VG SCIENTA

VG Scienta PES solutions

By Henrik Bergersen
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VG SCIENTA

Company Overview

Vacuum Generators
(UK, 1962)

+

Scienta
(Sweden, 1983)

Vacuum Technology

Scientific Instruments

=

VG Scienta inc
Denver, CO
Tel: 720 350 5000

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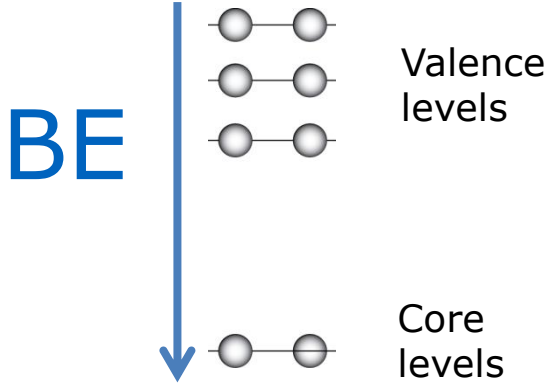
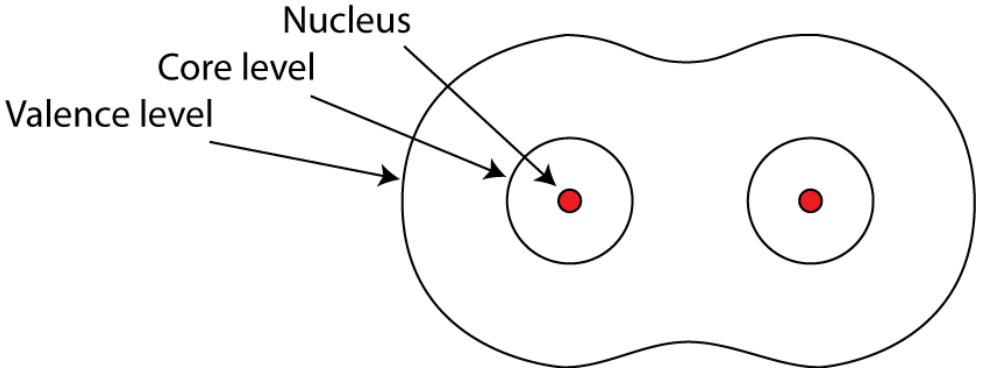
Scientific Instruments

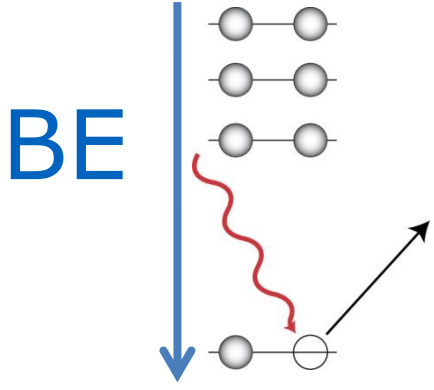
- 1981: Nobel Prize to Prof Siegbahn
- 1983: Prof Siegbahn co-founder of Scienta
- 1994: Parallel ARPES
- Today:
  - Global leader ARPES, HAXPES and APPES
  - Very active R&D
    - **Latest release: R4000 HiPP-3**

