Propriétés physiques des astéroïdes géocroiseurs : le point de vue de NEOShield

Davide Perna

l'Observatoire de Paris | LESIA

Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

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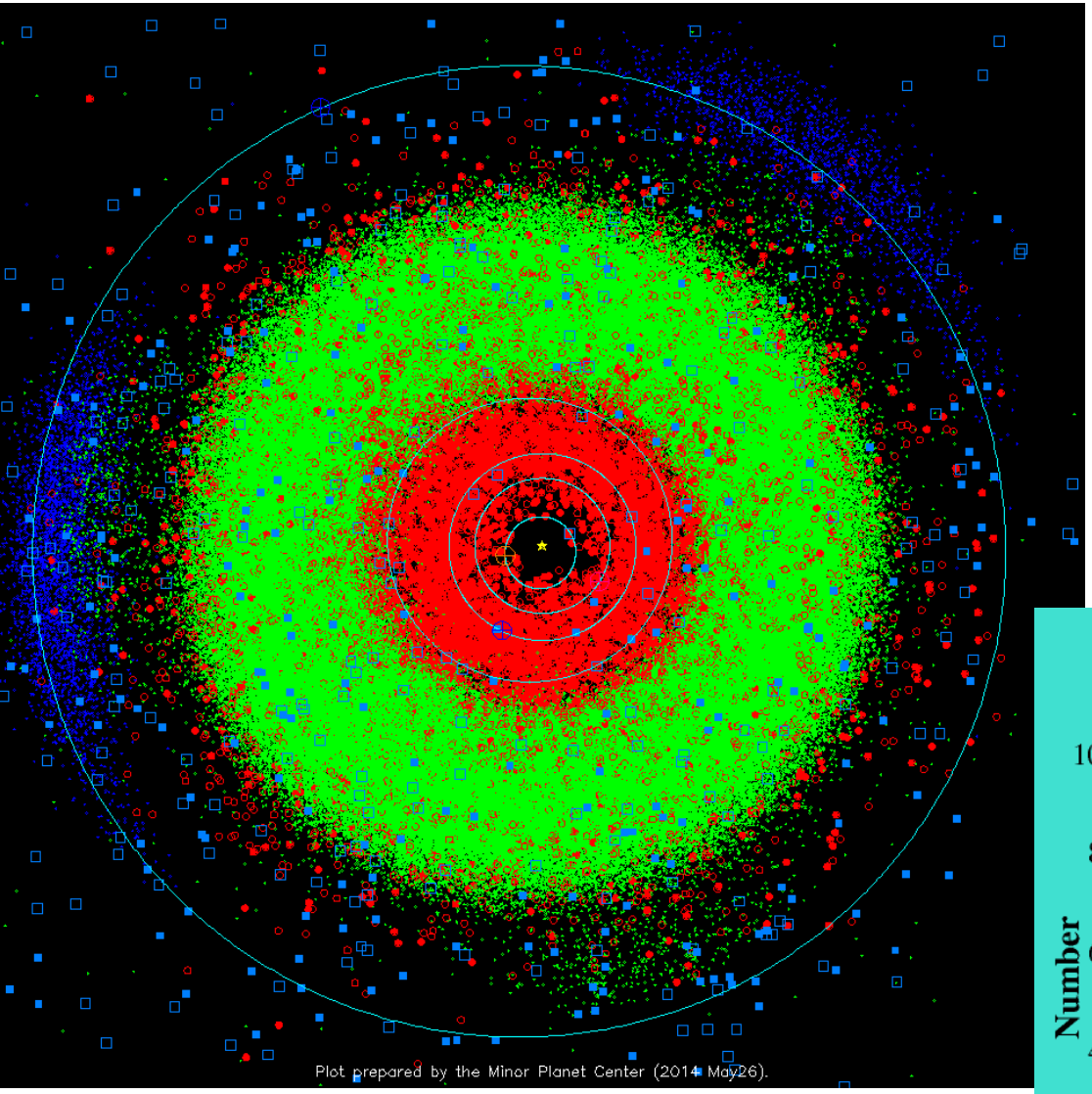
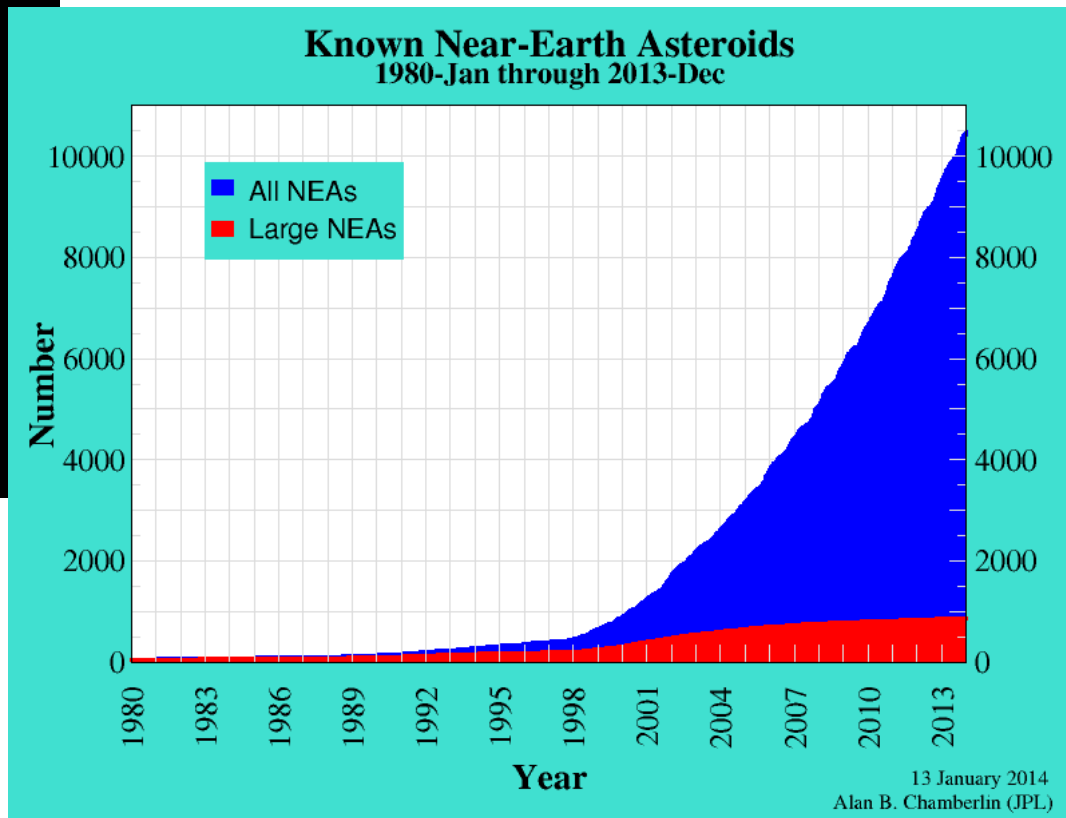
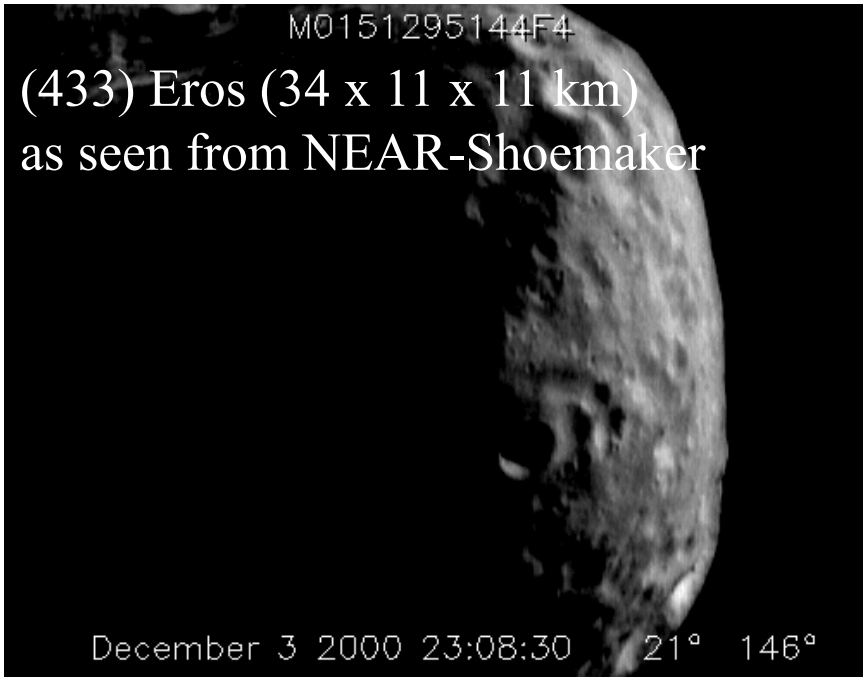
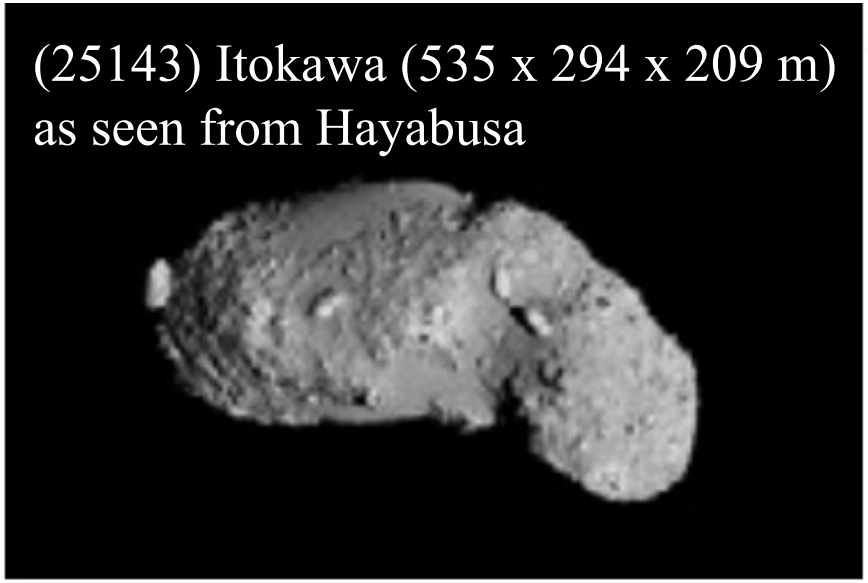
Les 11069 géocroiseurs connus, ce matin…

