電子ビームイオントラップ装置(CoBIT)
及びイオン照射実験装置

開発実験棟１Ｆ

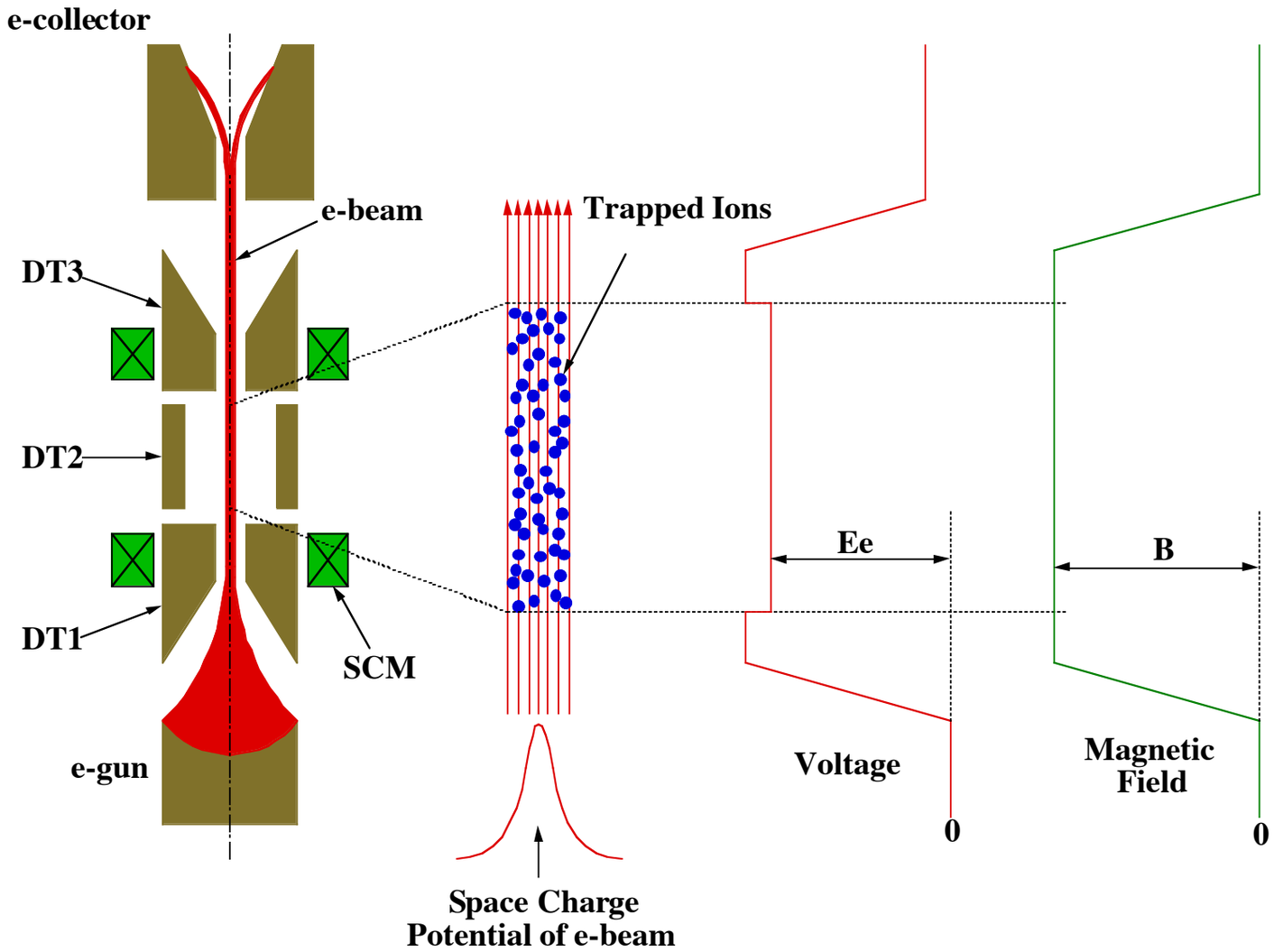
核融合システム研究系

坂上　裕之

2021.09.08

Electron Beam Ion Traps (EBIT)の原理

多価イオン源



Ion trap

+

high density and high energy electron beam

Electron beam are compressed by S.C.M.

Ion trap
Electrostatic potential
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Electron space charge

The trapped ions are ionized sequentially.

We observed the emitted photons from the trapped HCI

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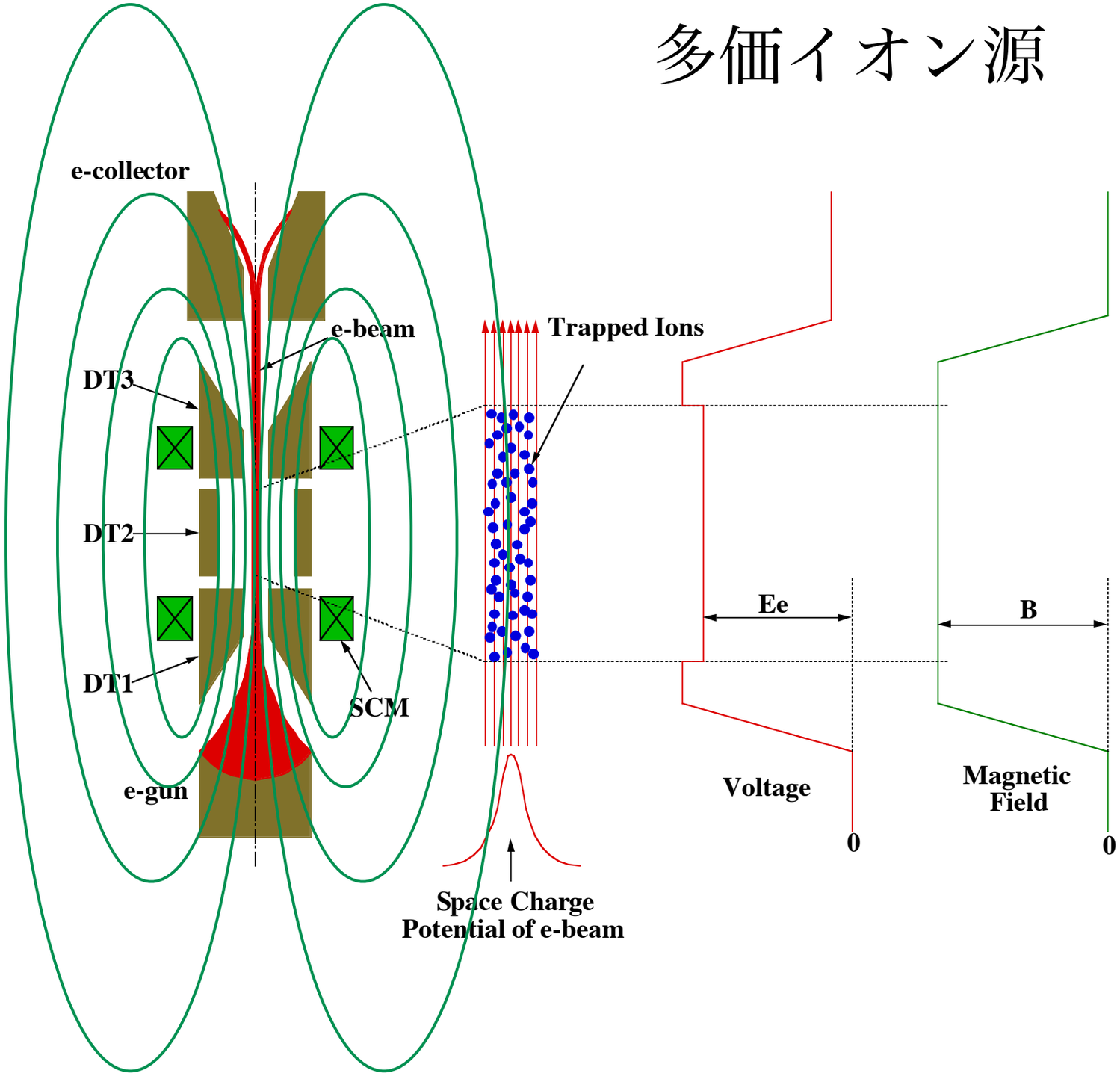

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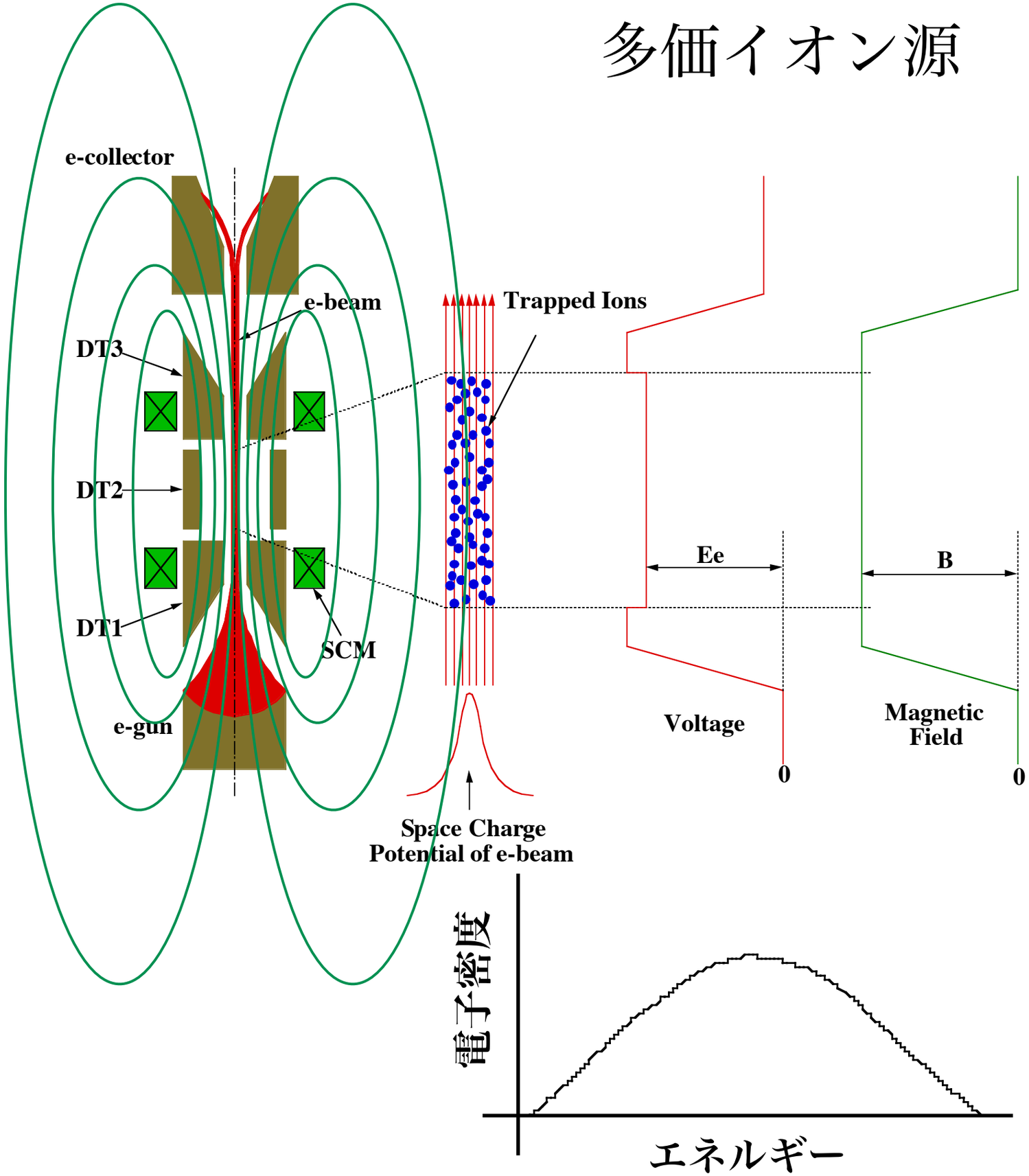

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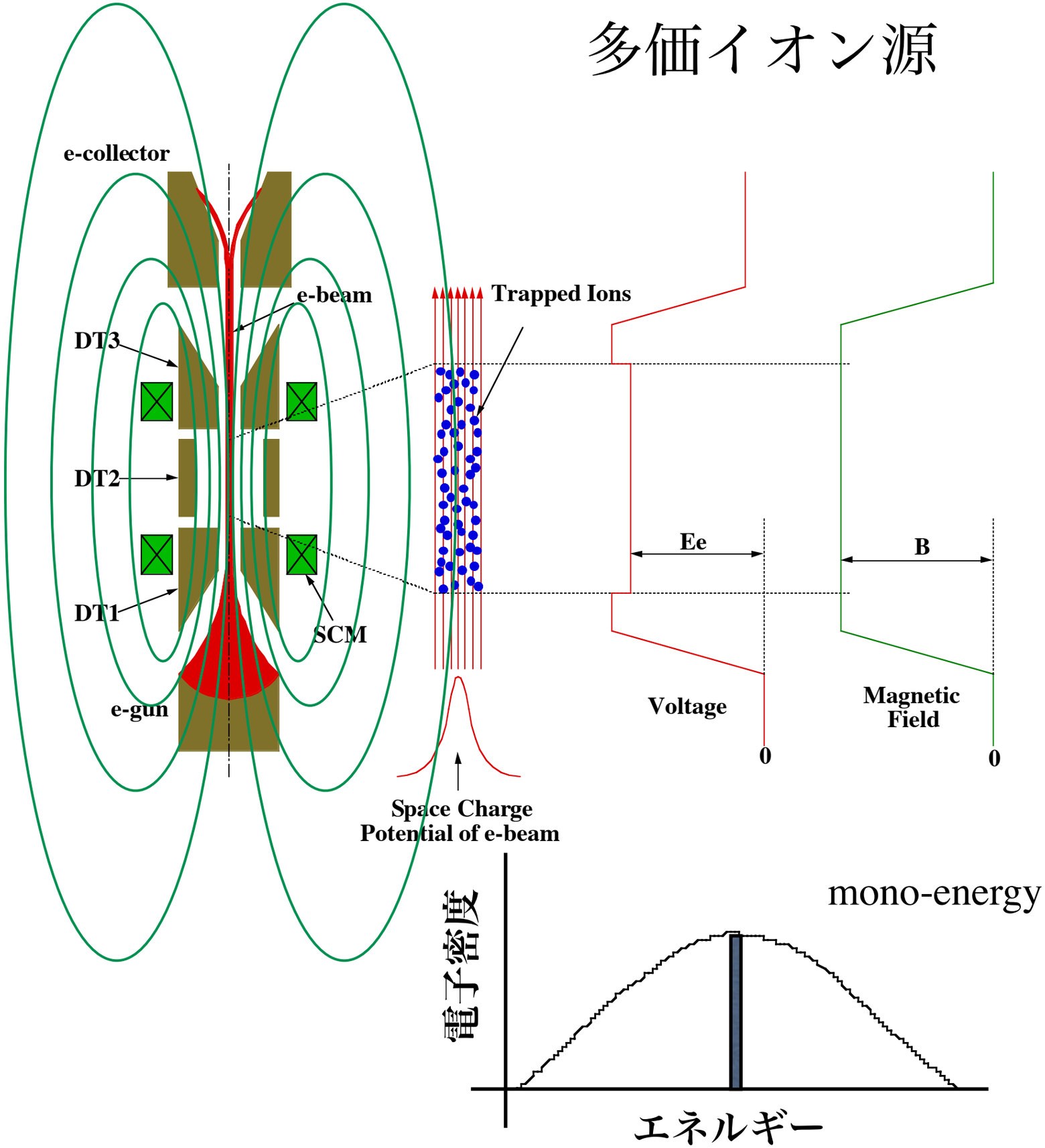

