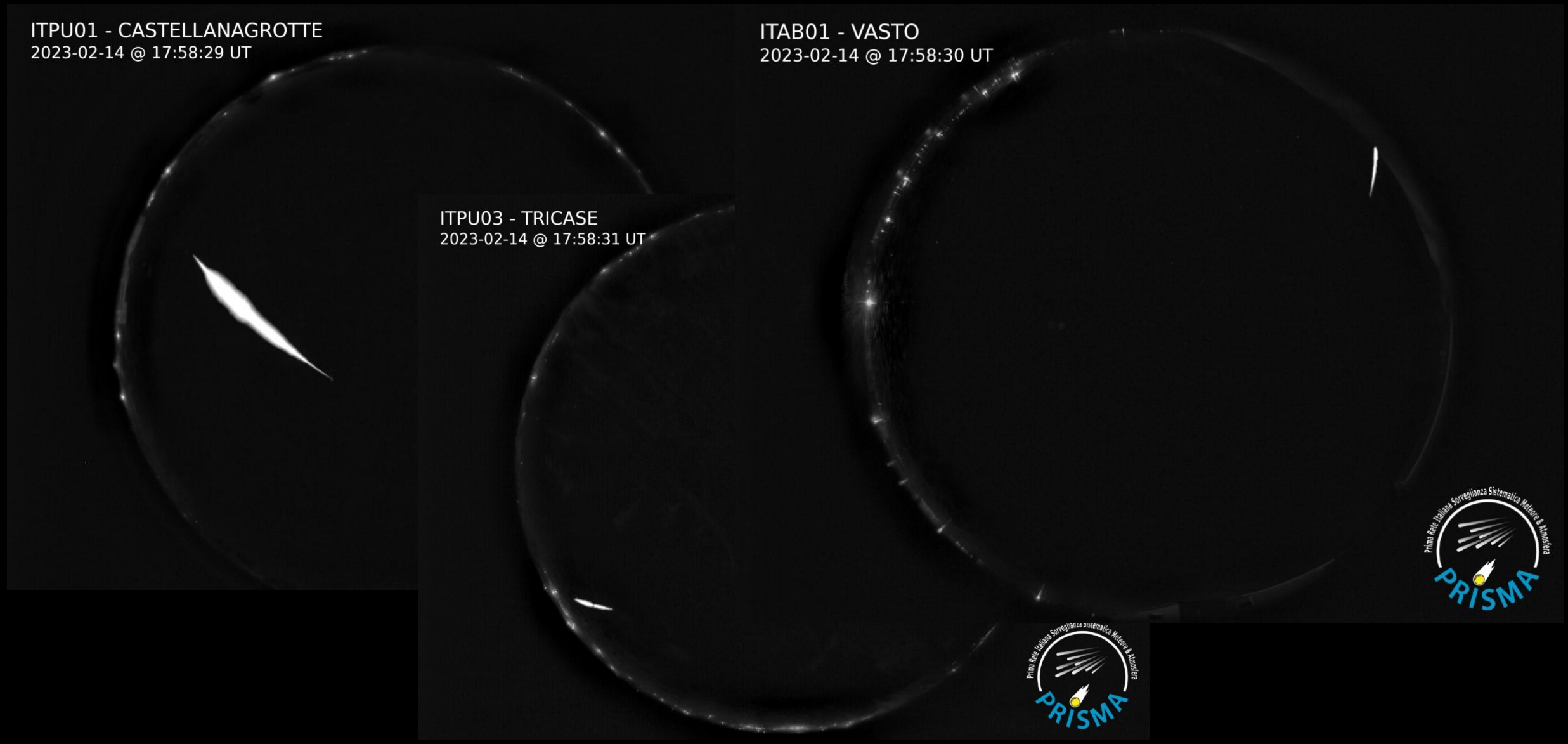
Analisi dati del bolide di San Valentino

D. Barghini, A. Carbognani et al.

PRISMA Days 2023
Prato, 17-18 Novembre 2023

The IT20230214 bolide



The IT20230214 bolide

An event similar to the Cavezzo bolide occurred on **Saint's Valentine Day of 2023** at 17:58:29 UT over the Puglia and Basilicata regions and was recorded by three PRISMA cameras

