TWINS SCIENCE DATA GUIDE

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SwRI® Project 04475

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1. INTRODUCTION

1.1 Project Overview

The Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS) mission provides a new capability for stereoscopically imaging the magnetosphere. In contrast to traditional space experiments, which make measurements at only one point in space, imaging experiments provide simultaneous viewing of different regions of the magnetosphere. Stereo imaging, as done by TWINS, takes the next step of producing 3-D images, and will provide a leap ahead in our understanding of the global aspects of the terrestrial magnetosphere.

This document lists the SPASE descriptions of all Level 1 data, as found on the Heliophysics Data Portal at http://heliophysicsdata.gsfc.nasa.gov. The TWINS website is located at: http://twins.space.swri.edu.

1.2 General Data Description from SPASE

TWINS (Two Wide-angle Imaging Neutral-atom Spectrometers) is a Mission of Opportunity under NASA's Small Explorer (SMEX) program. TWINS-1 and TWINS-2 are the designations for NASA-sponsored instruments flying on unspecified non-NASA U.S. government spacecraft.The TWINS-1 instrument high voltages were turned on in April 2007 and the TWINS-2 high voltages in May 2008; the exact launchdates are not available. The data (including both science data and spacecraft ephemeris/attitude information) from the two NASA-funded science instruments are publicly available to the scientific research community.

TWINS is a stereo mission whose overall scientific objective is to establish the global connectivities and causal relationships between processes in different regions of the Earth's magnetosphere. To meet this goal, TWINS-1 and TWINS-2 provide stereoscopic neutral atom imaging of the magnetosphere from two widely spaced, high-altitude, high-inclination spacecraft.

2. SPASE Metadata

Note that SPASE Data for TWINS 1 and TWINS 2 are identical save for the numbering of the spacecraft (1 or 2). SPASE data for TWINS 1 only will be listed.

2.1. TWINS 1 Spacecraft Ephemeris

Each spacecraft carrying TWINS instruments is in a Molniya orbit (63.4 deg, 7.2 Re apogee, 1000 km perigee; period 12 h), and is three-axis stabilized and approximately nadir-pointing. Each acquires image data with time resolution of 60 s. The time required to change actuator direction between scans (no data collection) was 25 seconds from June 2008 to July 2009, and 12 seconds at all other times. This gives an effective cadence of 72 or 85 seconds. The nominal design lifetime for each instrument is four years. TWINS operates only during the apogee portion of each orbit, when the spacecraft is above the radiation belts.

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designations for NASA-sponsored instruments flying on unspecified non-NASA U.S. government
spacecraft.The TWINS-1 instrument high voltages were turned on in April 2007 and the TWINS-2 high
voltages in May 2008; the exact launchdates are not available. The data (including both science data and
spacecraft ephemeris/attitude information) from the two NASA-funded science instruments are publicly
available to the scientific research community.

      TWINS is a stereo mission whose overall scientific objective is to establish the global
connectivities and causal relationships between processes in different regions of the Earth's
magnetosphere. To meet this goal, TWINS-1 and TWINS-2 provide stereoscopic neutral atom imaging of
the magnetosphere from two widely spaced, high-altitude, high-inclination spacecraft.

