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STEAMTeach

How to model objects with Tracker and GeoGebra

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HOW TO DOWNLOAD TRACKER

Tracker (Video Analysis and Modeling Tools for Physics Education) is available in the following link

https://physlets.org/tracker/

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PROBLEM

“Determine the maximum height that a ball reaches when we throw it into the air”

MODELLING THE TRAJECTORY

- Recording a video of the physical phenomenon.
- Obtaining mathematical information from the video using the Tracker program.
- Finding the curve equation that describes the movement.

Thus, Tracker allows obtaining measurements and equations just with a video

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USING TRACKER

RECORDING A VIDEO WITH METRIC REFERENCES TO IMPORT IT INTO THE TRACKER

In this case, we will employ the following video that you can find in Google Drive (tallertracker2023@gmail.com; tracker2023$)

Aspects to be considered

- Record the video with good contrast and background
- Record from the parallel plane and perpendicular focus
- Have a reference object that we can measure

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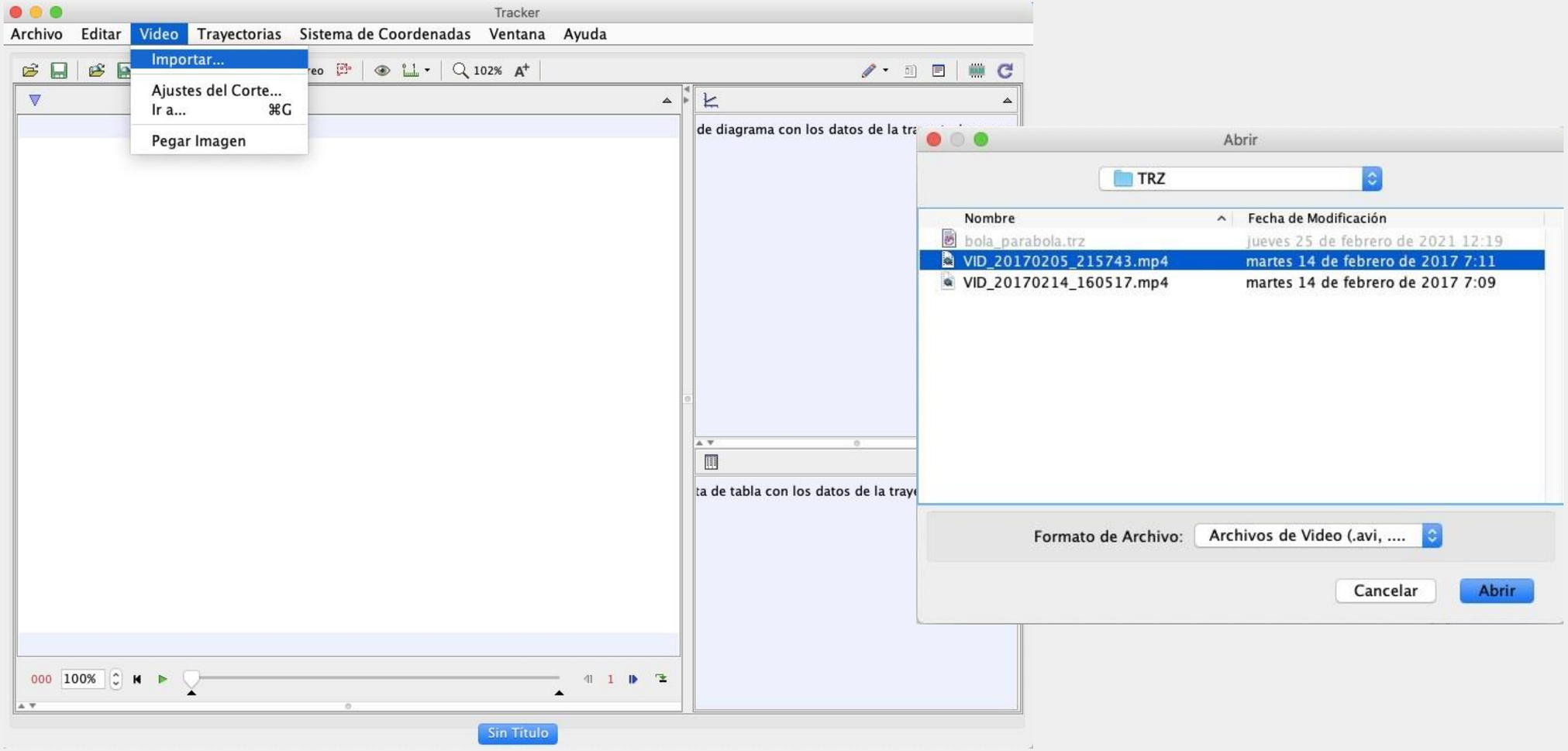
USING TRACKER

