

Near-Earth Asteroids as source of meteors

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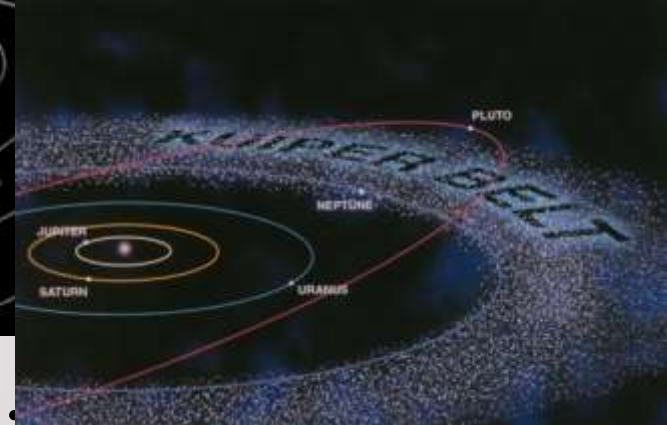
e-mail: Mirel.Birlan@imcce.fr



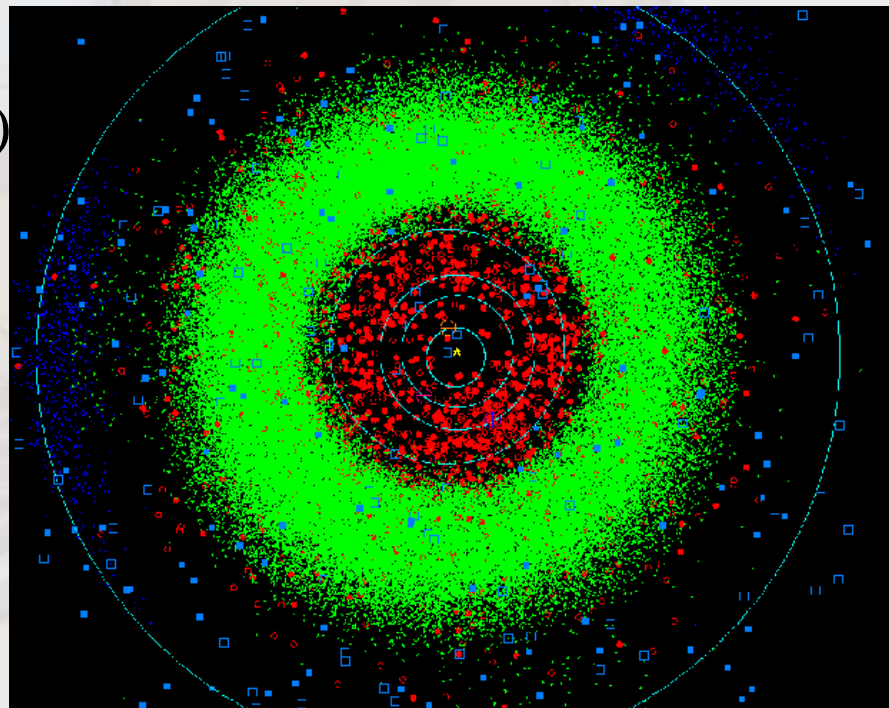
Solar System

Mercure
Venus
Terre
Mars
Jupiter
Saturn
Uranus
Neptune

(cf UAI, Res 5, 2006)

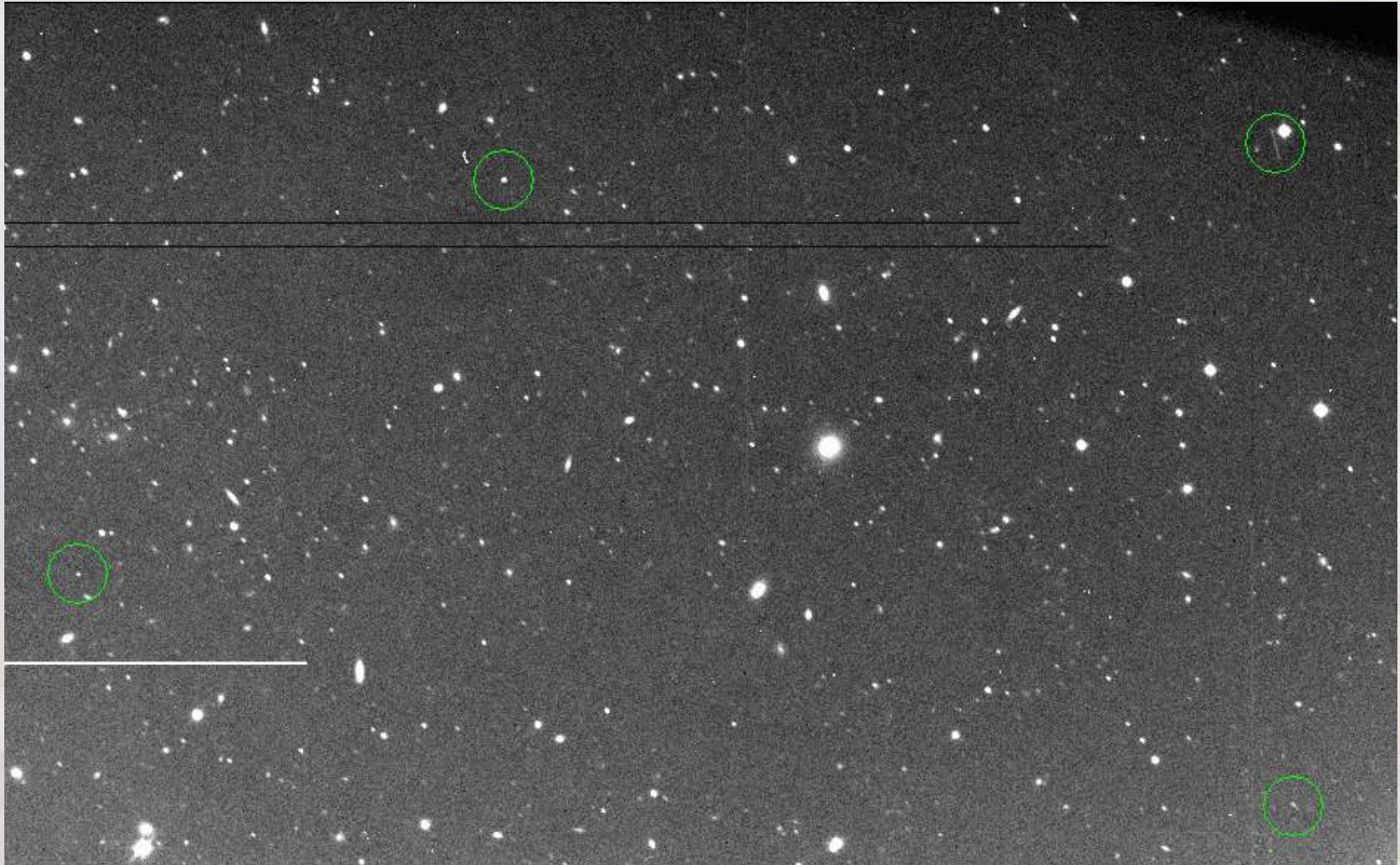


Dwarf planets: Pluton, Cérès, ...



Asteroids &
Near-Earth
Objects...