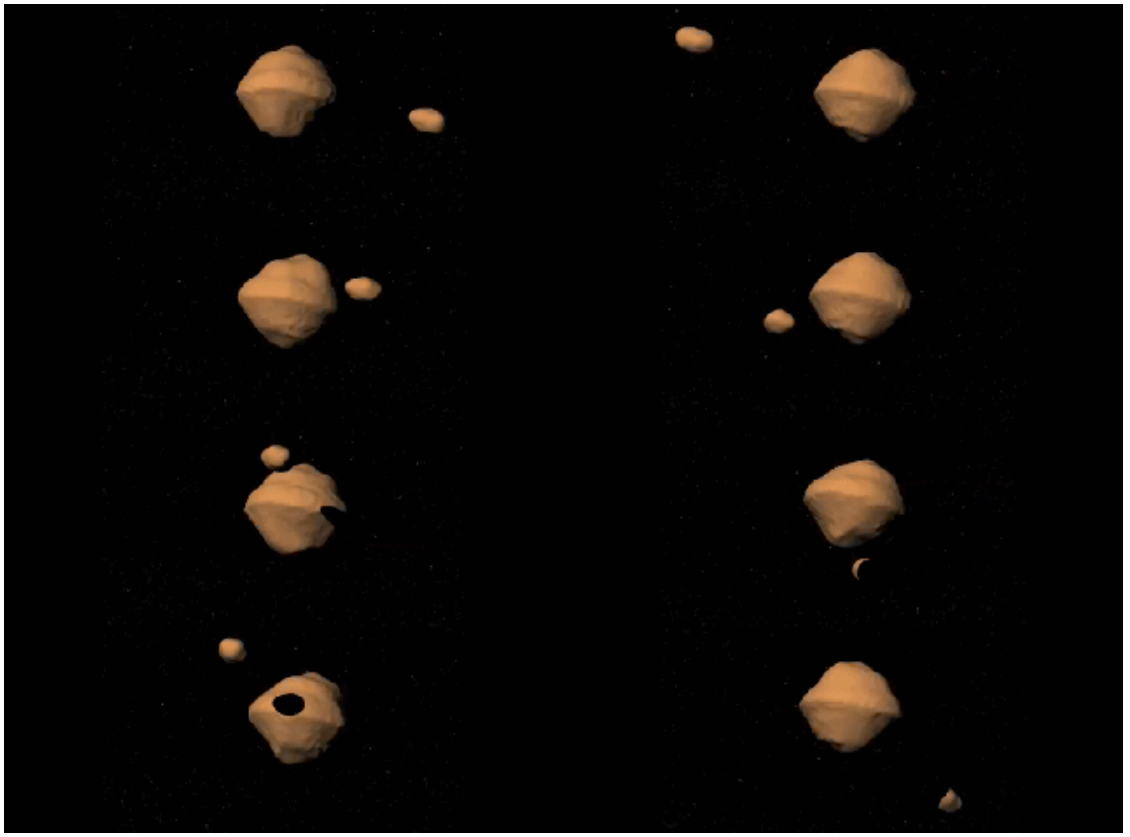




Une grande diversité de propriétés physiques

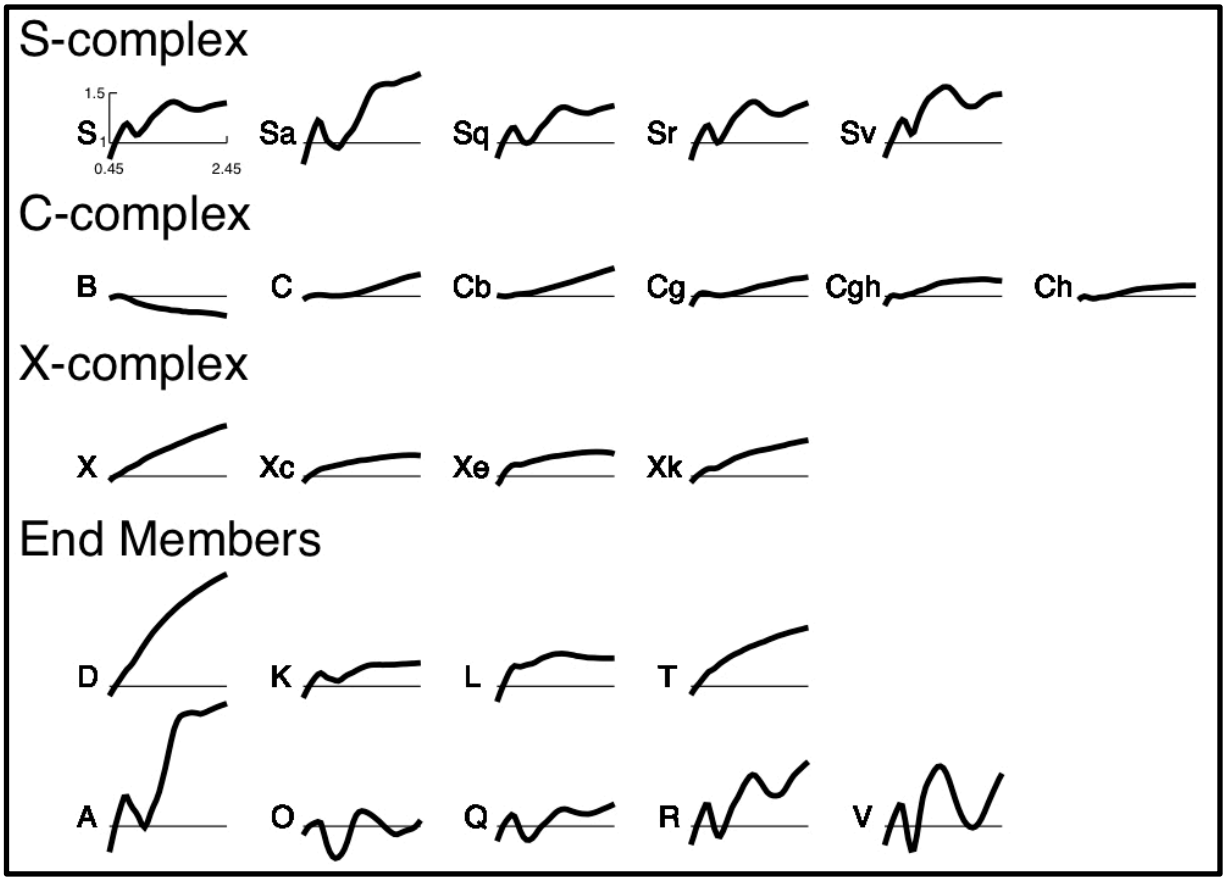


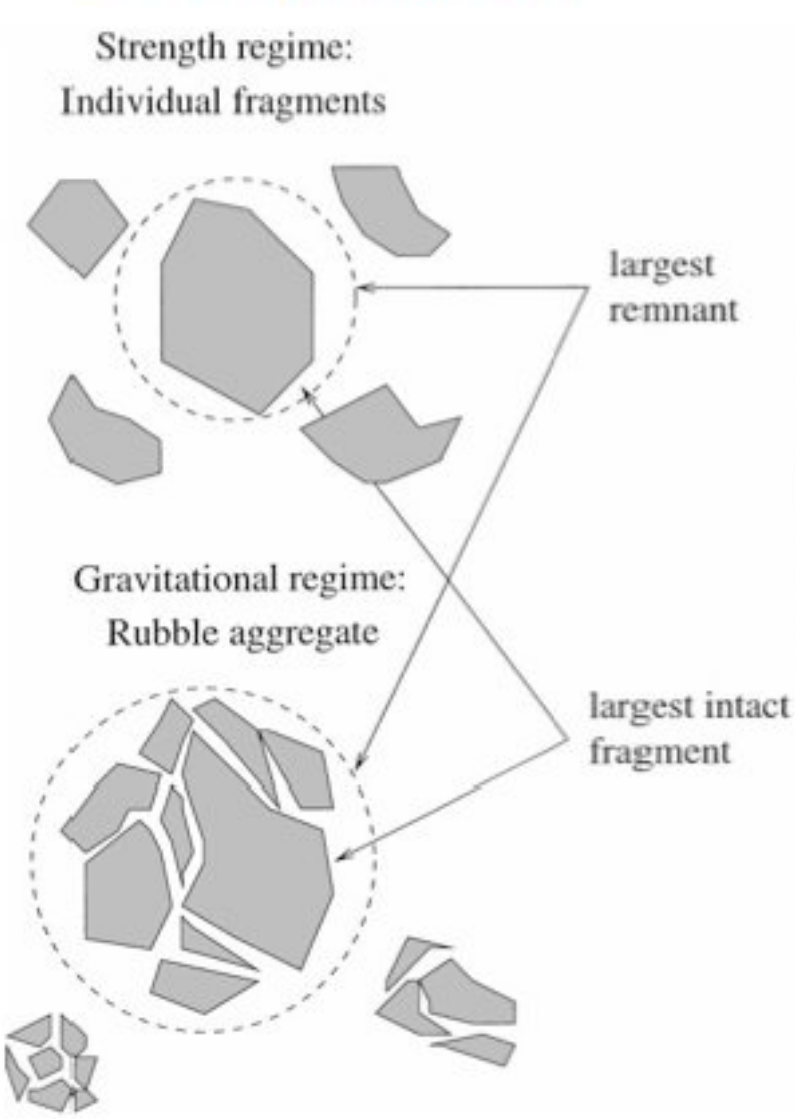




Binary NEA (66391) 1999 KW4
(~1.5 km + ~0.5 km), radar shape model

Une grande diversité de propriétés physiques





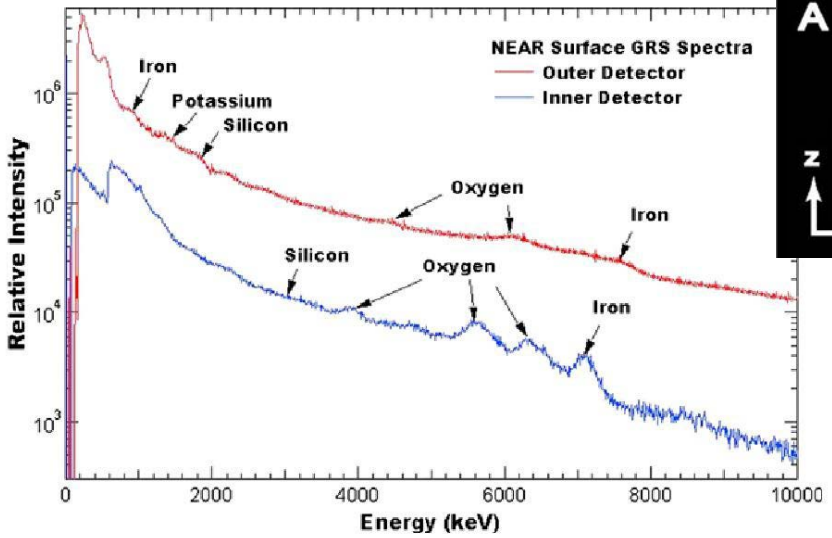
