A Pepper-pot Based Device for Diagnostics of the Single-shot Beam

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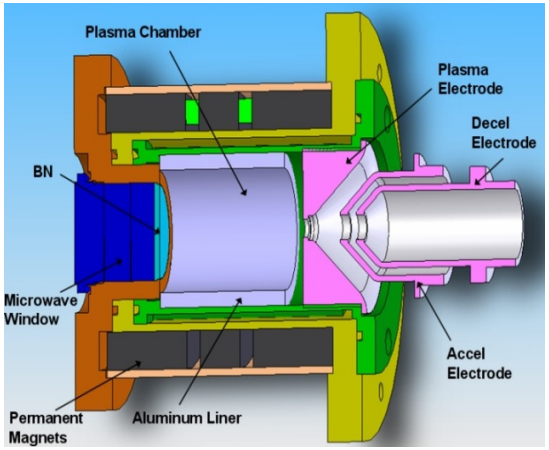
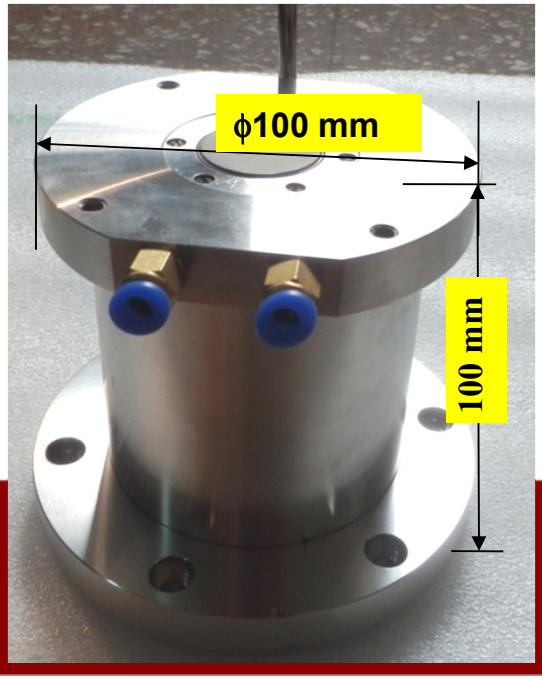
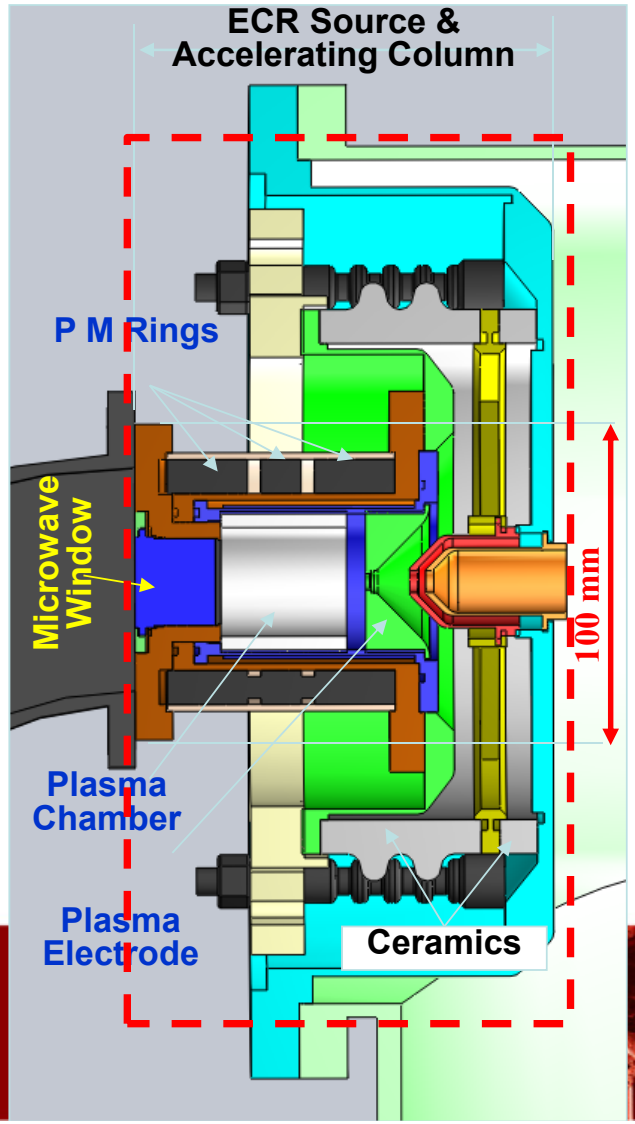
OUTLINE

- System Requirement
- Design Principle
- Experimental Results
- Conclusion
- Progresses of PKU 2.45GHz PMECR Ion source

1) PKU Standard Compact 2.45GHz PMECR Ion Source





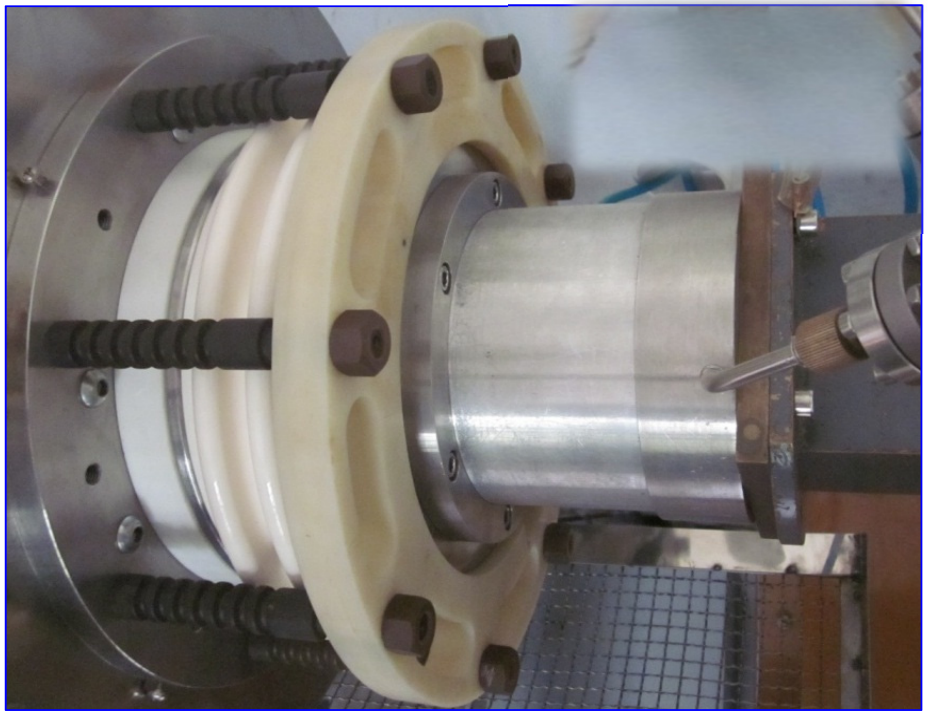


- **Source body**
  - ϕ_{out}: 10 cm
  - height: 10 cm
  - Wet: < 5 kg.
  - ϕ_{in}: 40 mm
  - L: 50 mm
- **Block** with RF Coupling, Source Body & Extraction column

145mmxϕ240mm

- **Ion Beam** (50keV/ϕ6mm)
  - H^+ 120mA
  - D^+ 83mA
  - He^+ 65mA
  - He^{2+} 4.4mA
  - N^+ 63mA
  - O^+ 50mA
  - Ar^+ 70mA