ESO-La Silla MPG/WFI 2.2 m telescope (12 Mars 2008)

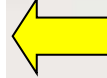
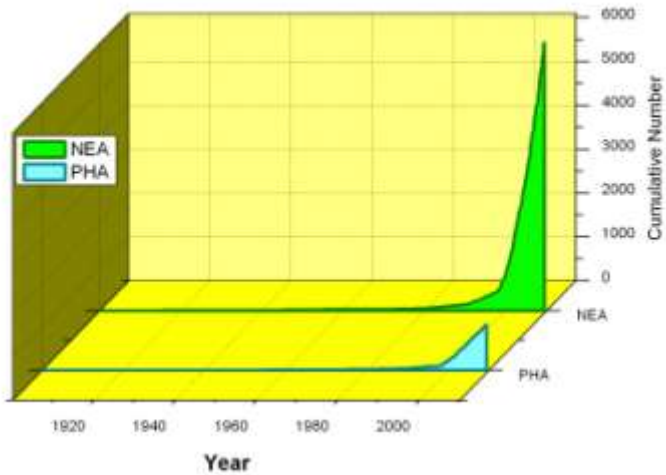


Credits:



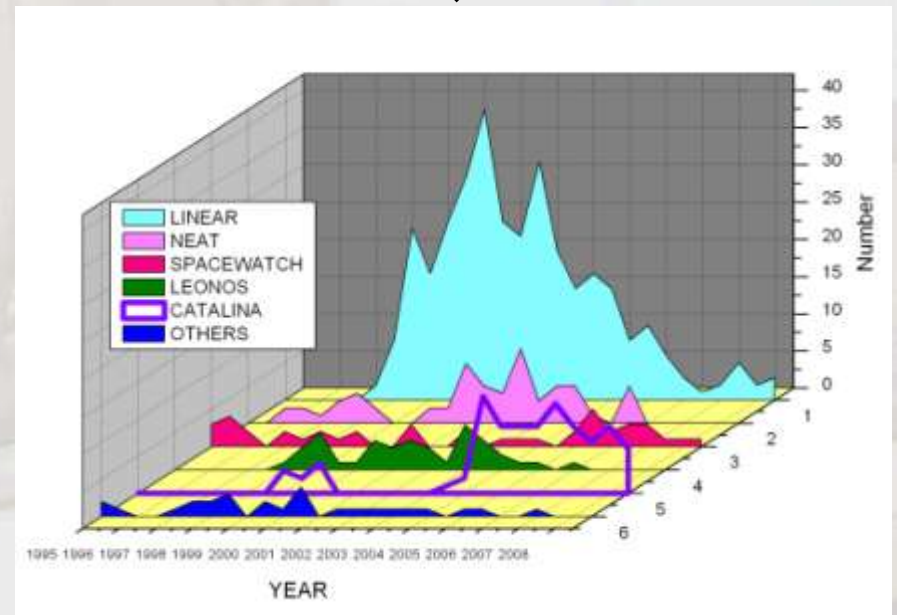
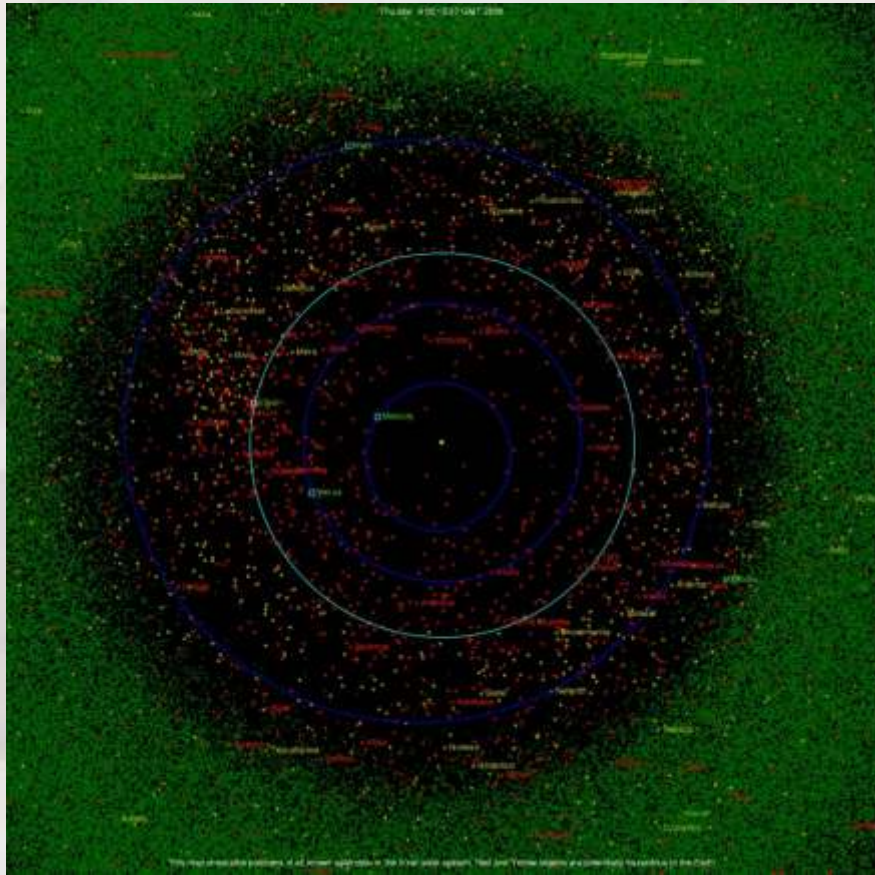
September 2011

Mirel Birlan - IMC2011-Sibiu



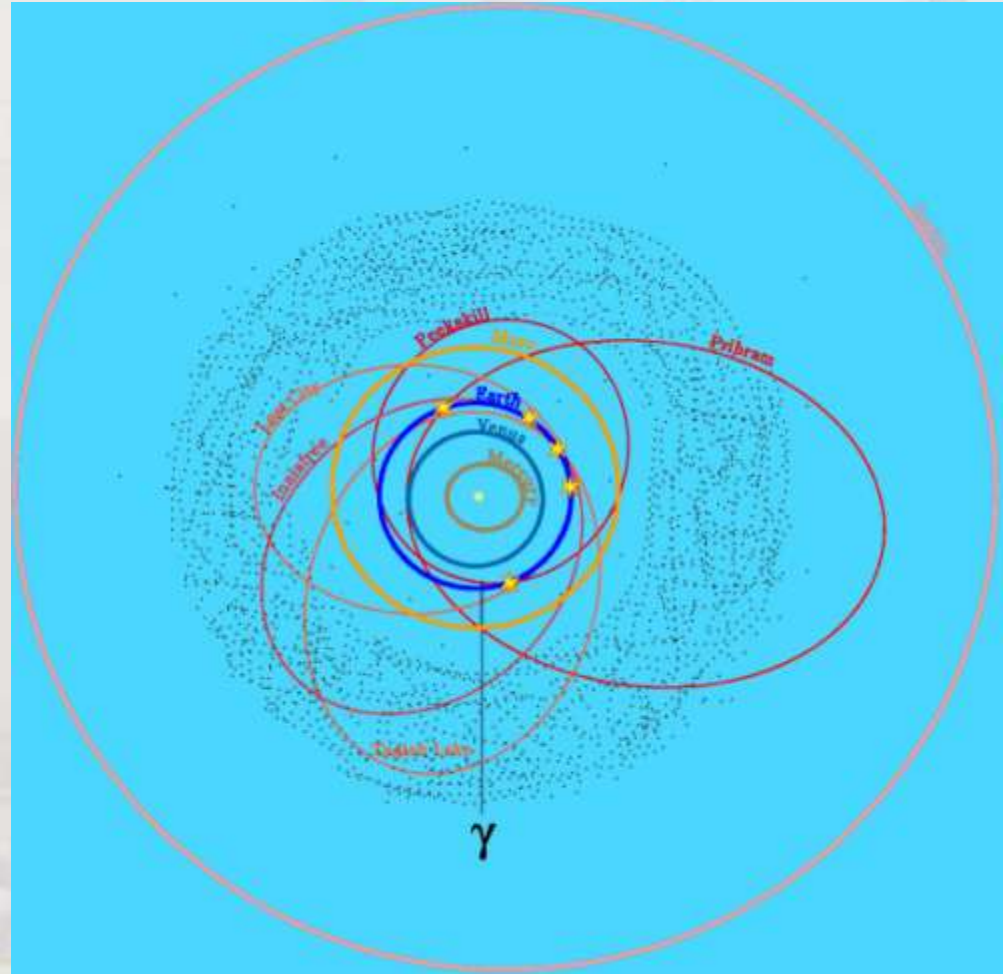
Statistics (April 17, 2009):
 NEA – 6,113 objects
 PHA – 1,041 objects

