Cosmic ray Astrophysics with AMS-02

On behalf of AMS-02 Collaboration

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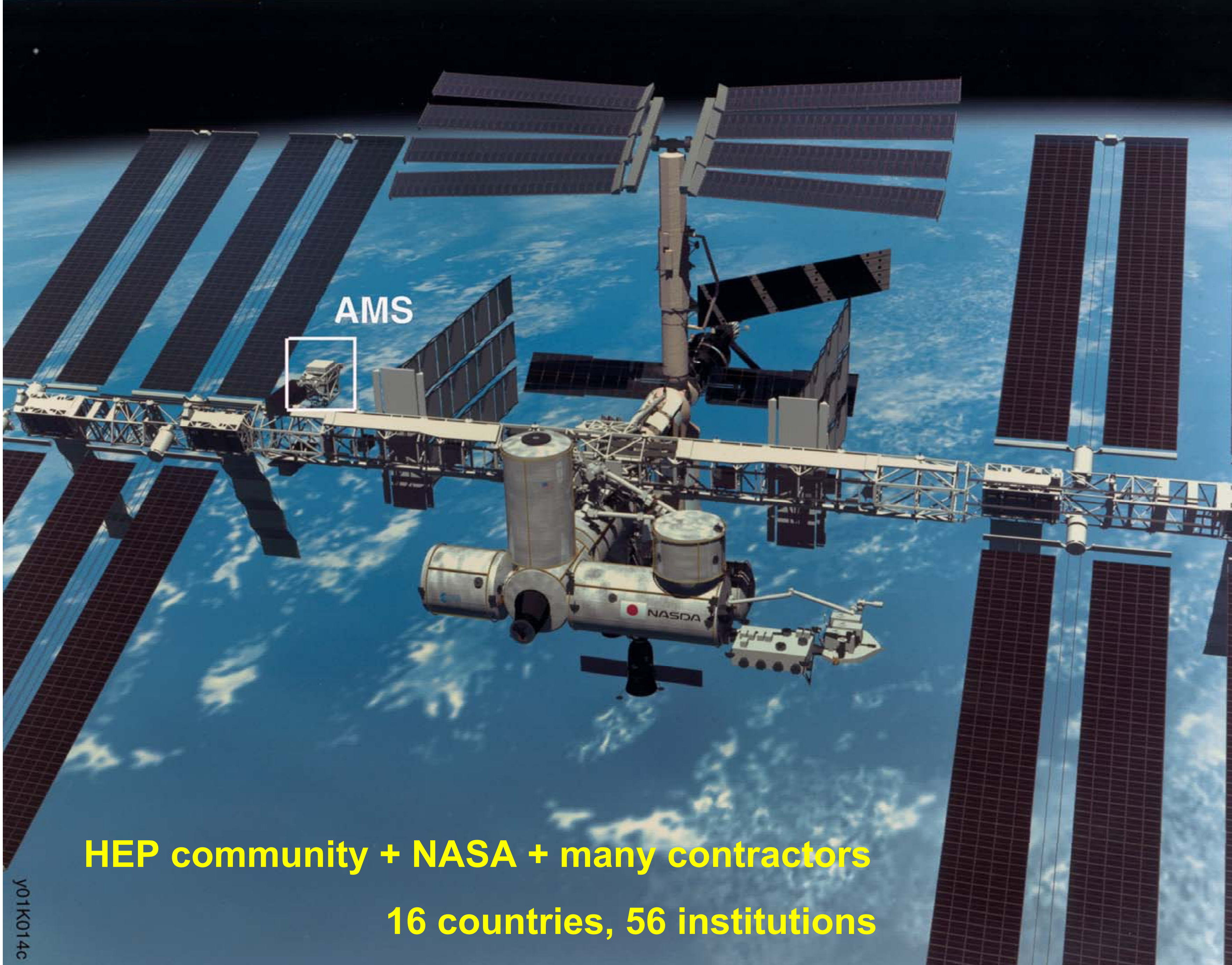
ICRC2005, Pune, India