2) To produce Tens mA H_2^+ Beam with 2.45GHz PMECR



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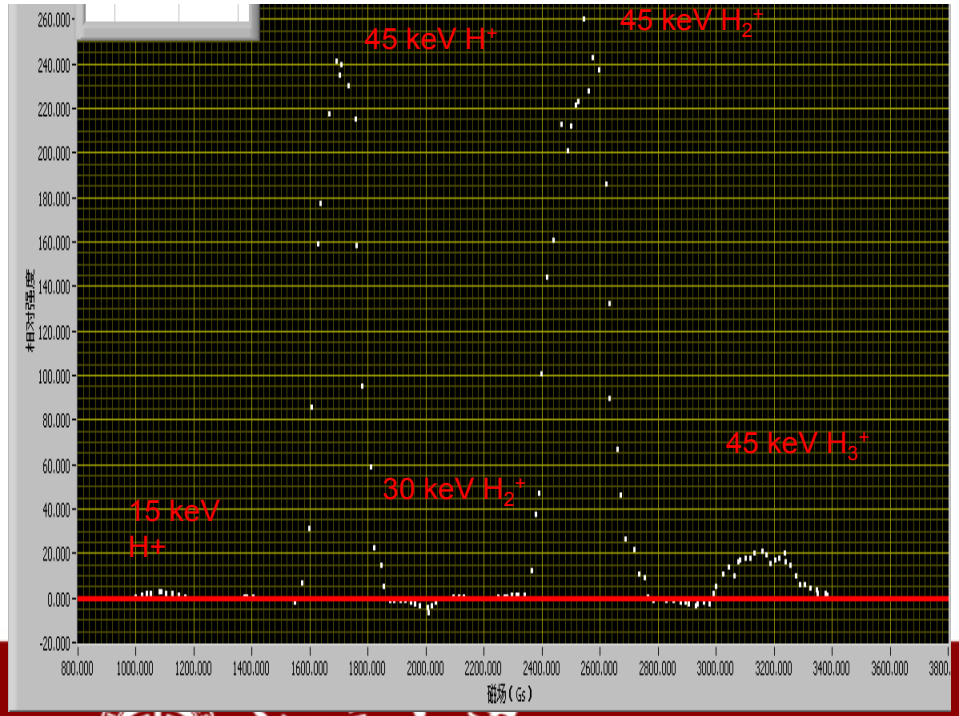
2) To produce Tens mA H_2^+ Beam with 2.45GHz PMECR

I_{total}: 85mA

H^+ 48%, **H_2^+ 47%,** H_3^+ 3.9%

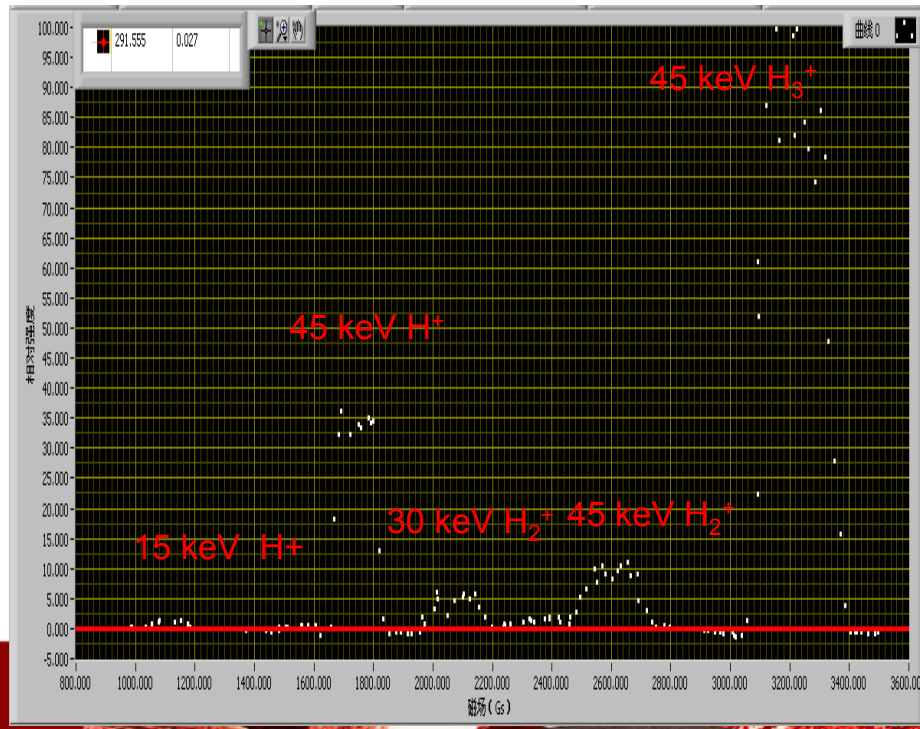
I_{H2+}:40mA



I_{Total}: 28mA

15 mA H_3^+ , 55%.

The highest factor of H_3^+ is 66%.



3) H⁻ BEAM Generated by a 2.45GHz Microwave-Driven Volume Source

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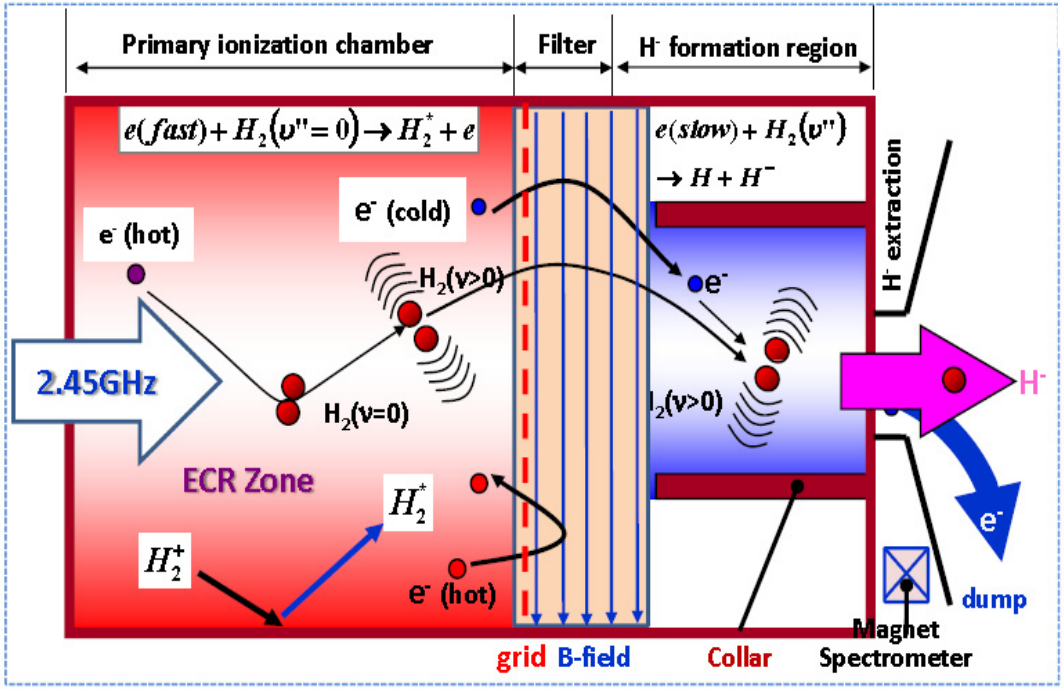
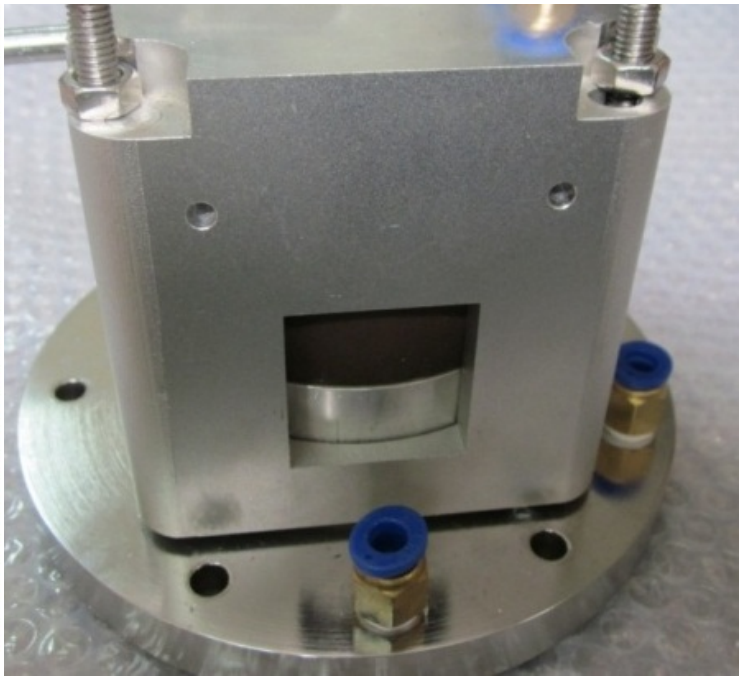
ECR Driven H⁻ Volume Source