Une grande diversité de propriétés physiques

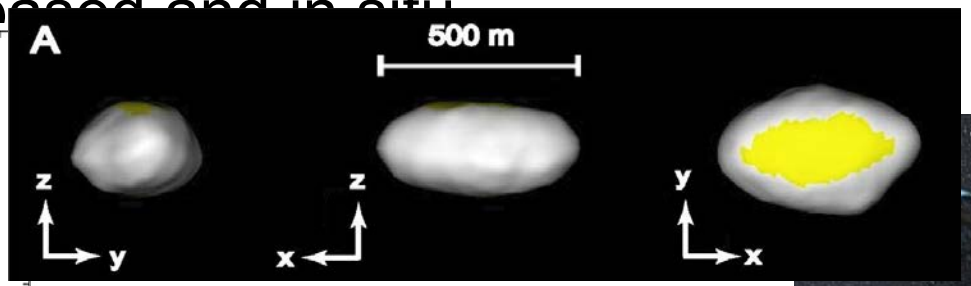
Within NEOShield:

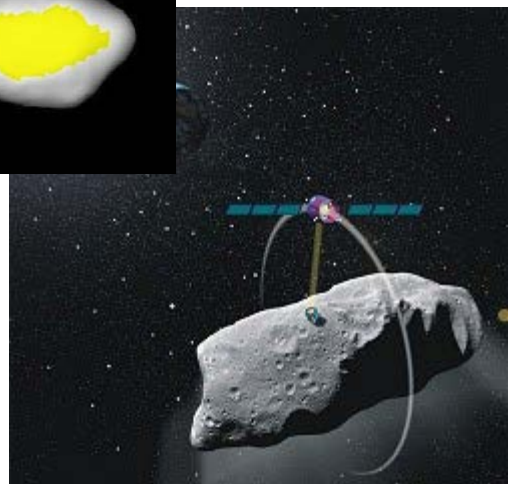
- Identification of what physical properties are relevant to each of the mitigation methods.

- Examination of the relevance and accuracy of a variety of observational techniques and data types to provide this crucial information.

