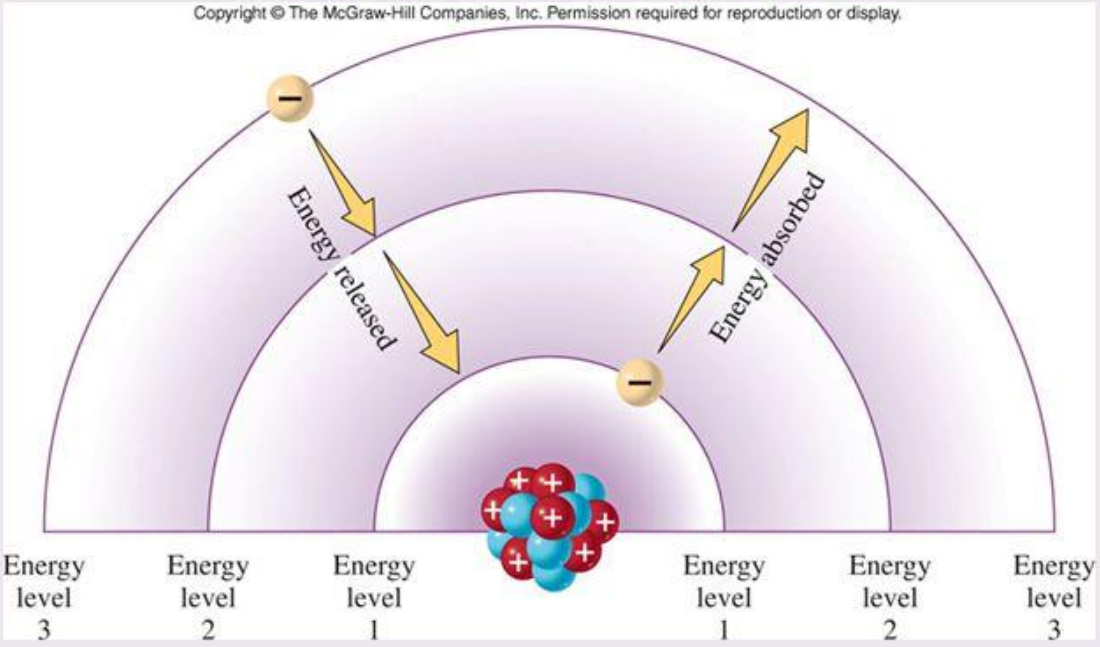
Field Portable X-Ray Fluorescence

How does it work?

- **X-ray fluorescence spectroscopy (XRF) is a non-destructive analytical technique used to determine the elemental composition of materials.**
- **Field portable XRF analyzers work by measuring the fluorescent (or secondary) X-rays emitted from a sample when excited by a primary X-ray source.**