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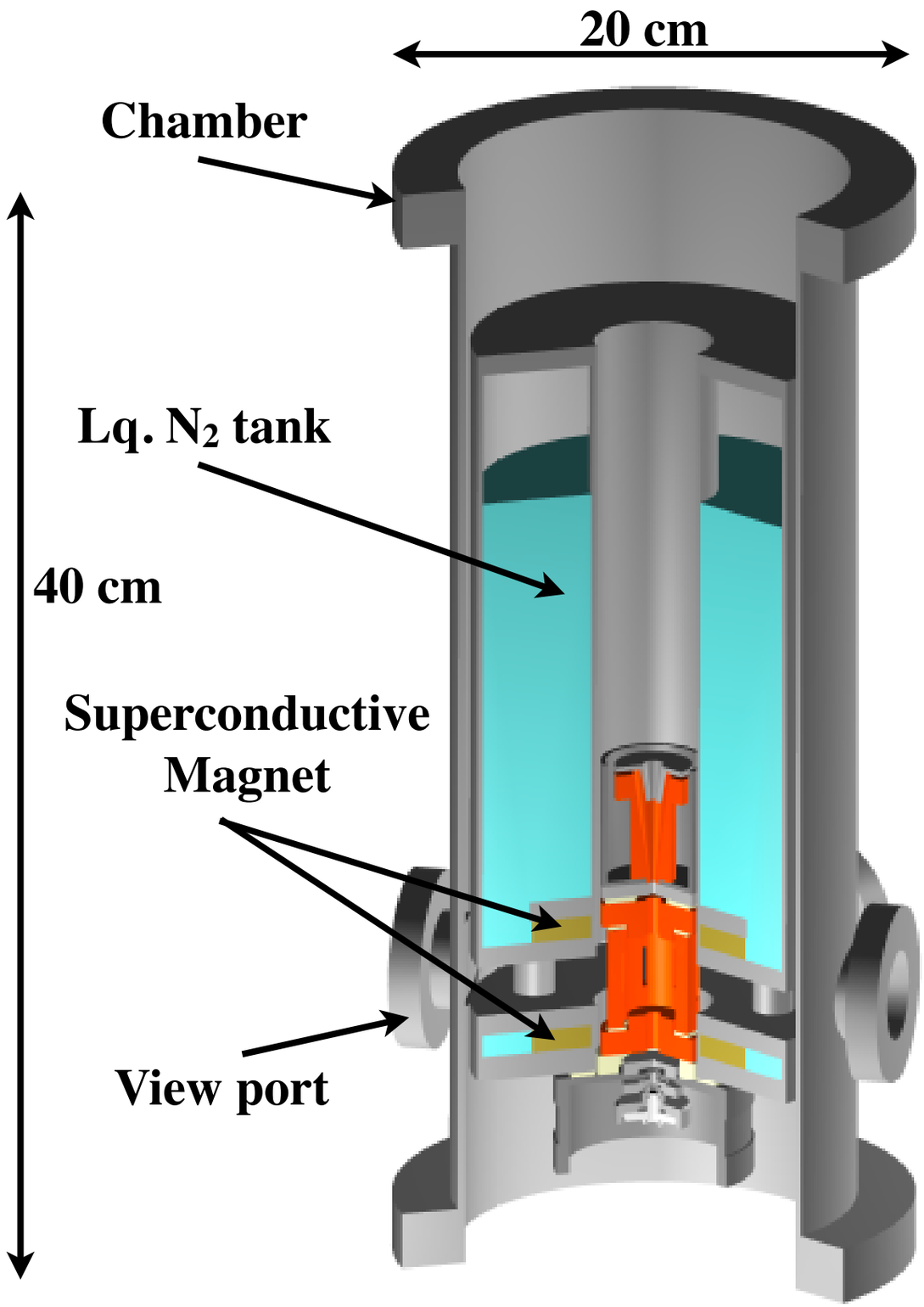

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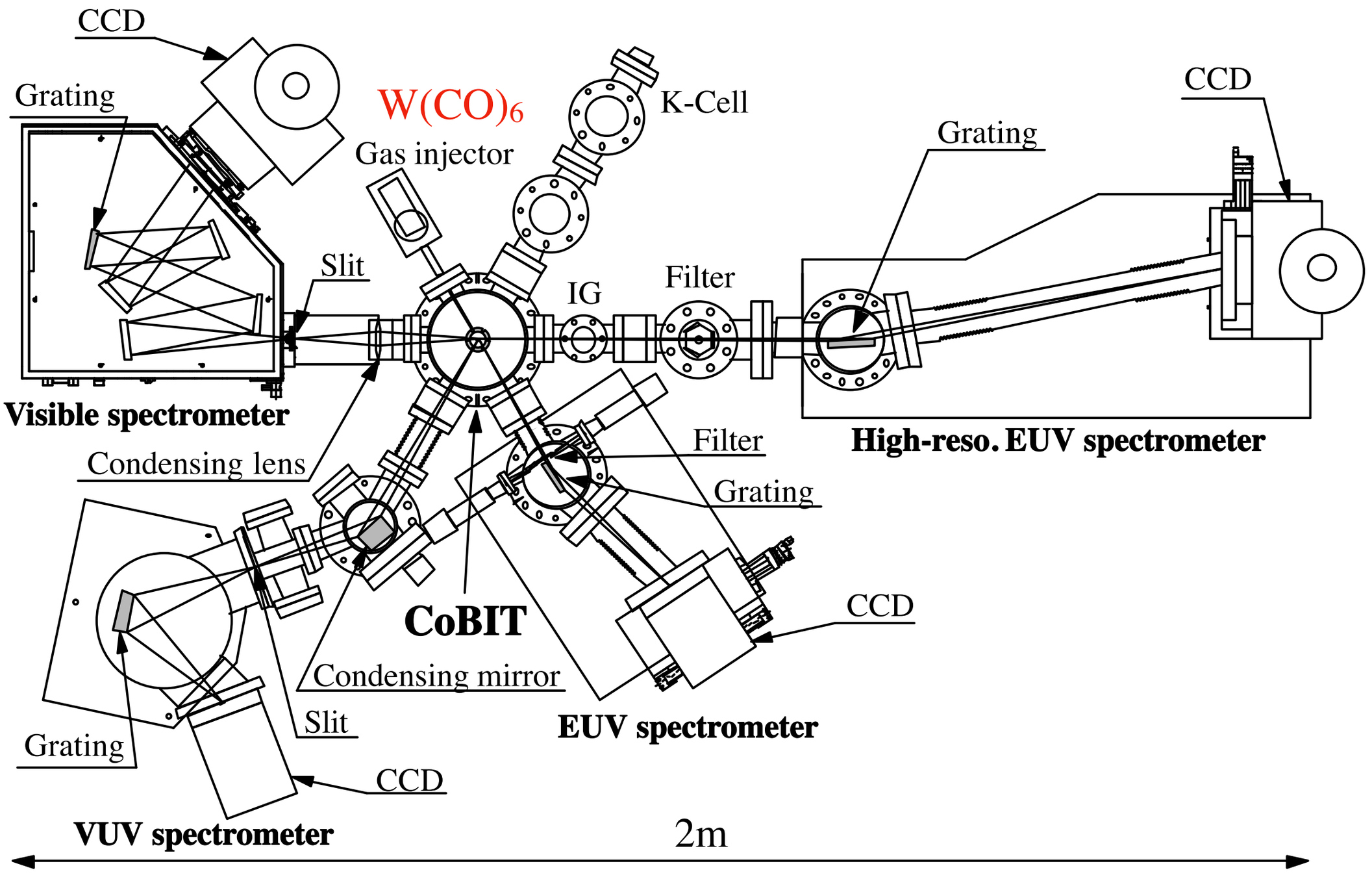
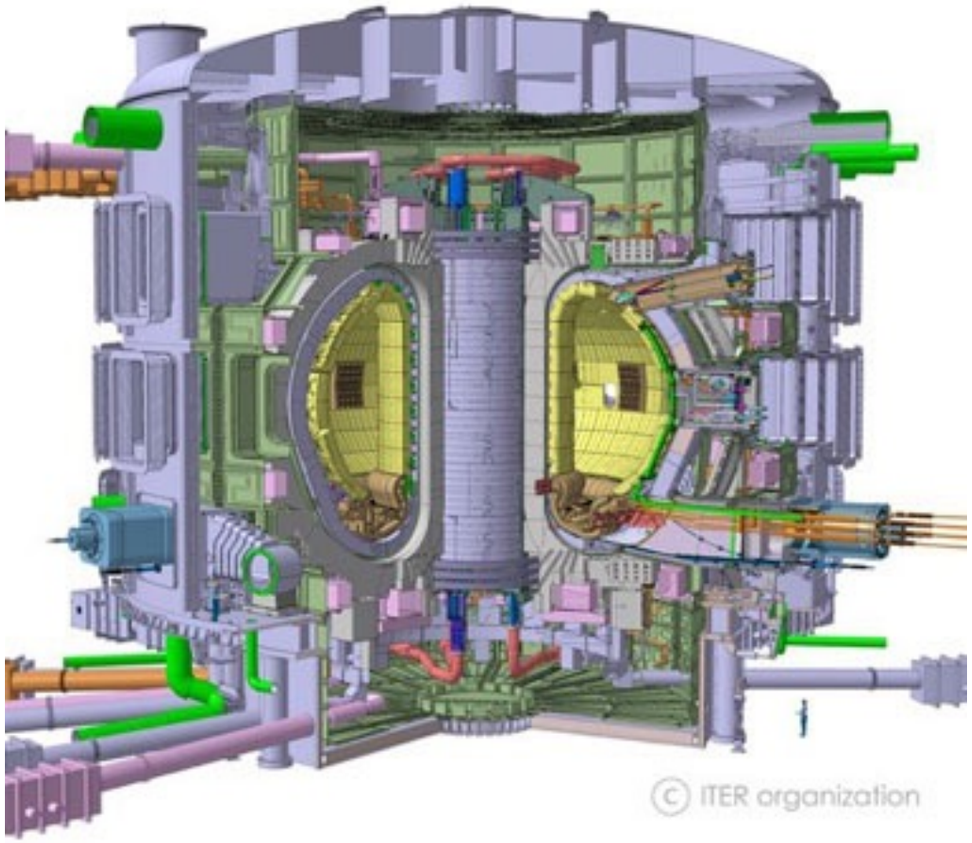
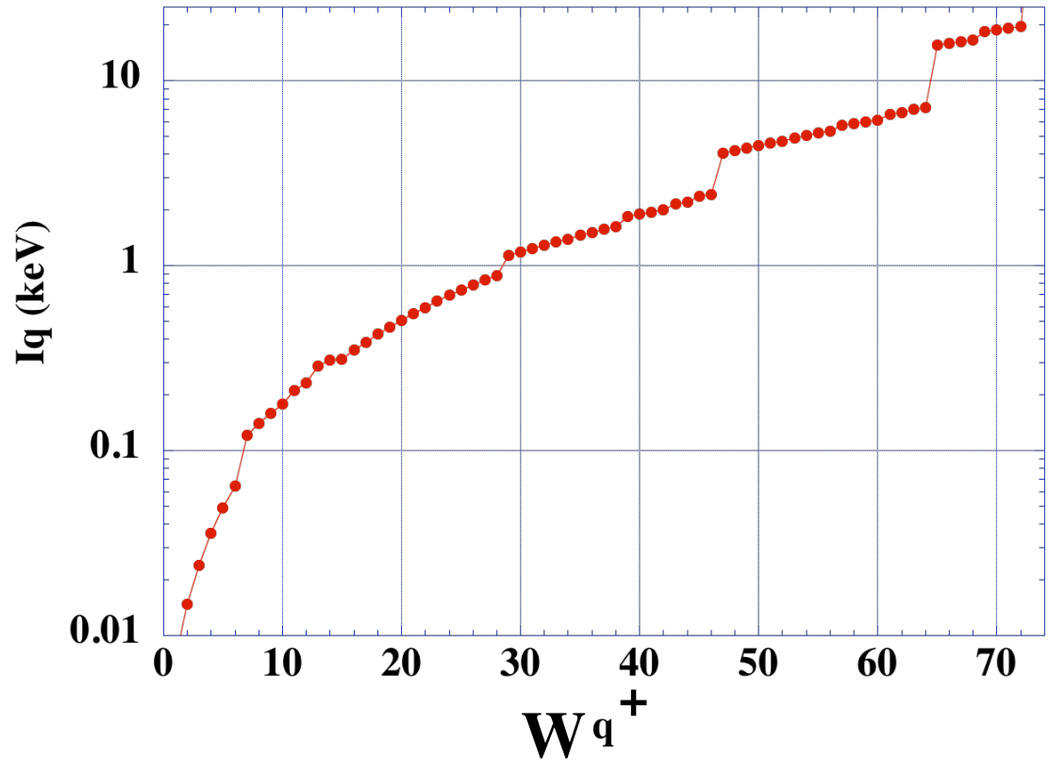


I) Atomic data needs for W ions



ITER



Wイオンの電離エネルギー

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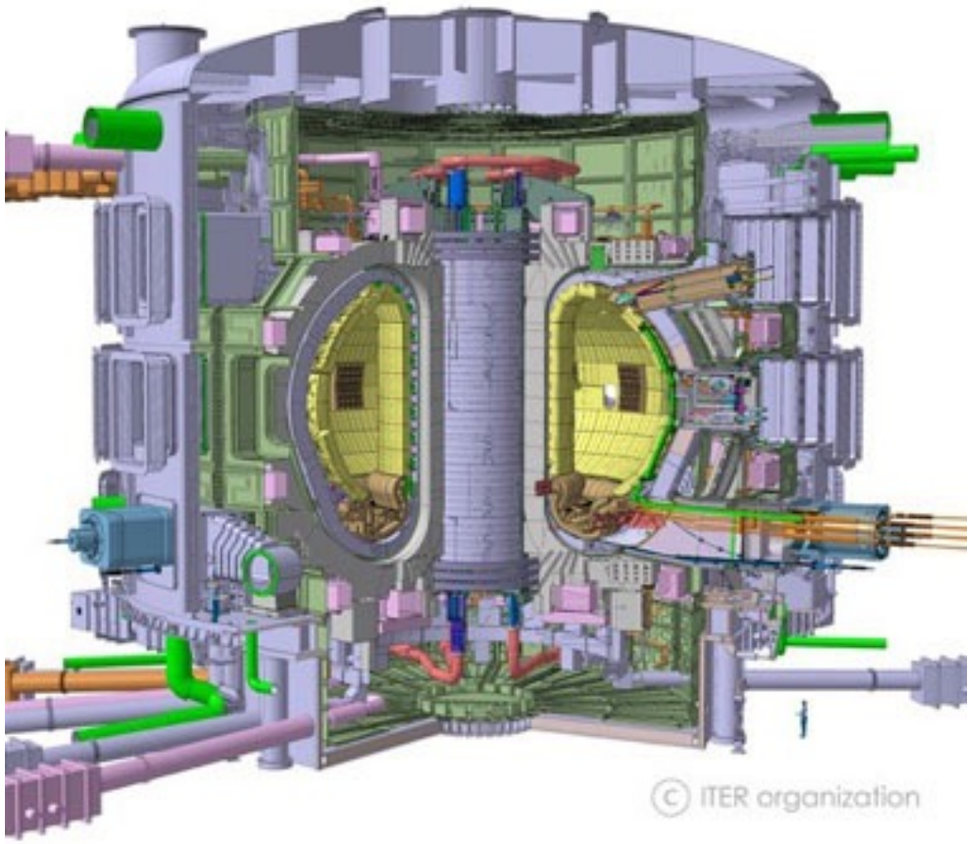

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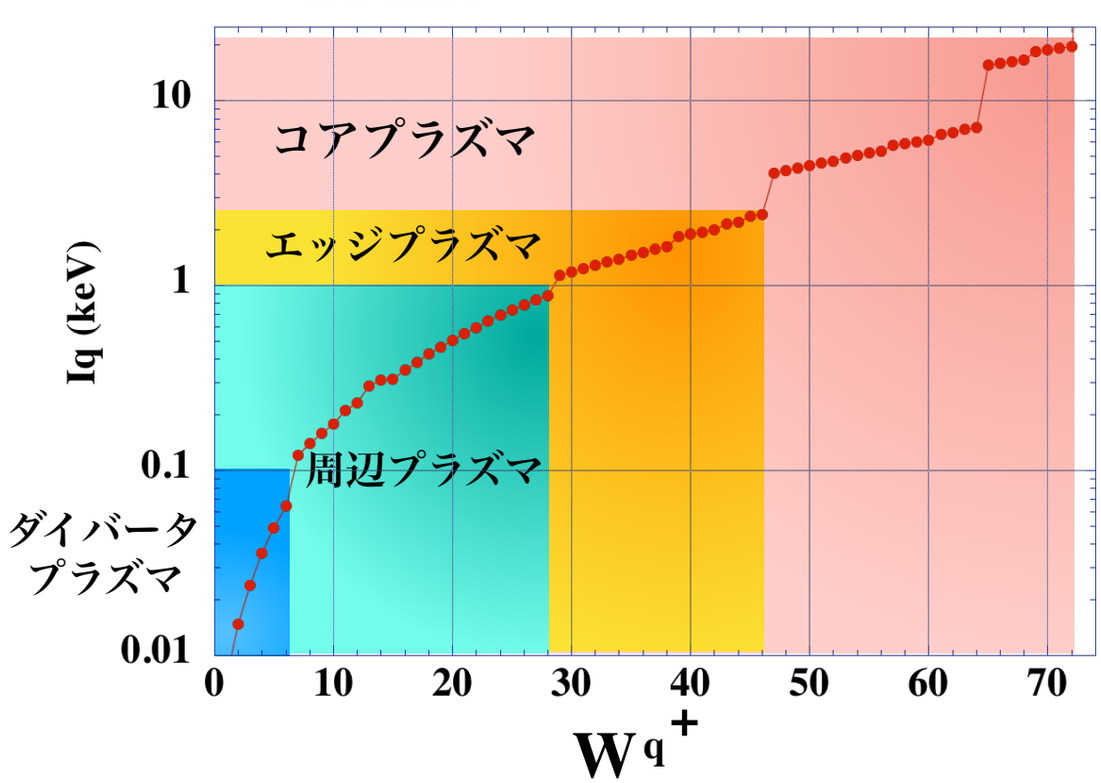

