

Search for Supernova-produced ⁶⁰Fe in Antarctica

Tracing the Local Interstellar Cloud

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Astrophysical Motivation

Solar System entered Local Interstellar Cloud (LIC) 40 kyr ago^[1]

- **Origin of LIC**
- **Interstellar medium dynamics of supernova ejecta**

How: Highly time-resolved ⁶⁰Fe data before LIC entry

Radionuclide	Half-life	Origin
¹⁰ Be	1.4 Myr	Cosmogenic
²⁶ Al	0.7 Myr	Cosmogenic
⁴¹ Ca	0.1 Myr	Cosmogenic
⁵³ Mn	3.7 Myr	Cosmogenic
⁶⁰ Fe	2.6 Myr	Supernova

Cryo-Archive Antarctica

- 300 kg EDML ice core sample
- Continuous Flow Analysis (CFA) waste water
- **Age: 40 – 80 kyr BP**
- Depth: 1.3 – 1.9 km
- Kohnen station (75°S, 0°E)
- Accumulation rate: 44.5 mm/yr^[2]



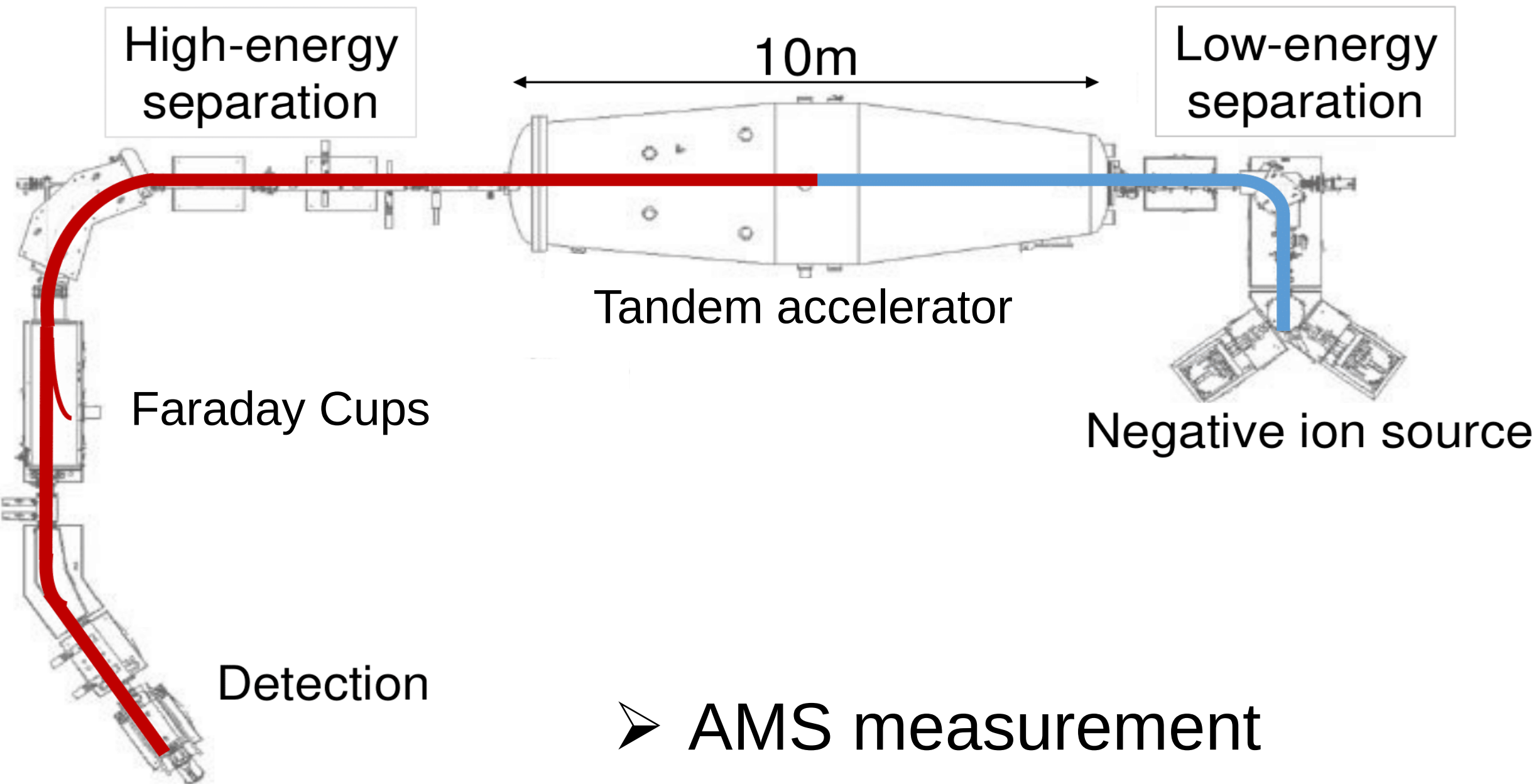
How To Count Single Atoms – Accelerator Mass Spectrometry