Quantum Nature of Atoms

The Bohr Atom



Electrons exist in fixed energy levels surrounding the nucleus

Quantization of energy

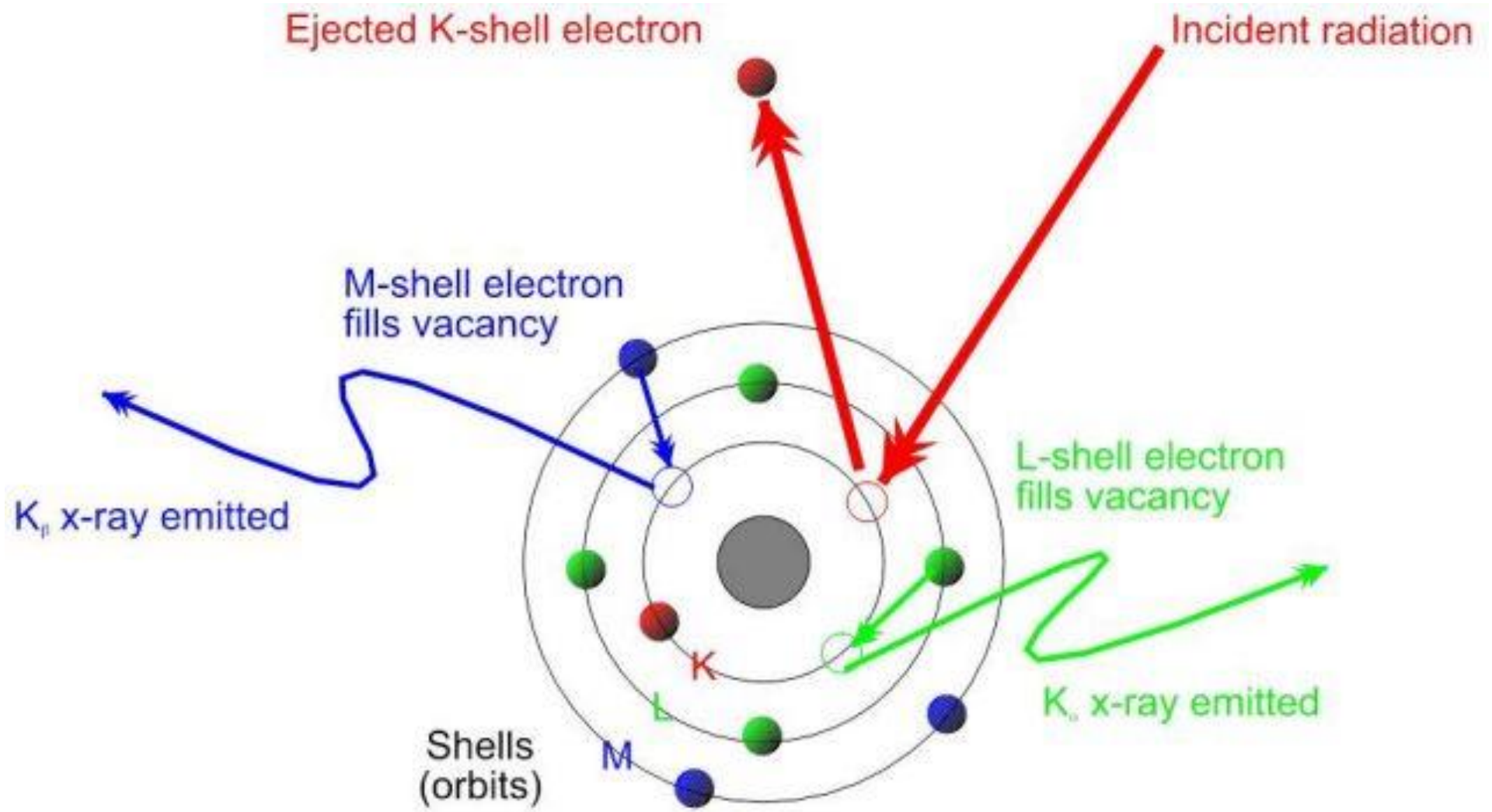
Promotion of electron occurs as it absorbs energy