Energy levels in the atom

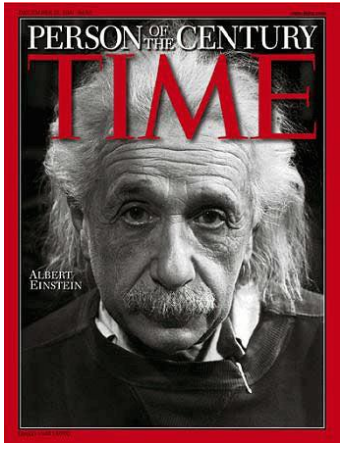




Photoelectron spectroscopy

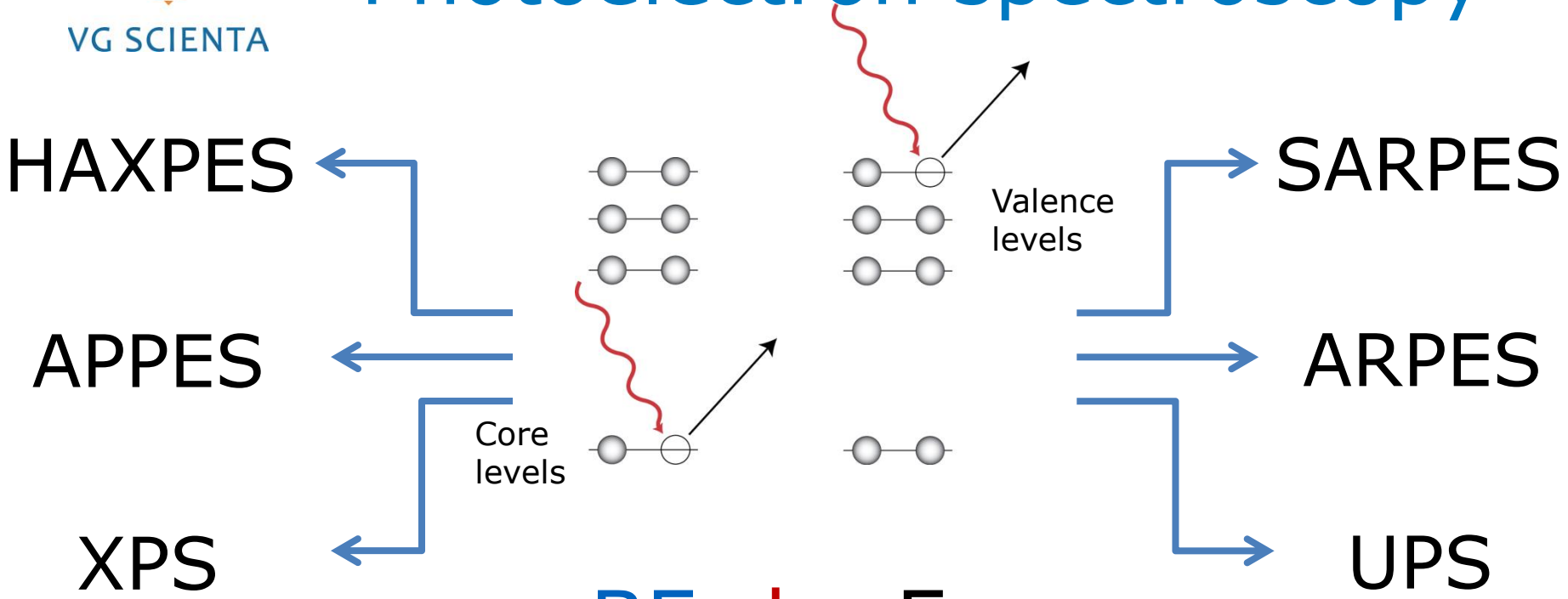


$BE = h\nu - E_k$



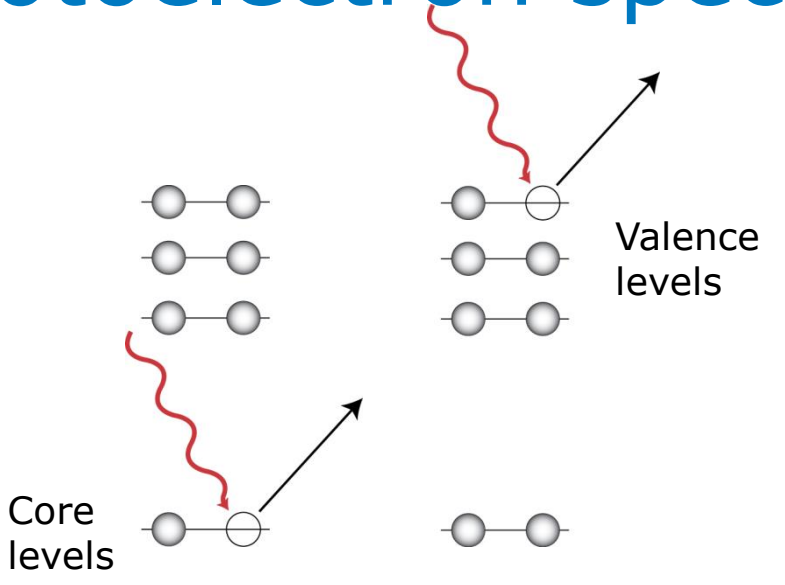
1921 Nobel Prize in Physics

Photoelectron spectroscopy



$$BE = h\nu - E_k$$

Photoelectron spectroscopy



$$BE = h\nu - E_k$$

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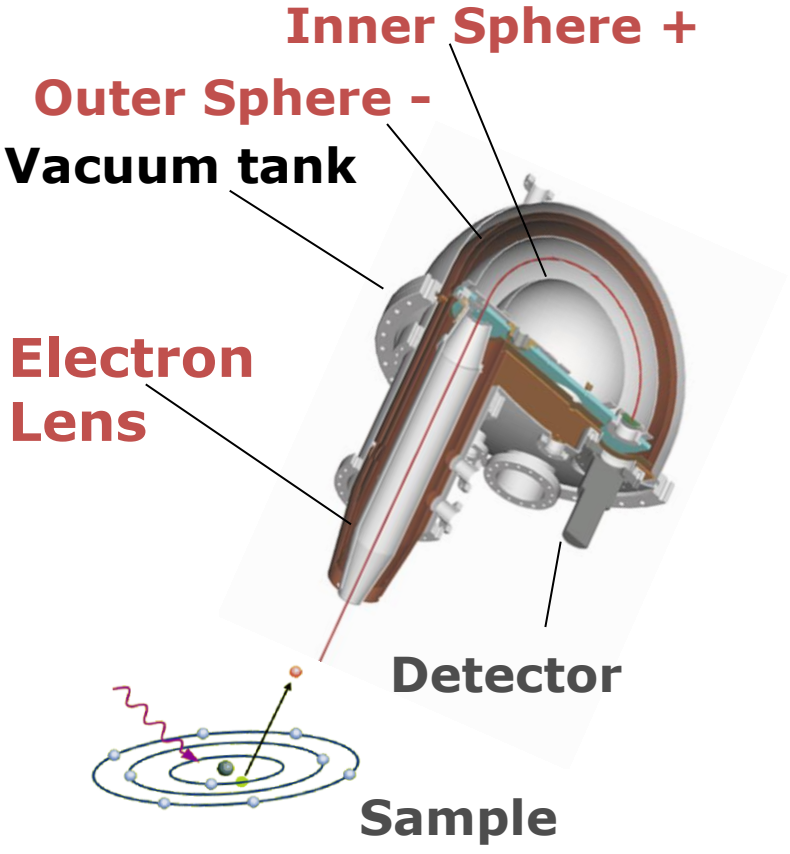
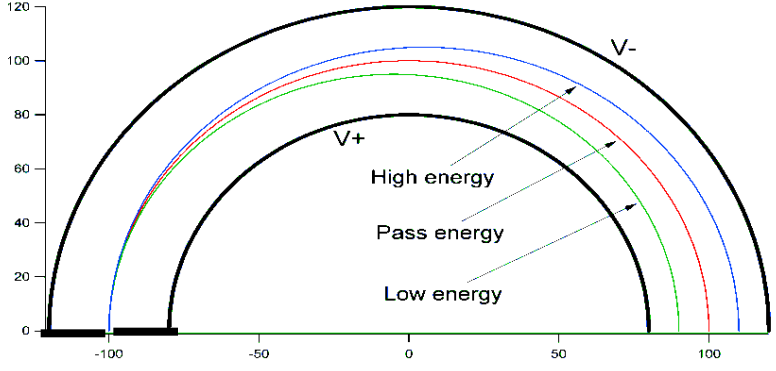
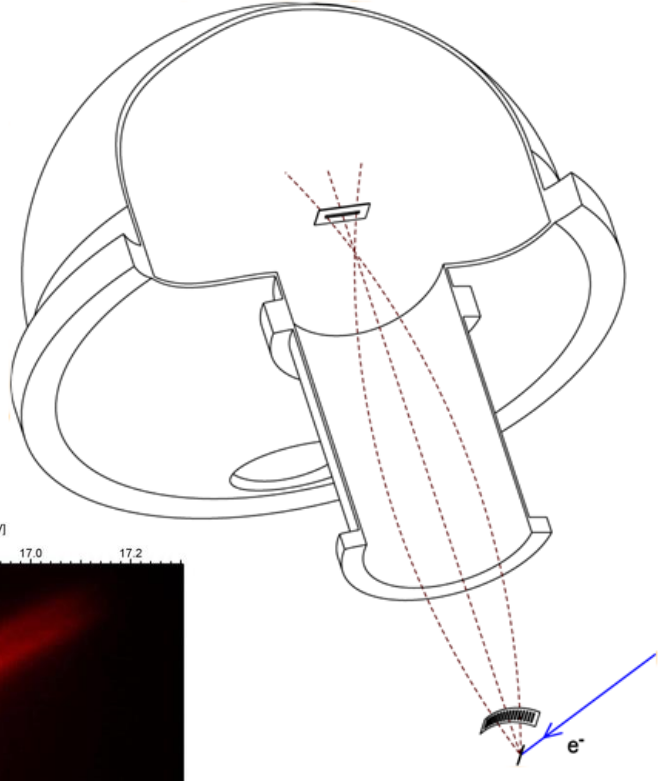
Photoelectron spectroscopy

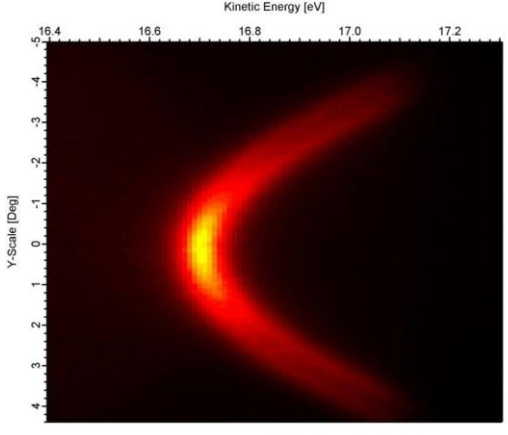


2-D detection

- 2-D detector: 2 properties may be probed
- Energy perpendicular to slit
- Angle/Position along slit







Angular mode

- Angular mode enables parallel measurement of different emission angles
- This enables a number of powerful techniques without sample rotation:
  - Band structure measurements (bandmapping)
  - Depth profiling
  - X-ray photoelectron diffraction (XPD)
- Technique pioneered by VG Scienta in 1994
- VG Scienta still world leading in energy and angular resolution

VG Scienta's Dr. Björn Wannberg was the recipient of the American Physical Society Keithley award 2008: "*For advances in the development of angle-resolved electron analyzers for photoelectron spectroscopy.*"