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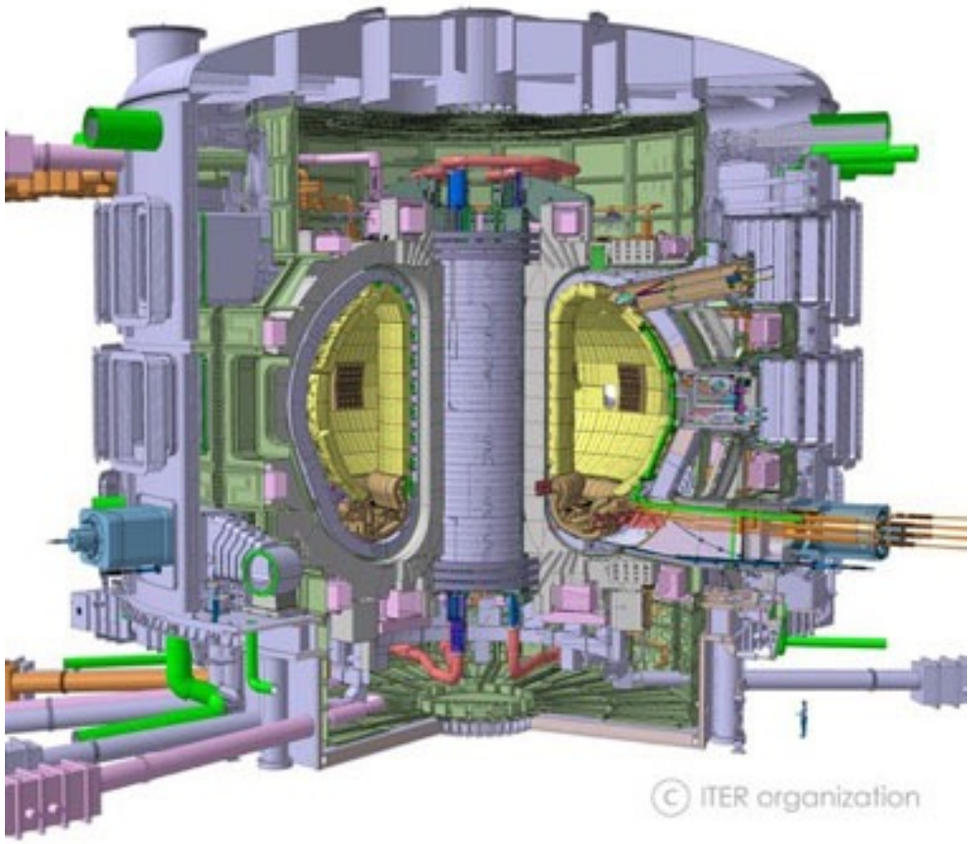

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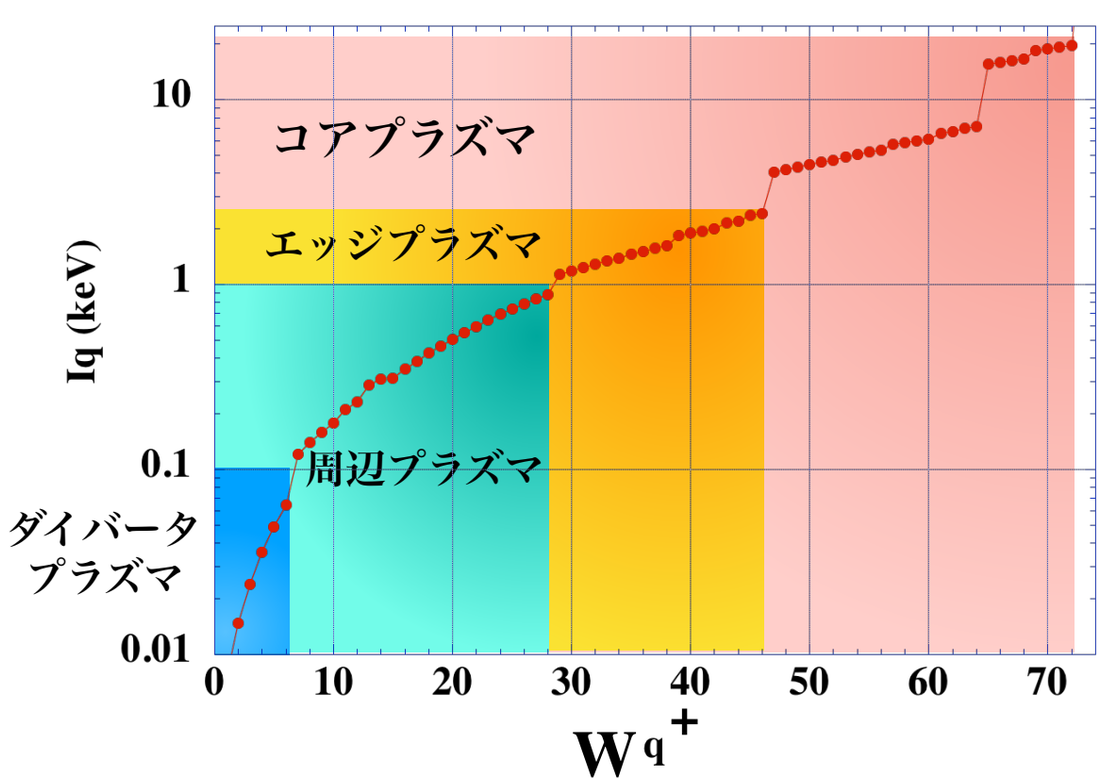

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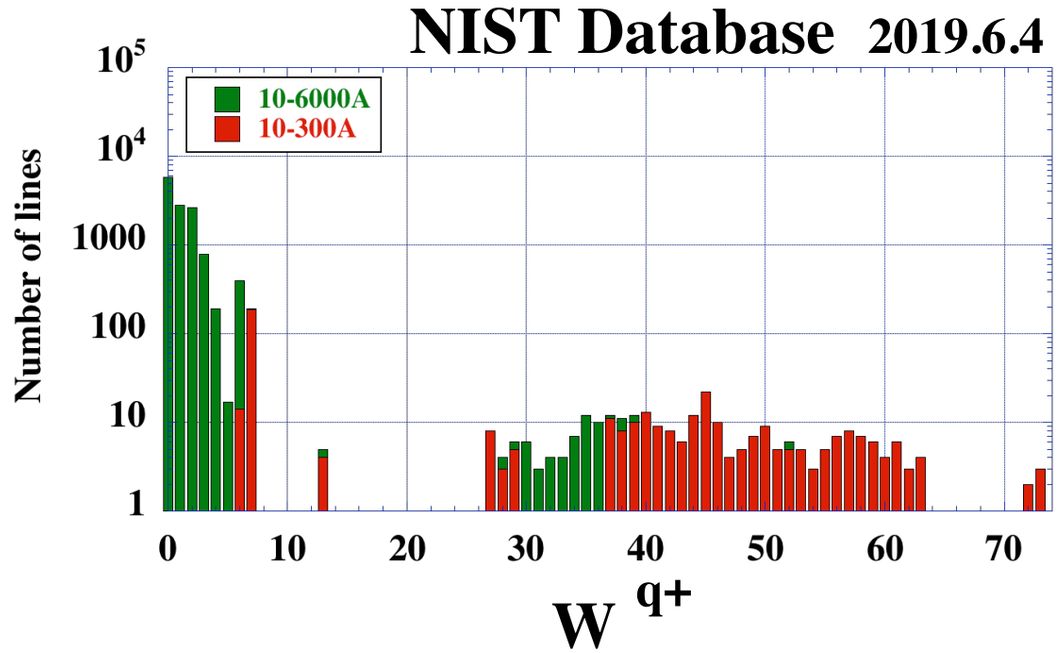

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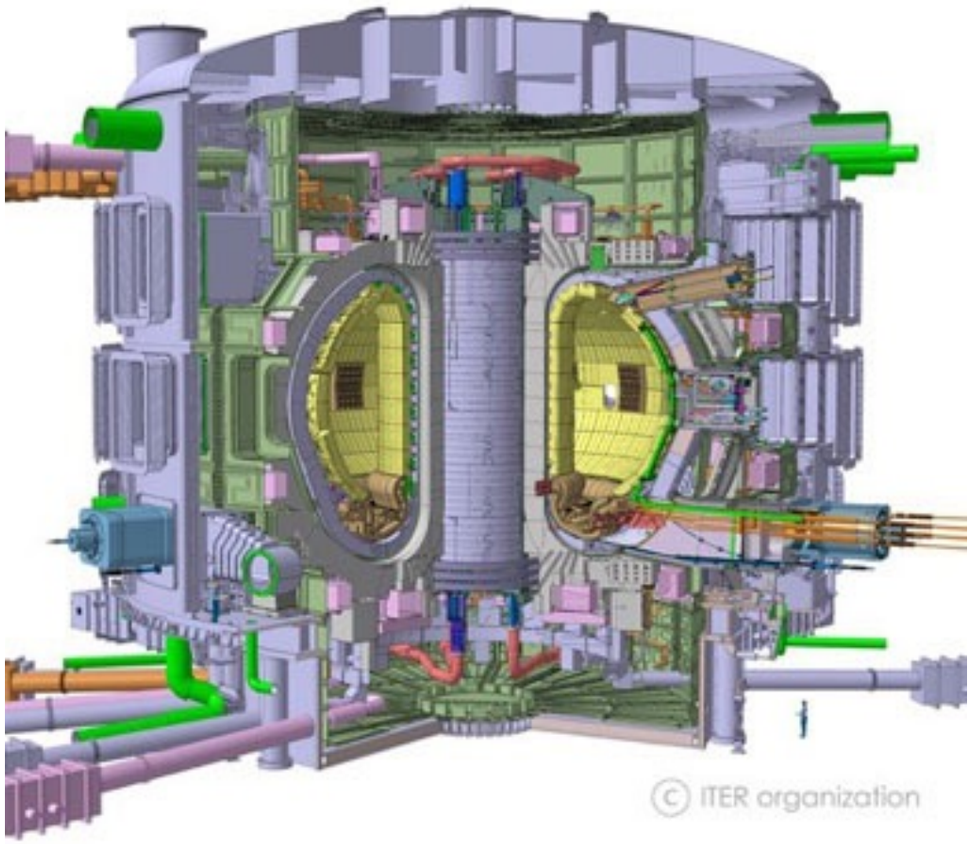

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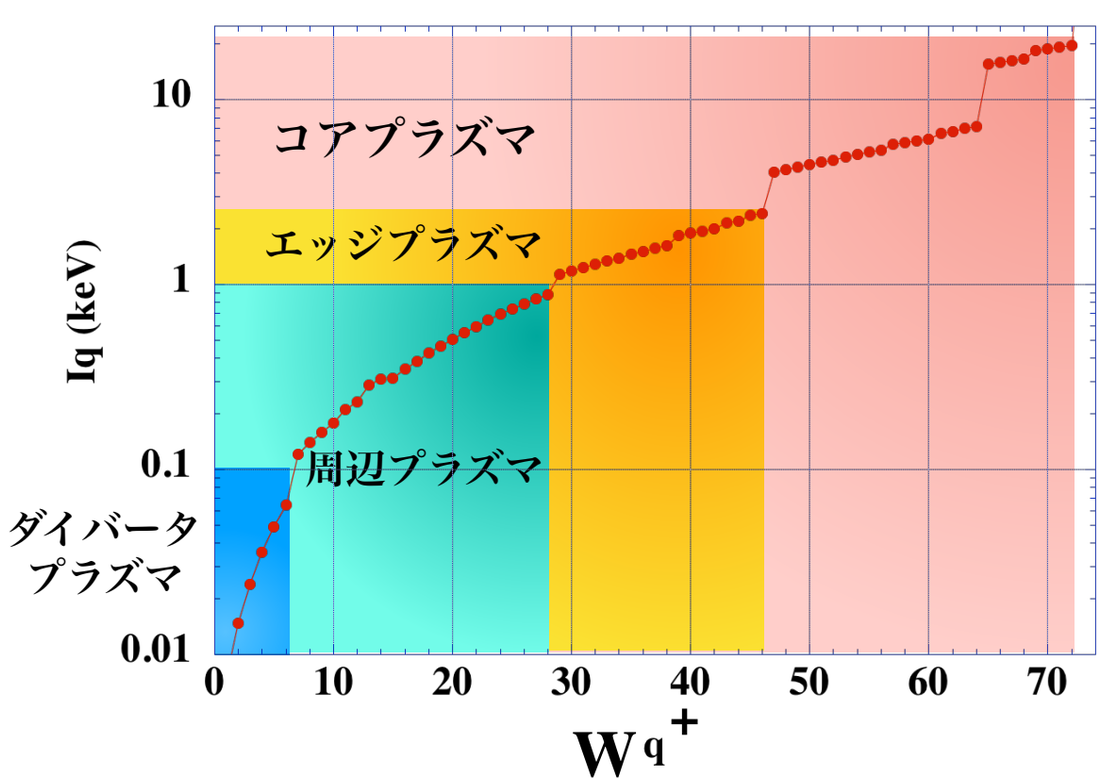

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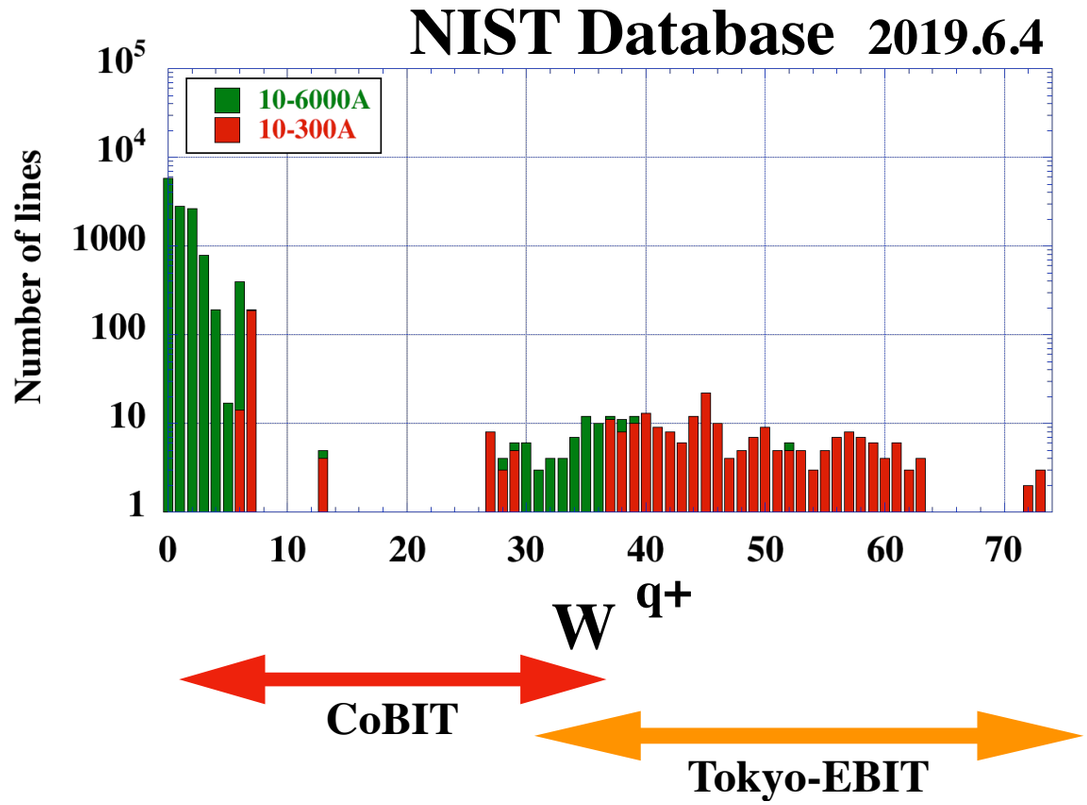
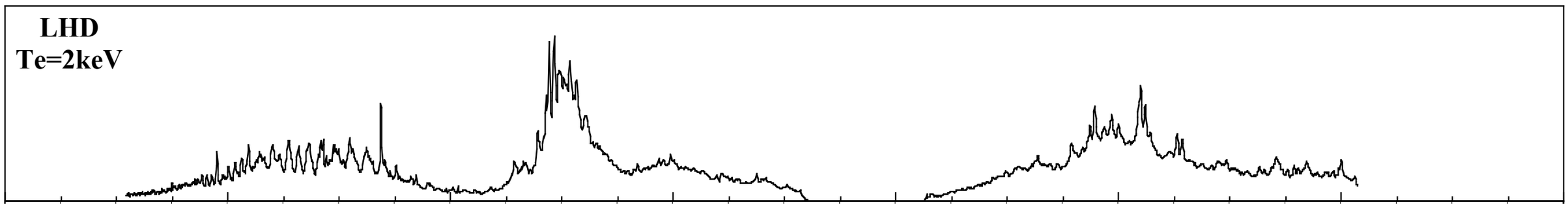


