Optical Flash Expansion Geometry in Hypervelocity Impact Events

Yayu Monica Hew
Adviser: Prof. Sigrid Close

Stanford University
Space Environment and Satellite System Lab
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Introduction
- Background
- Motivation

Method
- Experiment

Problem
- Science Question

Result
- Geometric Expansion
Fine grain sand 0.0161 g @ 4.65 km/s
impacting a differentially charged target ~ ± 145V
Source: NASA, Near Earth Impact.

D = 10 km

D = 3 mm to 10 cm
Hypervelocity Impact Phenomenon

Impact

Optical

RF

ESA Olympus 93'

Upper Level

E₂

Lower Level

E₁

Initial Expansion

Emission

Plasma Formation
Problem Overview

Q: How do the impact events connect to impact flash?

Optical Flash → Plasma Parameters → Impact Events

Measured optical spectrum
Temperature, Density, Mobility...
Mass, Velocity, Composition, Electrical Damages

Engineering: High Temperature ↔ RF ↔ electrical damages
Experiment at CCLDAS

Van de Graaff Electrostatic Dust Accelerator
Colorado Center for Lunar Dust and Atmospheric Studies

M = 0.1 – 1000 fg
V ~ 15 -100 km/s
10^{-5} Torr
Impact Flash Spatial Measurement

All Wavelength Photodiode

Spatial PMTs

AVGR

17 μs

34 μs

51 μs
AVGR Optical Expansion Polarization

Plasma Sensor

Grounded Target

Negatively Biased [-50V]

Floating Target

Positively Biased [+50V]

RF Sensors

AVGR
CCLDAS Optical Expansion Polarization Effect

Geometry
- LEFT
- CENTER
- RIGHT

Target
- Ext

Positive
- Center

Float
- Center

0 us 0.5 us 1 us
Time after impact

20% 30% 40% 50%

CCLDAS
CCLDAS Optical Expansion Polarization Effect

Positive

Float

CCLDAS
Summary

- Potential **Polarization effect** observed in impact events at both dust accelerator and light gas gun facilities
- Impact Plasma Flash can be used as a diagnostic tool for hypervelocity impactors in space
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