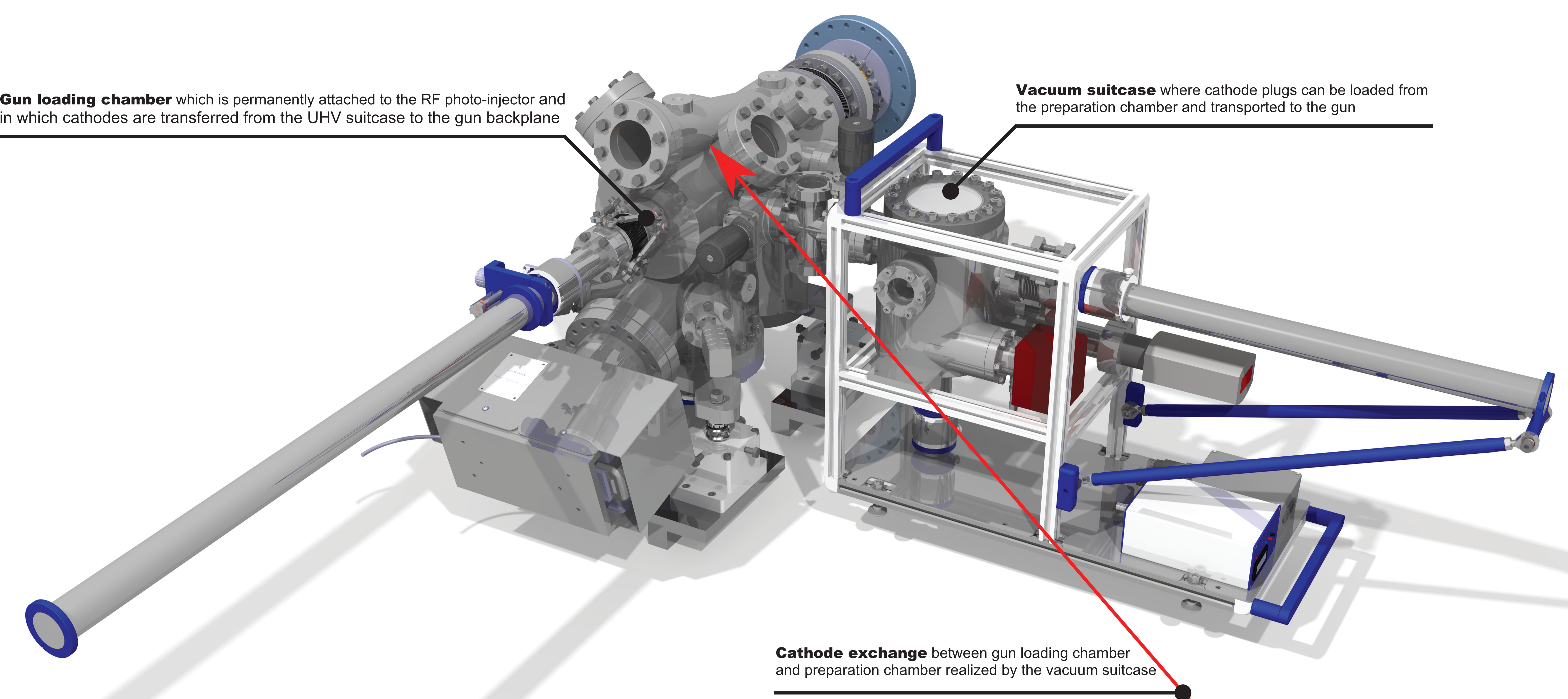


## SWISSFEL :: CATHODE LOAD-LOCK SYSTEM

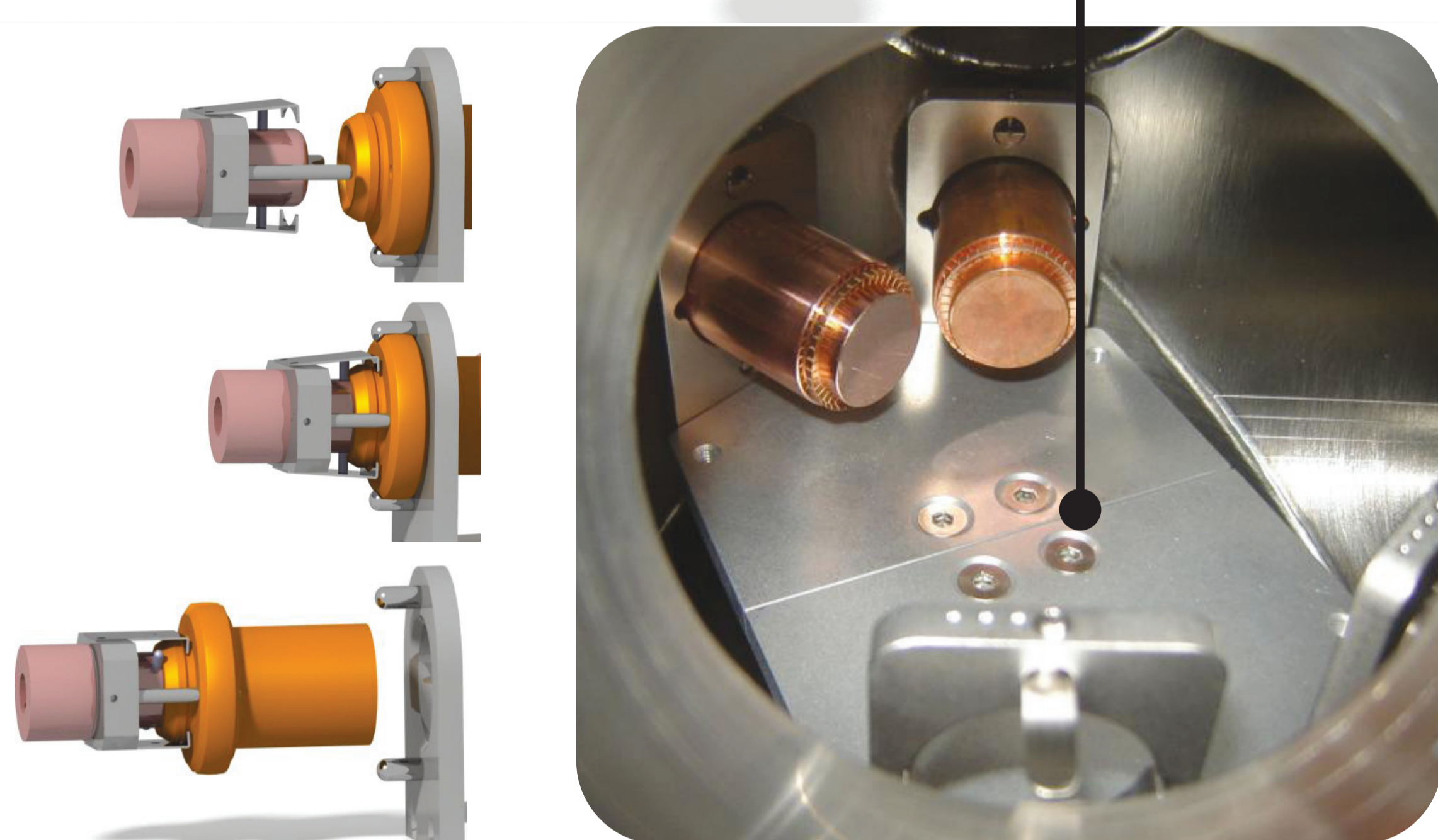
The SwissFEL electron source is an RF photo-injector in which the photo-cathode plug can be exchanged, all under UHV conditions. Without a load-lock, the cathode exchange takes about one week and cathode surface gets contaminated in the atmosphere during installation, leading to unpredictable quantum efficiency (QE) fluctuations. This motivated the construction of a load lock system to prepare and insert cathodes into the photo-injector.

The cathode loading system consists of three parts: the preparation chamber, the transportable vacuum suitcase and the gun loading chamber. This system facilitates annealing and coating of the cathode surface. QE can be measured and after transfer under UHV using the vacuum suitcase, the cathode plug inserted into the gun without breaking the vacuum. This will allow the use of semiconductor cathodes like Cs<sub>2</sub>Te.

