Conclusion for Beam Diagnostics Course

Diagnostics is the 'organ of sense' for the beam.

It required for operation and development of accelerators

Three types of demands leads to different installations:

- Quick, non-destructive measurements leading to a single number or simple plots.
- Instrumentation for daily check, malfunction diagnosis and wanted parameter variation.
- Complex instrumentation used for hard malfunction and accelerator development.

A clear interpretation of the results is a important design criterion.

General comments:

- Good knowledge of accelerators, general physics and technologies needed.
- Quite different technologies are used, based on various physics processes.
- Each task and each technology calls for an expert.
- Accelerator development goes parallel to diagnostics development.

$\Rightarrow$ Interesting and challenging subject!

Beam Quantities and their Diagnostics I

LINAC & transport lines: Single pass ↔ **Synchrotron:** multi pass

Electrons: always relativistic ↔ **Protons/Ions:** non-relativistic for $E_{kin} < 1$ GeV/u

Depending on application: Low current ↔ high current

Overview of the most commonly used systems:

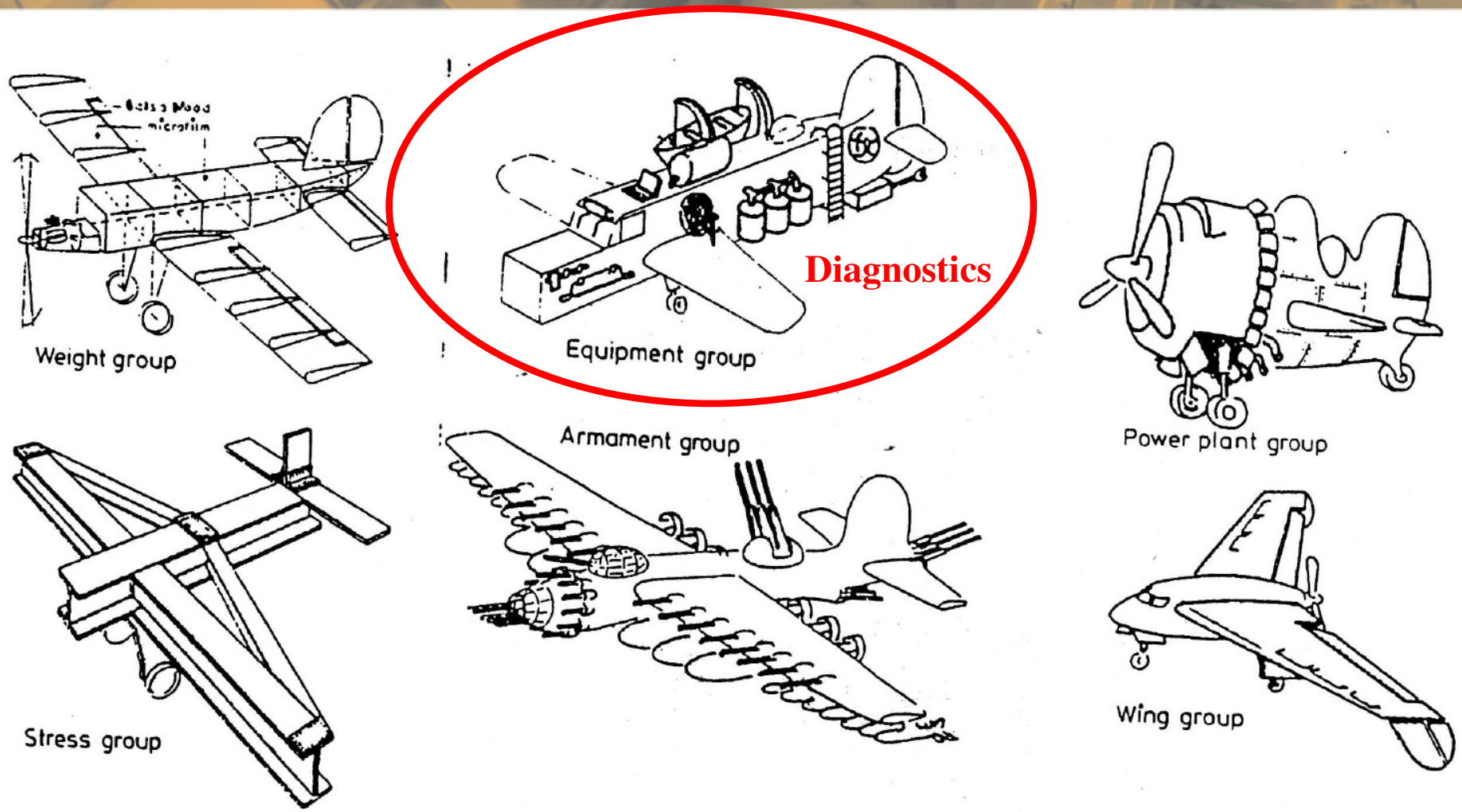
Beam quantity		LINAC & transfer line	Synchrotron
Current *I*	*General*	**Transformer, dc & ac** **Faraday Cup**	**Transformer, dc & ac**
	Special	**Particle Detectors**	Pick-up Signal (relative)
Profile x_{width}	*General*	**Screens, SEM-Grids** **Wire Scanners, OTR Screen**	**Residual Gas Monitor** **Wire Scanner,** **Synchrotron Light Monitor**
	Special	MWPC, **Fluorescence Light**	
Position x_{cm}	*General* *Special*	**Pick-up (BPM)** Using position measurement	**Pick-up (BPM)**
Transverse Emittance ε_{tran}	*General*	**Slit-grid** **Quadrupole Variation**	**Residual Gas Monitor** **Wire Scanner**
	Special	**Pepper-Pot**	Transverse Schottky

Beam Quantities and their Diagnostics II

Beam quantity		LINAC & transfer line	Synchrotron
Bunch Length $\Delta\varphi$	*General* *Special*	**Pick-up** **Secondary electrons**	**Pick-up** **Wall Current Monitor** **Streak Camera, Laser**
Momentum p and Momentum Spread $\Delta p/p$	*General* *Special*	**Pick-ups (Time-of-Flight)** Magnetic Spectrometer	**Pick-up (e.g. tomography)** Schottky Noise Spectrum
Longitudinal Emittance ε_{long}	*General* *Special*	**Buncher variation** Magnetic Spectrometer	 **Pick-up & tomography**
Tune and Chromaticity Q, ξ	*General* *Special*	--- ---	**Exciter + Pick-up** Transverse Schottky Spectrum
Beam Loss r_{loss}	*General*	**Particle Detectors**	
Polarization P	*General* *Special*	Particle Detectors Laser Scattering (Compton scattering)	
Luminocity L	*General*	Particle Detectors	

- Destructive and non-destructive devices depending on the beam parameter.
- Different techniques for the same quantity ↔ Same technique for the different quantities.

Conclusion for Beam Diagnostics Course



For a successful construction and operation of an accelerator,
the understand and right balance of all disciplines is required!