TRACKER INTERFACE AND VIDEO LOADING, ADJUSTING THE DESIRED START AND END WITH THE SLIDERS



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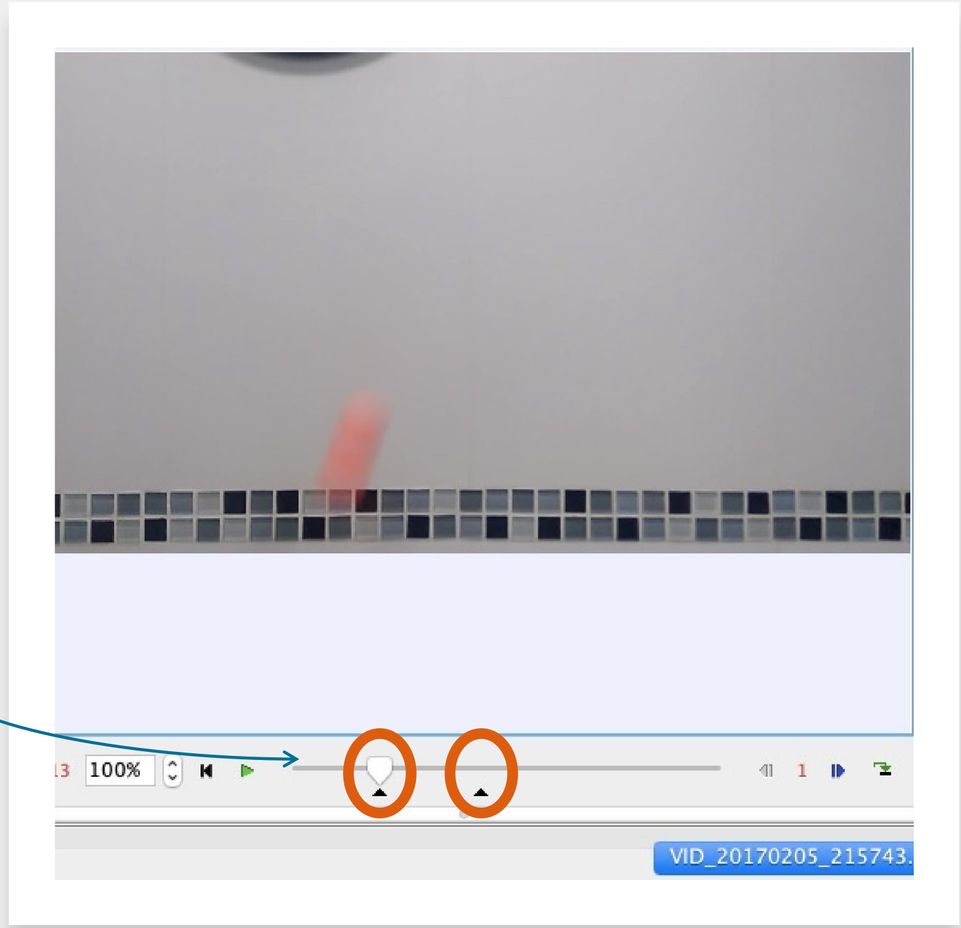
USING TRACKER