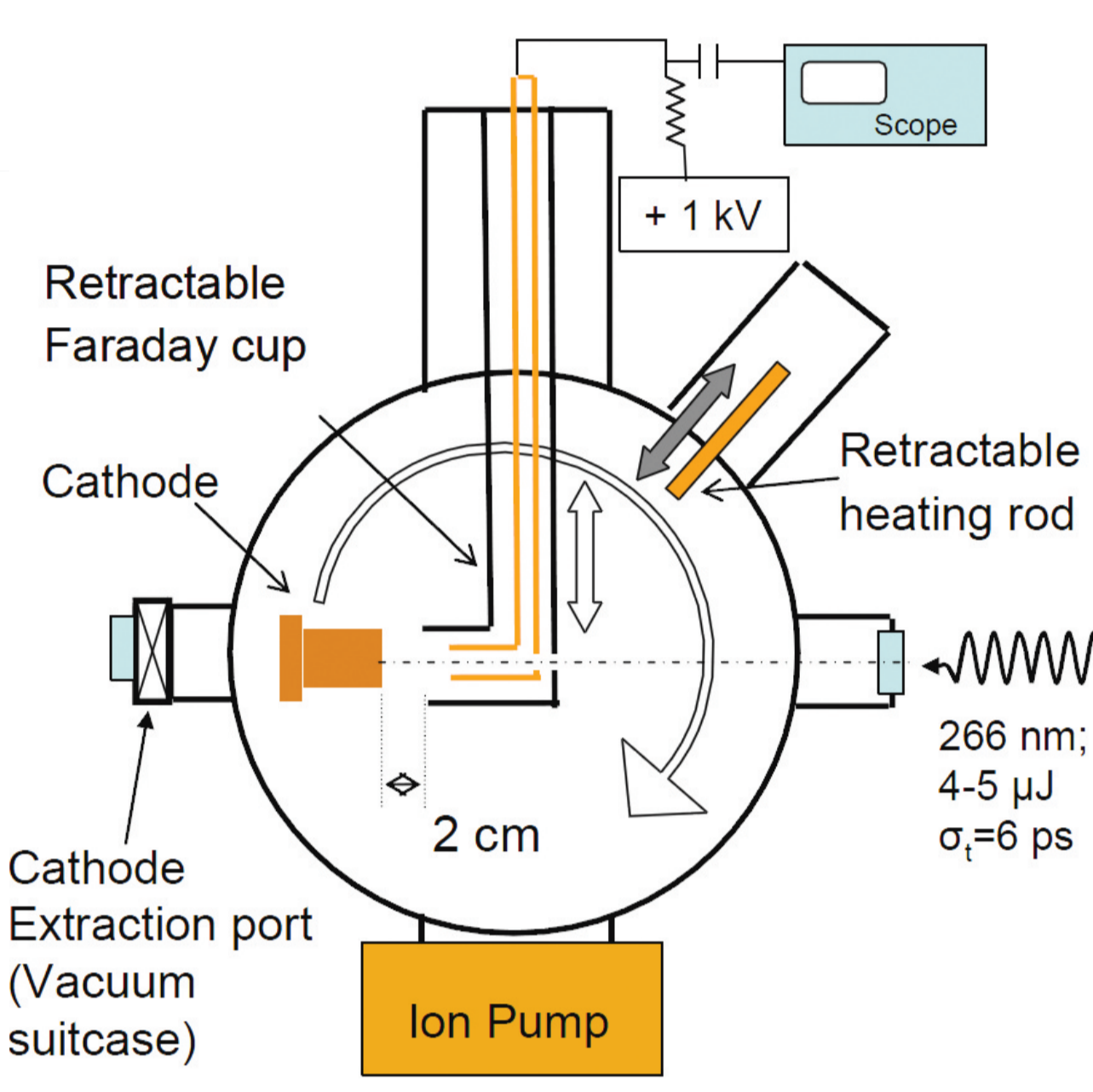
The described system was successfully installed in the winter of 2012 and subsequently tested at the SwissFEL Injector Test Facility (SITF).