- Definition of a strategy for the necessary reconnaissance observations, both Earth-based and in situ







Ready to Launch

Build and Launch

Last chance if asteroid too big and/or short warning time. Still, try to avoid fragmentation…

Nuclear

Diameter (m)

1000

100

50

20

10

Kinetic

Tractor

Civil Defense

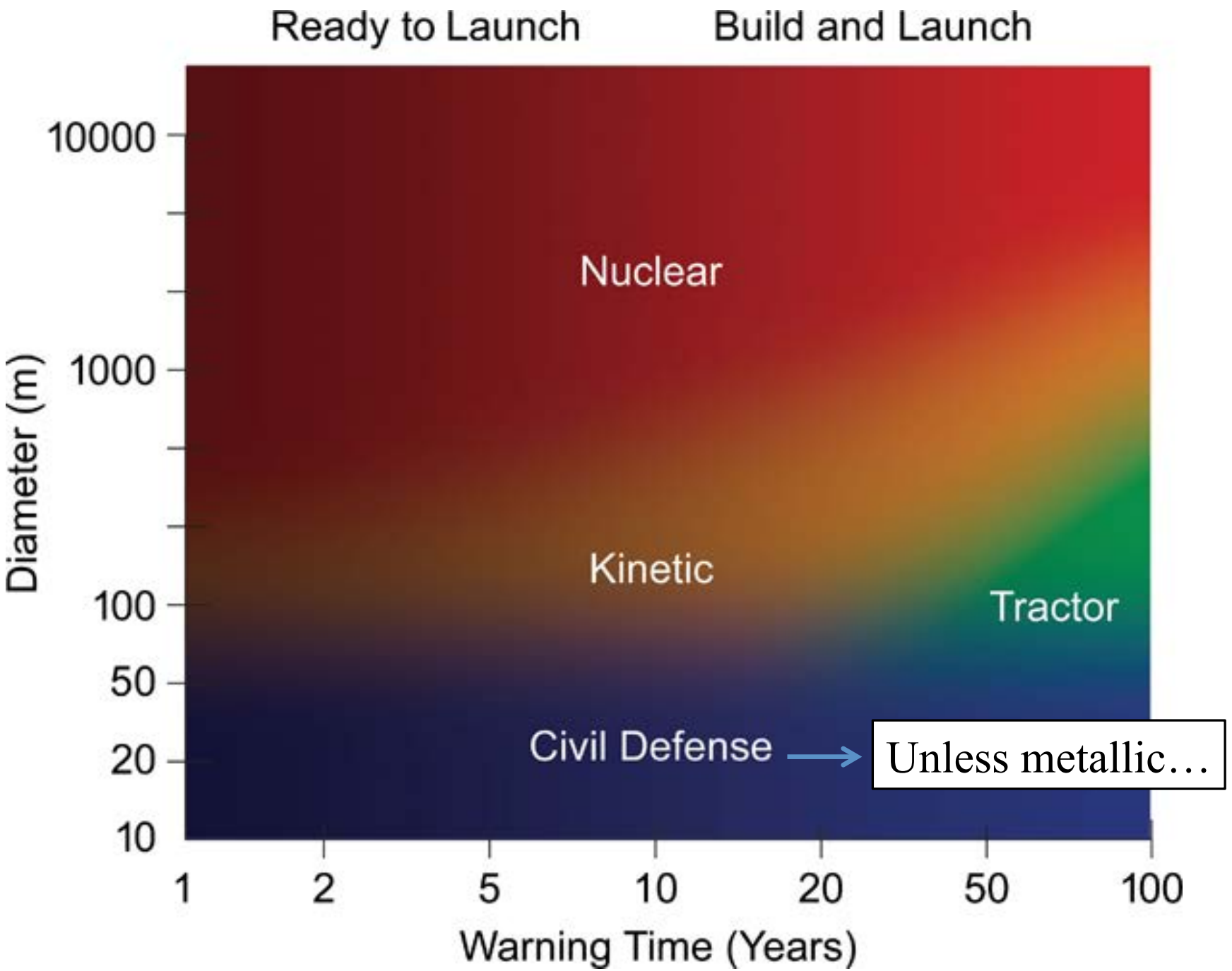
10

g Time (Y

Most mature technique:

- ESA Don Quijote mission study
- NASA Deep Impact mission

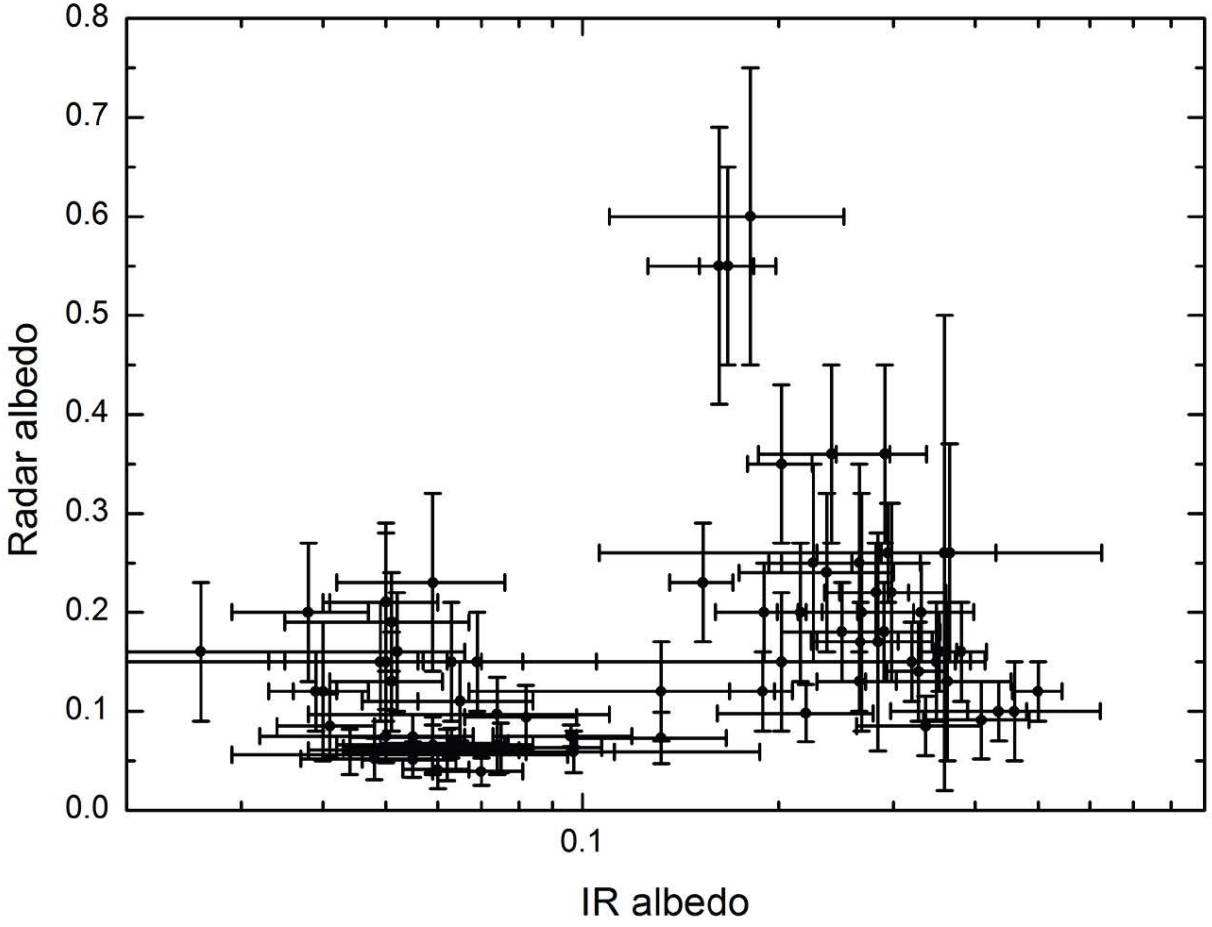
No physical attachment, uses gravity as a towline. Most insensitive technique to the asteroid's physical properties


Ready to Launch
Build and Launch
10000
1000
100
50
20
10
Diameter (m)
Nuclear
Kinetic
Tractor
Civil Defense
Unless metallic…
1
2
5
10
20
50
100
Warning Time (Years)

Quelques exemples des résultats de NEOShield (1/3)

η parameter as a proxy of the metal content of asteroids?

