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Scientific Motivation

Scientific Objectives I

Three Major Research Topics:

1) Investigate the nature of comets
   - Cometary activity, morphology, surface properties, active / inactive regions
   - Physical properties and complex chemistry

2) Implications to the origin of water and evolution of life
   - Origin of atmospheres, water and organics

Scientific Objectives II

3) Implications for solar system formation and comet formation
   - Conditions during formation of the solar nebula and early planetary formation phase
   - Pristine materials in comets

Resulting Mission Goals:

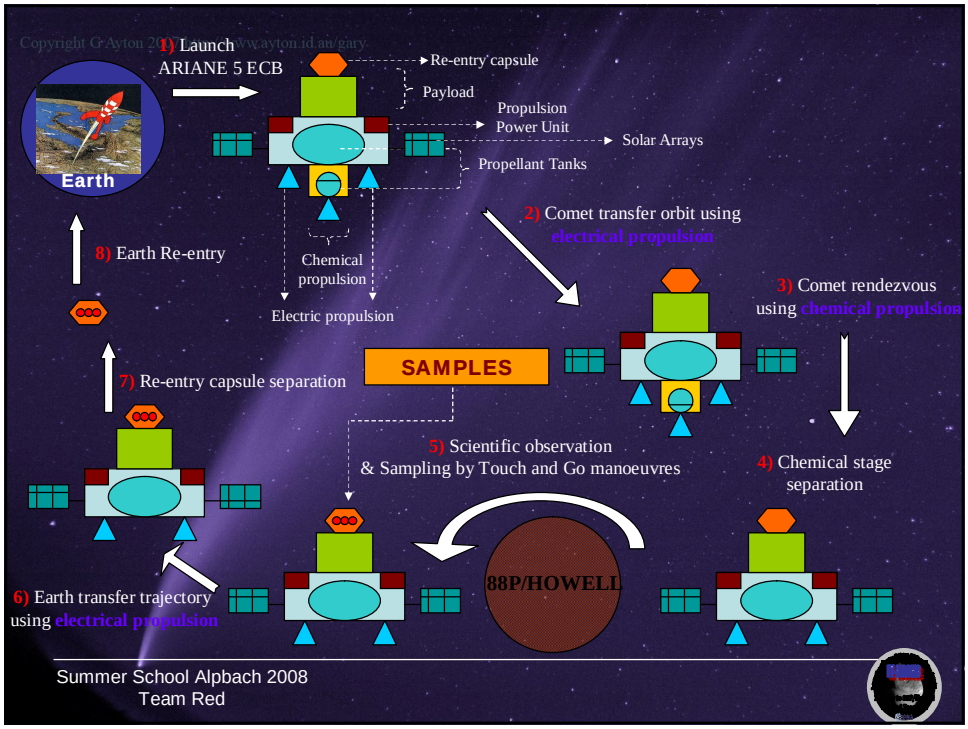
→ Sample return, remote sensing, insitu measurements
→ Examine organic molecules, D/H ratio, noble gases
→ Pristine and processed materials, protoplanetary nebula