Excited State

Energy is released as the electron travels back to lower levels

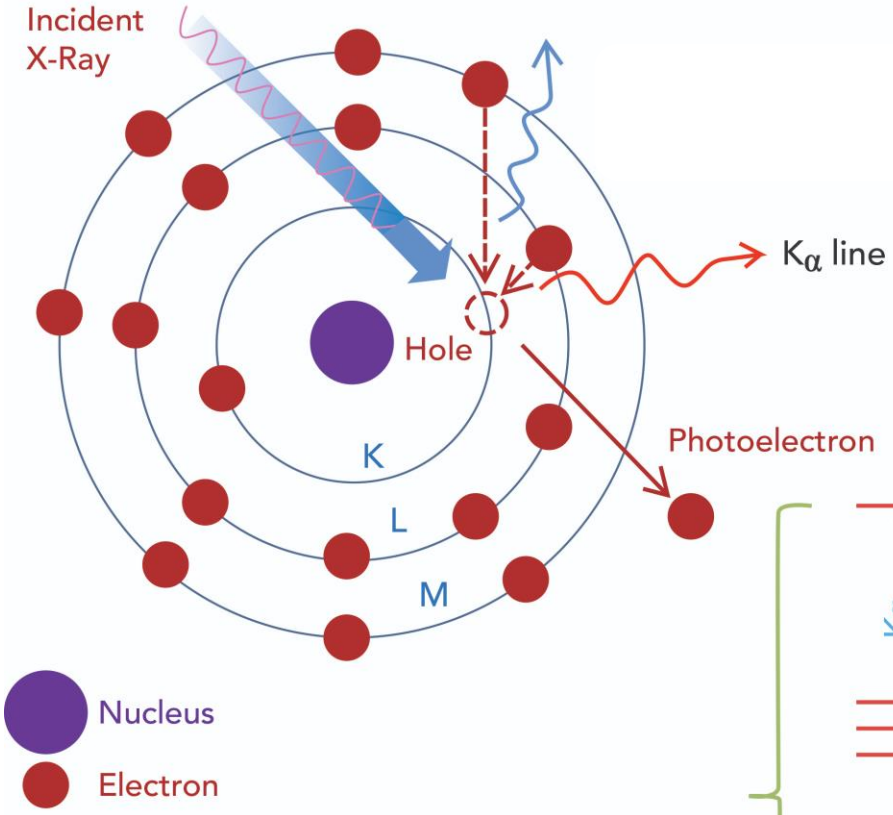
Relaxation

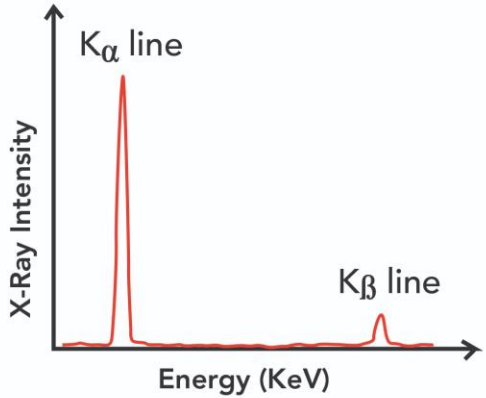
Production of Secondary Fluorescence



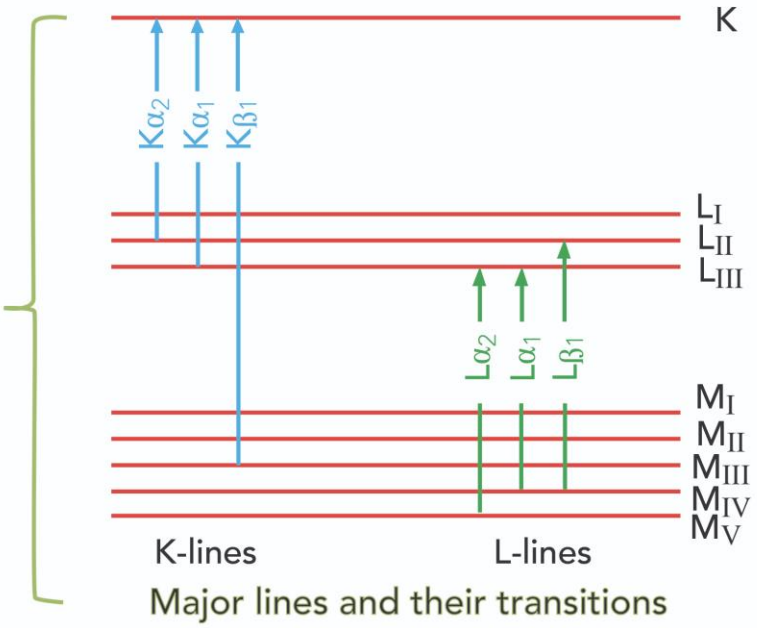
- **Each of the elements present in a sample produces a set of characteristic fluorescent X-rays providing “unique fingerprints”.**
- **These “fingerprints” are distinct for each element, making handheld XRF analysis an excellent tool for quantitative and qualitative measurements.**

