



^{39}Ar Enrichment System Based on a 2.45 GHz ECR Ion Source

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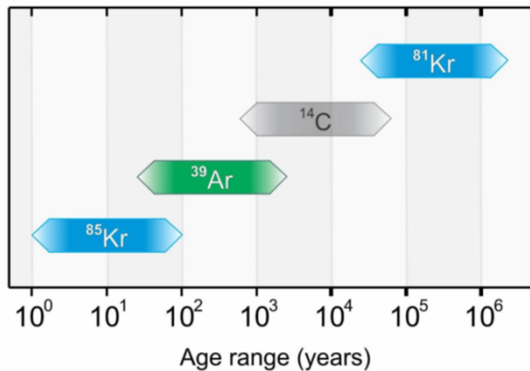
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OUTLINE

- Backgrounds
- Introduction of system design
- Enrichment results
- Outlook and Summary

Backgrounds

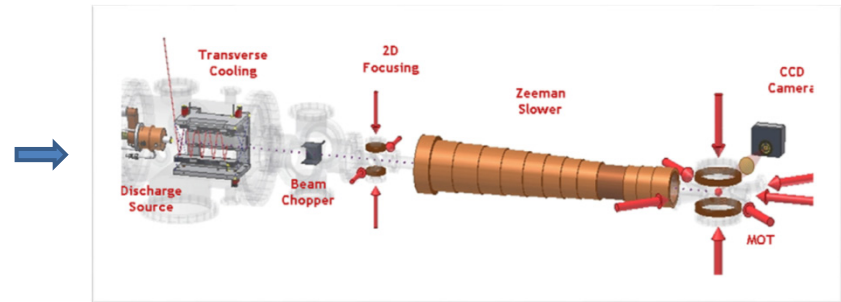


ATTA (Atom Trap Trace Analysis) is the most effective way to Ar measuring.

- Low counting rate (10 atoms/hr, Z.T- Lu's team, USTC)
- Long measuring time (at least 20 hours)
- Only 2 samples a week

	Source	Half-life	Abundance	Atoms/kg (ice)
³⁹ Ar	cosmic rays	269 y	8.0×10^{-16}	4,000

- ³⁹Ar: Ideal isotope for water or ice dating.
- 10 to 1000 years.



Solution:

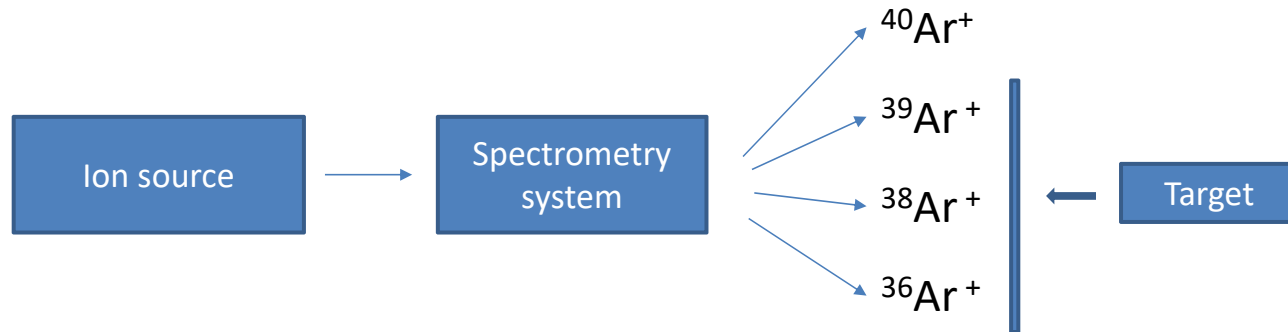
- Improve the ³⁹Ar's abundance

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System Development

□ Enrichment design



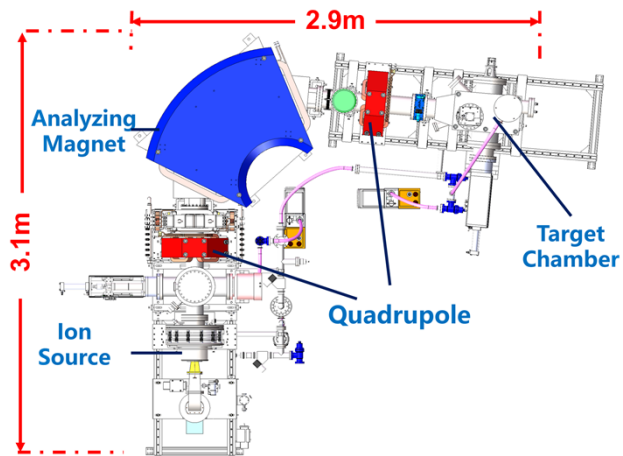
➤ Key points



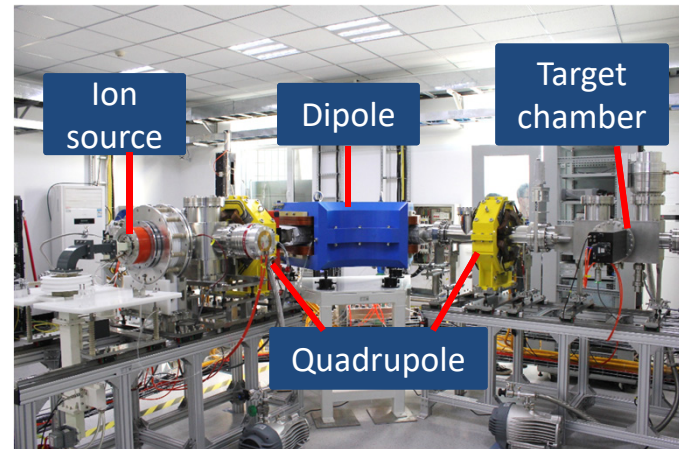
- Sufficient sample gas ionization
- High transmission efficiency
- Efficient Ar isotopes collection
- Avoiding sample memory

System Development

Layout and picture of platform



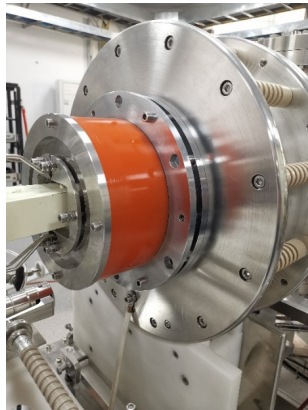
Layout of Enrichment system



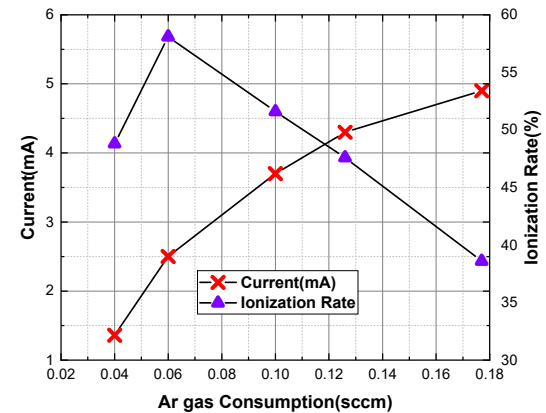
Picture of Enrichment system (V1)

System Development

□ 2.45 GHz ECR ion source



Ion Species	Ar ⁺
Maximum Current	>10 mA
Operation Model	DC
Ion Energy	40 keV
Beam stability	≤1%



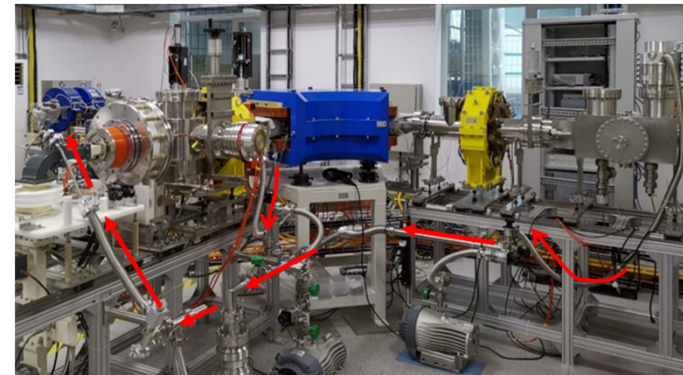
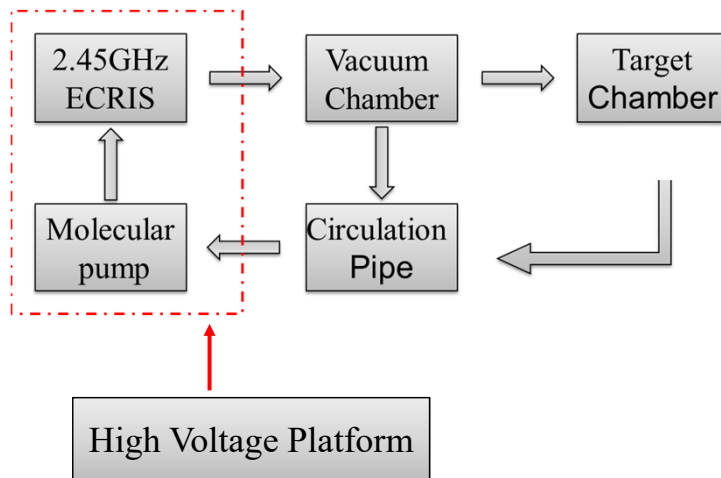
Ionization rate curve of ion source at different Ar gas consumption and beam current.