Obtained: 15 mA

Required: 5mA



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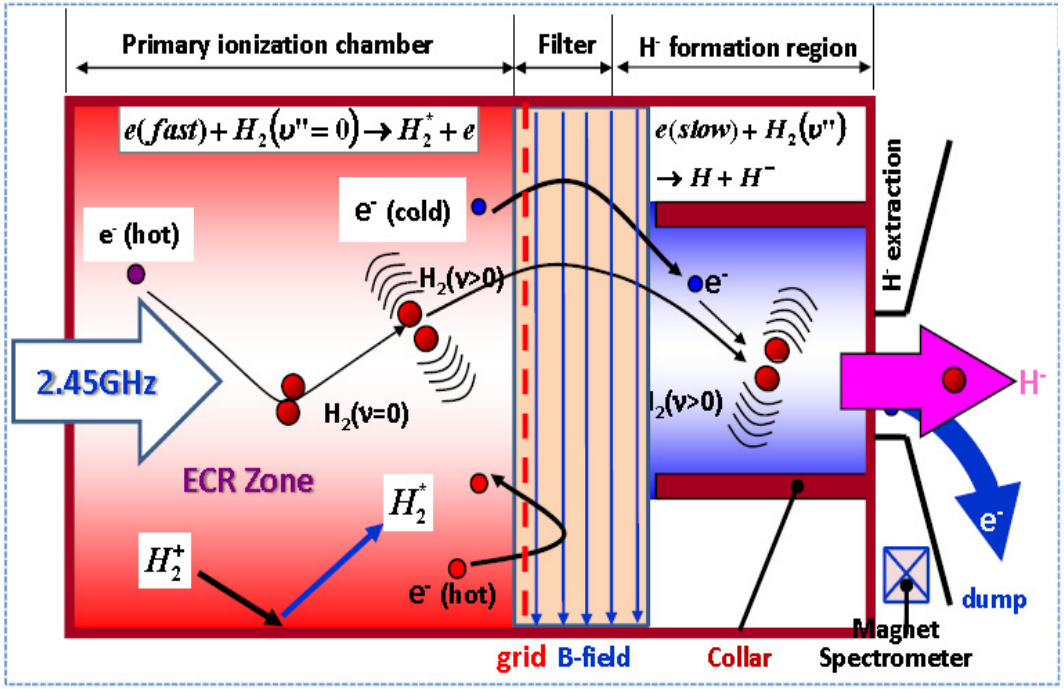

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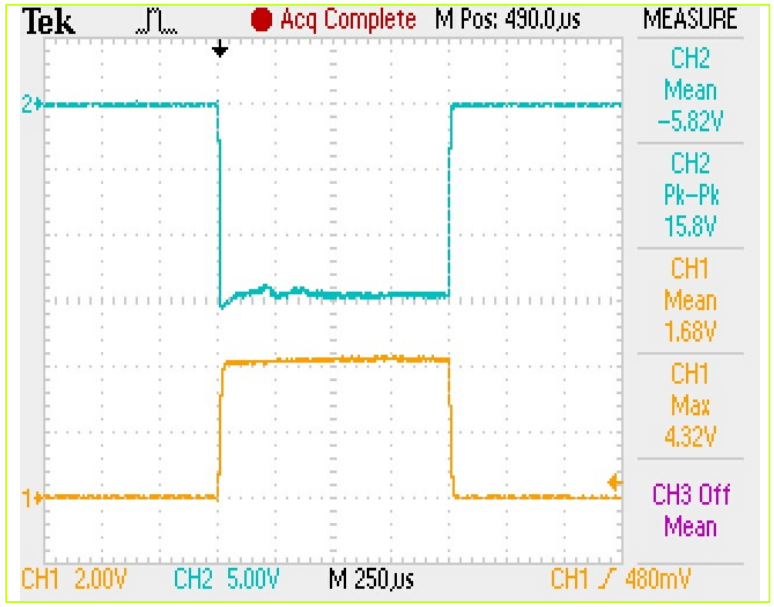
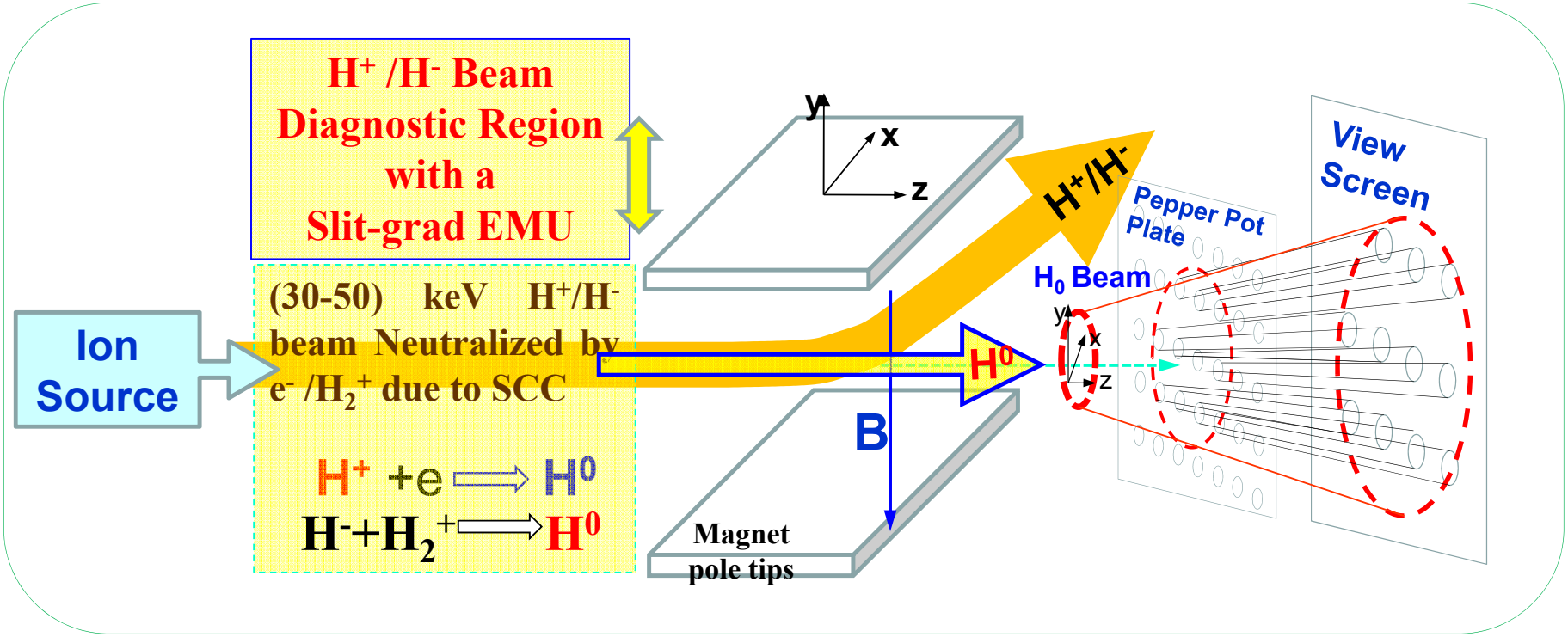