AMS
NASDA
HEP community + NASA + many contractors
16 countries, 56 institutions
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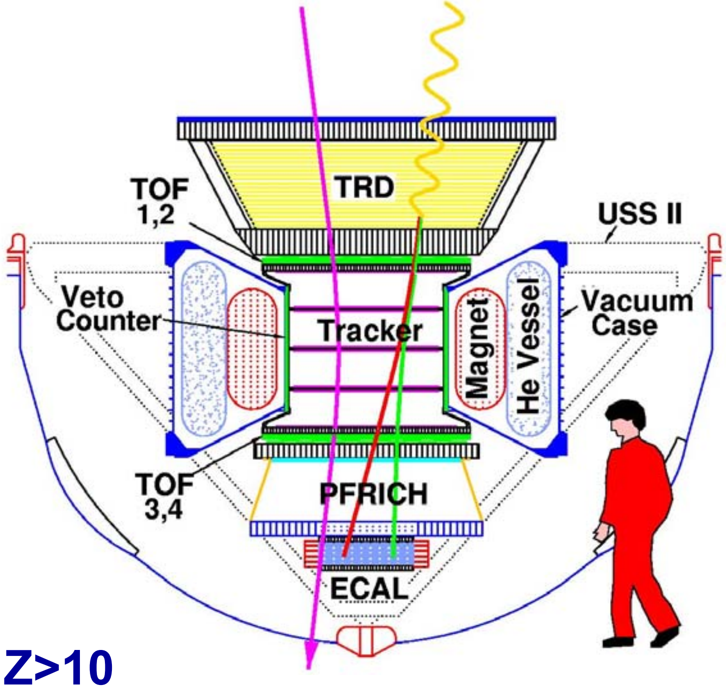
AMS-02 spectrometer



- **Acceptance for charged CR**: **0.5 m^2sr**
- **Exposure: at least 3 years** (from 2008)
- **Charge:**

  Z determination up to Z = 26

  charge confusion < 10^{-7} @ Z=1 & < 10% @ Z>10
- **Rigidity (R=p/Z):**
  σ(R)/R = 1.5% @ 10 GV, Max Detectable Rigidity > 2-3 TV
- **Velocity** (β):
  TOF: σ(β)/β = 3.5% (protons)
  RICH: σ(β)/β = 0.1% (protons)

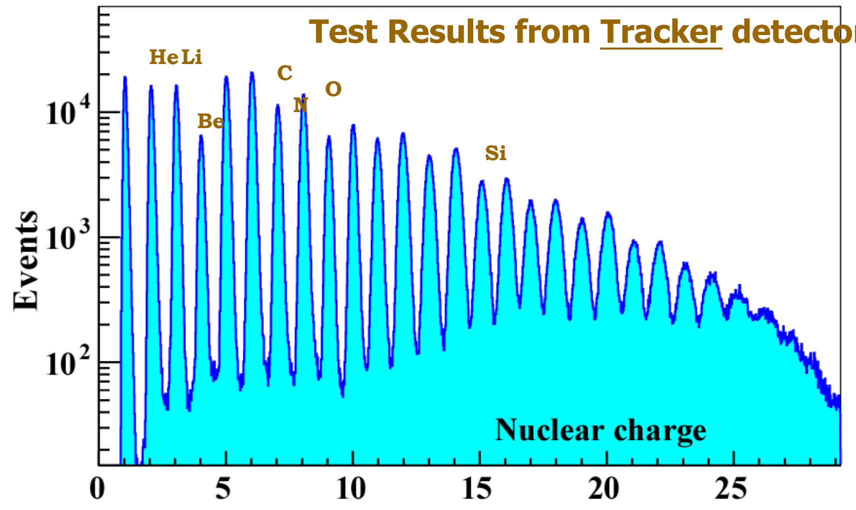
for more details see talks: C.Lechanoine-Leluc, P.Zuccon, F.Giovacchini and F.Barao (OG 1.5)

