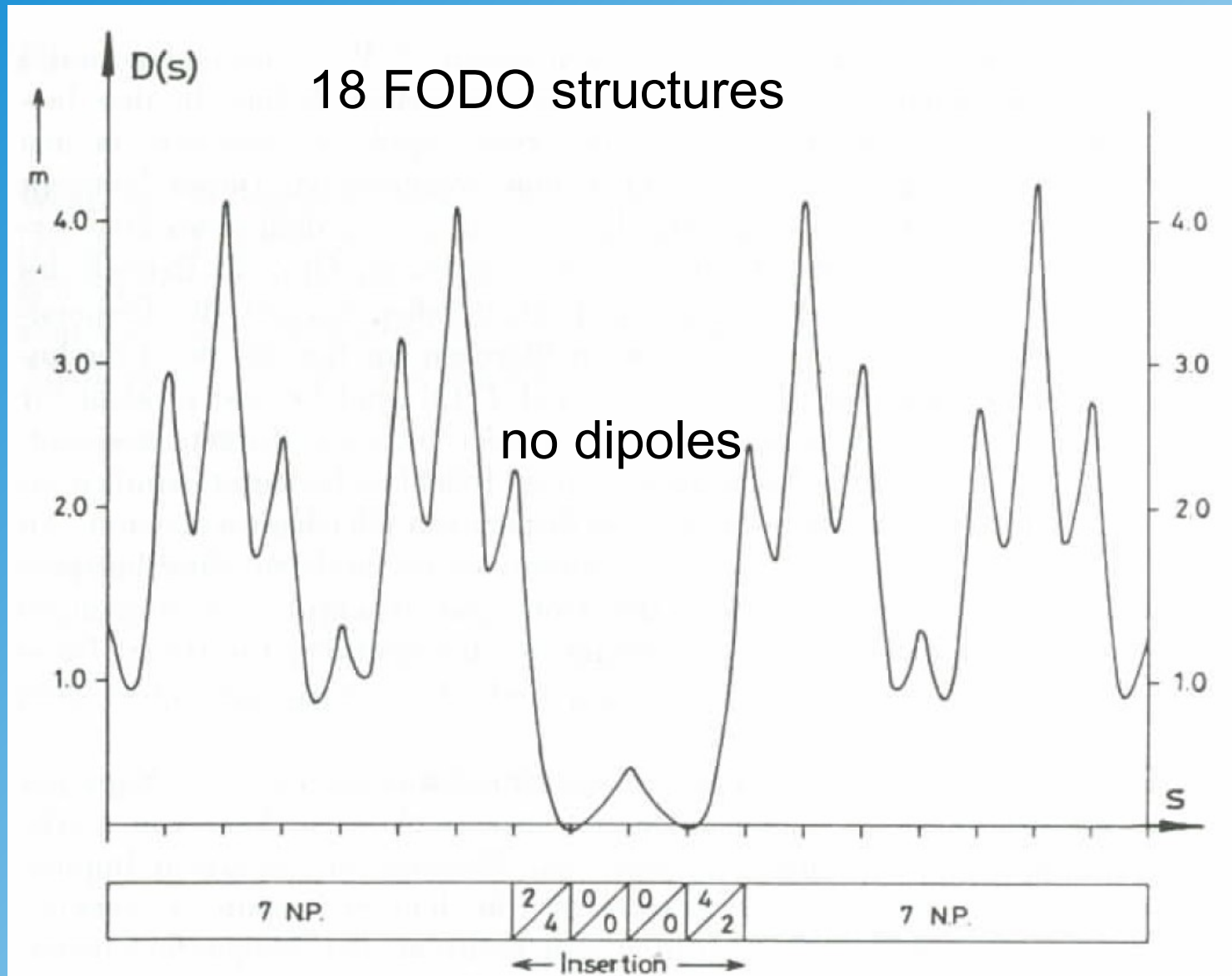
