EXACT:

Experiment for X-Ray Characterization and Timing

Speaker

Ryan Vogt

Contributors

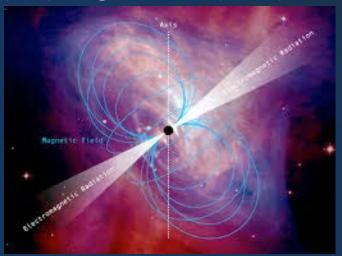
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University of Minnesota

Astrophysical Sources of High Energy Radiation

- Solar Eruptive Events
 - Solar Flares
 - Coronal Mass Ejections

Figure 1: (Right) X-ray image of solar flare (NASA). (Left) Image of Pulsar (NASA)





- Gamma Ray Bursts
- Pulsars



Solar Eruptive Events

Solar Flares and Solar Cycle

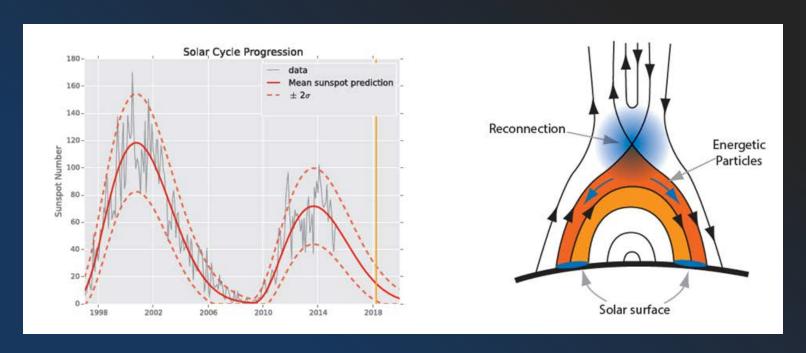


Figure 2: (Left) Sunspot numbers and flare activity in Solar Cycles 23 and 24. (Right) Standard Solar Flare Cartoon (Both Steven Christe, 2007)

Solar Eruptive Events

Coronal Mass Ejections (CME)

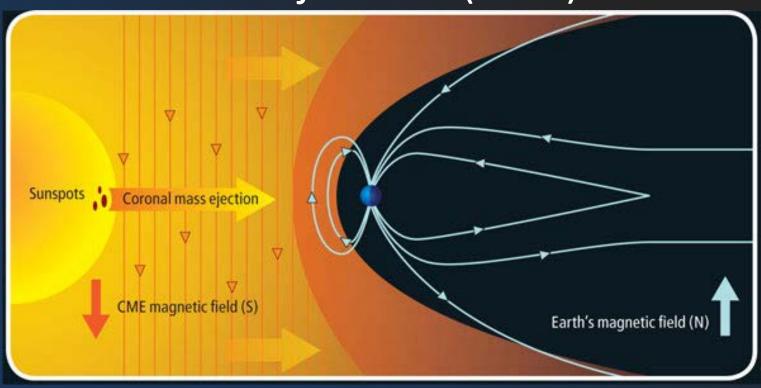


Figure 3: Coronal Mass Ejection and Earth's Magnetic Field (thewatchers.adorraeli.com)

Solar Eruptive Events: Still Unknown

- Energy Transfer
 - Magnetic fields to kinetic energy
 - Hard X-Ray signature

- Hard X-Ray Emission
 - Solar surface
 - Corona
 - CME cores

Navigation in Space

- Gamma Ray Bursts
 - Large, distant, highenergy EM events
- Pulsars
 - Periodic X-ray radiation source
- Precision timing of events
- Relative timing to give relative position
- Similar to GPS

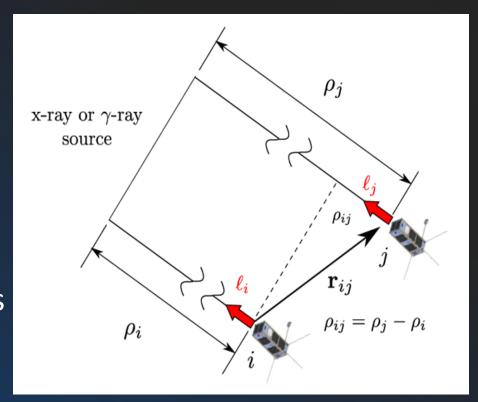


Figure 4: Determination of timing and position using X-Ray and Gamma Ray sources

EXACT: One Project, Two Missions

Shared Requirements: Shared Resources:

- Energy ranges
- Timing requirements
- Sensor requirements

- Project funding
- Expertise and experience
- Two departments



Figure 5: UMN EXACT Project Logo

EXACT Team Structure

Aerospace Engineering (9) Space Physics (10)

