Timeline NASE + MICROMETEORITES

2023, October 28th

Timeline NASE + METEORITES

13:30 – 13:40 ***Opening session.*** **Beatriz García & Rosa M. Ros**, NASE.

13:40 - 13:45 ***"The role of the municipality in the development of science"***, **Jordi Mazon**, Viladecans Municipality, Spain.

13:45 – 14:00 ***"Searching for micrometeorites with students in Zhongguancun No.2 primary school students"***, **Geya Zhu**, Zhongguancun No. 2 Primary School, Beijing, China.

Timeline NASE + METEORITES

14:00-14:15 ***"NASE project on Micrometeorites in Iran"***, **Fateme Hashemi**, ITAU, Bushehr, Iran.

14:15-14:30 ***"City stardust: Comparison between two micrometeorites"*, Ambrozie Chis and Paula Chis**, George Baritiu School, Cluj, Romania.

Timeline NASE + METEORITES

14:30-14:45 ***"Micrometeorites from the middle of the world in Latin America"***, **Nicolas Vasquez**, Escuela Politecnica Nacional, Quito, Ecuador.

14:45-15:00 ***"Observations of ablating micro-meteoroids using high-power and large-aperture radars"*** , **Qihou Zhou**, Miami University, USA.

Timeline NASE + METEORITES

15:00-15:15 ***Summary of "Micrometeorites in Viladecans"***, **Ivo Jokin**, Bulgaria; **Stefan Müller-Champrenaud**, Germany; **Bayarkhuu Chinzoring**, Mongolia; **Varduhi Mkrtchyan**, Armenia.

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Timeline NASE + METEORITES

15:15 – 15:20 ***"Will we see the constellation of Orion without the star Betelgeuse on December 12th?",*** **Antoni Selva**, Associació Astronómica de Sabadell, Sabadell, Spain.

15:20 – 15:30 ***Closing session,*** **Beatriz García & Rosa M. Ros**, NASE.

NASE project on Micrometeorites in Iran
Inspiring Discovery and Learning

Fateme Hasheminasab

ITAU

IRAN
October2023

Our Journey in Three Key Steps

Preparation

Project Launch and Information Dissemination

Collecting Data

Preparation Steps for Project Launch

Translation into Persian

Micrometeorites: easy-to-get extraterrestrial material

It is easy to collect micrometeorites, often suspended in the atmosphere for long periods of time and falling with different types of precipitation (such as rain or snow). These types of objects come directly from the matter that gave rise to the solar system, and therefore have an age of about 4,500 million years. The surprising thing is that and can be collected in a simple way.

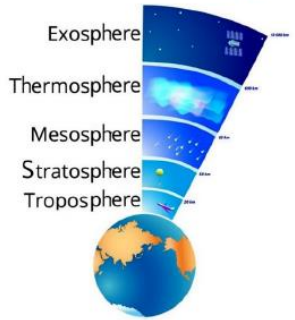


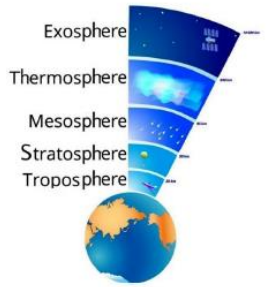
Fig. 1: Terrestrial atmosphere.

Meteors pass through the exosphere and thermosphere without difficulty because these layers are not very dense. But when they reach the mesosphere, the density is greater and when friction with the air occurs and heat is dissipated, the conditions are given for the material to melt and then solidify again in the stratosphere and troposphere, so that in the end it presents a spherical shape, sometimes with striations and sometimes small bubbles, the effect of rapid solidification.

Already on the surface of the Earth, those that are made of iron and nickel can be detected, separating them from other objects and rocks on the surface with the help of a magnet. However, in the soil there is a huge amount of ferromagnetic elements that remain trapped in the magnet, and separated from the rest of the small non-ferrous particles in the collected sample. Micrometeorites have a unique characteristic that allows them to be identified: they are spherical!

ریزشهابسنگ ها: مواد فرازمینی که به آسانی یافت می شوند.

بیشتر ریزشهابسنگ ها، برای مدت طولانی در اتمسفر معلق هستند و به همراه انواع مختلفی از بارش ها همچون باران یا برف به سطح زمین می رسند. این نوع از اجرام به صورت مستقیم از ماده ای که منظومه شمسی را تشکیل داده، بدست می آیند، بنابراین عمری در حدود ۴۵۰۰ میلیون سال دارند. نکته شگفت آور آن است که به راحتی می توان این اجرام را جمع آوری نمود.



شکل۱: لایه های اتمسفر زمین

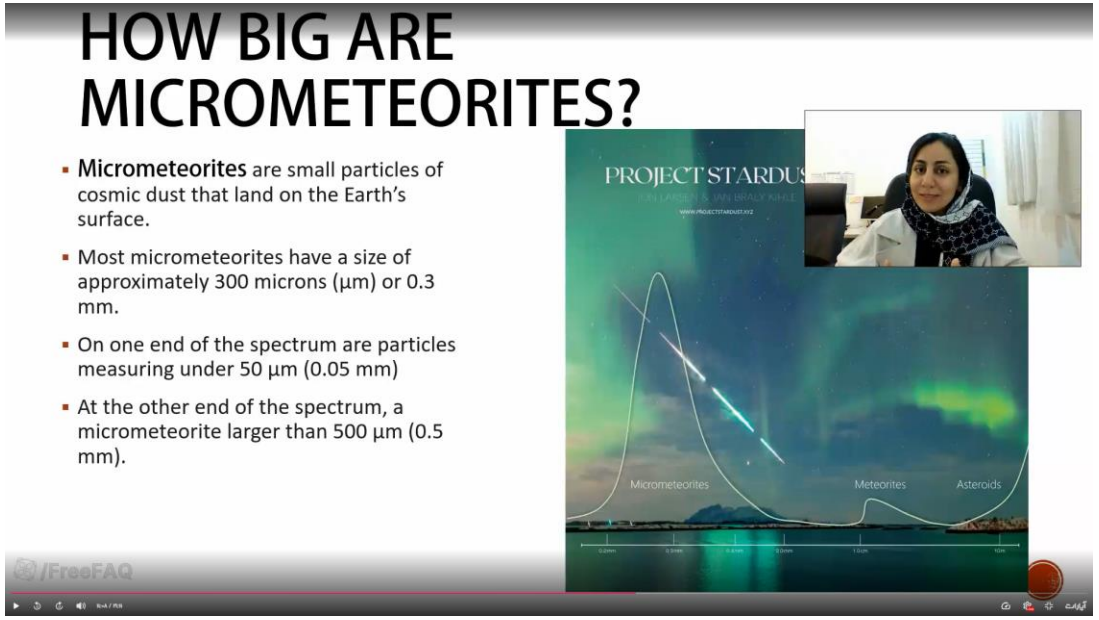
به علت کم چگال بودن اگزوسفر و ترموسفر، شهاب ها بدون مشکل خاصی از این دو لایه عبور می کنند. اما با رسیدن به مزوسفر که چگالی بیشتری دارد، مشکل آغاز می شود. در این لایه اصحکاک با هوا موجب ایجاد گرما شده و شرایط برای ذوب این اجرام فراهم می شود. با عبور از این لایه، در استراتوسفر و تروپوسفر این اجرام دوباره به صورت کروی جامد شده که گاهی اوقات دارای خطوط و حباب‌های کوچکی هستند که ناشی از فرایند انجماد سریع است.

در حال حاضر شهابسنگ های آهنی و نیکلی که بر روی سطح زمین وجود دارند را می توان به کمک یک آهنربا، از سایر اجسام و سنگ ها جدا کرد. با این حال، در خاک مقدار زیادی مواد فرومغناطیسی وجود دارد که به آهنربا جذب می شوند اما نکته مهم این است که ریزشهابسنگ ها یک ویژگی شاخص دارند:

آن ها کروی شکل هستند.

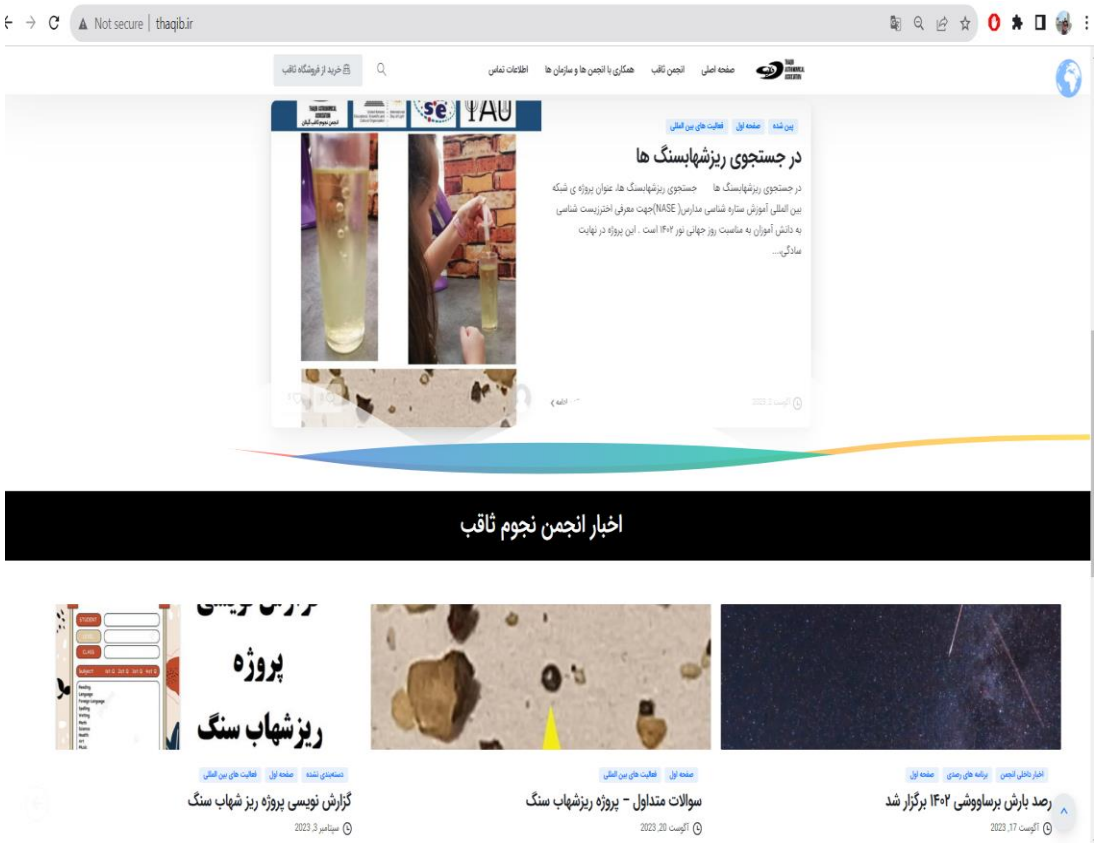
پس این نکته را برای شناسایی آن ها به خاطر داشته باشید.

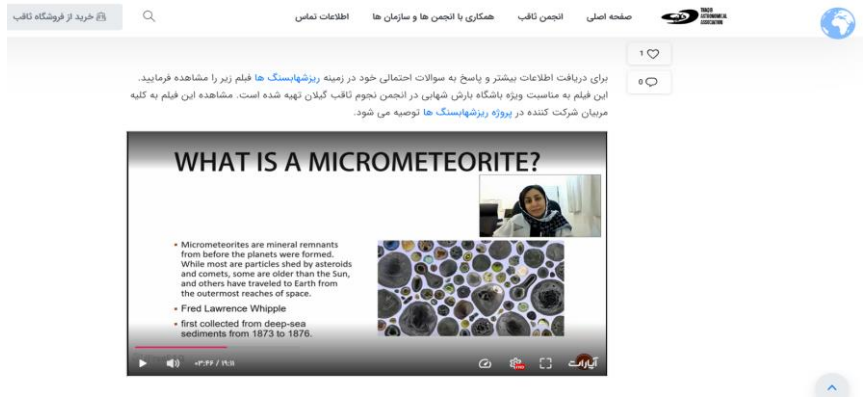
Informative Video Clips and Guidance for Teachers

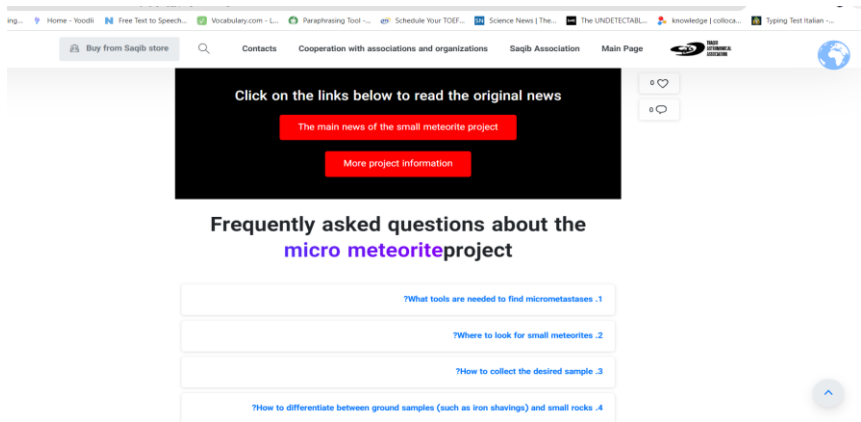


Support Advisor Group

Centralized Website







Project Launch and Nationwide Promotion

- Institute for the Intellectual Development of Children and Young Adults

- Thaqib Astronomy Association

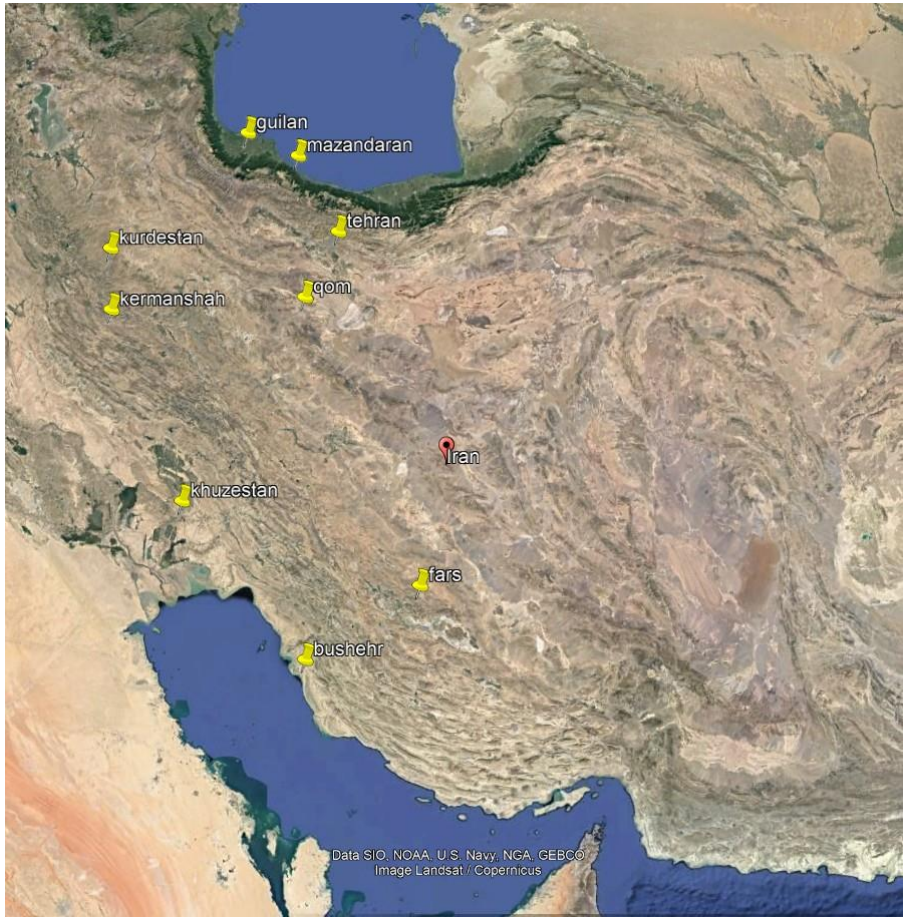
THAQIB ASTRONOMICAL ASSOCIATION

کانون پرورش فکری کودکان و نوجوانان

Collecting Data
Geographic Diversity of Participants

Teacher	Student	Province
38	205	9

Province	Latitude	Participants
Guilan	37	58
Fars	30	36
Qom	34	33
Bushehr	29	30
Kermanshah	34	16
Mazandaran	36	12
Kurdistan	35	11
Khuzestan	31	10
Tehran	35	9



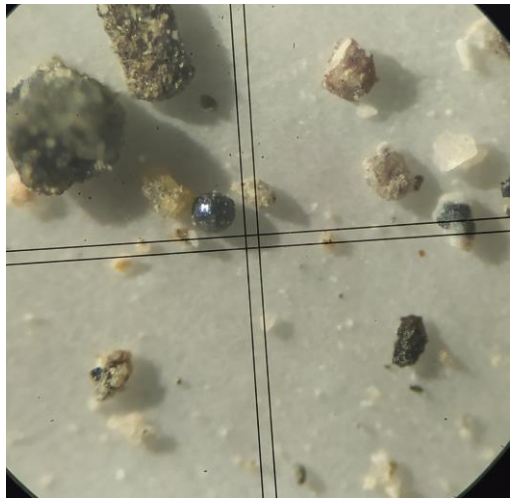
IRAN Map

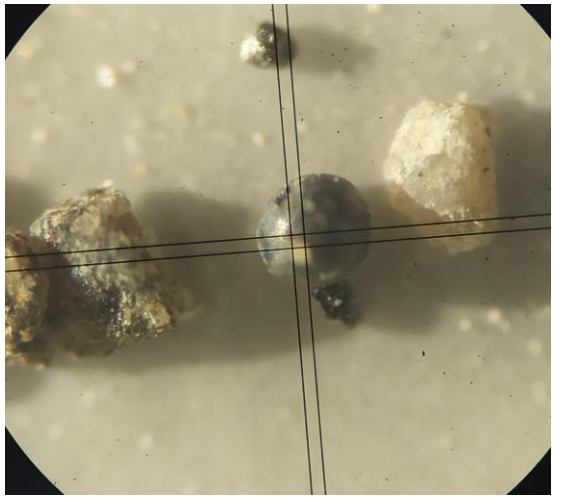

Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google Earth


guilan
mazandaran
tehran
kurdestan
qom
kermanshah
Iran
khuzestan
fars
bushehr
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus

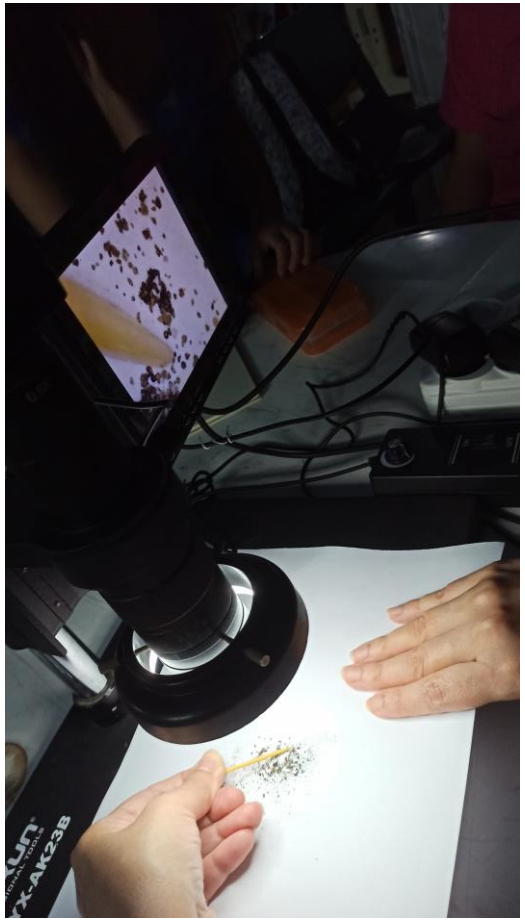
Guilan

- 58 students
- 4 Centers and schools
  - Thaqib
  - Baharestan
  - Adabestan
  - Shahid moghdam

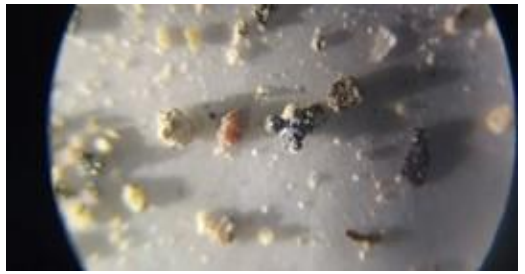


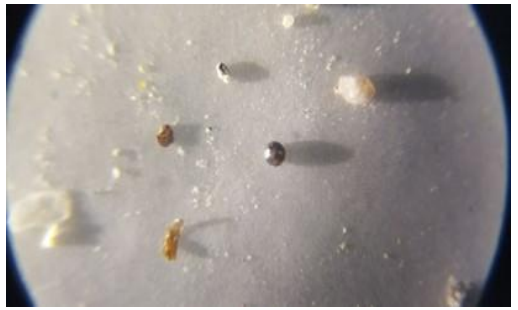


Guilan

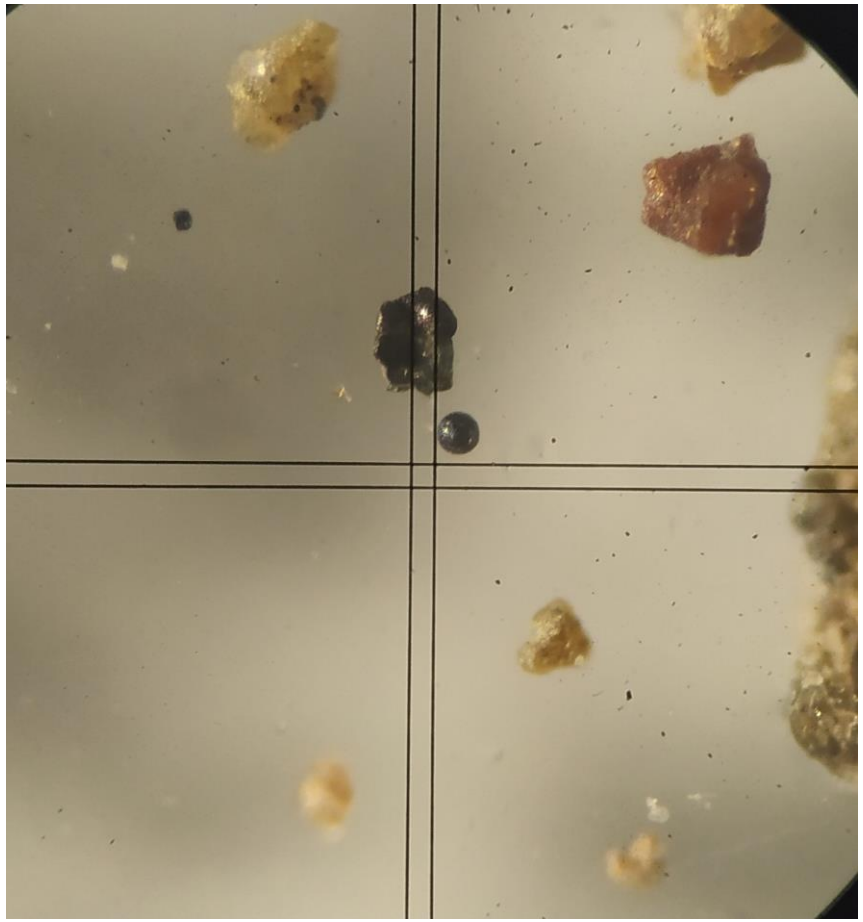


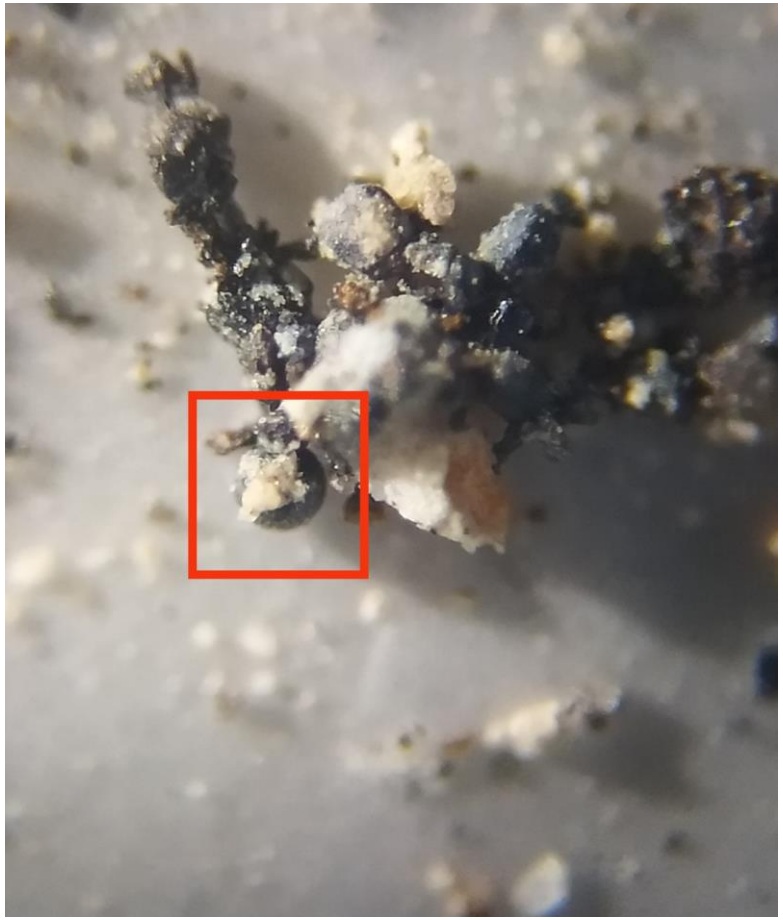
Guilan

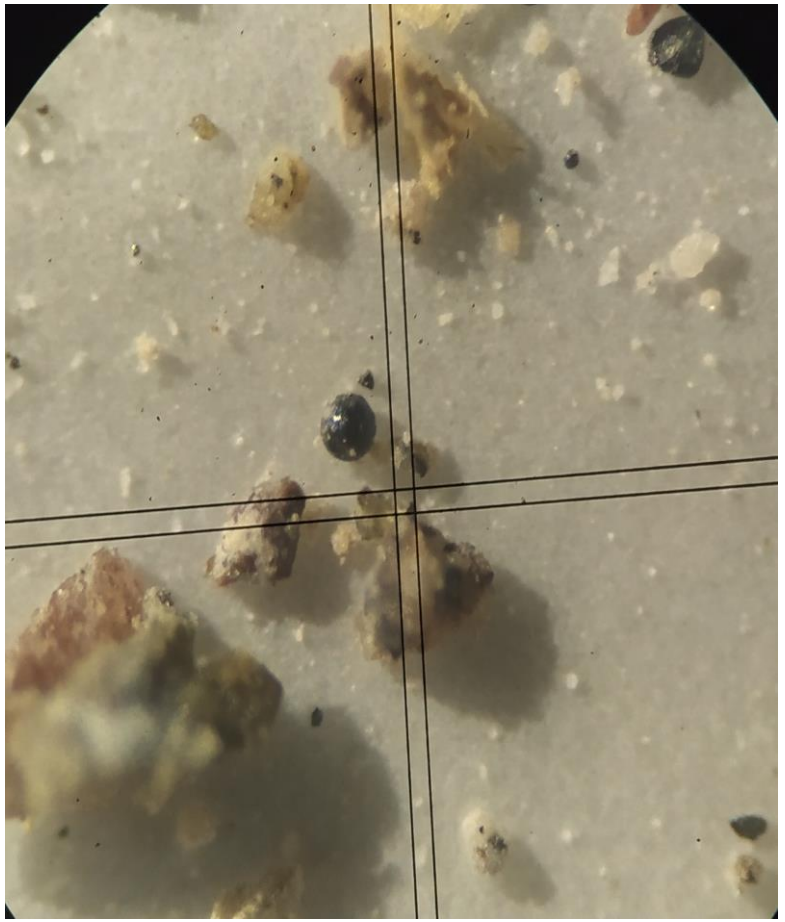




Guilan



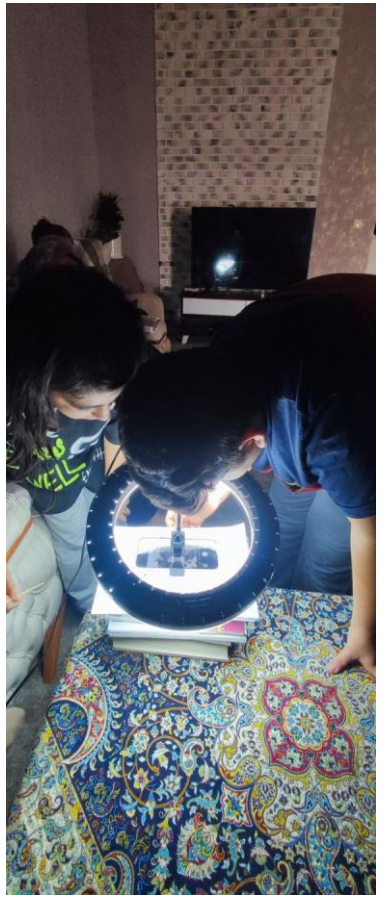




Bushehr

- 30 Students
- 3 Centers and Schools
  - Proxima
  - Shahid Ardeshiri
  - Dahom Farvaridn