**Storage carousel** with SwissFEL gun cathode plugs and grabbing principle (left)

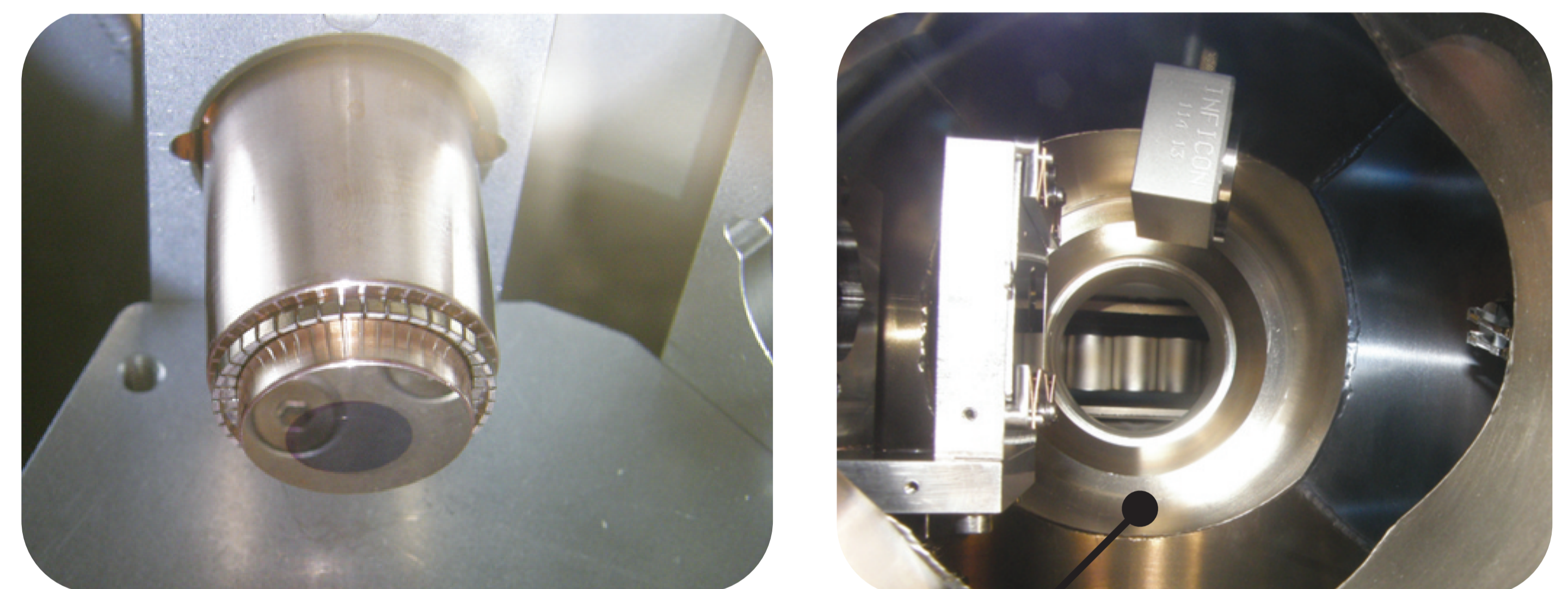
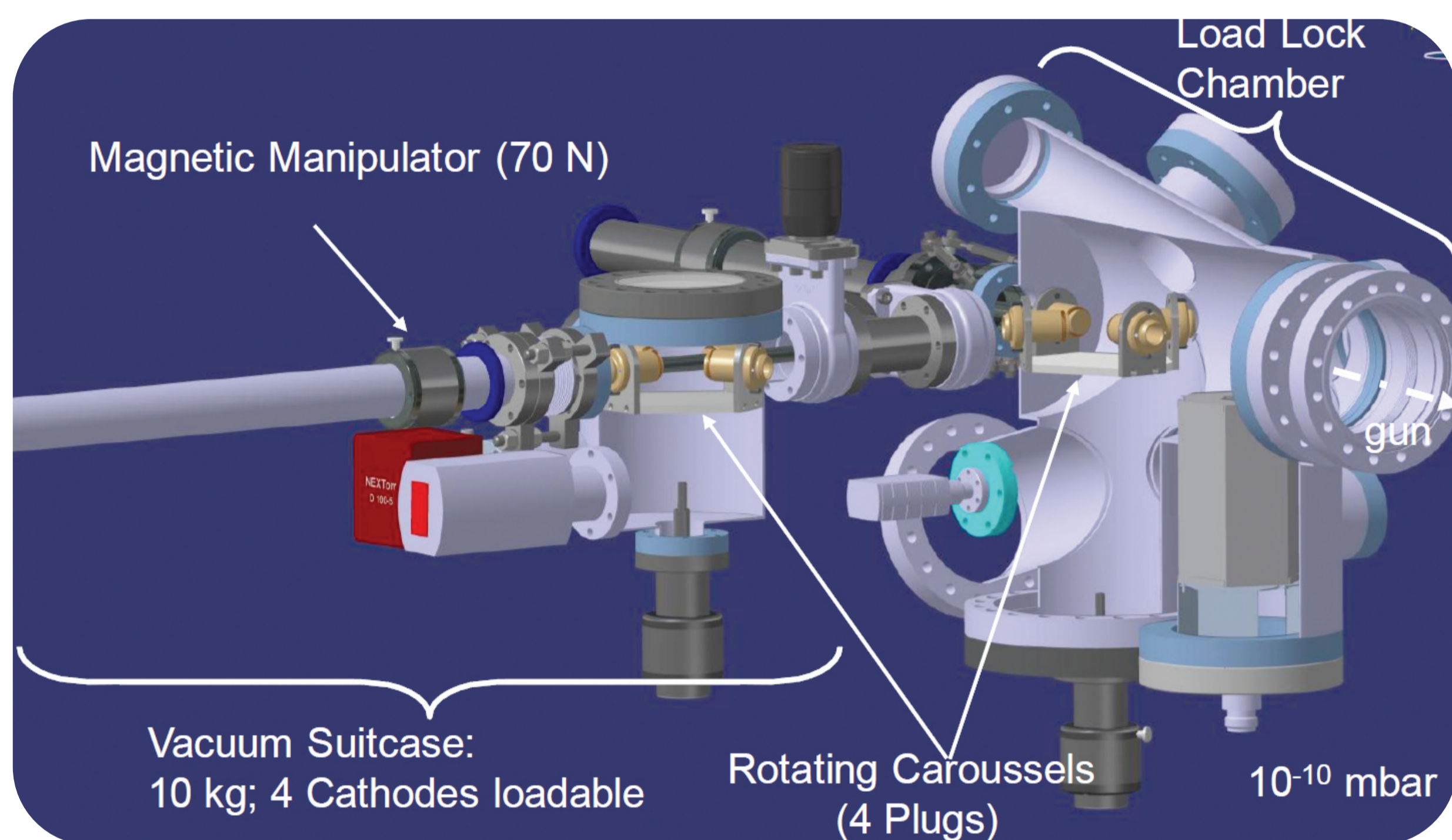