      Space Science and Engineering Division
      Southwest Research Institute
      P. O. Drawer 28510
      6220 Culebra Road
      San Antonio, Texas 78228-0510
      (210) 684-5111
```

Each spacecraft carrying TWINS instruments is in a Molniya orbit (63.4 deg, 7.2 Re apogee, 1000 km perigee; period 12 h), and is three-axis stabilized and approximately nadir-pointing. Each acquires image data with time resolution of 60 s. The time required to change actuator direction between scans (no data collection) was 25 seconds from June 2008 to July 2009, and 12 seconds at all other times. This gives an effective cadence of 72 or 85 seconds. The nominal design lifetime for each instrument is four years. TWINS operates only during the apogee portion of each orbit, when the spacecraft is above the radiation belts.

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    <OrganizationName>NASA Goddard Space Flight Center</OrganizationName>
    <Address>Code 672, Greenbelt, MD 20771, USA</Address>
    <Email>mcguire@mail630.gsfc.nasa.gov</Email>
    <PhoneNumber>+1 301 286 7794</PhoneNumber>
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    <Address>Code 672, Greenbelt, MD 20771, USA</Address>
    <Email>robert.m.candey@nasa.gov</Email>
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<Address>Code 672, Greenbelt, MD 20771, USA</Address>
<Email>jan.merka@nasa.gov</Email>
<PhoneNumber>+1 301 286 8751</PhoneNumber>
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2.2. TWINS 1 Spacecraft Attitude

This TWINS data set contains spacecraft attitude data as polar and azimuthal instrument pointing vectors, each expressed with respect to an ECI Cartesian basis. The polar vector points along the TWINS rotation axis. The azimuthal vector lies in the plane normal to the polar vector and points toward the central scanning position (i.e., the zero-point location). Such pointing is derived from both the spacecraft attitude history file (SAH) and the sensor mounting orientation. The computation employed is designed to achieve a pointing accuracy of 0.5 degrees. Any deviation from this accuracy level is indicated in the header record metadata.

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2.3 TWINS 1 L1 Neutral-atom Images and Movies

TWINS 1 neutral-atom spectrometer level-1 magnetospheric images and image movies at full (9 energy steps and 15 minute) resolution. Images have been smoothed using a technique that provides approximately uniform statistics across the image. Each image has 4x4 degree angular resolution and includes 15 minutes of data. These images are derived on the ground from direct events measurements of the time of flight and detection location on the anode for individual ENAs. Each image has 4x4 degree angular resolution and includes 15 minutes of data. The first dimension of the image represents the scan angle in instrument coordinates. In this system the azimuthal attitude vector points to +90 degree scan angle. The second is the imaged angle, where 90 degrees is the central viewing angle of the instrument and the direction of the polar attitude vector.

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These images are derived on the ground from direct events measurements of the time of flight and detection location on the anode for individual ENAs. Each image has 4x4 degree angular resolution and includes 15 minutes of data. The first dimension of the image represents the scan angle in instrument coordinates. In this system the azimuthal attitude vector points to +90 degree scan angle. The second is the imaged angle, where 90 degrees is the central viewing angle of the instrument and the direction of the polar attitude vector. </Description>
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16, 20, 25, 30, and 50 keV.</Description>
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image.</Description>
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each pixel is given by sqrt(counts) / counts using the counts included in each pixel of the
image.</Description>
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      <ParameterKey>smooth_error_image_e3</ParameterKey>
      <Description>TWINS smoothed image error image at 8 keV energy.  The error in the flux for
each pixel is given by sqrt(counts) / counts using the counts included in each pixel of the
image.</Description>
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      <ParameterKey>smooth_error_image_e4</ParameterKey>
      <Description>TWINS smoothed image error image at 12 keV energy.  The error in the flux for
each pixel is given by sqrt(counts) / counts using the counts included in each pixel of the
image.</Description>
      <Units>(cm^2 sr s eV)^-1 </Units>
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      <ParameterKey>smooth_error_image_e5</ParameterKey>
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      <ParameterKey>smooth_error_image_e6</ParameterKey>
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Southwest Research Institute
P. O. Drawer 28510
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San Antonio, Texas 78228-0510
(210) 684-5111

<Description>TWINS smoothed image error image at 20 keV energy. The error in the flux for each pixel is given by sqrt(counts) / counts using the counts included in each pixel of the image.</Description>
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<ParameterKey>smooth_error_image_e9</ParameterKey>
<Description>TWINS smoothed image error image at 50 keV energy. The error in the flux for each pixel is given by sqrt(counts) / counts using the counts included in each pixel of the image.</Description>
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value of 0 indicates data are available; a value of 1 indicates that either attitude or ephemeris information
is not available for a given time interval. </Description>
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make the given image. </Description>
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      <ParameterKey>sc_posv_re_eci</ParameterKey>
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coordinates (cartesian XYZ components).  </Description>
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      <UnitsConversion>6.380e6&amp;gt;m</UnitsConversion>
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coordinates (Cartesian XYZ components). The polar attitude vector points to 90 degree instrument polar
(imaged) angle.</Description>
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      <ParameterKey>sc_posv_re_sm</ParameterKey>
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coordinates (Cartesian XYZ components).  </Description>
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      <UnitsConversion>6.380e6&amp;gt;m</UnitsConversion>
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designations for NASA-sponsored instruments flying on unspecified non-NASA U.S. government
spacecraft.The TWINS-1 instrument high voltages were turned on in April 2007 and the TWINS-2 high
voltages in May 2008; the exact launchdates are not available. The data (including both science data and
spacecraft ephemeris/attitude information) from the two NASA-funded science instruments are publicly
available to the scientific research community.

        TWINS is a stereo mission whose overall scientific objective is to establish the global
connectivities and causal relationships between processes in different regions of the Earth's
magnetosphere. To meet this goal, TWINS-1 and TWINS-2 provide stereoscopic neutral atom imaging of
the magnetosphere from two widely spaced, high-altitude, high-inclination spacecraft.

        Each spacecraft carrying TWINS instruments is in a Molniya orbit (63.4 deg, 7.2 Re apogee, 1000
km perigee; period 12 h), and is three-axis stabilized and approximately nadir-pointing. Each acquires
image data with time resolution of 60 s. The time required to change actuator direction between scans (no
data collection) was 25 seconds from June 2008 to July 2009, and 12 seconds at all other times.  This
gives an effective cadence of 72 or 85 seconds.  The nominal design lifetime for each instrument is four
years. TWINS operates  only during the apogee portion of each orbit, when the spacecraft is above the
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Space Science and Engineering Division
Southwest Research Institute
P. O. Drawer 28510
6220 Culebra Road
San Antonio, Texas 78228-0510
(210) 684-5111

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spacecraft.The TWINS-1 instrument high voltages were turned on in April 2007 and the TWINS-2 high
voltages in May 2008; the exact launchdates are not available. The data (including both science data and
spacecraft ephemeris/attitude information) from the two NASA-funded science instruments are publicly
available to the scientific research community.

        TWINS instrumentation includes an energetic neutral atom (ENA) imager to capture charge-
exchange-produced neutral atoms over a broad energy range (approximately 1-100 keV) and a Lyman-
alpha detector to measure the density of the neutral hydrogen geocorona needed for extraction of
magnetospheric ion fluxes from neutral atom data. The TWINS-1 and TWINS-2 instruments are identical.
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      <Contact>
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   <OrganizationName>NASA Goddard Space Flight Center</OrganizationName>
   <Address>Code 672, Greenbelt, MD 20771, USA</Address>
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<Address>Code 672, Greenbelt, MD 20771, USA</Address>
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