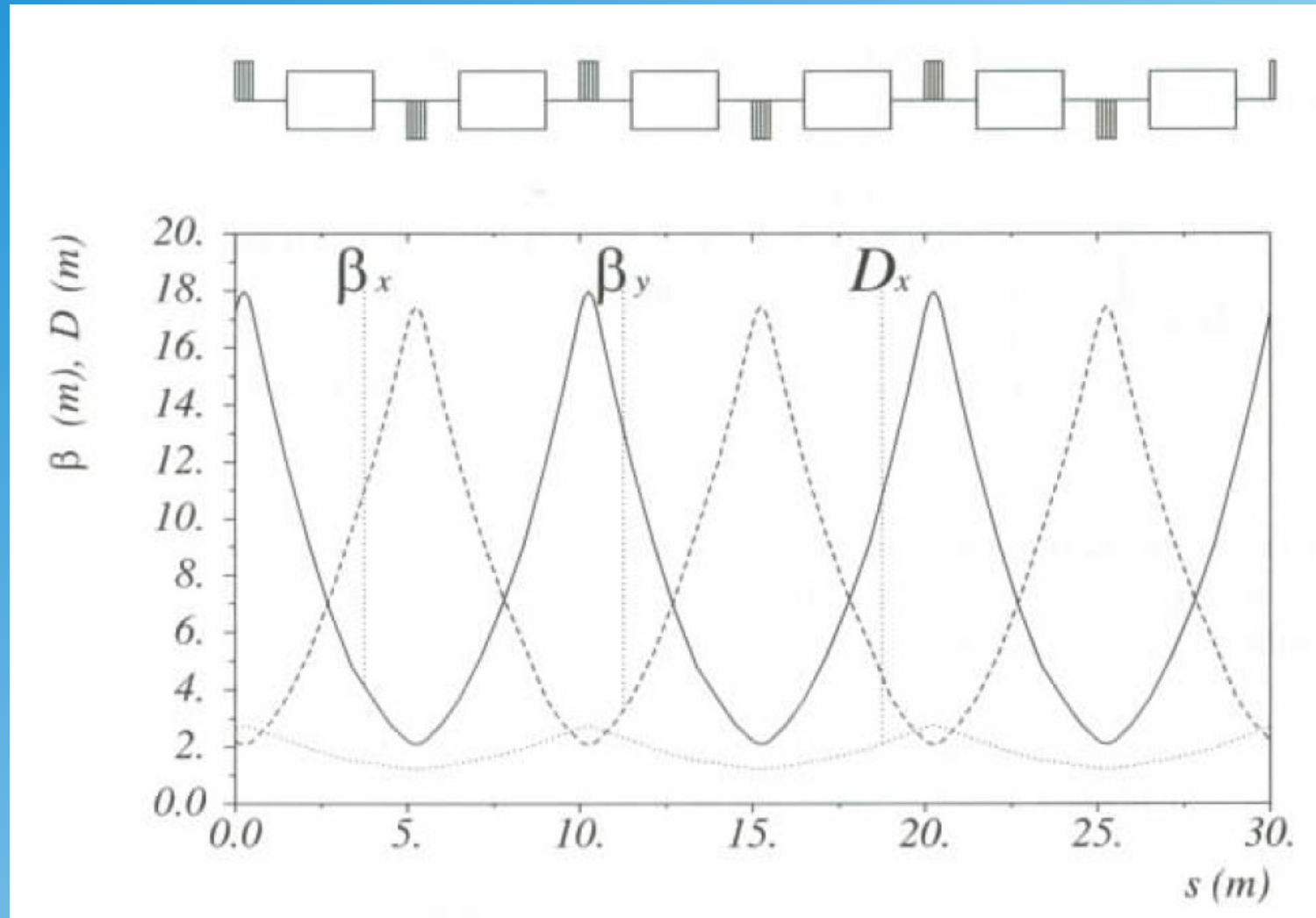


