

# STEREO *IMPACT*

## Performance Specification

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## Document Revision Record

Rev.	Date	Description of Change	Approved By
A	2001-Apr-5	Preliminary Draft	-
B	2001-May-3	Inputs from Reinhold for SEPT	-
C	2001-Jun-22	Inputs from Walpole for SIT	-
D	2001-Jul-9	Inputs from Larson for SWEA, STE	-
E	2001-Jul-17	Fix some typos, update SIT timing TBD, add HET/LET requirements	-
F	2001-Sep-7	Update MAG Requirements Add level 1 requirements	-
G	2002-Apr-8	Update to match latest level 1 requirements from the MRD rev B; reference MRD rather than listing the higher level requirements.	

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**Table of Contents**

**Document Revision Record**..... i  
**Distribution List** ..... i  
**1. Introduction**..... 1  
    1.1. *Document Conventions*..... 1  
    1.2. *Applicable Documents* ..... 1  
**2. Science Requirements**..... 1  
**3. Performance Requirements** ..... 2  
    3.1. *MAG Requirements*..... 2  
    3.2. *SWEA Requirements*..... 2  
    3.3. *STE Requirements* ..... 3  
    3.4. *SIT Requirements* ..... 3  
    3.5. *SEPT Requirements*..... 4  
    3.6. *LET Requirements* ..... 5  
    3.7. *HET Requirements* ..... 6

## 1. Introduction

This specification describes the performance goals and requirements for the IMPACT investigation on the STEREO mission. These specifications are at the derived science requirements level, listing verifiable instrument performance requirements. It does not include the derived engineering requirements (mass, power, interfaces, etc.), which are largely covered by documents like the Spacecraft ICD.

### 1.1. *Document Conventions*

In this document, **TBD** (To Be Determined) means that no data currently exists. A value followed by **TBR** (To Be Resolved) means that this value is preliminary. In either case, the value is typically followed by a code such as UCB indicating who is responsible for providing the data, and a unique reference number.

### 1.2. *Applicable Documents*

The following documents include drawings and STEREO Project policies. All documents and drawings can be found on the Berkeley STEREO/IMPACT FTP site:

<http://sprg.ssl.berkeley.edu/impact/dwc/>

1. PhaseAReport/ - Phase A Report, split into a number of files
2. [Project/Project/460-RQMT-001-MRDrevB – Mission Requirements Document](#)

## 2. Science Requirements

The top-level science requirements and their flow-down to the IMPACT instrument are listed in the STEREO Mission Requirements Document (reference 2). From these requirements, the instrument performance requirements below have been extracted or derived.

### 3. Performance Requirements

The requirements are listed below by instrument. The table lists both the desired goal as well as the minimum acceptable requirement. Inability to meet requirements within the allocated resources must be waived by the Principal Investigator, and STEREO PROJECT will be informed. **All of these requirements are imposed on the instruments for both spacecraft.**

#### 3.1. **MAG Requirements**

Description	Goal	Requirement	Source
Noise level	0.01 nT	0.01nT	Derived from MRD 3.2.2
Absolute Accuracy	+/- 0.1 nT	+/-0.1nT	MRD 4.7
Range	+/-512 nT, +/-65536 nT	+/-512 nT	MRD 4.7
Drift	+/-0.2 nT/yr	+/-0.2nT/yr	Derived form Absolute accuracy & MRD 4.6.2.6.1
Time Resolution	1/4 sec. 1/32 sec. (Burst)	1 sec	MRD 4.7

#### **SWEA Requirements**

Description	Goal	Requirement	Source
FOV	360 x 130 degree	360 x 60 degrees	MRD 4.7
Resolution	22.5 degree	45 degrees	MRD 4.7
Energy	1 to 5000eV	20 to 1000eV	MRD 4.7
Energy Resolution (Telemetry)	65%	100%	Derived from MRD 4.7 & solar wind characteristics
Geometric Factor	0.01 cm <sup>2</sup> ster E(eV)	0.001 cm <sup>2</sup> ster E(eV)	Derived from MRD 4.7 & solar wind characteristics
Max Count Rate (per 22.5 degree sector)	1E6 counts/sec	1E5 counts/sec	Derived from MRD 4.7 & solar wind characteristics
Time Resolution	1 minute (3D) to 2 seconds (moments, burst)	1 minute	MRD 4.7

### 3.3. *STE Requirements*

Description	Goal	Requirement	Source
FOV	Two opposite 80 x 80 degree	60 x 60 degree	Derived from MRD 4.7 & solar wind characteristics
Resolution	80 x 20 degrees	60 x 20 degrees	Derived from MRD 4.7 & solar wind characteristics
Energy	2 - 100 keV	5 - 100 keV	MRD 4.7
Energy Resolution (Telemetry)	35%	100%	Derived from MRD 4.7 & solar wind characteristics
Energy Resolution (Electronic)	300eV FWHM	2keV	Derived from lower energy and resolution requirements above.
Geometric Factor	0.4 cm <sup>2</sup> ster	0.1 cm <sup>2</sup> ster	Derived from MRD 4.7 & solar wind characteristics
Background	<1c/s/detector	<30c/s/detector	Derived from MRD 4.7 & solar wind characteristics
Max Count Rate (per detector)	100,000 counts/sec	10,000 counts/sec	Derived from MRD 4.7 & solar wind characteristics
Time Resolution	16 seconds 2 seconds (burst)	1 minute	MRD 4.7