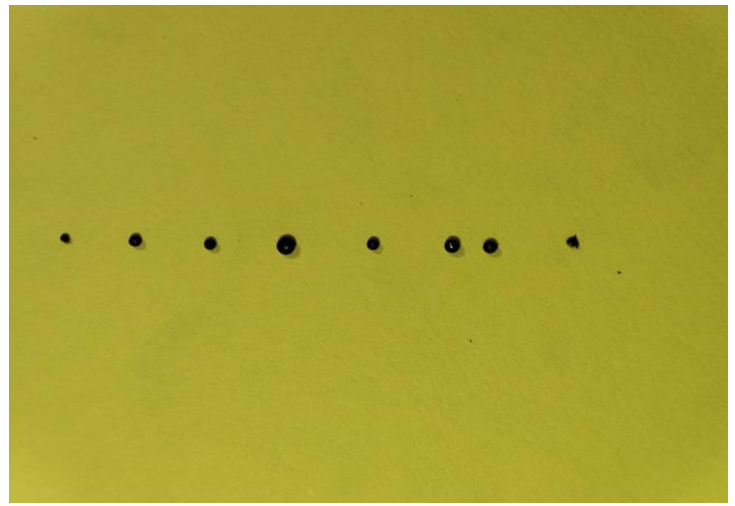
Bushehr



Qom

- 33 Students
- **Institute for the Intellectual Development of Children and Young Adults, Qom Branch**

Qom



Kermanshah

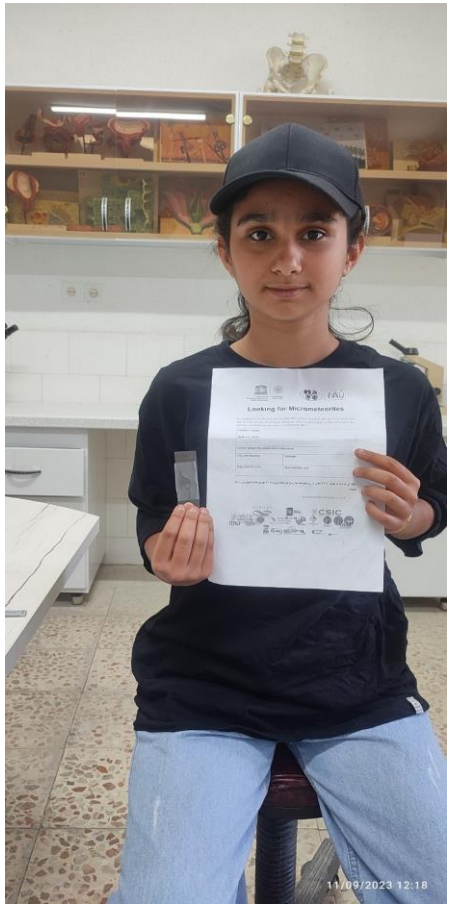
- 16 Students
- 4 Branches of the Institute for the Intellectual Development of Children and Young Adults in Kermanshah

Kurdistan

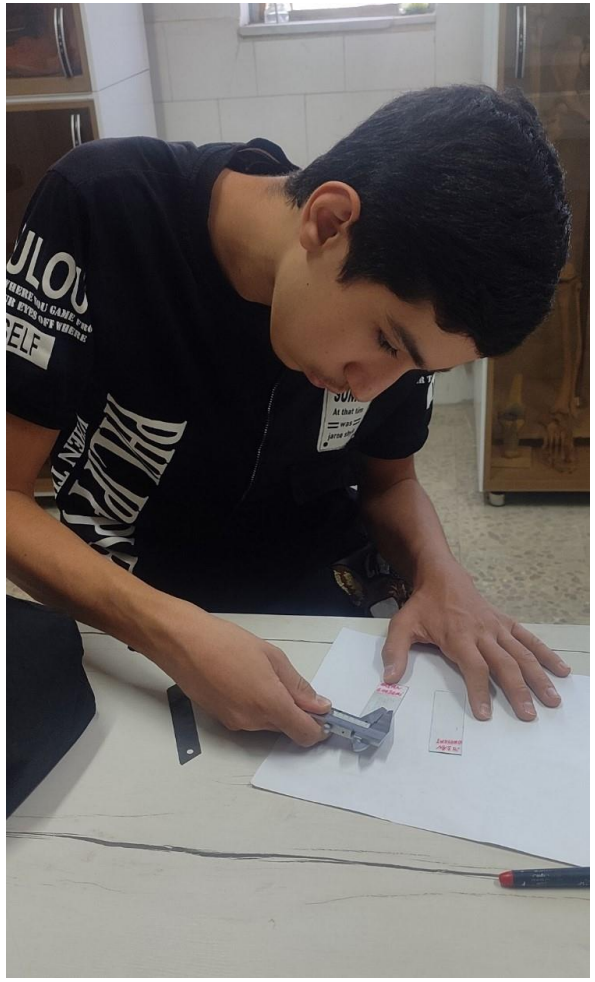
- 11 Students
- Razi Student Research Center

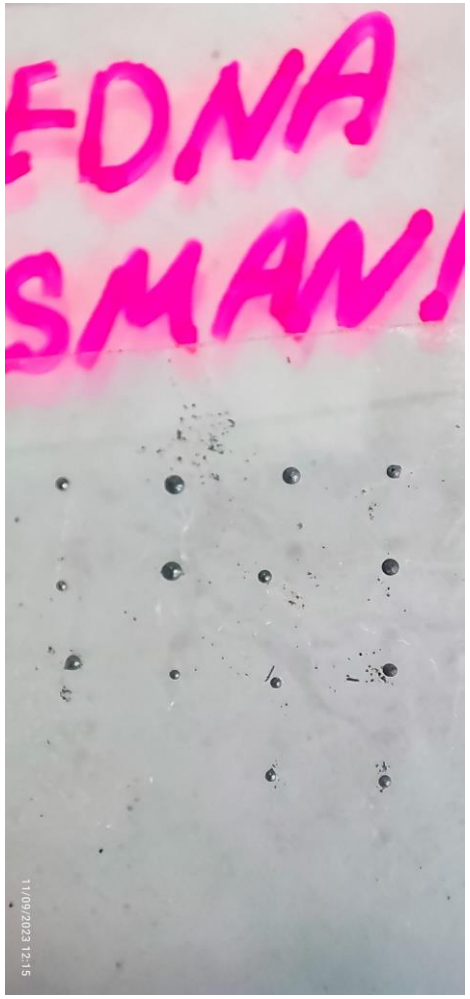
Kurdistan

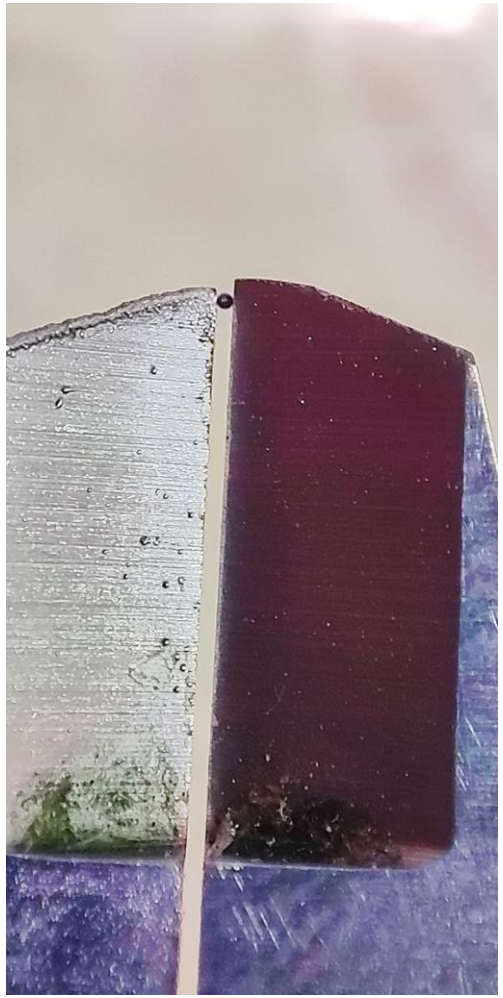

Looking for Micrometeorites
11/09/2023 12:19


Looking for Micrometeorites
11/09/2023 12:18

Kurdistan



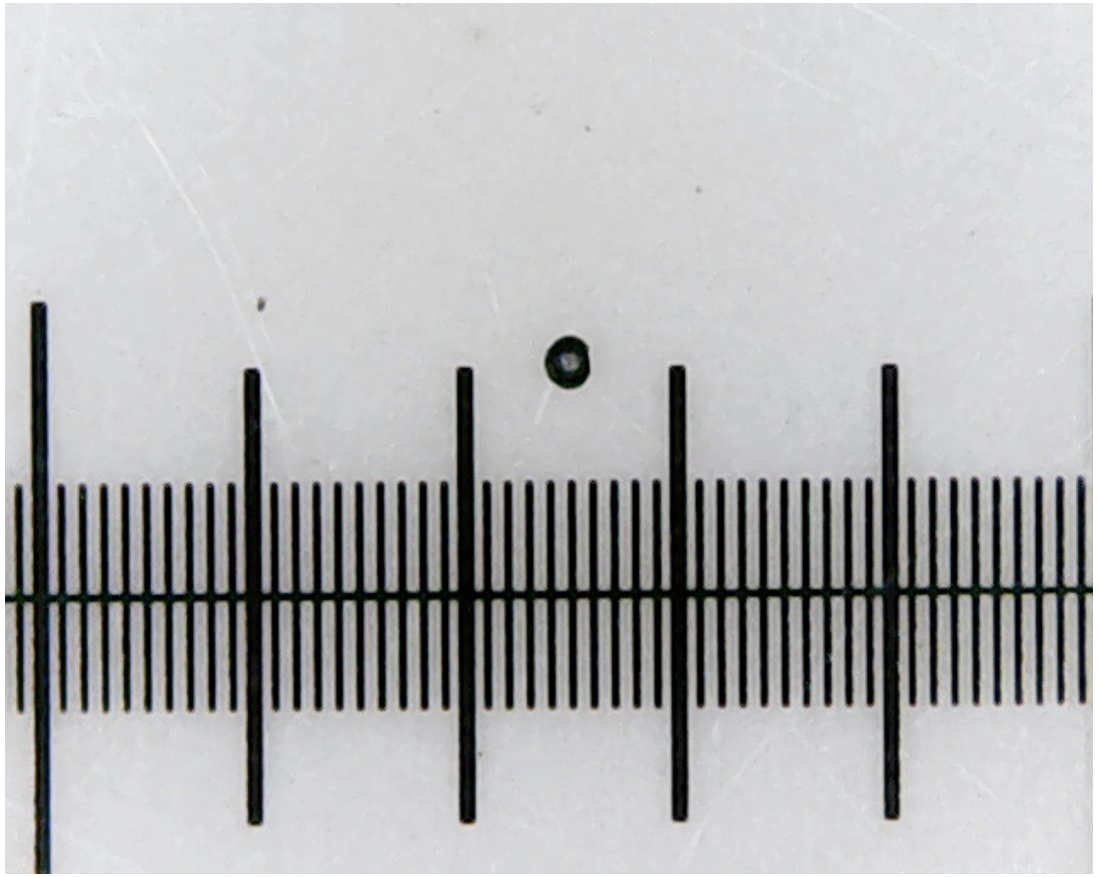




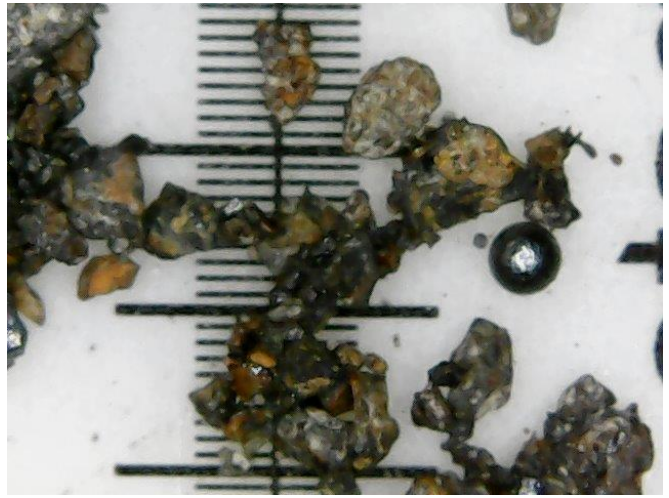
Mazandaran

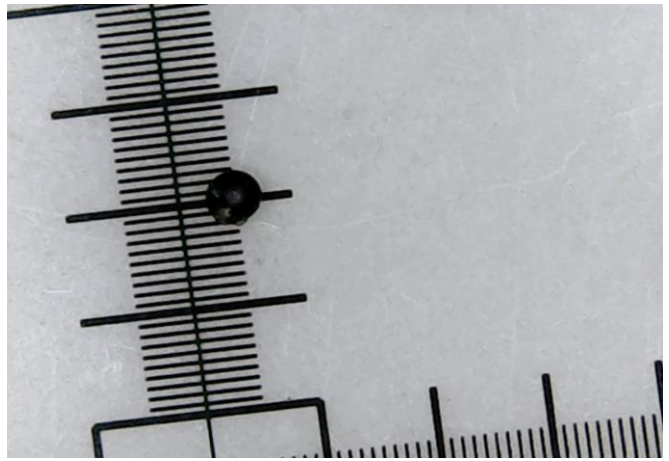
- 12 Students
- **Institute for the Intellectual Development of Children and Young Adults, Ramsar Branch**

Mazandaran



Mazandaran





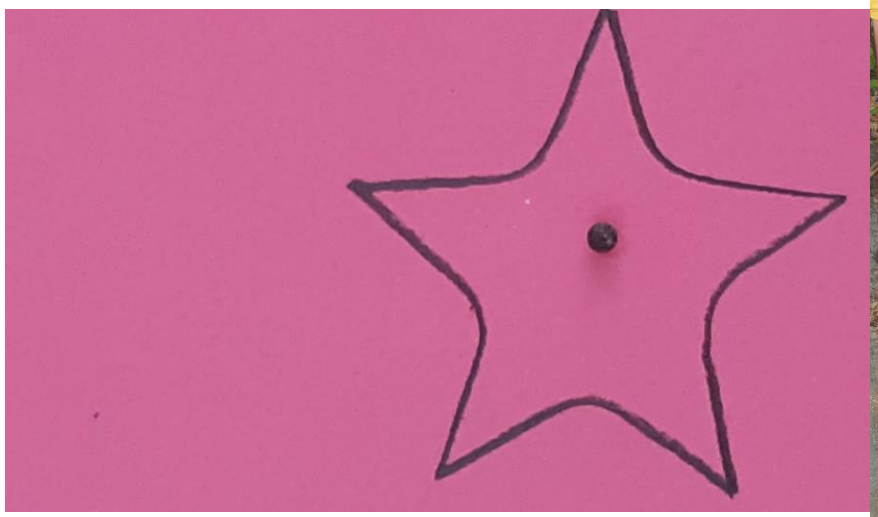
Tehran

- 8 Students
- Institute for the Intellectual Development of Children and Young Adults, Tehran Branch

Tehran

Khuzestan

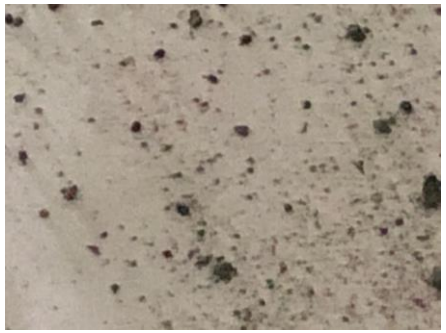
- 9 Students
- Institute for the Intellectual Development of Children and Young Adults, 4 Branches in Ahwaz

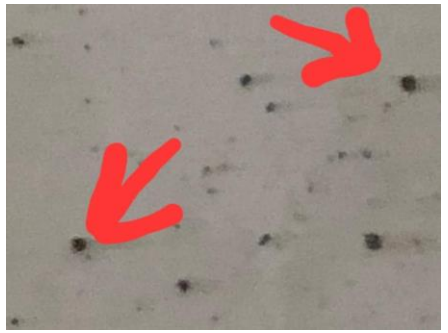


Khuzestan

Fars

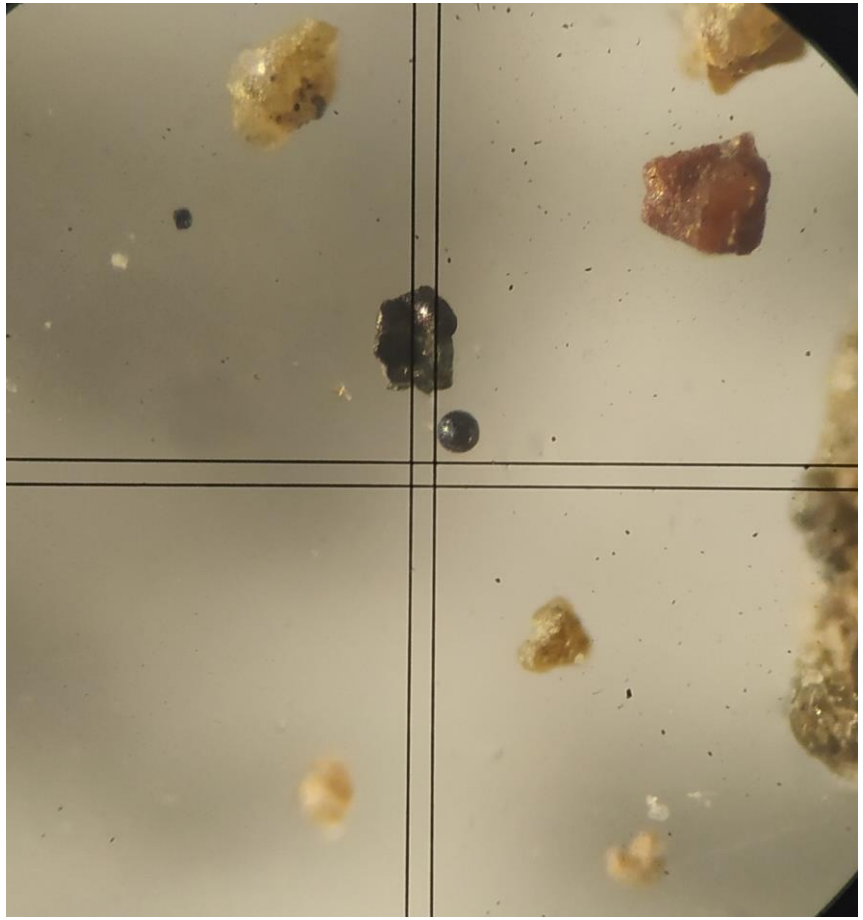
- 36 Students
- Pasargad Astronomy Community





Associated institutions

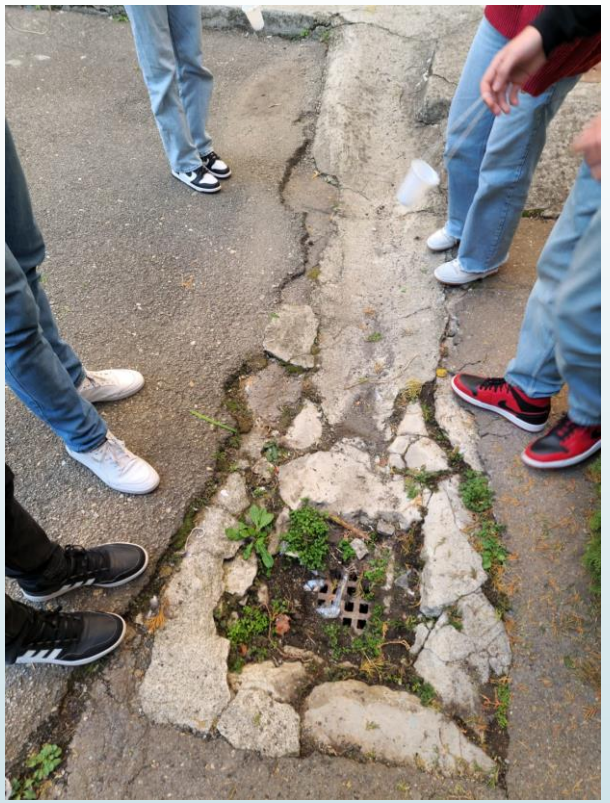
- Thanks for your attention.