- Sample collection & treatment

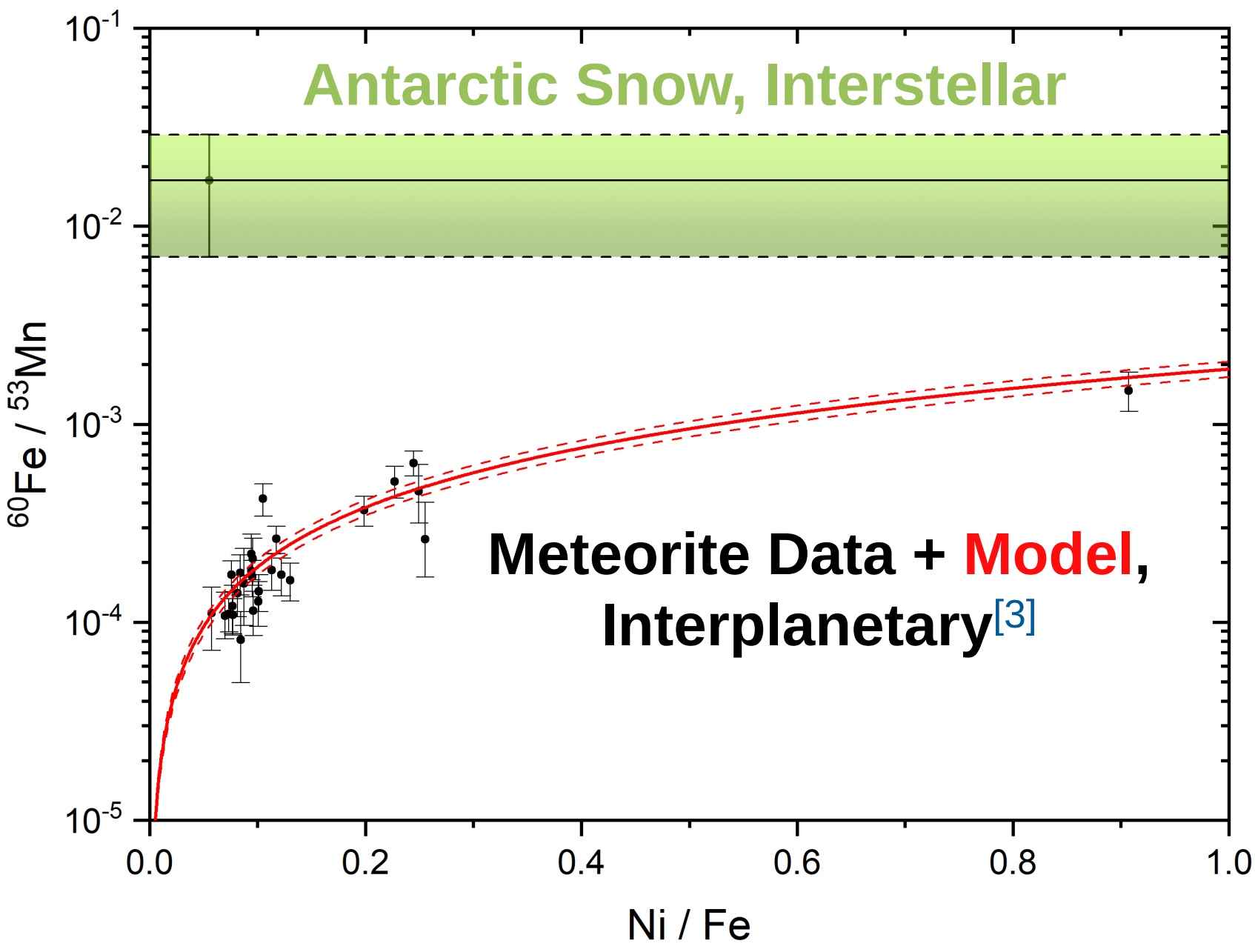


- Chemical isolation



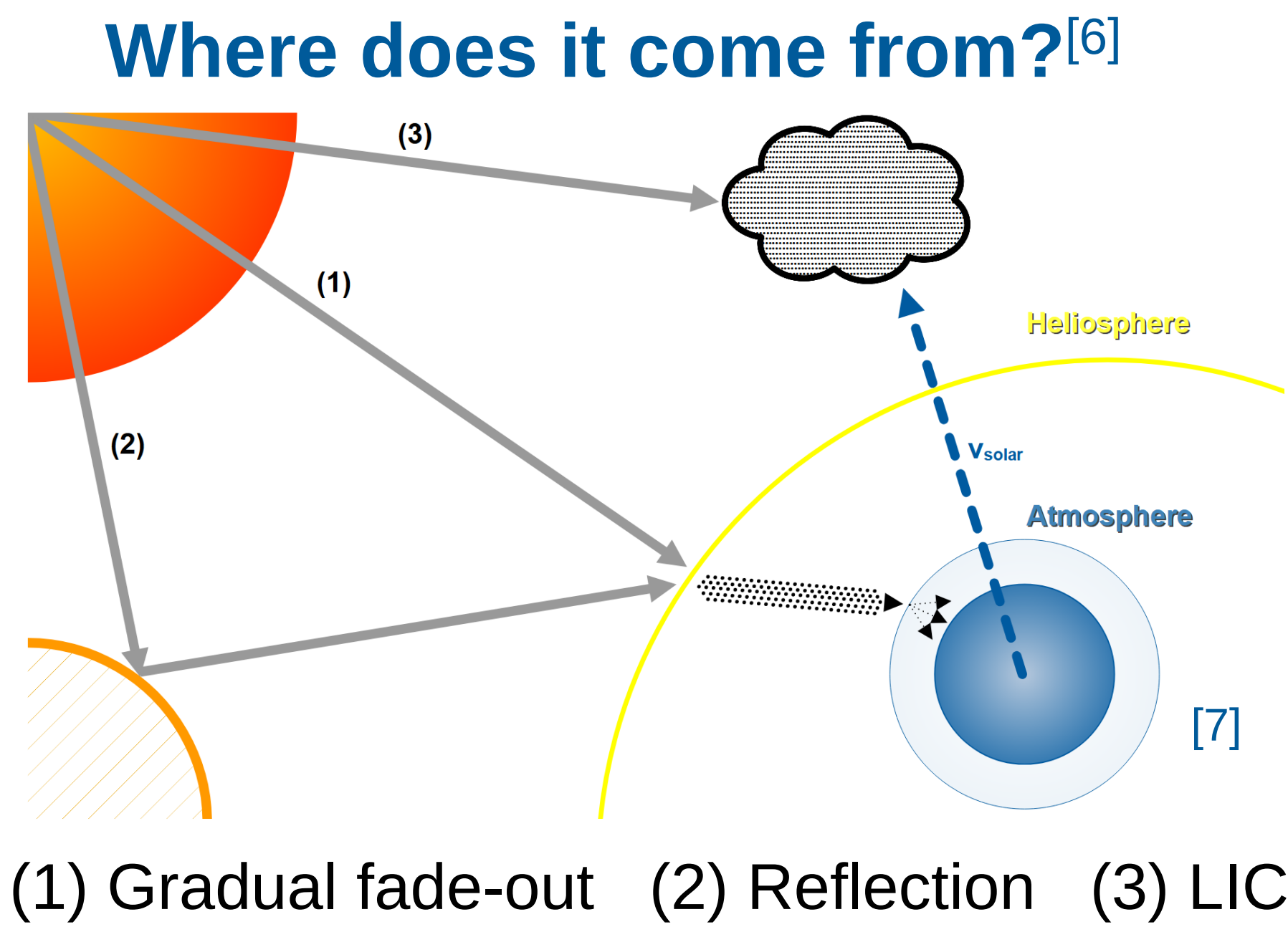
- AMS measurement

Interstellar Dust in Antarctic Snow

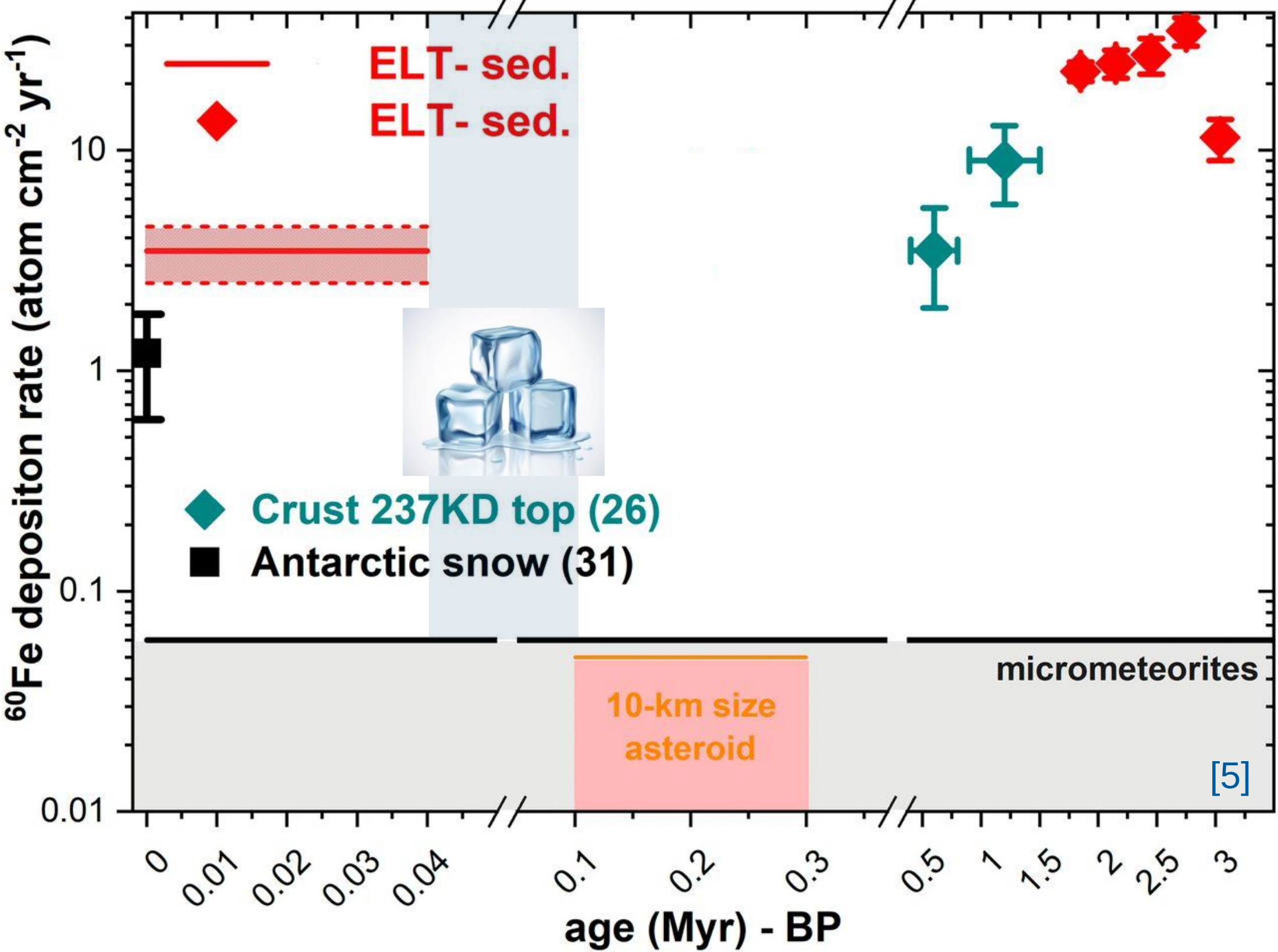


- Interplanetary contribution quantified by ⁶⁰Fe/⁵³Mn ratio^[3]
- Proof of a **present day ⁶⁰Fe deposition** on Earth of about 1.2 atoms/cm²/yr^[4]
- Confirmed & extended by deep sea sediment measurements till 33 kyr ago^[5]

Antarctic snow: Solar System inside Local Interstellar Cloud (< 40 kyr)



Preliminary Results in Antarctic Ice



- ²⁶Al/¹⁰Be: Perfectly agrees with data from Auer et. al.^[8] CFA water suitable sample, no loss of ⁶⁰Fe
- ⁴¹Ca: No dominant interplanetary or meteoritic contamination
- ⁵³Mn: Interplanetary ⁵³Mn detected
Global annual deposition of interplanetary dust deducible by ⁵³Mn/¹⁰Be

- **⁶⁰Fe**: **Interstellar ⁶⁰Fe detected**
Lower influx than in Antarctic snow

Antarctic ice: Solar System outside Local Interstellar Cloud (> 40 kyr)

References ¹Frisch et. al., ASTRA (2006), ²Ruth et. al., Climate of the Past 3 (2007), ³Koll et al., EPJ Web Conf. 260 (2022), ⁴Koll et al., Phys. Rev. Lett. 123 (2019), ⁵Wallner et al., P. Natl. Acad. Sci. 117.36 (2020), ⁶Koll et al., EPJ Web Conf. 232 (2020), ⁷Koll PhD Thesis (2024), ⁸Auer et. al., EPSL 287 (2009)