Characteristic Fluorescence Xray



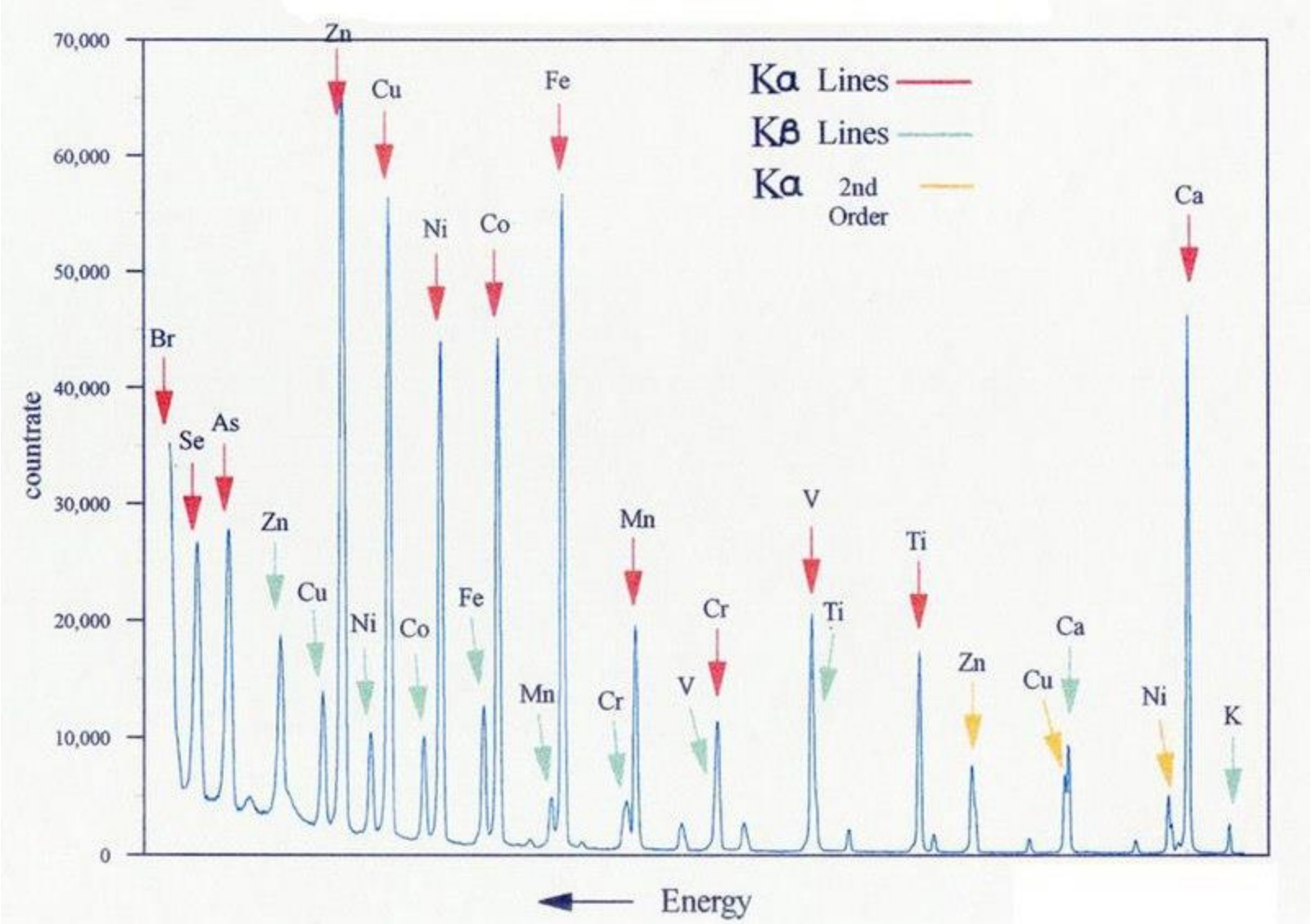


Overview of most important lines with their transitions in Siegbahn notation



Major lines and their transitions