Discovery statistics for the
 Main Surveys of NEAs



Why asteroids during IMC?

- Origin of Meteorites?



Courtesy: Mathieu Gounelle

Why asteroids during IMC?

- Physical properties of asteroids
<=>constrains for meteoroids (meteors and meteorites)

Example: porosity



Spectroscopy of NEAs

(Visible & Near Infra-Red Regions)



SpeX 0.8-5.4 micron Medium-Resolution

IRTF Middle-class telescope (aperture = 3 m)
Mauna Kea, Hawaii

Infrastructure:

- Two(One) PC's (Linux OS)
- Polycom conference system
- Three regular internet connections
- Telephone (backup)
- Connections via ssh or vnc tunnels



Videoconference system

Spectrograph acquisition terminal

Guiding camera display



Centre d'Observation à Distance en Astronomie à Meudon

MOVIE, DAYLIGHT RUN FROM MEUDON



September 2011

MAY 2002 IRTF TELESCOPE SCHEDULE

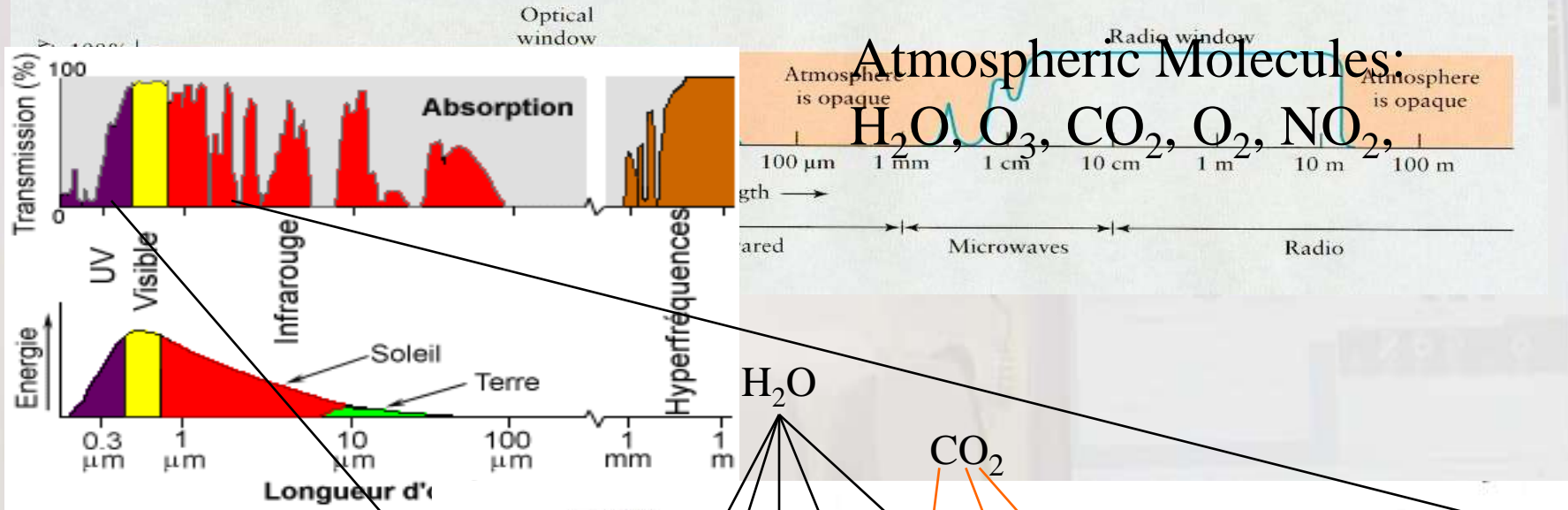
HST Date	HST Time	TO	Prog and PI	Instrument	SA	Comment
May. 1 We	18:00 - 06:00	B	051 Joseph	SpeX	JTR	
May. 2 Th	07:00 - 14:00	B	006 Sprague	SpeX/CSHELL	JTR	Day tim
	18:00 - 06:00	B	064 Rothberg	SpeX	JTR	
May. 3 Fr	07:00 - 14:00	B	006 Sprague	SpeX/CSHELL	JTR	Day tim
	18:00 - 06:00	B	064 Rothberg	SpeX	JTR	
May. 4 --	07:00 - 14:00	B	006 Sprague	SpeX/CSHELL	JTR	
	18:00 - 06:00	B	058 Howell	SpeX	SJB	
May. 5 --	07:00 - 14:00	B	006 Sprague	SpeX/CSHELL	JTR	
	18:00 - 06:00	B	058 Howell	SpeX	SJB	
May. 6 Mo	18:00 - 23:59	D	014 Binzel	SpeX	JTR	
	23:59 - 06:00	D	045 Cotera	SpeX/T-T	JTR	
May. 7 Tu	18:00 - 23:59	D	014 Binzel	SpeX	JTR	
	23:59 - 06:00	D	045 Cotera	SpeX/T-T	JTR	
May. 8 We	18:00 - 23:59	D	026 Marion	SpeX	SJB	Remote
	23:59 - 06:00	D	083 Pizagno	SpeX	SJB	
May. 9 Th	18:00 - 23:59	D	026 Marion	SpeX	SJB	Remote
	23:59 - 06:00	D	083 Pizagno	SpeX	SJB	
May. 10 Fr	18:00 - 06:00	B	040 Turnshak	NSFCAM	SJB	
May. 11 --	18:00 - 06:00	B	040 Turnshak	NSFCAM	SJB	
May. 12 --	18:00 - 06:00	B	040 Turnshak	NSFCAM	SJB	
May. 13 Mo	18:00 - 18:30	B	050 Orton	NSFCAM	SJB	Service
	18:30 - 06:00	B	040 Turnshak	NSFCAM	SJB	
May. 14 Tu	18:00 - 06:00	D	012 Tokunaga	SpeX	SJB	
May. 15 We	18:00 - 06:00	D	012 Tokunaga	SpeX	SJB	
May. 16 Th	18:00 - 06:00	D	057 Marsh	SpeX	SJB	
May. 17 Fr	18:00 - 06:00	D	057 Marsh	SpeX	SJB	
May. 18 --	18:00 - 06:00	B	071 Barsony	SpeX	SJB	
May. 19 --	18:00 - 06:00	B	071 Barsony	SpeX	SJB	
May. 20 Mo	18:00 - 06:00	B	071 Barsony	SpeX	SJB	
May. 21 Tu	18:00 - 06:00	B	999 Engineering			Inst.spo
May. 22 We	18:00 - 06:00	D	999 Engineering			-
May. 23 Th	18:00 - 06:00	D	999 Engineering			-
May. 24 Fr	18:00 - 06:00	D,P	999 Engineering			-
May. 25 --	18:00 - 06:00	P	020 Beck	SpeX	SJB	
May. 26 --	18:00 - 06:00	P,B	020 Beck	SpeX	SJB	Full mo
May. 27 Mo	18:00 - 06:00	B	016 Rayner	SpeX	JTR	
May. 28 Tu	18:00 - 06:00	B	016 Rayner	SpeX	JTR	