Abb. 6.12. SPS-Superperiode: Periodische Dispersion  $D(s)$ . Aus [Wi85] entnommen

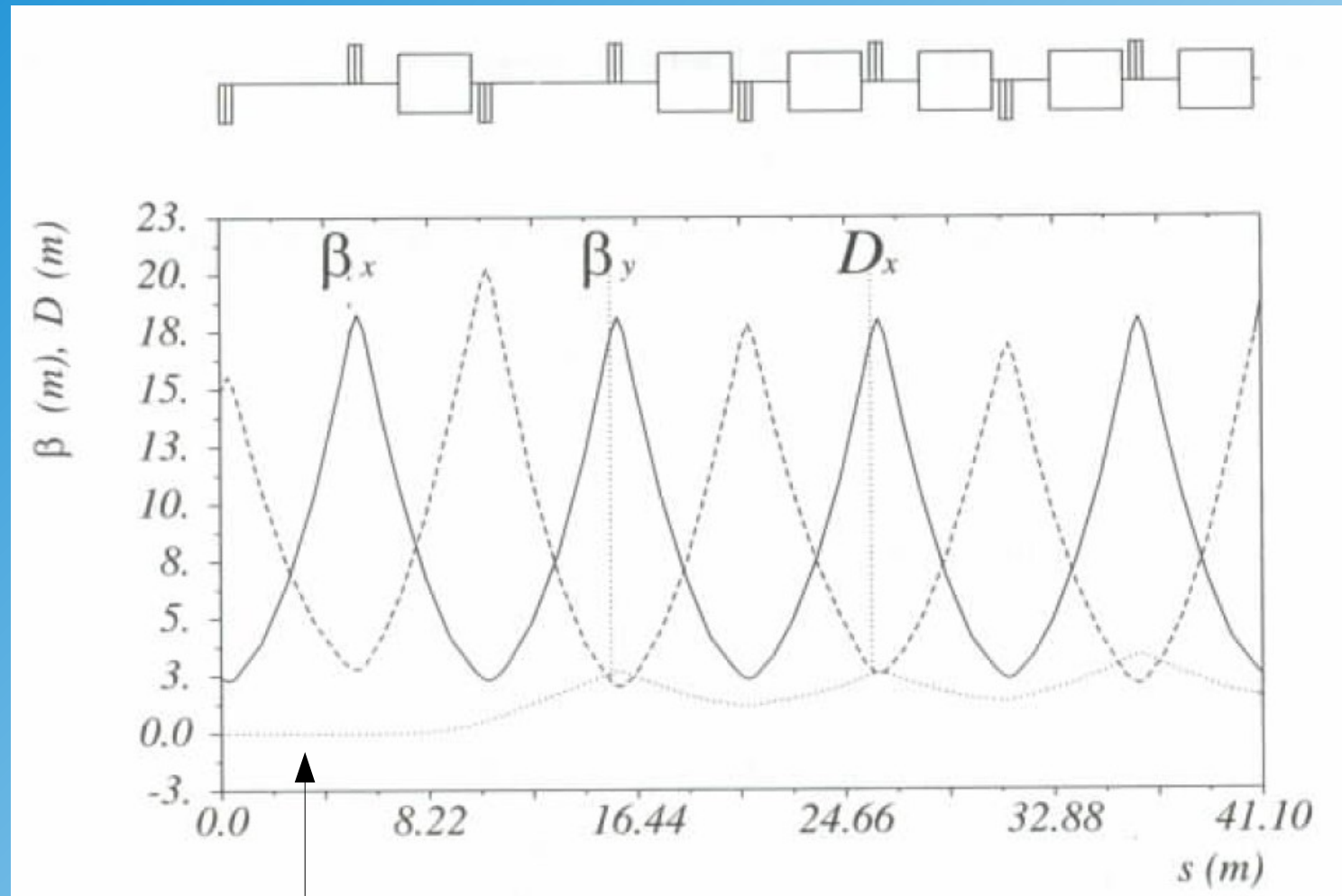


# Model Ring



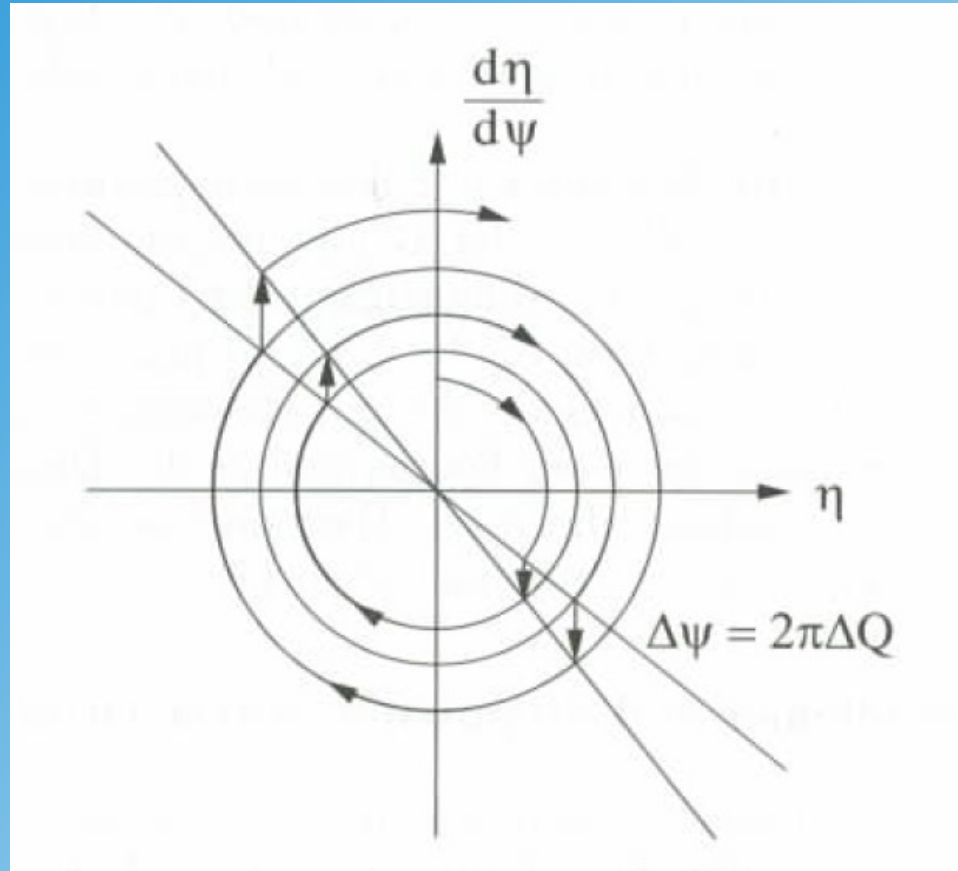
# ELSA (Electron Stretcher Anlage)