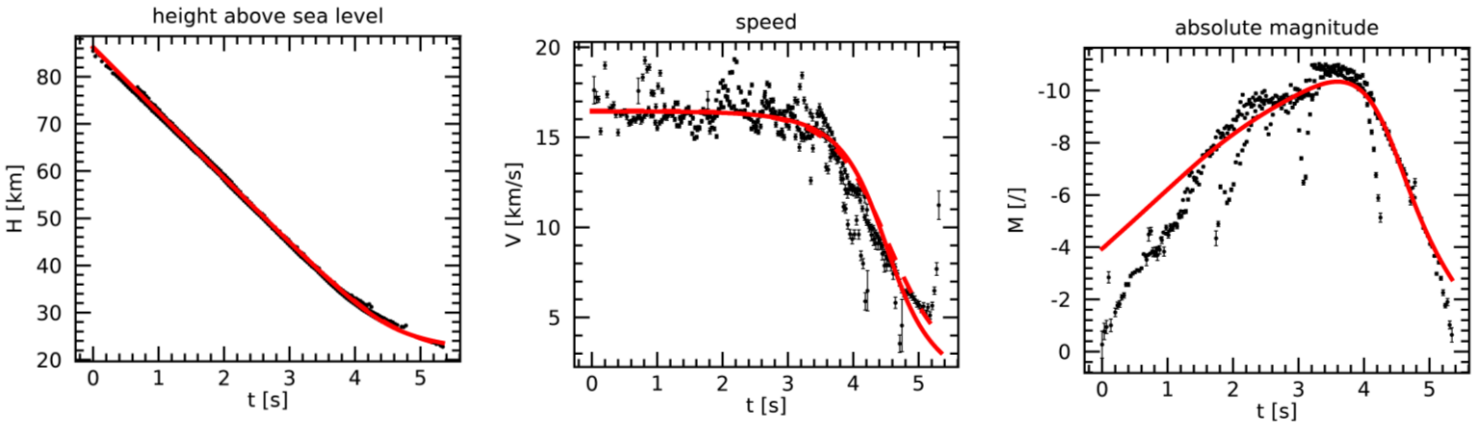
- **Low pre-atmospheric speed** (16.4 ± 0.2 km/s), **high inclination** ($56.7 \pm 0.3°$), absolute magnitude -11

Triangulation

			Beginning	Ending
Time	t	(UT)	17:58:29.54	17:58:34.89
Latitude	ϕ	[deg N]	41.0893 ± 0.0006	40.7496 ± 0.0006
Longitude	λ	[deg E]	16.8053 ± 0.0004	16.5996 ± 0.0004
Height	H	[km]	85.5 ± 0.1	22.8 ± 0.1
Speed	V	[km/s]	16.3 ± 0.1	3 ± 1
Time of Flight	ToF	[s]	5.34 ± 0.05	
Trajectory Length	L	[km]	75.0 ± 0.1	
Trajectory Inclination	γ	[deg]	56.7 ± 0.3	
Trajectory Azimuth	a	[deg]	24.3 ± 0.1	
Min. Abs. Magnitude	$\mathcal{M}_{min}$	[/]	-11.1 ± 0.1	