MAY2005 IRTF TELESCOPE SCHEDULE

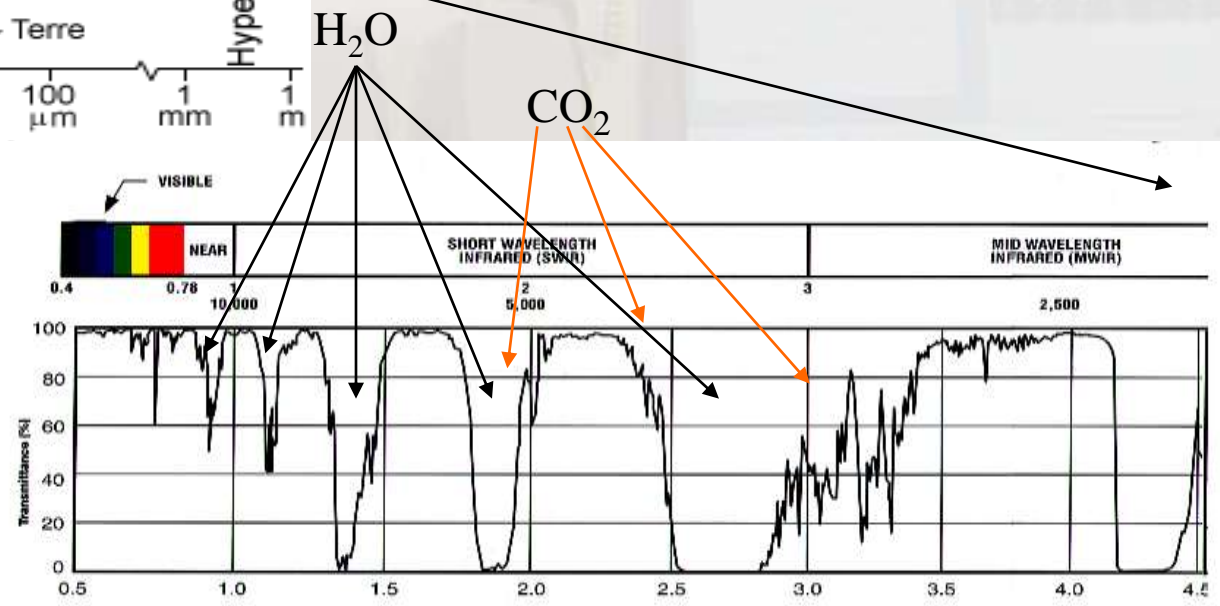
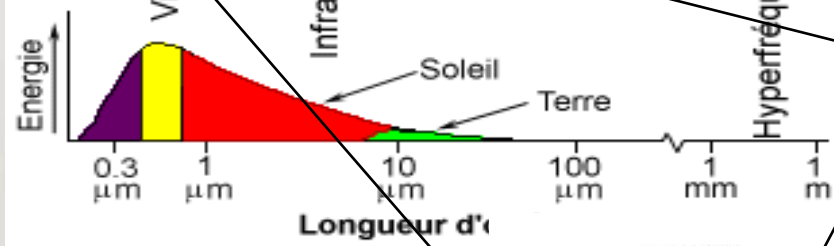
HST Date	HST Time	TO	Remote	Prog and PI	Instrument	SA	Comment
May. 1 --	08:00 13:00	E		063 Sprague	MIRSI	EVT	
	15:00 21:00	E,B		004 Orton	MIRSI/NSFCAM2	EVT	
	21:00 06:00	B	X	077 Sykes	MIRSI	SJB	X-ofc
May. 2 Mo	08:00 13:00	E		063 Sprague	MIRSI	EVT	
	15:00 21:00	E,B		004 Orton	MIRSI/NSFCAM2	EVT	
	21:00 06:00	B	X	077 Sykes	MIRSI	SJB	X-ofc
May. 3 Tu	08:00 13:00	E		063 Sprague	MIRSI	EVT	
	15:00 21:00	E,D		004 Orton	MIRSI/NSFCAM2	EVT	
	21:00 06:00	D	X	077 Sykes	MIRSI	SJB	X-ofc
May. 4 We	08:00 13:00	E		063 Sprague	MIRSI	EVT	
	15:00 21:00	E,D		004 Orton	MIRSI/NSFCAM2	EVT	
	21:00 06:00	D	X	003 Tedesco	MIRSI	SJB	X-ofc
May. 5 Th	08:00 13:00	E		063 Sprague	MIRSI	EVT	
	18:00 22:00	D		089 Yanamandra-Fisher	MIRSI/SpeX	EVT	
	22:00 06:00	D	X	003 Tedesco	MIRSI	SJB	X-ofc
May. 6 Fr	08:00 13:00	E		063 Sprague	MIRSI	EVT	
	18:00 22:00	D		089 Yanamandra-Fisher	MIRSI/SpeX	EVT	
	22:00 06:00	D	X	003 Tedesco	MIRSI	SJB	X-ofc
May. 7 --	18:00 23:59	B	X	044 Mueller	MIRSI	SJB	X-ofc
	23:59 06:00	B	X	003 Tedesco	MIRSI	SJB	X-ofc
May. 8 --	18:00 23:59	B	X	044 Mueller	MIRSI	SJB	X-ofc
	23:59 06:00	B	X	067 Grundy	SpeX	SJB	X-ofc
May. 9 Mo	18:00 21:00	B	X	013 Binzel	SpeX	SJB	X-ofc
	21:00 22:00	B	X	069 Rathbun	SpeX	SJB	X-ofc
	22:00 06:00	B	X	013 Binzel	SpeX	SJB	X-ofc
May. 10 Tu	18:00 06:00	B	X	047 Thomas	SpeX	SJB	X-ofc
May. 11 We	18:00 06:00	D		019 Kilic	NSFCAM2	EVT	1st night
May. 12 Th	18:00 06:00	D		019 Kilic	NSFCAM2	EVT	
May. 13 Fr	18:00 22:00	D		032 Rodriguez	MIRSI	EVT	
	22:00 06:00	D		019 Kilic	NSFCAM2	EVT	
May. 14 --	18:00 22:00	D		032 Rodriguez	MIRSI	EVT	
	22:00 06:00	D		019 Kilic	NSFCAM2	EVT	
May. 15 --	18:00 22:00	B		032 Rodriguez	MIRSI	EVT	
	22:00 06:00	B		019 Kilic	NSFCAM2	EVT	
May. 16 Mo	18:00 06:00	B	X	012 Vemazza	SpeX	JTR	X-ofc
May. 17 Tu	18:00 06:00	B		999 Engineering	AO/NSFCAM2	EVT	
May. 18 We	18:00 06:00	R,P		999 Engineering	AO/NSFCAM2	EVT	
May. 19 Th	18:00 06:00	P	X	020 Leggett	NSFCAM2/SpeX	EVT	X-Hilo
May. 20 Fr	18:00 06:00	P	X	020 Leggett	NSFCAM2/SpeX	EVT	X-Hilo
May. 21 --	18:00 06:00	P,D	X	020 Leggett	NSFCAM2/SpeX	EVT	X-Hilo
May. 22 --	13:00 22:00	ED		004 Orton	MIRSI/NSFCAM2	EVT	
	22:00 06:00	D	X	067 Grundy	SpeX	SJB	X-ofc
May. 23 Mo	13:00 22:00	ED		004 Orton	MIRSI/NSFCAM2	EVT	