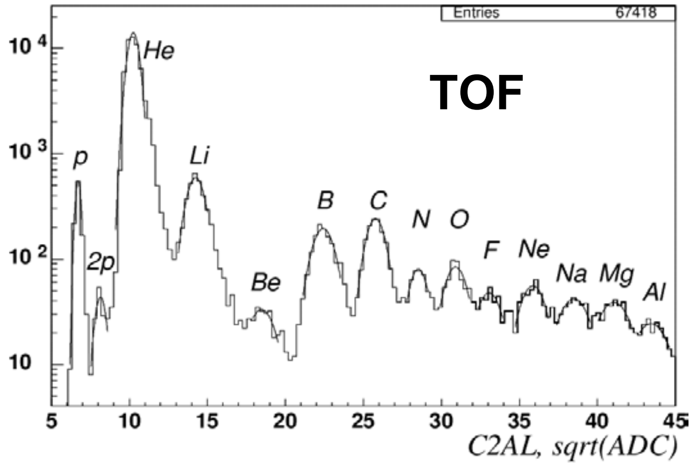
Nuclei separation

Charge measurement:

TOF, Tracker and RICH

Verified by heavy ion beam tests at CERN & GSI.





AMS-02 goals and capabilities

Search for Antimatter in Space

Search for Dark Matter → see talk of J. Pochon (HE 2.3)

Cosmic rays spectra and chemical composition up to 1 TeV

↓

AMS will identify and measure the fluxes for:

- **p for E < 1 TeV with unprecedented precision**
- **e+ for E < 300 GeV and e– for E < 1 TeV (unprecedented precision)**
- **Light Isotopes for E < 10 GeV/n**
- **Individual elements up to Z = 26 for E < 1 TeV/n**

Absolute fluxes and spectrum shapes of protons and helium are important for calculation of atmospheric neutrino fluxes

Physics motivation: CR propagation models

Propagation model:

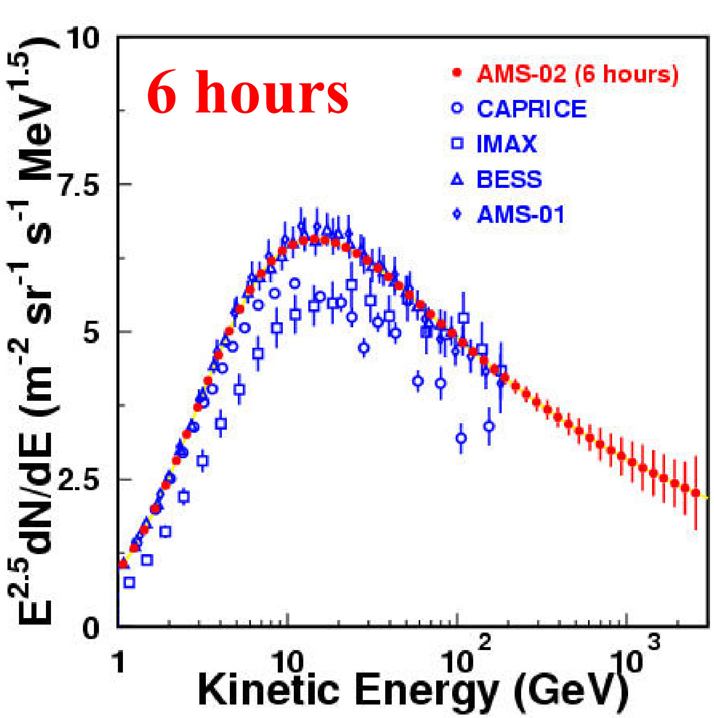
- **describes propagation (diffusion, convection, reacceleration) of cosmic ray particles in galaxies**
- **calculates nuclear interaction of primary produced particles with interstellar medium (ISM)**
- **Predicts abundances of element.**
- **Estimates backgrounds for rare signals (**eg. DM signal in antiproton channel**)**
- **Considers local modulation effects, solar modulation.**