Xray Fluorescence Spectrum



Step-by-step XRF analysis

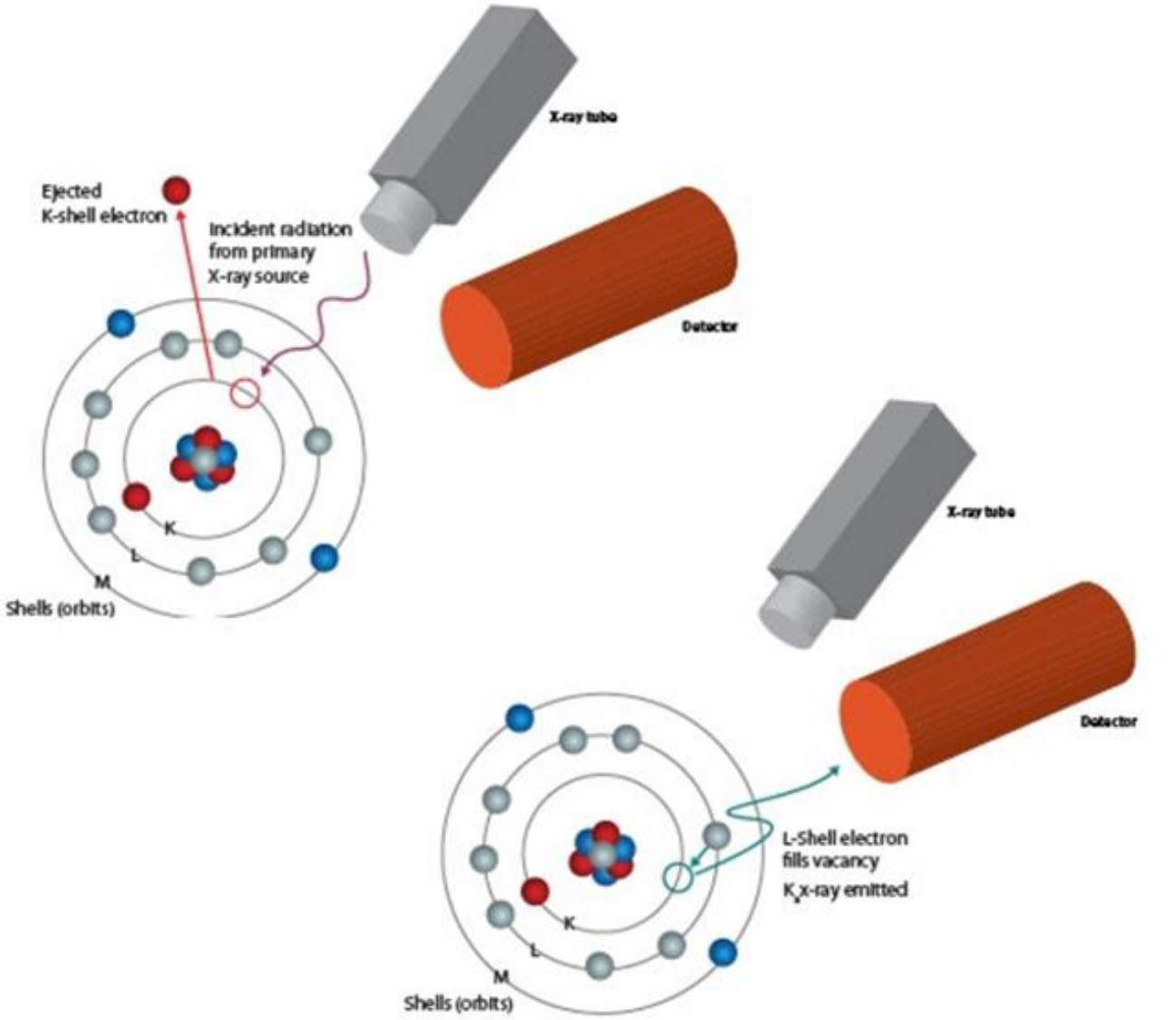
1. X-rays are produced by the analyzer and pointed at a sample surface.