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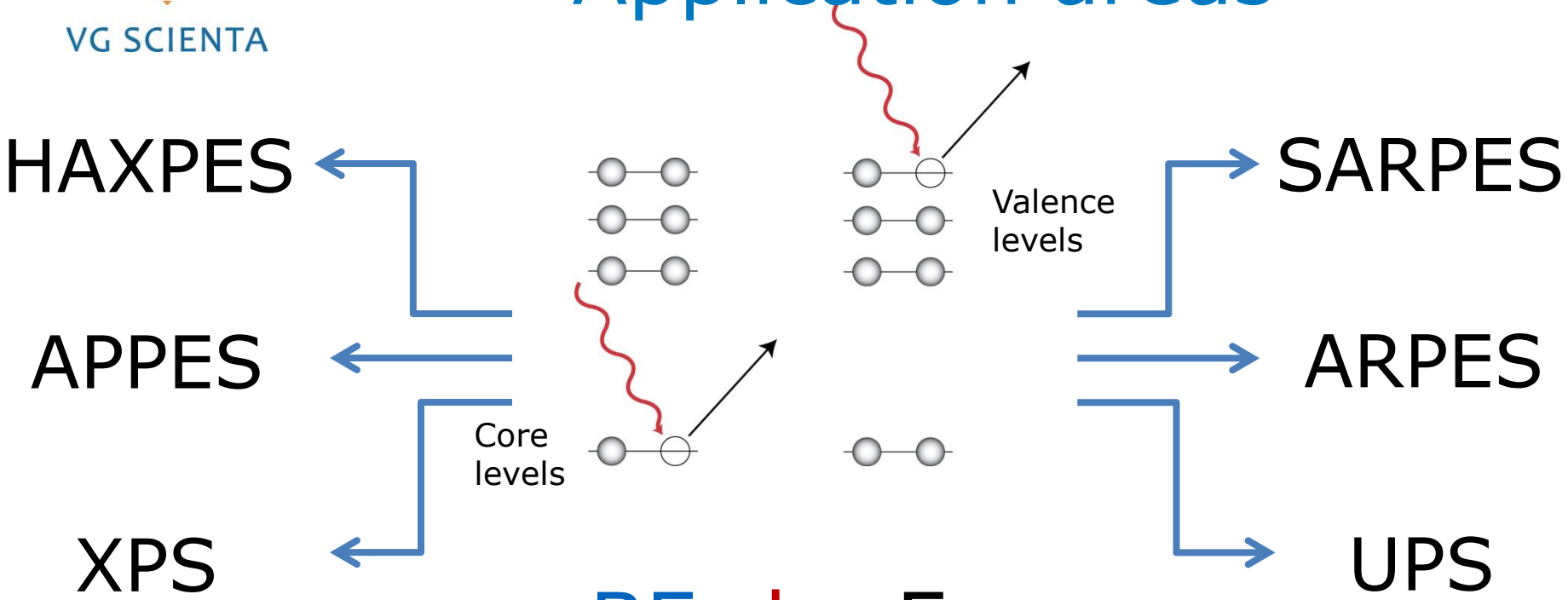
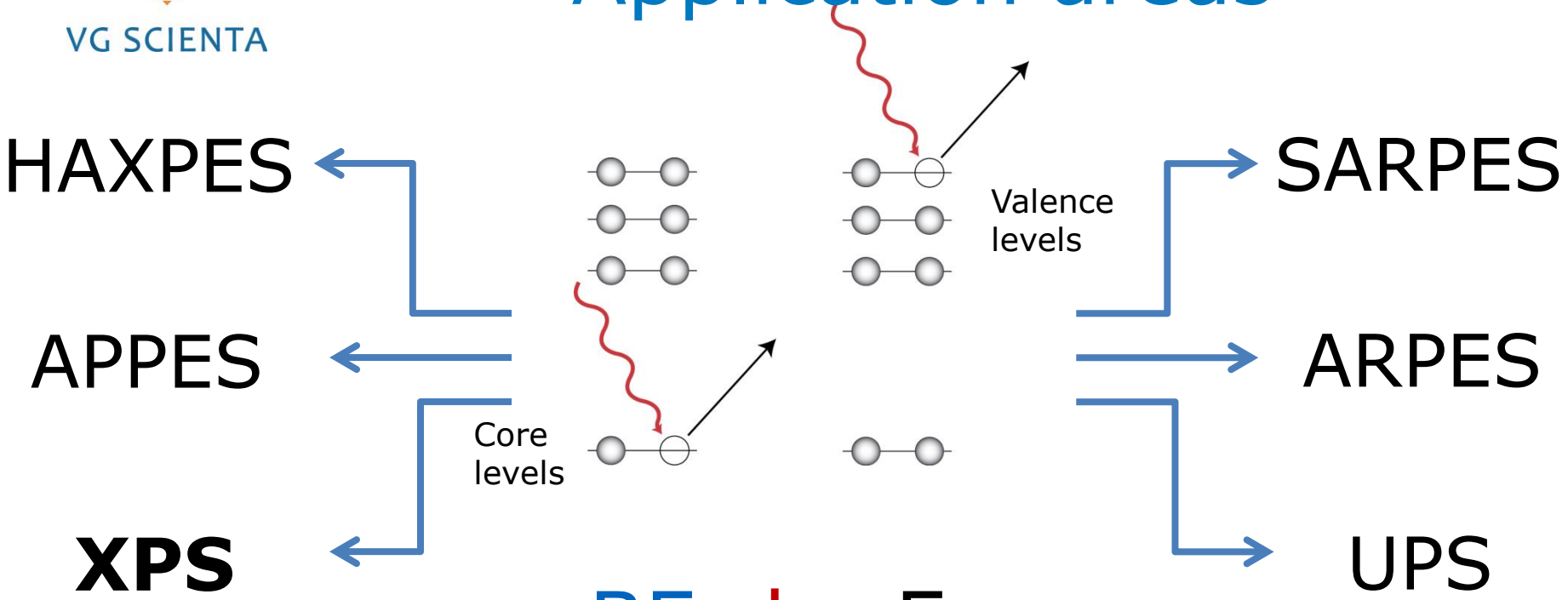
Application areas



$$BE = h\nu - E_k$$

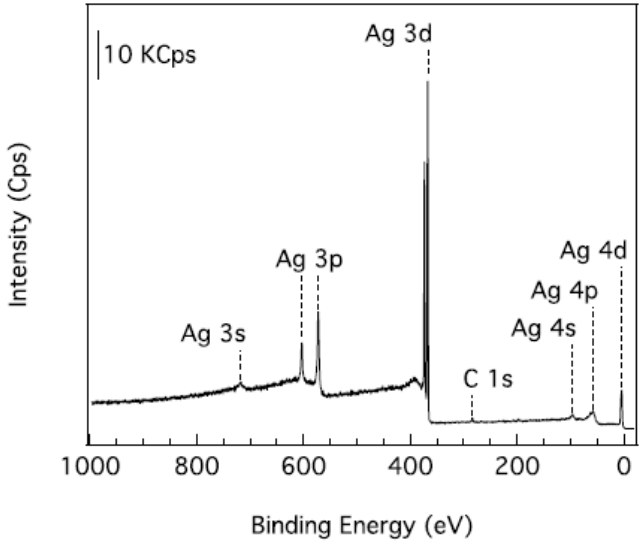
Application areas



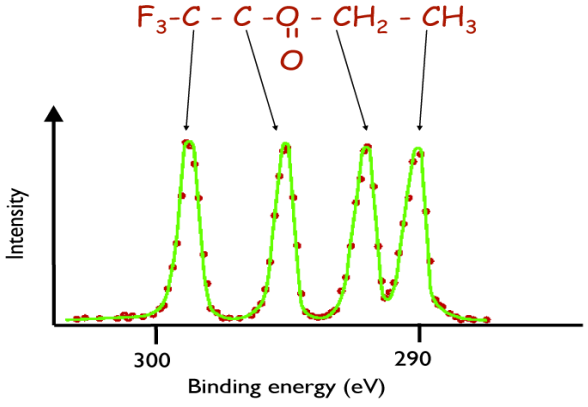
$$BE = h\nu - E_k$$

XPS – X-ray Photoelectron Spectroscopy

Element and chemical state specific information



Data courtesy: F. Mangolini



Siegbahn: "The ESCA molecule"