TRACKER INTERFACE AND VIDEO LOADING, ADJUSTING THE DESIRED START AND END WITH THE SLIDERS

Adjusting the beginning and the end



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USING TRACKER

CALIBRATION ROD, TO GIVE METRIC SCALE TO THE VIDEO

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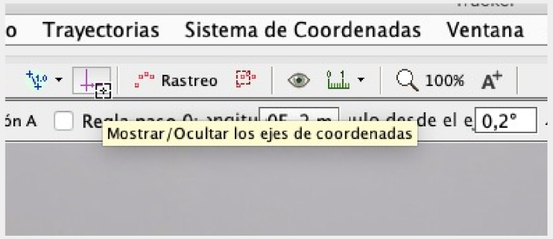
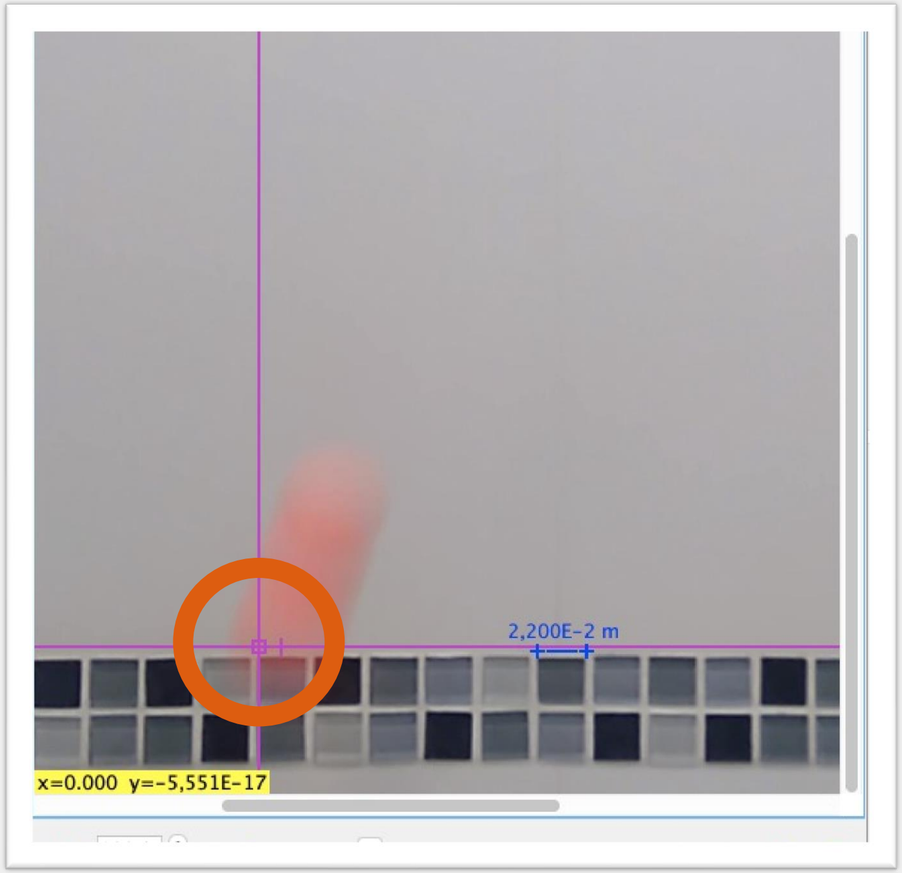
USING TRACKER

