LET Performance Requirements

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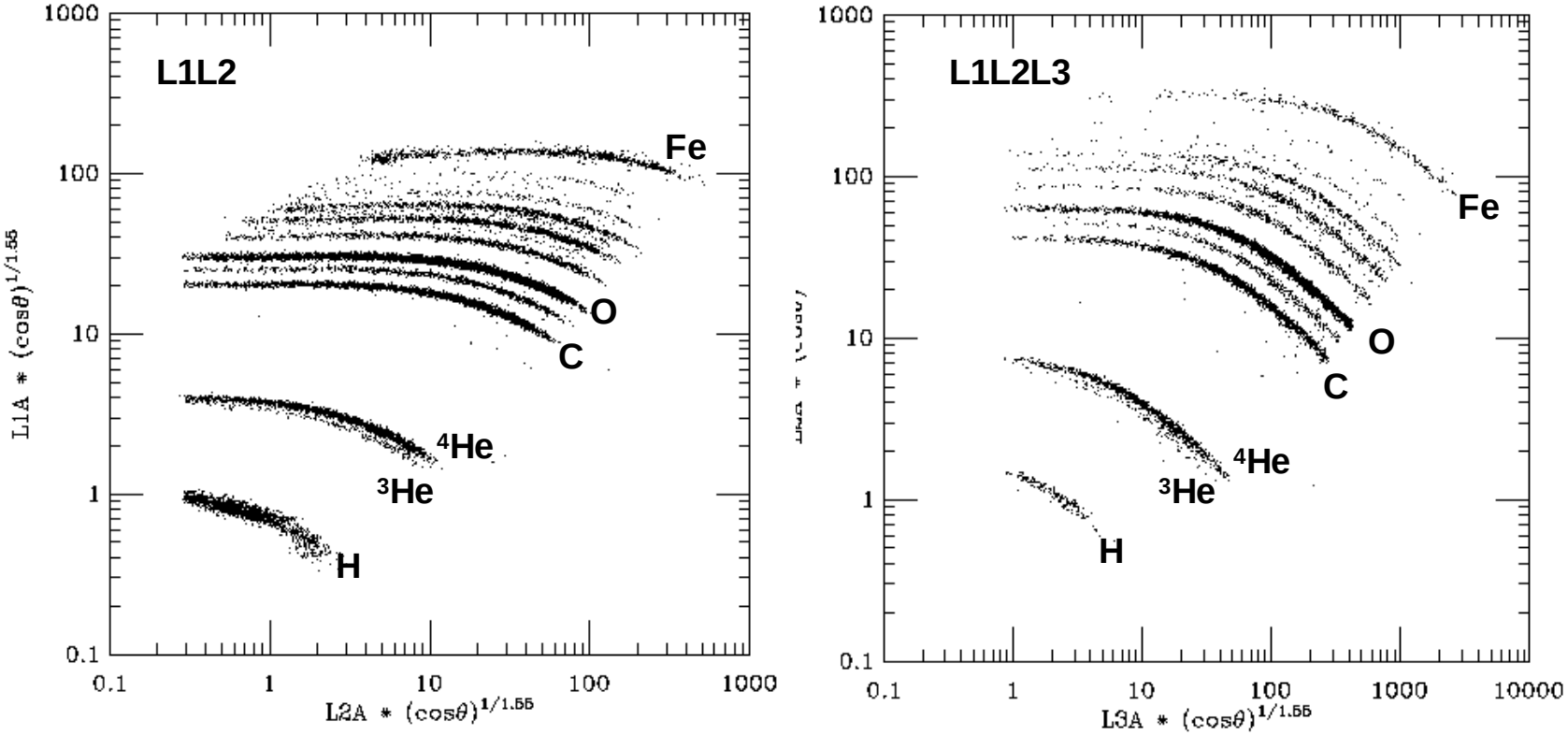
Illustration of DE-Total Energy Particle Identification



Scatter plot of simulated pulse-heights from the L1 vs. L2 and the L2 vs. L3 detectors on LET illustrating particle tracks from H to Fe. The resolution and calibration of the LET system must be sufficient to resolve the tracks of these and other species and measure their kinetic energy.

