Measurement of Nuclear Fragmentation Cross Sections with NA61/SHINE for a better understanding of the Propagation of Cosmic-Ray Nuclei in the Galaxy

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International Cosmic Ray Conference, Berlin
12th-23rd July, 2021

Physics Case:

Cosmic ray propagation in the galaxy

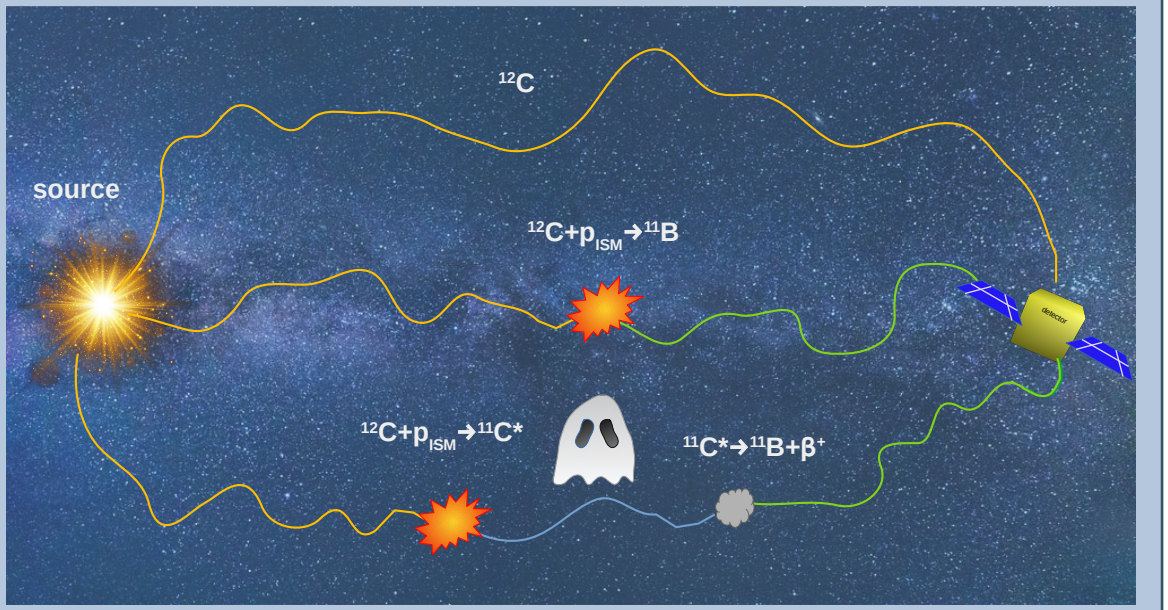
Ghost in Space:

- Short lived secondary nuclei for e.g. secondary ^{11}C – decays to ^{11}B (^{11}C lifetime ≈ 20 minutes)
- Important for total B production

Propagation Models:

Key Inputs:

1) secondary-to-primary flux ratio (precise measurements)
2) nuclear fragmentation cross sections (large uncertainty on current values)

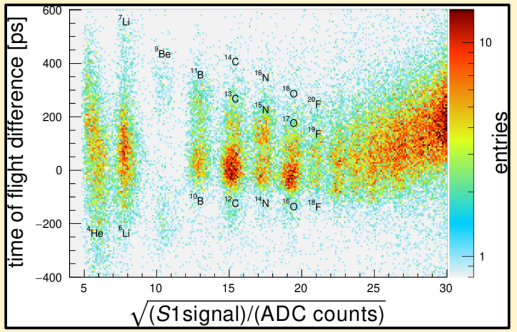


inspired by N.Tomasetti, CRATER 2018

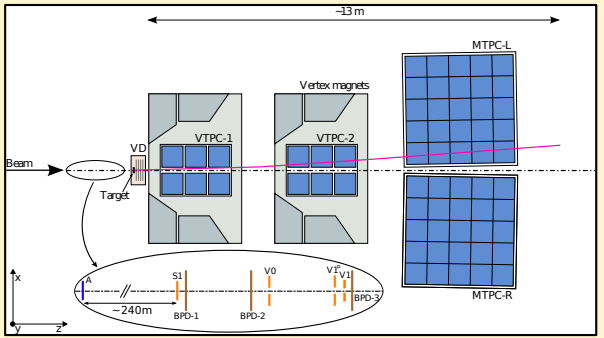
Need for precision laboratory measurements of nuclear fragmentation cross sections!

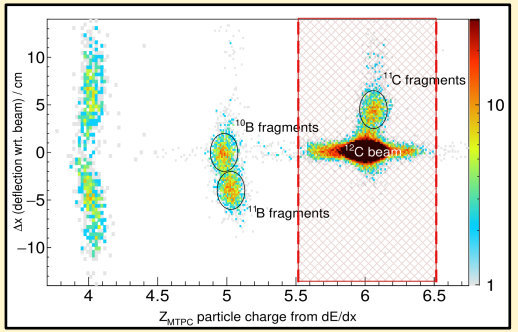
New data from NA61/SHINE!