A magnetically coupled manipulator arm grabs the plug out of a parking holder and safely transfers it linearly over half a meter distance under ultra high vacuum. In each of the 3 chambers a rotatable carousel holds up to 4 cathode plugs. Cathode exchange, including RF conditioning of the new cathode, takes only half a day versus about 1 week since no venting of the gun is necessary (tested on Cu<sub>17</sub>). The figure below shows how the vacuum suitcase is connected to the gun loading chamber. The fine adjustment knob of the magnetically coupled manipulator keeps the cathode pushed into the gun during operation.



**Preparation chamber** where cathodes can be cleaned, annealed and where the quantum efficiency (QE) can be checked.

Cathode surface cleaning is done in the preparation chamber. The most effective way to remove surface contaminants is to heat up the cathode plug for several hours. The preparation chamber is equipped with a heating rod which can be directly inserted into the back of the cathode plug. Thanks to the vacuum suitcase, the cathode is protected from exposure to atmosphere. Therefore preparation processes such as Dicaesium Telluride vapor deposition can be included (see image below right).



**Deposition chamber** equipped with an aperture and a quartz micro-balance. The cathode is loaded from the left and the evaporation source from the right.

### Ferrovac Synchrotron Radiation Instrumentation:

- Portable UHV Suitcases
- Portable SPMs in UHV Suitcases
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