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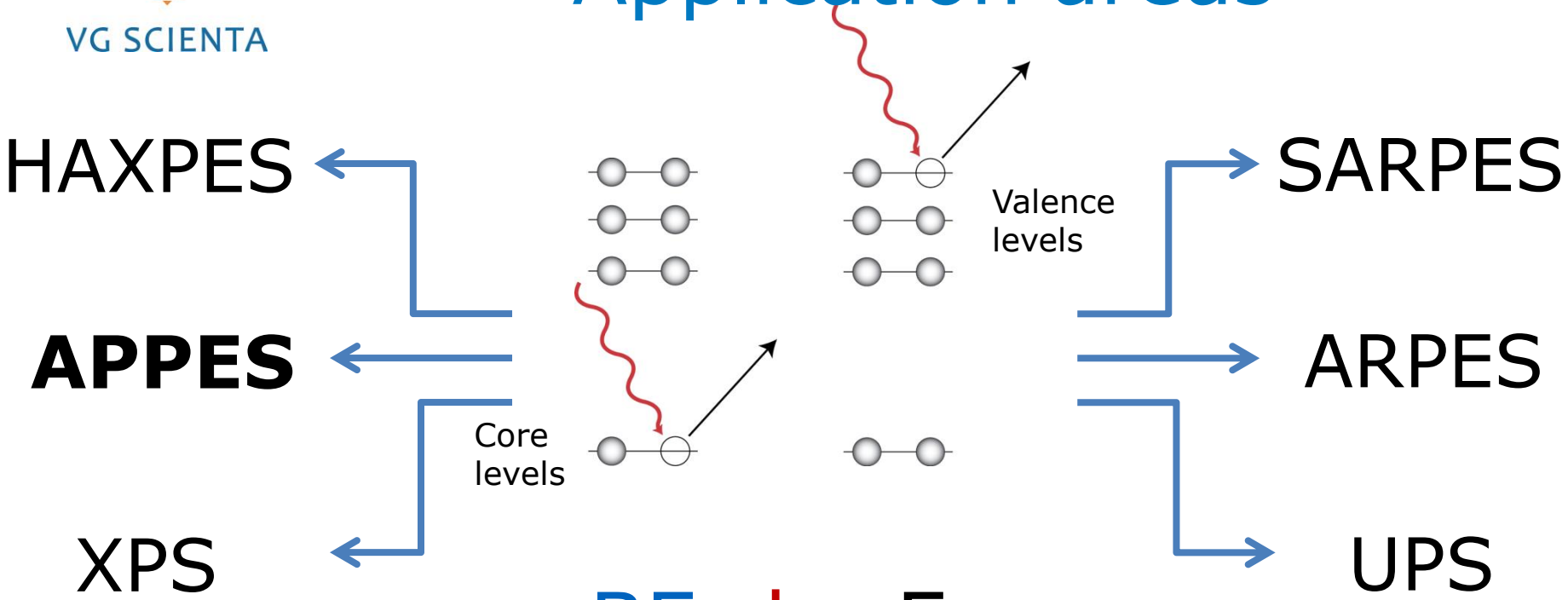
Application areas



$$BE = h\nu - E_k$$

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Ambient Pressure

- Traditional PES require UHV
- Some systems/processes can not be studied under UHV
  - Volatile samples prohibits UHV (gaseous samples, liquids)
  - Some processes are fundamentally different in higher pressures

Problems:

- Some components sensitive to high pressures (e.g. MCP)
- Electrons are scattered before reaching the detector
  - Differential pumping

