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RI-Bornite

MeV-UED as a Commercial Instrument

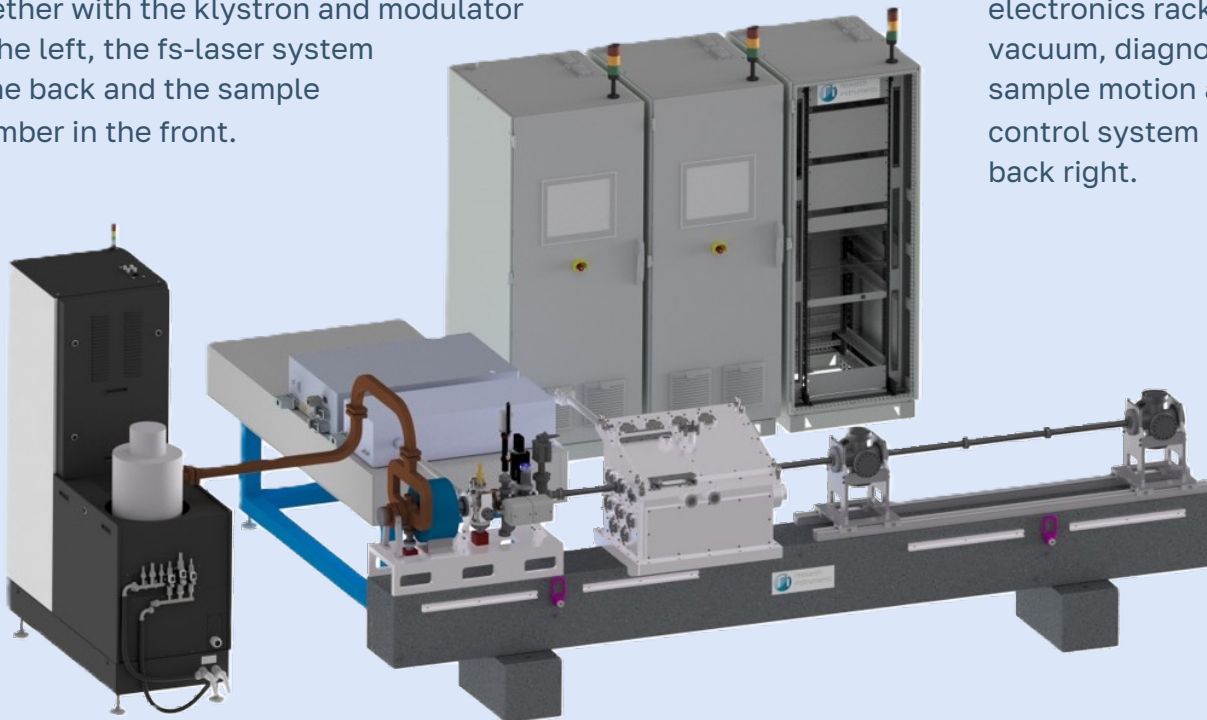
RI-Bornite MeV-UED as a Commercial Instrument

Modern nano and quantum materials require information about atoms and their dynamics on the atomic scale in space ($\sim \text{\AA}$) and time (~ 100 fs). This demands ultra-fast time resolved experiments.

RI offers a Megaelectron Volt Ultra-fast Electron Diffraction (MeV-UED) instrument as a commercial product. This instrument provides a high-brightness electron beam ($e = 0.5 \text{ mm} \cdot \text{mrad}$), sample environment, a fs-laser system ($Dt = \text{ca. } 50 \text{ fs}$) with pump (IR) and probe (UV) branches and detectors.

Concept design of the RI-Bornite MeV-UED system showing the 2.5 cell RF-photogun together with the klystron and modulator on the left, the fs-laser system in the back and the sample chamber in the front.

The two detectors are shown on the right and electronics racks for vacuum, diagnostics, sample motion and the control system in the back right.



The urgent need?

Quantitative information for **nano, energy & quantum materials** on **atomic scale** in **space & time**.

Complement / alternative to **XFELs**, which are too expensive and hard to get to.