### 3.4. *SIT Requirements*

Description	Goal	Requirement	Source
FOV	17 x 44 degrees	17 x 44 degrees	Derived from MRD 4.7 & CME characteristics
Energy	30-2,000 keV/nuc He-Fe	30-2,000 keV/nuc He-Fe	MRD 4.7
Mass Resolution	0.85 AMU ( <sup>16</sup> O at 100keV/nuc)	0.85 AMU ( <sup>4</sup> He at 1MeV/Nuc)	Derived from MRD 4.7 & CME characteristics
Energy Resolution	20keV FWHM	35keV FWHM @ 22C	Derived from MRD 4.7 & CME characteristics
Geometric Factor	0.4 cm <sup>2</sup> ster	0.4 cm <sup>2</sup> ster	Derived from MRD 4.7 & CME characteristics
Background	10 <sup>-2</sup> events/sec in quiet time	10 <sup>-2</sup> events/sec during vac test	Derived from MRD 4.7 & CME characteristics
Max Event Rate	1000 events/sec	1000 events/sec	Derived from MRD 4.7 & CME characteristics
Time Resolution	1 Minute	15 Minutes	Derived from MRD 4.7 & CME characteristics

### 3.5. SEPT Requirements

Description	Goal	Requirement	Source
FOV	2 sets of oppositely directed 52 degree cones each for electrons and protons	2 sets for electrons and protons, each with: 2 oppositely directed view cones in-ecliptic, 2 oppositely directed view cones off-ecliptic, 45 degree full opening angle	Derived from MRD 4.7 & CME characteristics
Energy	20-400 keV electrons, 20-7000 keV protons	30-400 keV, electrons 30-2000 keV, protons	MRD 4.7
Energy Resolution (Telemetry)	20% electrons, 20% protons	30%, electrons 30%, protons	Derived from MRD 4.7 & CME characteristics
Geometric Factor	0.52 cm <sup>2</sup> ster, electrons, 0.68 cm <sup>2</sup> ster, protons	0.4 cm <sup>2</sup> ster, electrons, 0.4 cm <sup>2</sup> ster, protons	Derived from MRD 4.7 & CME characteristics
Background	< 0.2 counts/s on ground, 20°C	< 2 counts/s on ground, 20°C	Derived from MRD 4.7 & CME characteristics
Max Event Rate	25,000 counts/s at 2.2 MeV 250,000 counts/s at 55 keV	25,000 counts/s at 2.2 MeV 250,000 counts/s at 55 keV	Derived from MRD 4.7 & CME characteristics
Time Resolution	60 sec	60 sec	Derived from MRD 4.7 & CME characteristics

### 3.6. LET Requirements

Description	Goal	Requirement	Source
FOV	2 oppositely directed 130 x 30 degree fans	2 oppositely directed 100 x 30 degree fans	Derived from MRD 4.7 & CME characteristics
Energy Range (MeV/nucleon)	H: 1.4 - 6 He: 1.4 - 13 O: 2.5 - 25 Fe: 2.5 - 50	H: 1.5 - 3 He: 1.5 - 13 O: 3 - 25 Fe: 3 - 25	MRD 4.7
Geometric Factor cm <sup>2</sup> ster	H, He: 0.9 6=Z=26: 4.5	H, He: 0.5 6=Z=26: 2	Derived from MRD 4.7 & CME characteristics
Element Resolution	Also resolve Na, Al, S, Ar, Ca	Resolve H, He, C, N, O, Ne, Mg, Si, Fe	Derived from MRD 4.7 & CME characteristics
<sup>4</sup> He Mass Resolution	=0.25 AMU	=0.35 AMU	Derived from MRD 4.7 & CME characteristics
Max Event Rate	5000 events/sec	1000 events/sec	Derived from MRD 4.7 & CME characteristics
Energy Binning	8 intervals per species for Z=2 4 intervals for H	6 intervals per species for Z=2 3 intervals for H	Derived from MRD 4.7 & CME characteristics
Species Binning	Add S, Ar, Ca	H, <sup>3</sup> He, <sup>4</sup> He, C, N, O, Ne, Mg, Si, Fe	Derived from Element Resolution above.
Time Resolution	1 minute H, He, 15 minutes Z=6 4 prioritized events/sec	15 minutes  1 prioritized event/sec	Derived from MRD 4.7 & CME characteristics
Beacon Telemetry:	1 minute for H, He, 6=Z=26	1 minute for H, He, 6=Z=26	Derived from MRD 3.1



**3.7. HET Requirements**

Description	Goal	Requirement	Source
FOV (full angle)	58 degree cone	50 degree cone	Derived from MRD 4.7 & CME characteristics
Energy Range (MeV/nucleon)	e: 1 - 8 H, He: 13 - 100 <sup>3</sup> He: 16 - 50 ~30 to 80 for 6 = Z = 26	1 - 6 13 - 40 16 - 40 ~30 to 80 for 6 = Z = 14	MRD 4.7
Geometric Factor, cm <sup>2</sup> ster	0.7	0.5	Derived from MRD 4.7 & CME characteristics
Element Resolution, dZ (rms), for stopping particles	= 0.3 for 16 = Z = 26	= 0.2 for 1 = Z = 14	Derived from MRD 4.7 & CME characteristics
<sup>4</sup> He Mass Resolution	=0.20 amu	=0.25 amu	Derived from MRD 4.7 & CME characteristics
Max Event Rate	5000 events/sec	1000 events/sec	Derived from MRD 4.7 & CME characteristics
Energy Binning	Eight intervals per species	Six intervals per species	Derived from MRD 4.7 & CME characteristics
Species Binning	Add 16 = Z = 26	H, <sup>3</sup> He, <sup>4</sup> He, 6=Z=14, Electrons	Derived from Element Resolution above.
Time Resolution	15 minutes 1 prioritized events/sec	15 minutes 0.3 prioritized event/sec	Derived from MRD 4.7 & CME characteristics
Beacon Telemetry:	1 minute H, He, e	1 minute H, He, e	Derived from MRD 3.1