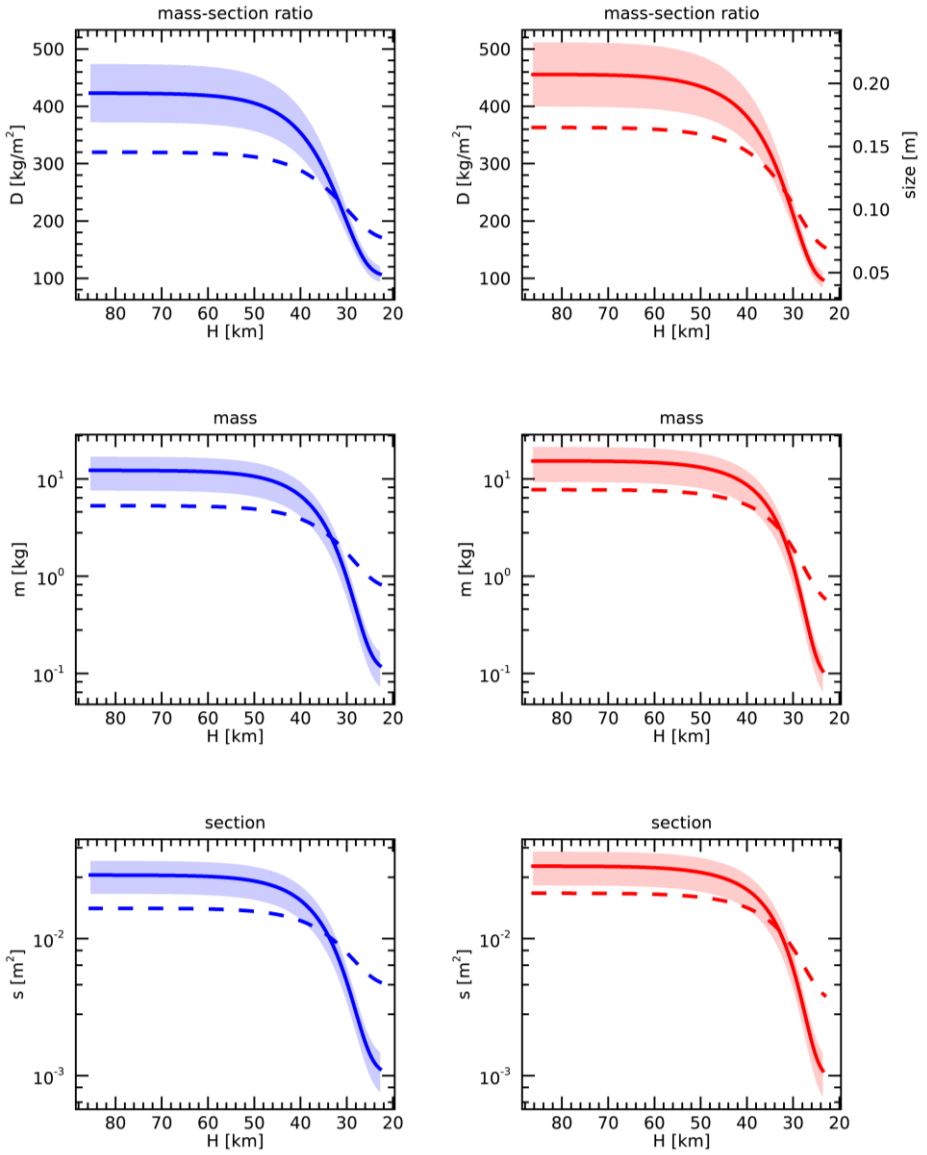

Path meteorite Matera
With dark flight 3D
Azimut: 23° (NE-SW)
Inclination: 57°
Trajectory path: 77 km
Duration: 5.3 s
Initial height: 90 km
Final height: 22.5 km
Starting speed in atmosphere: 16.5 km/s
Starting mass: 2-3 kg
Roccaraso
Isernia
Vasto
San Salvo
Termoli
Campobasso
Pozzuoli
Aversa
Napoli
Sorrento
Pompei
Avellino
Benevento
Ariano Irpino
Lucera
San Severo
Foggia
San Giovanni Rotondo
Manfredonia
Vieste
Salerno
Battipaglia
Eboli
Melfi
Cerignola
Rionero In Vulture
Venosa
Polla
Avigliano
Atena Lucana
Palazzo San Gervasio
Barletta
Trani
Potenza
Genzano di Lucania
Sala Consilina
Padula
Villa D'agri
Castelmezzano
Tricarico
Irsina
Altamura
Bari
Meteorite Matera
Matera
Ferrandina
Acquaviva delle Fonti
San Brancato
Gioia del Colle
Senise
Pisticci
Ginosa
Tursi
Google Earth
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
50 km