EUV Spectra of W

LHD spectrum



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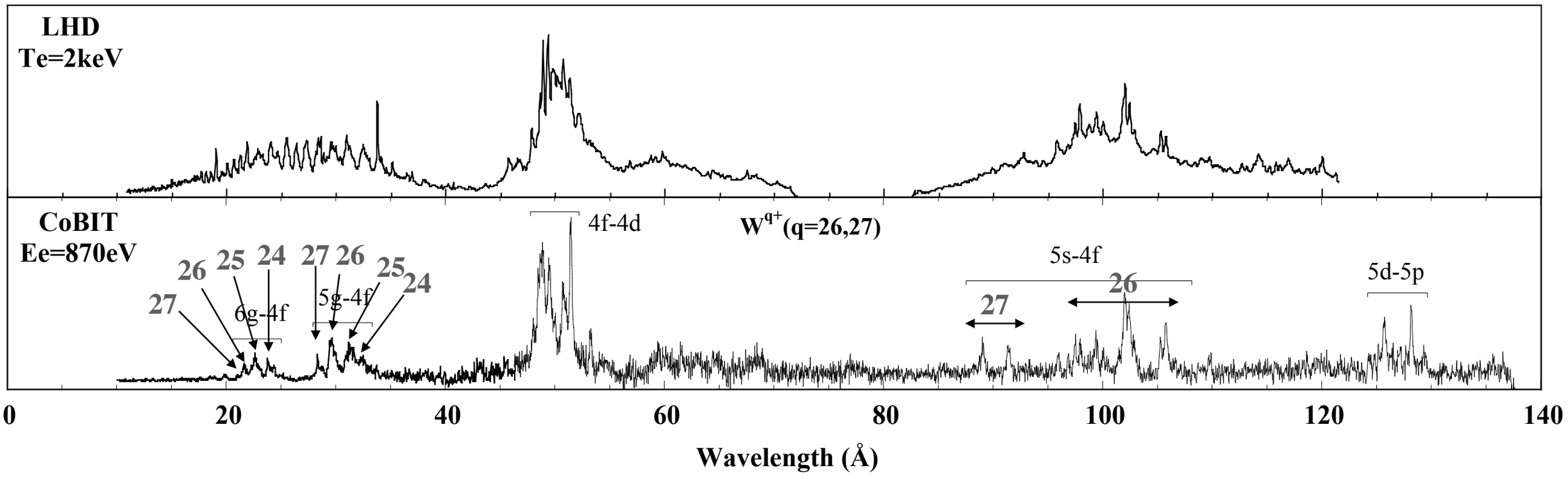
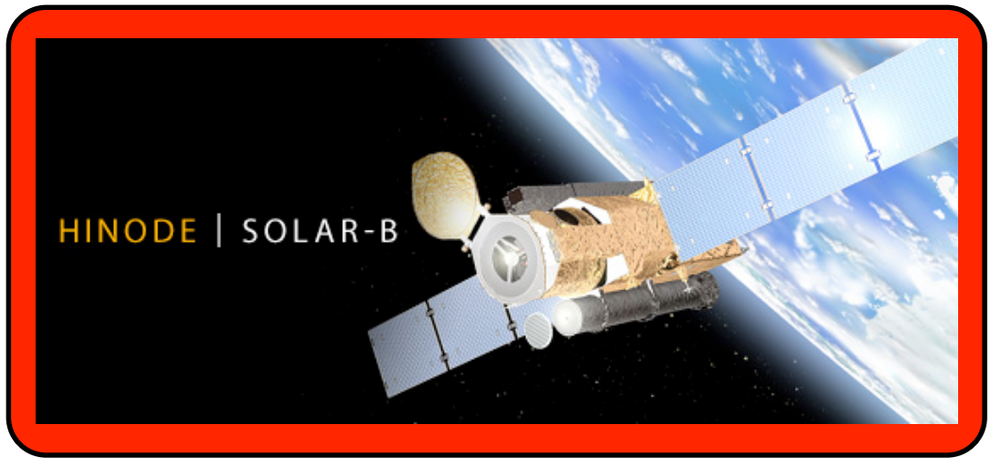


CoBIT spectrum

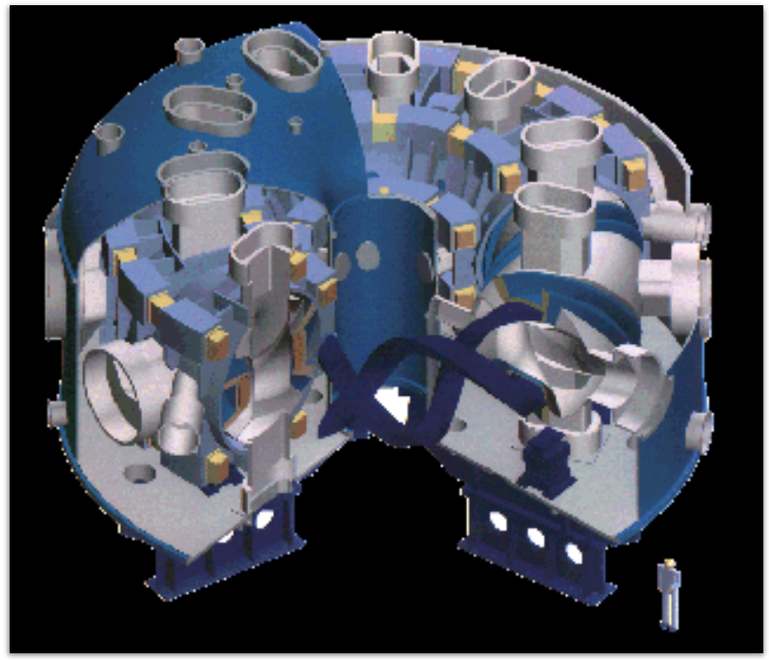
II) Atomic data needs for Fe HCI

NAOJ



Hinode

Comparison



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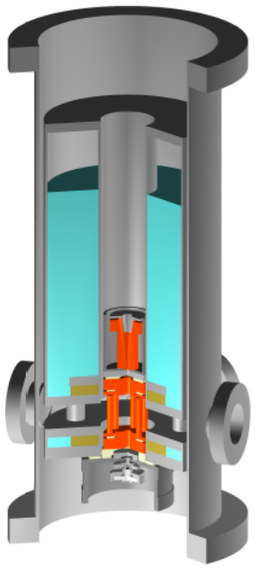

Comparison

Compact Electron Beam Ion Trap (CoBIT)

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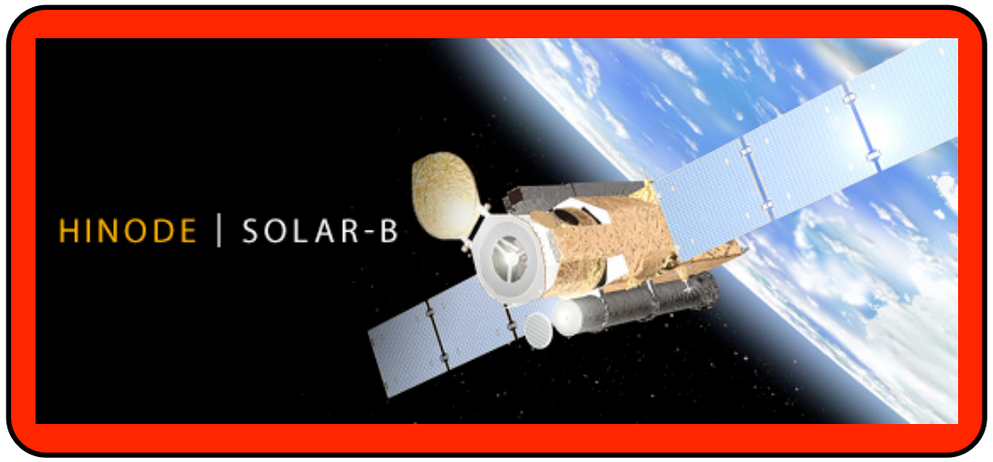
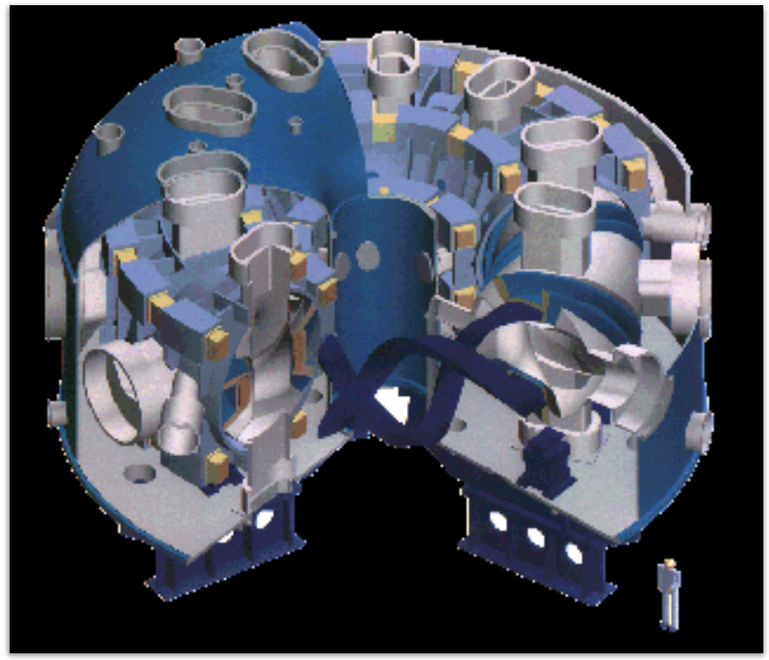


Hinode

Comparison

Fe^{q+}



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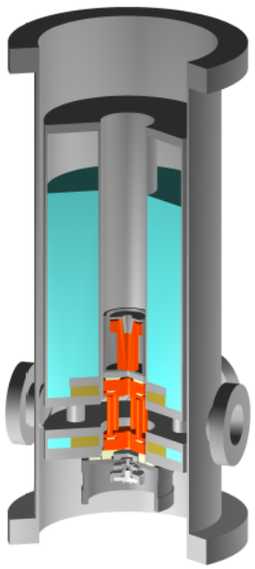

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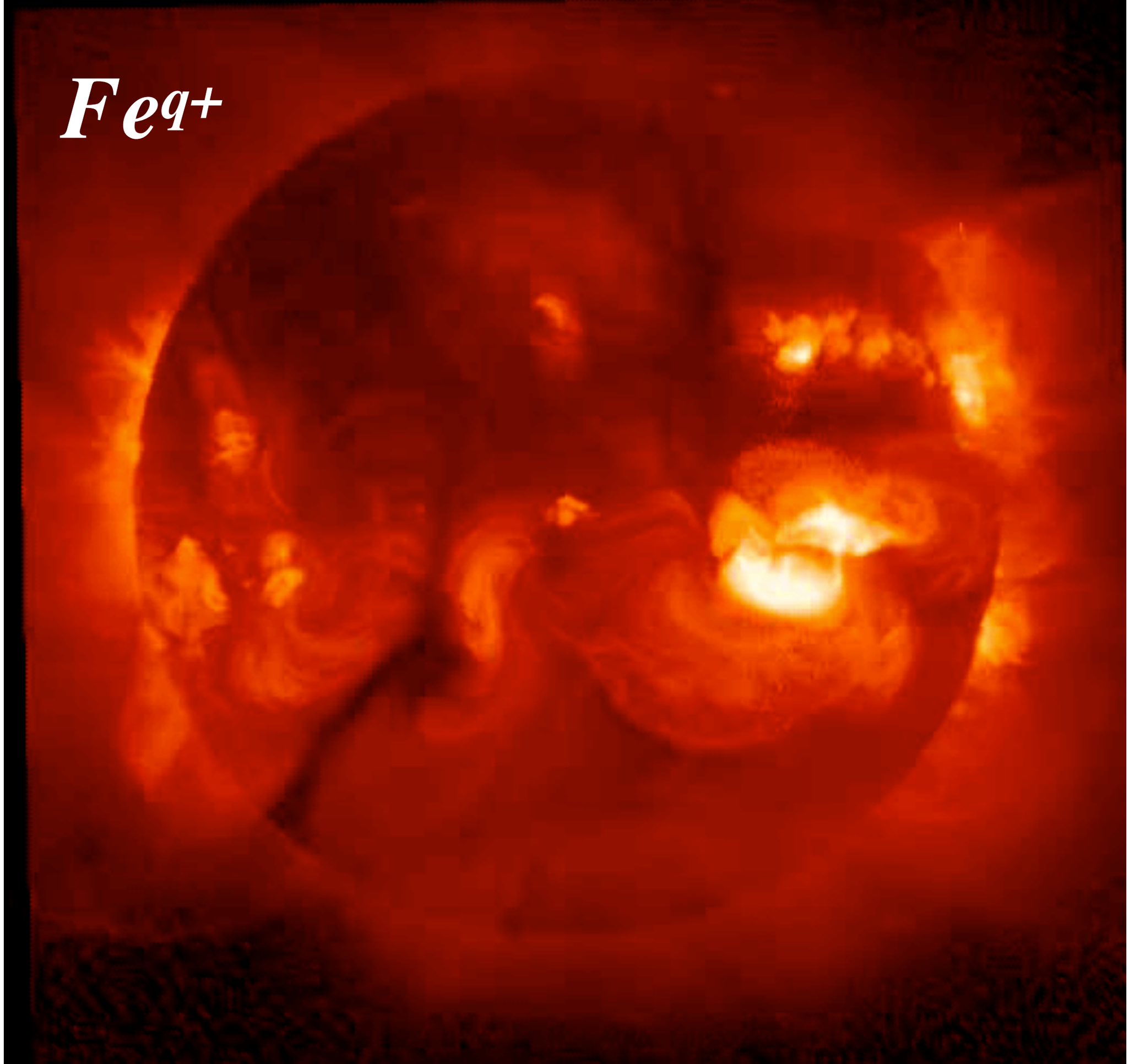
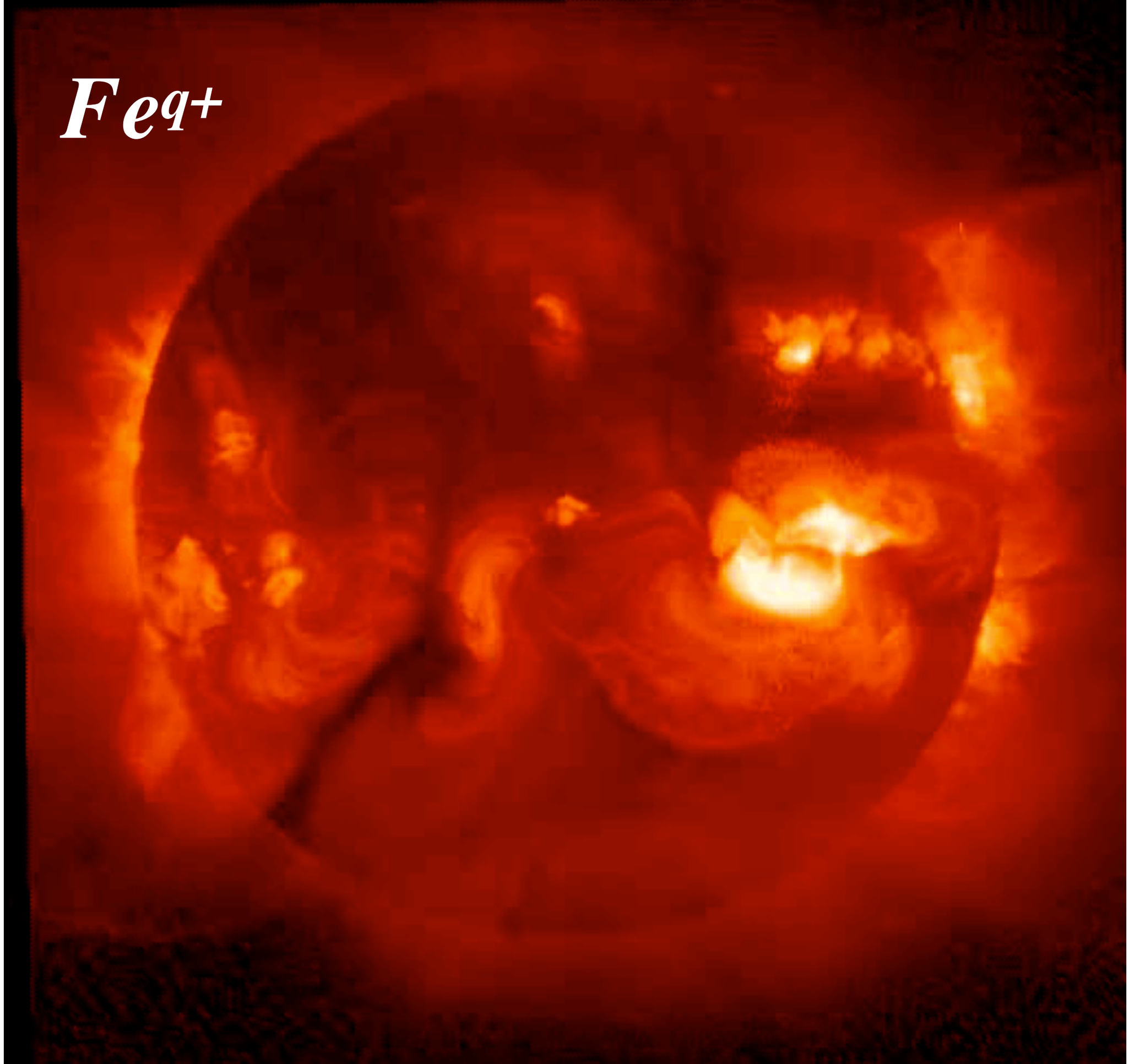