Bonn



dispersion = 0

# Distortions and Stop-Band 2<sup>nd</sup> Order



# Resonance Diagram SPS

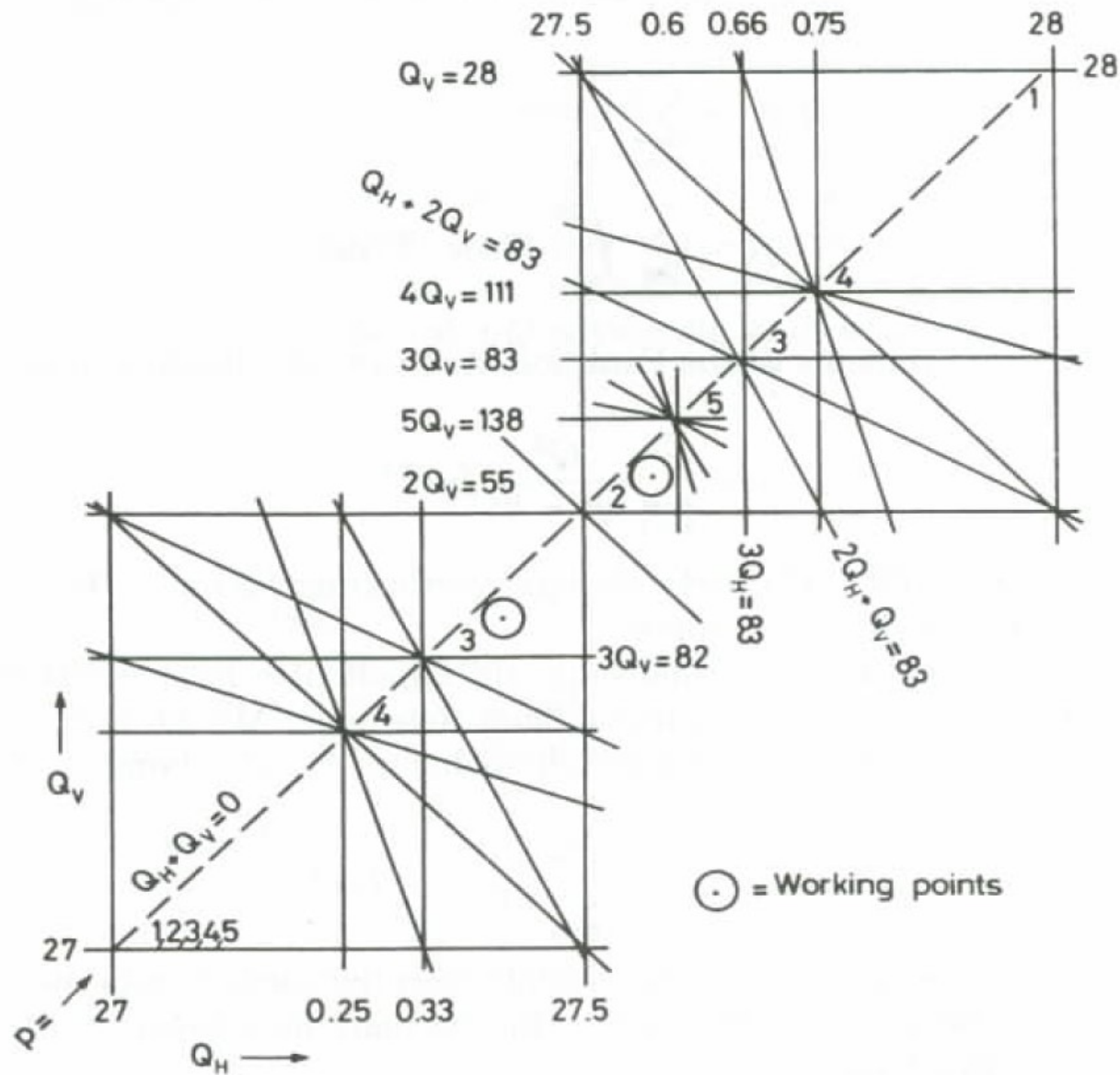
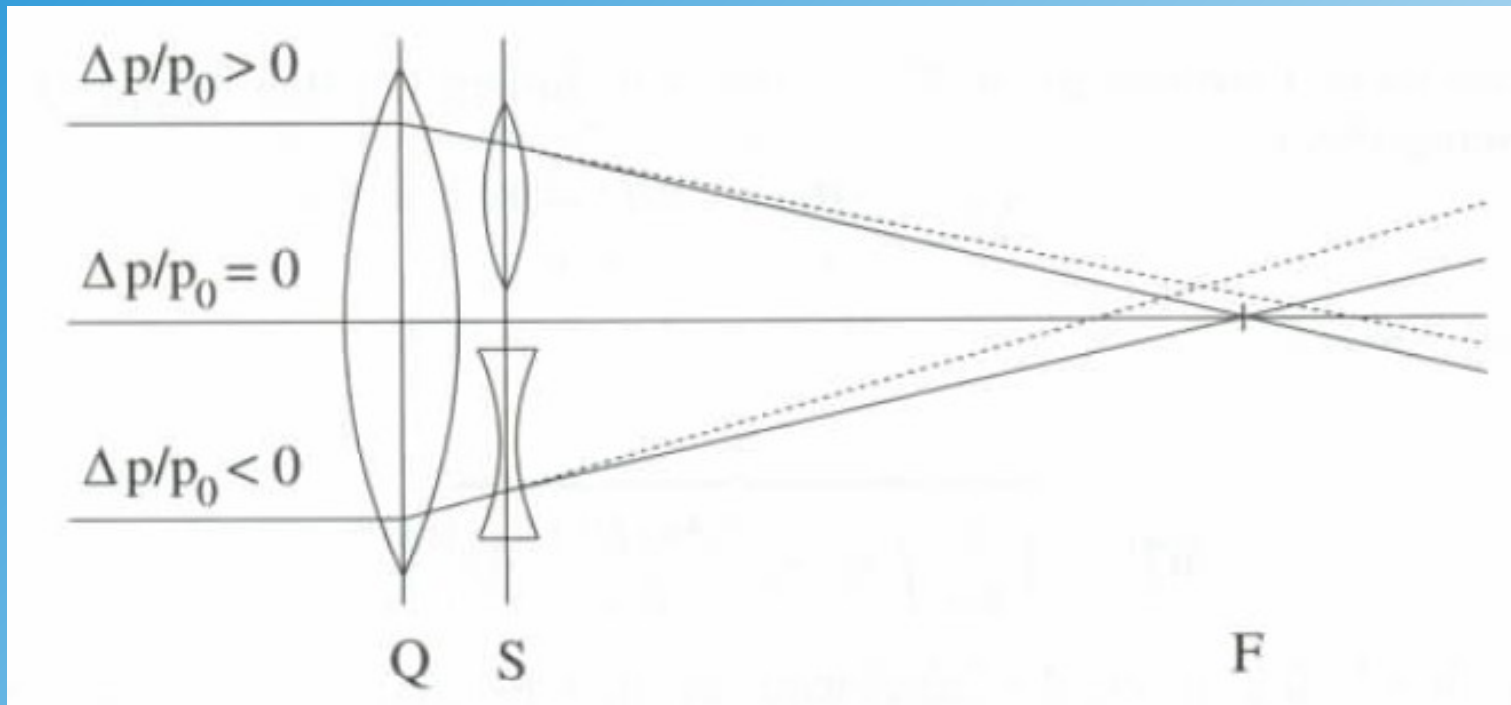