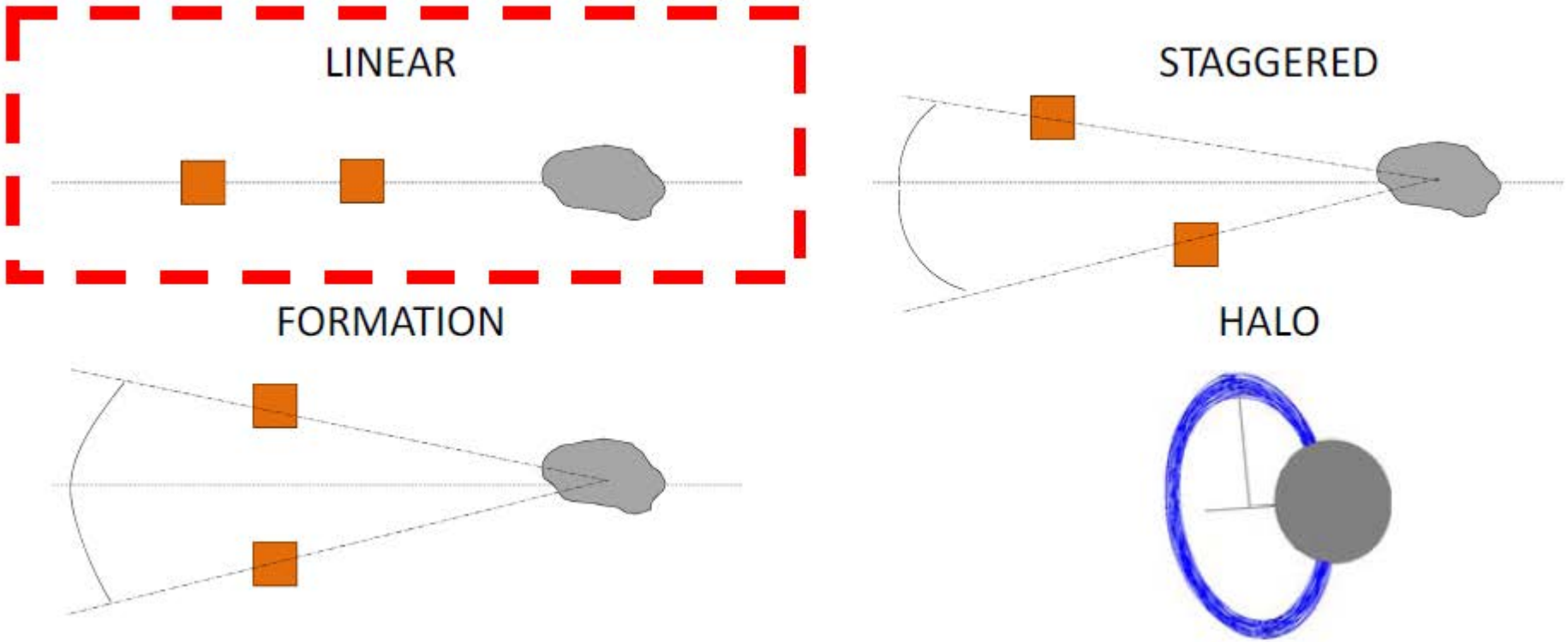
(higher values of η for asteroids with enhanced values of surface thermal conductivity due to high metal content)



Quelques exemples des résultats de NEOShield (2/3)

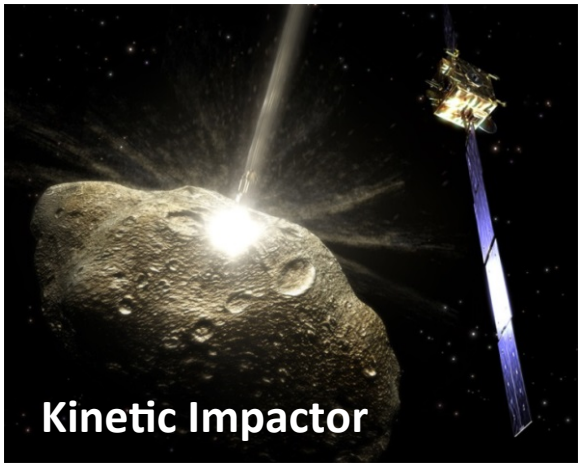
Identify critical issues of mitigation techniques

GRAVITY TRACTOR:
"This proposed deflection method is insensitive to the structure, surface properties and rotation state of the asteroid." (Lu & Love 2005, Nature 438, 177)



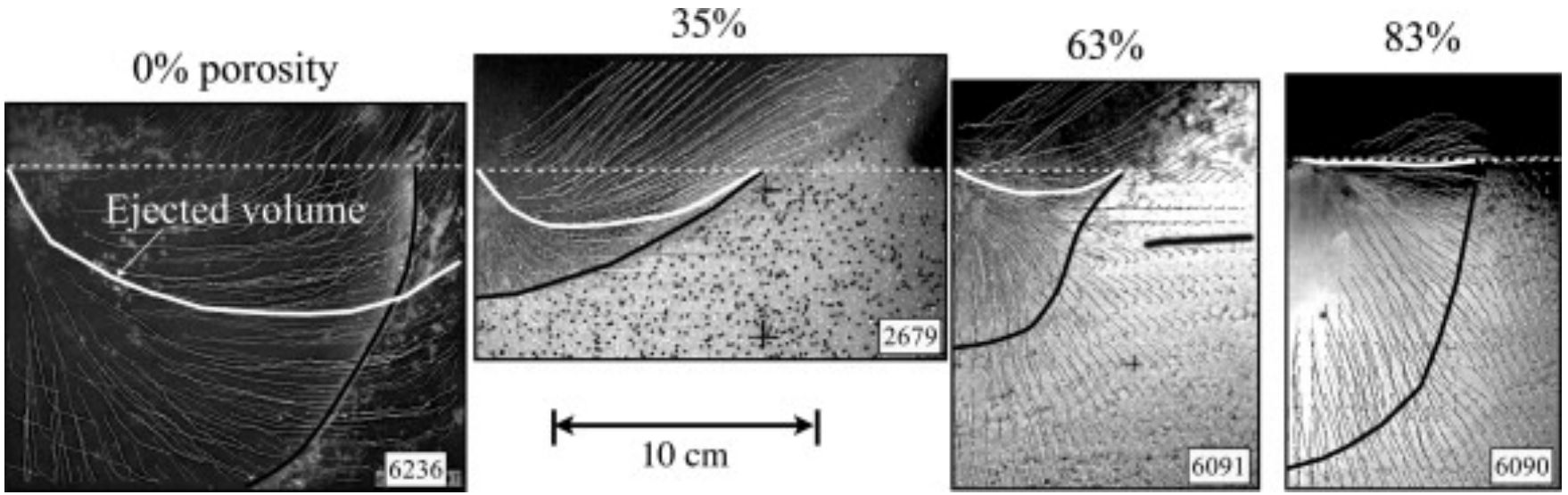
Quelques exemples des résultats de NEOShield (3/3)

Identify critical issues of mitigation techniques



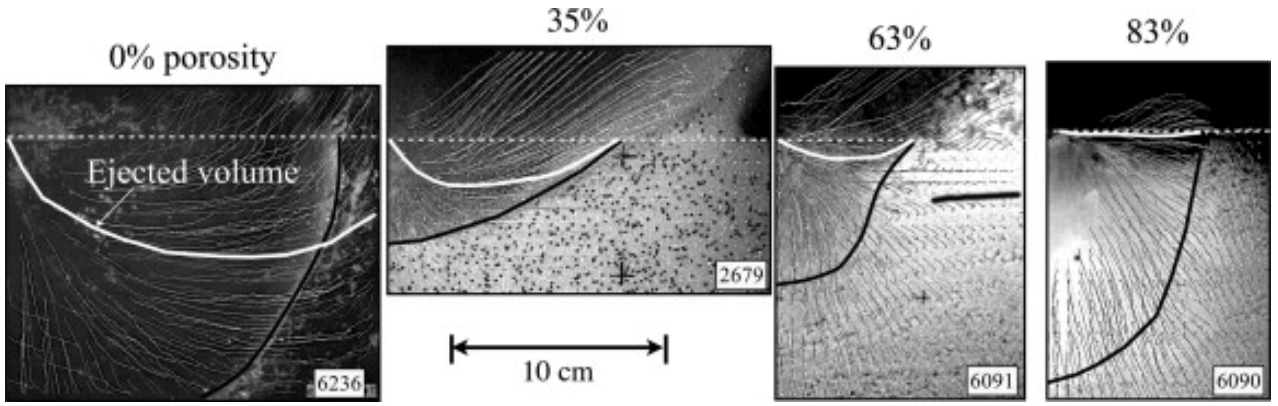
momentum transfer enhancement due to ejecta