4) Non-intercepting Beam Diagnostic Device

using Neutral Beam Fluorescence Method



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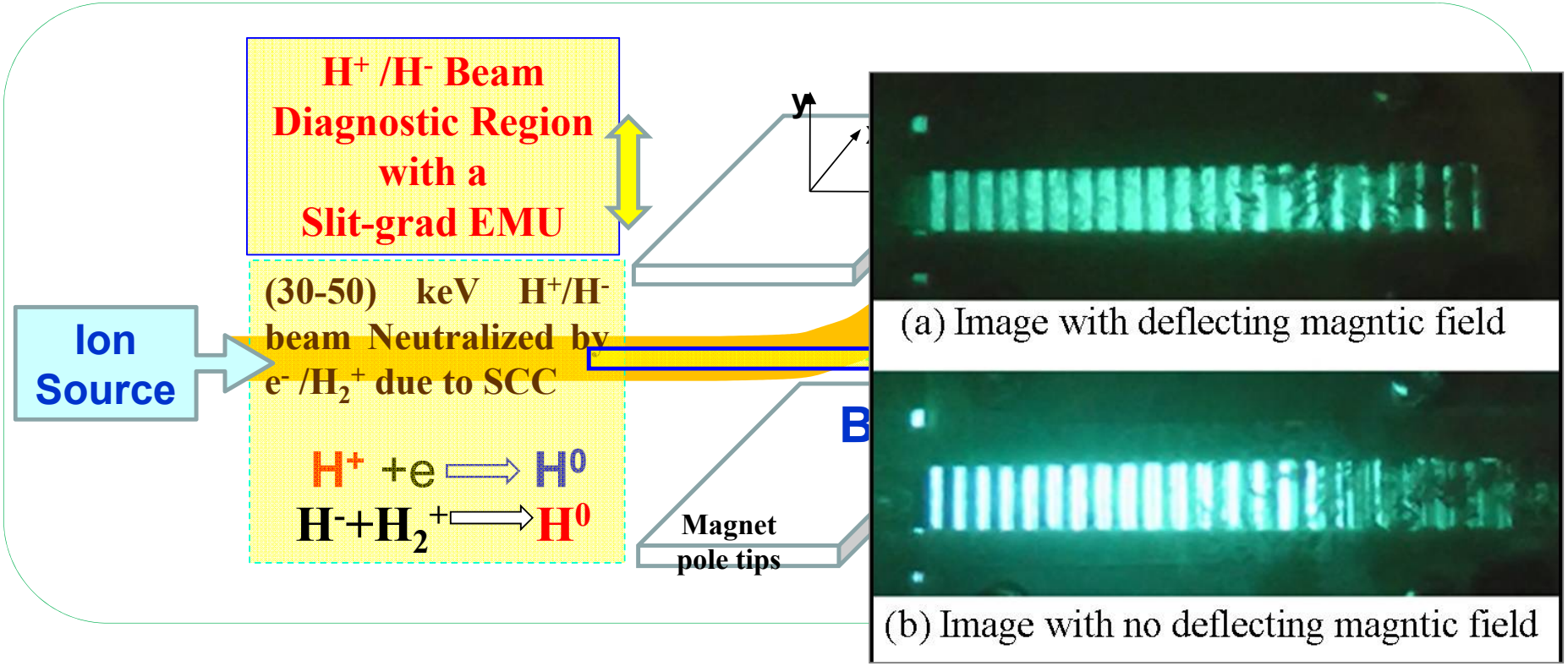

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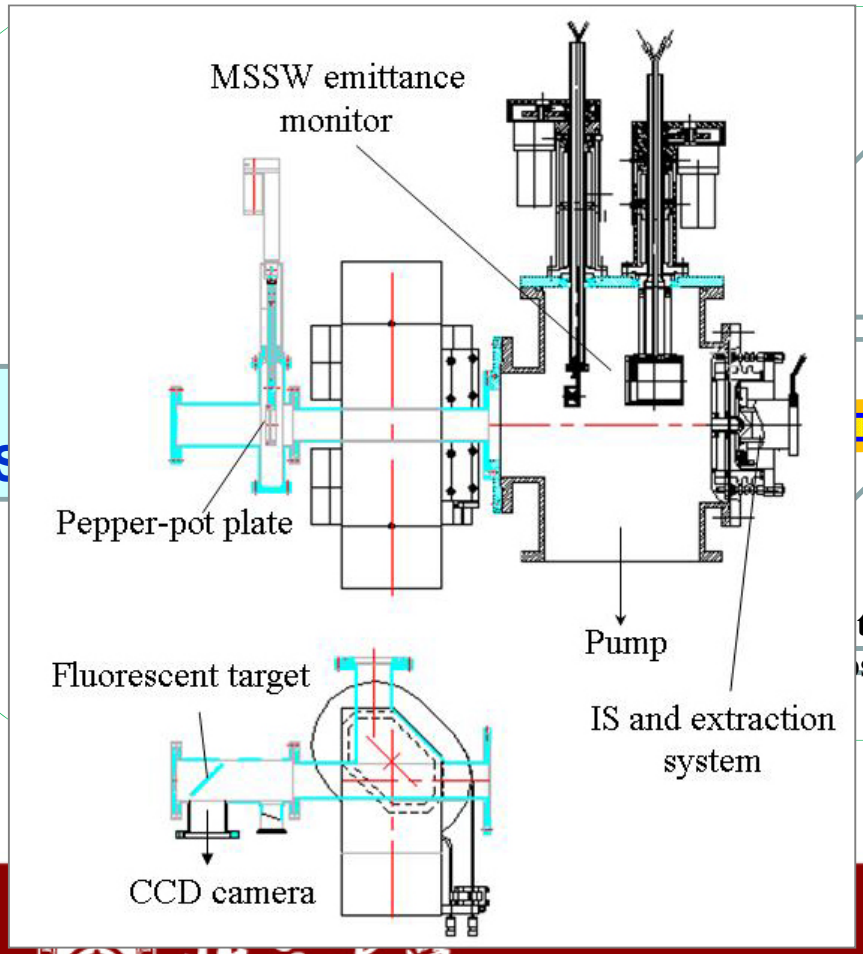