City stardust: Comparison between two micrometeorites

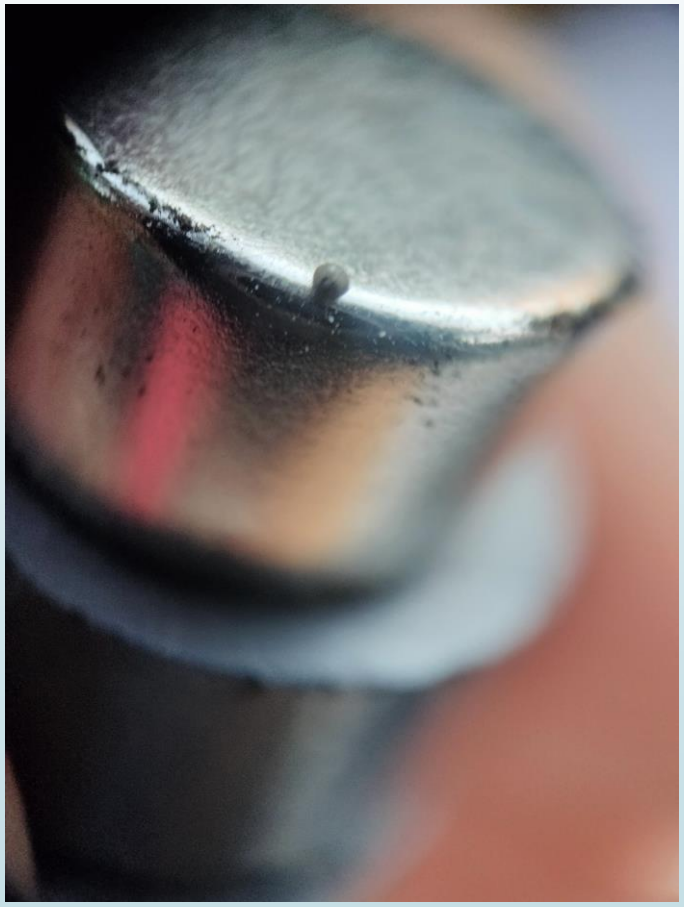
Ciencia en Acción, Viladecans, 2023
Chis Paula , Chis Ambrozie
Romania, Cluj-Napoca

We did this interesting project in our schools. The methods to recover this material is to look for it in the gutters, which collect the material that is deposited on the roofs, or in the gutters of the streets

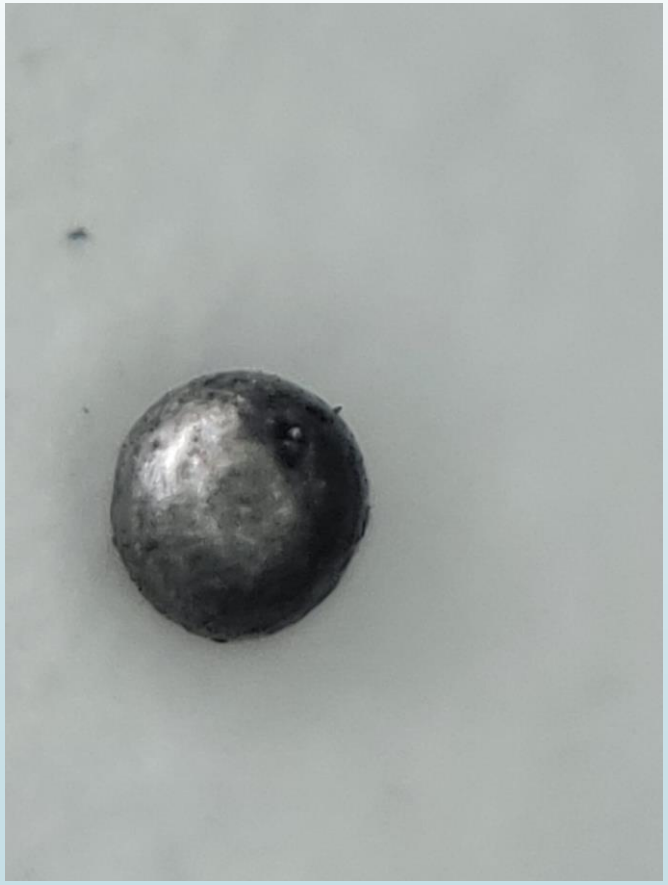


Cosmic dust form into solidified droplets during their hypervelocity entry into the Earth`s atmosphere and finally get spread over the Earth`s surface

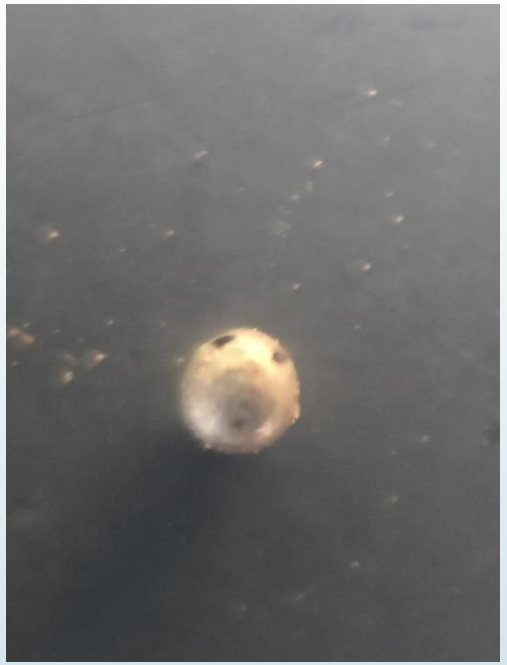
They are attracted by magnets



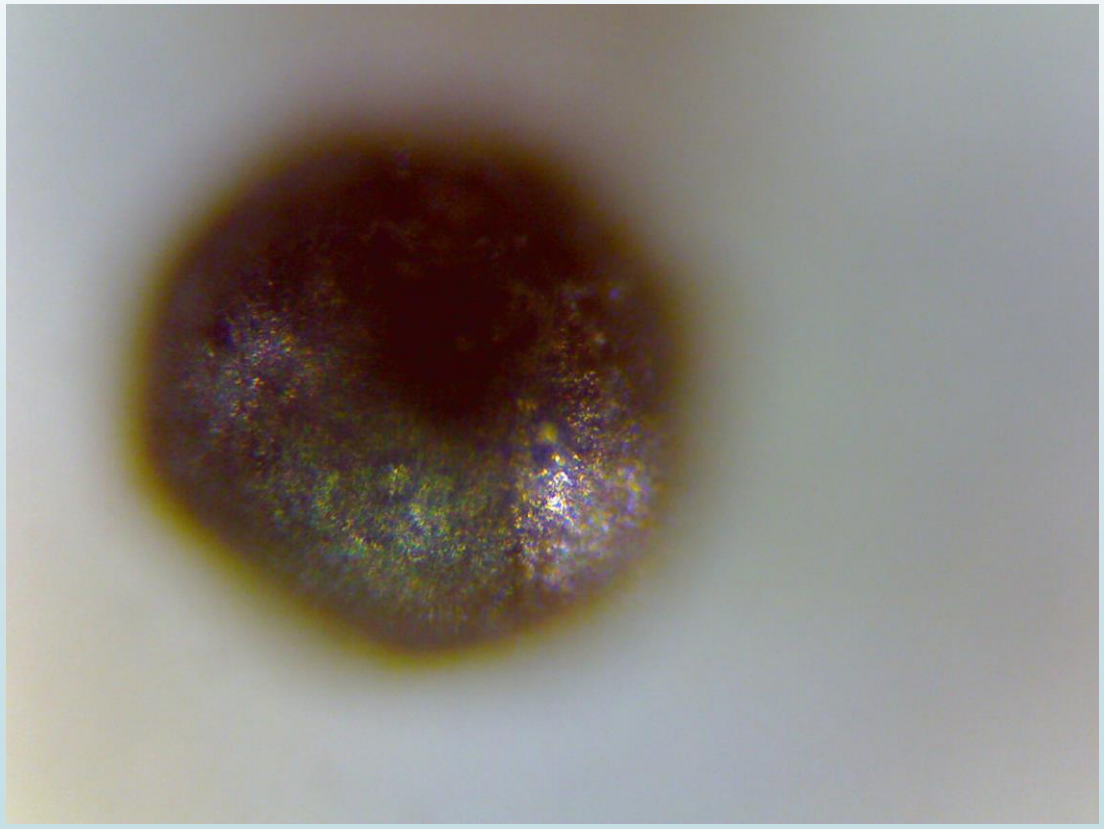
They have spherical shape

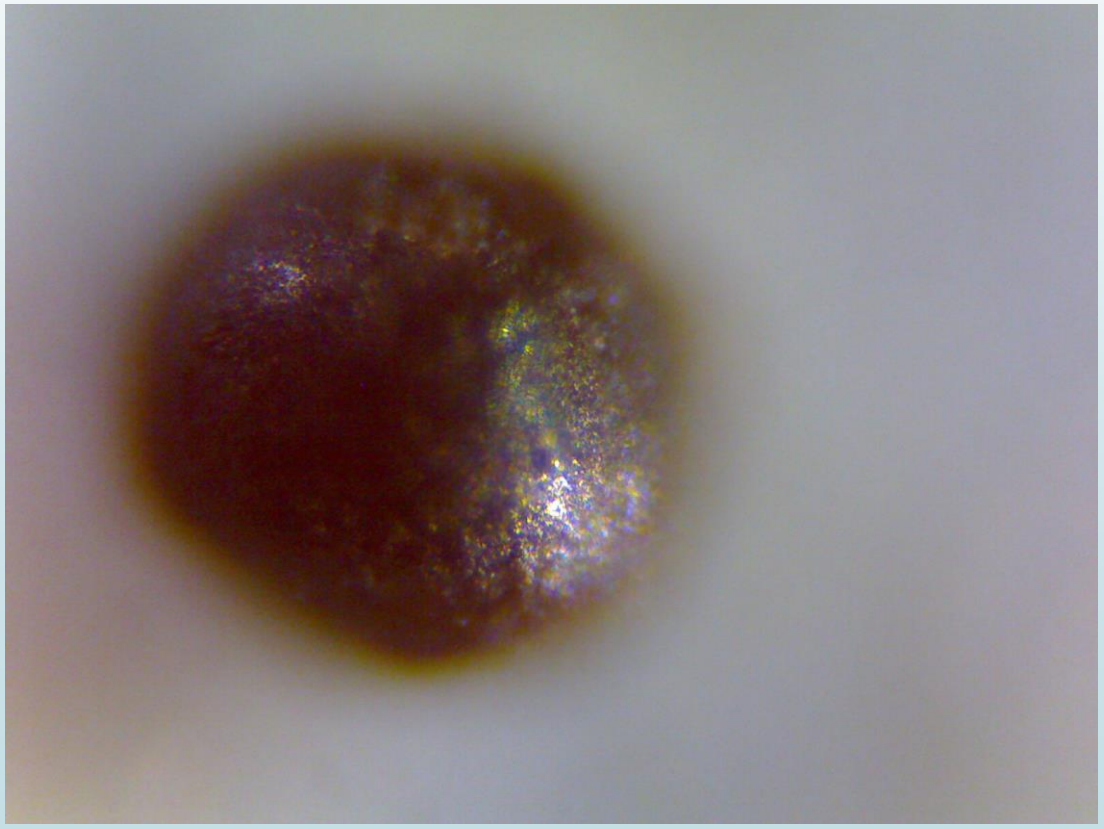


Some different types of micrometeorites

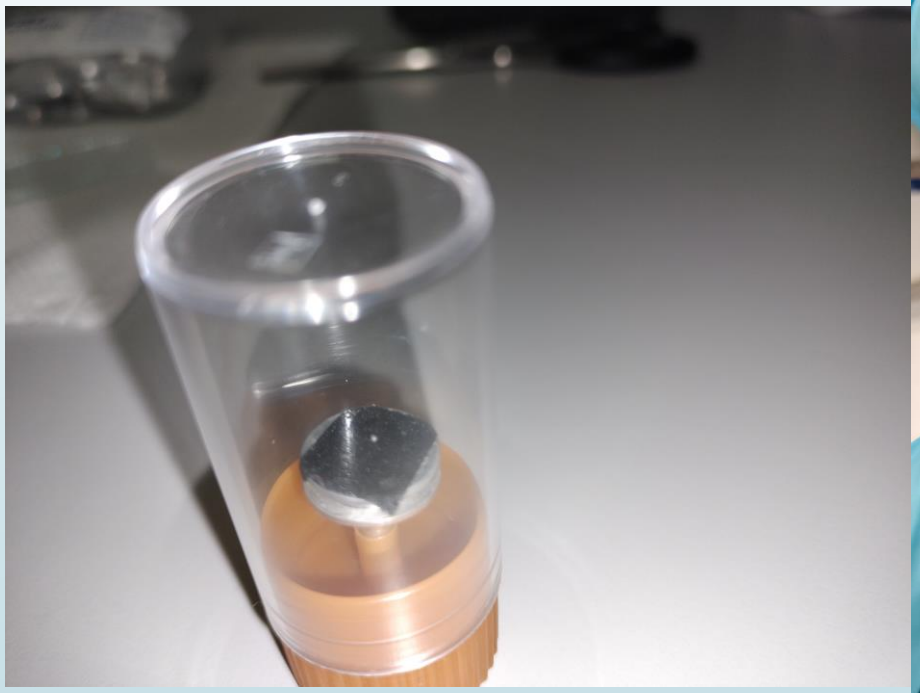


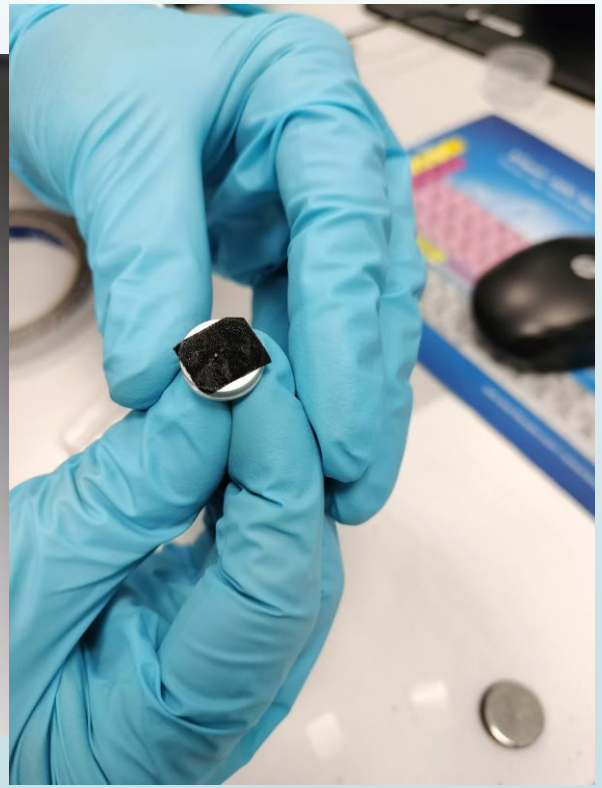
Pictures of another MM made from different sides with an optical microscope





SEM- Scanning Electron Microscope - an analytical tool for science

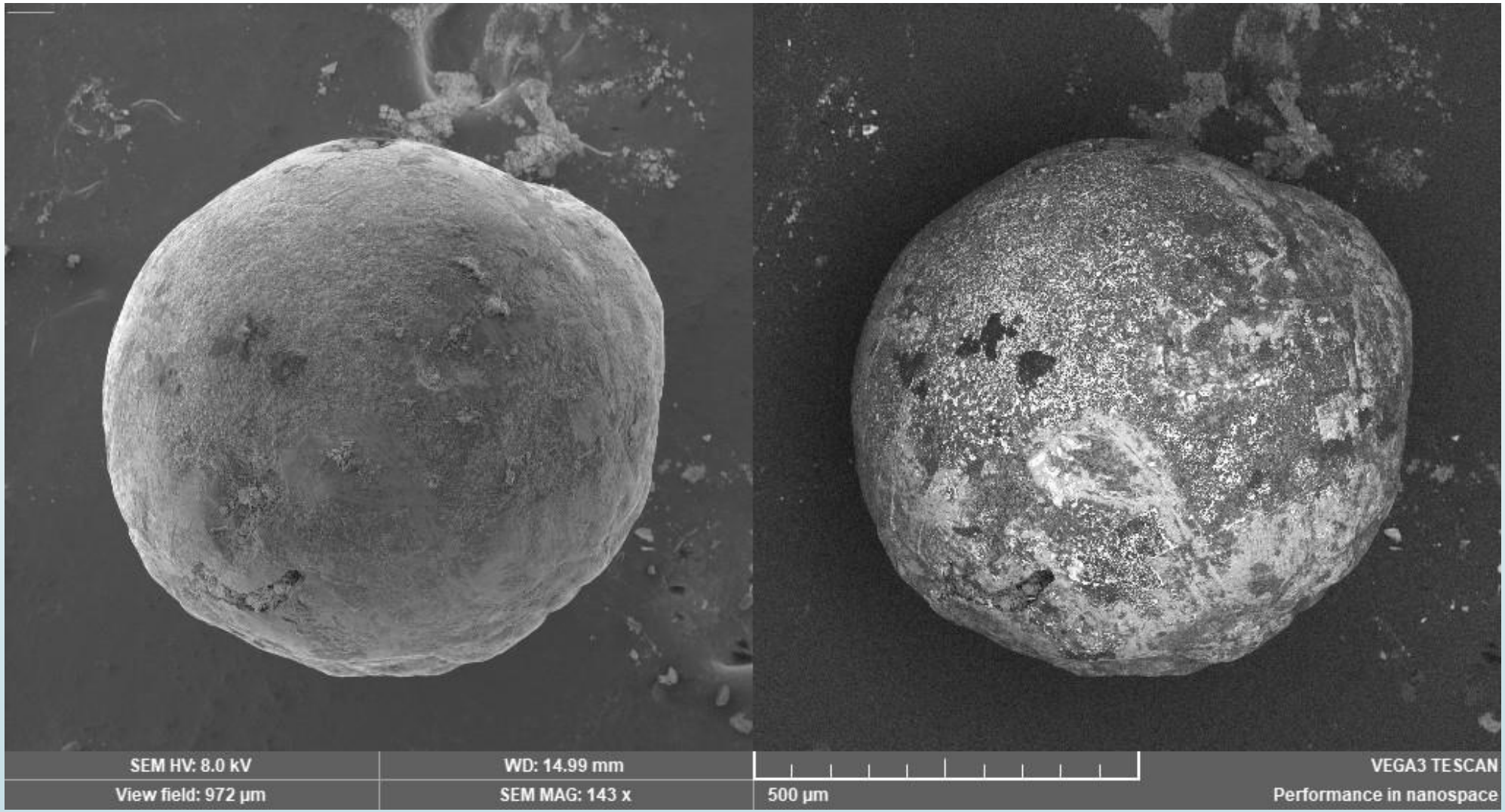


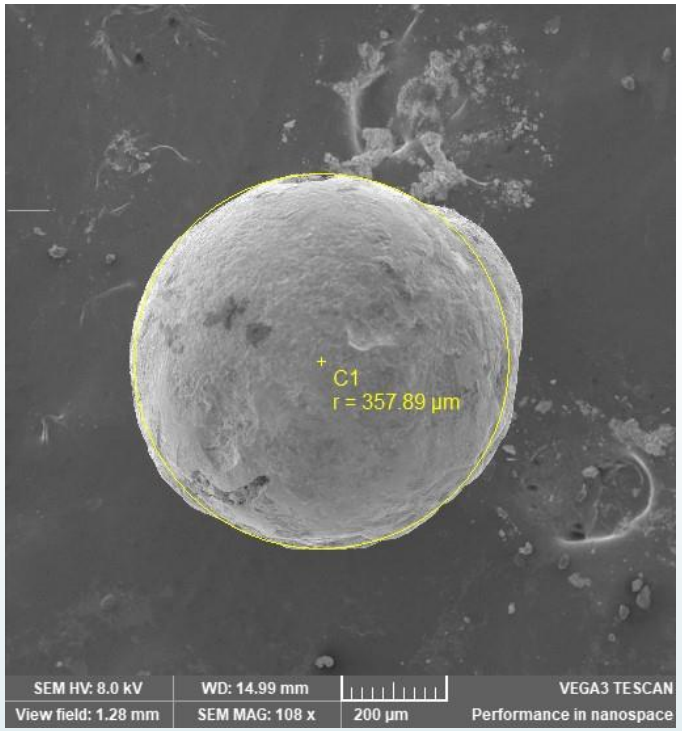


TESCAN VEGA 3 SEM

- VEGA3 high vacuum model of SEM with 3-axis motorized stage for investigation of small conductive samples. VEGA3 is a favorable package of a scanning electron microscope fully integrated with a selected EDX microanalyser.

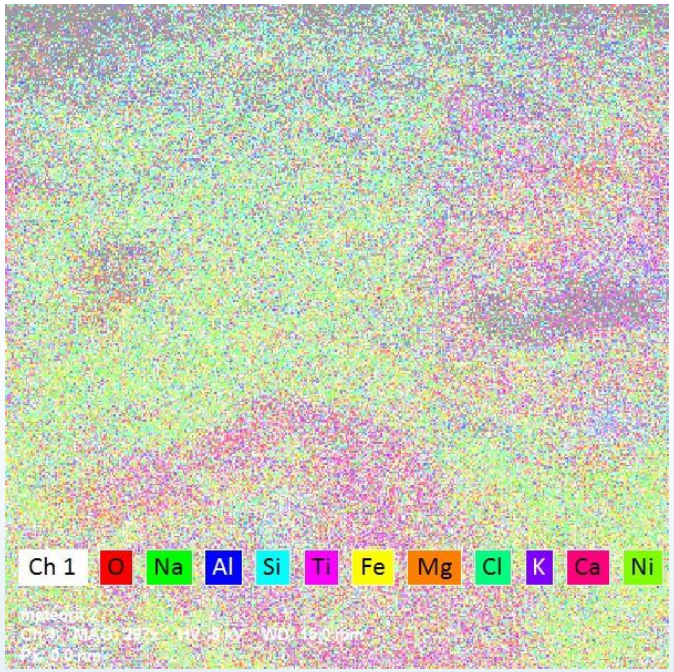
Is this a micrometeorite?

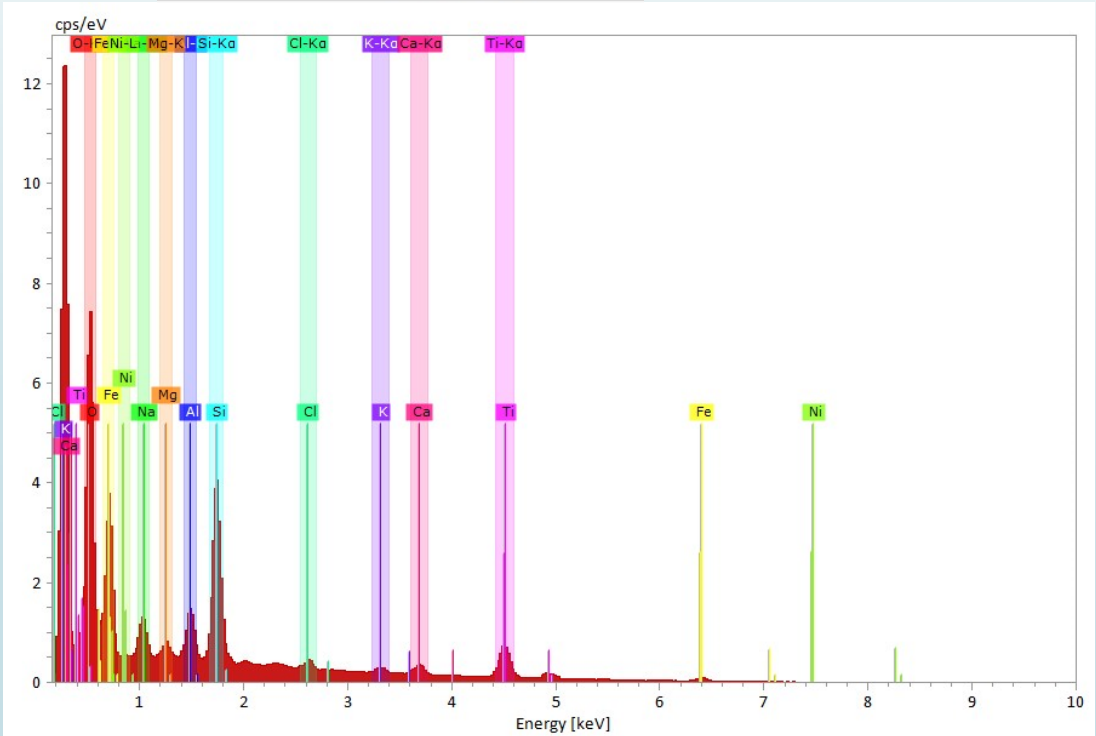




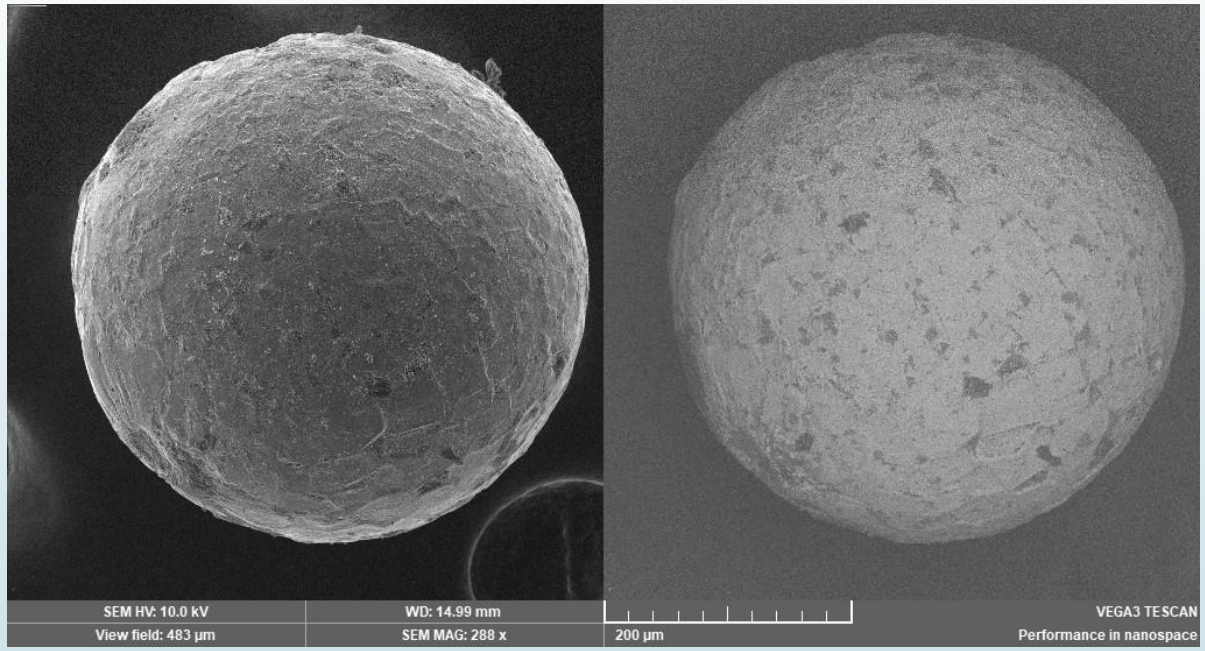
Map

Element	At. No.	Mass [%]	Mass Norm. [%]
Fe	26	23.04	32.88
O	8	19.79	28.25
Ti	22	12.45	17.77
Si	14	8.55	12.21
Ca	20	1.65	2.35
Al	13	1.41	2.02
Na	11	1.36	1.94
K	19	0.58	0.83
Cl	17	0.57	0.82
Mg	12	0.34	0.48
Ni	28	0.31	0.44
		70.05	**100.00**