Ambient Pressure - Range

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10^{-13} mbar

10^{-11} - 10^{-1} mbar

1 - 5 mbar

~25 mbar

$P_{Water\ vapor}$

1 bar

$P_{Atmosphere}$

Pressure

Catalysis

Water chemistry

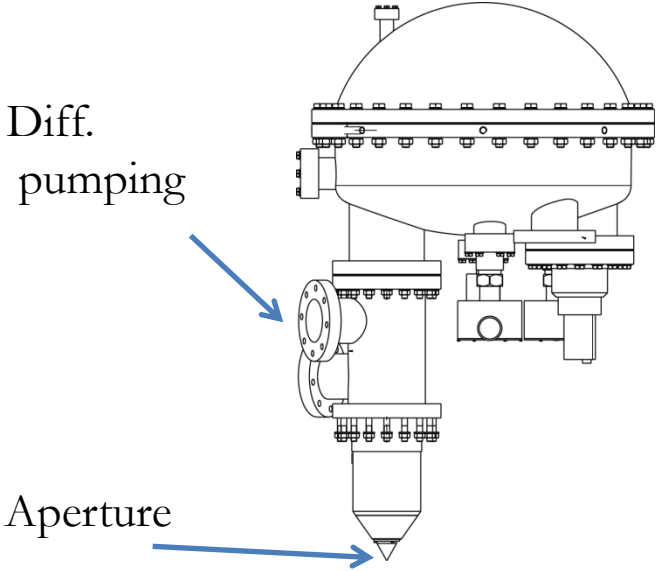
Atmospheric chemistry

Liquid jet

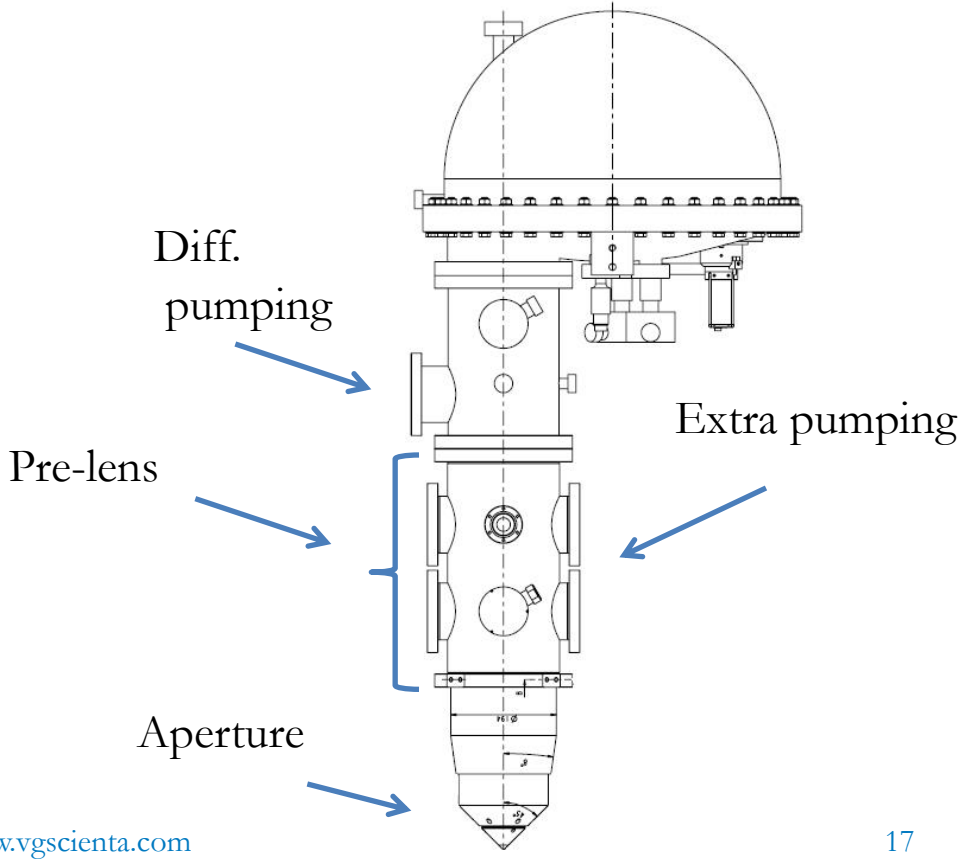
Ionic liquids

Ambient Pressure Analysers

R3000 HP



R4000 HiPP-3



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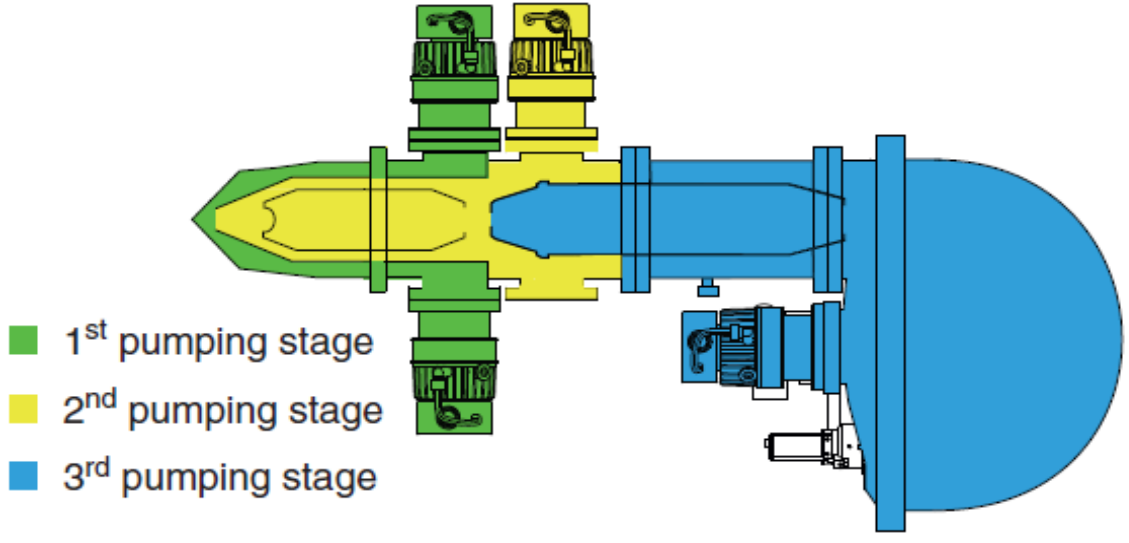
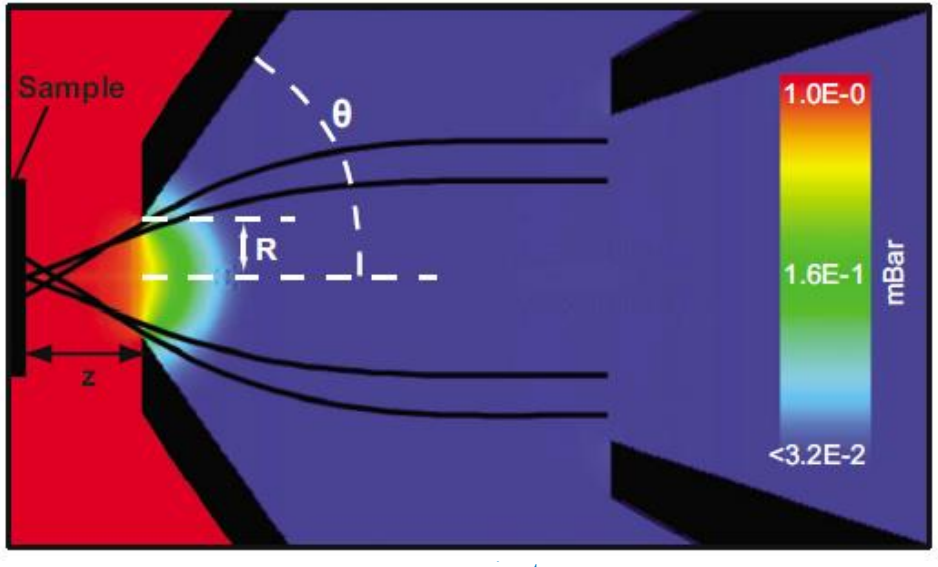
Differential pumping stages



Differential pumping design

- The Scienta design provides very rapid pressure decrease
- Nodeless design
  - High transmission
  - Angular mode in full kinetic energy range



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Install Base

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10^{-13} mbar

10^{-11} - 10^{-1} mbar

1 - 5 mbar

~25 mbar

$P_{Water\ vapor}$

1 bar

$P_{Atmosphere}$

Pressure

Suzuki SES-100

de Brito R4000 Spec.