SPECTROSCOPY

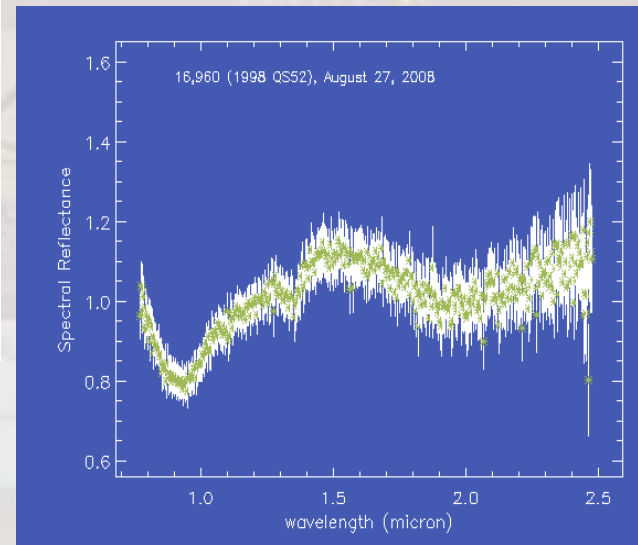
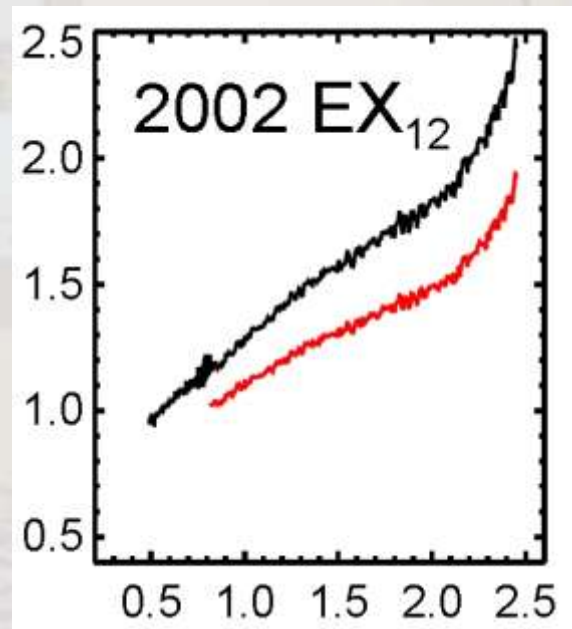
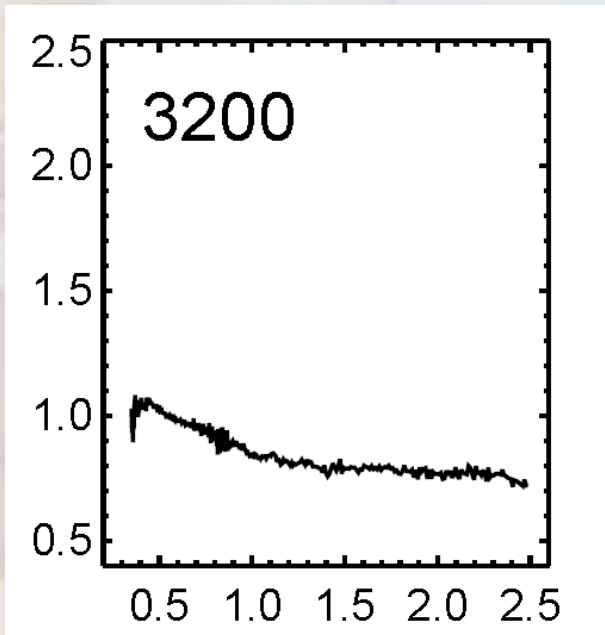
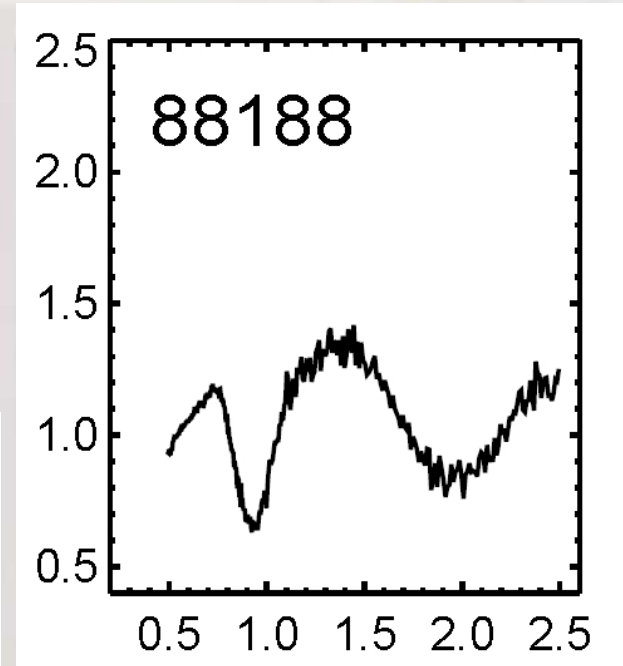
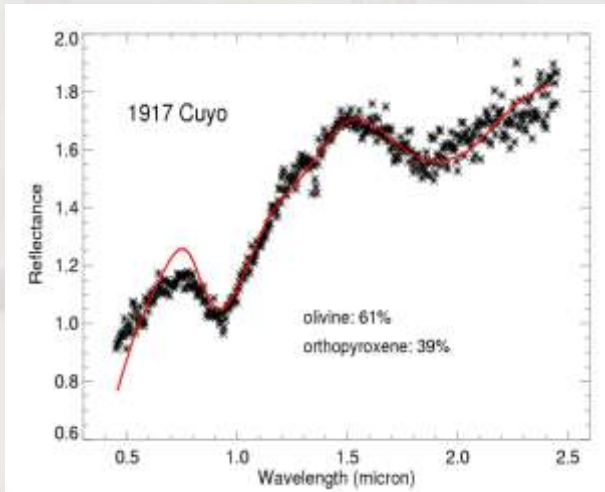
ATMOSPHERIC TRANSPARENCY