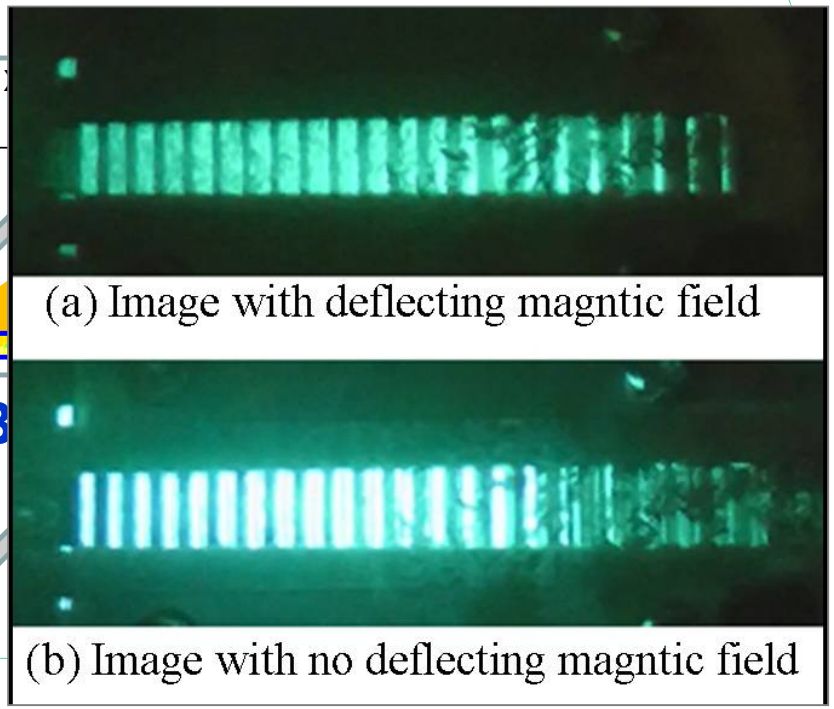

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1. System Requirement

To measure the **Beam Distribution** and **its Peak Beam Current**

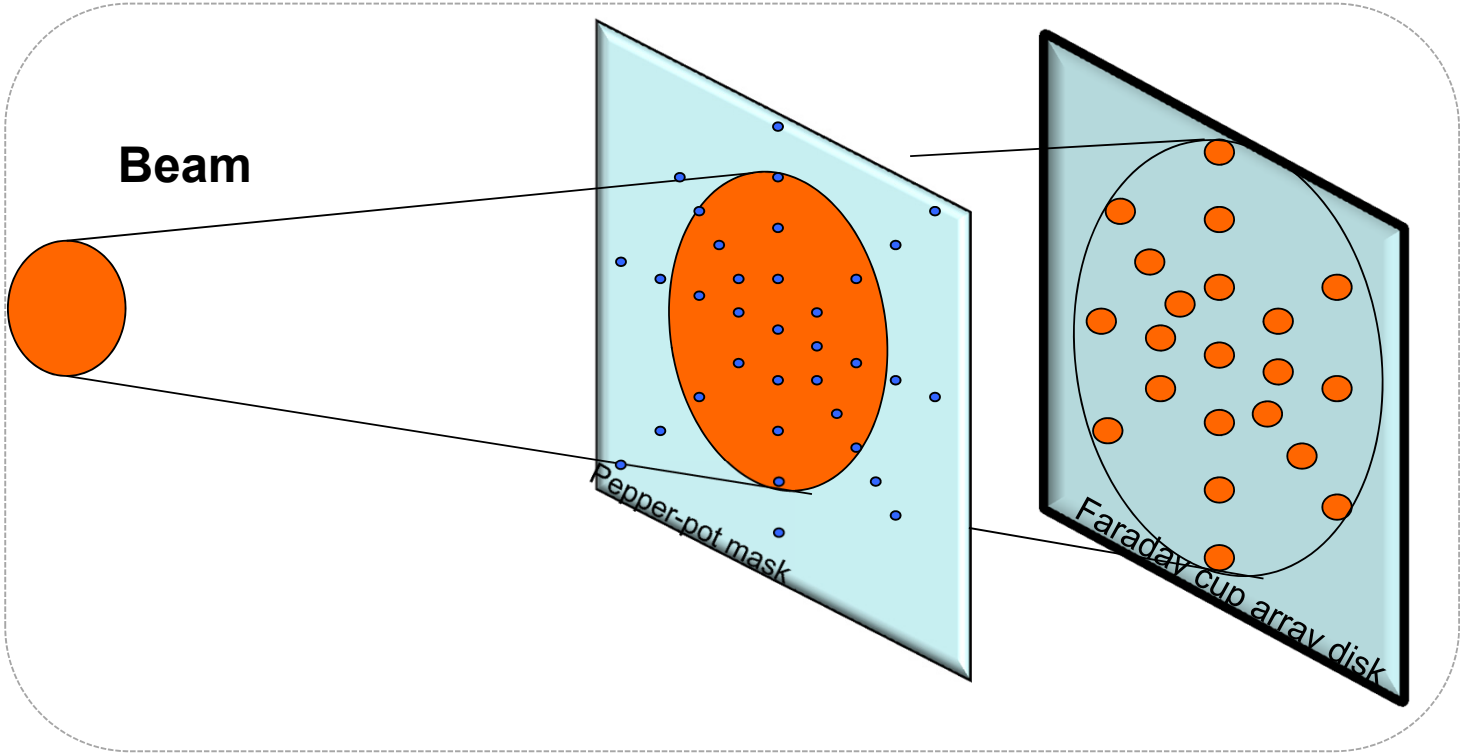
Parameters	Value
Beam energy	20~150 keV
Beam current	0.1~10 A
Beam size	< 30 mm
Time schedule	**Single shot**
Pulse length	**4 μs**

2. Design principle

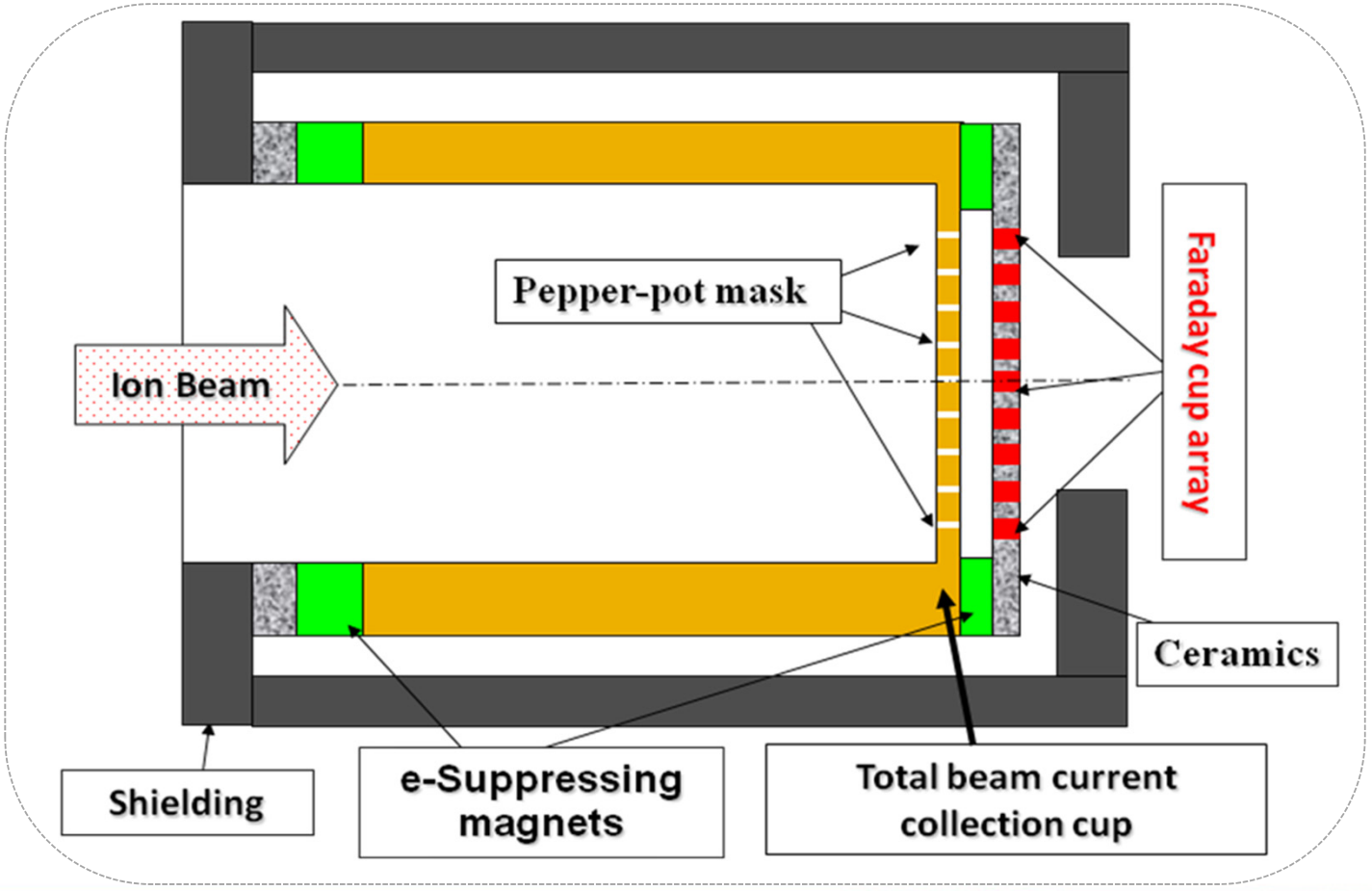
Facility	Current	Distribution	Single - Shot
Faraday Cup	√	×	√
ACCT/DCCT	√	×	√
Allison Scanner	×	√	×
Slit-grid	×	√	×
Pepper-pot device	×	√	√
???	√	√	√

Cost is another issue for this design.