Methods For small samples (< 5 ml STP)

- Helium assisted
- Gas circulation

System Development

- Gas circulation system

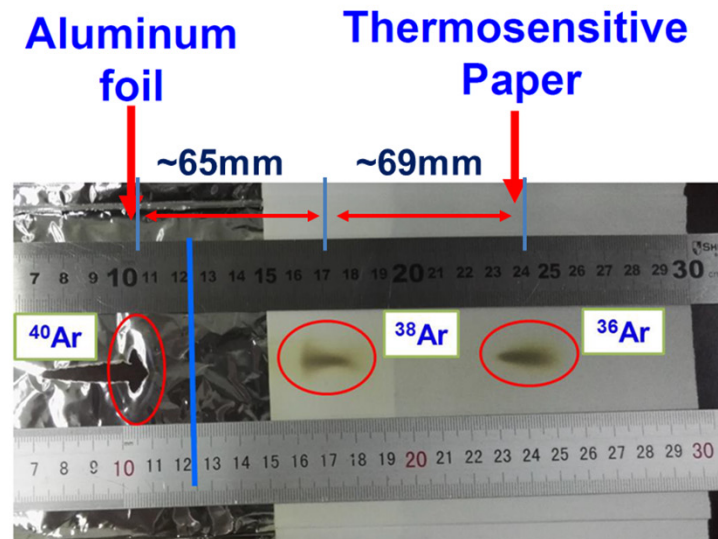
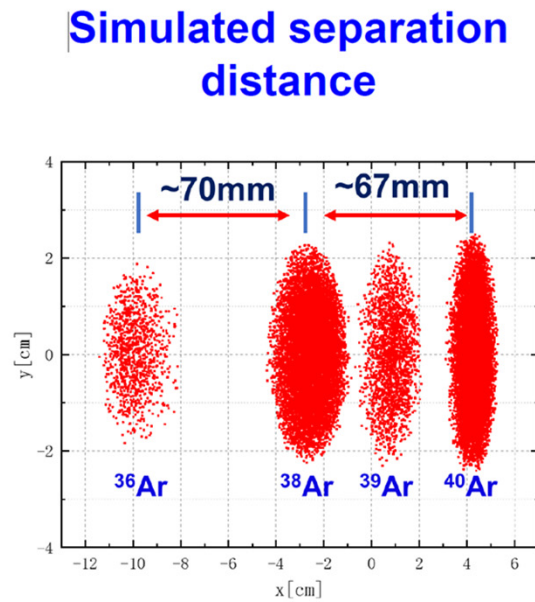


Picture of Enrichment system (V2)

- Ion source worked about 2 hours
- Vacuum pressure raised to 10^{-5} mbar (without NEG pump)

System Development

□ Test Experiment

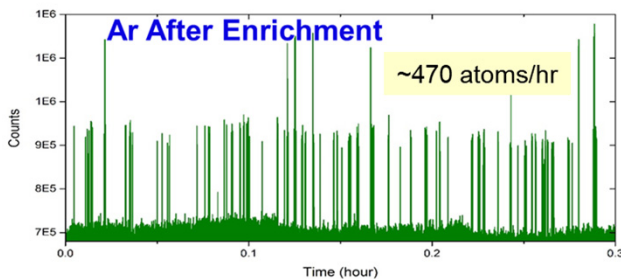
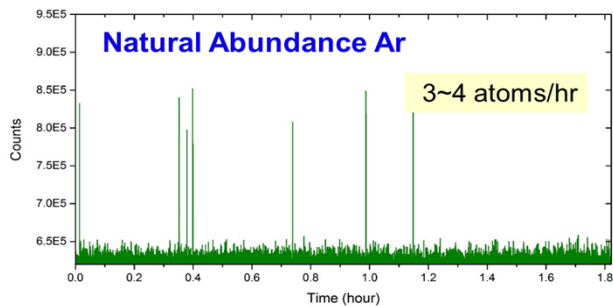


OUTLINE

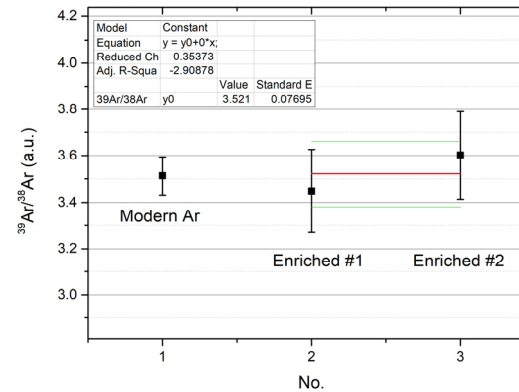
- Backgrounds
- Introduction of system design
- **Enrichment experiments**
- Next experiment plan

Enrichment experiments

- Enrichment factor check -- Constant gas flow (natural Ar gas)



- Dating information check -- Constant gas (5 ml STP, natural Ar gas)



Within ATTA's error range:

- Enrichment factor: > 100
- Dating information is well preserved.

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Outlook and Summary

□ Outlook

- The enrichment effect of smaller sample gas.
- Gas circulation with test samples
 - Whether sample memory is exist.
 - Appropriate gas volume for circulation.

□ Summary

- This system can improve ^{39}Ar 's abundance evidently.
- After ATTA check, Enriching process can preserve dating information well.



Thanks for your attention !