Dynamic model

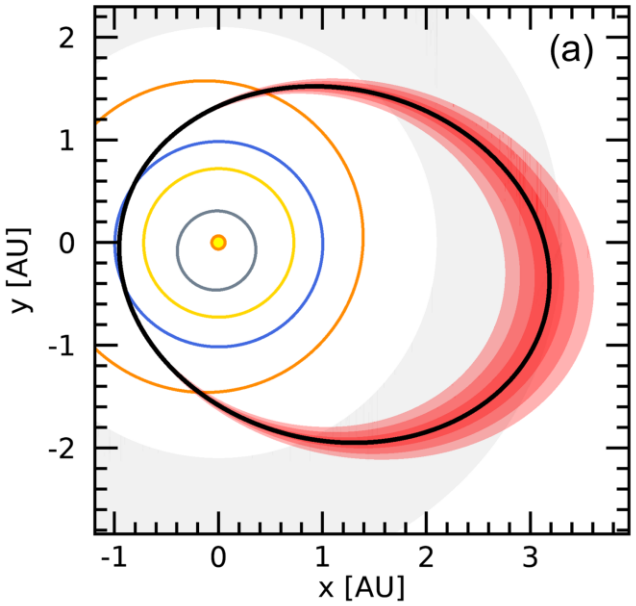


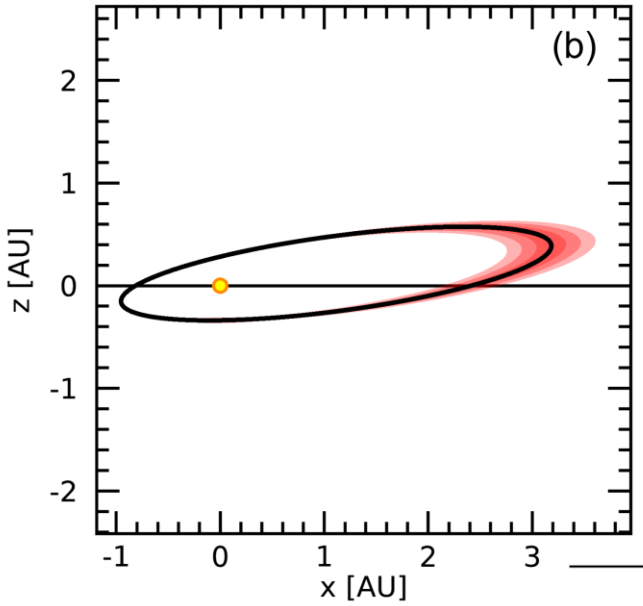
Dynamic model

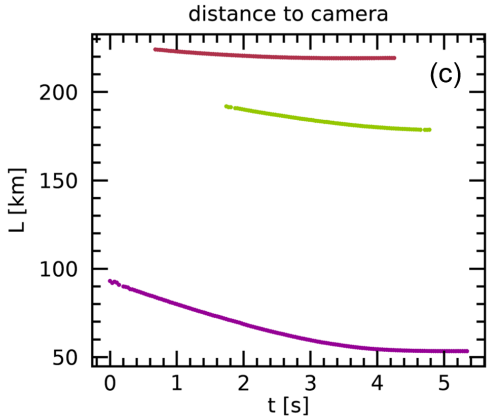
			NUM_DYN	NUM_PHD
Preatm. speed	V_∞	[km/s]	16.4 ± 0.2	16.4 ± 0.2
Ablation coeff.	σ	[s^2/km^2]	0.020 ± 0.005	0.038 ± 0.002
Shape-change coeff.	μ	[/]	2/3	0.69 ± 0.03
Luminous efficiency	τ	[%]	–	1.5 ± 0.5
Preatm. MSR	D_∞	[kg/m^2]	360 ± 50	460 ± 50
Preatm. mass	M_∞	[kg]	8 ± 3	15 ± 6
Preatm. size	$2r_\infty$	[cm]	17 ± 2	21 ± 3
Final MSR	D_{fin}	[kg/m^2]	150 ± 30	100 ± 10
Final mass	M_{fin}	[kg]	0.6 ± 0.3	0.10 ± 0.04
Final size	$2r_{fin}$	[cm]	7 ± 1	4.4 ± 0.7