NA61/SHINE 2018 Pilot Run on Nuclear Fragmentation:

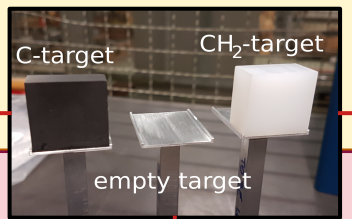


Secondary ion beam composition emerging from H2 beam line, at NA61/SHINE

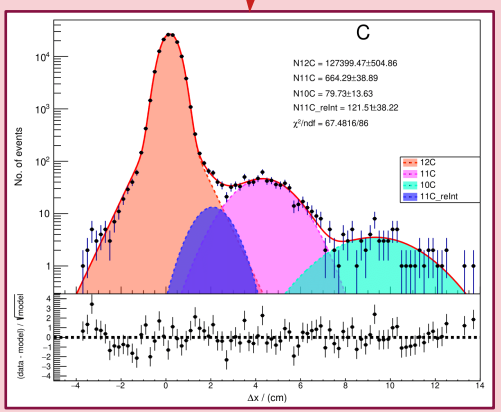


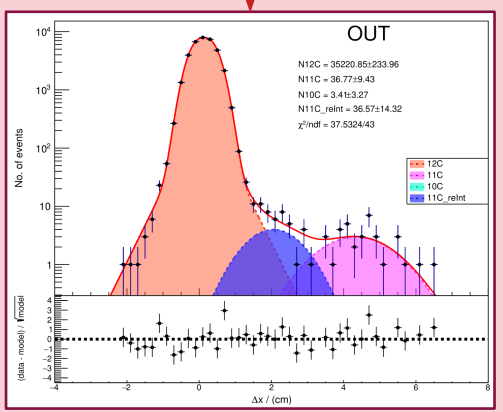


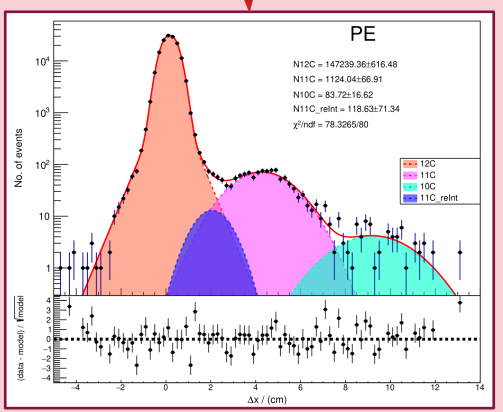
Resultant fragments separated by dE/dx in the main detector



Carbon isotopes distribution

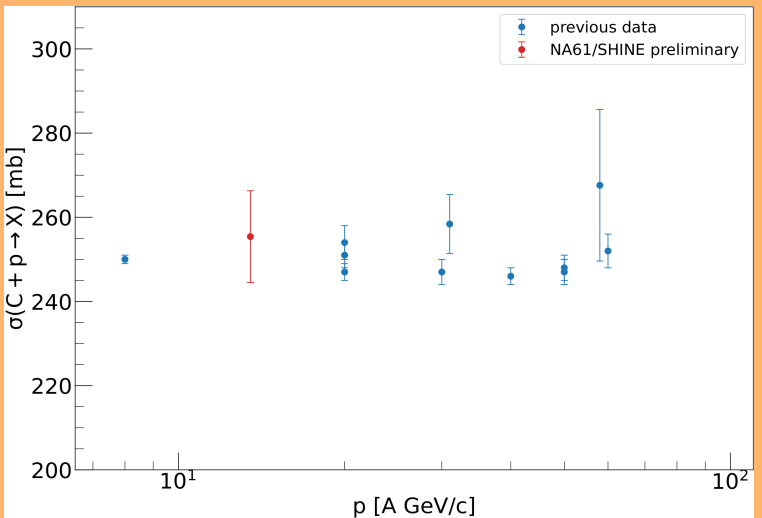




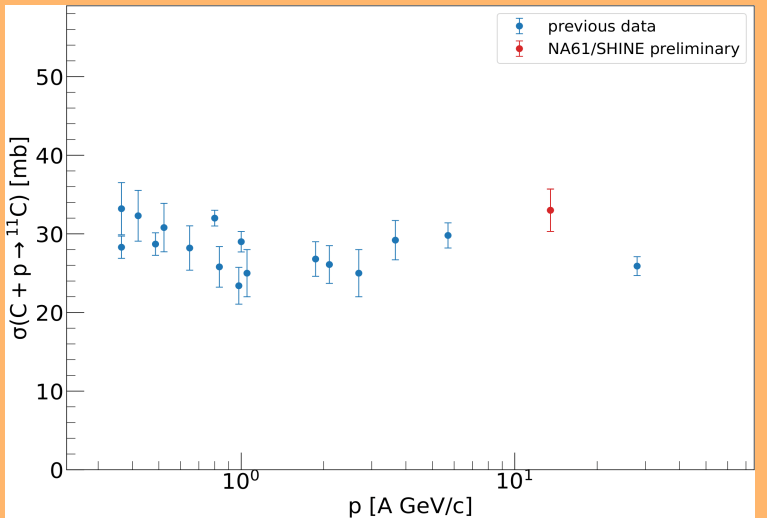


Preliminary results from 2018 Pilot run:

Carbon mass-changing cross section: $^{12}C + p \rightarrow X$



Carbon-11 production cross section: $^{12}C + p \rightarrow ^{11}C$



Outlook:

- Preliminary measurements are in good agreement with previous data sets.
- Dedicated data taking with higher statistics planned for 2022.