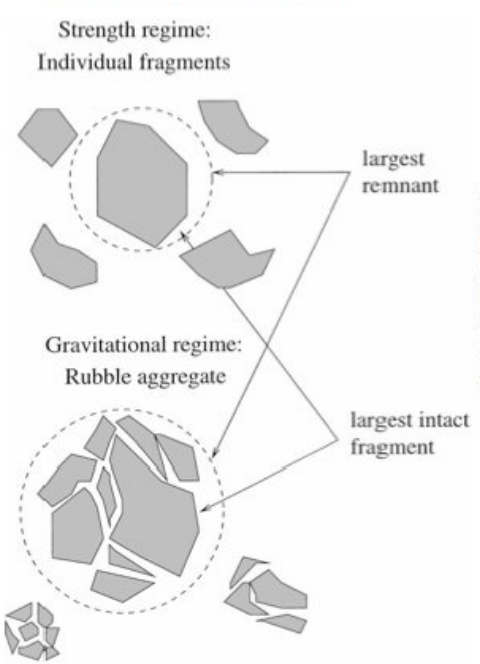
$$\Delta V = K \frac{m}{m+M} v_{rel}$$

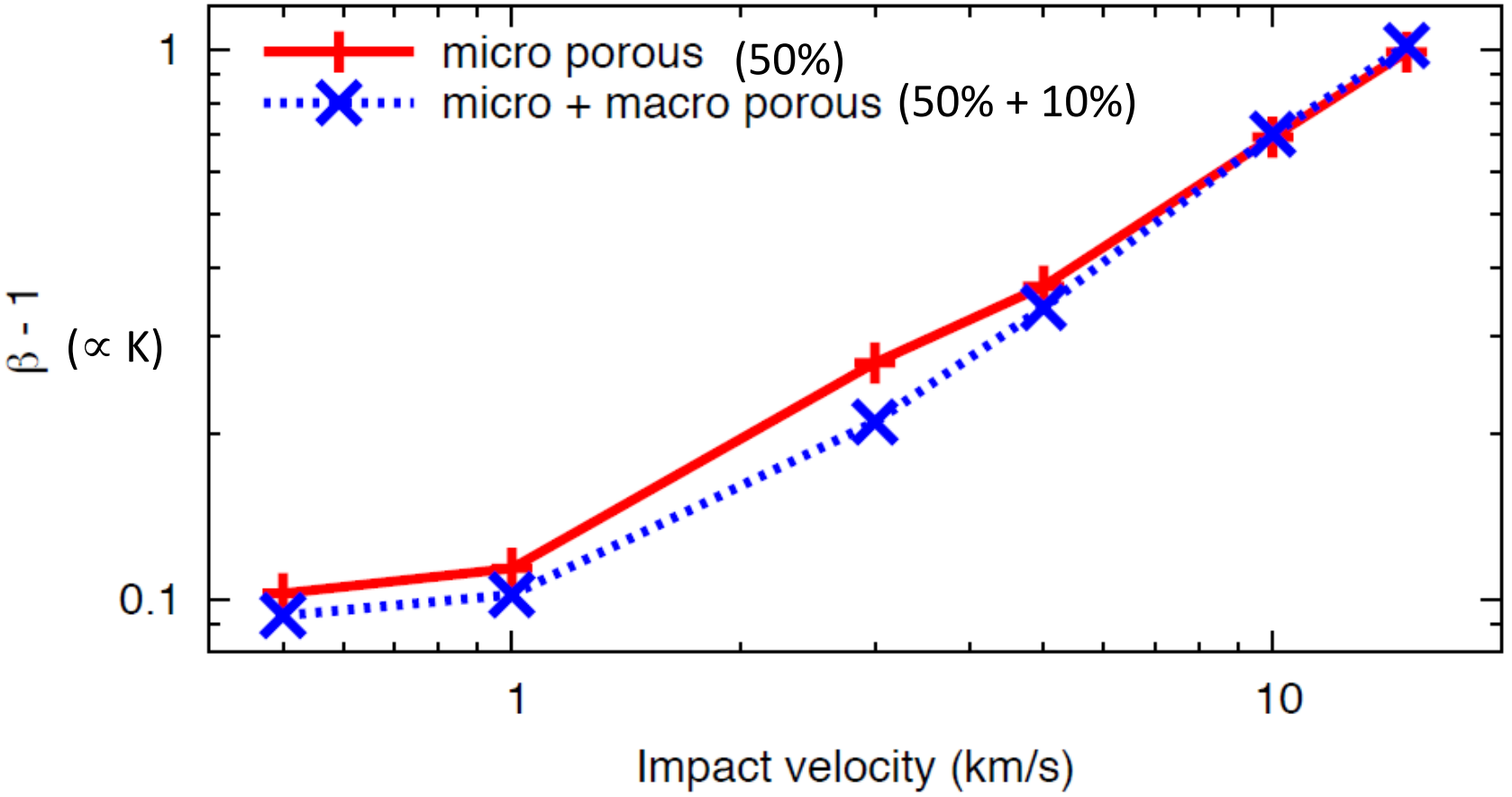


Housen & Holsapple (2012)

Quelques exemples des résultats de NEOShield (3/3)







Instrumentation pour une mission spatiale de reconnaissance

We study the appropriate instrumentation for

i) mitigation precursor missions
(real menace, “no limits”)

ii) mitigation demo missions
(balancing scientific return, cost, system impact, technological readiness)

	Heritage	Mass (kg)	Power (W)
Radio Science Exp.	Contained in the resources of the spacecraft radio subsystem	---	---
Camera	AMIE / SMART-1	2,3	2,2
LIDAR	NLR / NEAR-Shoemaker (LIDAR / Hayabusa)	5.3 (3.7)	17.3 (17 + heater)
Thermal-IR spec.	MERTIS / BepiColombo	2,6	9,4
Vis-NIR spec.	MaRIS / MarcoPolo-R	6,2	20

Un mot de conclusion:

For a recent review about NEOs and their associated impact risk, you can consult:

"The near-Earth objects and their potential threat to our planet"