Fe^{q+}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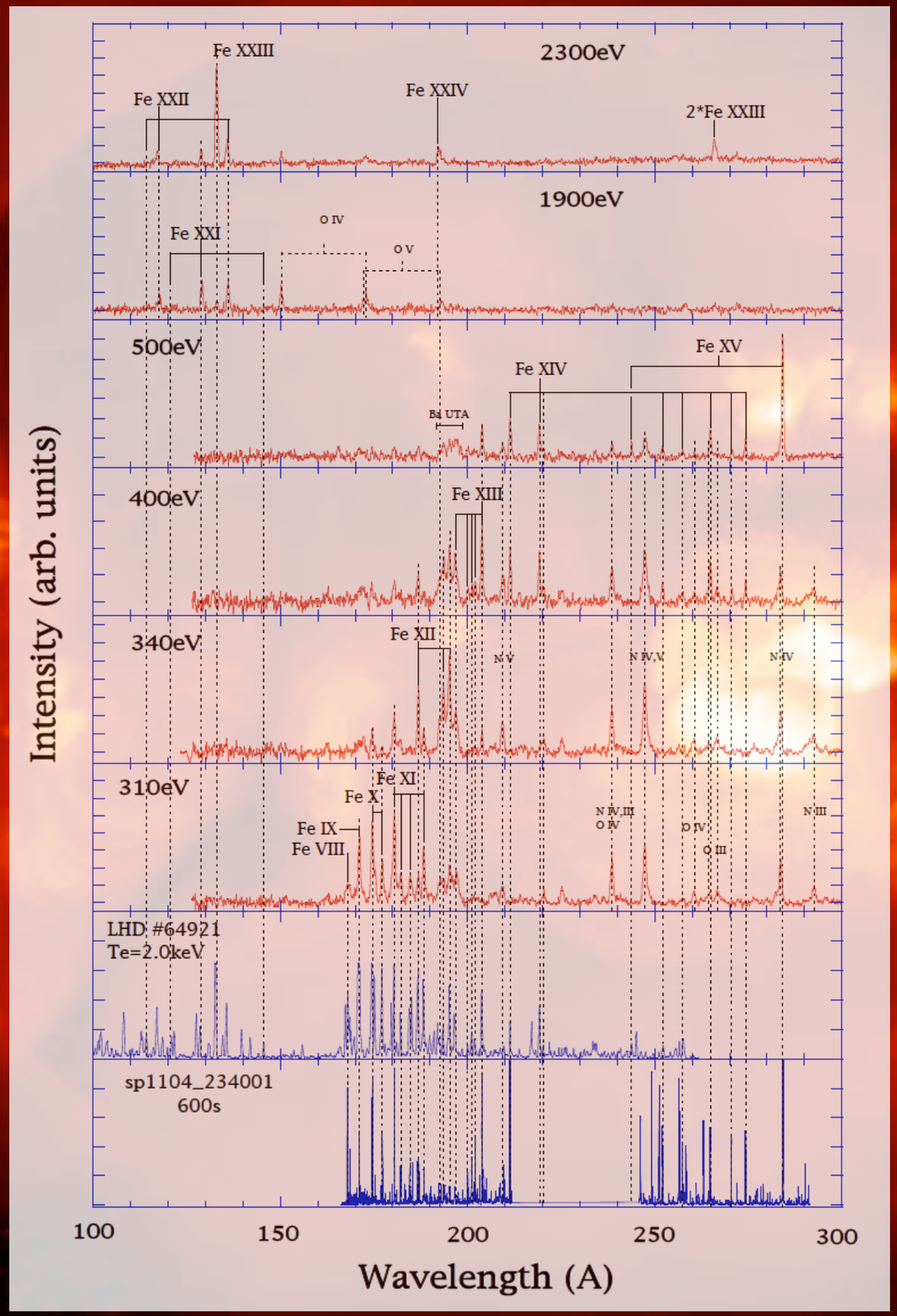


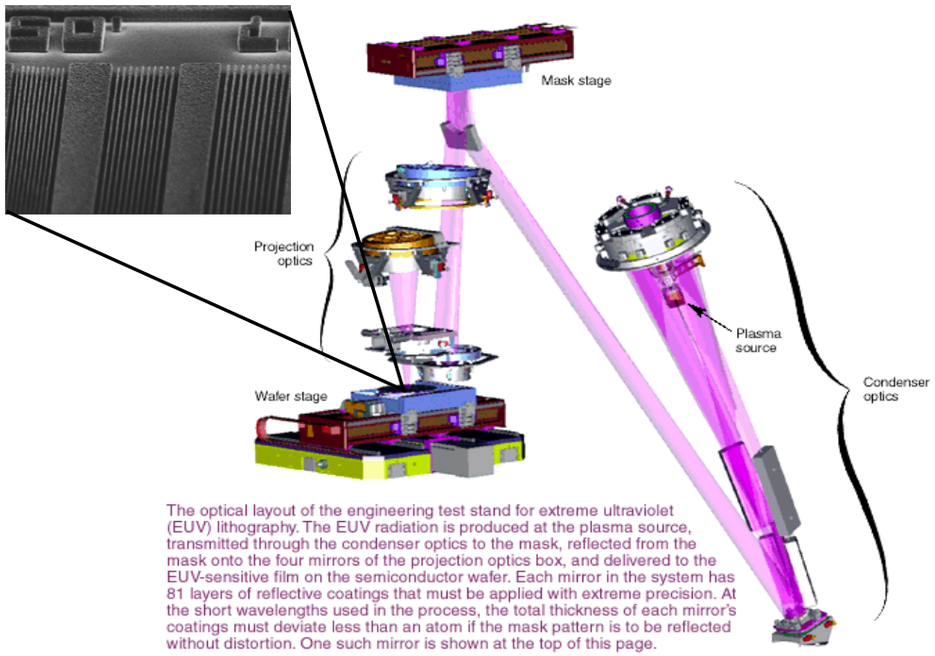
CoBIT

LHD

Hinode

III) ***Development of plasma light sources***

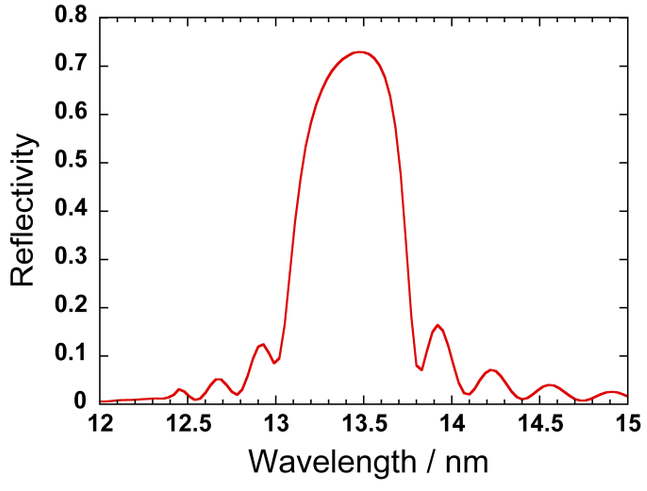
Semiconductor photo-lithography



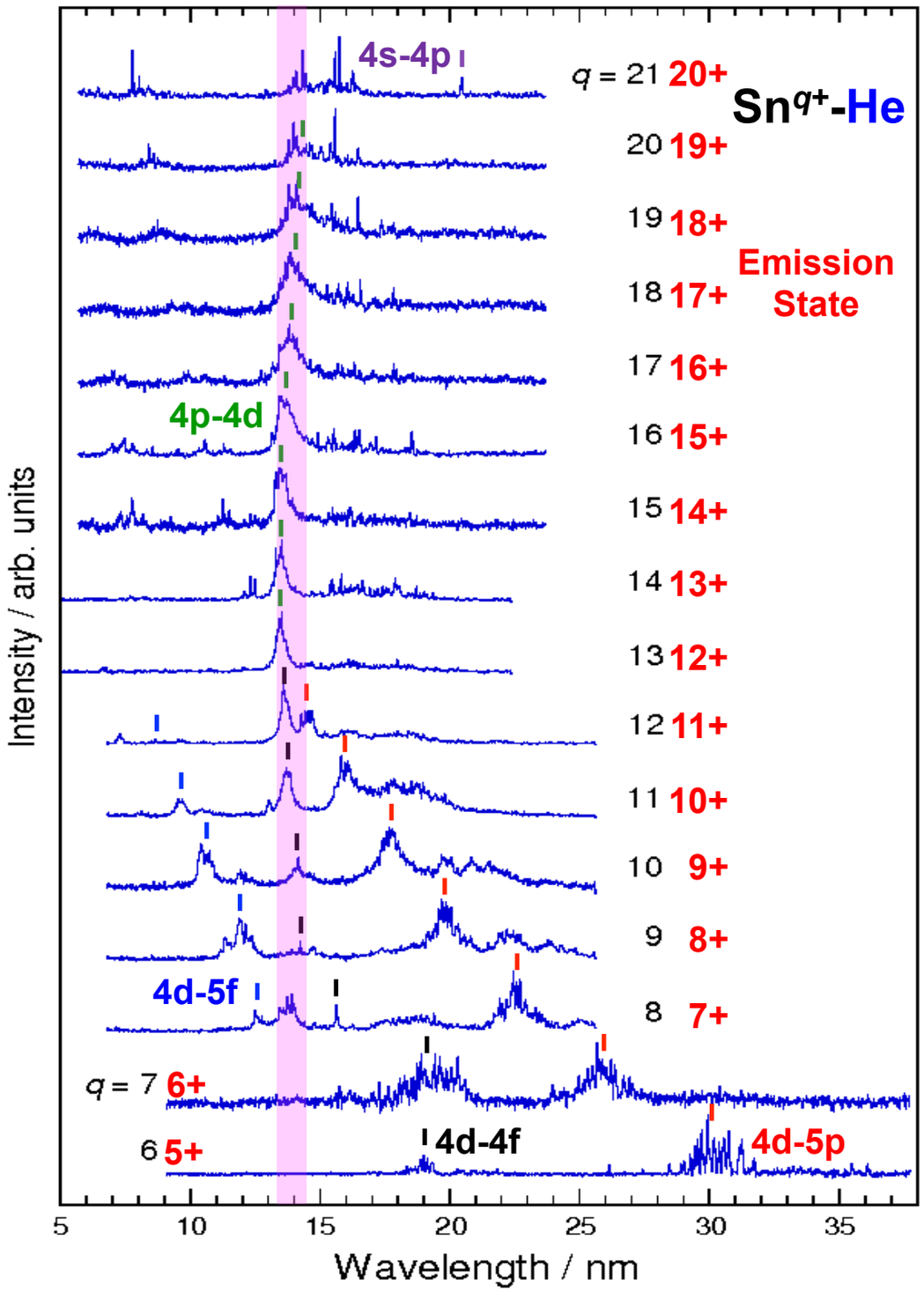
The optical layout of the engineering test stand for extreme ultraviolet (EUV) lithography. The EUV radiation is produced at the plasma source, transmitted through the condenser optics to the mask, reflected from the mask onto the four mirrors of the projection optics box, and delivered to the EUV-sensitive film on the semiconductor wafer. Each mirror in the system has 81 layers of reflective coatings that must be applied with extreme precision. At the short wavelengths used in the process, the total thickness of each mirror's coatings must deviate less than an atom if the mask pattern is to be reflected without distortion. One such mirror is shown at the top of this page.

The optical layout of the engineering test stand for EUV lithography.
http://www.llnl.gov/str/Sween.html

Photo courtesy of EUVA/Gigaphoton



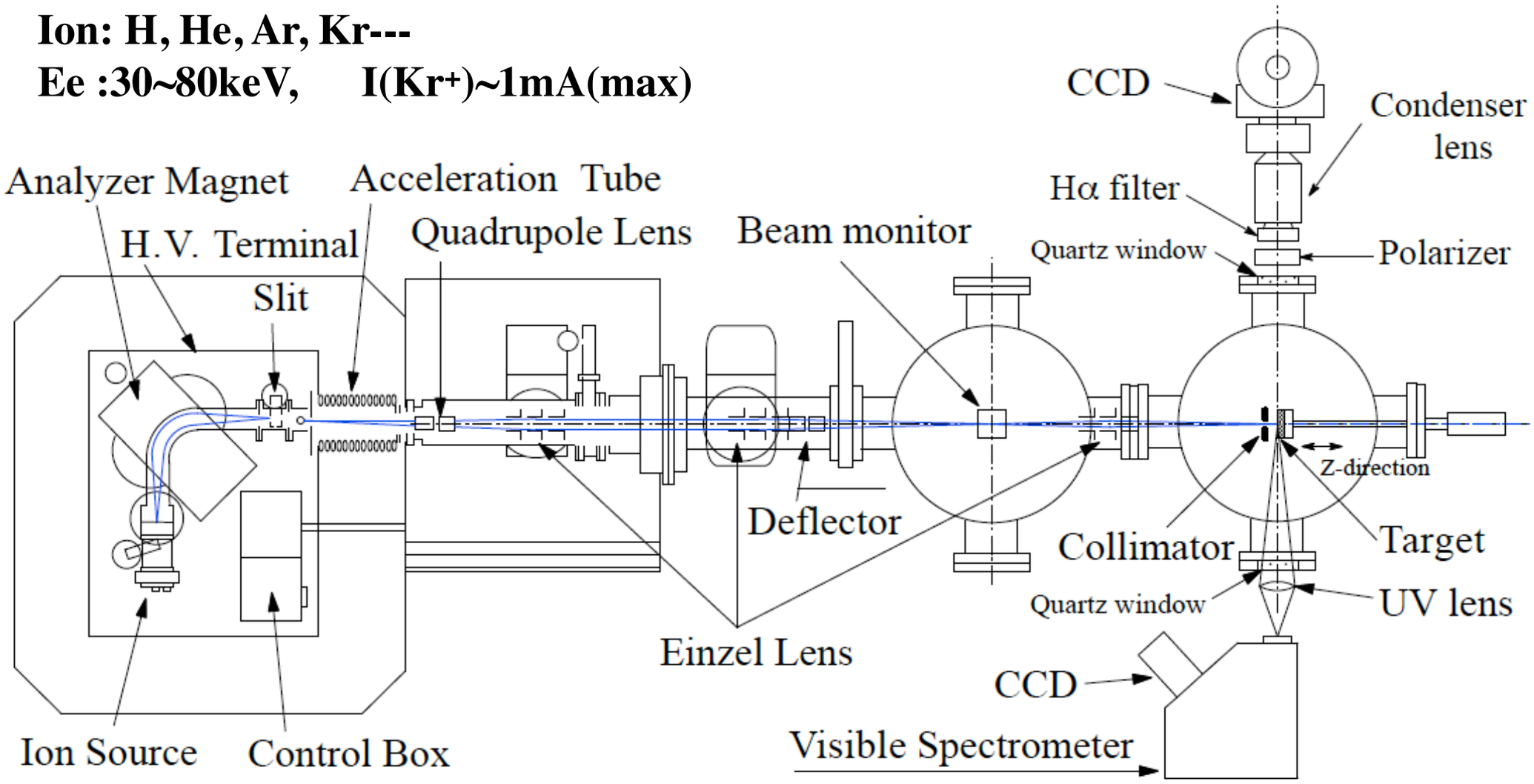
Reflectivity of Mo/Si multi-layer mirror for EUV lithography.



H. Ohashi *et al.,* J. Phys. B, 43 065204 (2010)

大強度イオン源（照射装置）

Ion: H, He, Ar, Kr---
Ee :30~80keV,　　I(Kr^+)~1mA(max)



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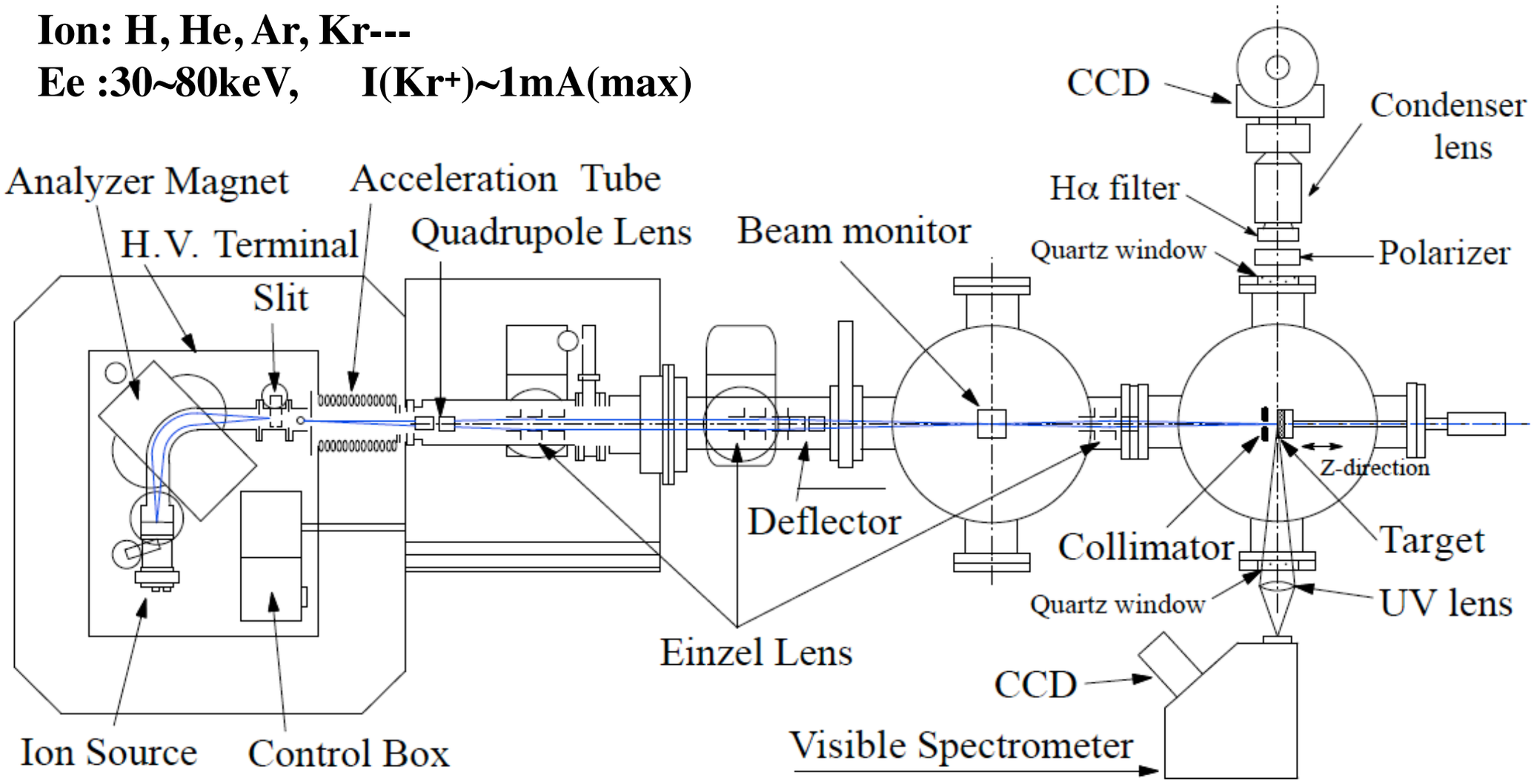
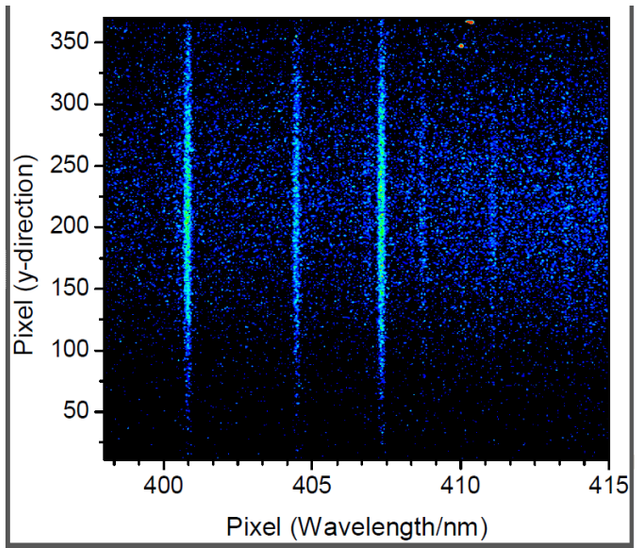