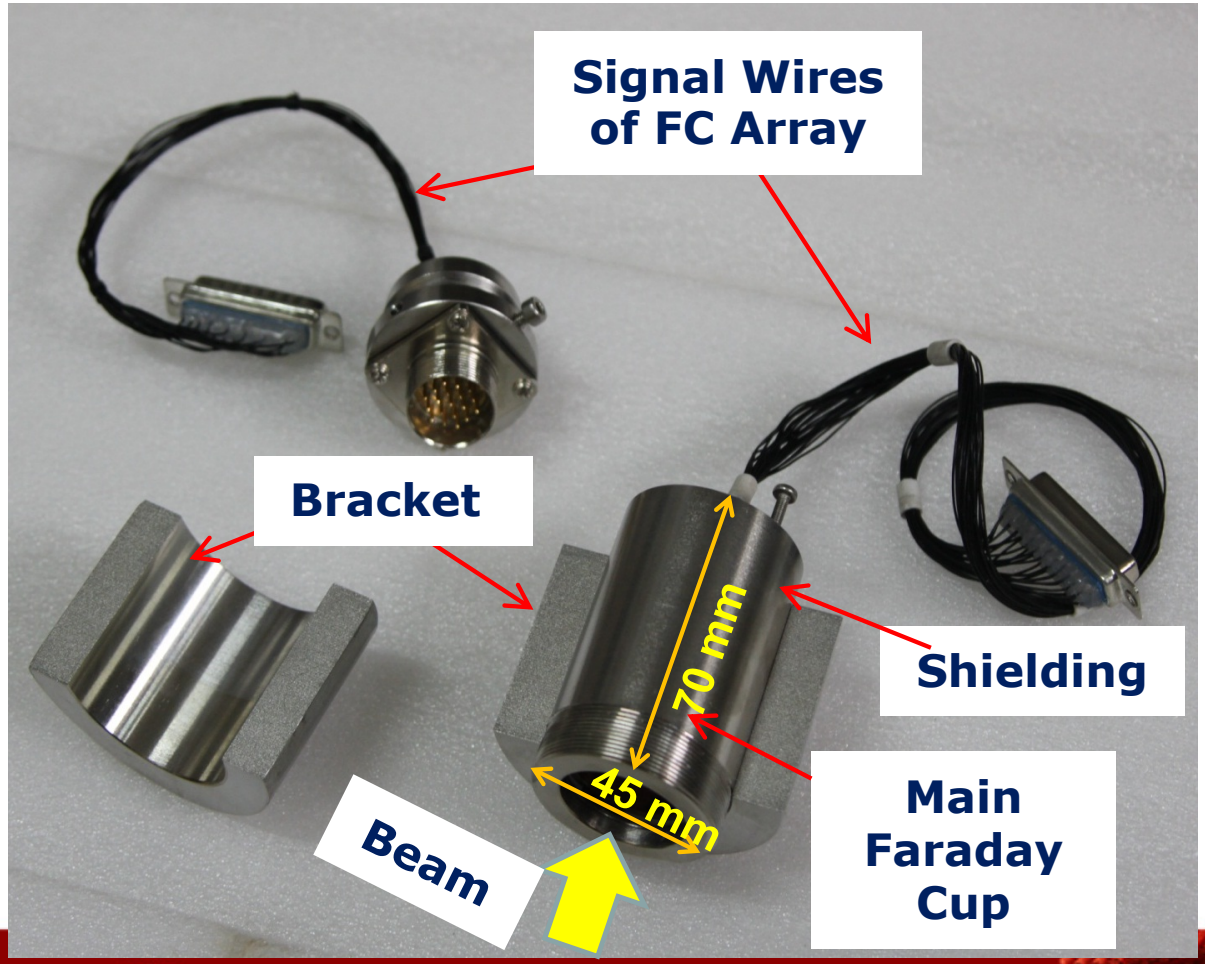
➢Solution: Pepper-pot principle coupled with Faraday Cup



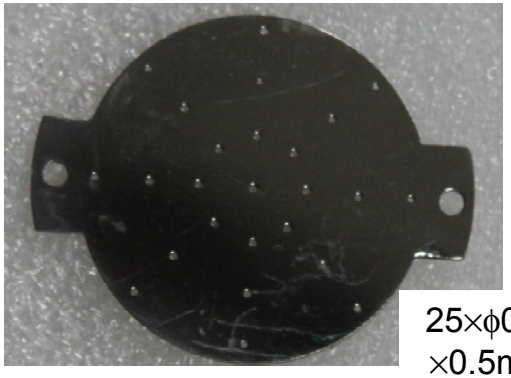
➢The cut view of this device



➢The components

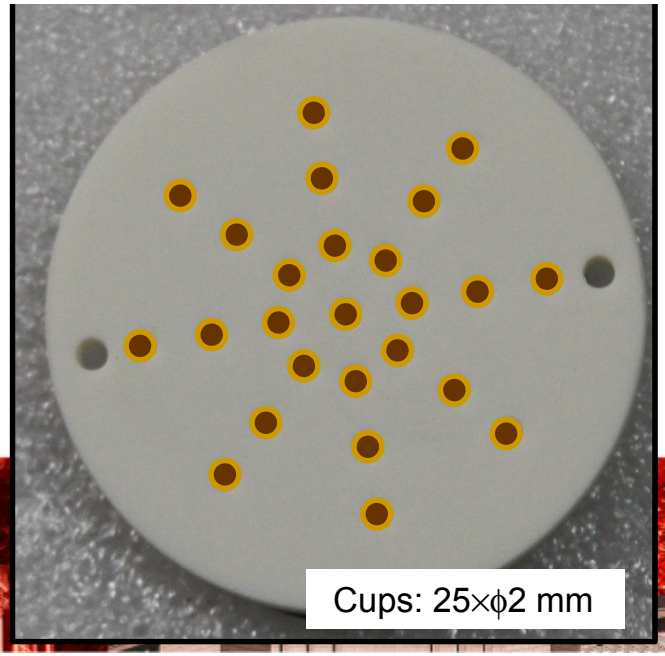


Pepper-pot mask(Mo)