Our Approach

Electron diffraction using MeV beams.

RI offers MeV-Ultrafast Electron Diffraction as a **commercial instrument**.
Laser pump, electron probe, RF-accelerators ca. 1-5 MeV.

Your Benefit

Atomic resolution (MeV \rightarrow access to high Bragg peaks).
Ultra-fast time scales (< 100 fs).
Broad range of samples: solid (cryo), liquid, gas.
Bundle academic experience in one commercial turn-key instrument.

Cost / Competition

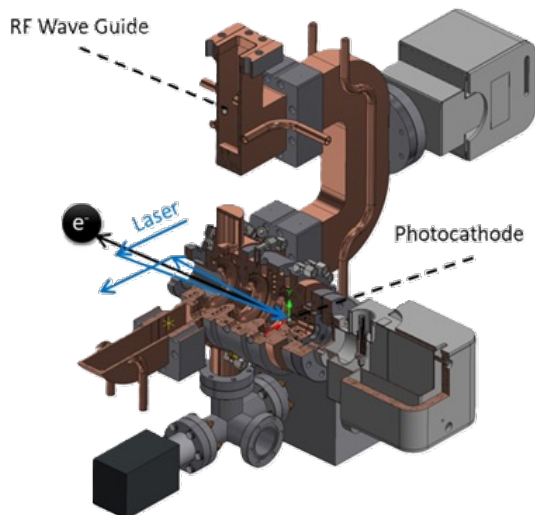
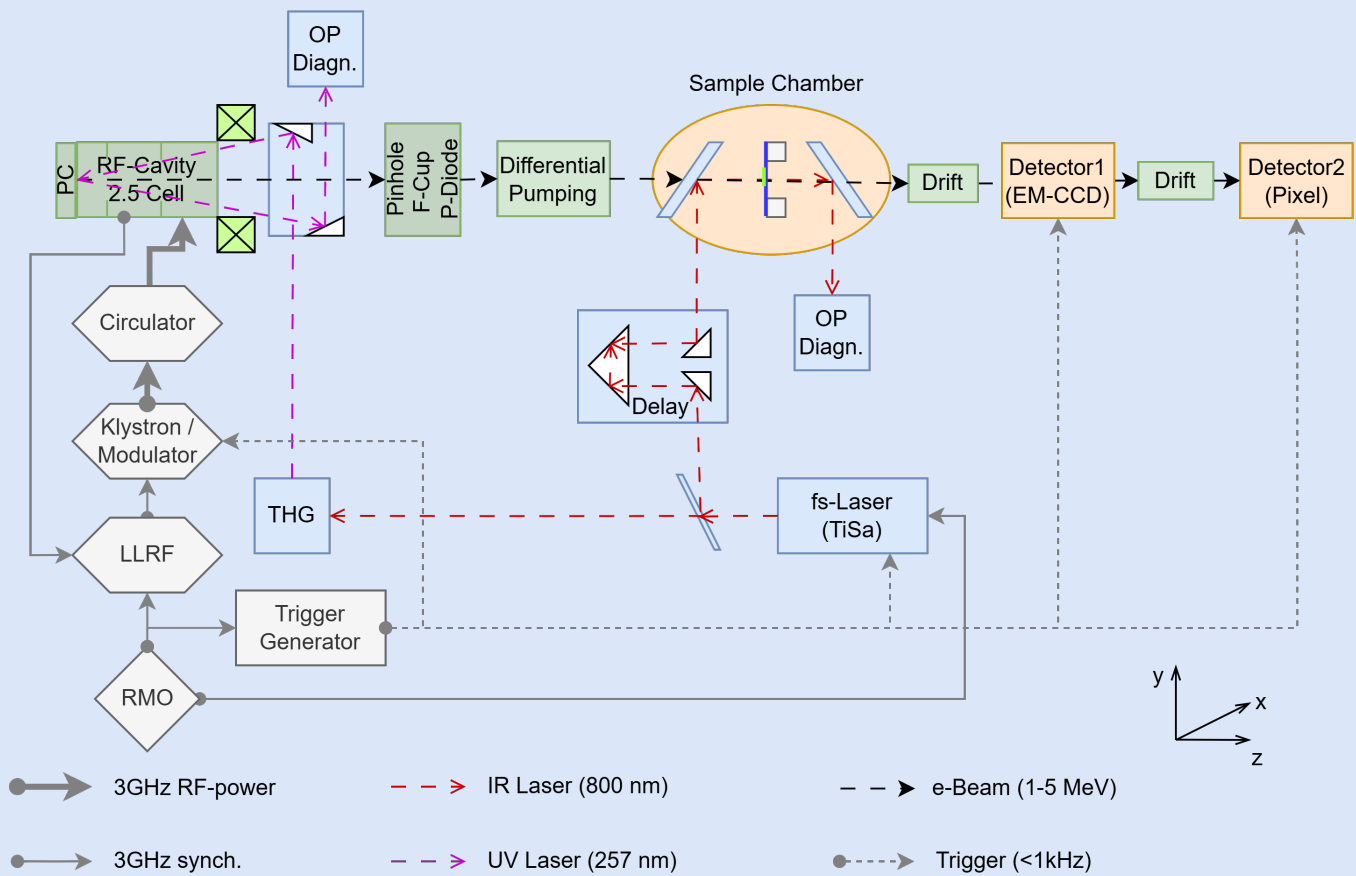
Goal: *"Half the cost of a SR beamline"* ca. 5M€
Radiation shielding, AC, clean lab space needed.