Target: 88P/Howell

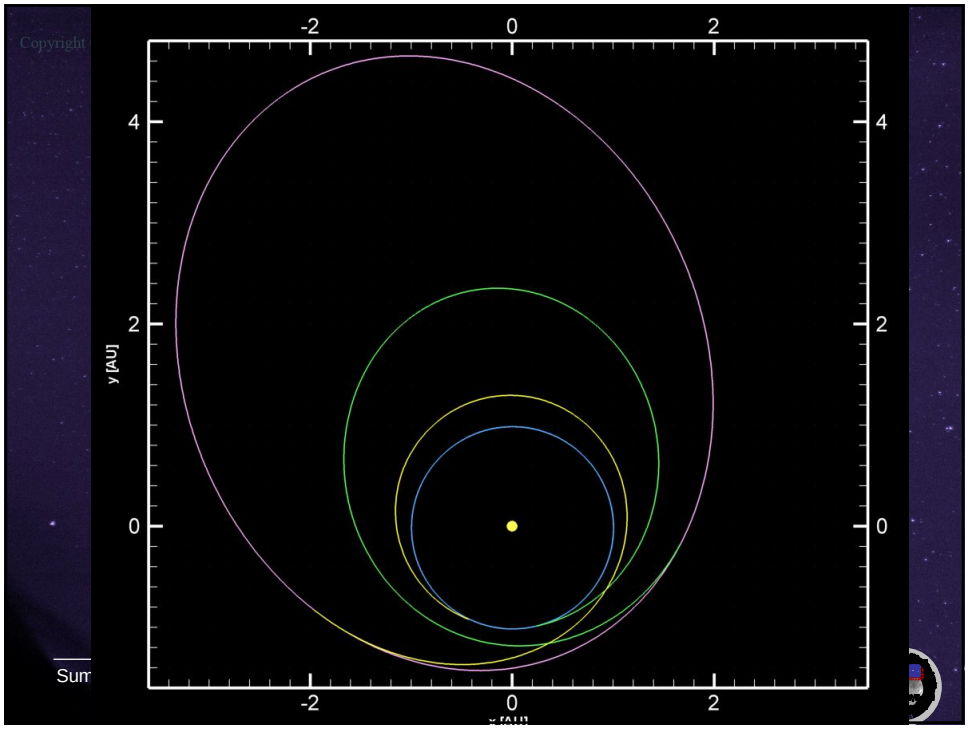
Property	Value
Nucleus Radius	1.1 km
Jupiter Family Comet	P < 20 a, T > 2
Mass	1.16×10^{12} kg (est.)
Bulk Density	200 kg/m^3 (est.)
Gravity on surface	6.15×10^{-5} m/s^2 (est.)
Revolution Period	5.5 a
Rotation Period	5.5 d (approx.)
Absolute nuclear magnitude	17m.4

Typical Comet with very high activity

Mission Scenario

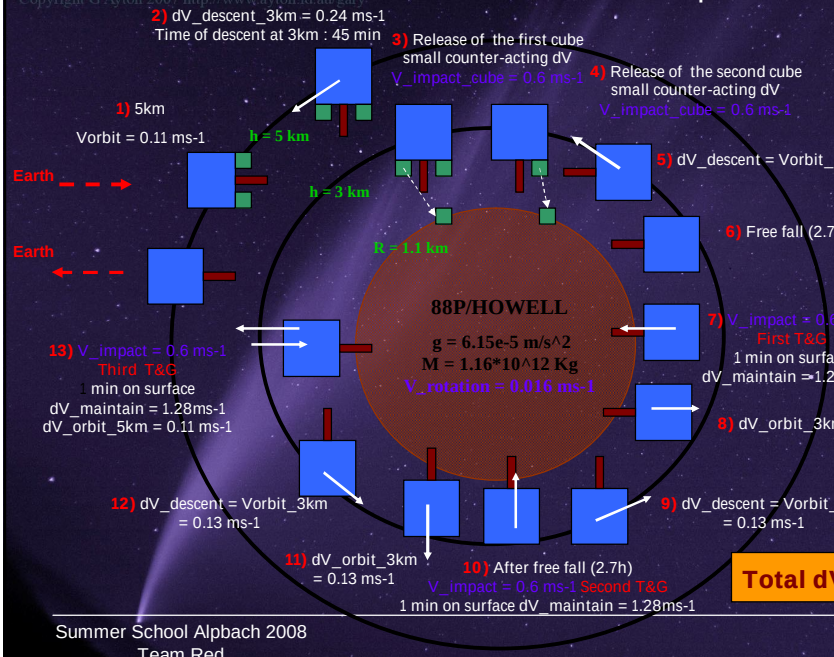


Summer School Alpbach 2008
Team Red



Close-to-comet operations

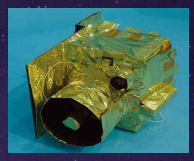
Close to Comet Operation Phases



Total dV ~ 5 ms-1

Instruments used for close-to-comet Operations

Gravity field determination



Goal: Precise gravity field determination to assess descent and Touch and Go maneuvers

Instrument: LIDAR (Light Detection And Ranging) used to determine small scale topography of the surface, the gravity field and possibly the altitude of the spacecraft

Active Control Descent

Goal: Landing requires measurement of the spacecraft velocity and the altitude of the spacecraft.