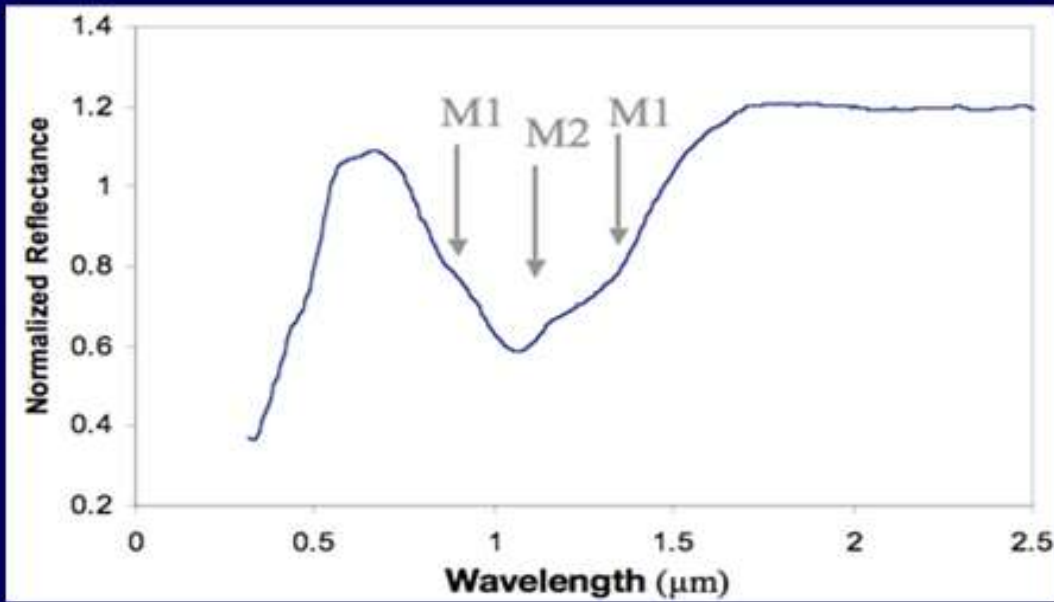
Atmospheric Molecules:
 H_2O , O_3 , CO_2 , O_2 , NO_2



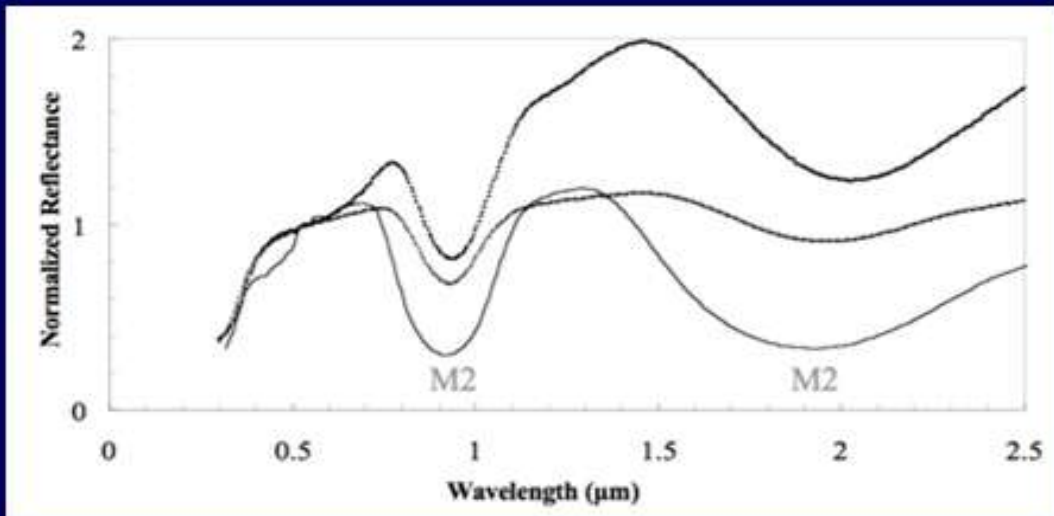
NEOs spectra- Exemples



What is a Cosmochemical element ?



Olivine
(Mg, Fe)₂SiO₄



Pyroxene
(Mg, Fe)₂Si₂O₆

Classification des oiseaux



Classification des astéroïdes

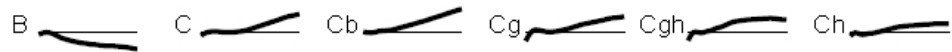
Spectre du visible et de l'infrarouge proche

Bus-DeMeo Taxonomy Key

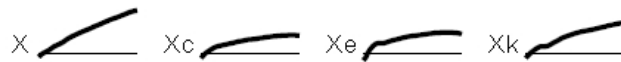
S-complex



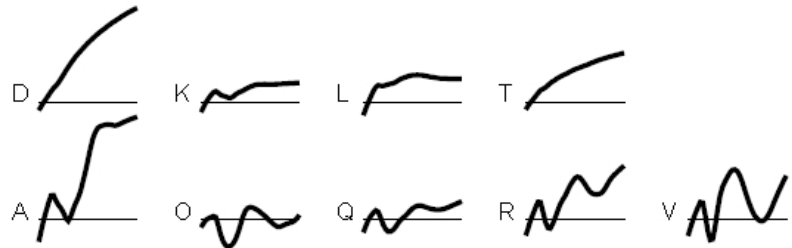
C-complex



X-complex

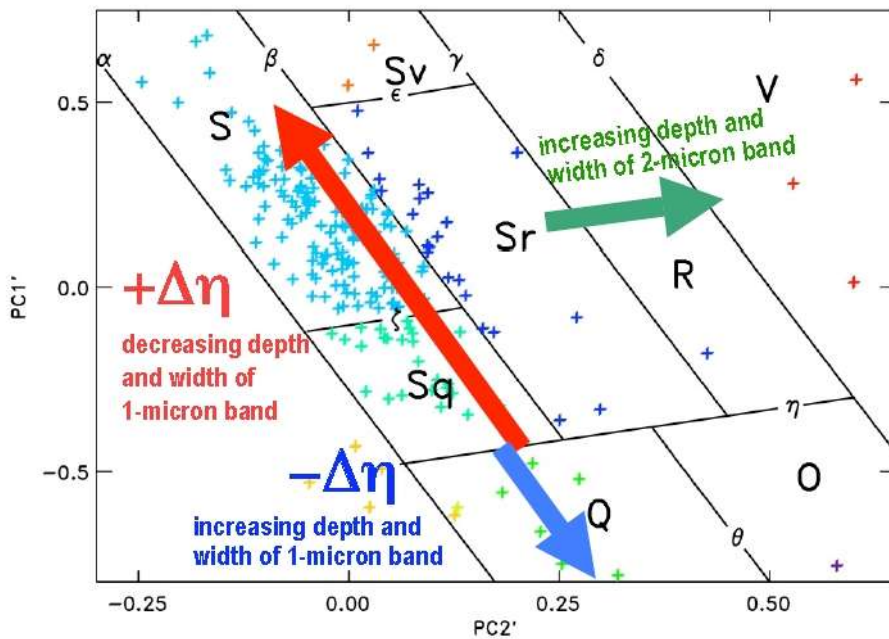


End Members



DeMeo et al, Icarus, 2009

Établir l'ADN des astéroïdes par le biais de la planétologie comparée!