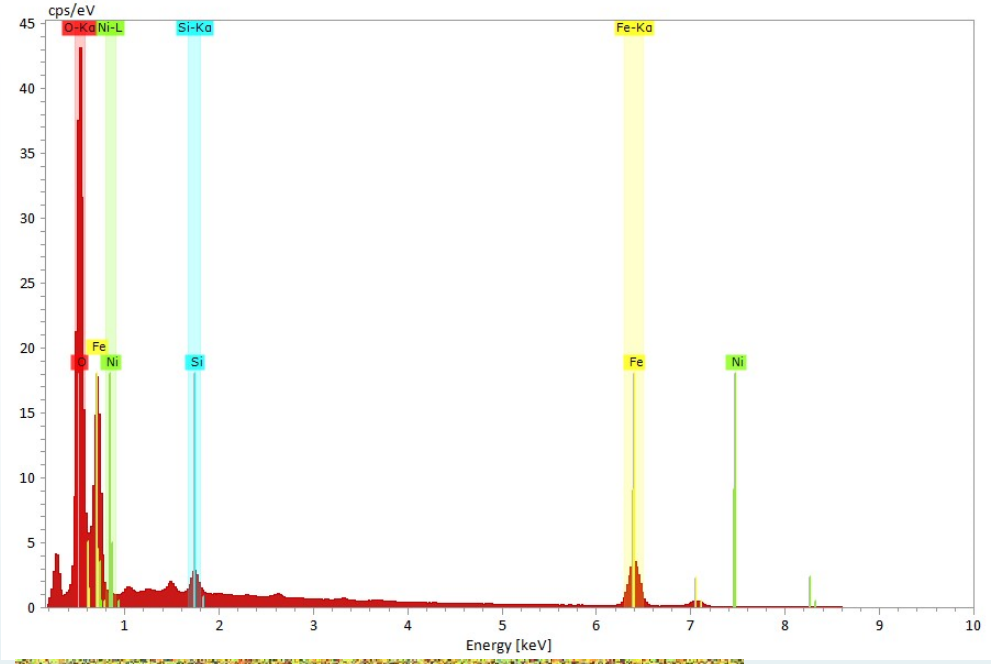


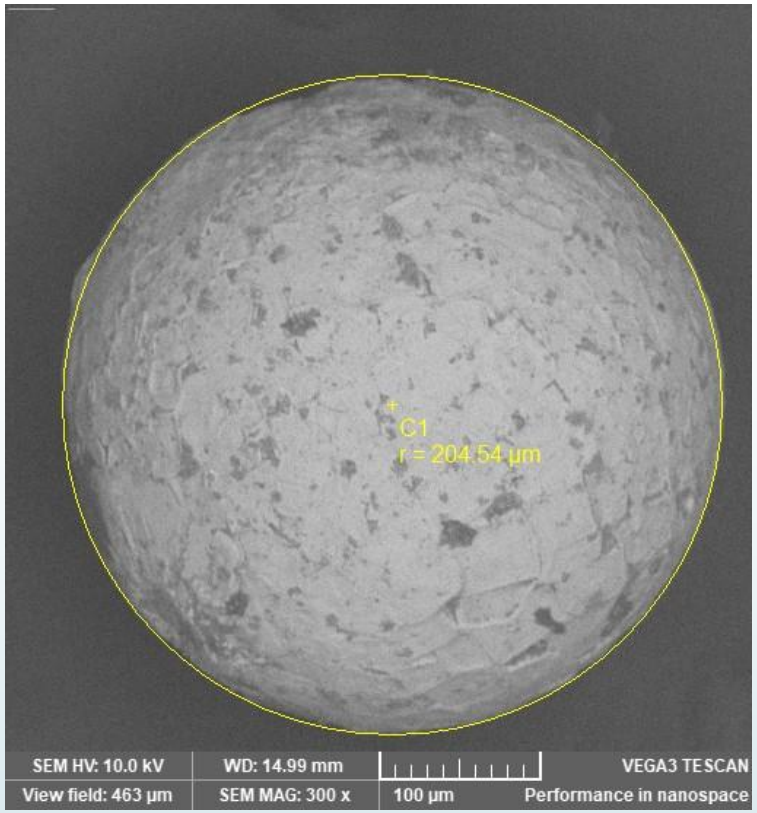
Micrometeorite with Ni-Fe

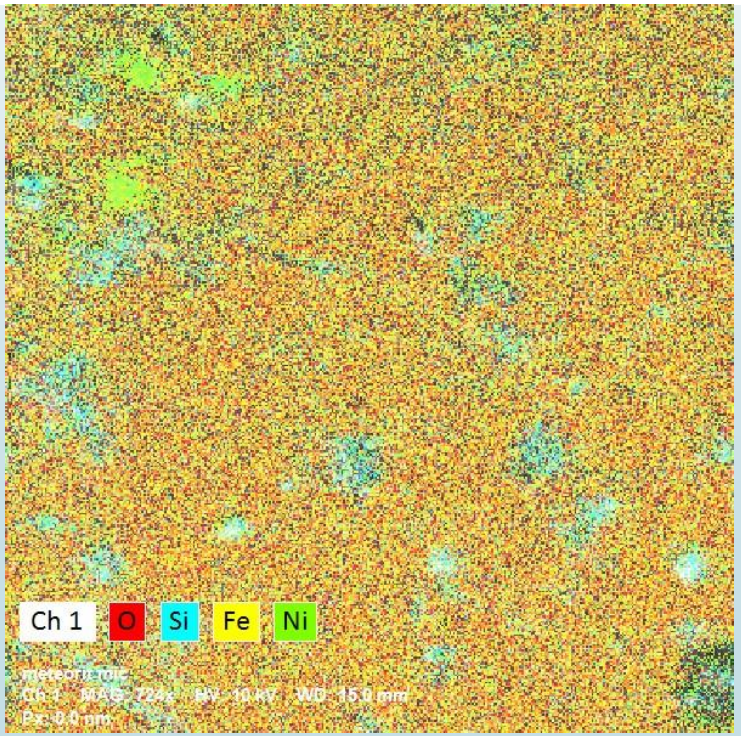


Map

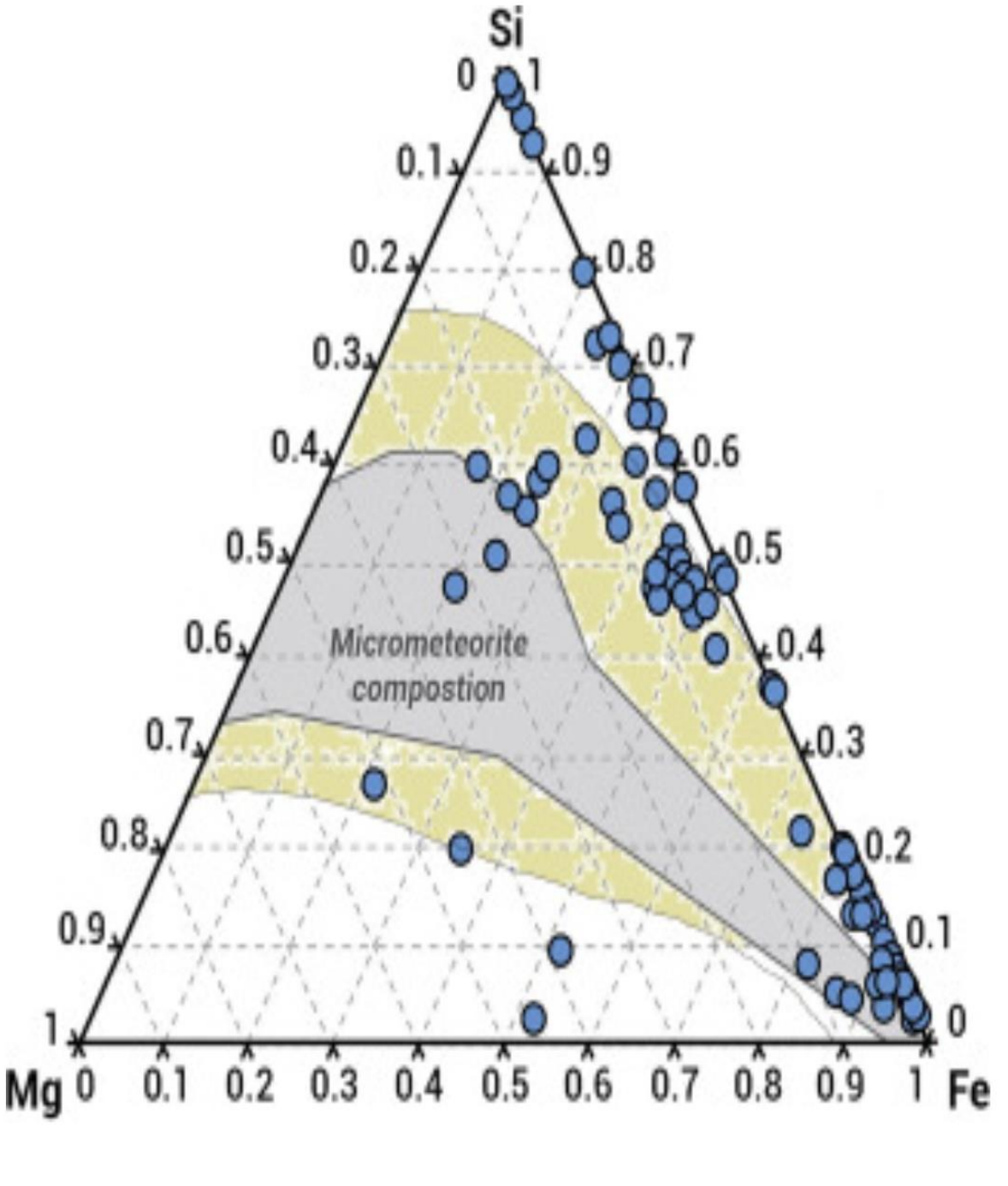
Element	At. No.	Mass [%]	Mass Norm. [%]
Fe	26	68.11	64.84
O	8	34.04	32.40
Si	14	1.53	1.46
Ni	28	1.36	1.29
		105.04	**100.00**


cps/eV
O-Ka
Ni-L
Si-Ka
Fe-Ka
Fe
O
Ni
Si
Fe
Ni
Energy [keV]


C1
r = 204.54 µm
SEM HV: 10.0 kV
WD: 14.99 mm
VEGA3 TESCAN
View field: 463 µm
SEM MAG: 300 x
100 µm
Performance in nanospace


Ch 1
O
Si
Fe
Ni


SEM HV: 10.0 kV
WD: 14.99 mm
VEGA3 TESCAN
View field: 47.8 µm
SEM MAG: 2.91 kx
10 µm
Performance in nanospace


Si
Mg
Fe
Micrometeorite
compostion

Possible micrometeorites

- We think that according with the criteria established by Genge and all (2021) our spherules are good candidates to be micrometeorites since they meet at least 2 of 3 essential features

  1. magnetite shell

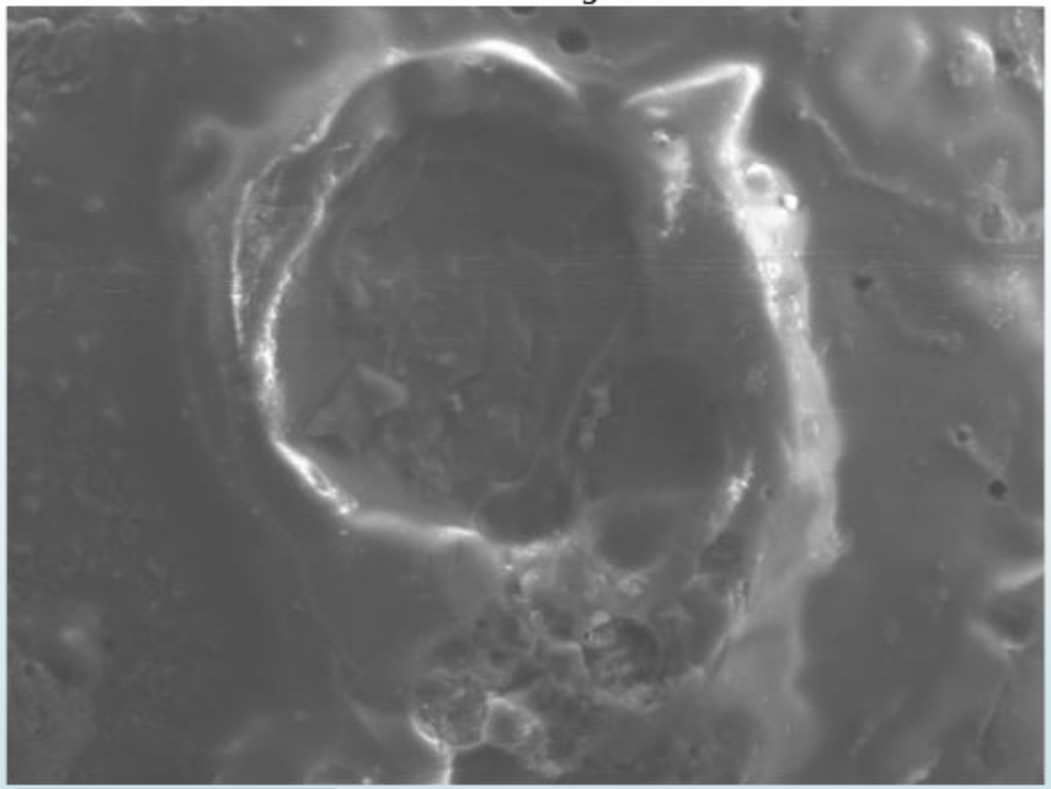
  2.Ni bearing iron metal

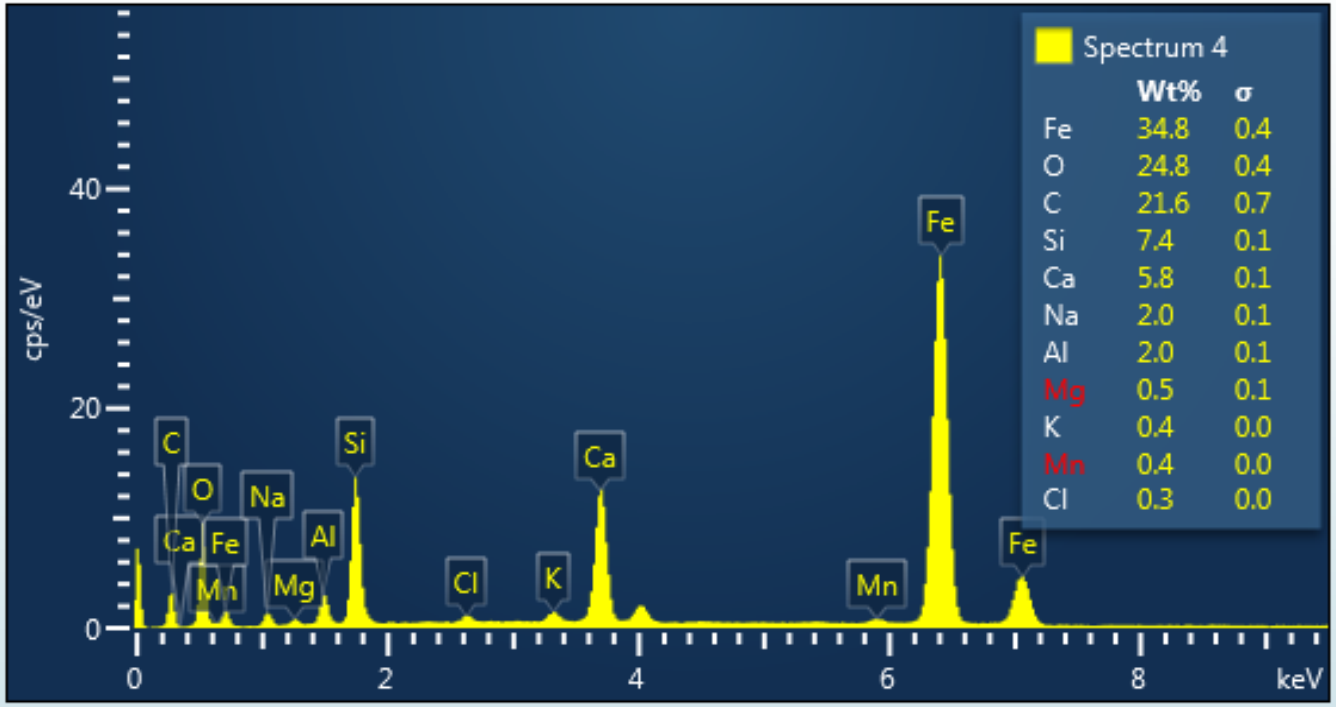
  3. chondritic composition

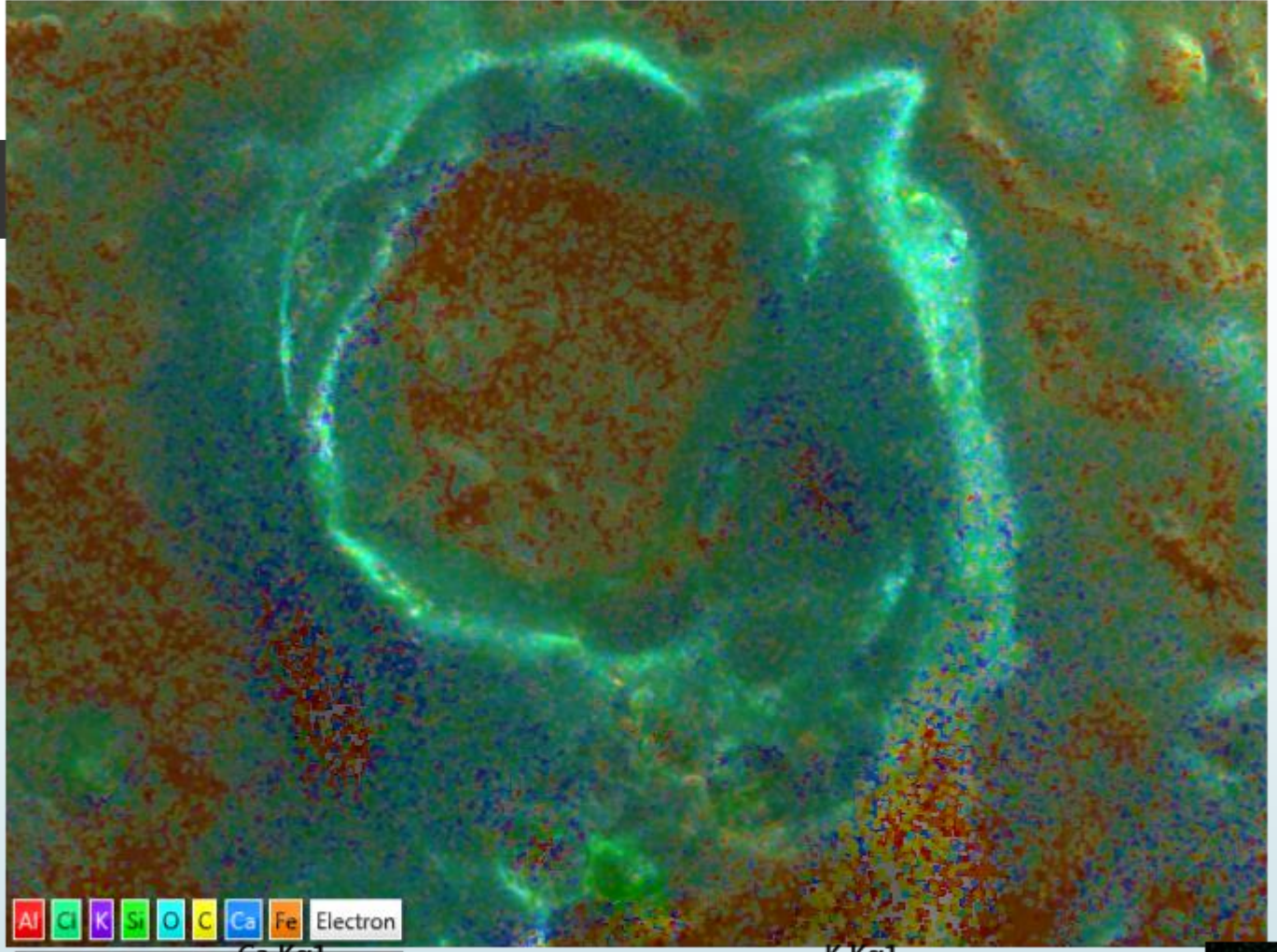
- Chondrites are broadly ultramafic in composition, consisting largely of iron, magnesium, silicon and oxygen.

  The most abundant constituents of chondrites are chondrules, which are igneous particles that crystallized rapidly in minutes to hours.