U Penn R3000 HP

Pune R3000 HP

ALS HiPP

Nilsson SES-100

PSI HiPP-2

ALS HiPP-2

Tokyo HiPP-2

Spring-8 HiPP-2

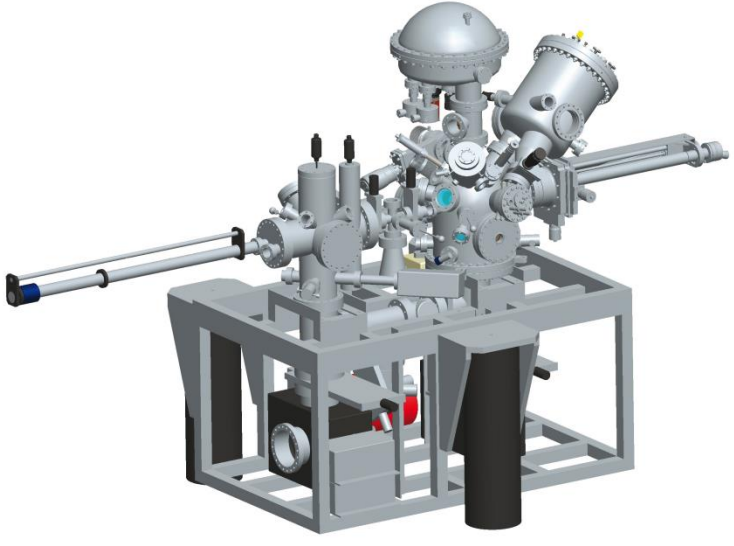
Imp. Collage

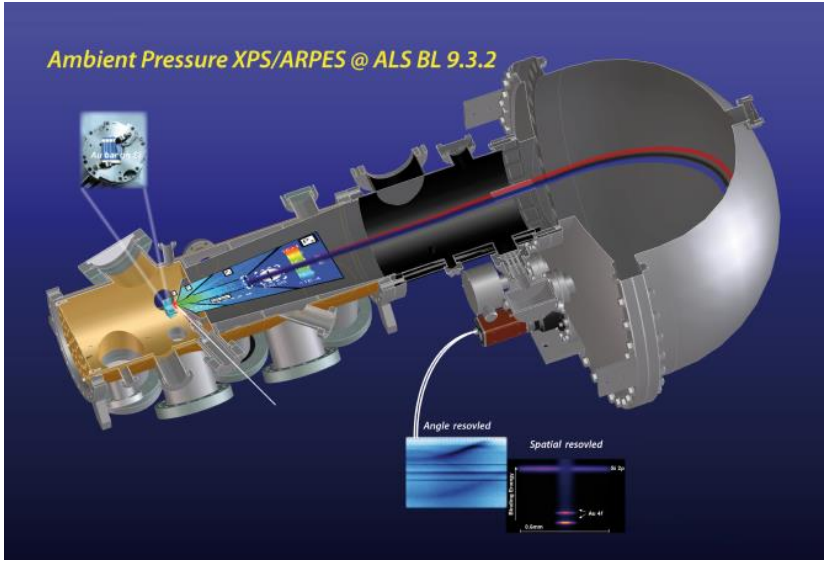
HiPPlab

FZ Jülich

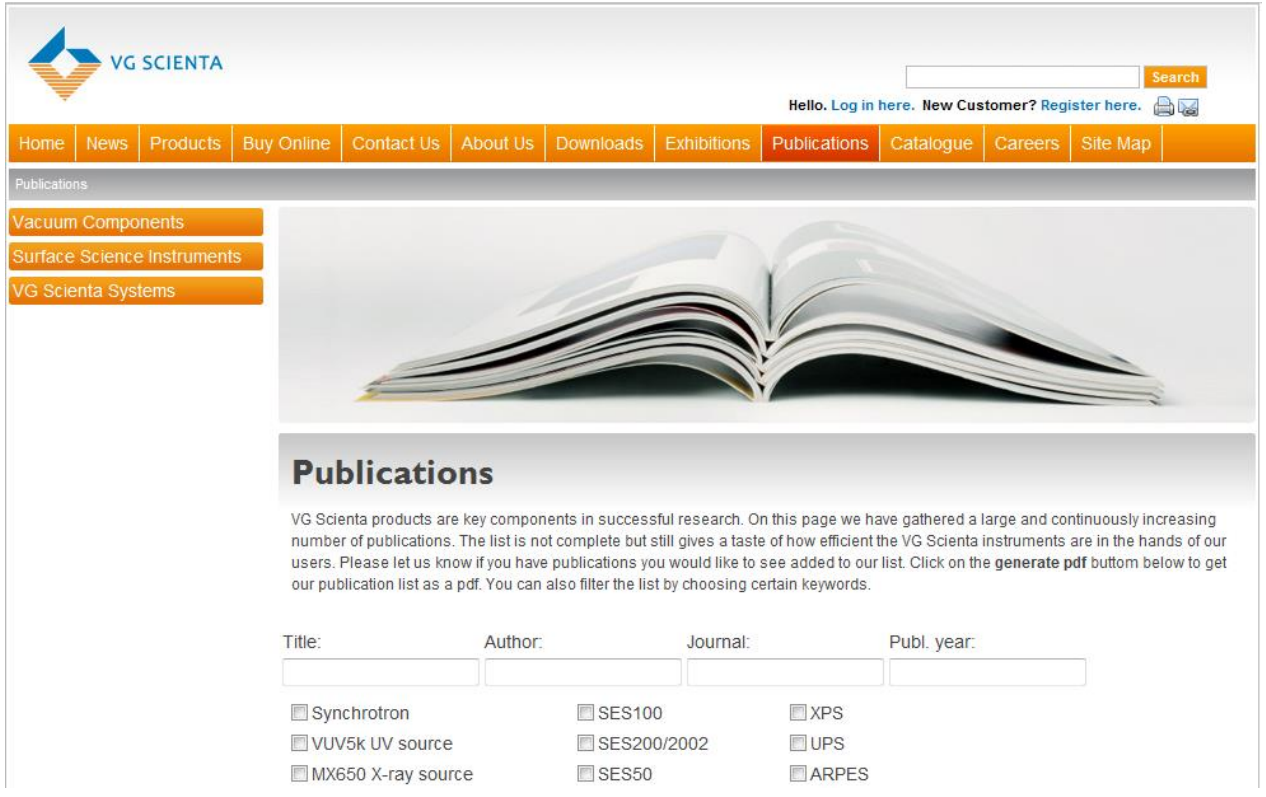
HiPPlab

Install Base - examples





Customer proven performance



http://www.vgscienta.com/publicationlist.aspx

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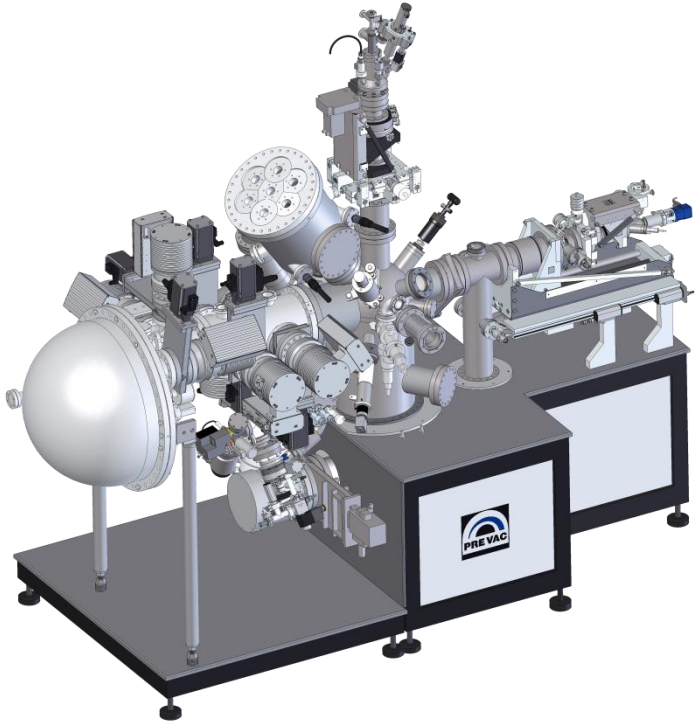
HiPP-3 System Solution

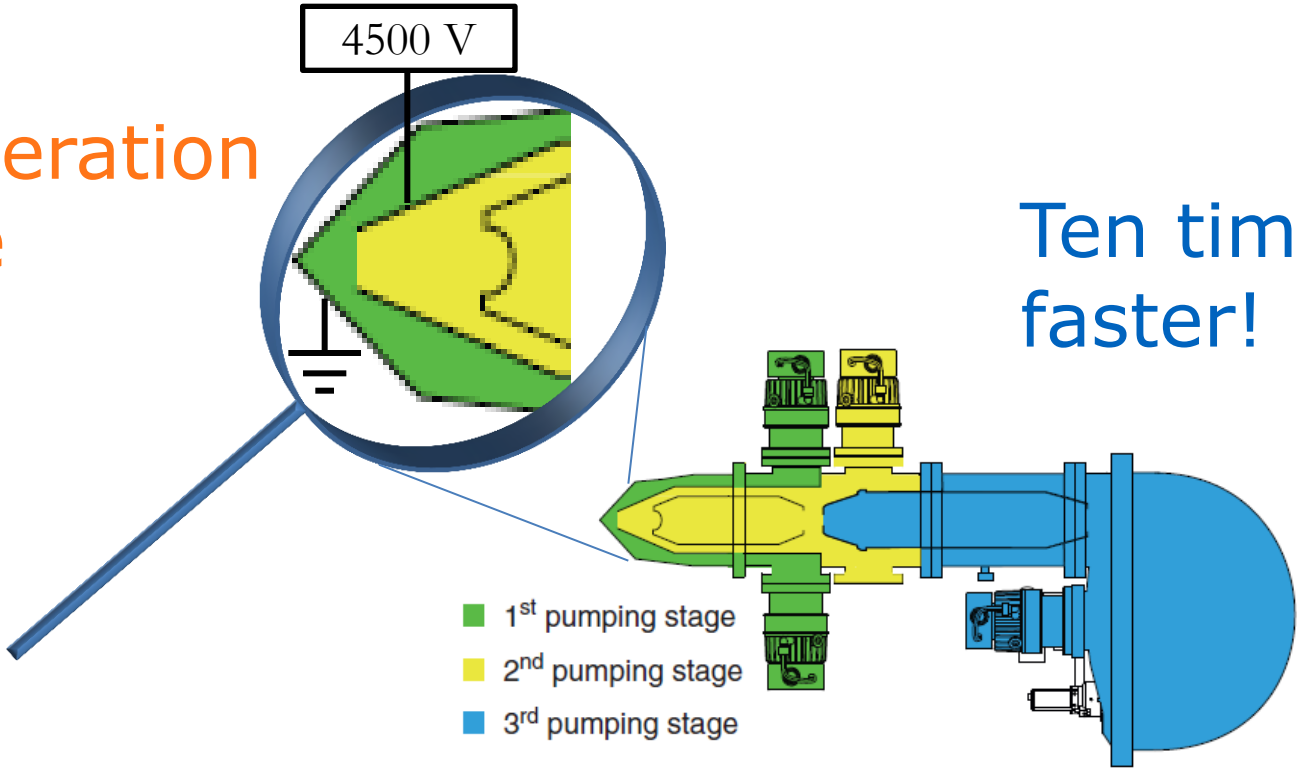


Scienta R4000 HiPP-3
New analyser for APPES+Imaging

- Based on Scienta R4000 HiPP-2
- Optimized for XPS energies (Ek<1500 eV) but available up to 6 keV
- Improved Swift Acceleration Mode
- Imaging XPS <20 µm

Scienta R4000 HiPP-3

Swift Acceleration Mode



Ten times faster!