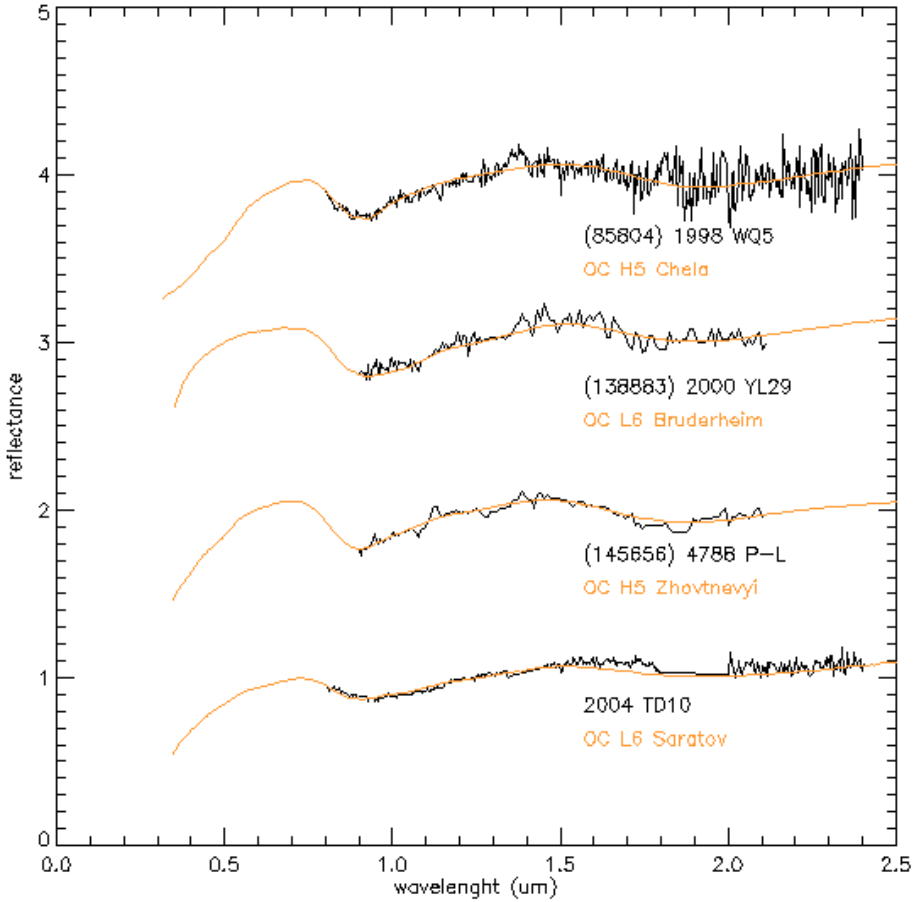
D. Perna, M.A. Barucci, M. Fulchignoni

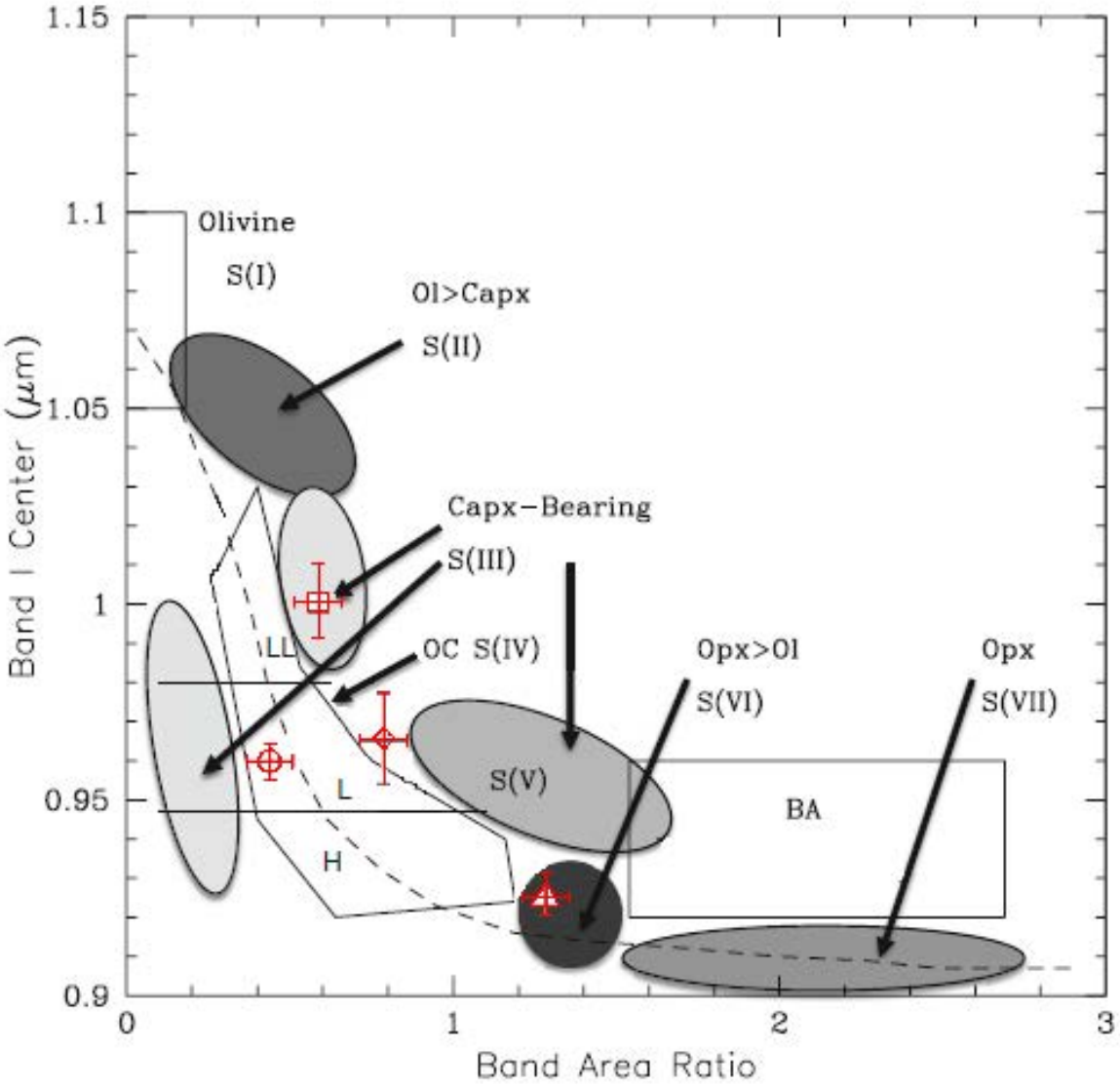
Astronomy & Astrophysics Review (2013) 21:65

Merci !

