



Contribution ID: 70 Contribution code: AAN-5

Type: Oral Presentation

Search for Interstellar ^{60}Fe , ^{244}Pu and ^{247}Cm in a Pacific Ferromanganese Crust

Tuesday, 22 October 2024 11:00 (20 minutes)

The radionuclide ^{60}Fe ($t_{1/2} = 2.6$ Myr) is a tracer for recent nucleosynthesis in massive stars and core-collapse supernovae, whereas the longer-lived radionuclide ^{244}Pu ($t_{1/2} = 81$ Myr) is synthesized in the astrophysical r-process. The nucleosynthesis site of the r-process is heavily debated in the astrophysics community with rare supernovae and neutron star mergers being the prime candidate sites.

In contrast to freshly synthesised ^{60}Fe , ^{244}Pu , due to its much longer half-life, could accumulate in the interstellar medium over geological timescales. A time-resolved profile of ^{60}Fe and ^{244}Pu abundances would provide important information about the site of the r-process and interstellar medium dynamics. The r-process nuclide ^{247}Cm ($t_{1/2} = 15.6$ Myr) with a shorter half-life than ^{244}Pu could additionally serve as an independent clock for r-process nucleosynthesis in the galaxy when compared to ^{244}Pu .

The search for ^{60}Fe and ^{244}Pu on Earth with AMS resulted in the discovery of both interstellar radionuclides. Two distinct global influxes of interstellar ^{60}Fe around 2.4 Myr [e.g. 1,2] and 7 Myr ago [e.g. 2,4] into marine archives, a recent ^{60}Fe influx into Antarctic snow [3] as well as a corresponding influx of interstellar ^{244}Pu into a marine ferromanganese crust [4] were reported. The time-resolution of the ^{244}Pu profile was so far insufficient to fully relate the influx characteristics of ^{244}Pu to that of ^{60}Fe . Up to now, no interstellar ^{247}Cm has been detected on Earth.

In this contribution, we report on a new time-profile of ^{60}Fe and ^{244}Pu in a Pacific ferromanganese crust. The acquired ^{60}Fe profile shows two pronounced peaks of ^{60}Fe influxes with improved timing. A continuous r-process ^{244}Pu influx was discovered with a time-resolution of 1 Myr over the last 10 Myr owing to the extraordinarily high total efficiency of Pu AMS of 1% achieved in this project. Recent work on detecting interstellar ^{247}Cm in the same archive will be presented.

[1] Knie et. al., Phys. Rev. Lett. 93 (2004).

[2] Wallner et al., Nature 532 (2016).

[3] Koll et al., Phys. Rev. Lett. 123 (2019).

[4] Wallner et al., Science 372 (2021).

Student Submission

No

Primary author: KOLL, Dominik (The Australian National University & TU Dresden & Helmholtz-Zentrum Dresden-Rossendorf)

Co-authors: WALLNER, Anton (Helmholtz-Zentrum Dresden-Rossendorf); HOTCHKIS, Michael (Australian Nuclear Science and Technology Organisation); FICHTER, Sebastian (Helmholtz-Zentrum Dresden-Rossendorf); FIELD, L. Keith (The Australian National University); FROELICH, Michaela B. (The Australian National University); PAVETICH, Stefan (The Australian National University); SLAVKOVSKA, Zuzana (The Australian National University); TIMS, Stephen G. (The Australian National University)

Presenter: KOLL, Dominik (The Australian National University & TU Dresden & Helmholtz-Zentrum Dresden-Rossendorf)

Session Classification: Applications in Astrophysics and Nuclear Sciences

Track Classification: Applications in Astrophysics and Nuclear Sciences