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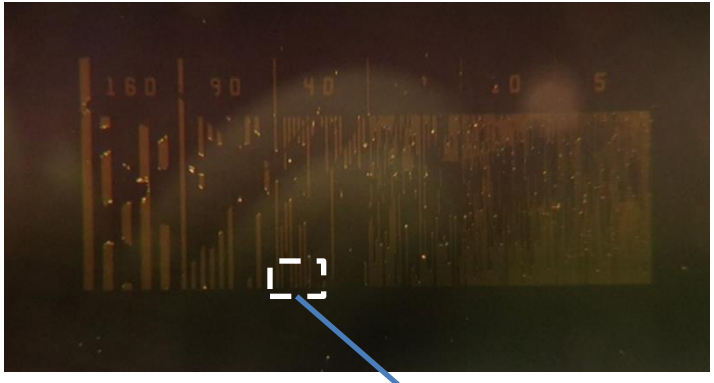
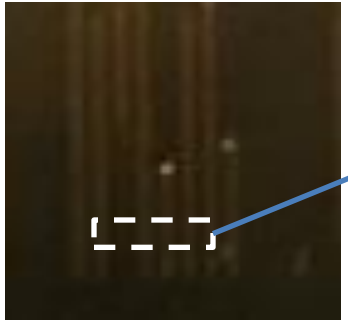
Imaging XPS

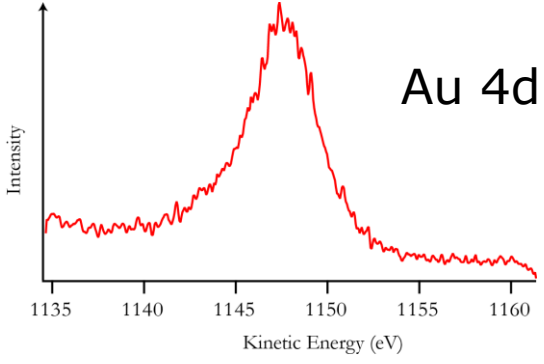
- Spatial Resolution 20 µm
- Field of view 0.8 mm
- Step size 2.5 µm