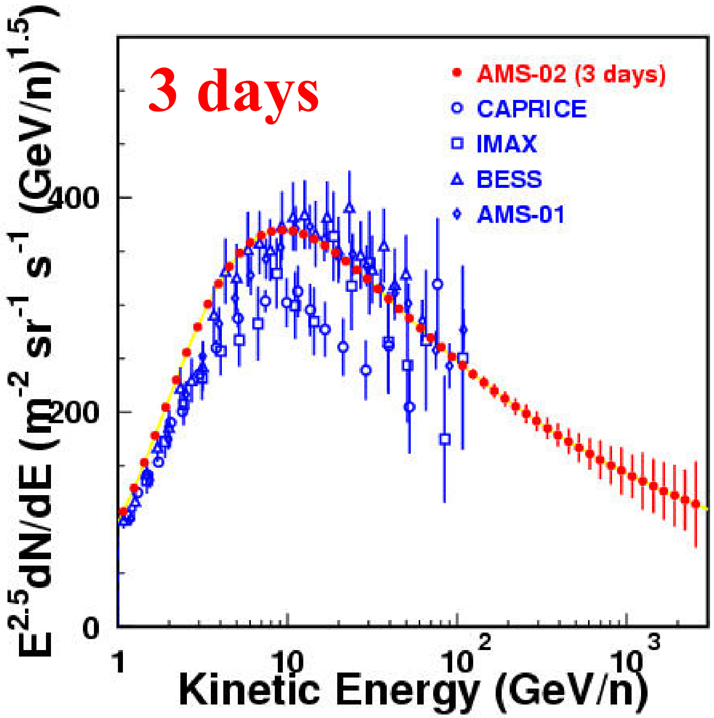
To constrain model:

- **primary CR : injection spectra, nature of sources**
- **secondary CR : propagation, density of ISM**
- **radioactive CR: age of CR**

Protons and helium

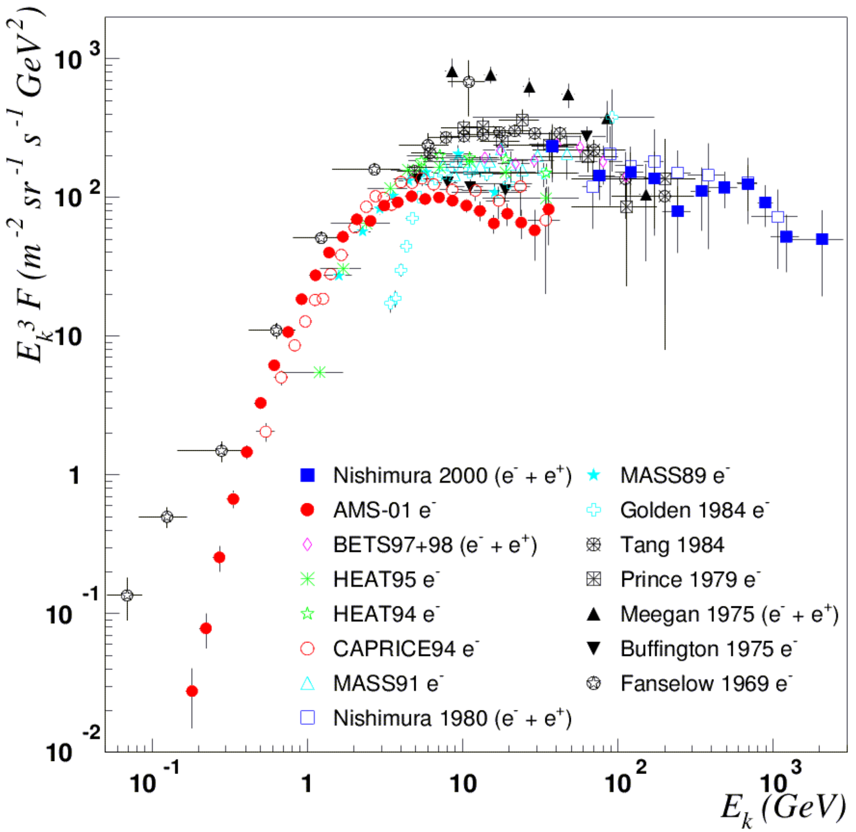
- AMS will measure H & He fluxes for E < 1 TeV
- after 3 years will collect ≈10^8 H with E > 100 GeV
- and ≈10^7 He with E > 100 GeV/n