Level-1 Science Requirements Flowdown

From the STEREO Mission Requirements Document Program-Level Requirements for the Stereo Project

Baseline Science Requirements:

3. Discover the mechanisms and sites of energetic particle acceleration in the low corona and the interplanetary medium

The STEREO mission shall determine:

- **Characterize distribution functions to an accuracy of ±10% for electrons and/or ions with energies typical of solar energetic particle populations.**
- **Determine the location of particle acceleration in the low corona to within 300,000 km in radius and in interplanetary space to within 20°in total longitude.**

Requirements on LET (from the Level-1 Requirements Document):

Shall measure SEP ion fluxes, spectra, and composition in two oppositely directed 100 x 30 deg or better FOVs, covering the energy range from 3 - 25 MeV/nuc for C to Fe ions, 1.5 to 13 MeV/nuc for He, and 1.5 - 3 MeV for H. The mass resolution shall be better than 0.35 amu for ^{3}He and ^{4}He. Time resolution shall be 1 minute for H and He Beacon data, and 15 minutes otherwise. Shall handle at least 1000 events/sec.

Specific LET Performance Requirements

(from the IMPACT Performance Specification Document, Rev H)

Description	Requirement	Goal	Capability	Verification
Field of View	2 oppositely directed 100°x30° fans	2 oppositely directed 130°x30° fans	2 oppositely directed 133°x30° fans	Geometrical analysis; lab detector mapping
Energy Range (MeV/nuc)	H: 1.5 - 3 He: 1.5 - 13 O: 3 - 25 Fe: 3 - 50	H: 1.4 - 6 He: 1.4 - 13 O: 2.5 - 25 Fe: 2.5 - 50	H: 1.2 - 10 He: 1.2 - 13 O: 2.3 - 33 Fe: 2 - 56	Pulser, proton, a - particle calibrate; detector maps; particle accelerator
Geometry Factor (cm^2sr)	H, He: 0.9 6=Z=26: 4.5	H, He: 0.9 6=Z=26: 4.5	H, He: 0.9 6=Z=26: 4.5	Geometric analysis
Element Resolution	Resolve H, He, C, N, O, Ne, Mg, Si, Fe	Also resolve Na, Al, S, Ar, Ca	H, He, C, N, O, Ne, Na, Mg, Al, Si, S, Ar, Ca, Fe, Ni	Detector thickness maps, Monte Carlo analysis, particle accelerator

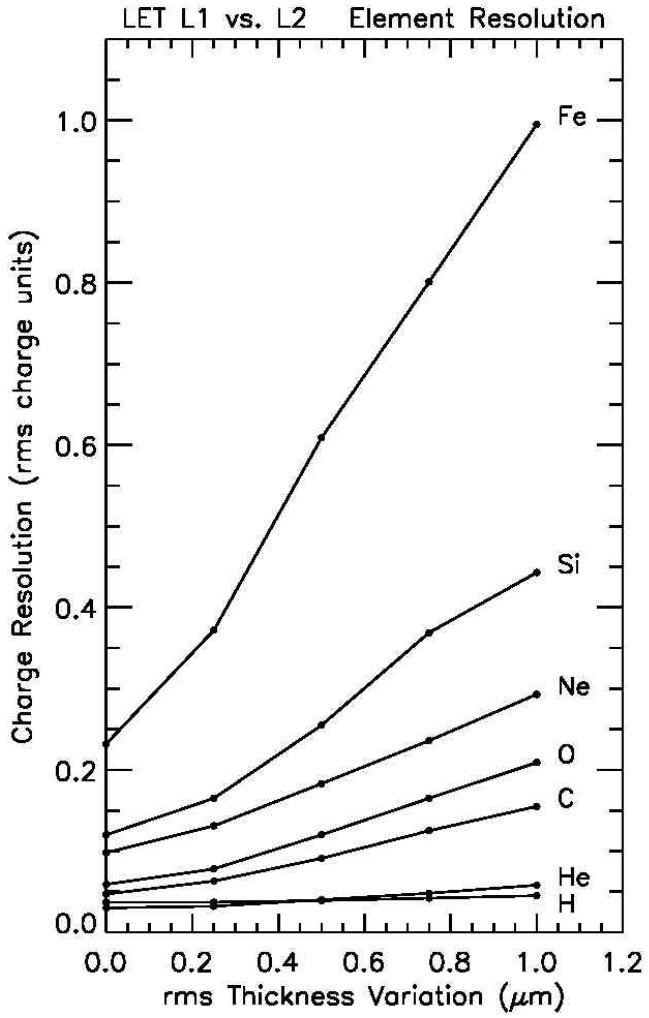
Specific LET Performance Requirements - continued