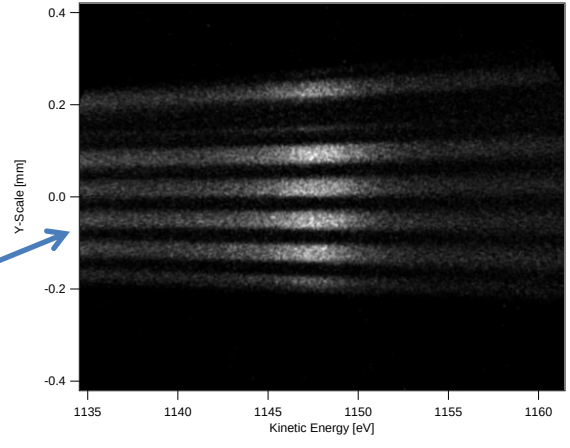
- Parallel imaging in one direction

Imaging XPS – first results



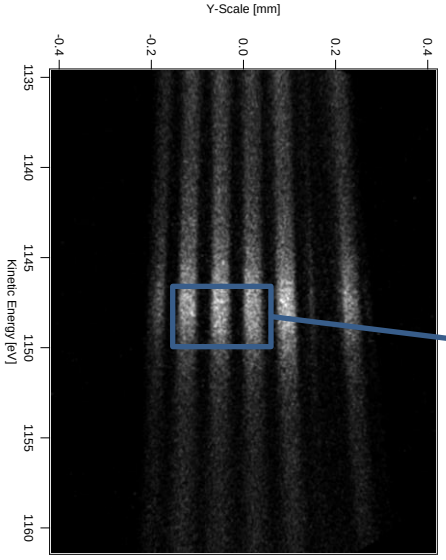


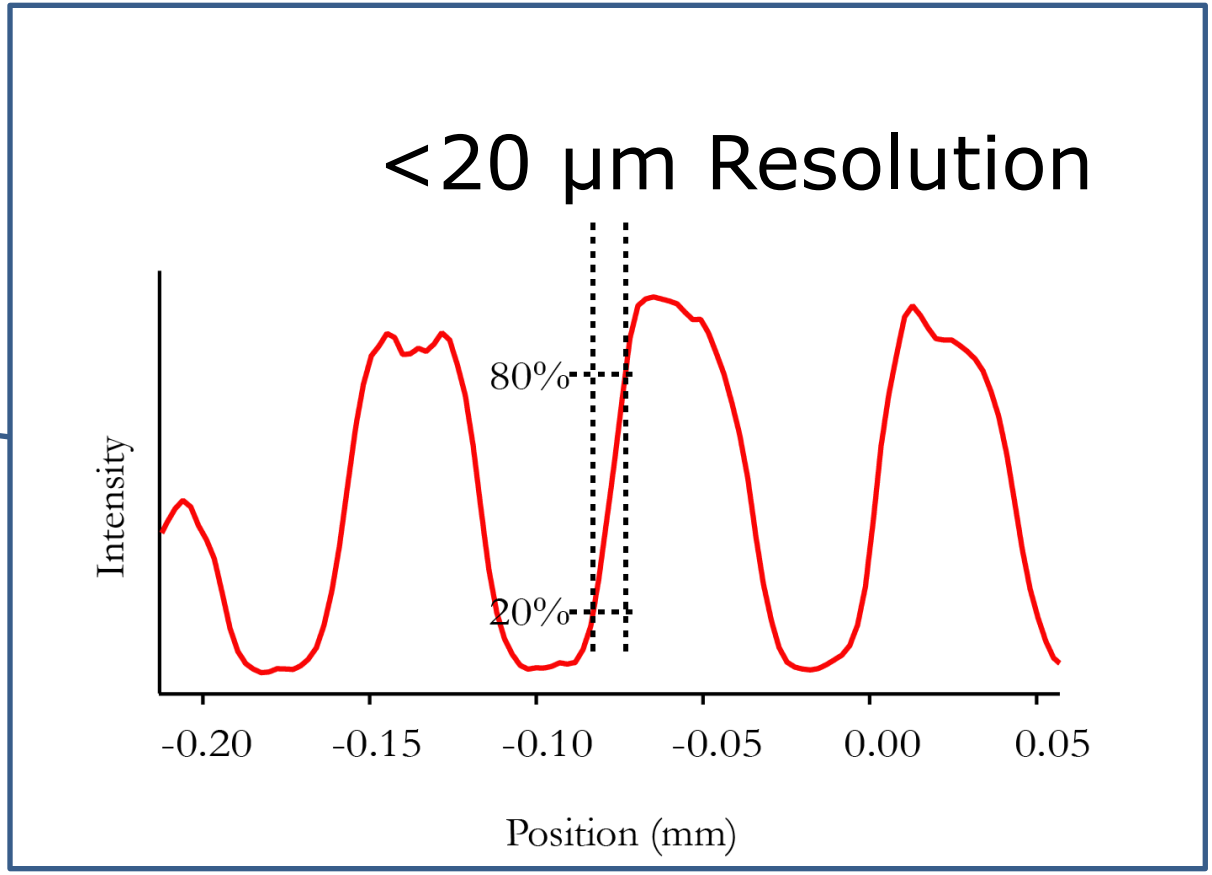




Sample:
Si substrate with Au lines

Spatial Resolution





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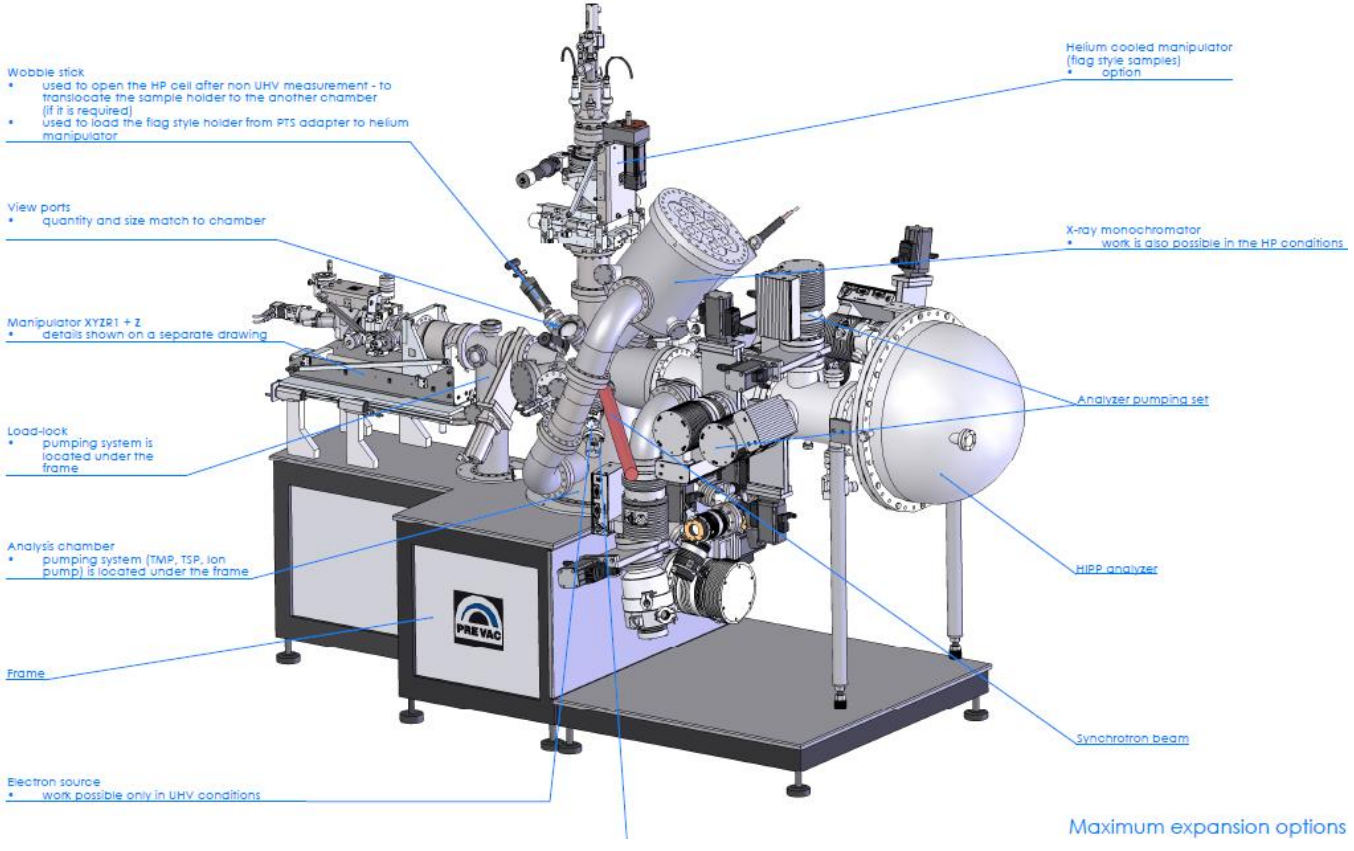
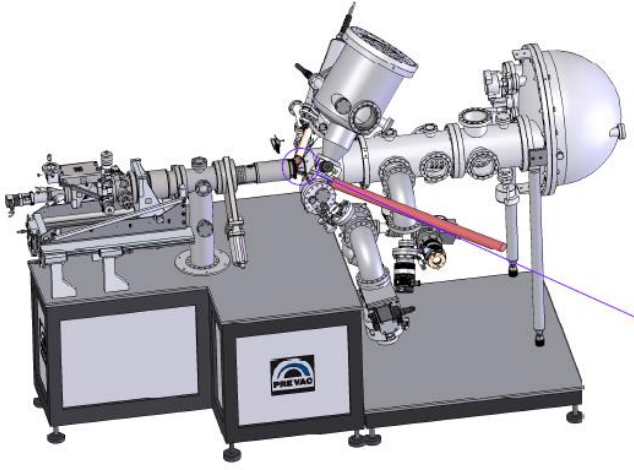
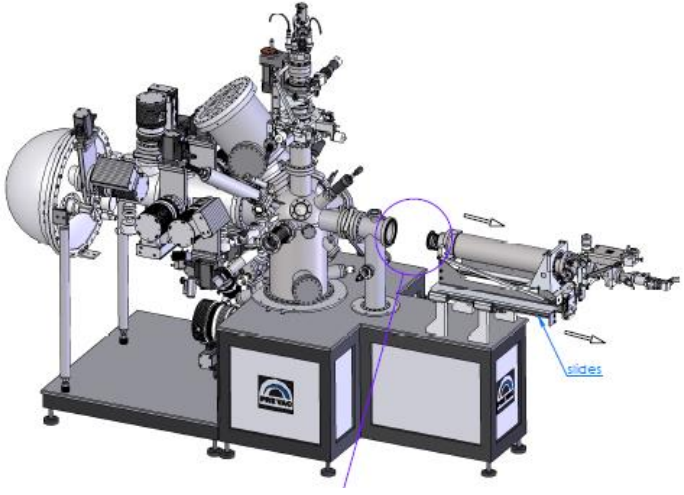
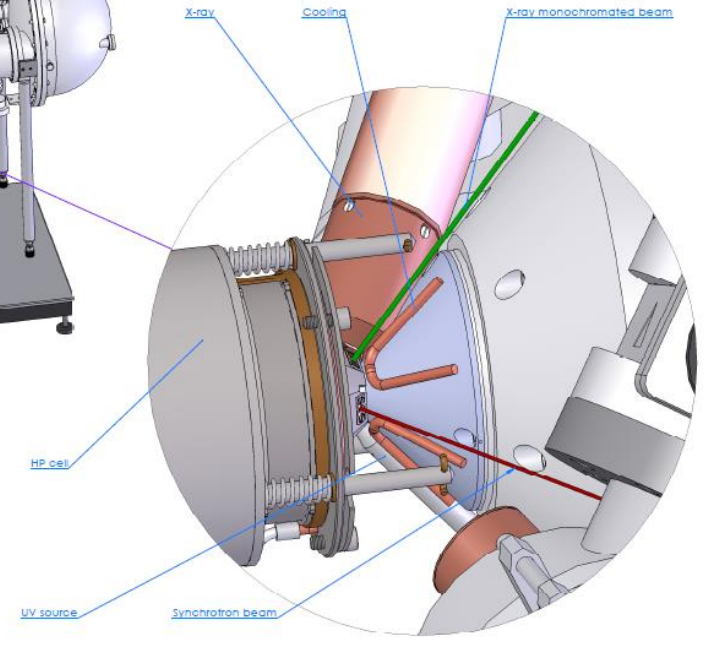
HiPP-3 System Solution



HiPP-3 HPGC







Components inside the chamber