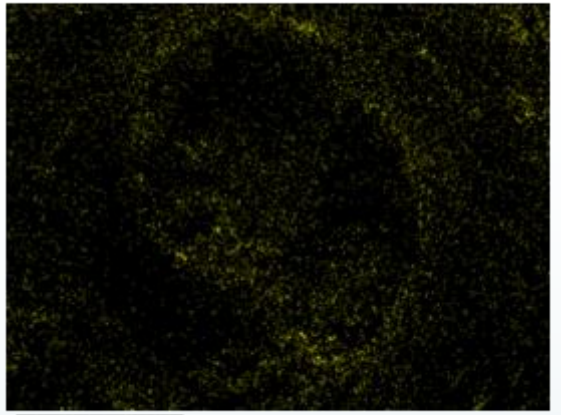
Electron Image 4



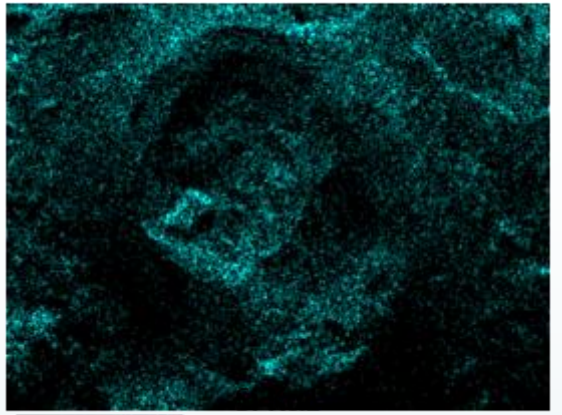




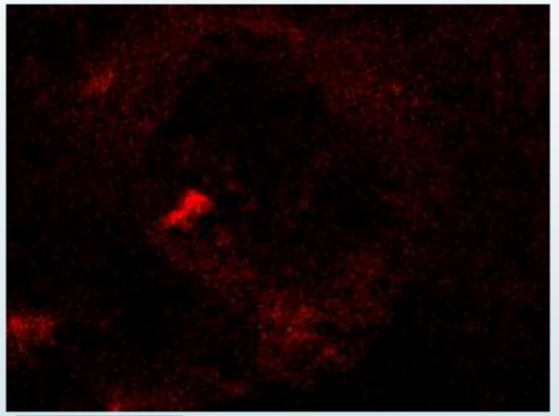
C Kα1_2

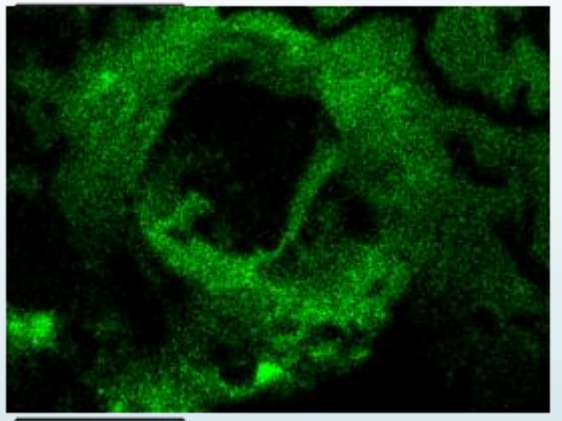


O Kα1

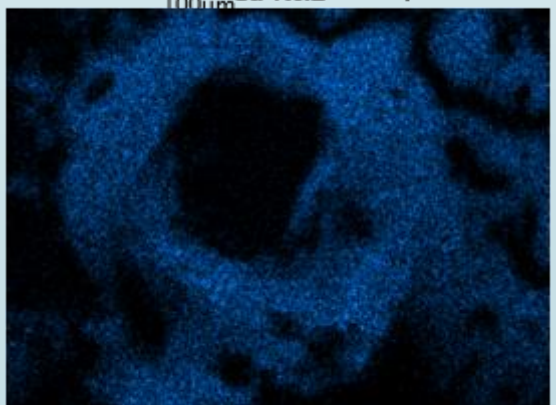


Al Kα1

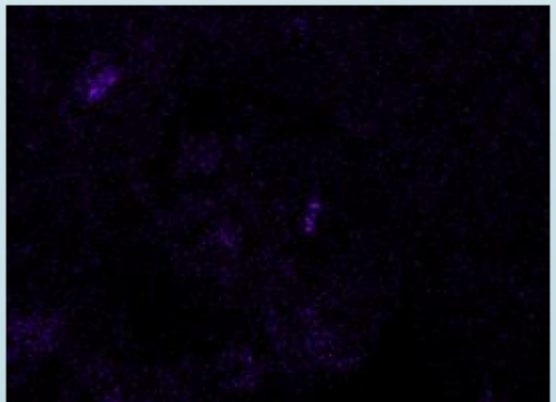




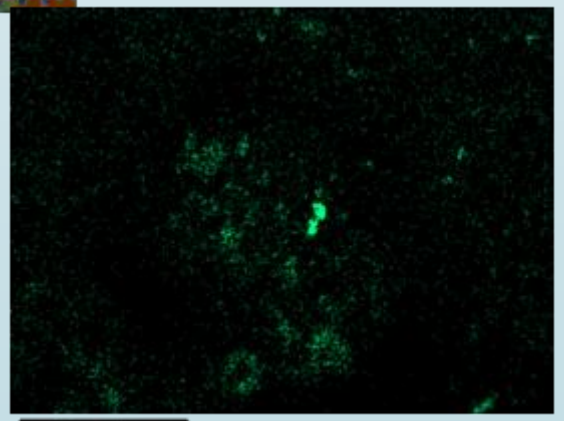
Ca Kα1



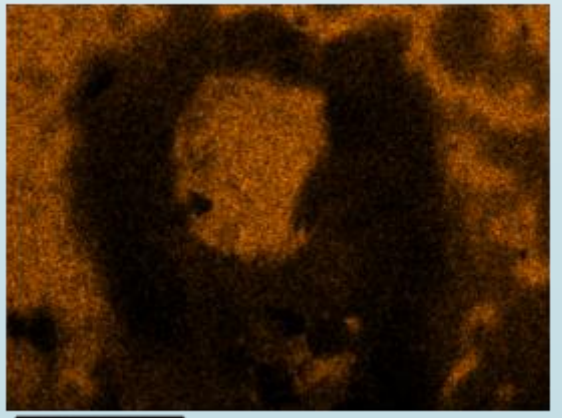
K Kα1



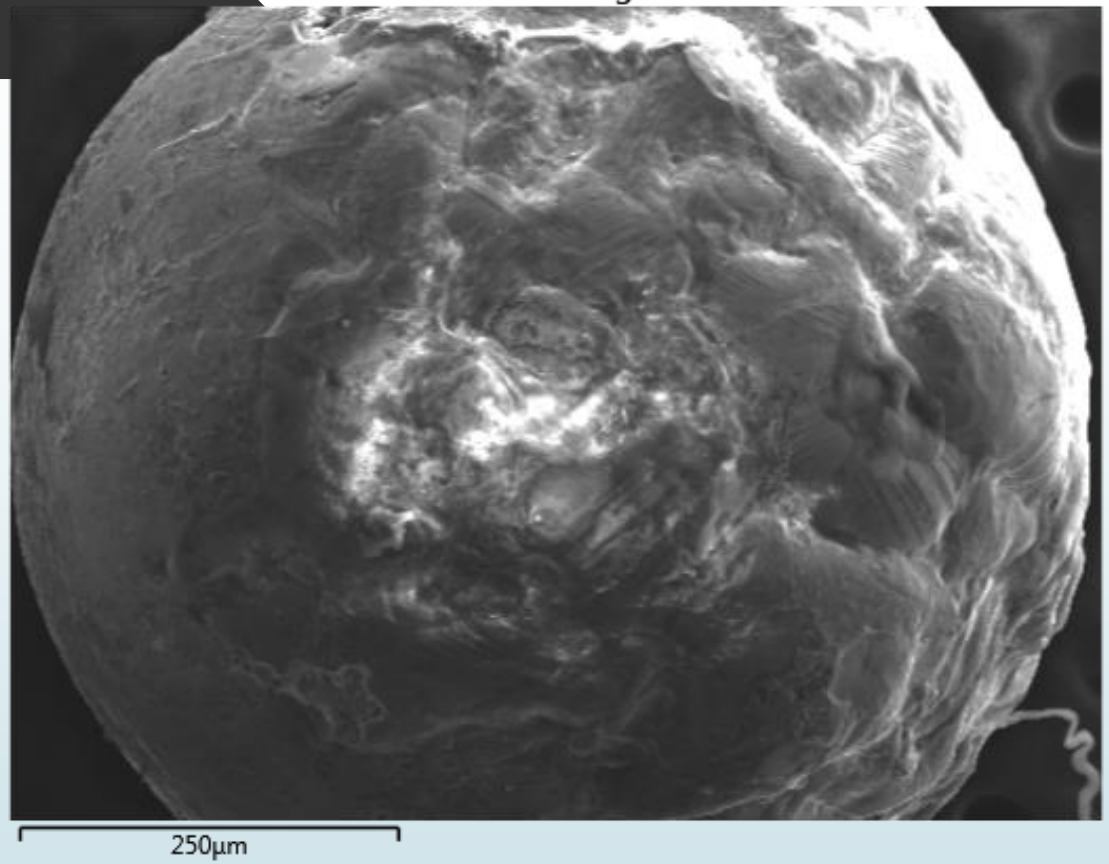
Cl Kα1

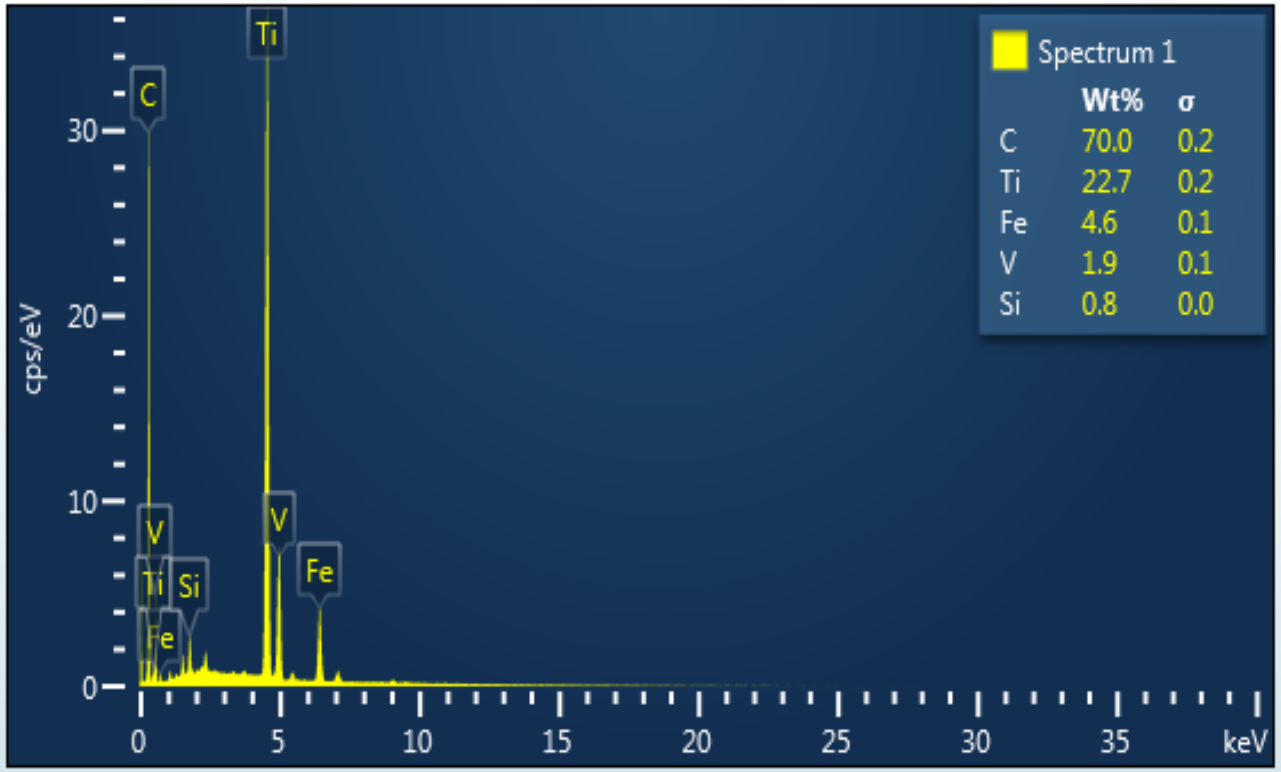


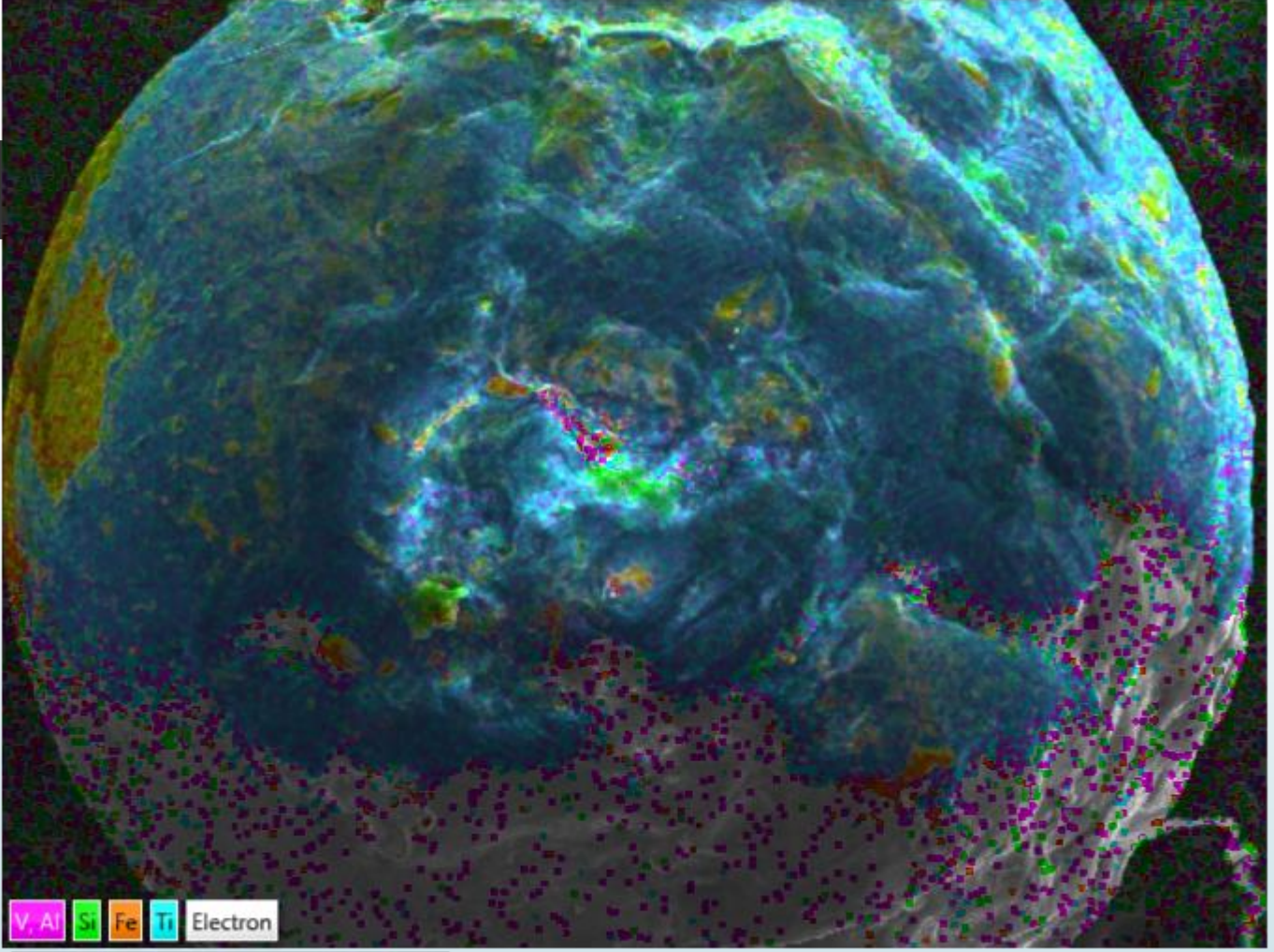
Fe Kα1



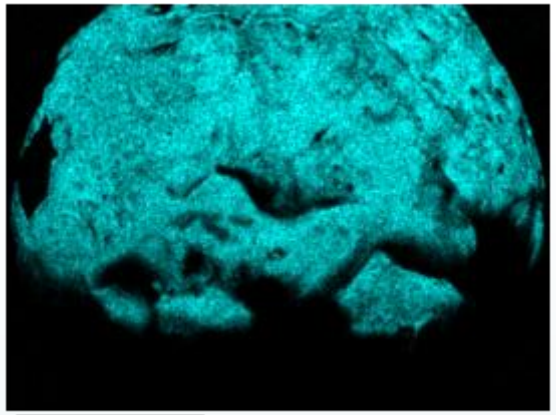
Electron Image 2



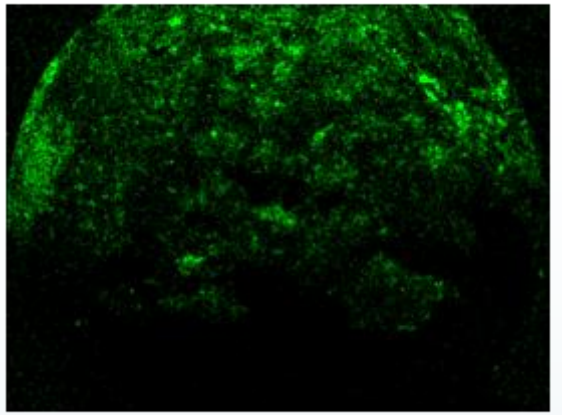




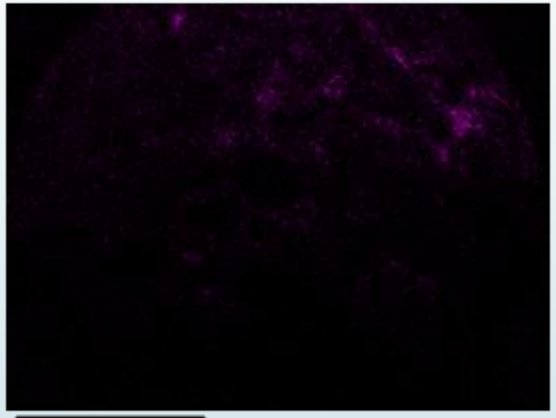
Ti Kα1



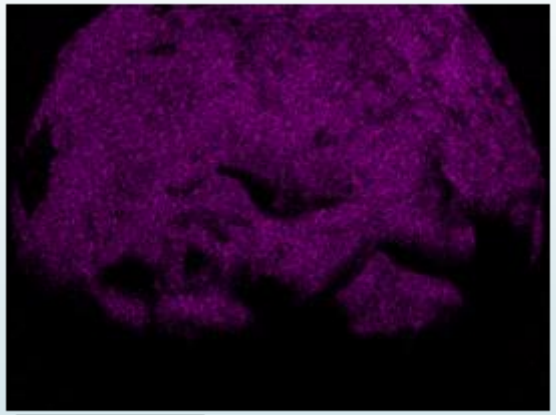
Si Kα1



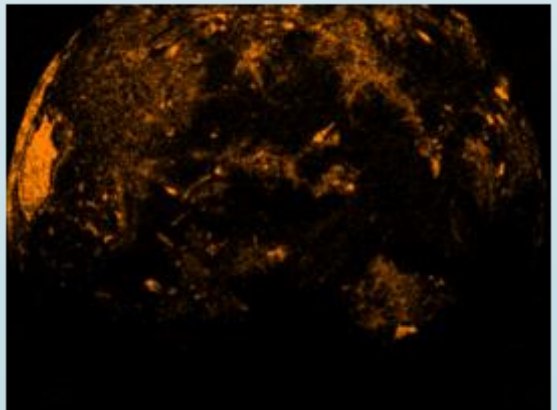
Al Kα1



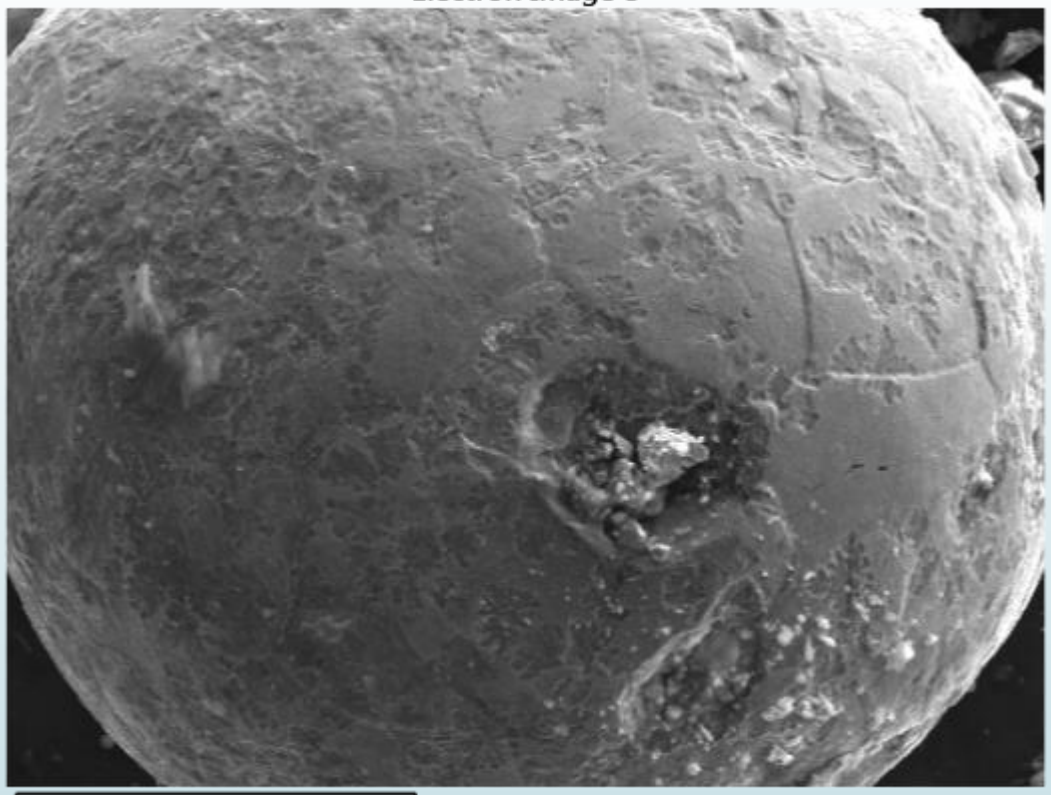
V Kα1

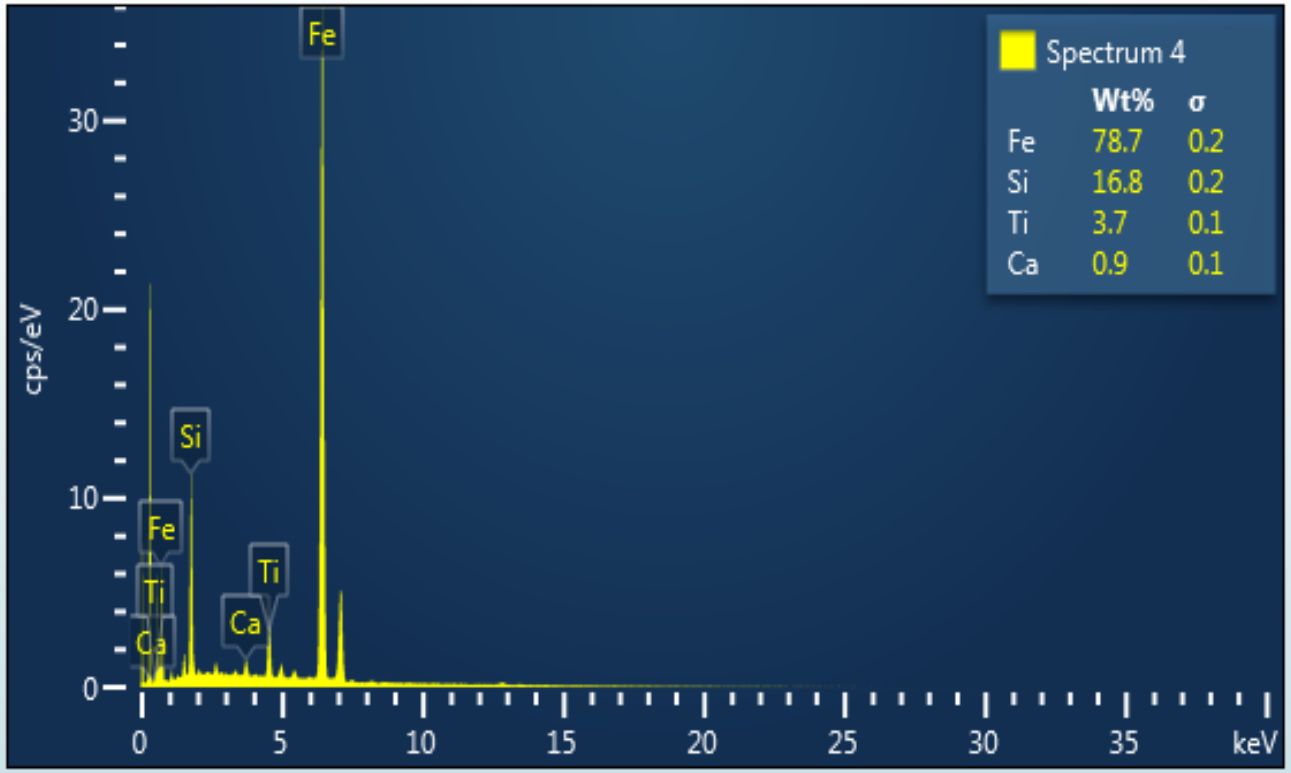


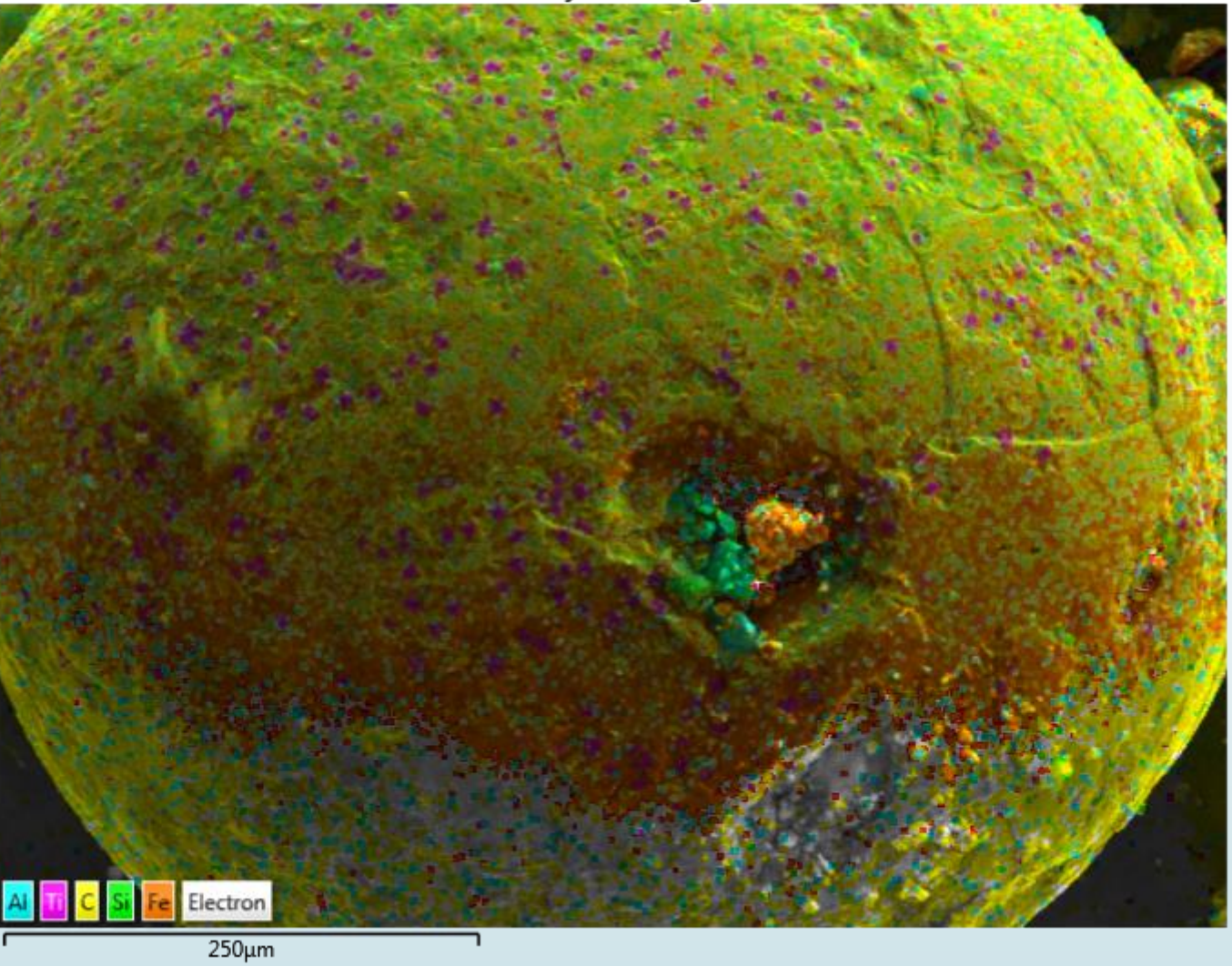
Fe Kα1

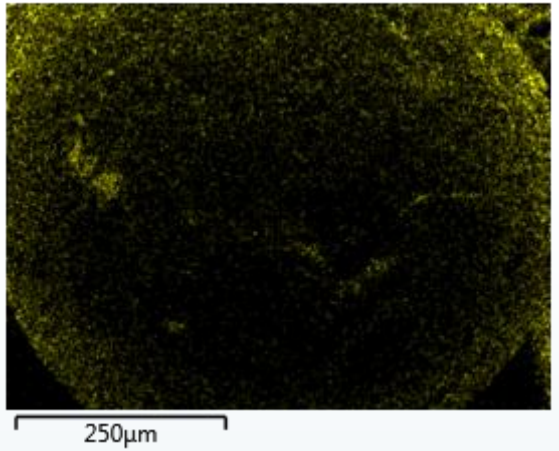


Electron Image 8

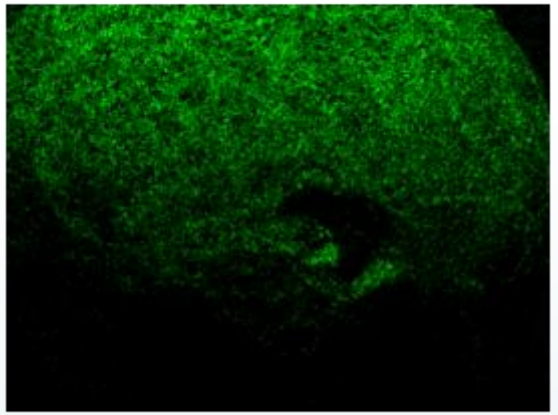




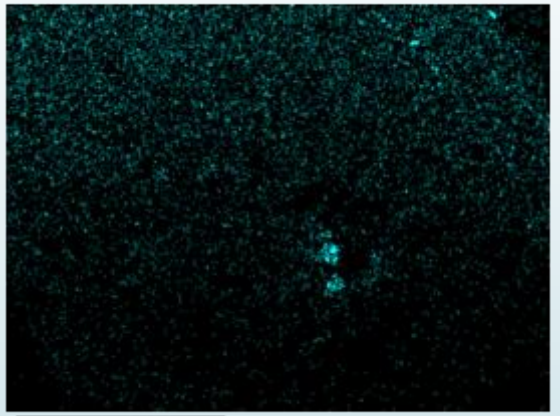




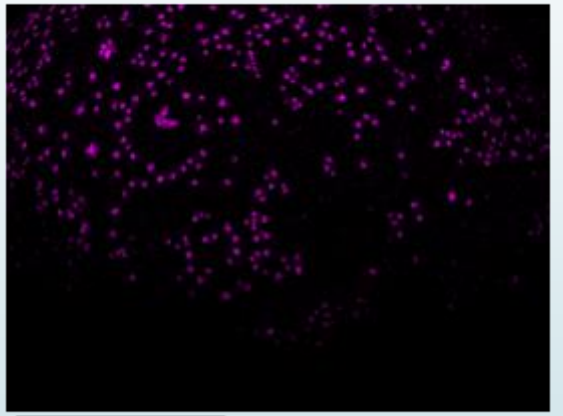
Si Kα1



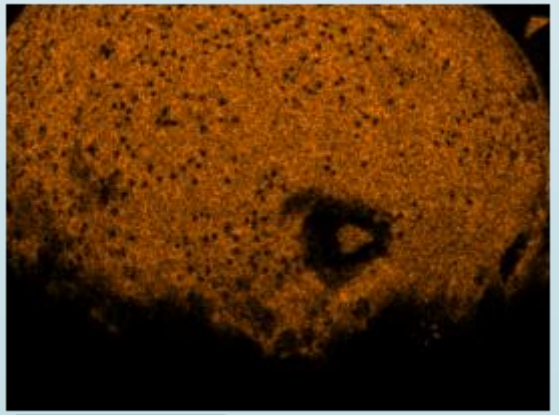
Al Kα1



Ti Kα1



Fe Kα1



Conclusions

- The students are very interested in MM, so we decided to continue learning and using scientific methods (optical and electronic microscope , spectroscopes)
- They learn more about the different layers of the Earth`atmosphere and how to explain the spherical shape of MM

  We can make collection and photo albums with MM

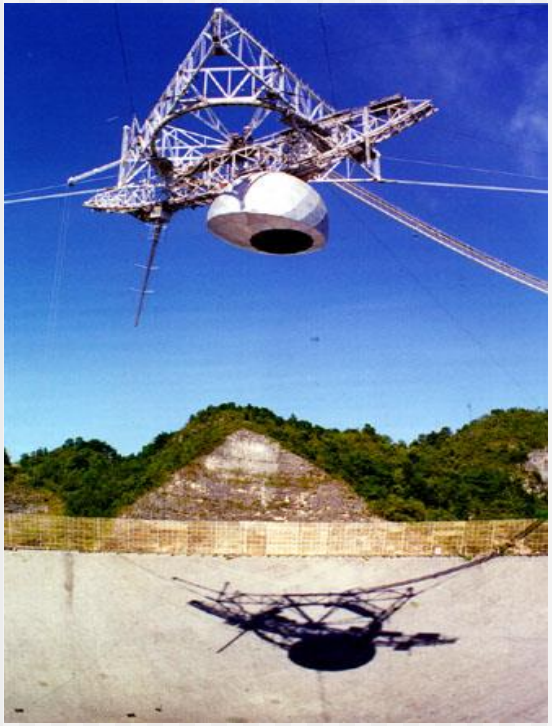
- MM are made of different chemical elements so, as a consequence there are different types / categories of MM.
- Comparison between MMs might allow some information about the place where they are collected

Bibliographies

- 1.Genge M.J., Engrand C., Gounelle M., Taylor S., 2008, The classification of micrometeorites. *Meteoritics & Planetary Science 43 Nr. 3, 497-515*
- 2.Suttle M.D., Hasse T., Hecht I.,2021. Evaluatingureban micrometeorites as a research resource- A large population collected from a single rooftop. . *Meteoritics & Planetary Science 56 Nr. 8, 1531-1555.*
- 3.Jennifer A.Grier, Andrew S. Rivkin, 2019, The creation of regolith and soils-Impact Cratering and other Processes. *Airless Bodies of the inner solar system*

Thank you for your attention!