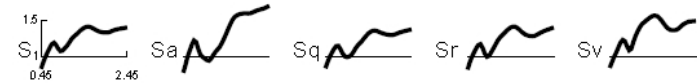
Statistique =>
(V+NIR data)

=> Taxonomie
(The alphabet of asteroids)

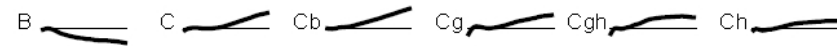


Bus-DeMeo Taxonomy Key

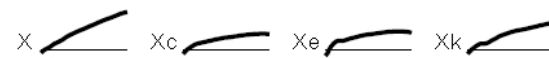
S-complex



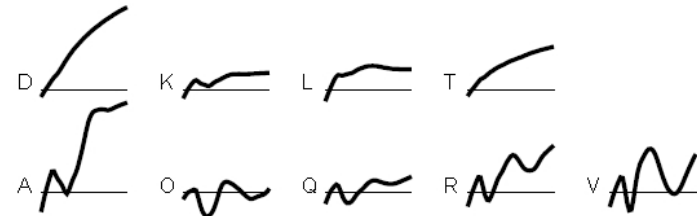
C-complex



X-complex

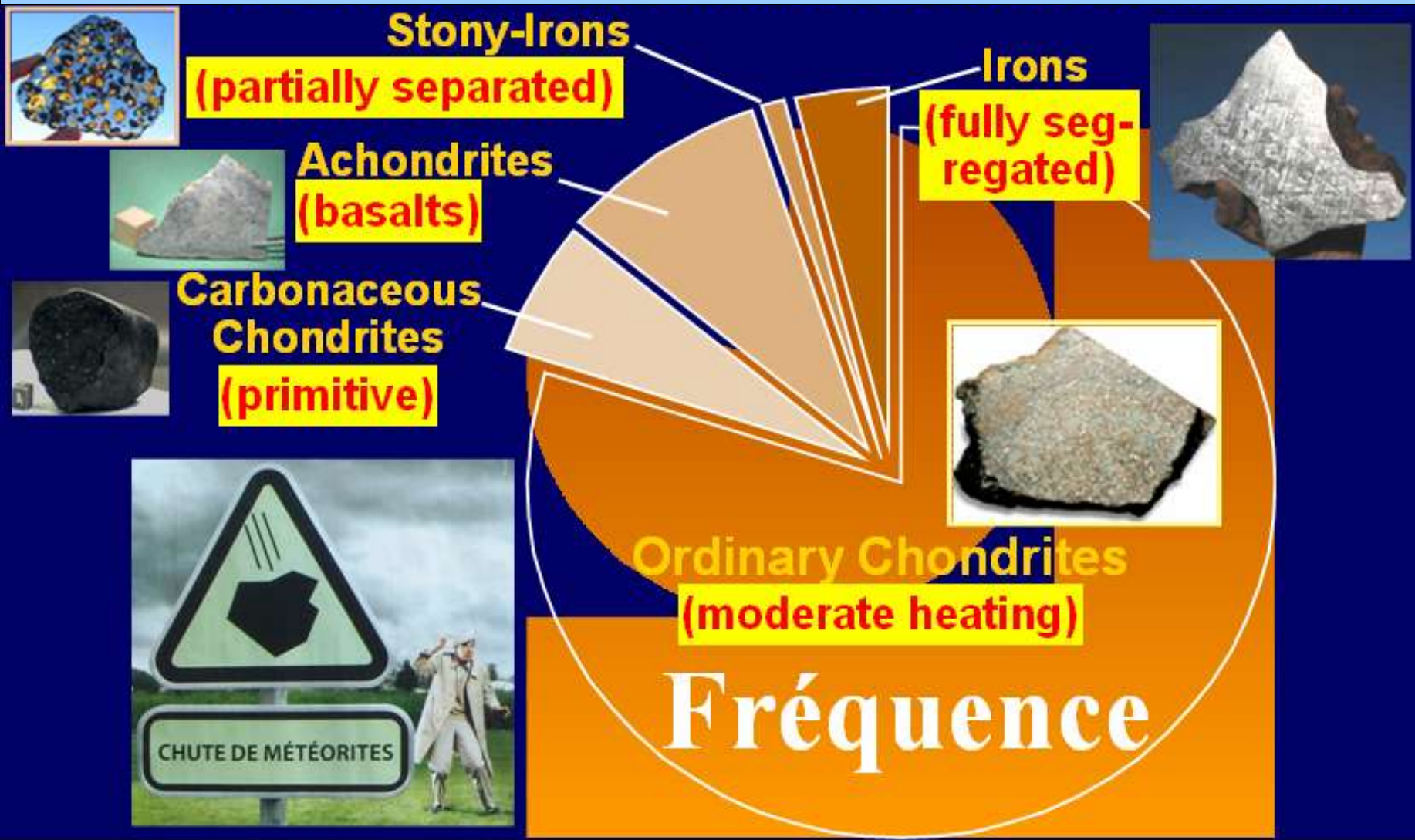


End Members




DeMeo et al Icarus 2009

Link between asteroids and meteorites (meteors)?



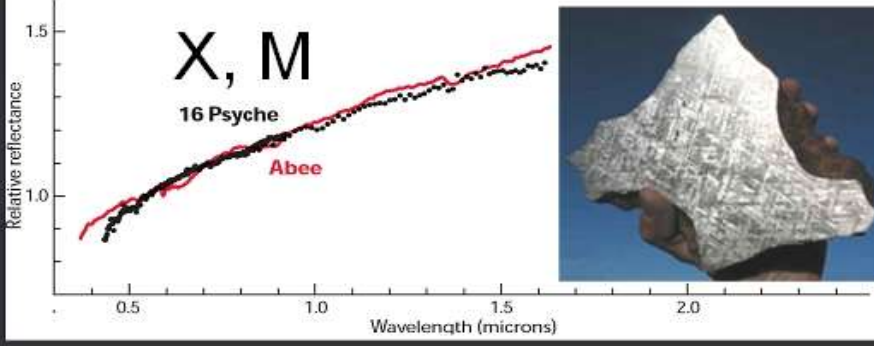
Good Fit for some of classes



A

Stony-Irons

This panel shows a spectral plot labeled 'A' on the left, which features a broad absorption band between 0.5 and 1.0 microns. To the right is a photograph of a stony-iron meteorite, characterized by its metallic, crystalline texture and irregular shape.



X, M
16 Psyche
Abee

Relative reflectance

Wavelength (microns)

Irons


This panel displays a spectral plot for '16 Psyche' (labeled 'X, M') and 'Abee' (labeled 'Abee'). The plot shows relative reflectance on the y-axis (ranging from 0.5 to 2.0) versus wavelength in microns on the x-axis (ranging from 0.5 to 2.0). Two curves are shown: a red curve for 'Abee' and a black curve for '16 Psyche'. To the right is a photograph of an iron meteorite, showing a highly reflective, crystalline surface.



V

Basalts (HED)

This panel shows a spectral plot labeled 'V' on the left, which exhibits a prominent absorption band around 0.9 microns. To the right is a photograph of a basalt meteorite, which is dark and has a rough, crystalline texture.