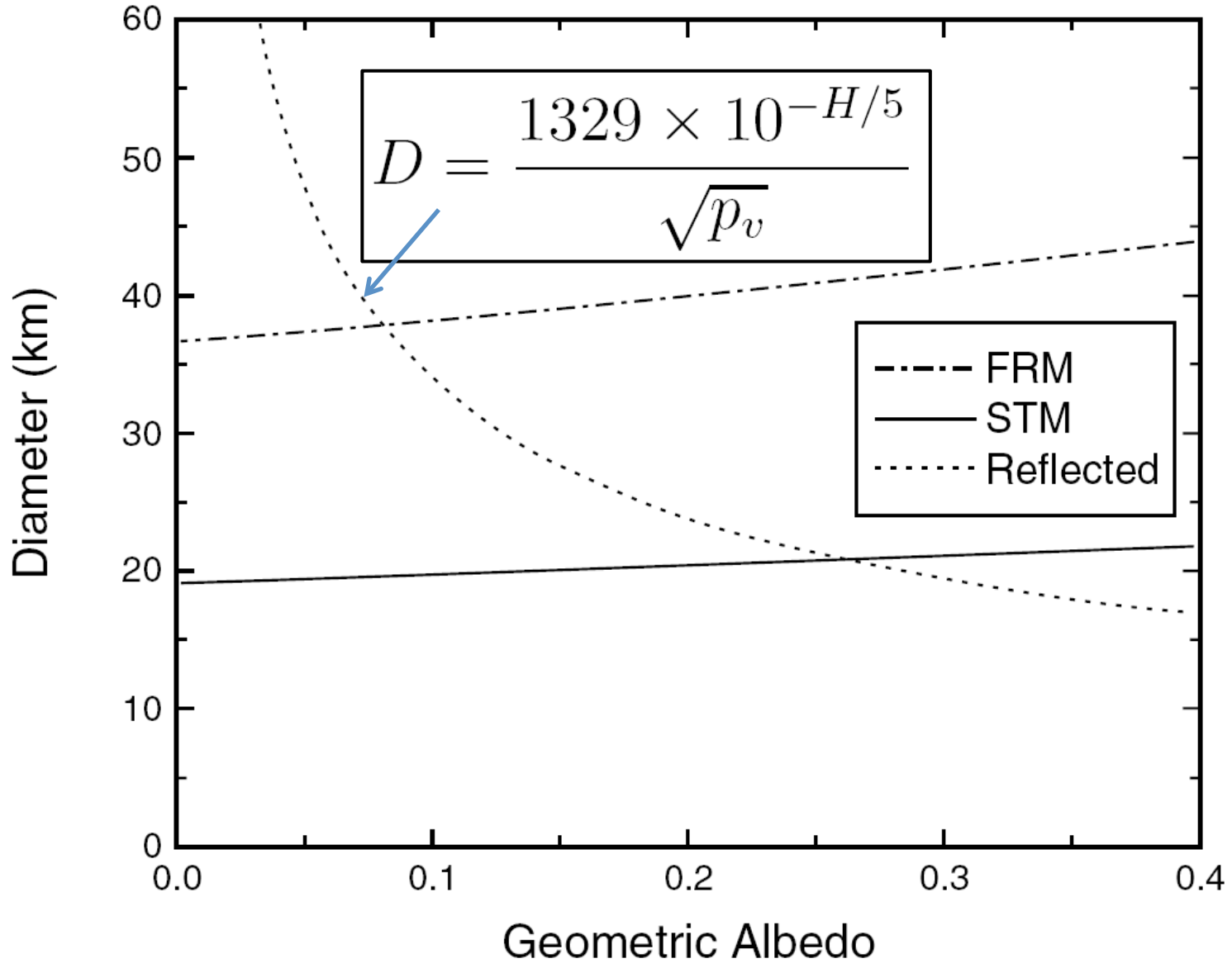
Diapositives supplémentaires

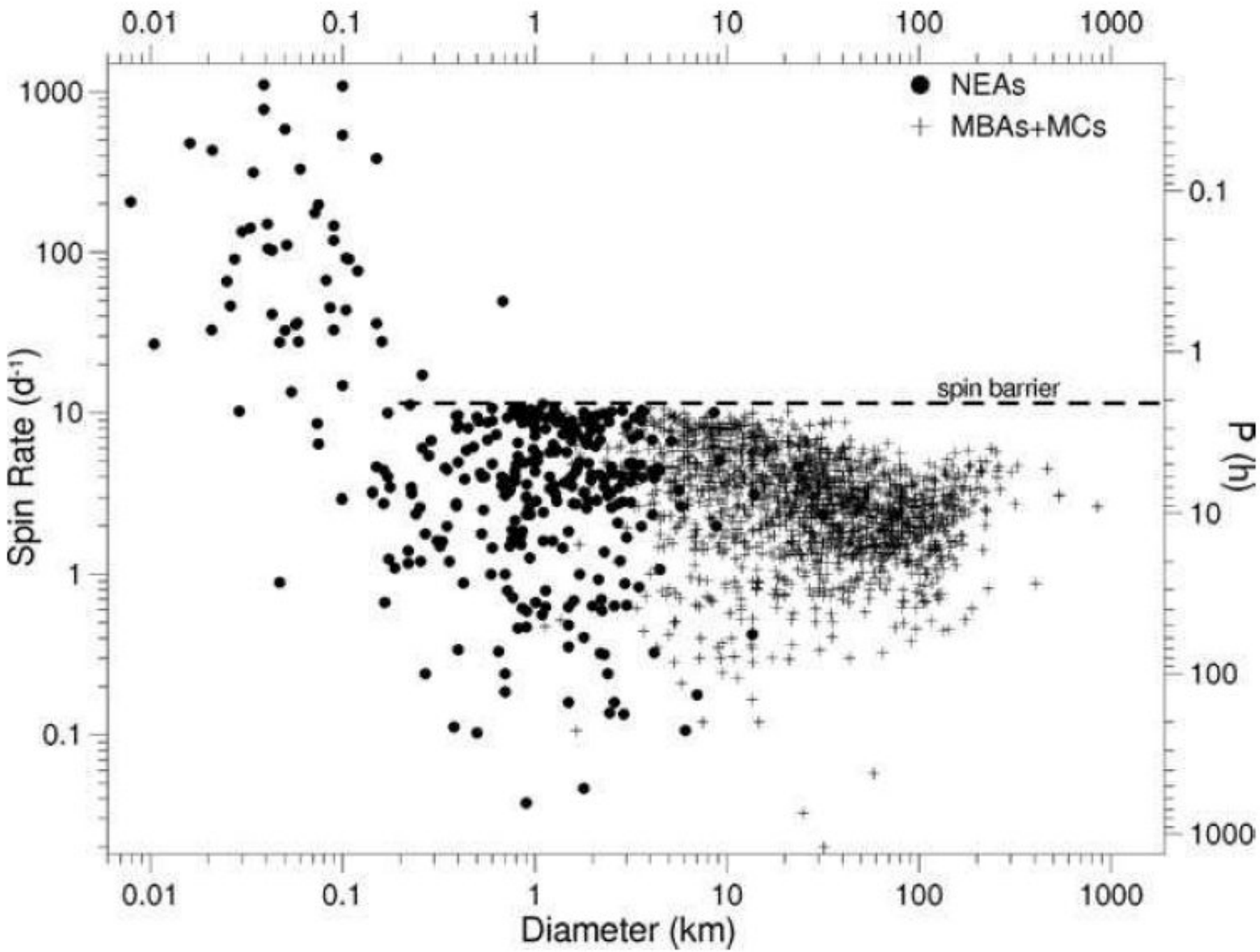
Analyse des spectres

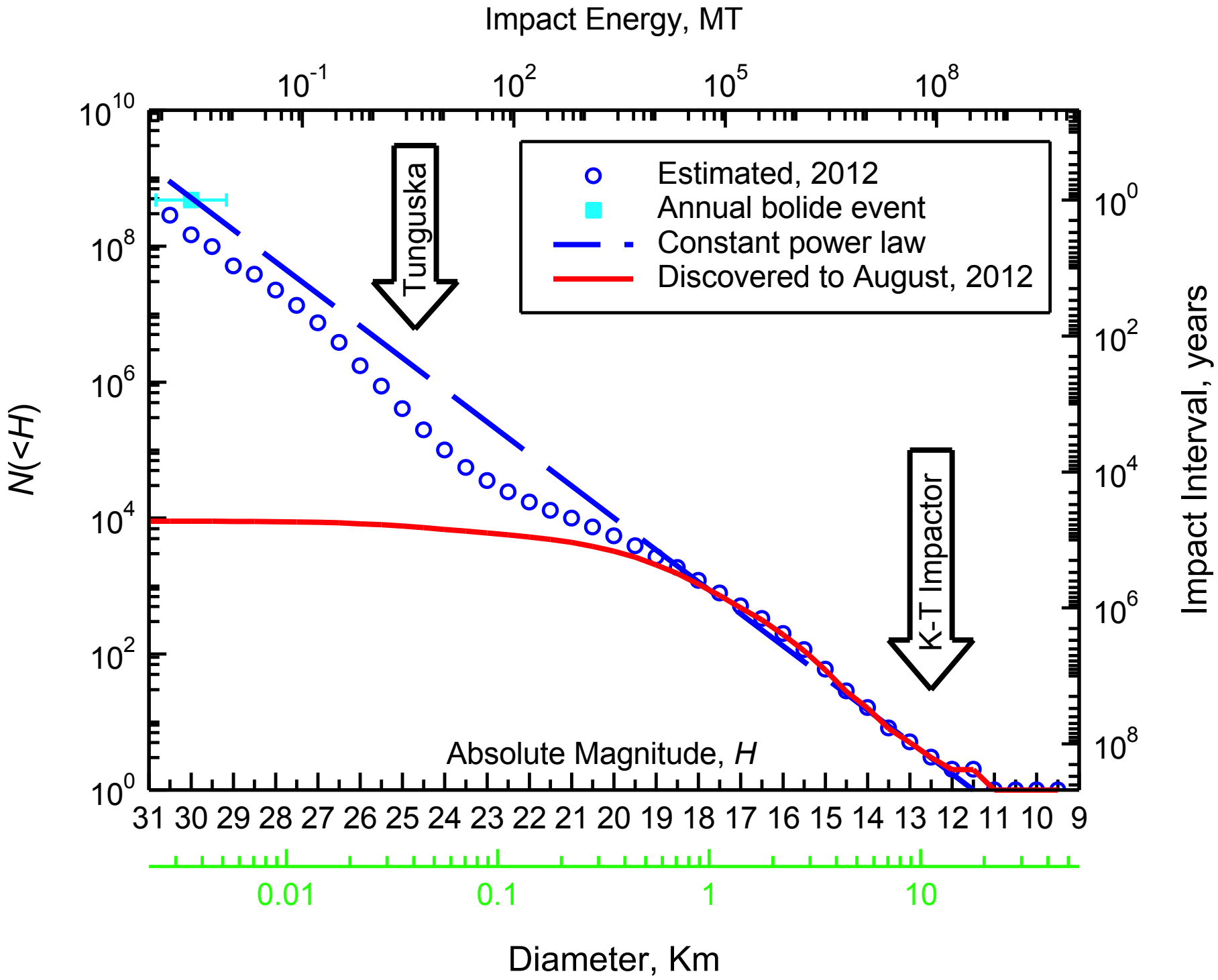




Technique radiométrique




0.01
0.1
1
10
100
1000
NEAs
MBAs+MCs
spin barrier
Spin Rate (d-1)
P (h)
Diameter (km)


Impact Energy, MT
10^-1
10^2
10^5
10^8
10^10
10^8
10^6
10^4
10^2
10^0
N(<H)
Tunguska
K-T Impactor
Estimated, 2012
Annual bolide event
Constant power law
Discovered to August, 2012
10^0
10^2
10^4
10^6
10^8
Impact Interval, years
Absolute Magnitude, H
31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9
0.01
0.1
1
10
Diameter, Km