Micro-meteoroid observations using high power and large aperture radars



Qihou Zhou
Elec. & Comp. Eng. Dept.
Miami University
Oxford, OH45056

Outline

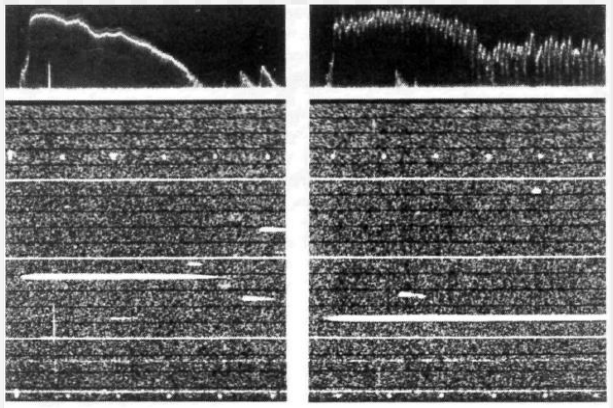
- Introduction to radar meteor echoes
- Meteor studies at Arecibo
  - Observational characteristics
  - Meteoroid velocities and mass
  - radiant studies
- Conclusions

Meteoroids, meteors and meteorites

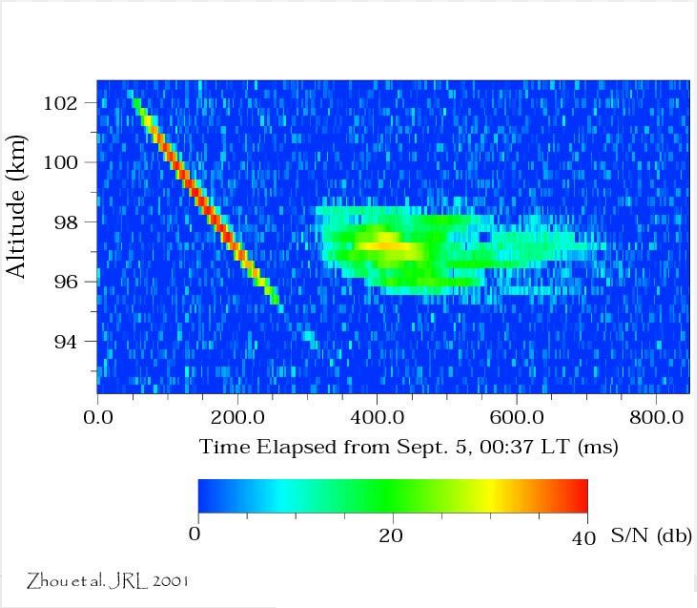
- Meteoroids: dust particles roaming the solar system. Meteoroids are subject to all the forces planets experience plus radiation pressure and solar wind drag
- Meteors: ablating meteoroids characterized by ionization trail and light emission
- Meteorites: surviving meteoroids reaching the surface of the Earth.

Radar meteor echoes

Meteor echoes were recognized soon after radar was invented in the 1930's. First organized meteor observation was done in 1946. (Millman, 1968)



- three types of echoes:
- **Trail echoes** ($\perp \boldsymbol{k}$): VHF/MF, low power
- **Range spread trail echoes** ($\perp \mathbf{B}$); powerful VHF radars
- **Head echoes** (plasma ball, overdense): powerful UHF/VHF radars



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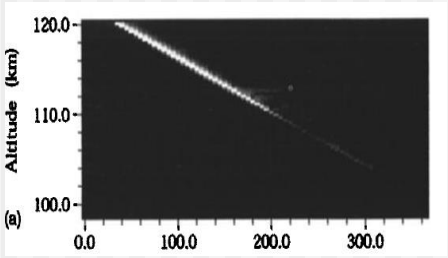
High Power Large Aperture radar observations

From 1960's to early 1990's, meteors were mostly used for wind profiling.

1990's Arecibo (430 MHz), Jicamarca (50 MHz) and EISCAT (224 MHz, 930 MHz) were interpedently used for meteor observations (Chapin and Kudeki 1994, Pellinen-Wannberg and Wannberg, Zhou et al. 1995).

There have been many publications since using HPLA.

HPLA echoes are predominantly head-echoes



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How powerful was the Arecibo radar?

- Dish:305 m; Power: 2 MW; Frequency: 430 MHz
- The observable effective cross-section at 100 km ~ 10^{-11} m^2.
- With Rayleigh scattering taken into consideration, the Arecibo radar can easily see a penny at 100 km away.
- Meteor echoes were not reported until 1995.
- Part of the reason was that they only last a few ms within the radar beam.

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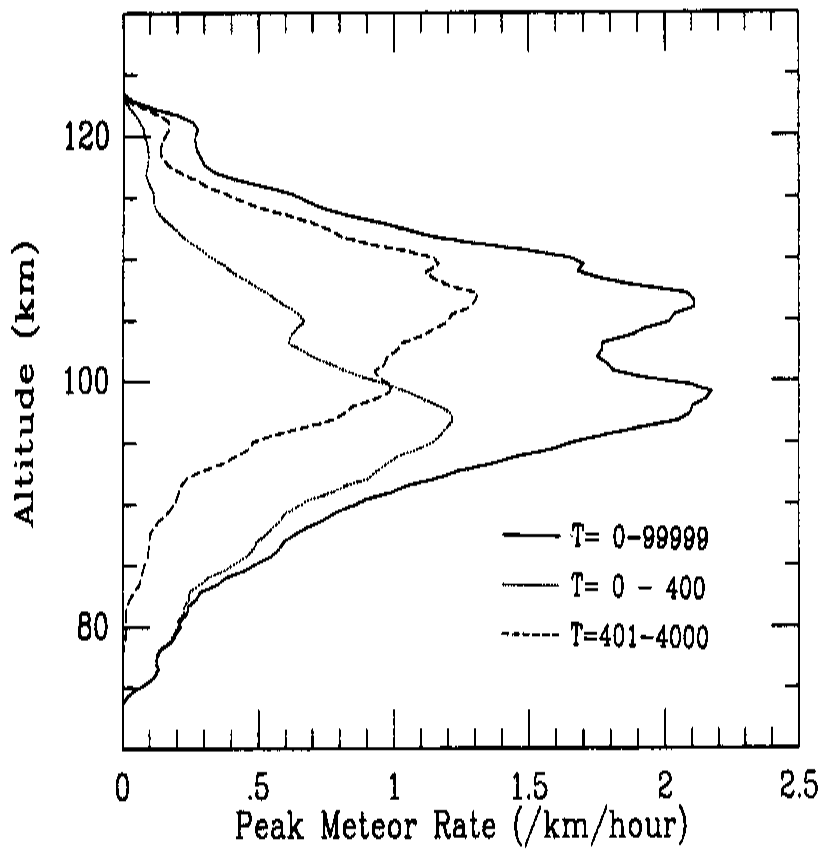
Altitude distribution



- Most meteors are seen around 100 km. This is the altitude with enough frictional heat to ionize meteoroids
- The altitude distribution is higher than traditional meteor VHF observations

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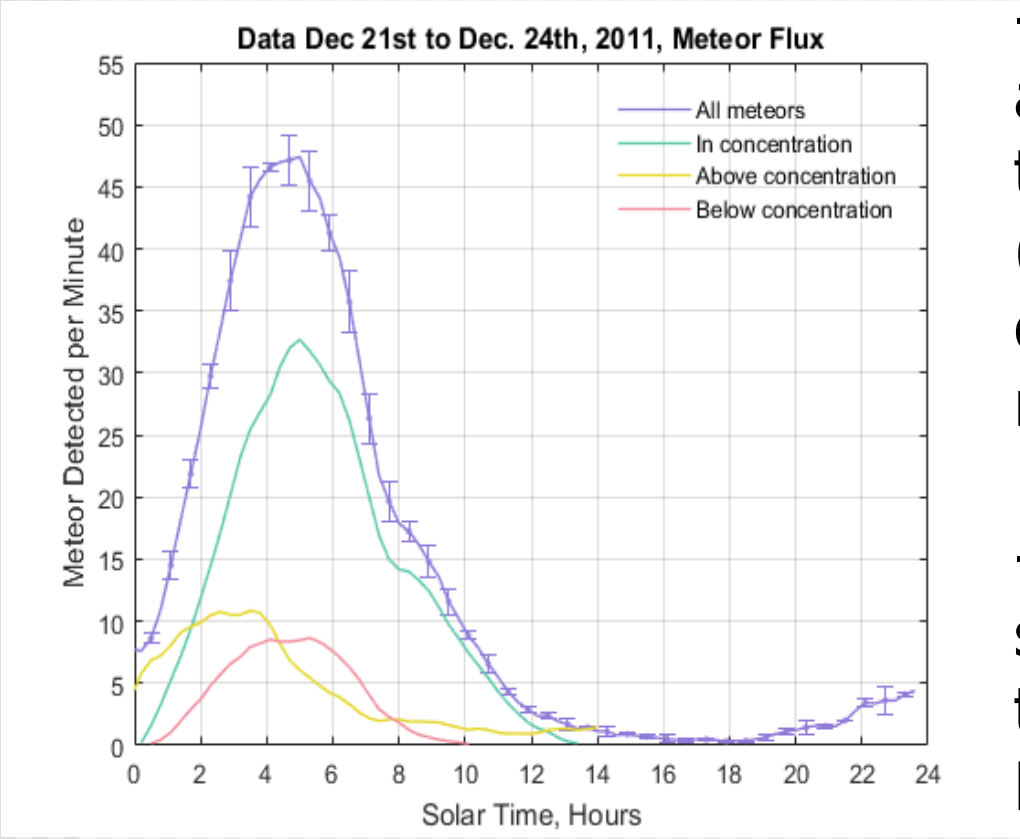
Time variation of meteor flux at Arecibo



Li & Zhou, 2018)

- Many more meteors are observed at dawn than at dusk. (windshield has more dead bugs than the rear-window!)

- The flux rate suggests Arecibo typical mass ~ 10^{-13} kg, smallest among any ground-based observations

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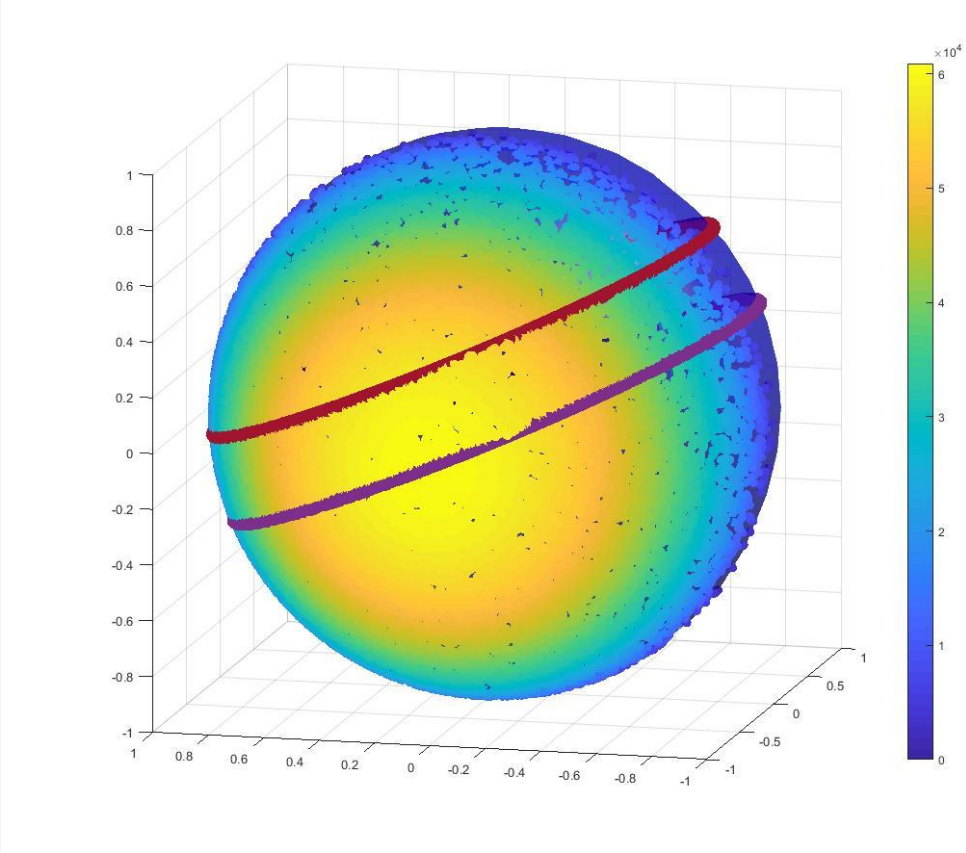
Line-of-sight velocity map

- Geocentric velocity of intra-solar meteoroids: 11-72 km/s.
- Arecibo is located at 18°N.
- Radar points vertically
- Map is line-of sight vel in Earth-ref. frame
  - All meteors from Apex direction at 30km/s



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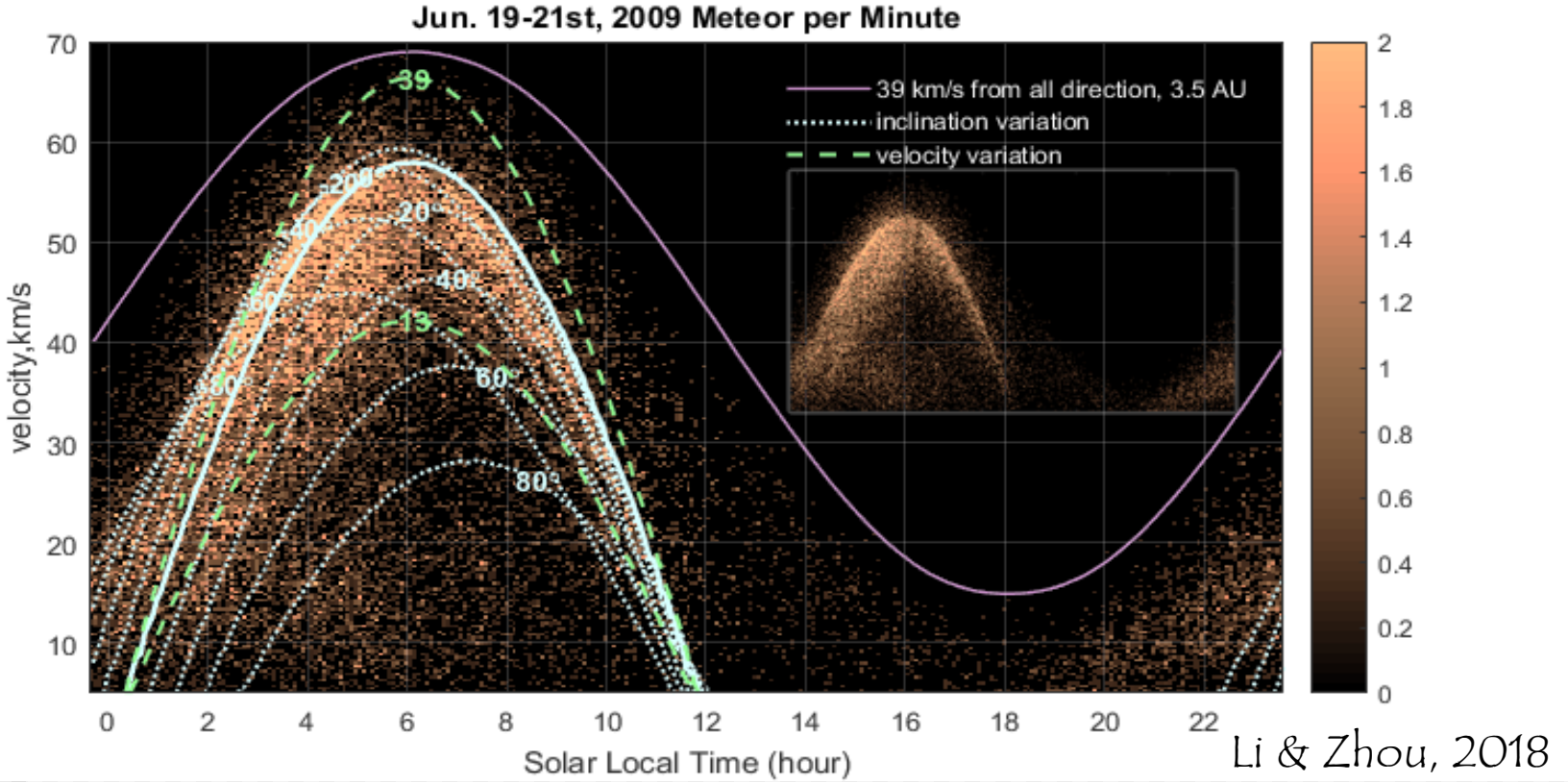
Velocity distribution - Data:



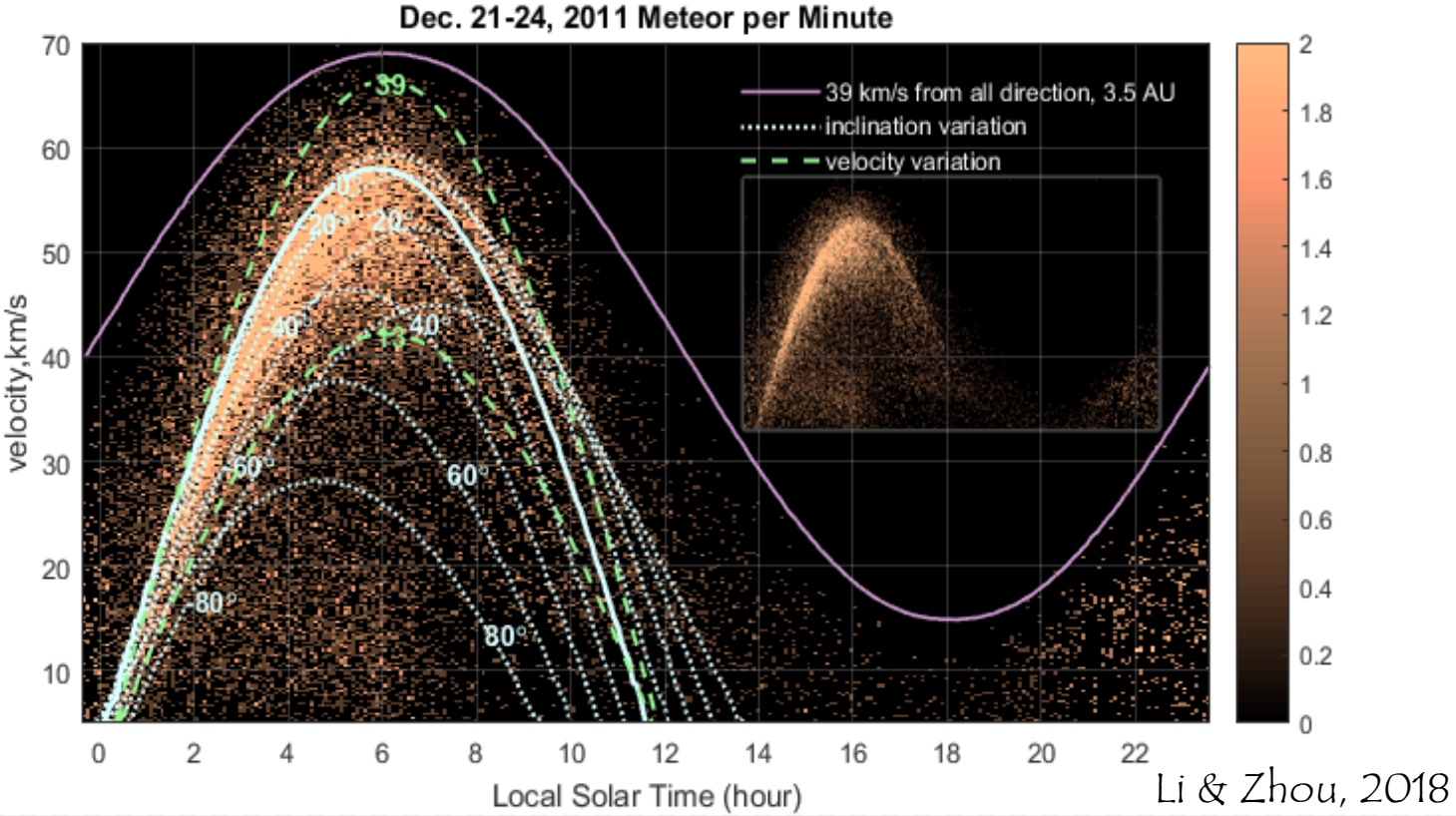
Li & Zhou, 2018

Gold dusts: observations, brightness and density of dots ∝ counts.
Focus is the arch from midnight to noon.

Purple line: upper velocity of interplanetary particles.

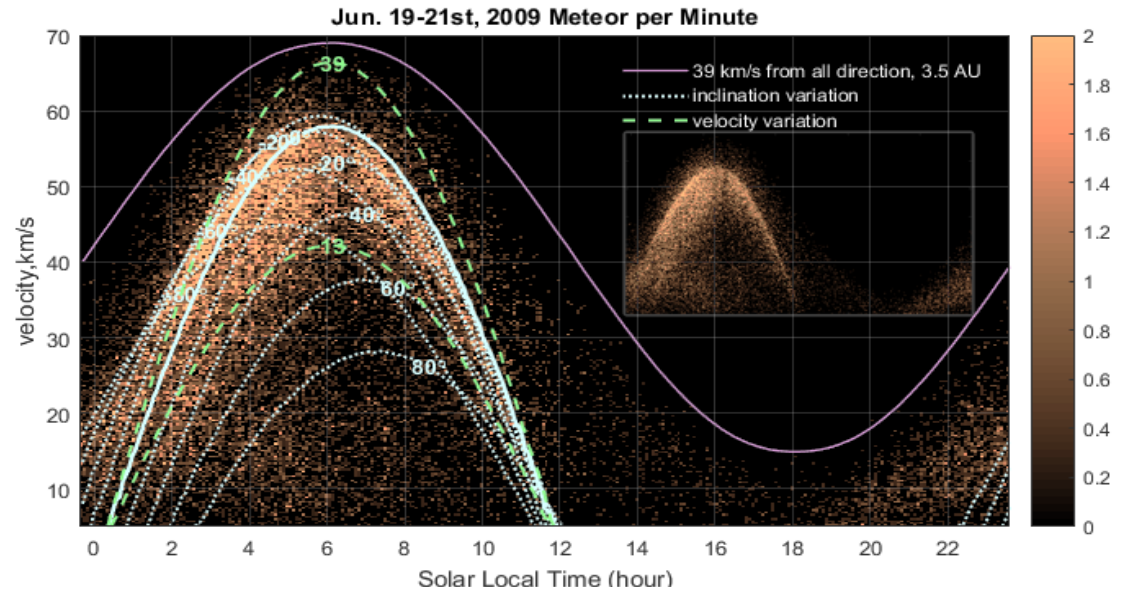
Green lines: expected vel of dust in circular orbit at diff. inclin.

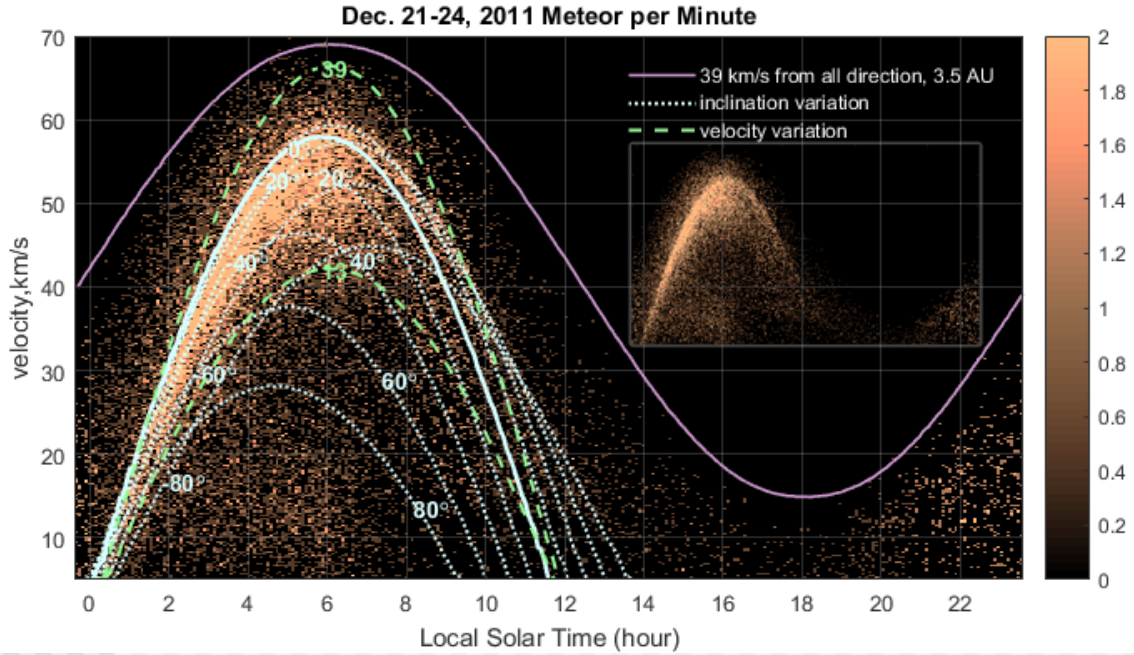
Velocity distribution – Dec.