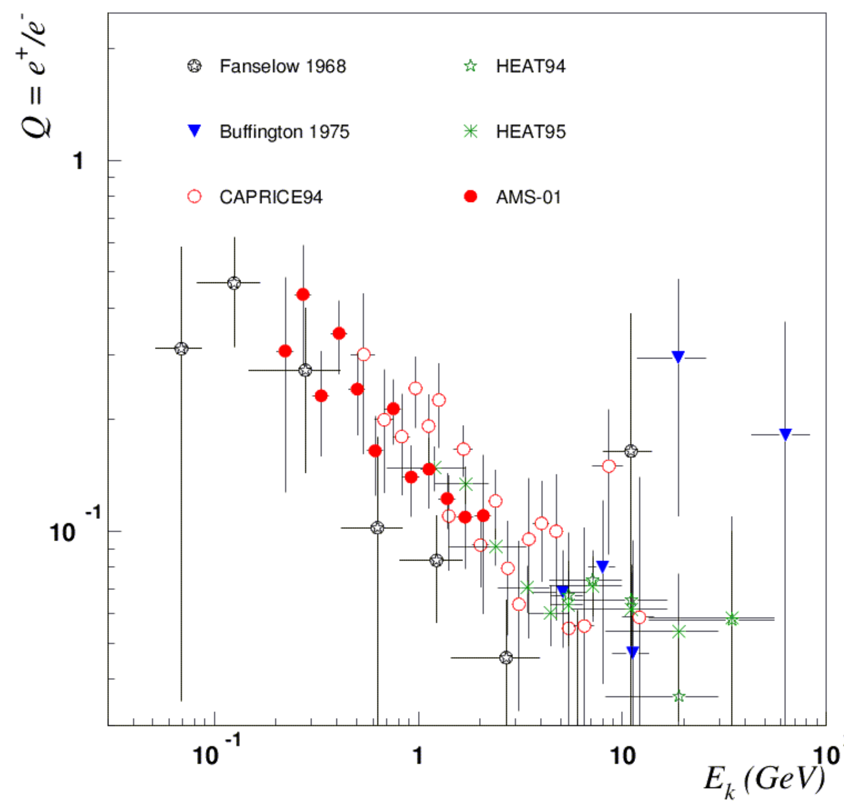




Electrons and positrons

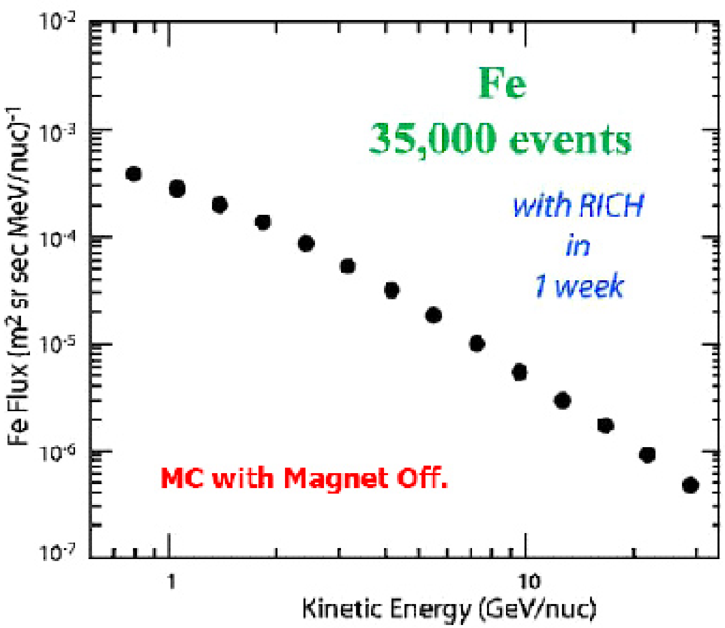
Energetic e+/e– cannot diffuse more than few kpc: they are sensitive probes of the Local Bubble and its neighbourhood.