Abb. 7.4. Resonanzdiagramm am Beispiel des CERN SPS-Synchrotrons. Die  $Q_H = Q_x$  bzw.  $Q_V = Q_y$  ist die Zahl der horizontalen bzw. vertikalen Transversenschwingungen pro Umlauf. Das Diagramm zeigt Resonanzlinien der Ordnung



# Correction of Chromaticity using Sextupoles



# Chromaticity from Quadrupole

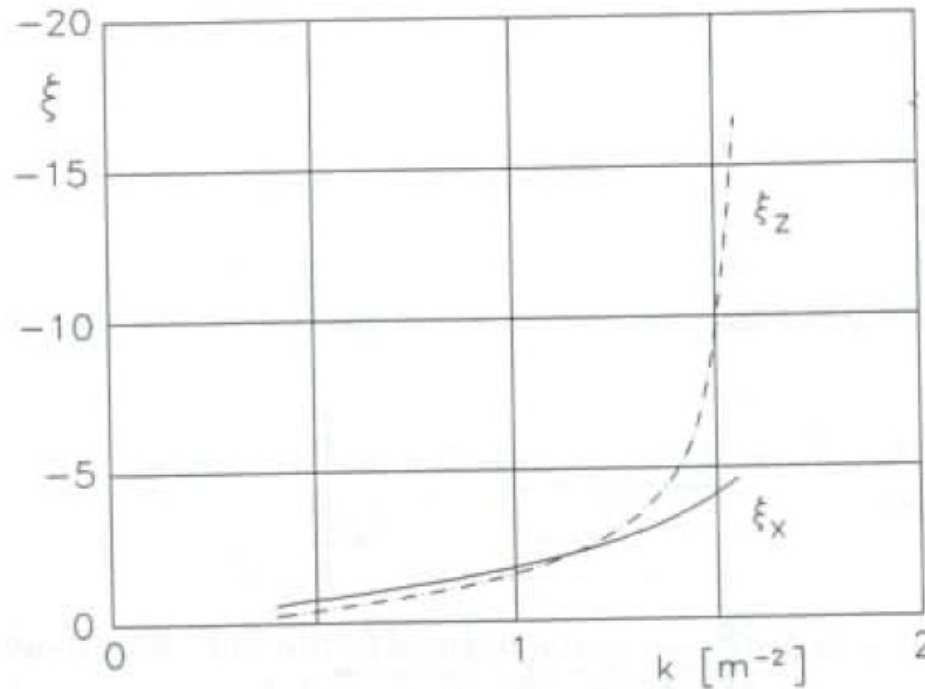


Fig. 6.6 Verlauf der horizontalen Chromatizitäten  $\xi_{x,z}$  des FODO-Modellrings als Funktion der Quadrupolstärke  $k$ .

# Dynamic Aperture from Sextupoles

