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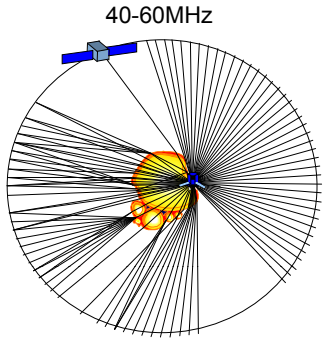
ASSERTトモグラフィ観測による小惑星内部構造探査

熊本篤志, 小野高幸, 笠羽康正 (東北大)
A. Herique, W. Kofman (UJF Grenoble/CNRS)

ASSERT

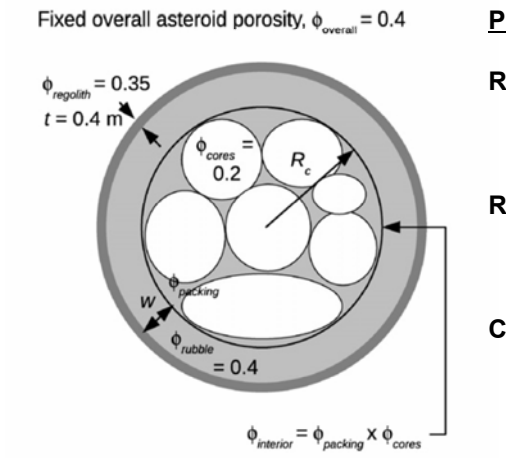
小惑星の内部構造探査
- 内部構造（Global～数mスケール）
- Porosity分布（←誘電率分布）

→小惑星の起源・進化の解明
- Accretion
- Structure modification
- Differentiation
- …



方法：
Rosetta（彗星探査機）に搭載実績のある
Consert（Bistatic radar）を小惑星探査に適用する。
→ASSERT (Observation of Asteroid by Consert)

観測すべき空間スケール：Itokawaの場合



[Barnouin-Jha et al., 2008]

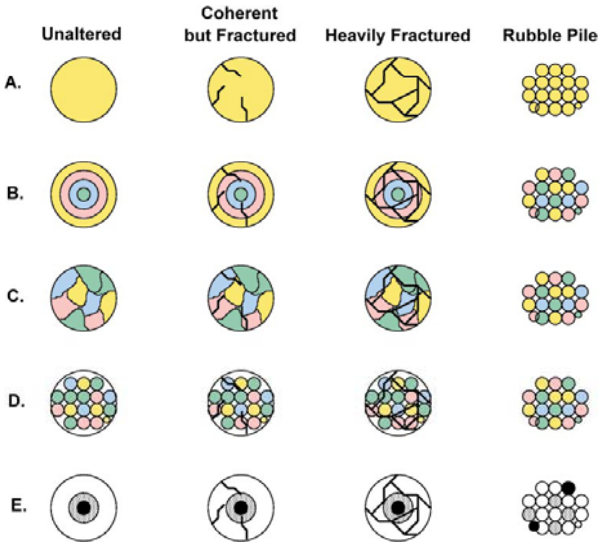
Proposed Structure

Regolith:
- Thickness: 0.4m
- Porosity: 0.35

Rubble:
- Thickness: <80m
- Porosity: 0.4

Cores:
- Diameter: ~200m
- Porosity: 0.2

小惑星の内部構造：どのモデルに合致？



A. The undifferentiated model (Wetherill & Chapman, 1988)

B. The onion shell model (Miyamoto et al., 1981)

C. The heterogeneously heated model (McCoy et al., 1990)

D. The metamorphosed planetesimal model (Scott & Rajan, 1981)

E. The differentiated model (Wetherill and Chapman, 1988)

Rosetta

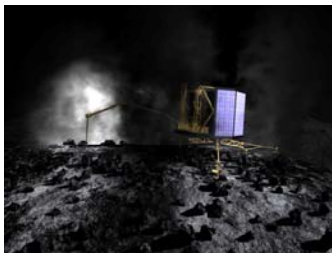
ESAの彗星探査機
観測対象：Churyumov- Gerasimenko彗星（3AU@2014年）

Orbiter
観測期間：18ヶ月
軌道半径：5～30km
観測項目
Surface Remote sensing : Imager & UV, IR, IRth, mW
Dust, plasma measurements
Nucleus internal structure: Radio science & Consert

Lander（PHILAE)
観測期間：7日（バッテリによる）＋α（太陽電池による）
観測項目
Chemical analysis, Drilling, Physical parameters,
Imager and microscope, Consert

運用履歴＆予定
2004年3月　打ち上げ
2014年8月　彗星周回軌道に投入
2014年11月　Landerを投下・彗星に着陸

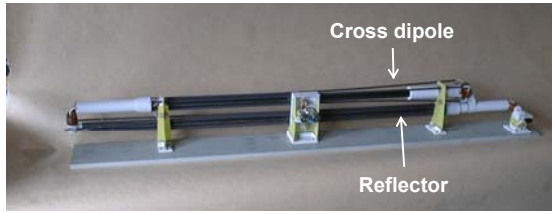
Orbiter



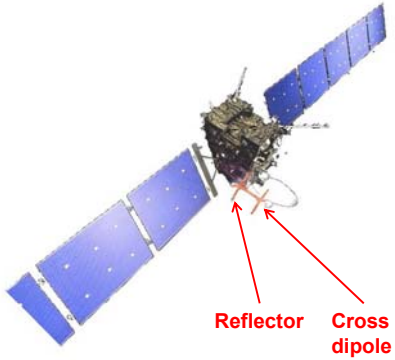
Lander (PHILAE)