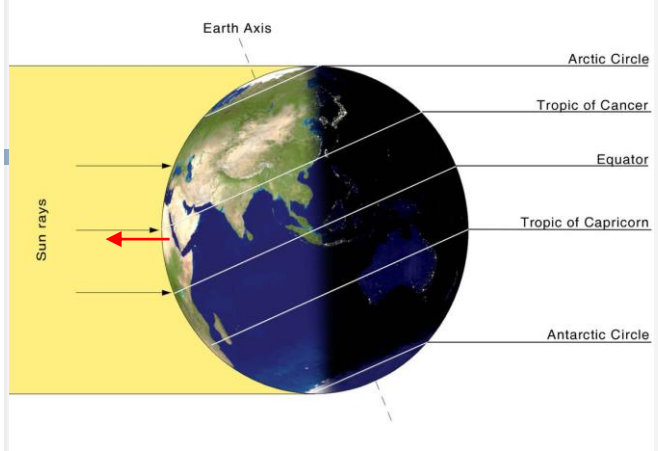


Li & Zhou, 2018

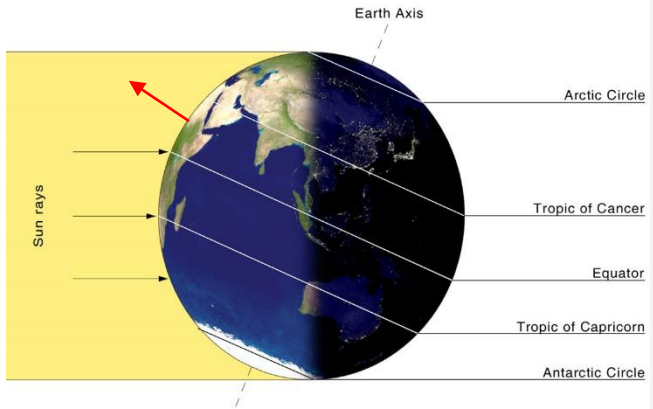
- Leg from 0 to 6 am is sharper than leg from 6 to 12 noon.
- As in June observation, this feature is consistent with dusts in circular orbit from diff. inclination





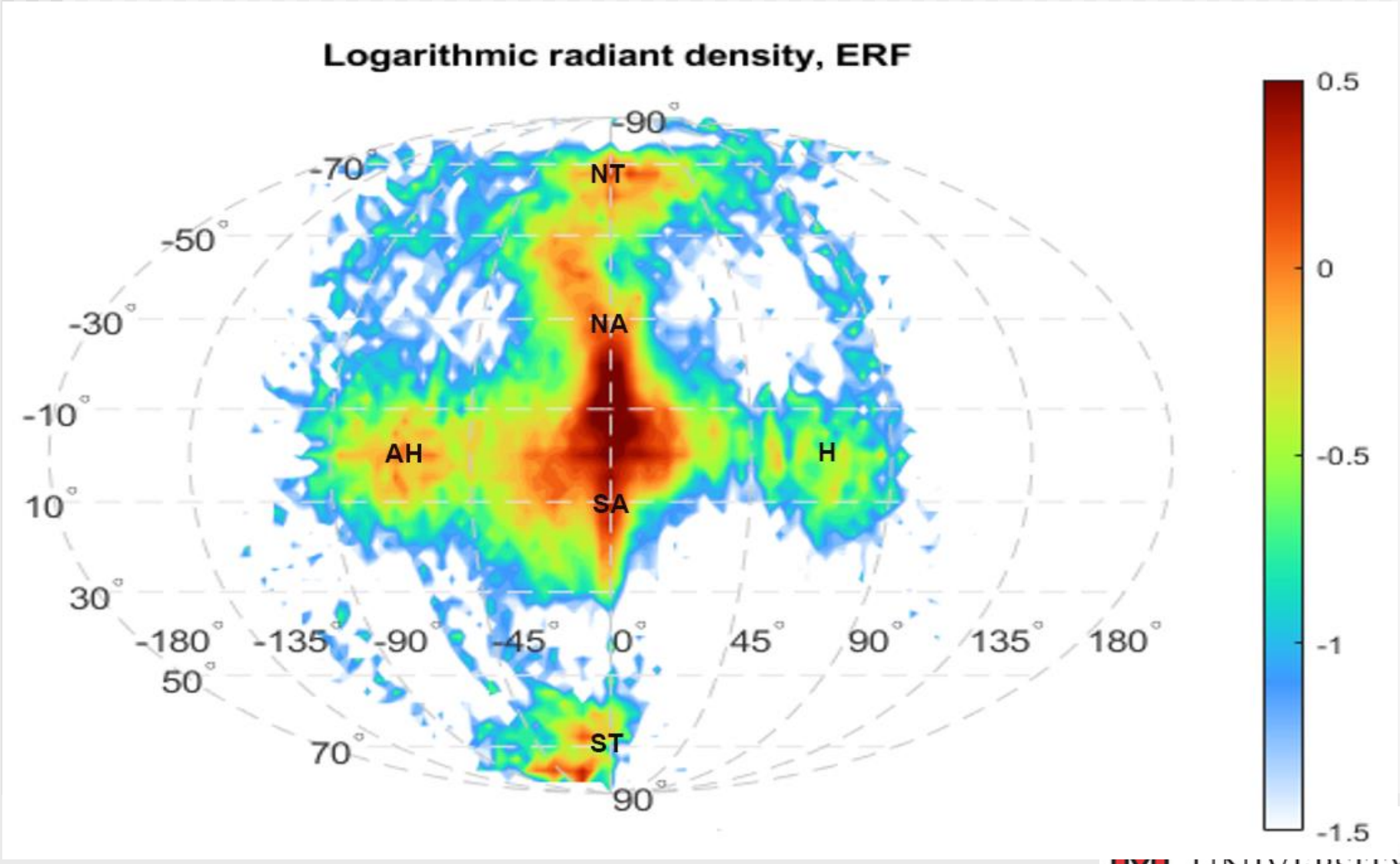


Radar pointing dir.

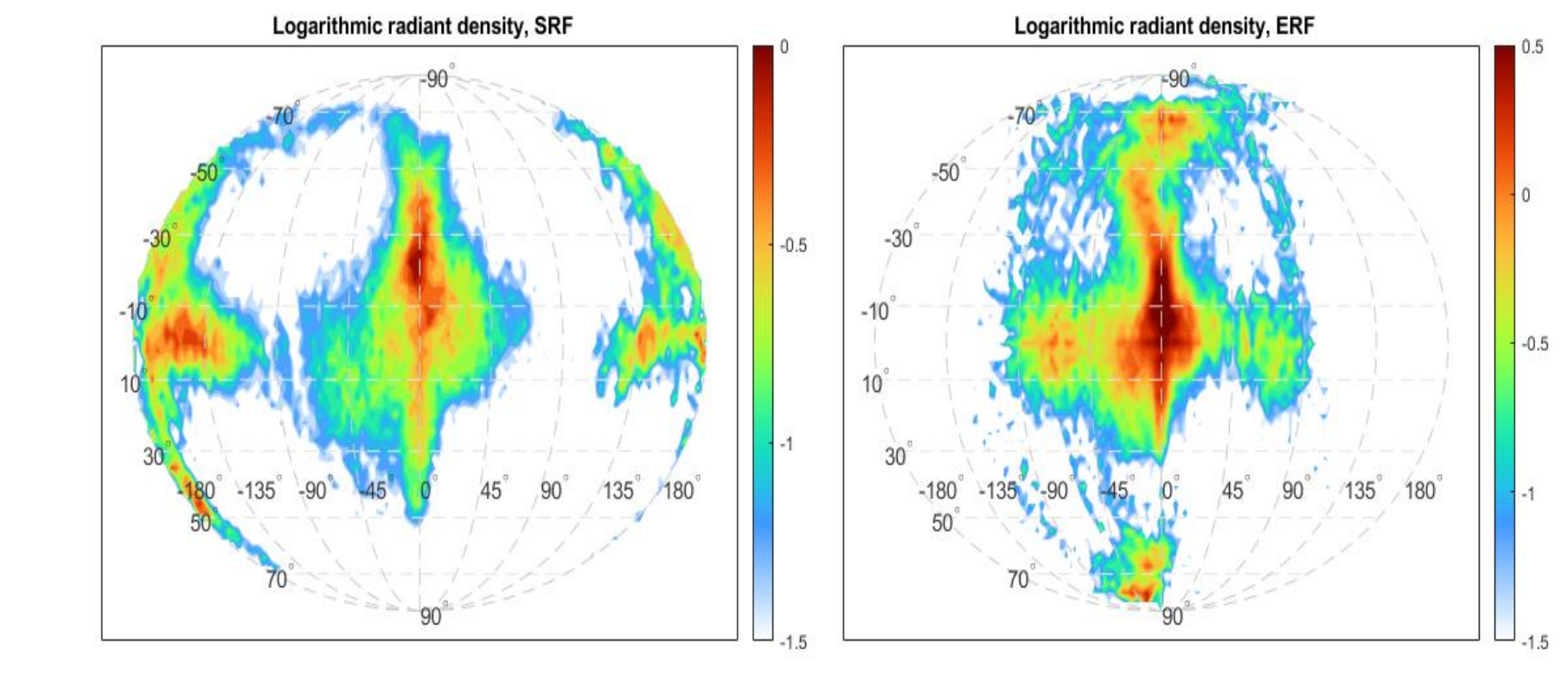


Arecibo meteoroids orbits are mostly quasi-circular.

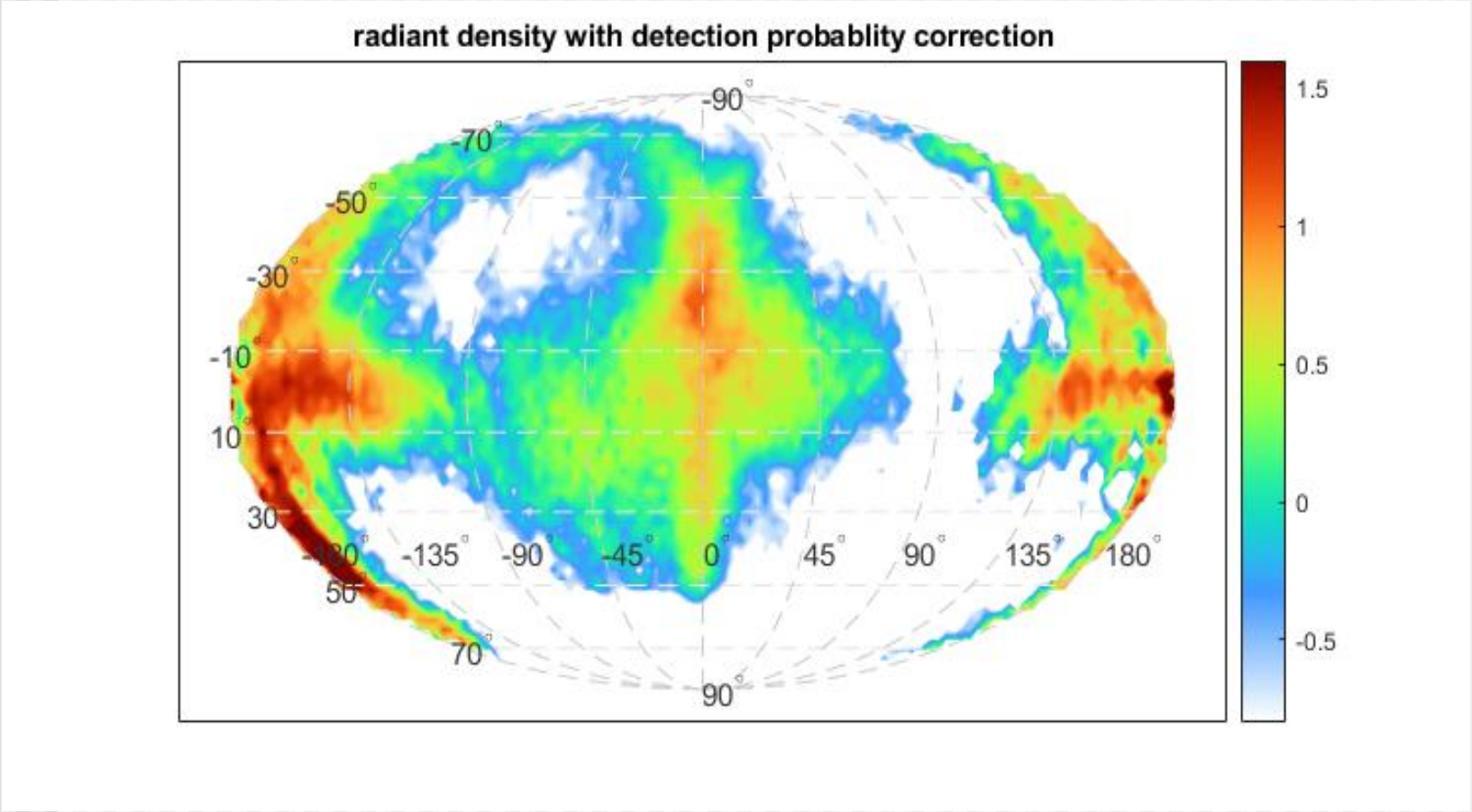
Radiant distribution - ERF



Solar Reference Frame



Distribution = detection probability corrected



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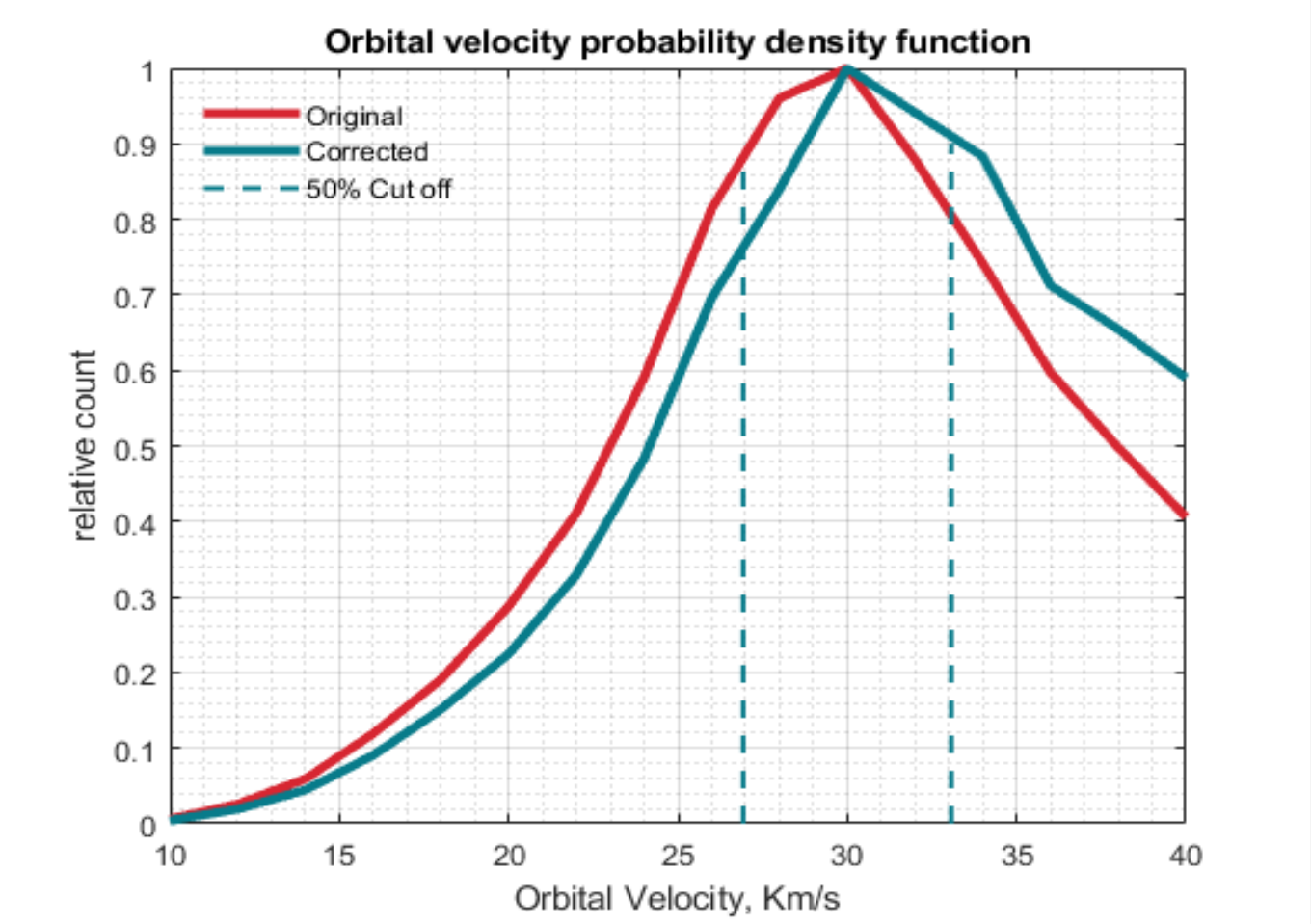
Aggregated velocity distribution



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Why Arecibo meteoroids on quasi-circular orbit?

- Micro-meteoroids' orbit significantly affected by radiation pressure
- β, the ratio of radiation pressure to solar gravitation force.
- $\beta > 0.5$, a particle will be blown out of the solar system.
- $\beta = 0.5$ a particle size of 1 μm and a mass of 10^{-14} kg
- $\beta < 0.5$, a particle will spiral toward the sun
- Meteoroid mass around 10^{-11} kg- 10^{-13} affected by Poynting-Robertson and solar wind drags.
- Arecibo meteors appear to have the "Goldilocks" size, small enough for the drags to force them into nearly circular orbits and being pulled inward to the Sun but large enough not to be blown away by the radiation pressure.

Conclusions

- Arecibo meteoroids, with a mass around 10^{-13} kg, are the smallest observed by any ground based instruments.
- Most of the particles are quasi-circular orbits, likely due to Poynting-Robertson and solar wind drags.
- No evidence on interstellar dust particles in our observations.
- There are more retrograde meteoroids observed. However, if we consider the collision probability, there would be more prograde micrometeoroids.

NASE-IAU Micrometeorites Project activites in Bulgaria

Ivo Jokin

Municipal center for extracurricular activities

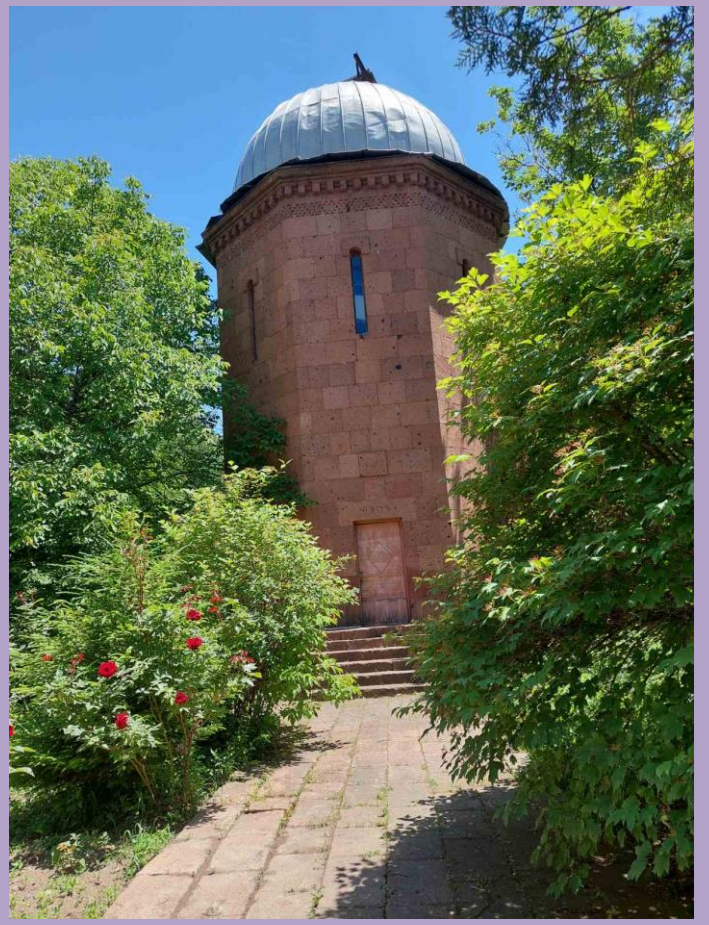
Bulgaria

Presenting the Project during
19th National Astro Party
Bulgaria, 2023

Project activites during "Ciencia en Accion", Viladecans, Spain 2023

Thank you for your attention!

NASE-IAU Micrometeorites Project activites in Armenia



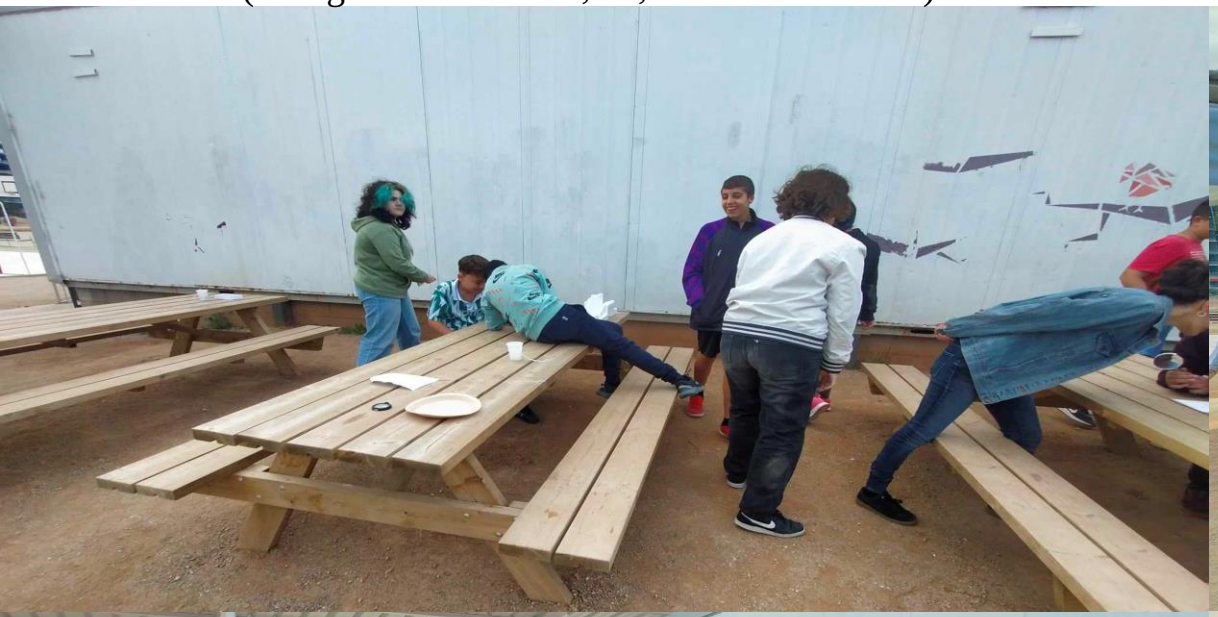
Thank you for your attention!