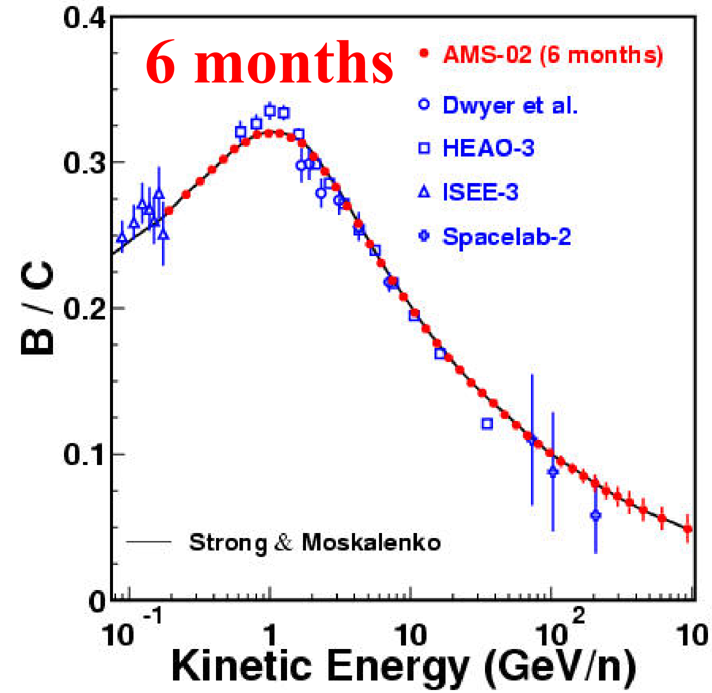




Heavier nuclei

- **AMS will measure the flux of Z ≤ 26 for E < 1 TeV/n**
- **The secondary to primary ratio B/C is used to fit the CR diffusion parameters**
- **After 3 years will collect ≈10^5 Carbon with E > 100 GeV/n and ≈10^4 Boron with E > 100 GeV/n**