Instruments: RADAR Navigation System (RNS) to provide navigation capability utilizing four frequency modulated beams. Three are used to determine the three velocity components , and the fourth to measure spacecraft altitude

Comet Mapping

Goal: **For** landing site selection and topography assessment, an accurate map of the comet surface is needed.

Instrument: A Wide Angle Imager (WAI) and a High Resolution Imager (HRI) will be used to assess this objective

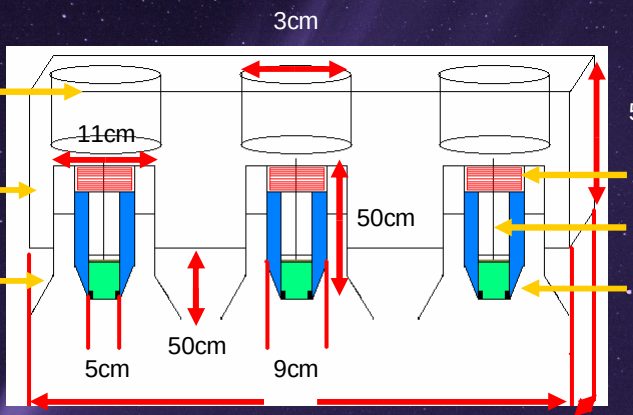
Sampling System

Requirements

- Low cost mechanical and electrical overhead
- Fast sampling mechanism (1-2s)
- Sampling up to 50cm depth
- Suitable for touch and go manoeuvres
- Preserve surface stratification
- Different site sampling
- Avoidance of cross contamination of samples

→ Use of penetrators

Titanium Dual Core Projectile



Not to scale

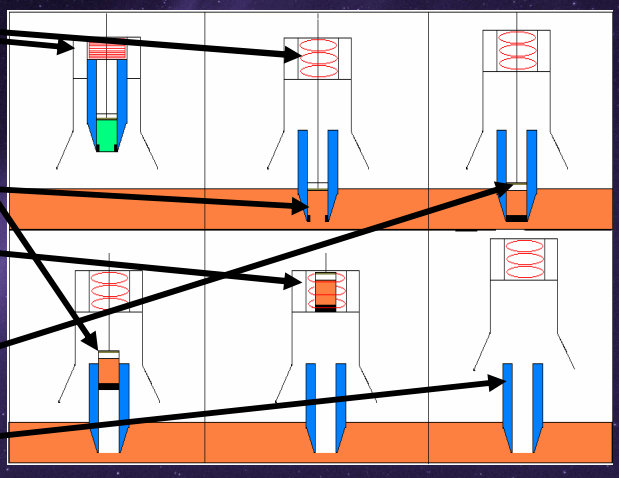
Successfully used during lunar missions!!!

Penetrator Operations

SPRINGS RELEASE PUSHING CANISTER IS CORER LIFTED IN INTO THE CRAFT FOR SURFACE STORAGE

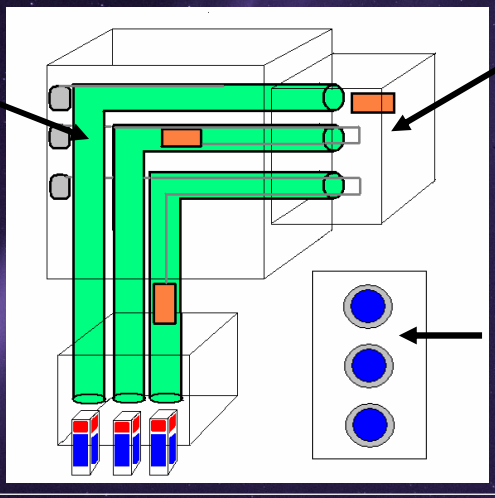
COLLECTION CANISTER CANISTER PASS FILLS WITH THROUGH APPROX 10cm SPRING OF MATERIAL SYSTEM

WHEN CRAFT LEAVES SURFACE COLLECTION CANISTER IS ABANDONED



Sample Transportation System

COLLECTION CANS WILL BE TETHERED AND CARRIED THROUGH A PIPE SYSTEM BY STEPPER MOTOR.