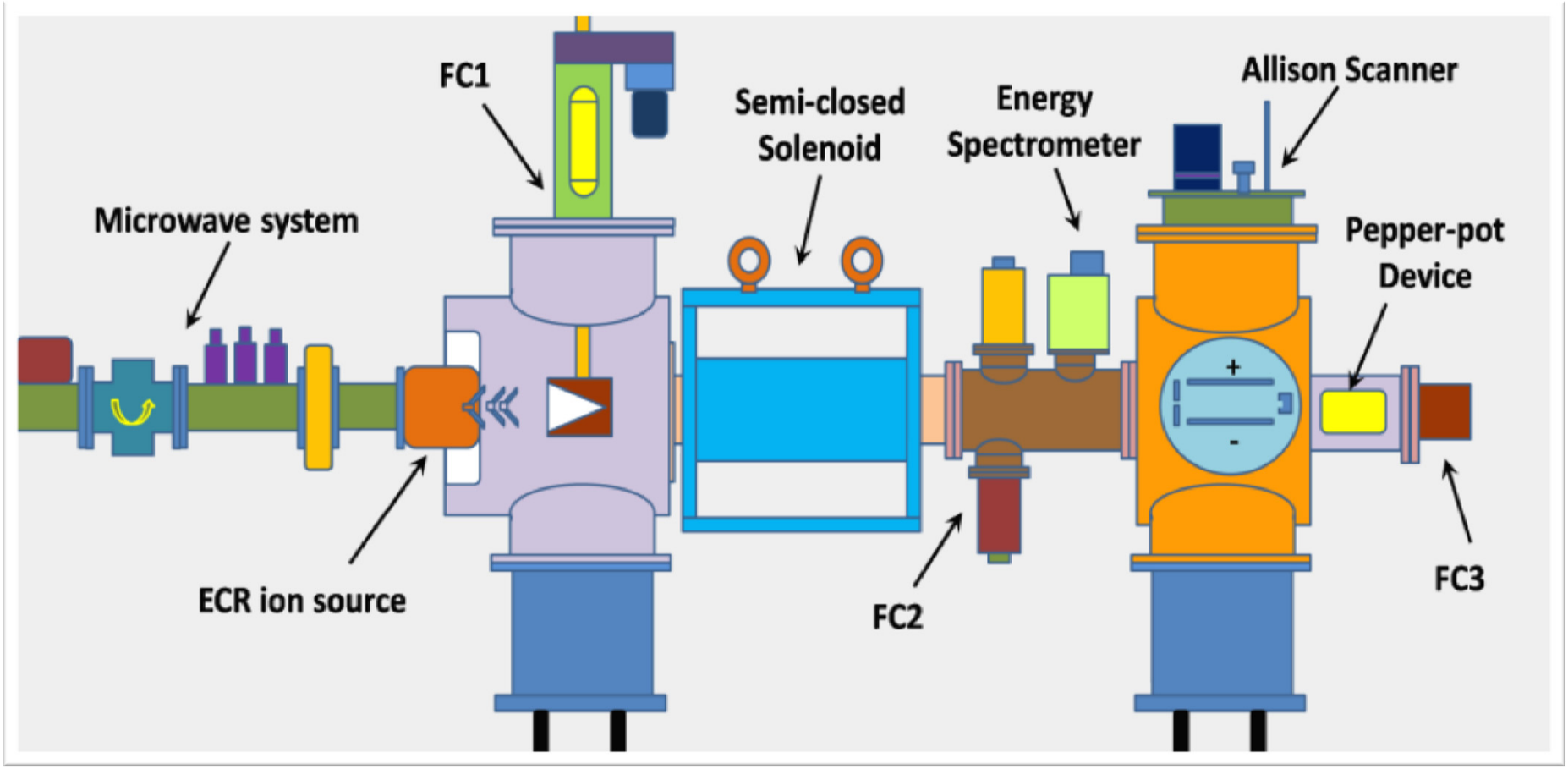


25×ϕ0.5mm ×0.5mm(H)

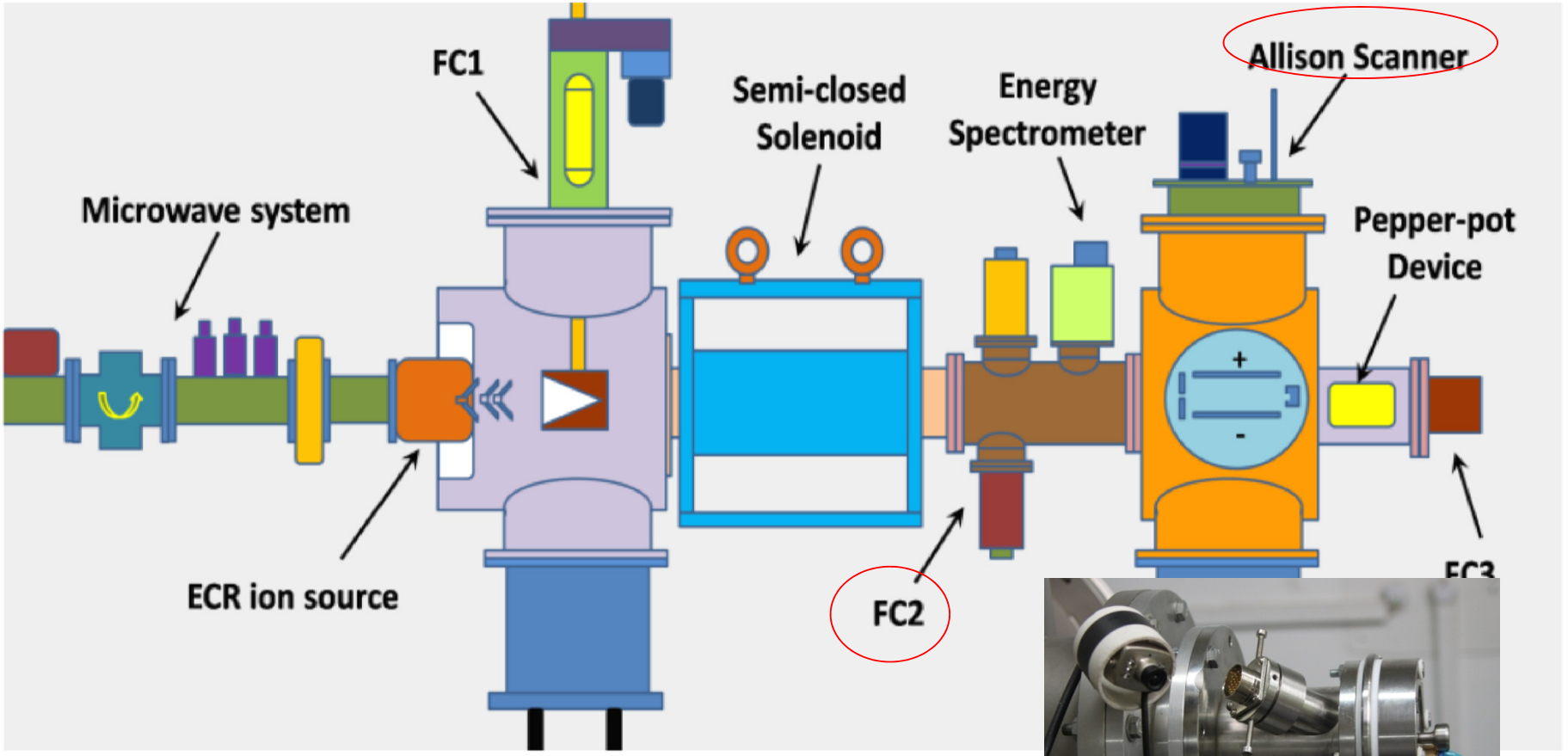
Faraday Array (Support: ceramic)