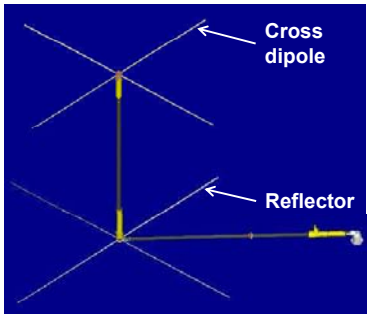
Antenna of Consert/Orbiter

Cross dipole + Reflector



Antenna of Consert/Orbiter (Folded)

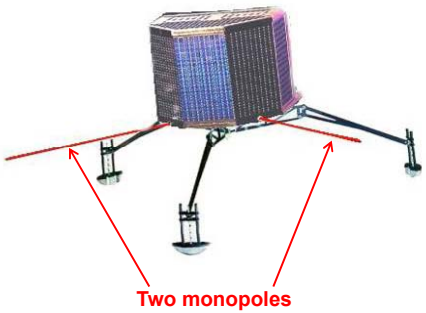




Antenna of Consert/Orbiter (Extracted)

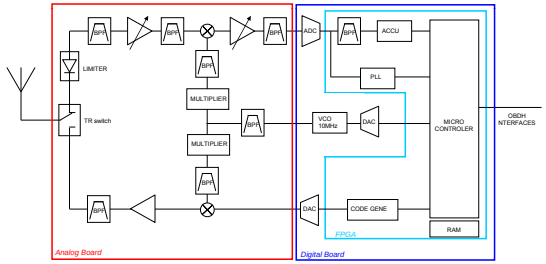
Antenna of Consert/Lander

Two monopoles

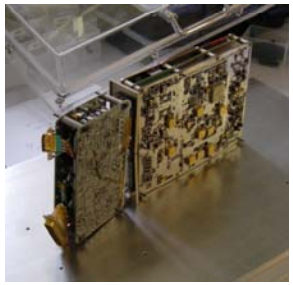


Antenna of Consert/Lander
(Folded on the lander body)

Electronics Box of Consert



送受信機のブロック図



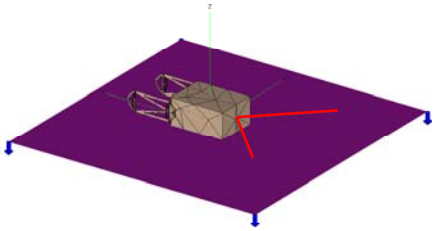
	Orbit	Lander
E box	1.5kg	1.5kg
Antenna, Harness	1.5kg	0.8kg
Volume	1500cc	1500cc
Mean power	3W	3W
RF power (TX)	2W	0.2W

送受信機の重量・サイズ・電力

ASSERT/Lander

Antenna: Two monopoles
- V configuration
- Deployment mechanism

Electronics Box: Consertに同じ

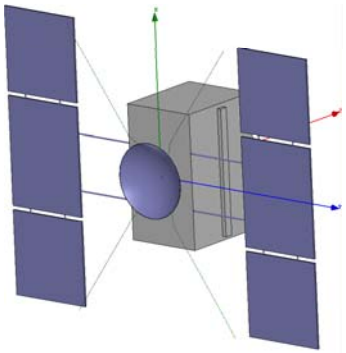


ASSERT/Orbiter

Interface TBD
- Housing, shielding, DC/DC & EMC

Antenna: TBD
- Feeding points behind the HGA (main lob + Z direction)
- Monopoles are angled
- Antenna length: 1.8m
- Deployment mechanism: TBD

Electronics Box: Consertに同じ



Resource Estimation of ASSERT

Total mass:
1920 g

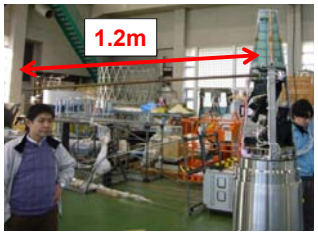
Total Power:
8 W (Average)
10 W (Max)

Data Rate:
~ 50 Mbits (Orbiter)
< 5 Mbits (Lander)

	LANDER	ORBITER
ELECTRONICS		
analogue part	125	125
Digital part	125	125
DC/DC	70	100
Housing	0	300
Shielding	150	100
colons, glue	30	70
total	**500**	**820**
ANTENNA		
Monopoles and mechanisms	180	300
harness	20	100
total	**200**	**400**
TOTAL	**700**	**1220**

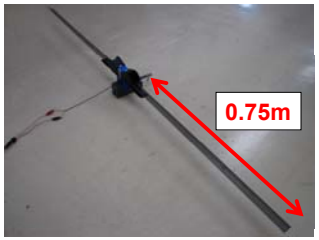
ASSERT/Orbiter用アンテナの検討

BeCu Interlocked
Bistem Antenna
(Kaguya)
2kg/unit→重すぎ



BeCu Ribbon Antenna
(Sounding rockets)
伸展長精度に難

200g/unit
(50g/element)
軽量化可能



CFRP Unistem Antenna
(ISAS搭載機器基礎開発,
H21)…現在はBBM段階

244g/unit
(8.63g/element)
軽量化可能

まとめ

Bistatic radarによる小惑星内部構造探査のため、
Hayabusa-2及びMascot LanderへのASSERTの搭載を提案.

ASSERT
・Consert/Rosettaを小惑星観測に適用
・送受信機(Orbiter/Lander双方に搭載)はConcertと同設計
・Lander側アンテナはV型モノポール
・Orbiter側アンテナは全長1.8mのクロスダイポール(位置等はTBD)
・Orbiter側の重量は1.2km、平均電力は4W