Kr+(35keV) - W



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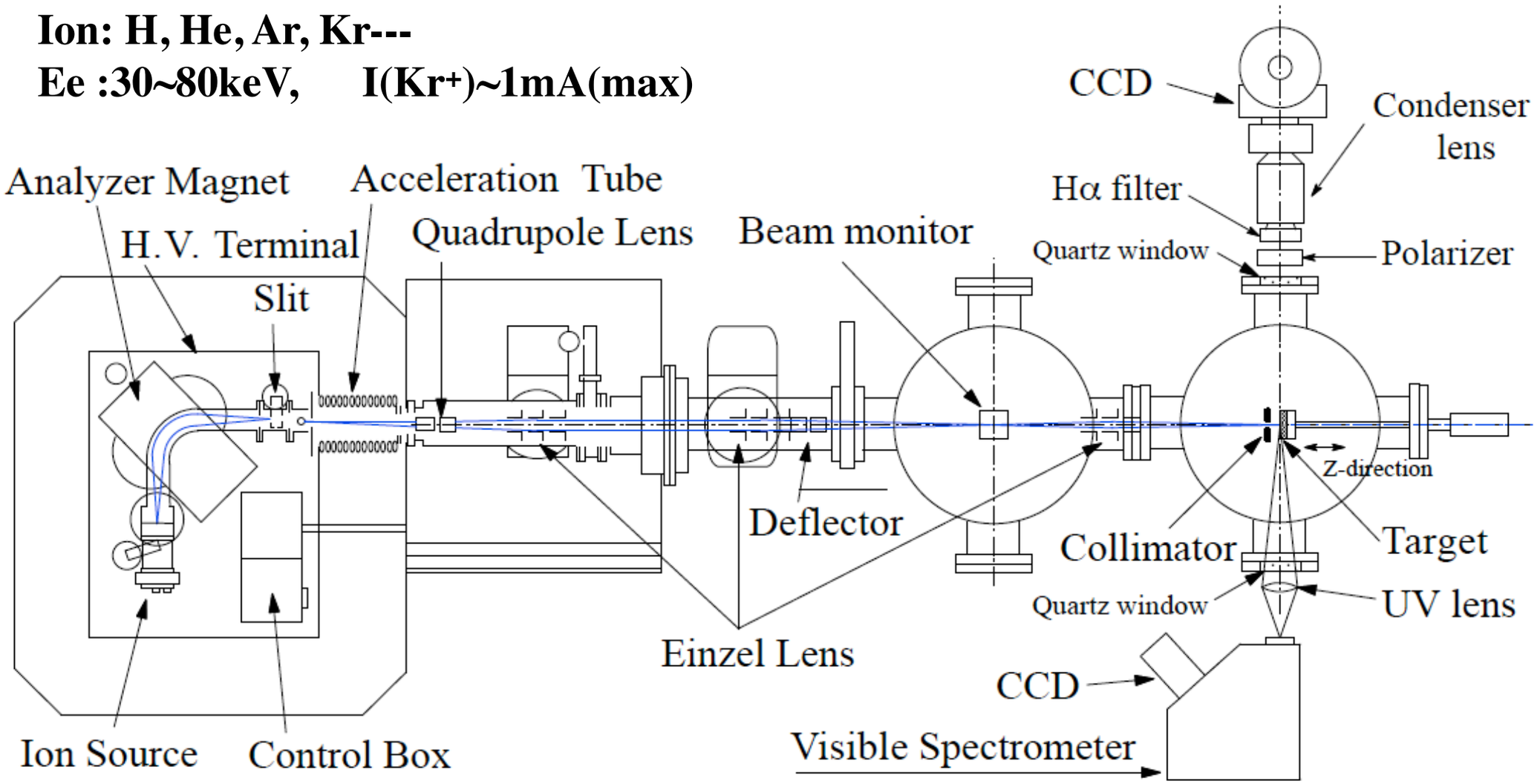

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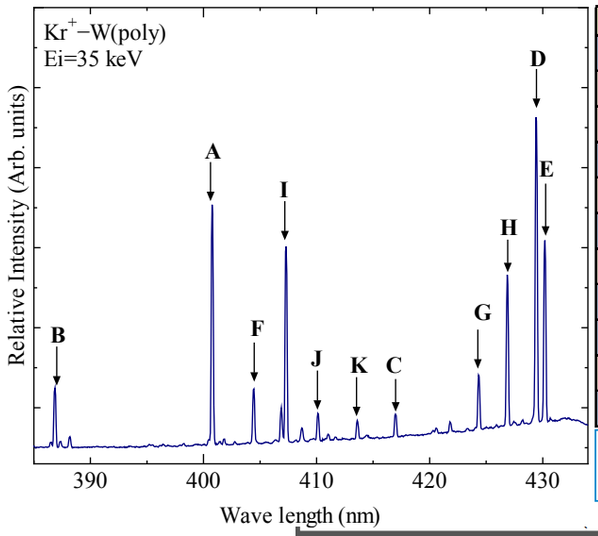

Labels	wavelength (nm)	Transitions
A	400.88	$5d^5(^6S)6p,^7P_4 \rightarrow 5d^5(^6S)6s,^7S_3$
B	386.80	$5d^46s(^6D)6p,^7D_4 \rightarrow 5d^5(^6S)6s,^7S_3$
C	417.12	$5d^46s(^6D)6p,^7D_4 \rightarrow 5d^46s^2,^5D_3$
D	429.46	$5d^5(^6S)6p,^7P_2 \rightarrow 5d^5(^6S)6s,^7S_3$
E	430.21	$5d^46s(^6D)6p,^7D_3 \rightarrow 5d^5(^6S)6s,^7S_3$
F	404.56	$5d^46s(^6D)6p,^5F_2 \rightarrow 5d^5(^6S)6s,^7S_3$
G	424.44	$5d^46s(^6D)6p,^7D_5 \rightarrow 5d^46s^2,^5D_4$
H	426.94	$5d^5(^6S)6p,^7P_4 \rightarrow 5d^5(^6S)6s,^7S_3$
I	407.44	$5d^5(^6S)6p,^7P_3 \rightarrow 5d^5(^6S)6s,^7S_3$
J	410.27	$5d^46s(^6D)6p,^5P_3 \rightarrow 5d^46s^2,^5D_4$
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Ground state
$1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^46s^2\ ^5D_0$

avelength/nm)

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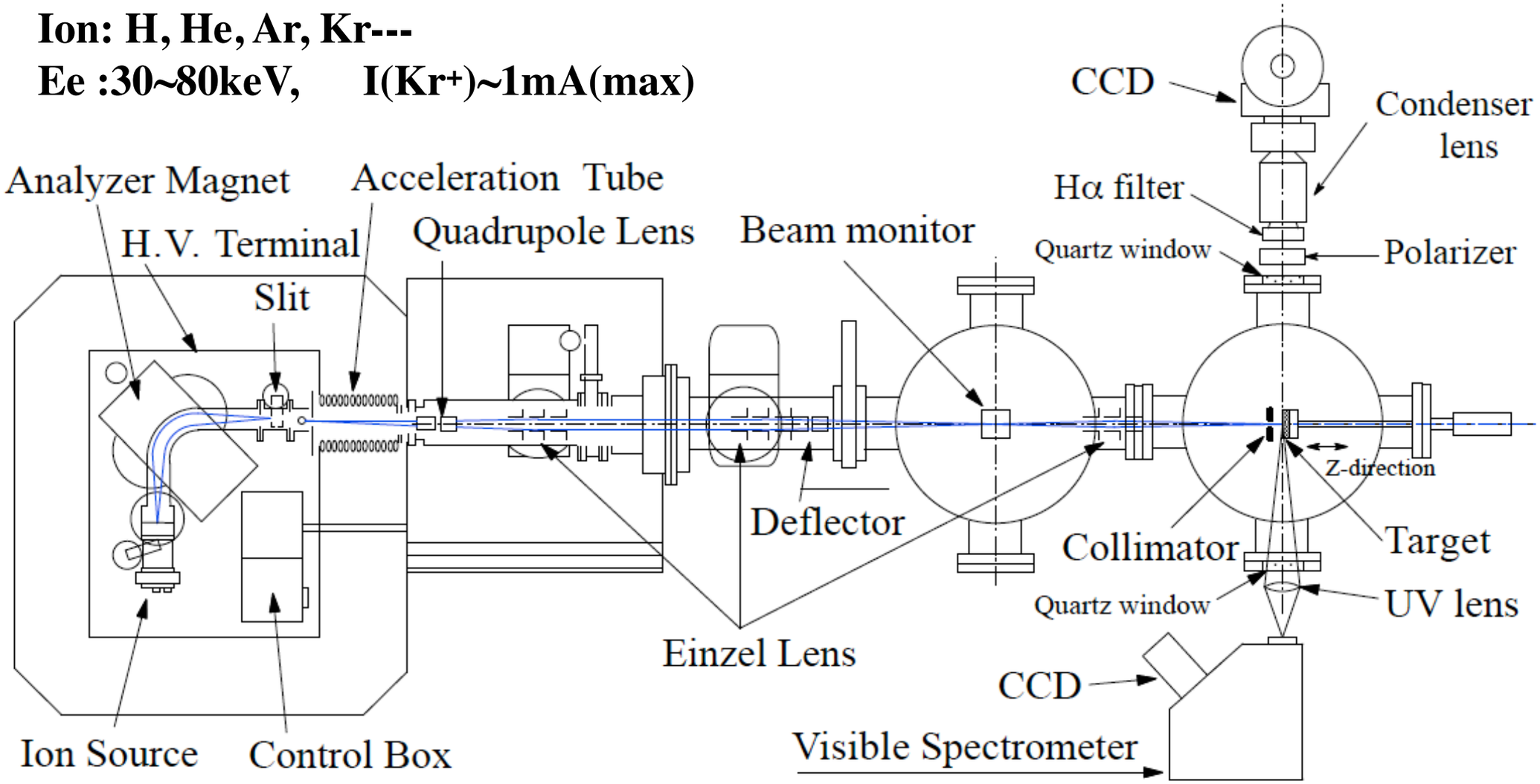

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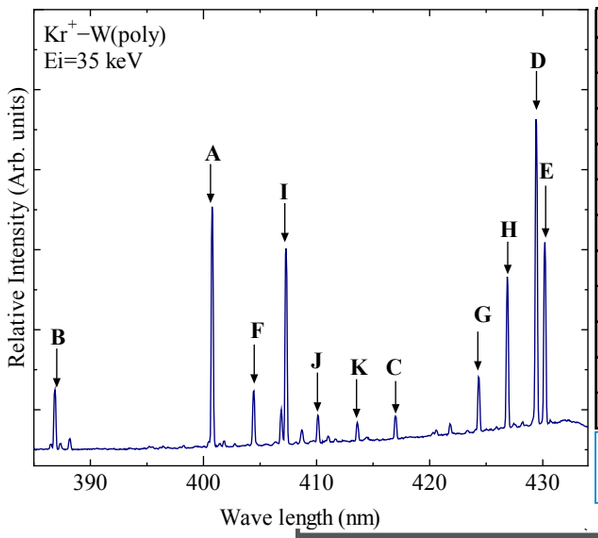

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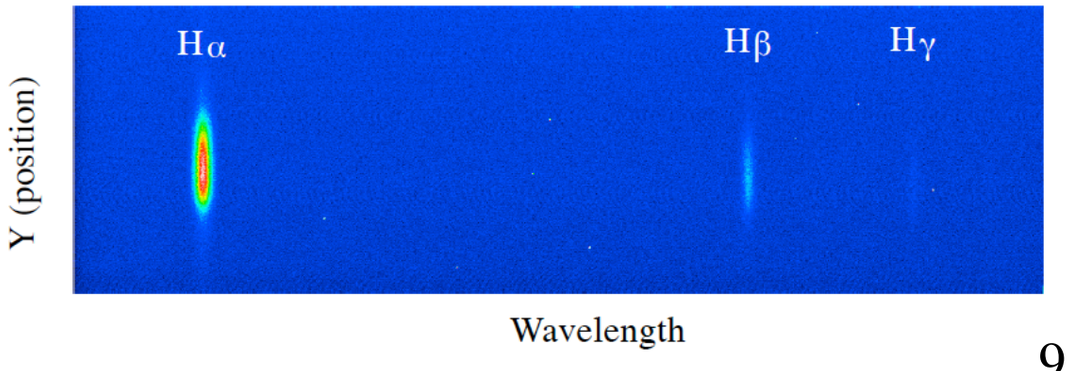
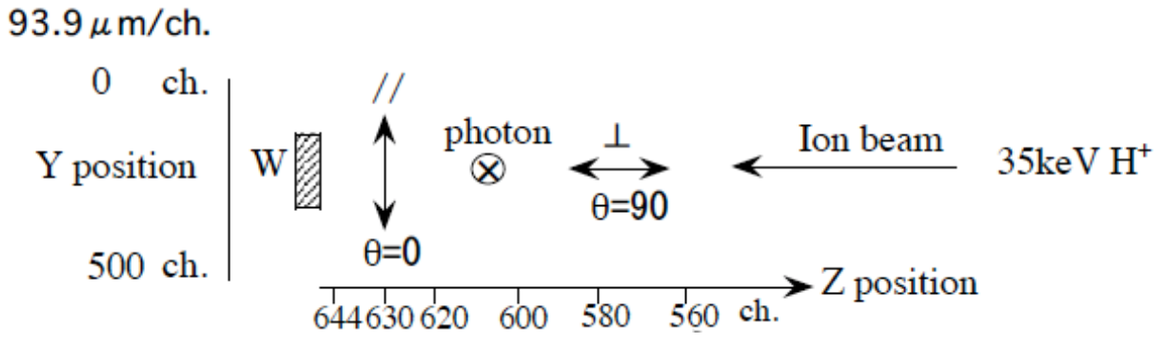
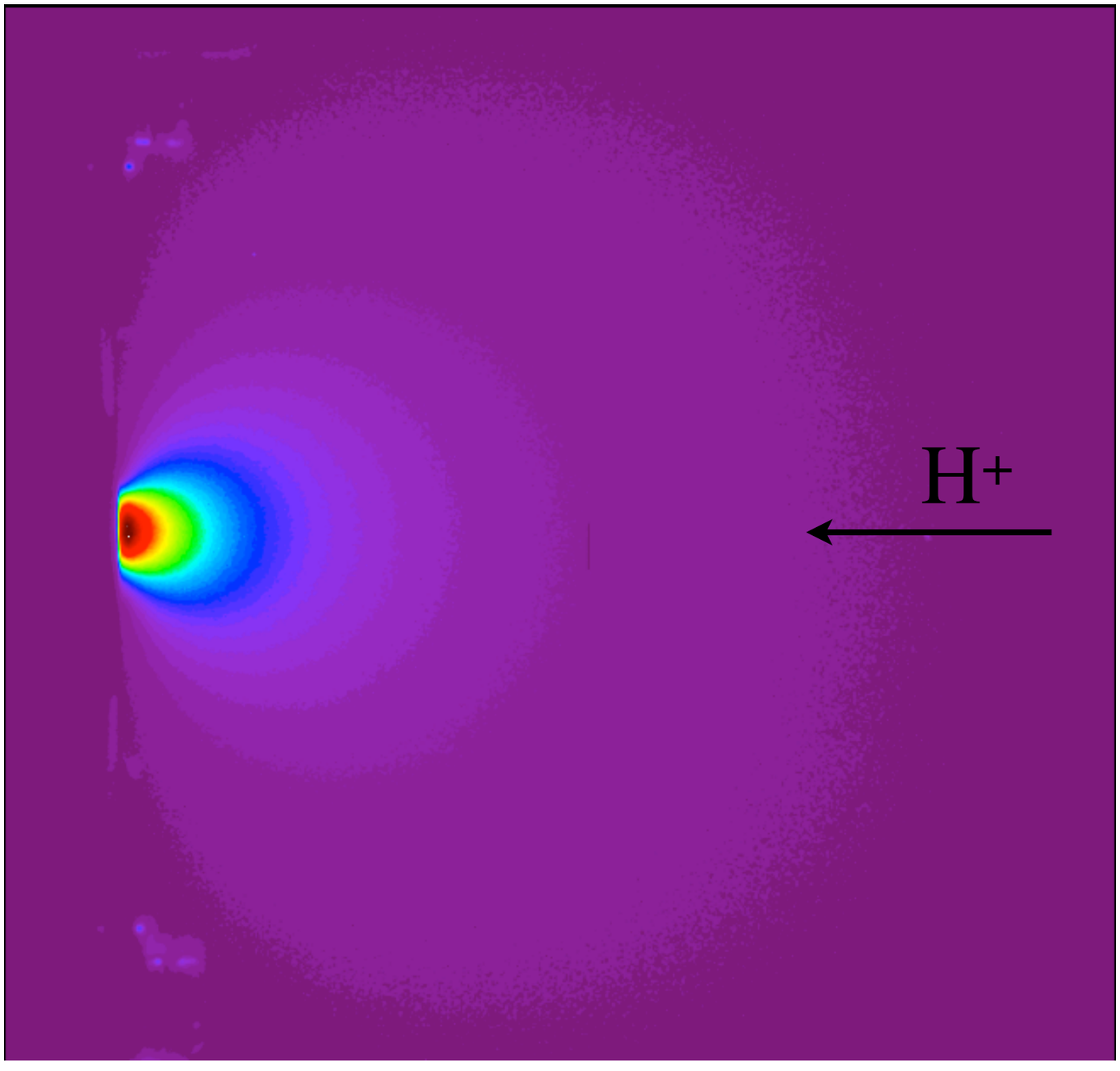