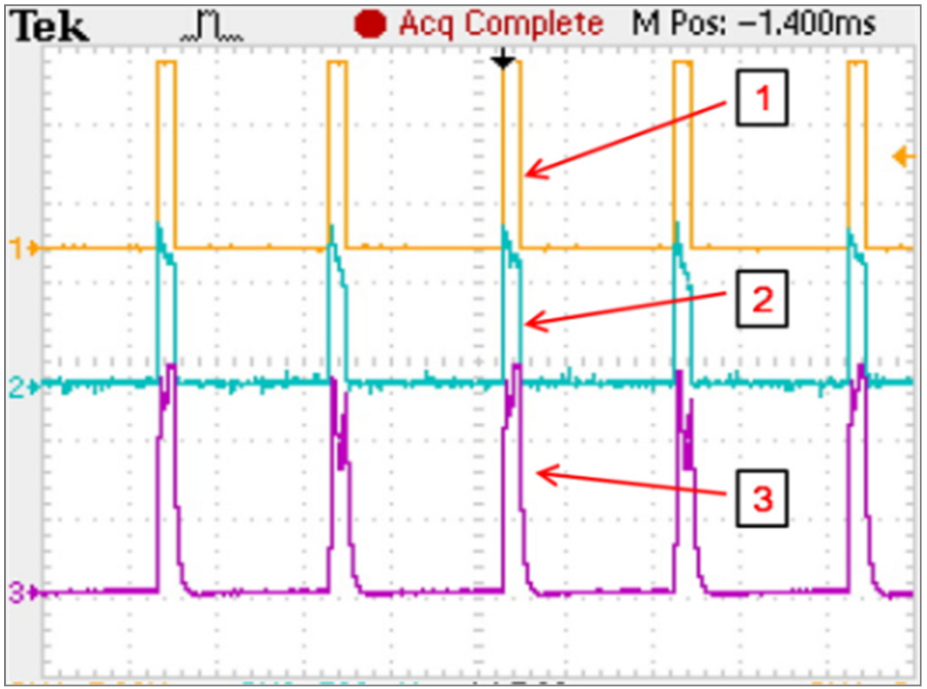
PKU LEBT Test Bench



PKU LEBT Test Bench

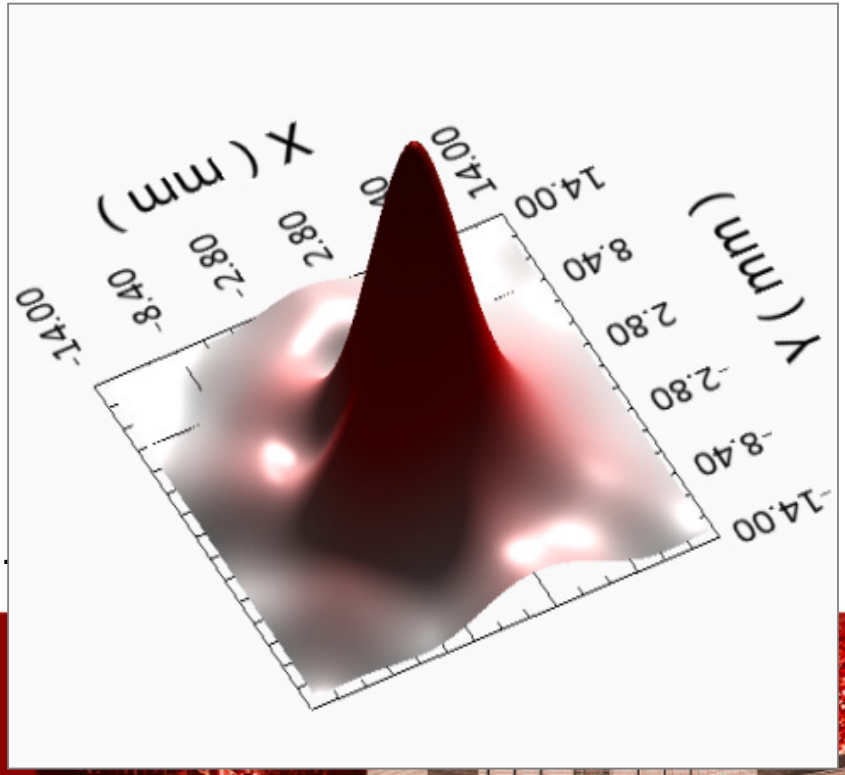


3. Experimental results



Testing beam

Pulsed H^+ ,100Hz@1ms
50keV@100mA

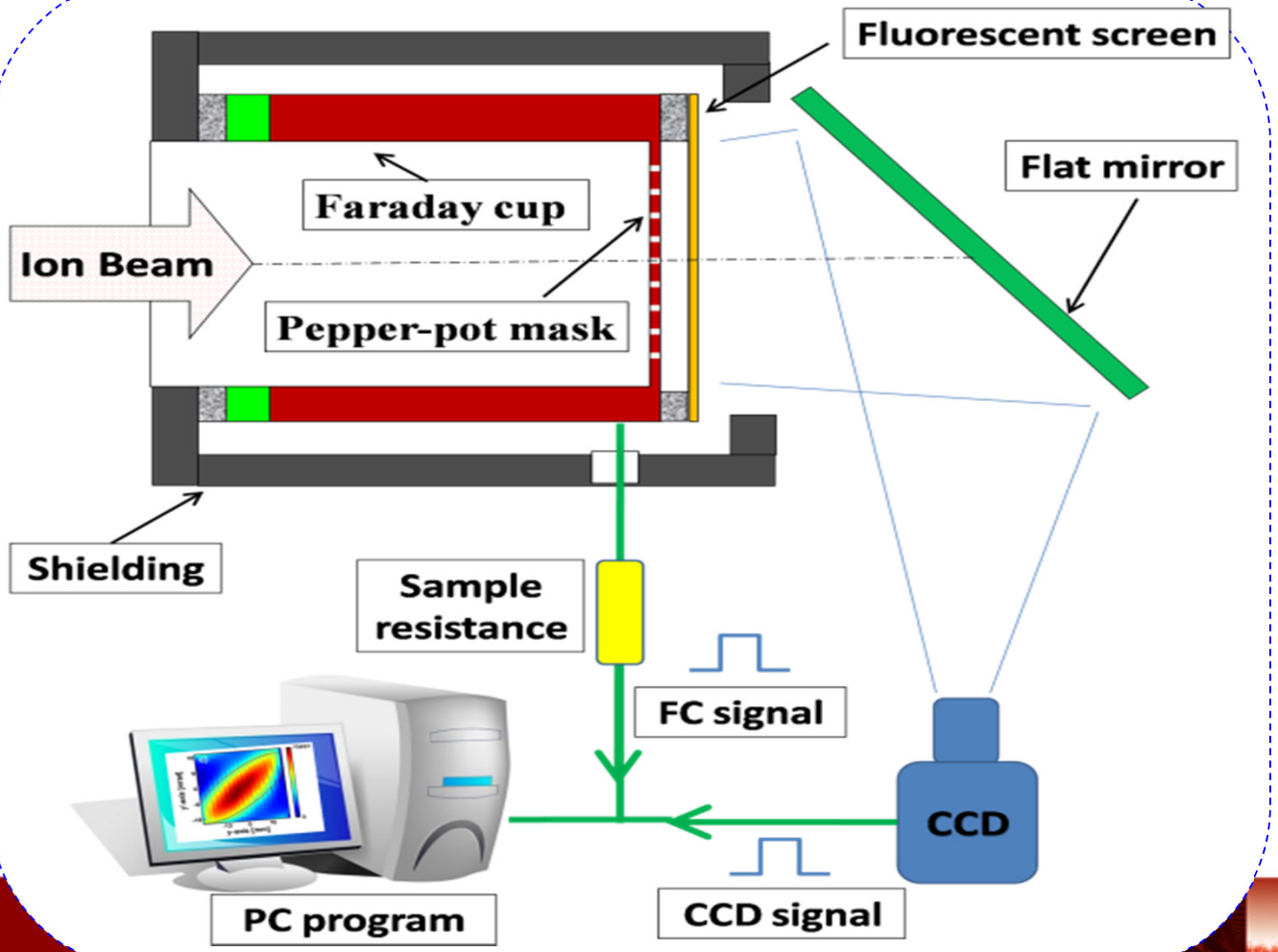


1.Trigger signal;
2. Main Faraday cup signal (~100 mA);
3. Signal of the central small Faraday cup (~15 uA).

4. Conclusion

1. This pepper-pot based device has the ability to measure the **total beam current** as well as the **beam distribution** for a single shot short pulsed beam.
2. This principle can be used to measure DC beam, any other single pulsed beam or multi-pulsed beam. Heat loading will be considered accordingly.
3. It will become a facility that is not only beam current, beam distribution measurement, but also provide **beam emmitance** through some improvement.

➢Improved Facility



a) Total Current
b) Beam distribution
c) Emmitance

Can be used to measure

Single-shot beam

Multi-pulsed beam

DC beam


Thank you for your attention!
感谢您的关注！