NASE-UNESCO Micrometeorites Project in Mongolia

Chinzorig Bayarkhuu
Solongo Batdelger
Nasanjargal Erentsen

Activities in Mongolia

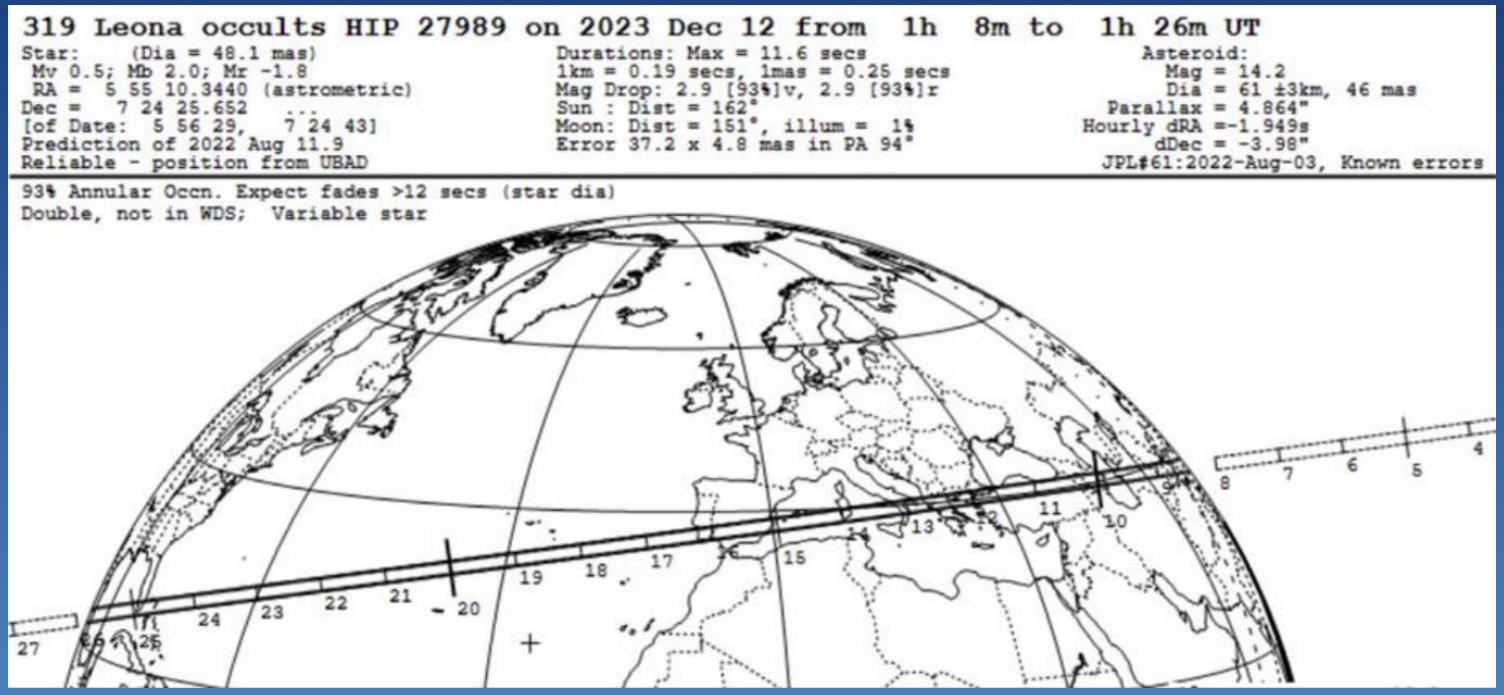
Location (Spain)
IES Olimpia (Avinguda dels Jocs Olímpics, 11, 08840 Viladecans)
IES Miramar (Avinguda de Miramar, 15, 08840 Viladecans)



Thank you for your attention

Betelgeuse occultation

2023, morning of December 12



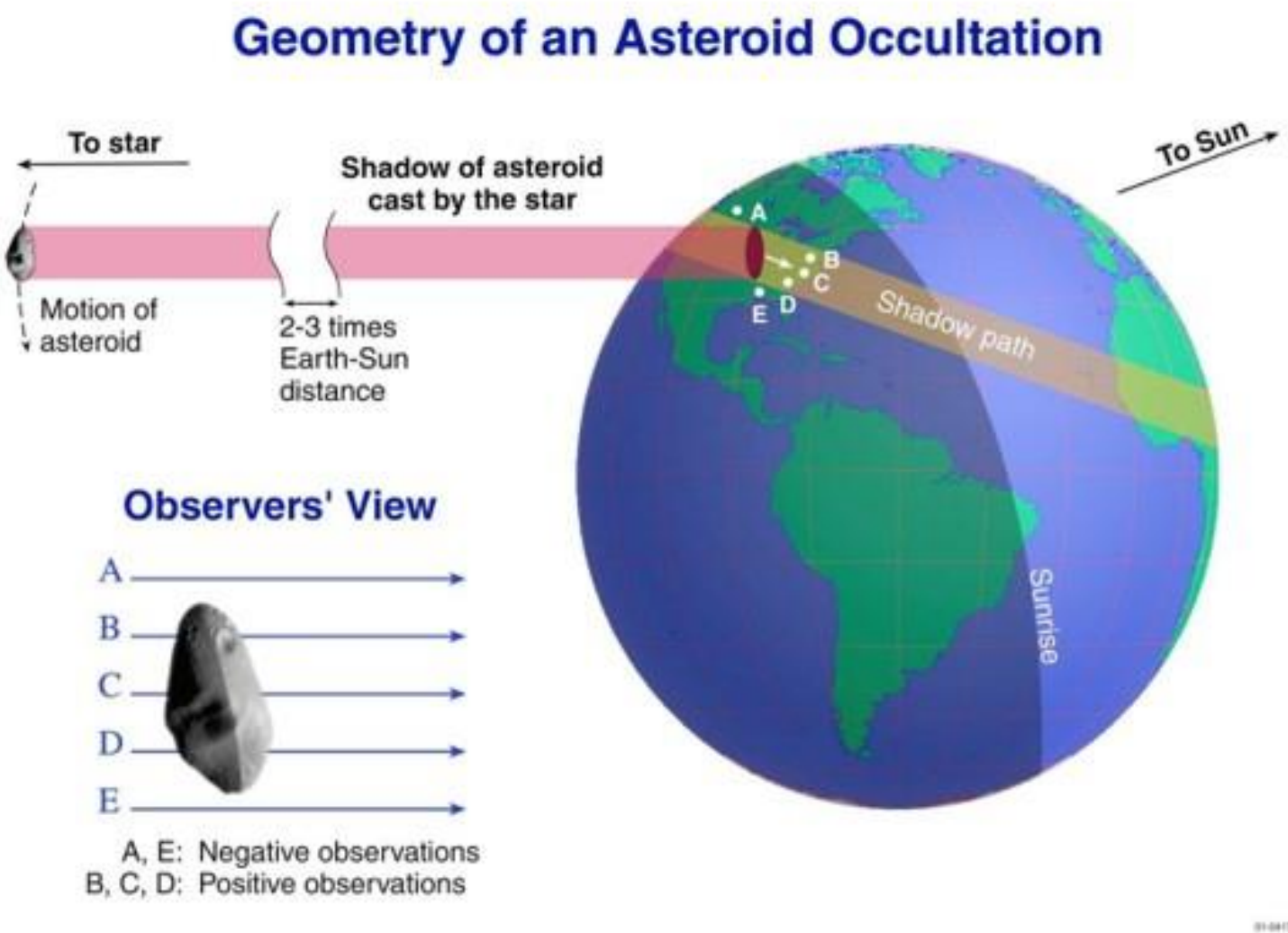
Antoni Selva

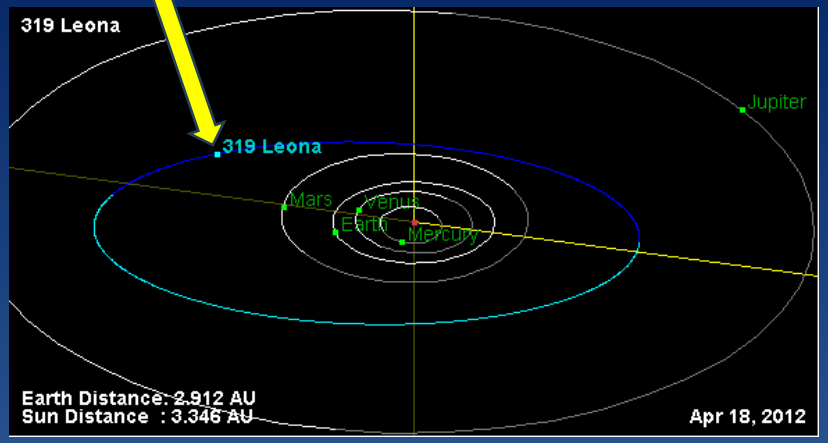
Agrupació Astronòmica de Sabadell – Catalonia/Spain

International Occultation Timing Association / European Section

On the night from 11 to 12 December 2023

Asteroid (319) Leona will occult the star Betelgeuse
as seen from a path going from central Asia to southern N. America



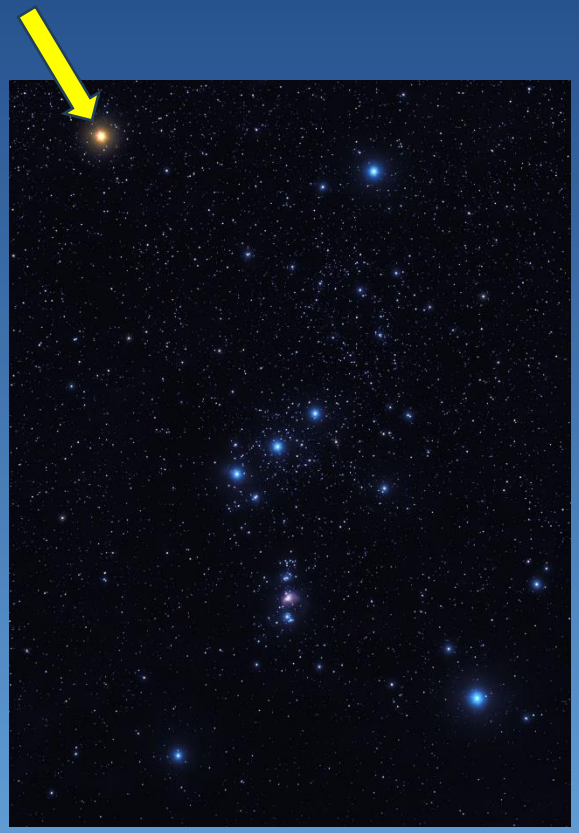


319 Leona is a dark asteroid.

It isn't visible to the naked eye.

Diameter: approximately 70 kilometers.

Distance to Earth: about 30 light minutes.



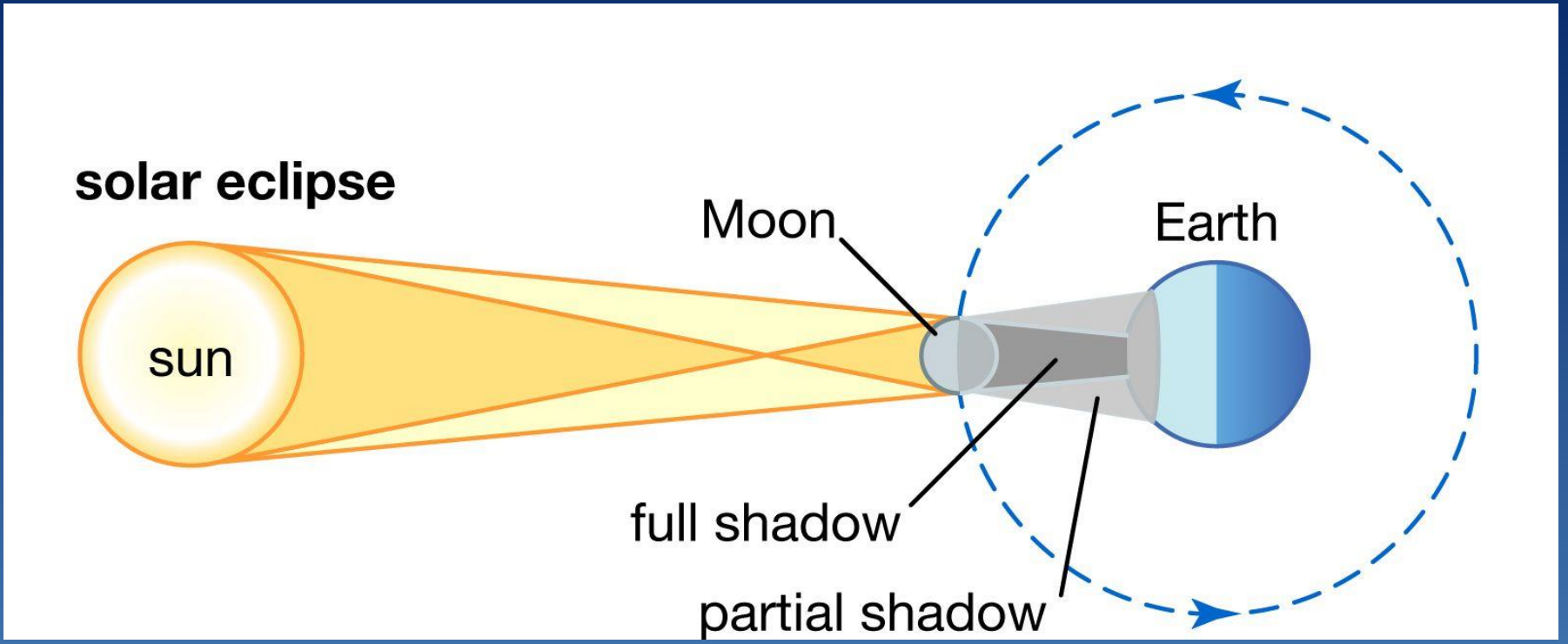
Betelgeuse is a red supergiant star in the constellation of Orion.

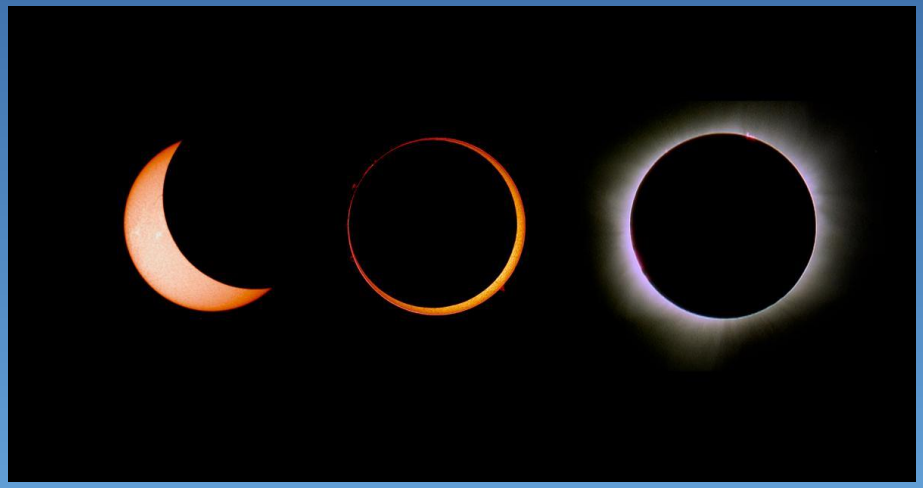
It's the tenth brightest star in the night sky.

Diameter: between 850 and 900 million kilometers.

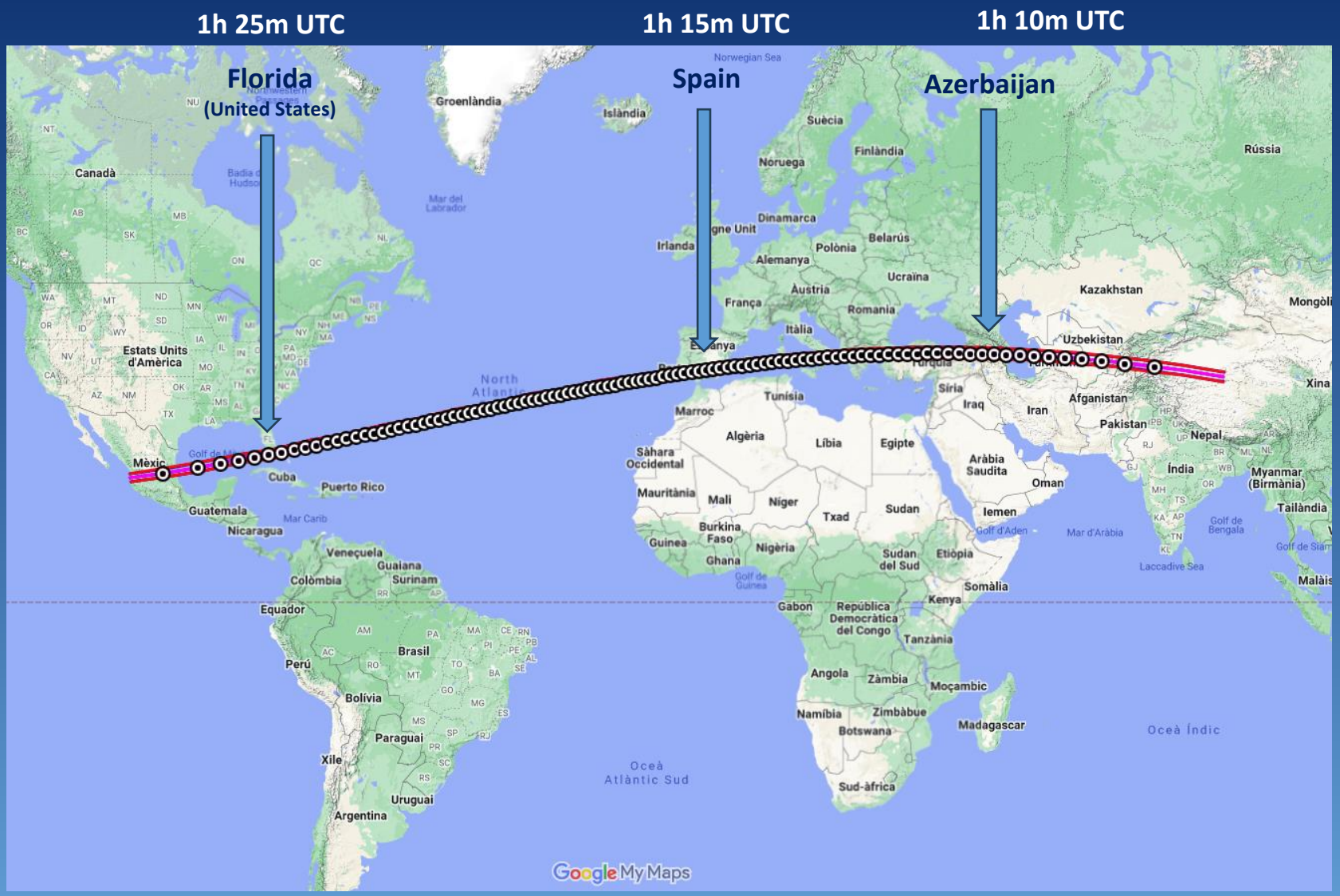
Distance to Earth: about 600 light years.

Occultation of the Sun: Eclipse of the Sun





Betelgeuse occultation on the night from 11 to 12 December 2023

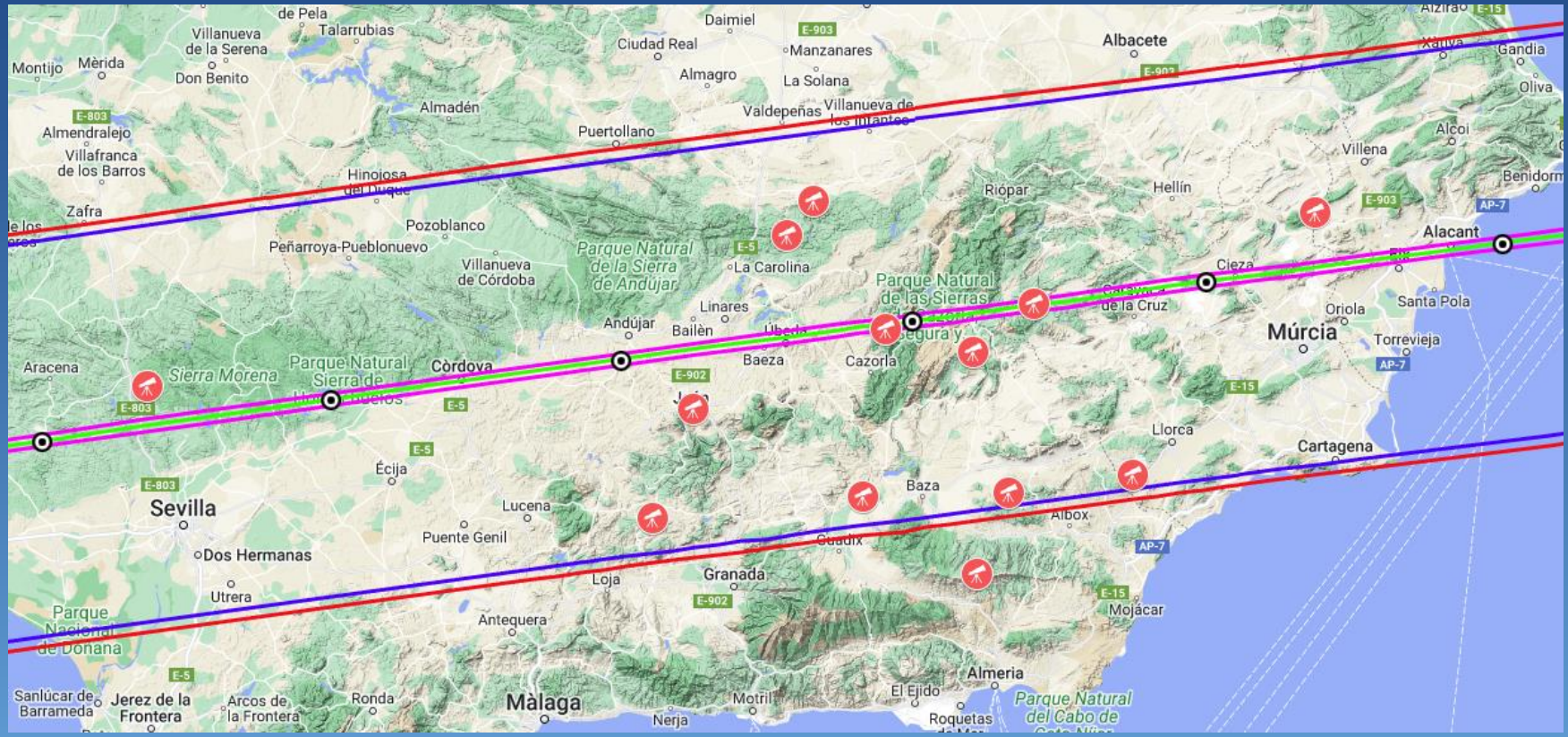


Link to the map: https://www.google.com/maps/d/edit?mid=1litFRSEU6DuXqaaUhVdMqb-AWJQBlyM&usp=share_link

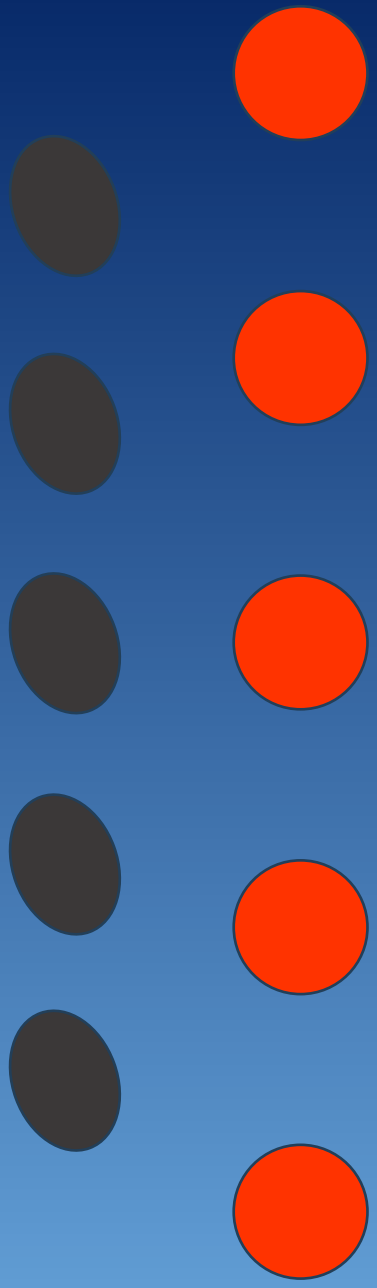
Betelgeuse occultation on the night from 11 to 12 December 2023

- The central green line is the center path of the eclipse.
- The nearby purple lines indicate a rough estimate of the limits of total eclipse.
- The blue lines indicate the limits of partial eclipse.
- The red lines indicate the uncertainty in the location of the partial limits.

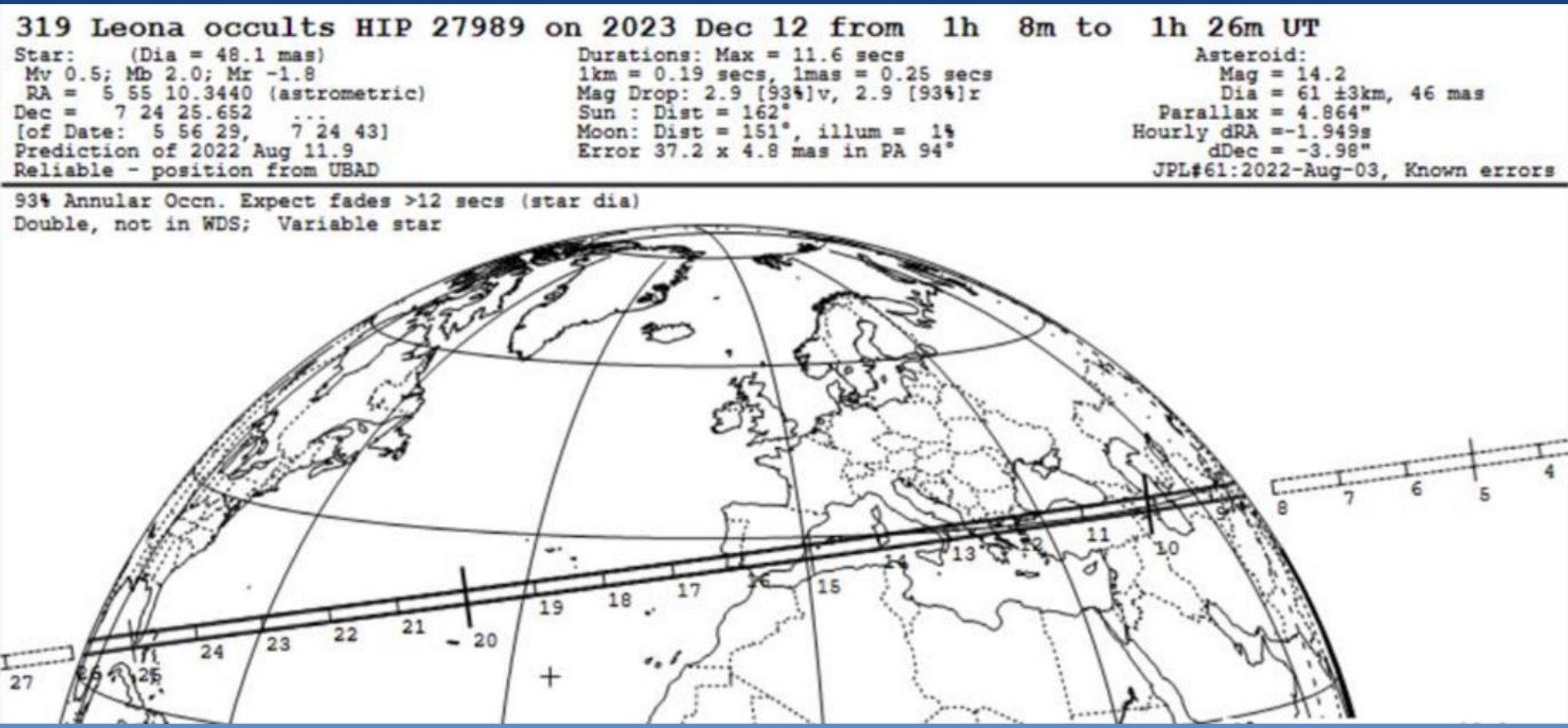
The overall event duration on the central line will be around 12 seconds.



Link to the map: https://www.google.com/maps/d/edit?mid=1litFRSEU6DuXqaaUhVdMqb-AWJQBlyM&usp=share_link



Thanks !
Moltes gràcies!



Antoni Selva / Carles Schnabel / Rat Parellada