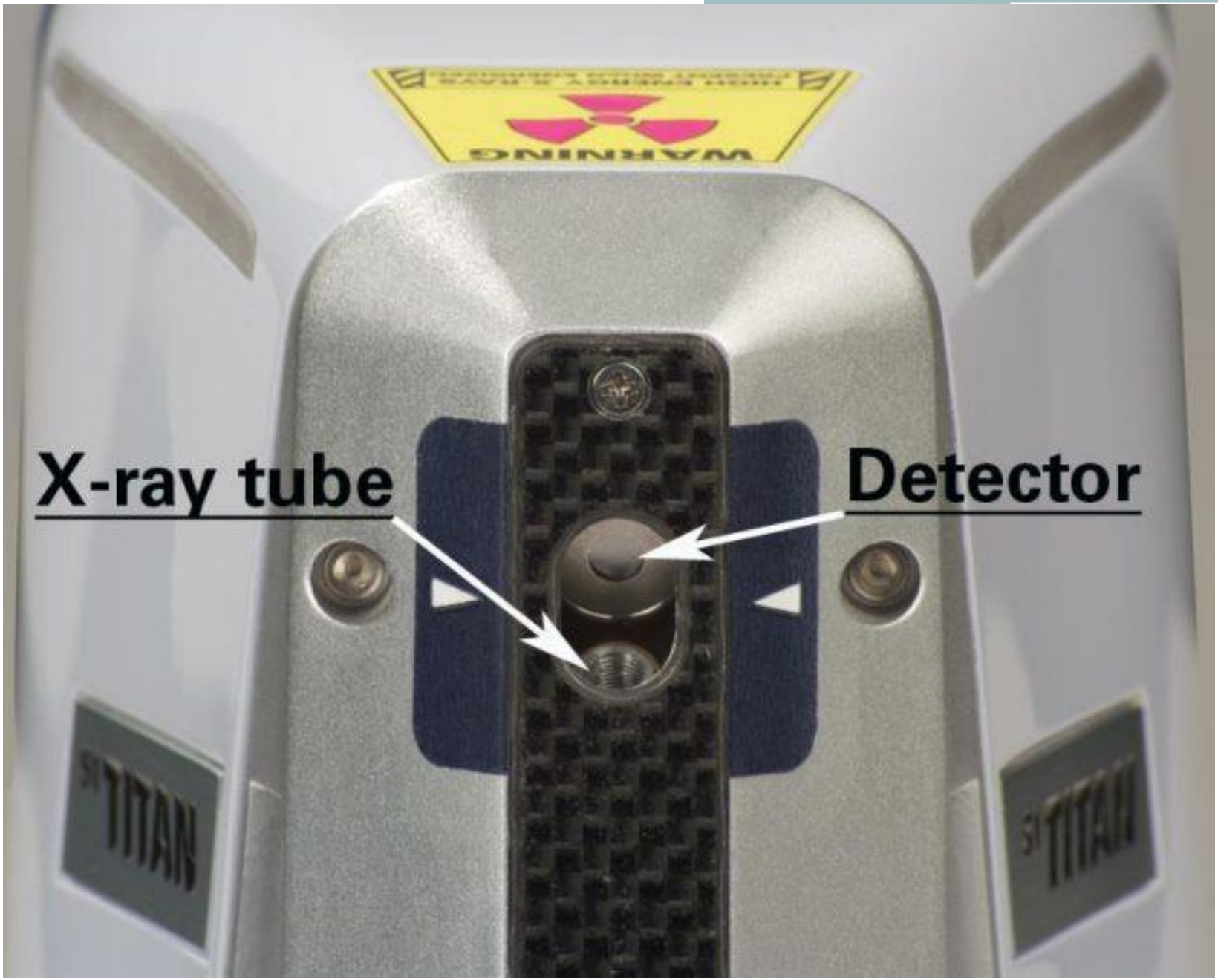
2. The energy causes inner-shell electrons to be ejected.