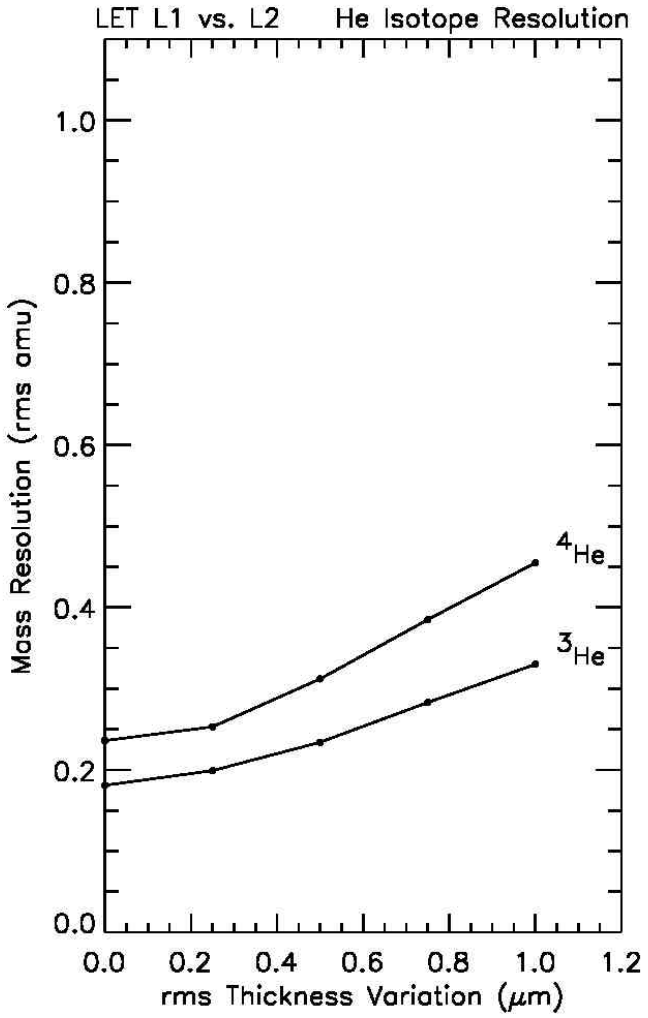
Description	Requirement	Goal	Capability	Verification
^{3}He, ^{4}He Mass Resolution	= 0.35 amu	= 0.25 amu	TBD	α-particle and pulser calibrations
L1 Noise	= 90 keV rms	= 50 keV rms for proton detection to 6 MeV and $\sigma_m(^4\text{He})$ = 0.25 amu	Expect ~30 keV rms	Pulser calibrations
L1 thickness uniformity	σ_T = 0.6 μm rms for ^{3}He identification	σ_T = 0.3 μm rms	σ_T ~ 0.3 to 0.6 μm rms in prototype devices (tbd)	α-particle thickness maps
Energy Resolution	Dist. Funct's accurate to 10%	1%	<3%; dep. on L1, L2 thick knowledge	Pulser, α-particle calibrations; particle accelerator
Maximum Event Rate	1000 per sec	5000 per sec	5000 per sec	Bench tests with pulser and sources, particle accelerator