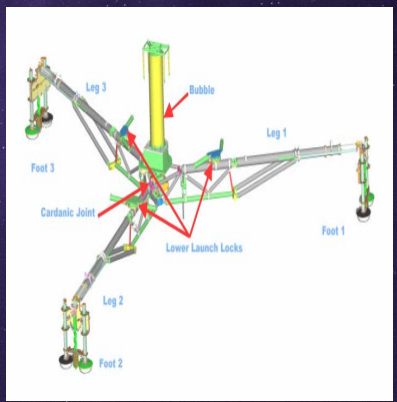


CANISTERS WILL BE DEPOSITED IN STORAGE IN RE-ENTRY MODULE

LOCATIONS OF PENETRATORS AT BASE WILL LOOK SOMETHING LIKE THIS

Landing Legs.

- Due to the dimensions and mass of the solar panels state of the art landing legs will be required to ensure space craft stablity upon touch down.
- In order to achieve this we will use the design of Rosetta´s Philae landing gear.
- This design must be rescaled in order to suit our space craft, however no major difficulties are foreseen.



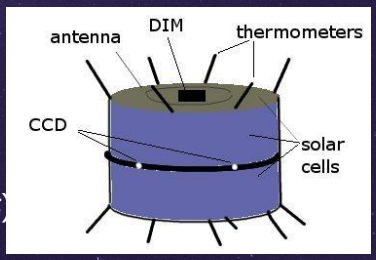
Rocky & Balboa

Hopping device for in situ measurements:

- Construction of a detailed surface model
- Direct measurements of surface temperature
- Counting dust particles rates for mapping activity

Selected instruments:

- 3 CCD cameras
- 6 thermometers
- 1 DIM (Dust Impact Monitor)



Planetary Protection

Planetary Protection Profile

Space Craft	Categories	Requirements
Orbiter	II	Clean room ISO 8 Report of contamination risks
Penetrator	II	Clean room ISO 8 Report of contamination risks
Payload	II	Clean room ISO 8 Report of contamination risks
Return capsule	V unrestricted earth return	Like Cat. II and additionally: sample sealing and quarantaine after retrieval

Budgets

Overall Budget

	Mass	Cost
Remote Sensing Payload [kg]	45,7	82,3
Sampling System [kg]	45,7	164,5
Subsystems [kg]	322,1	778,6
Harness [kg]	24,8	3,0
Structure [kg]	109,6	13,1
Margin [kg]	109,6	
Total Payload [kg]	657,5	
SEP Module		
Mass all el Thruster [kg]	103,4	62,0
Solar Arrays [kg]	220,7	264,8
Batteries [kg]	19,8	11,9
Thermal for Power System [kg]	16,8	20,2
Total Power System [kg]	257,3	
Total EP Propellant Mass [kg]	540,0	5,4
Tankmass EP [kg]	54,0	32,4
Harness [kg]	24,9	3,0
Structuremass SEP [kg]	244,9	29,4
Drymass SEP Module [kg]	684,5	

Wetmass SEP Outbound [kg]	1224,5	
Wetmass SEP Retrun [kg]	924,5	
Upper Stage Drymass [kg]	1341,9	
Upper Stage Wetmass Return [kg]	1581,9	
Thruster Mass chem [kg]	4,3	2,6
Propellant Mass chem [kg]	2609,2	26,1
Tankmass chem [kg]	260,9	156,6
Harness [kg]	15,9	1,9
Structuremass chem [kg]	722,6	86,7
Drymass chem Stage [kg]	1003,7	
Wetmass chem. Stage [kg]	3612,9	
Total Mass [kg]	5494,8	
		1744,4
Launcher		190,0
Ground Segment & Operation		90,0
Overall Costs		2024,4
without analysis (laboratory) costs		

Conclusions

- IT-ROCKS is the logical next step after the ROSETTA mission
- It will give answers to many of the most important questions in solar system science and maybe the evolution of life
- IT-ROCKS mission will shift our knowledge horizon to former unknown regions.

Thank you for your attention…

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