3. Outer-shell electrons fill the vacancies left by the ejected electrons and fluorescent x-rays are emitted.

4. The fluorescent x-rays enter the detector and send electronic pulses to the preamp.

Primary and Secondary Xrays




X-ray tube
Detector
TITAN
TITAN

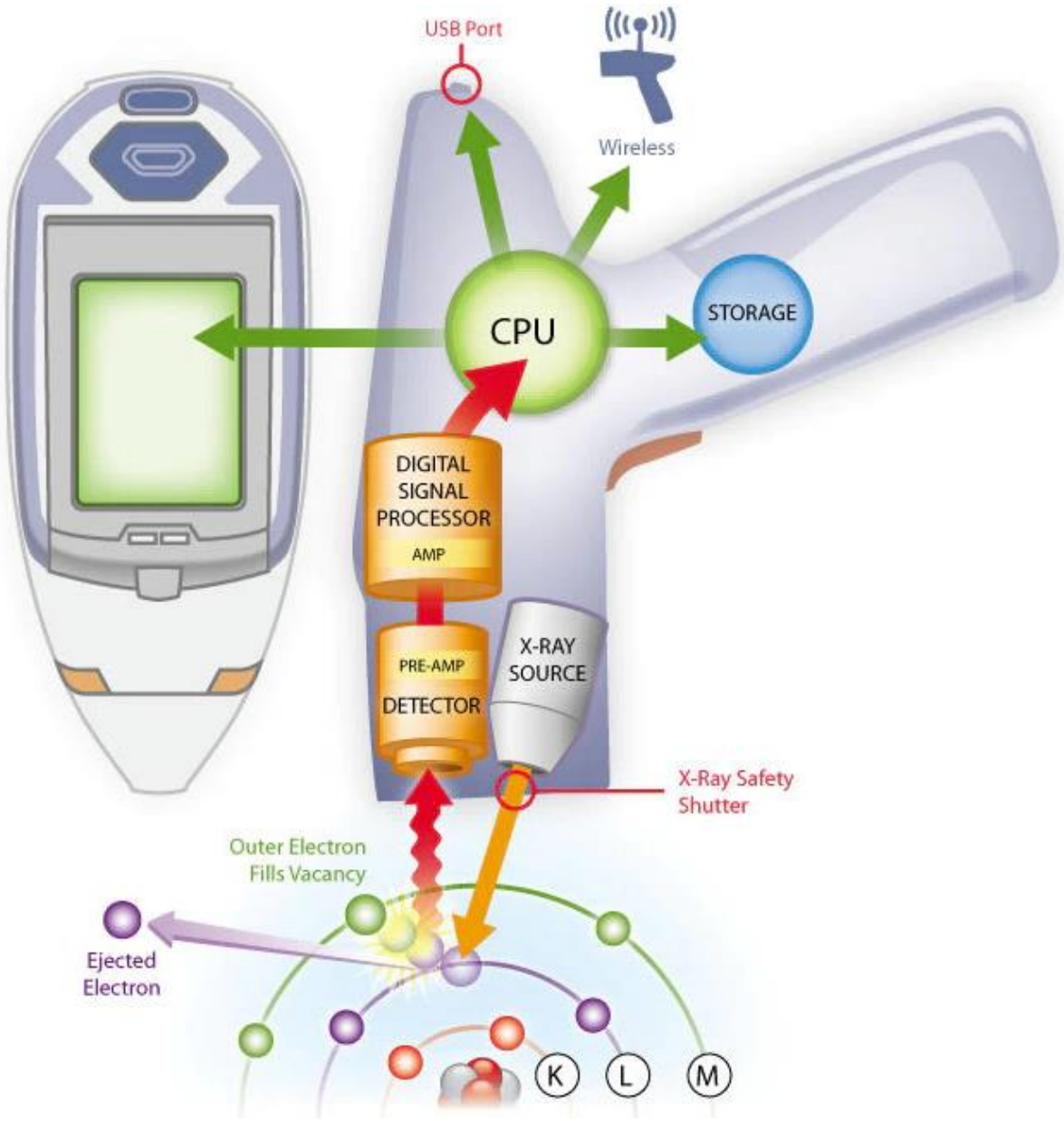
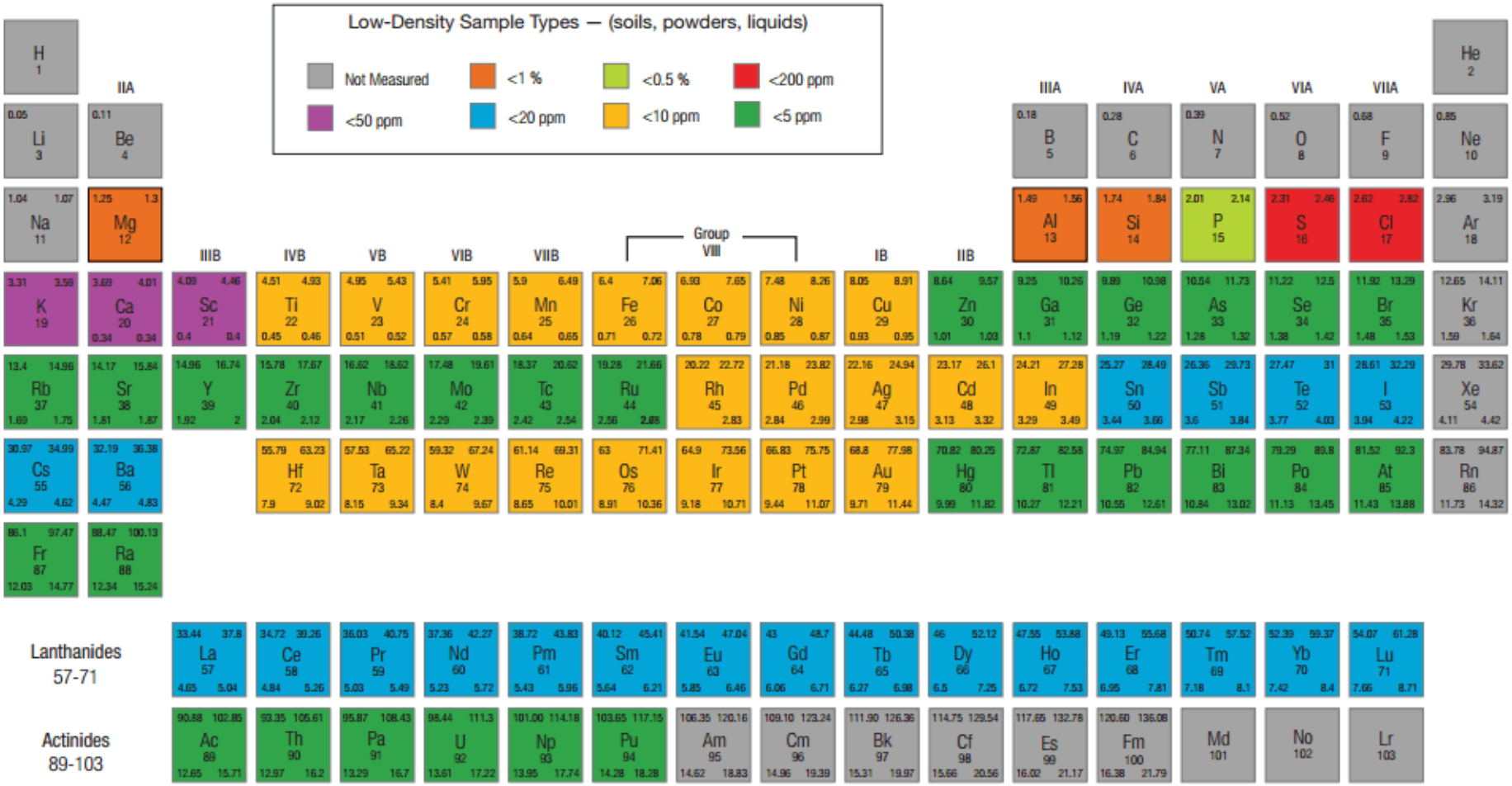
5. The preamp amplifies the signals and sends them to the Digital Signal Processor (DSP)

6. The DSP collects and digitizes the x-ray events and sends the spectral data to the main CPU for processing.

7. The CPU analyzes the spectral data to produce detailed composition analysis.

8. Composition data and other grade or value identification are displayed and stored in memory for later recall or download to an external PC.

Field Portable XRF



Typical Detection Limits for FP-XRF