Hα偏光度空間分布

偏光度の定義 $$P = \frac{I_{\parallel} - I_{\perp}}{I_{\parallel} + I_{\perp}},$$





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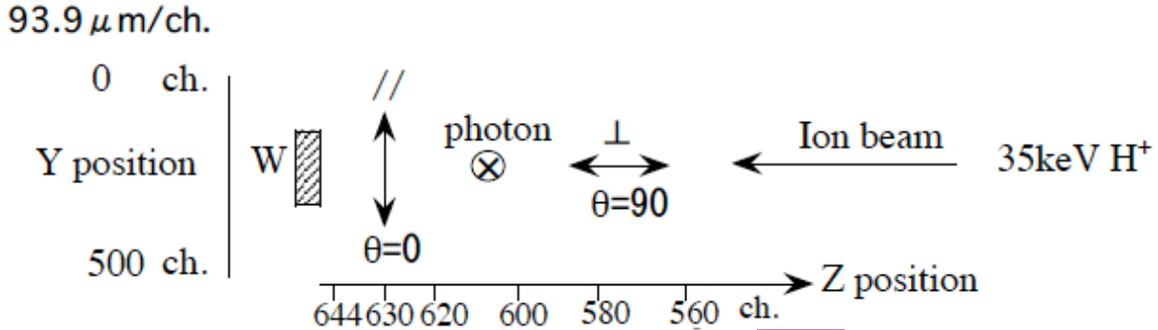
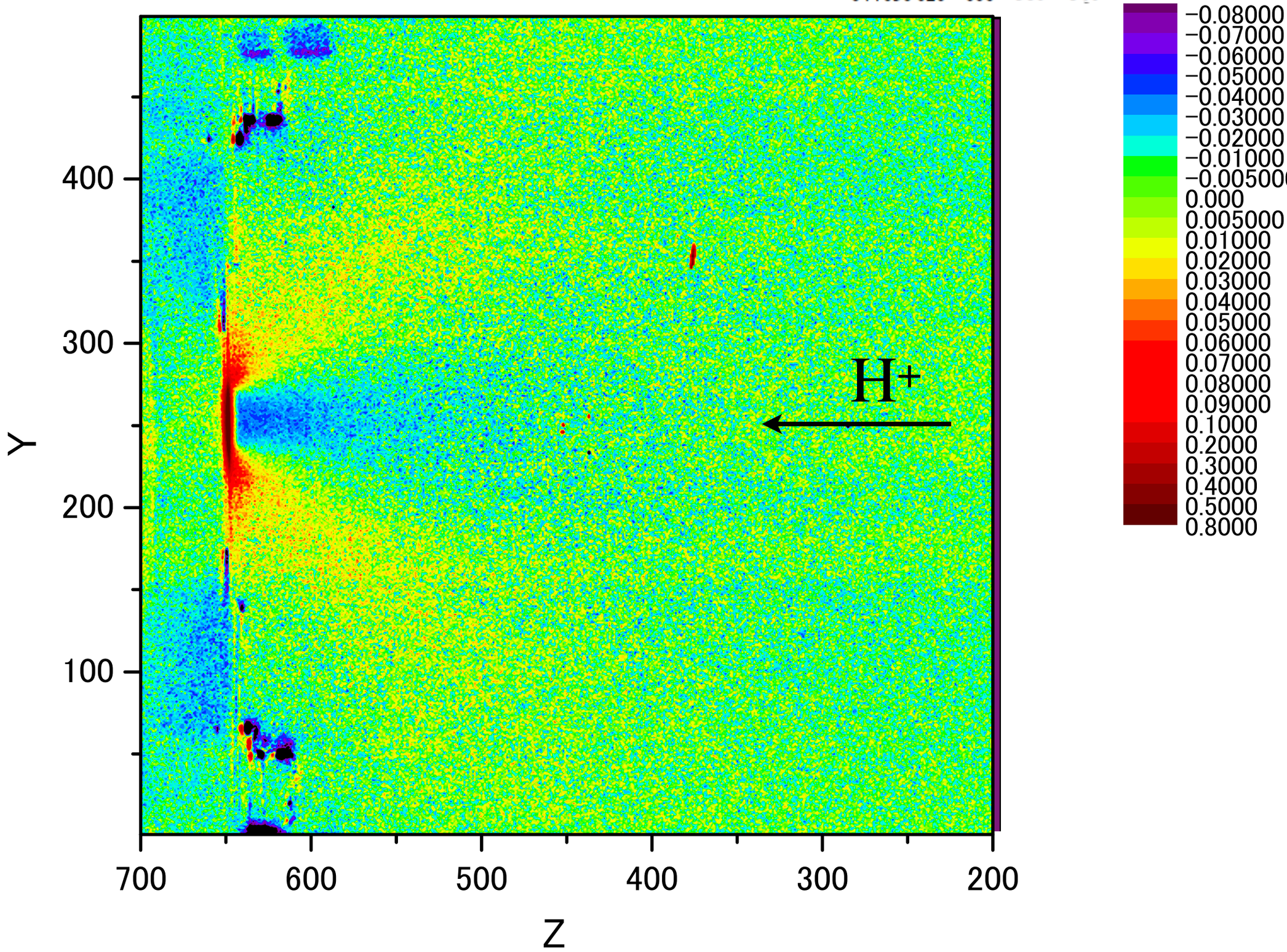
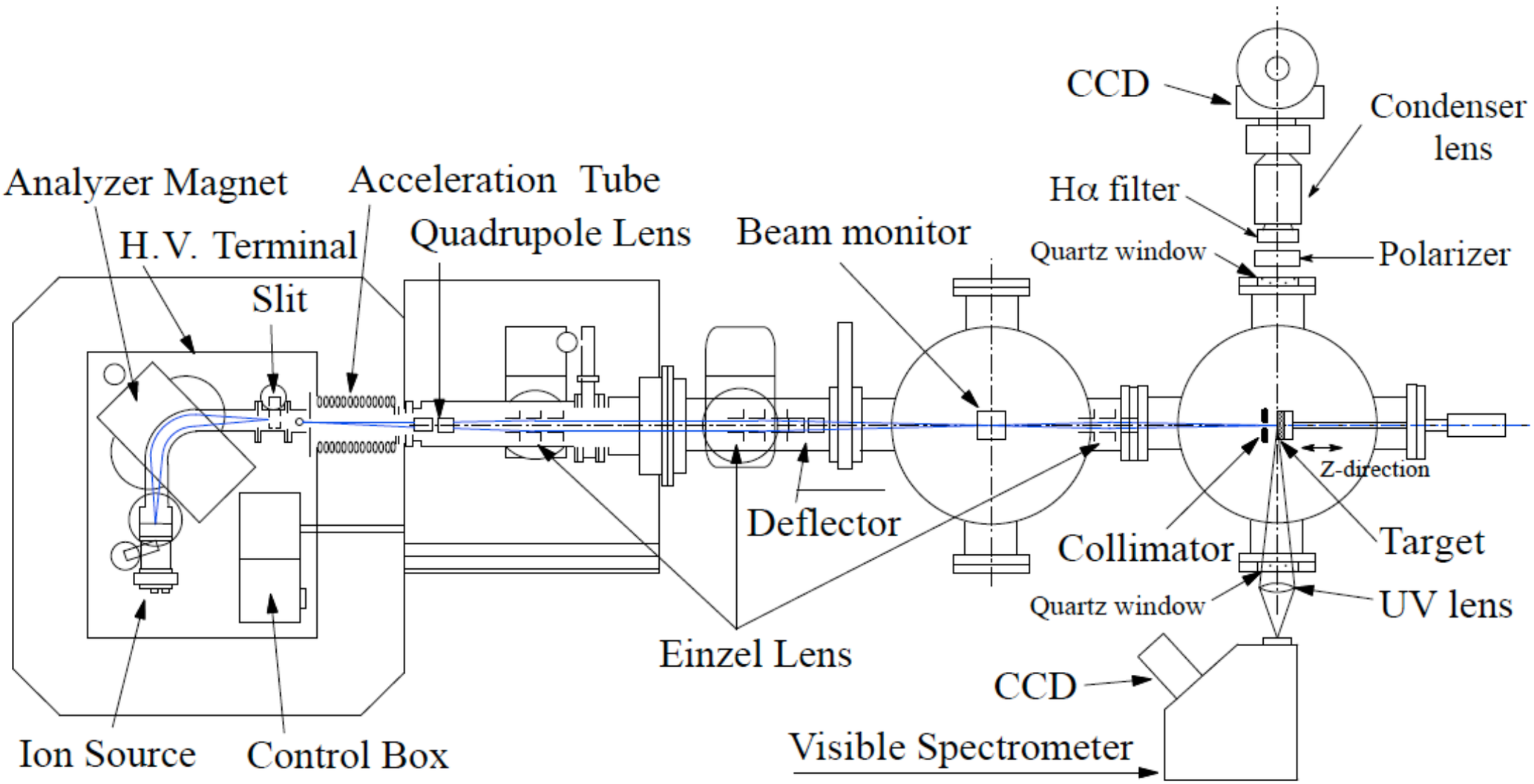
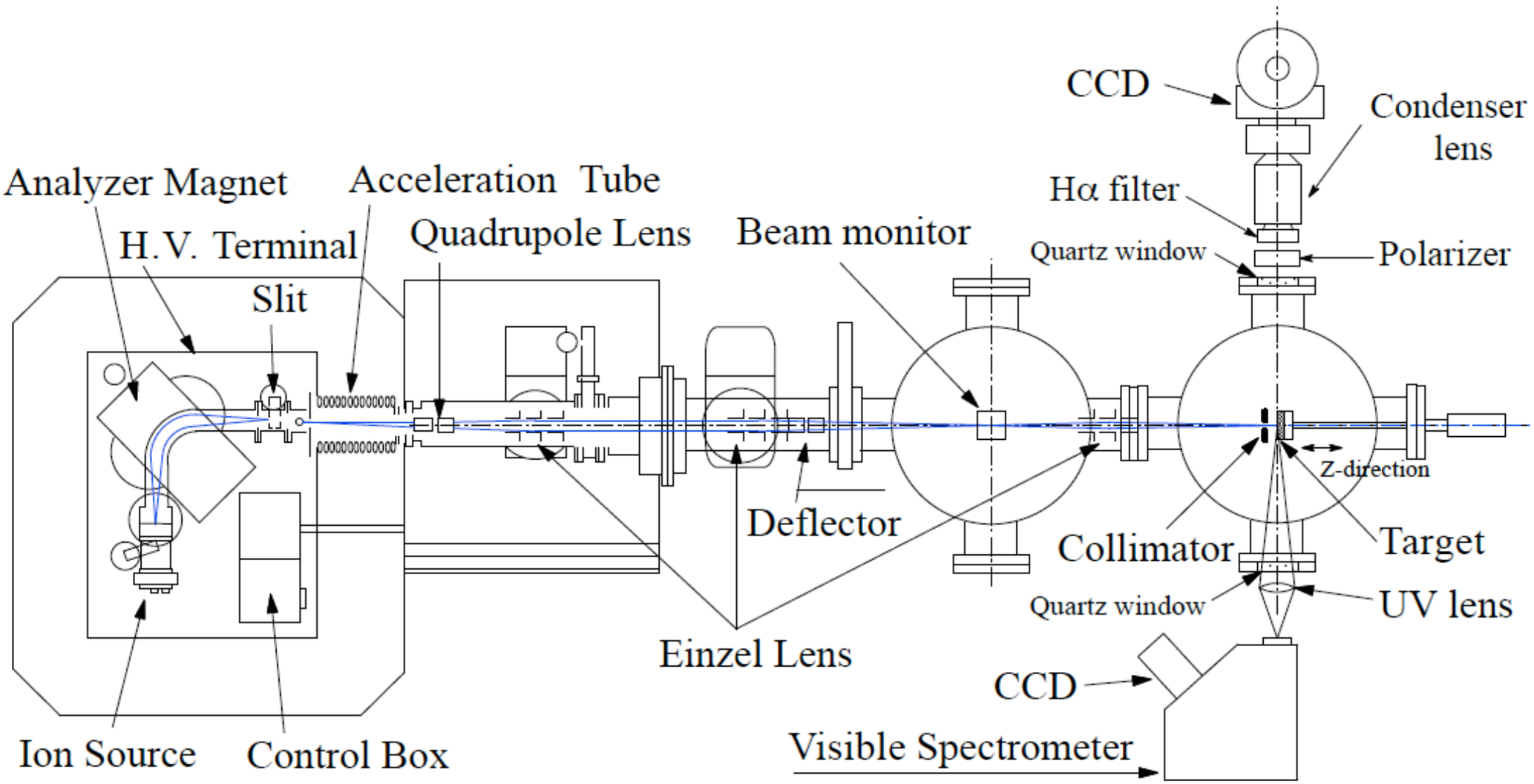




大強度イオン源（イオン照射装置）



大強度イオン源（イオン照射装置）



- ユーティリティー事故（圧空配管への水流入）

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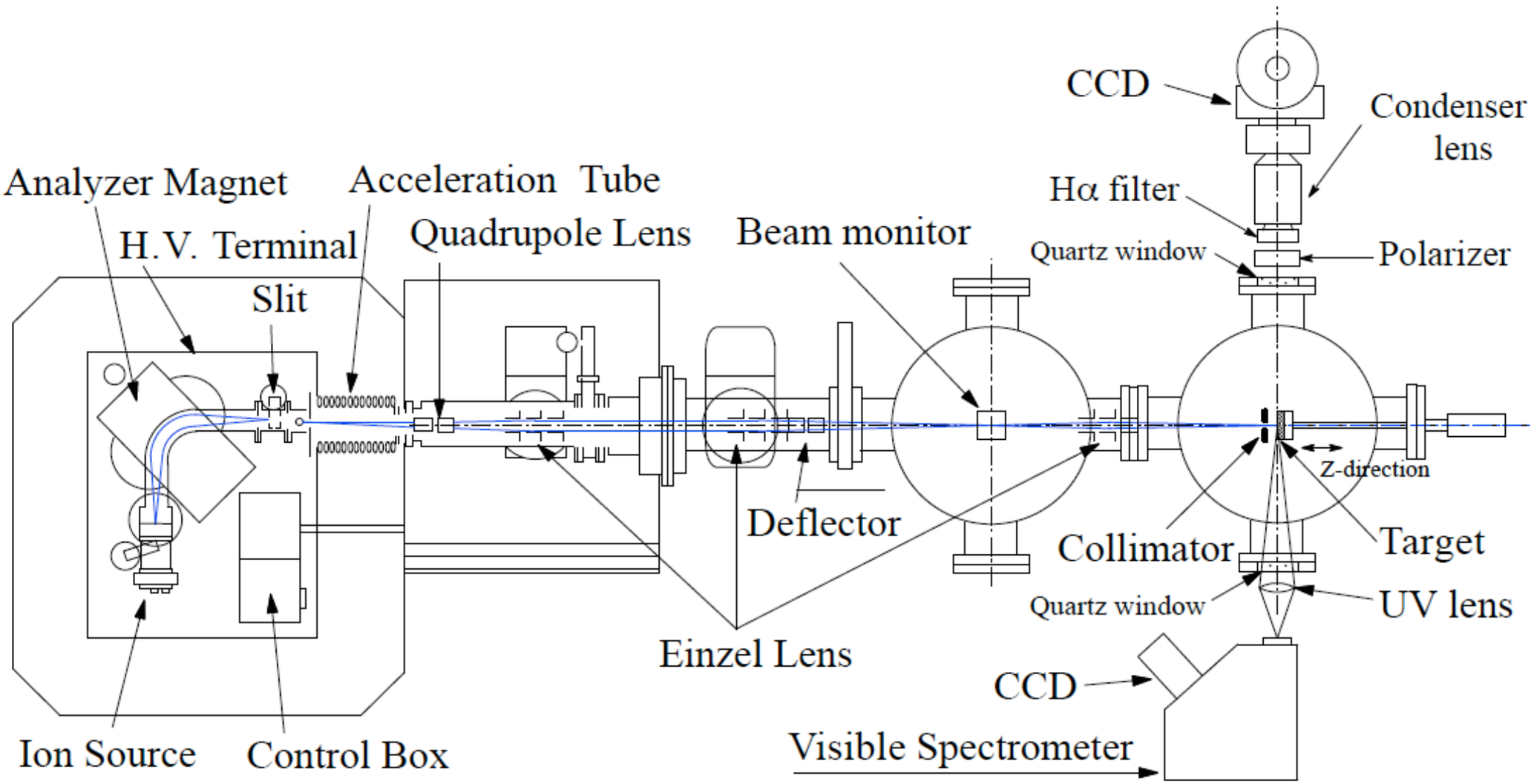