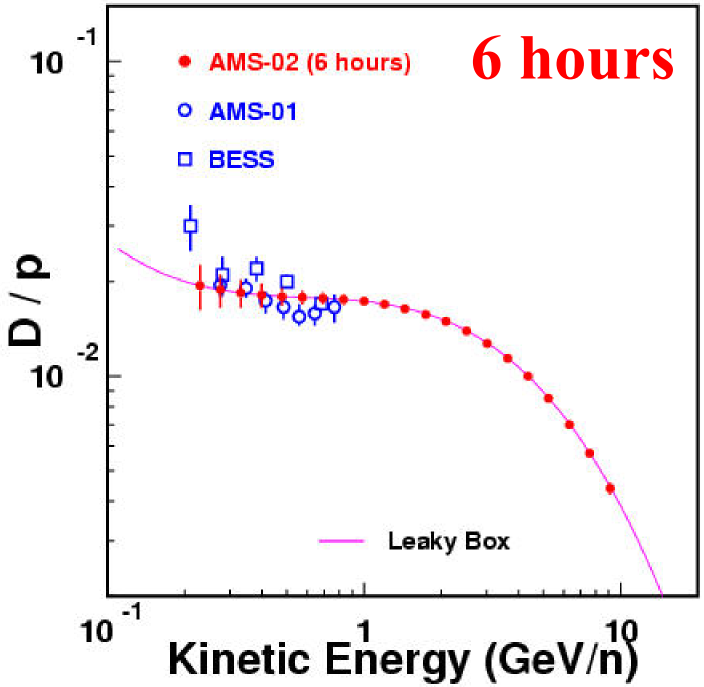


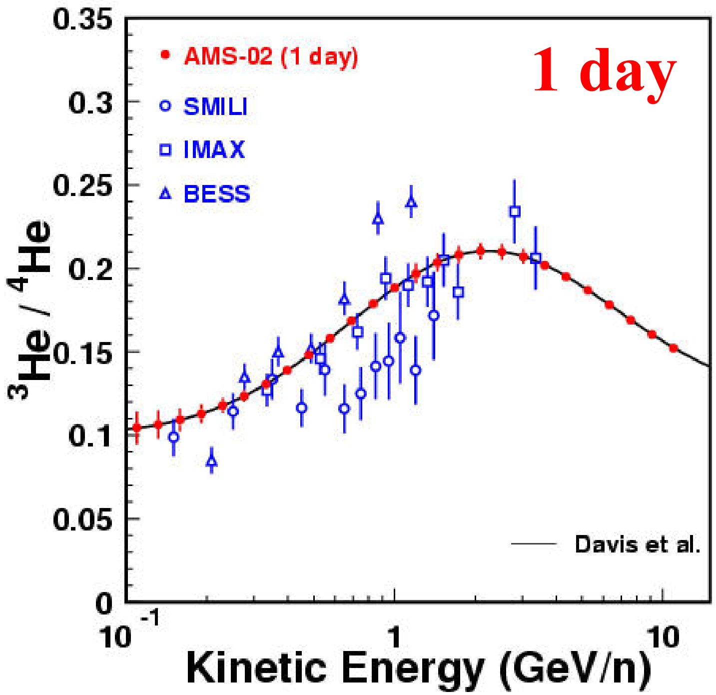


Light isotopes

Hydrogen and helium isotopes (deuterium and ^{3}He) are important tests of Big Bang nucleosynthesis which is their main source.

AMS-02 will identify D and ^{3}He up to 10 GeV/n



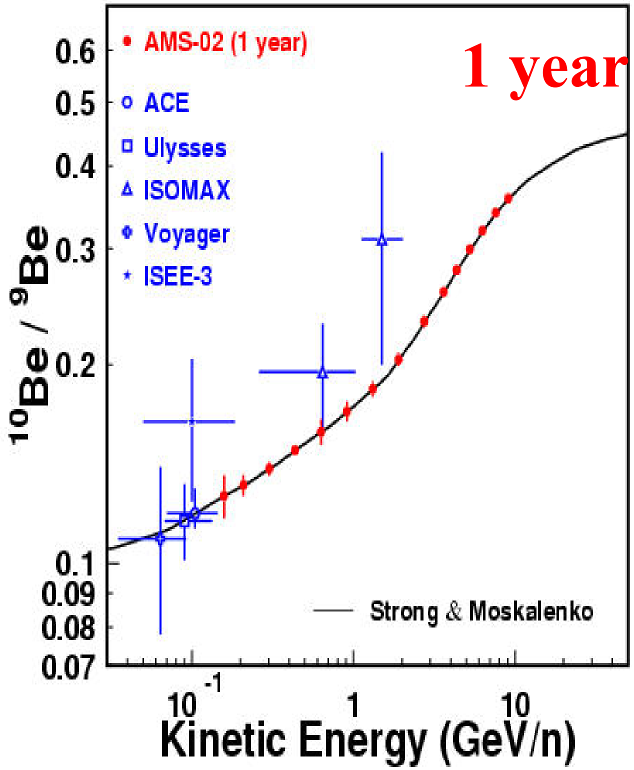


After 3 years AMS-02 will collect about 10^8 D and ^{3}He

$^{10}Be/^{9}Be$ – radioactive clock

- ^{10}Be ($t_{1/2}$ = 1.51 Myr) is the lightest β-radioactive secondary isotope having a half-life comparable with the CR confinement time in the Galaxy.
- In diffusion models, the ratio $^{10}Be/^{9}Be$ is sensitive to the size of the halo and to the properties of the local interstellar medium

AMS will separate ^{10}Be from ^{9}Be for
0.15 GeV/n < E < 10 GeV/n
after 3 years will collect ≈10^5 ^{10}Be



Conclusions

- AMS-02 is a large acceptance magnetic spectrometer which will be installed at the ISS in 2008 for a data taking period of 3 to 5 years
- In addition to the search for new physics in CR, AMS-02 unique particle identification capabilities will provide precise CR elemental and isotopic fluxes in a wide energy range
- These measurements will validate and constrain the free parameters of CR propagation models which will, in turn, provide more reliable estimates for the backgrounds in faint signal searches in CR