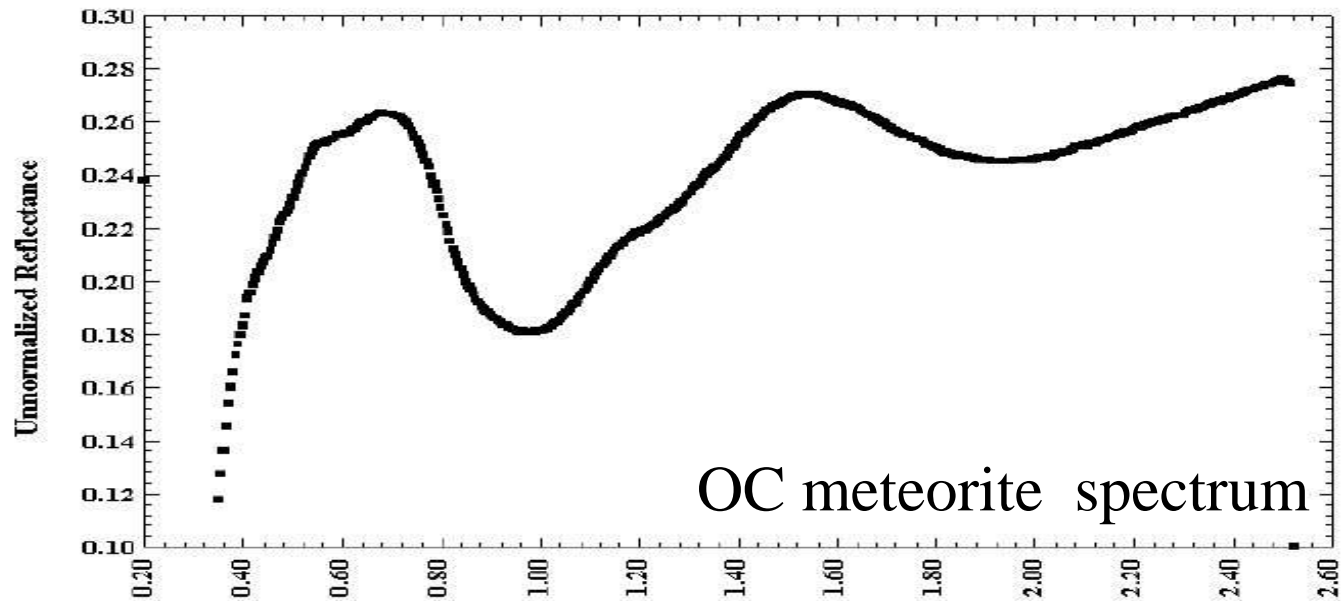
Carbonaceous chondrites

C-complex

B **C** **Cb**
Cg **Cgh** **Ch**

This panel features a photograph of a carbonaceous chondrite meteorite on the left, which is dark and porous. To the right is the text 'Carbonaceous chondrites' and a list of 'C-complex' meteorite classes: B, C, Cb, Cg, Cgh, and Ch. Each class is represented by a small spectral plot showing its characteristic absorption features.

Is the spectroscopy of meteors a good/real challenge?



OC meteorite spectrum

S-complex



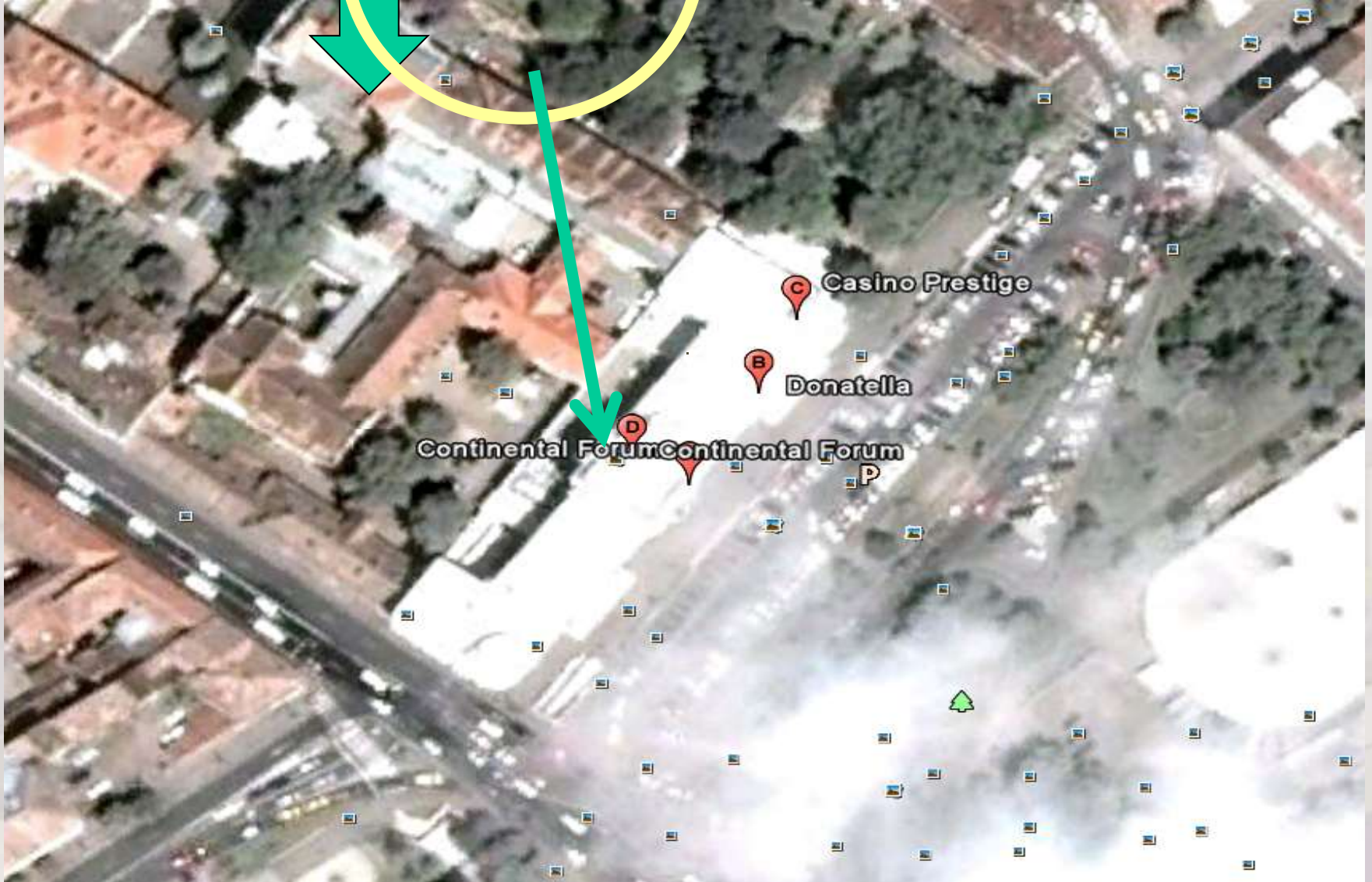
Yes, especially for CC composition!

Conclusions

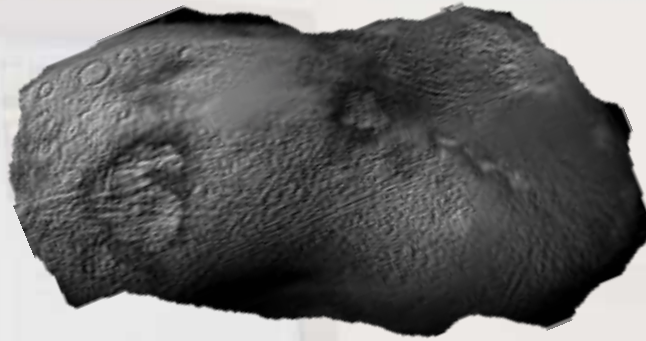
- Meteorites offer laboratory measurements for mineralogical modeling of asteroids
- Friable/fluffy meteorites are rare/inexistent
- Spectroscopy of meteors may bring new observational data concerning the chemical structure of meteoroids

SIBIU

You are here



50 m



2009 DD45 (low albedo)

SIBIU



20 m (S-type asteroid)



2009 DD45
(real size)

SIBIU