PI: Dr. Demoz Gebre Egziabher PI: Dr. Lindsay Glesener

Sub-system design

Solar activity research

Component assembly and installation

Detector testing and development

Spacecraft ranging

Solar flare characterization

EXACT Team Structure

Undergrad Executive Team:

Project Manager (PM)

Chief Engineer (CE)

Document Specialist

Senior Executive Team:

Dr. Gebre and Dr. Glesener

Executive PM

Executive CE

The EXACT Satellite: GRID

- Gamma Ray
 Incidence Detector
 - Scintillator Detector with 4 CsI(TI) crystals

Student designed

Inexpensive and replicable

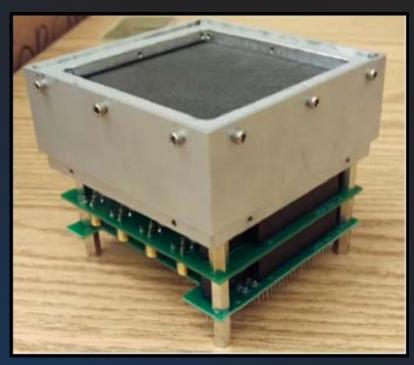


Figure 6: Image of GRID Detector

The EXACT Satellite: GRID

- GRID Detector
 - Redesign in progress
 - Time precision
 - Energy resolution
 - Continued Testing
 - At UMN
 - High Altitude Student Platform (HASP)

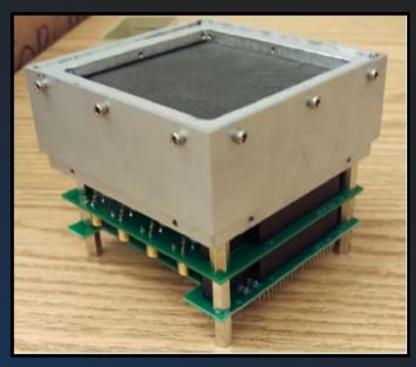


Figure 6: Image of GRID Detector

The EXACT Satellite: Sun-Pointing

- Solar Panels
 - Power generation
 - Attitudedetermination

- Magnetorquers
 - Attitude control

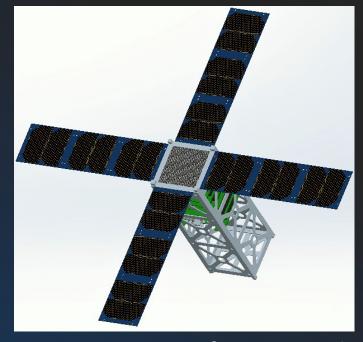


Figure 7: Image of EXACT with Solar Panels

EXACT Research and Testing

- Solar Flare Analysis
 - Predicted photon counts
 for each flare class
 - Used to predict data
 volume for detector

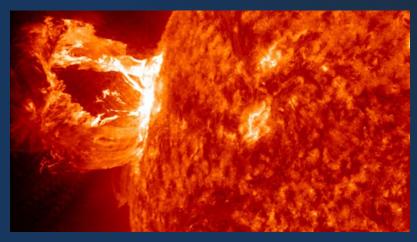


Figure 9: Image of Solar Flare (NASA)

Flare Class	Counts
B1	230,000
B5	935,000
B9	1,853,000
C1	3,370,000
C5	32,000,000
C9	58,000,000

Table 1: Solar flare counts by class

EXACT Research and Testing

- GRID Tests and Calibration
 - Testing with various radioactive sources

Discovered errors in current setup



Figure 10: Sample radioactive sources (imagesco.com)

EXACT Research and Testing

High Altitude Student Platform (HASP):

- Component Testbed
 - Detector
 - Communications
 - Power system
- Integration- August
- Flight- September

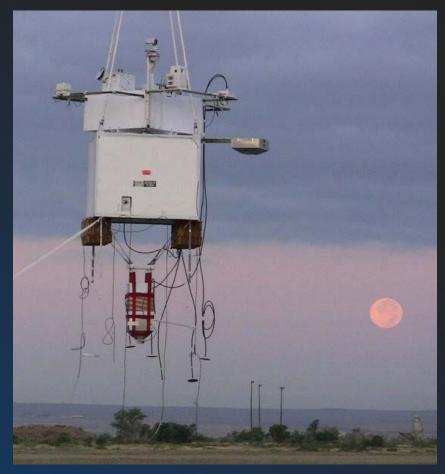


Figure 11: HASP Vehicle (stratocat.com.ar)

The Future and EXACT

 Inexpensive Hard X-Ray detector for solar observation Spacecraft ranging technique for positioning data in space