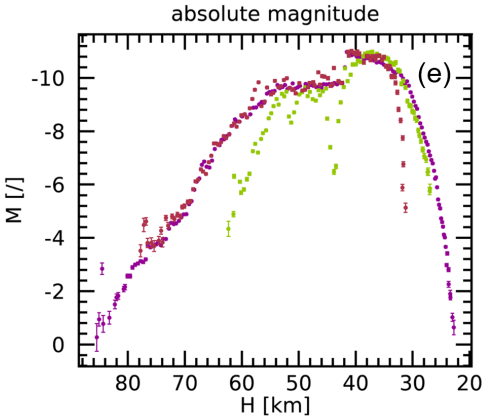


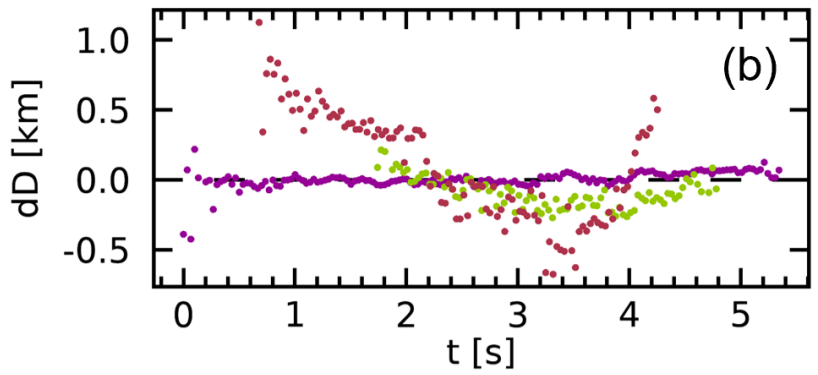
Pre-atmospheric orbit of Matera









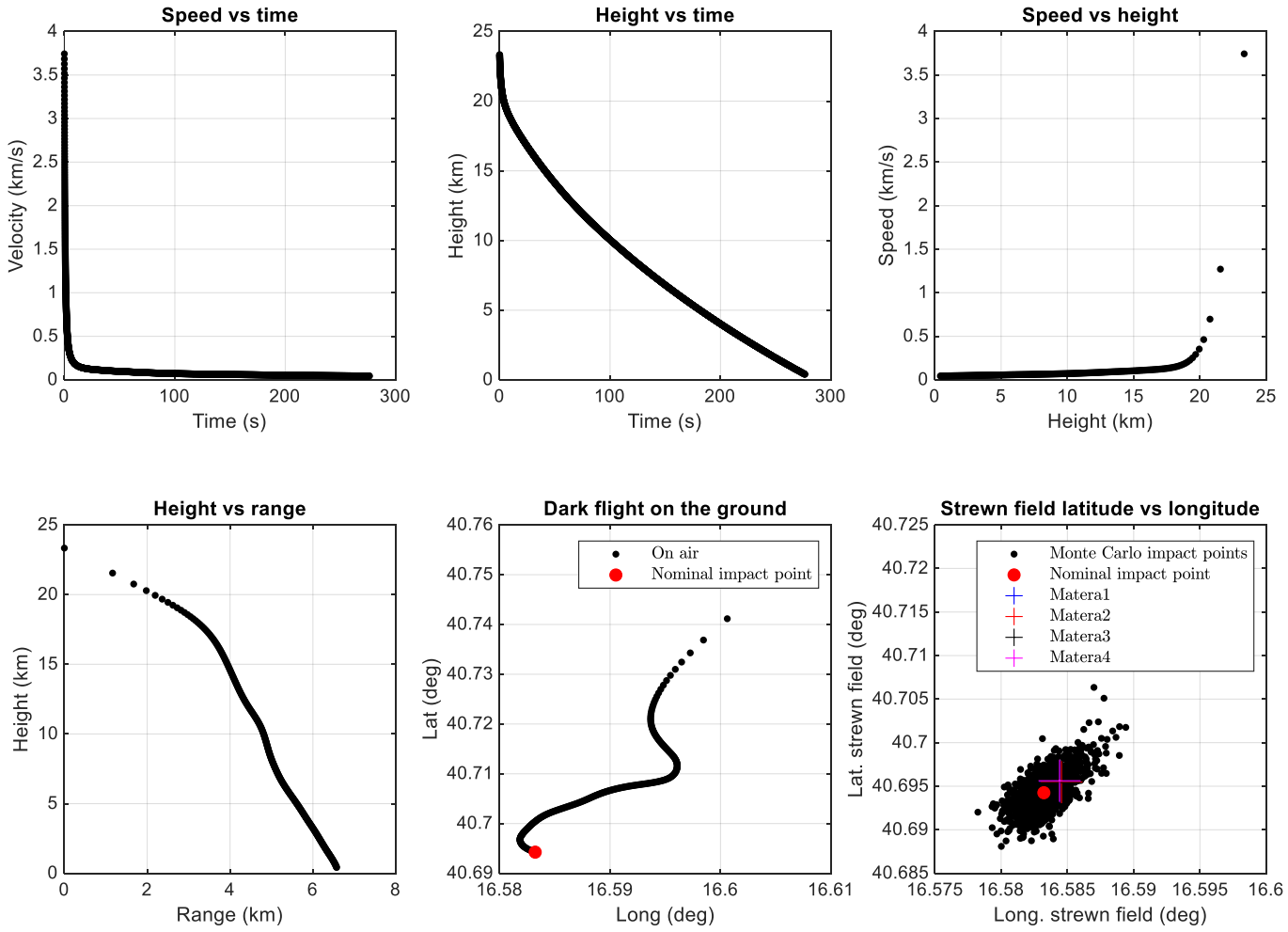


CASTELLANAGROTTE
TRICASE
VASTO

		This work	FRIPON
Epoch		J2000	J2000
a	[AU]	2.10 ± 0.07	2.32 ± 0.02
e	[/]	0.54 ± 0.02	0.586 ± 0.003
i	[deg]	14.5 ± 0.2	14.8 ± 0.1
Ω	[deg]	325.4660 ± 0.0001	325.4601 ± 0.0004
ω	[deg]	204.33 ± 0.07	202.87 ± 0.2
q	[AU]	0.9566 ± 0.0004	0.9588 ± 0.0005
Q	[AU]	3.2 ± 0.1	3.68 ± 0.03
T_J	[/]	3.51 ± 0.08	3.229 ± 0.03

Dark flight model

Dark flight and strewn field model IT20230214



On the left the model for the **dark flight** path of the Matera meteorite (for a mass of about 70 g), computed taking into account the **wind speed and direction** from about 22.5 km to the ground. Model equation:

$$\frac{d\vec{v}_m}{dt} = -GMm\frac{\vec{r}}{r^3} - \Gamma\rho_a\left|\vec{v}_m - \vec{W}\right|A\left(\vec{v}_m - \vec{W}\right)$$