Specific LET Performance Requirements - continued

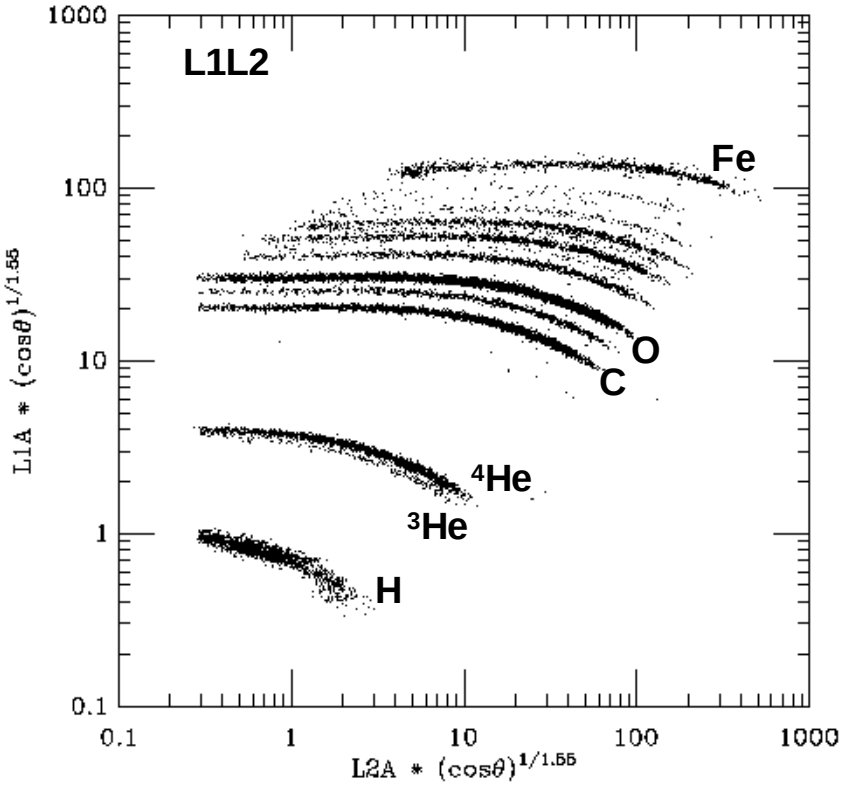
Description	Requirement	Goal	Capability	Verification
Energy Binning	6 intervals for Z = 2; 3 for H	8 intervals per species for Z = 2; 4 for H	10-12 intervals for Z = 2; 8 for H	Pulser, a-particle calibrations; Monte Carlo simulations; particle accelerator
Species Binning	H, ^{3}He, ^{4}He, C, N, O, Ne, Mg, Si, Fe	Also identify S, Ar, Ca	H, ^{3}He, ^{4}He, C, N, O, Ne, Na, Mg, Al, Si, S, Ar, Ca, Fe, Ni	Pulser, a-particle calibrations; Monte Carlo simulations; particle accelerator
Time Resolution	1-min H, He, Z = 6; Telem. 1 hi-priority event/s	1-min H, He; 15-min Z = 6; Telemeter 4 hi-priority events/s	1-min H, He, Z = 6; Telem. 4-5 hi-priority events/s	Pulser, a-particle calibrations; and particle accelerator
Beacon Telemetry	1-min for H, He, Z = 6	1-min for H, He, Z = 6	1-min for H, He, Z = 6	Pulser, a-particles, particle accelerator

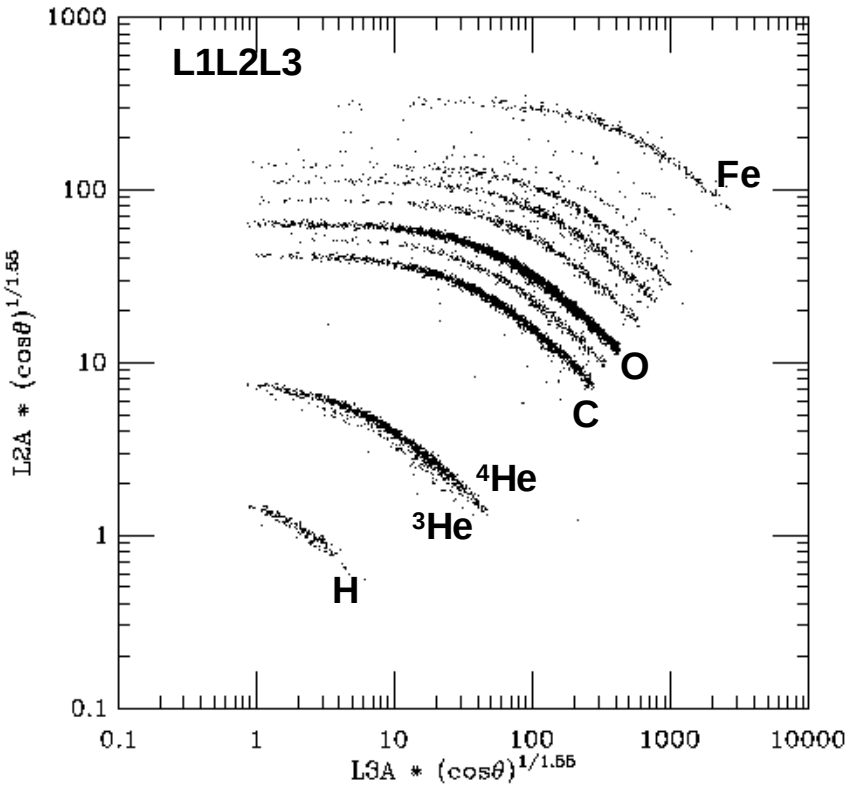
Effect of Detector Thickness Variations on ^{3}Heand ^{4}He Mass Resolution





Simulation of LET Response Including all Important Contributions to the Charge and Mass Resolution





These simulations include the effects of Landau fluctuations as well as variations in the angle of incidence and detector-thickness uniformity (s_T = 0.5 microns in L1, L2). All key species are resolved. Note that incidence-angle and detector-thickness corrections will be made onboard.