- ユーティリティー事故（圧空配管への水流入）
- 電源等の老朽化（昭和62年製造・・・33年前）

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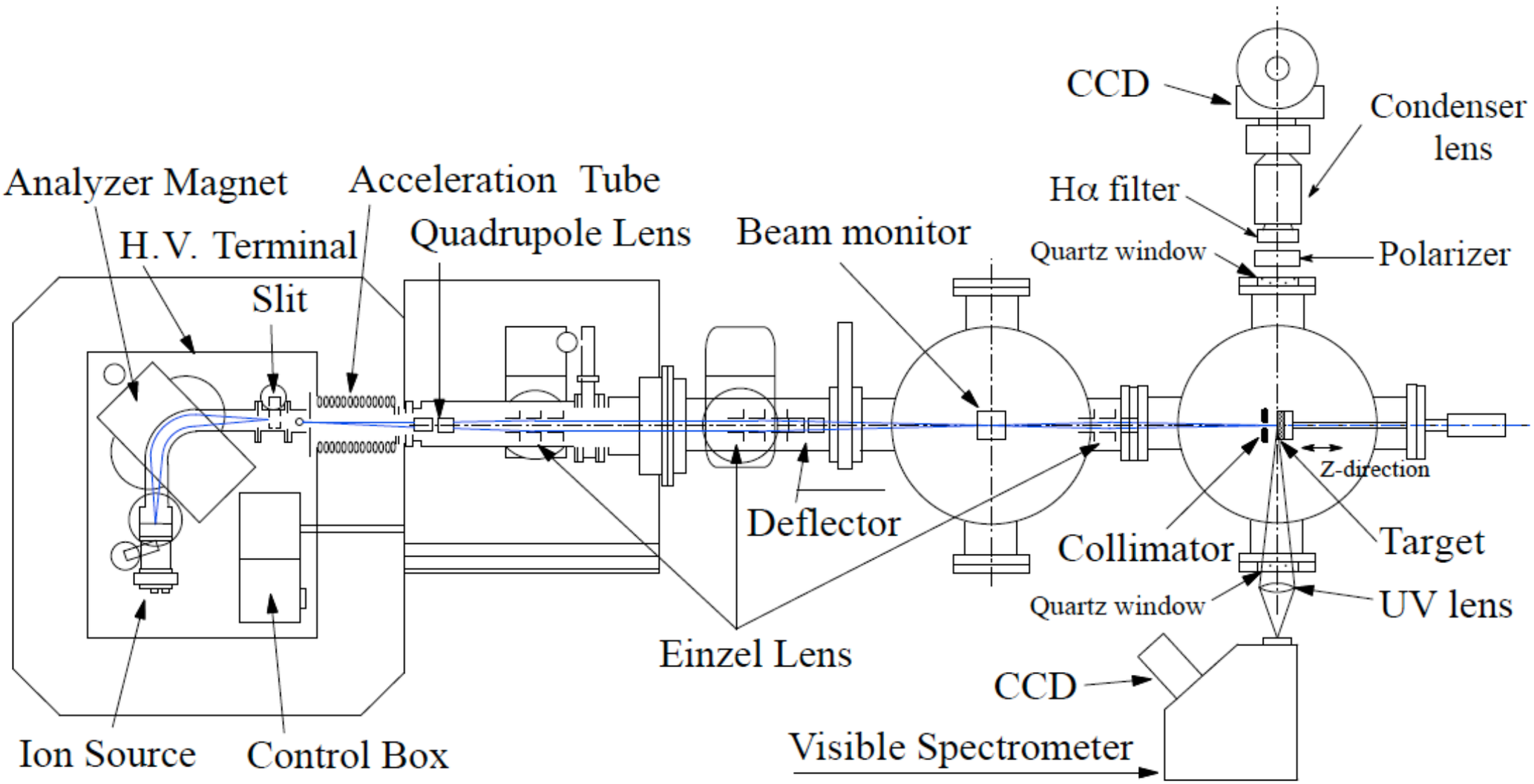

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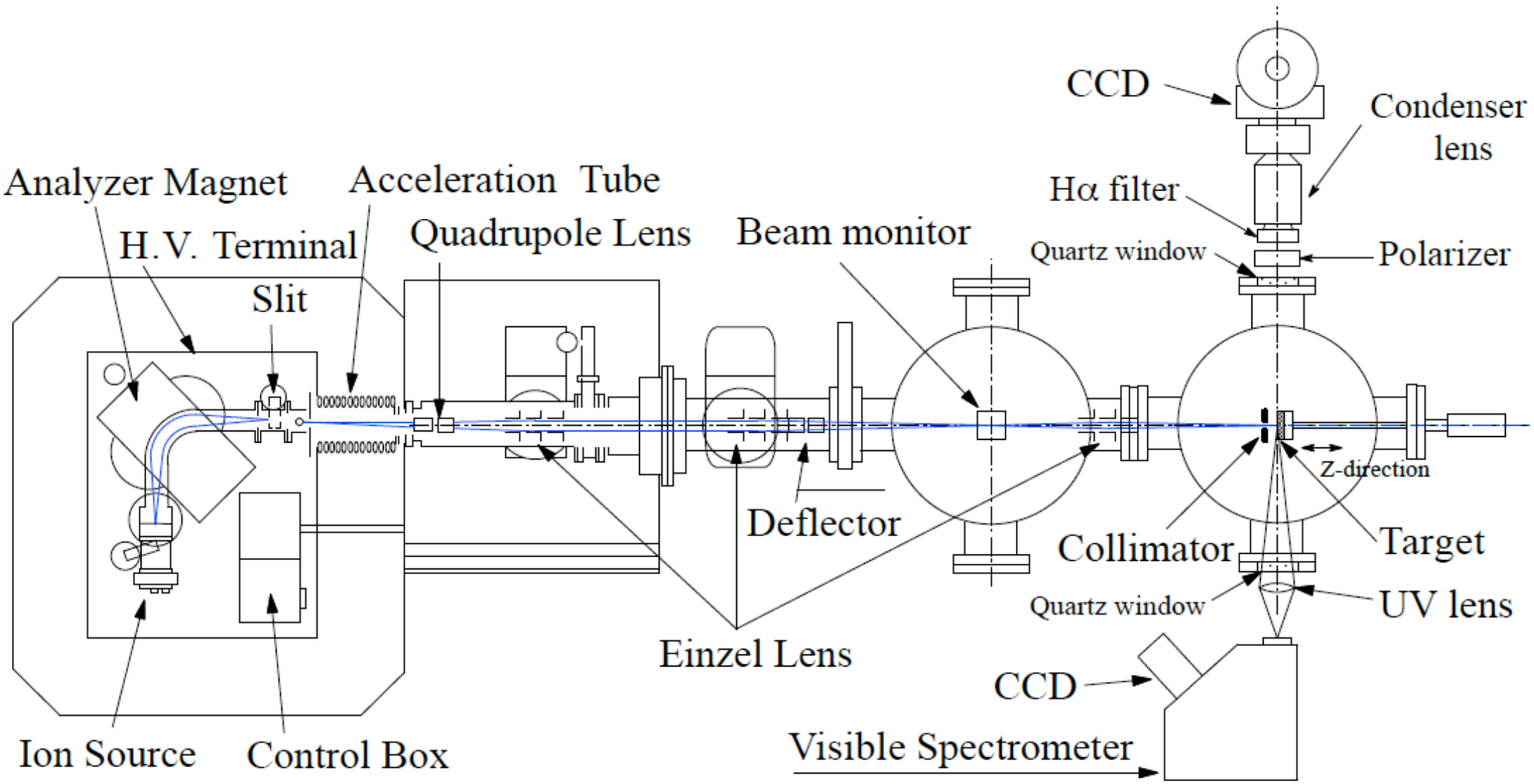

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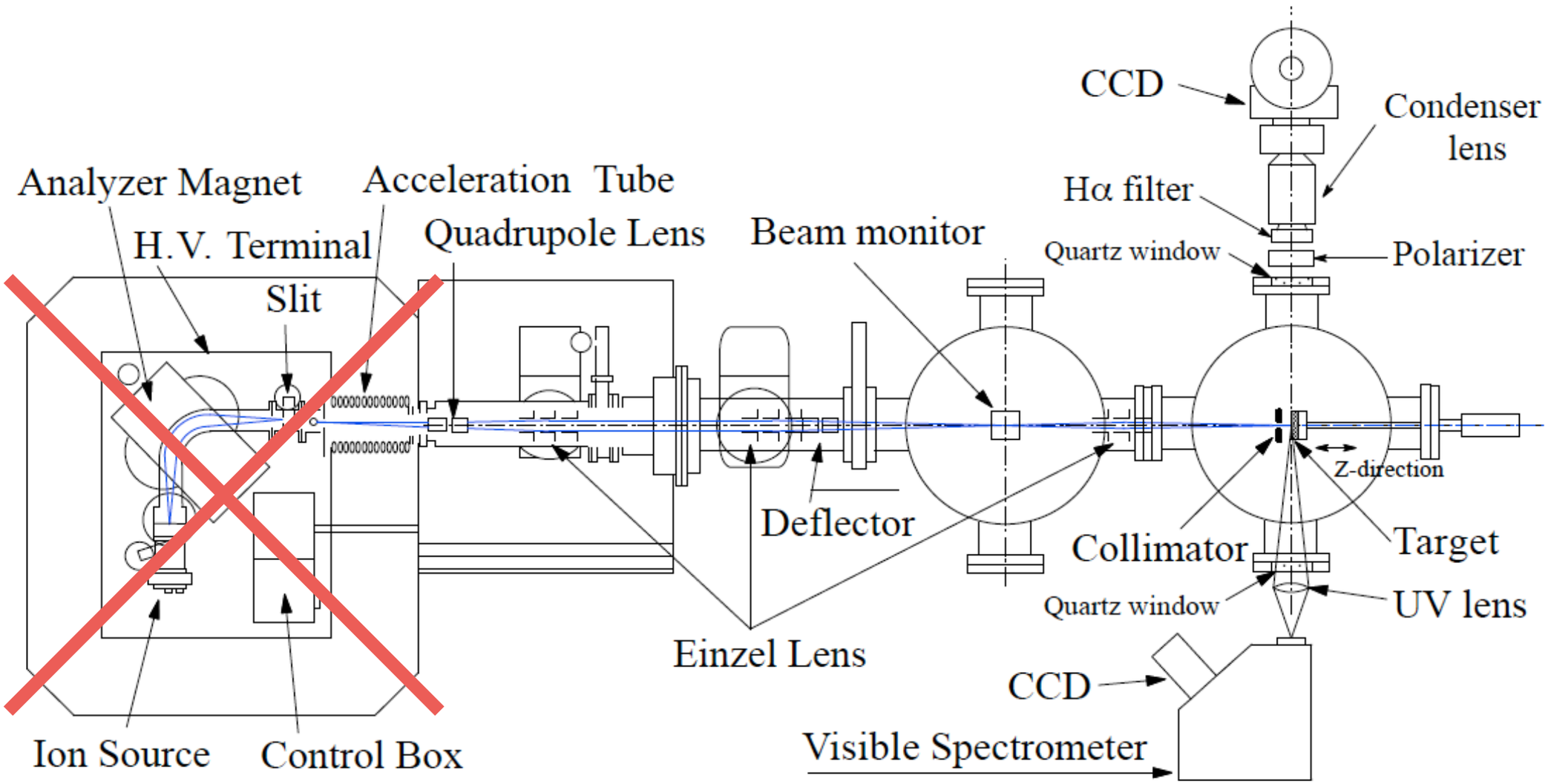

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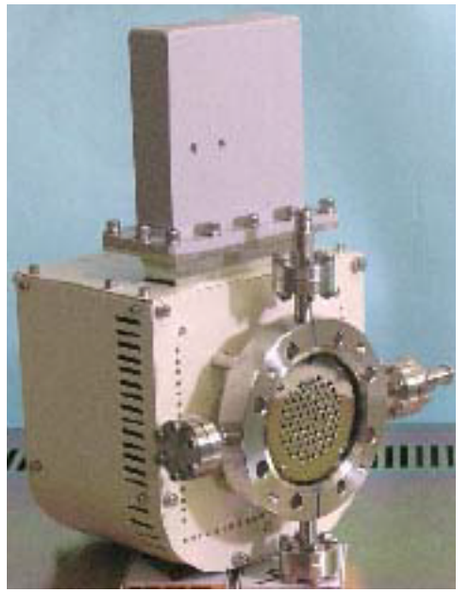
イオン照射実験　200keV仕様に改造予定



マイクロ波イオン源

ARIOSの導入

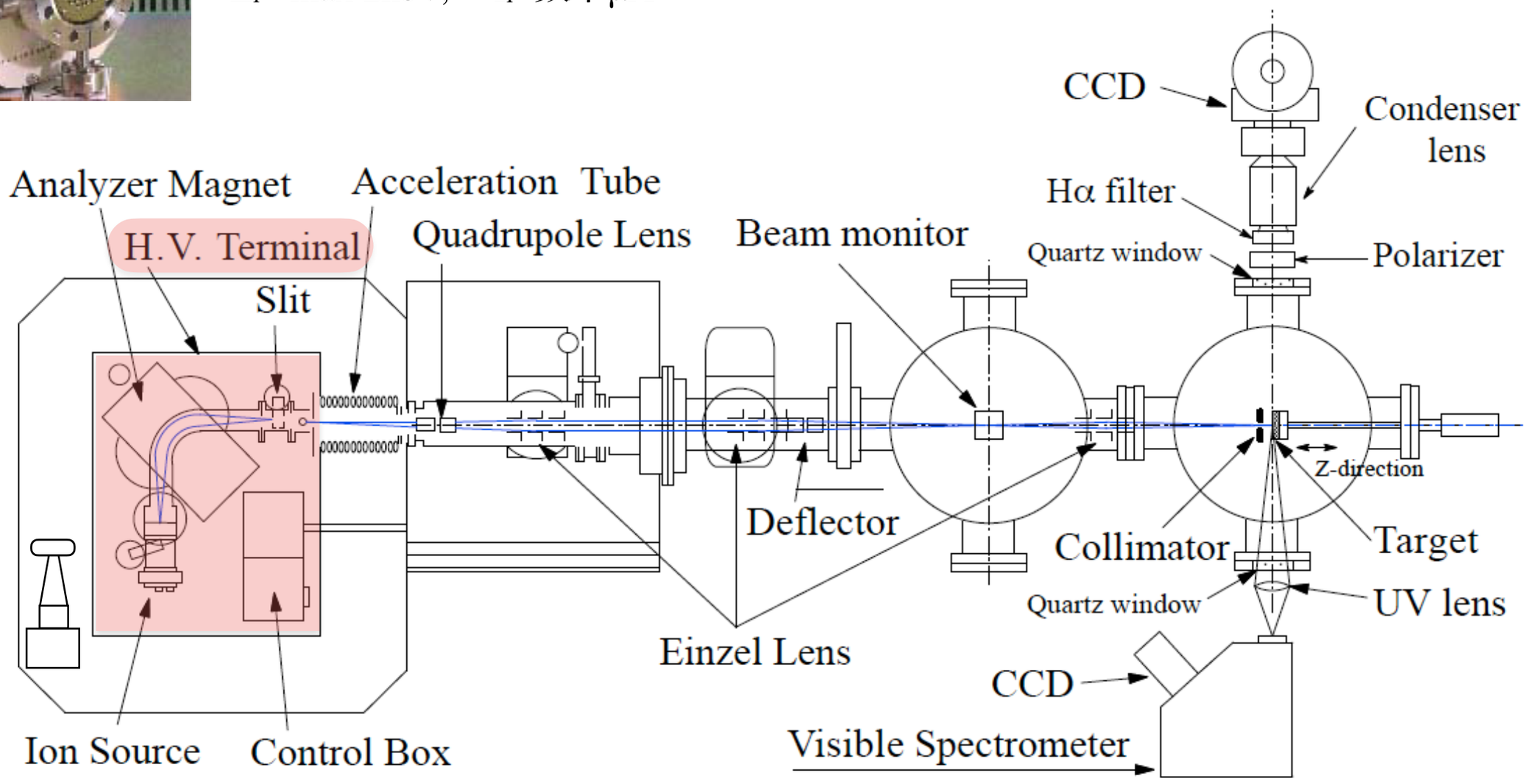
2.45GHz 200W

E_i= max 2keV,　I_i~数十μA

弾き出し損傷100回/原子以上の極限放射線環境における

無機機能材料の特性研究

-田中照也氏科研費-　コラボ



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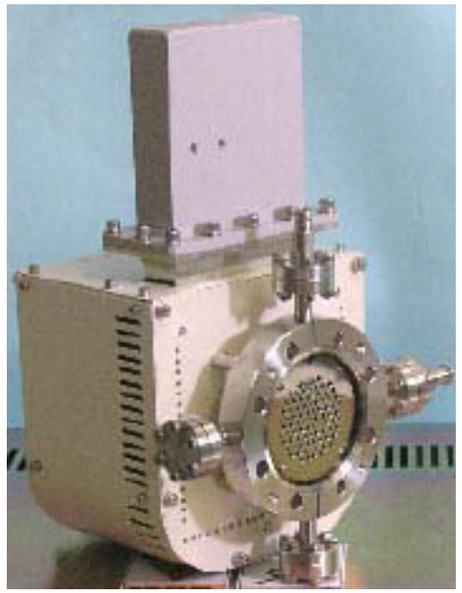

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