In this equation Γ is the drag coefficient, ρ_a is the atmospheric density, A is the area of the meteoroid, v_m is the speed of the meteoroid and W is the wind speed.

Discovery of Matera 1

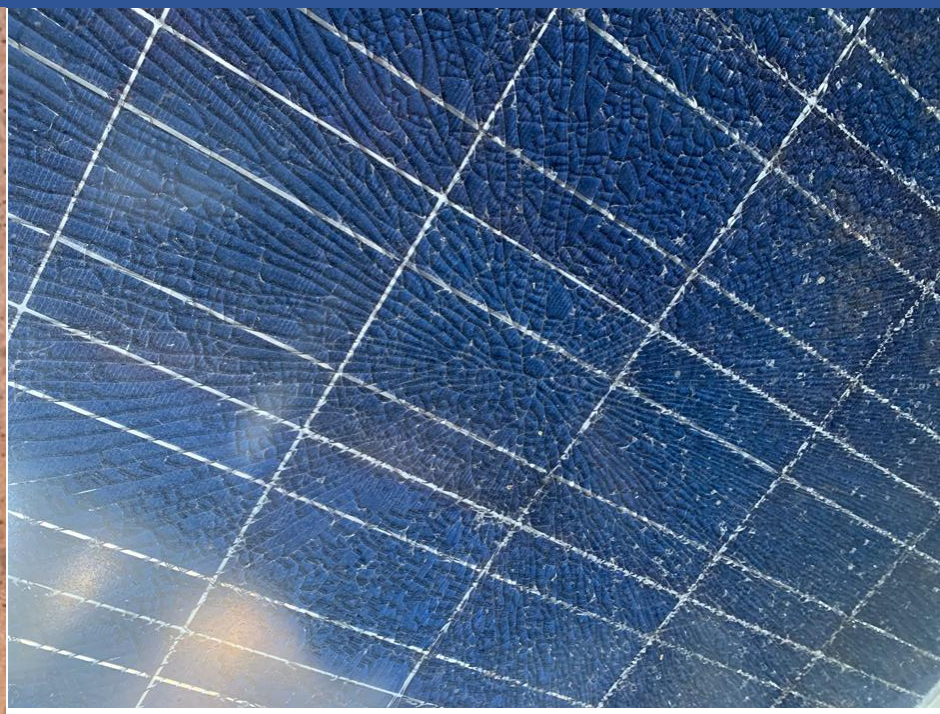
- Carmelo Falco, of the PRISMA Project Office, went to Matera on February 17, 2023 to organize the systematic search for meteorites, in coordination with various local associations.
- In the evening of the same day he is contacted by the brothers Gianfranco and Pino Losignore, who report the discovery of various rock fragments and impact damage at their home at the time of fireball fall.

Matera strewn-field

The strewn field of the Matera meteorite. It is an ordinary chondrite H-type, with cavities inside.

Overall there are 4 main fragments, with a total mass of about 117 grams.

Some damage caused by meteorite impact



On the left, the tile damaged by the fall of Matera 1.

Up, the photovoltaic panel damaged by Matera 2.