- XFEL (few B€)
- TEM (ns, ultra-thin samples)
- Home built (too complex)

From design to commissioning

Based on our expertise gained in over 30 years of service to the international scientific community, RI is capable of designing, producing, installing and commissioning unique instruments needed to drive discovery. Here we present the concept for the 1st commercial MeV-UED instrument. This instrument is designed with an emphasis on

robustness and usability. It uses building blocks proven in world-leading institutions. Yet it is open to customization in many aspects like sample environment (solid / liquid / gas), detectors (EM-CCD, hybrid pixel) and diagnostics.



About RI Research Instruments

We are specialists in high-precision engineering for extreme demands. With roots in European mega-projects like CERN, ITER, GSI, and DESY, our work bridges scientific innovation and industrial reliability.

On the left: A 3D CAD model of the 2.5-cell (S-band) RF gun with exchangeable Cu photocathode plug. Front illumination of the photocathode with 257 nm laser beam to create the electron beam.



Parameter	Design Goal – Basic Instrument
<i>Time resolution</i>	100 fs
<i>Electron energy</i>	1– 5 MeV (optimized for ca. 3.5 MeV)
<i>Repetition rate</i>	Up to 1000 Hz possible
<i>Bunch charge</i>	~ 30 fC (ca. 2 10 ⁵ electrons) for best t-resolution ~ 3 pC (ca. 2 10 ⁷ electrons) for single-shot experiments
<i>Detectors</i>	Ca. 1M Pixels, 75µm pixel size, <2 kHz read out rate Scintillator screen read out by EM-CCD (1M pixel, 13 µm, <56 fps)
<i>Spot size @ sample</i>	ca. 100 µm
<i>Pump laser energy per pulse</i>	5 mJ/pulse
<i>Pump laser energy range</i>	800 nm (Ti:Sa)
<i>Delay range</i>	1 ns, 100 fs/step
<i>Sample environment</i>	Room temperature solid sample mounted on piezo stages. Optional: cooling w/ cryo-cooler (ca. 10K) and load-lock.
<i>Single-shot capability</i>	Possible
<i>Dynamic range</i>	Ca. 10 ⁴
<i>Momentum resolution</i>	<0.15 Å ⁻¹
<i>Delivery time</i>	~20 months
<i>Software</i>	Included: E-beam & laser beam control, sample positioning, diagnostic read out, machine safety, image acquisition.

- *We are happy to help!*

If you can think it, we can build it.

Let's team up and see how our experts can support your cause.



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