COORDINATE AXES, TO LEAVE THE ORIGIN AND THE X AND Y AXES ORIENTED





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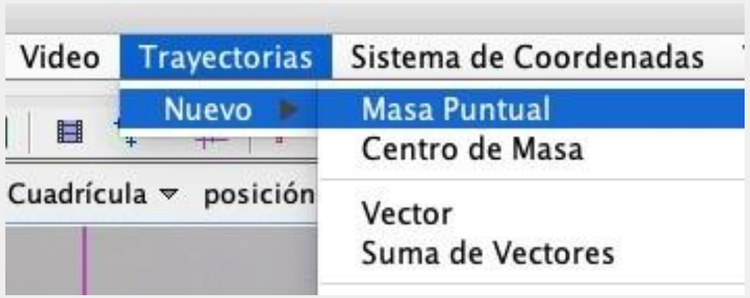
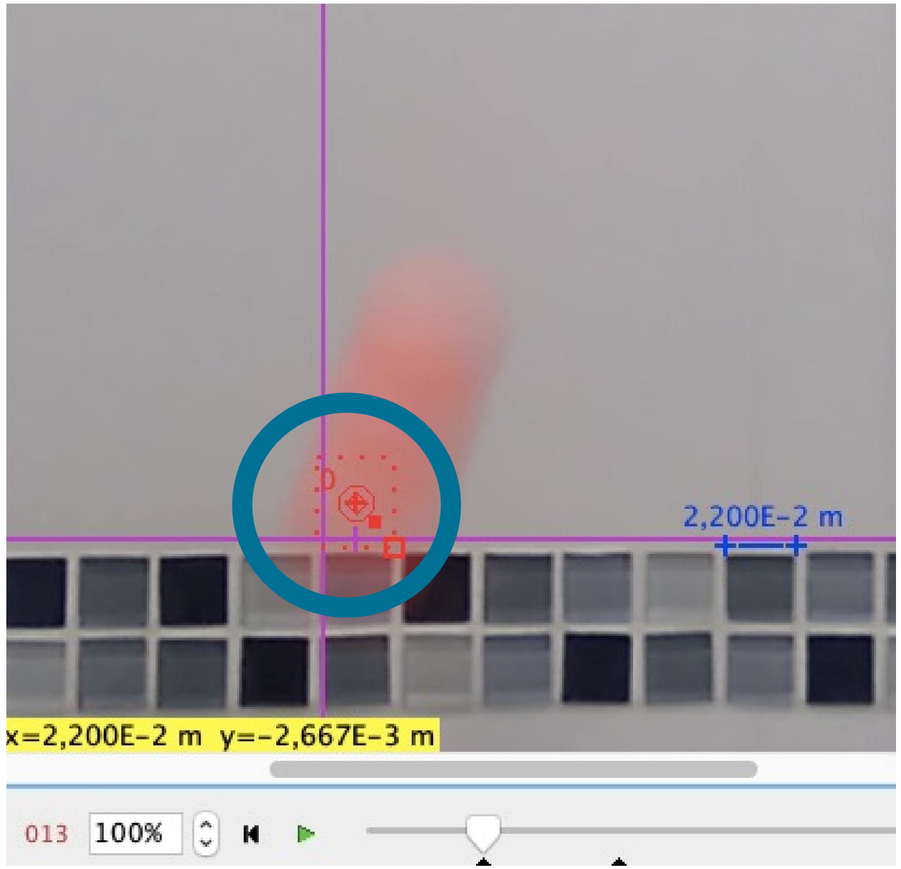
USING TRACKER

IDENTIFY THE POINT MASS OF THE MOVING OBJECT



We use the key combination:
Ctrl + Shift [⇧] + Left mouse button

- Circle: search pattern
- Square: search area



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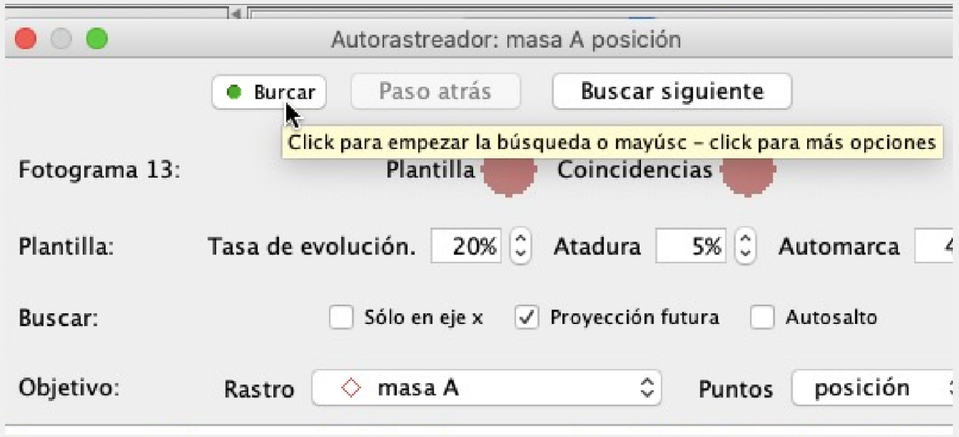
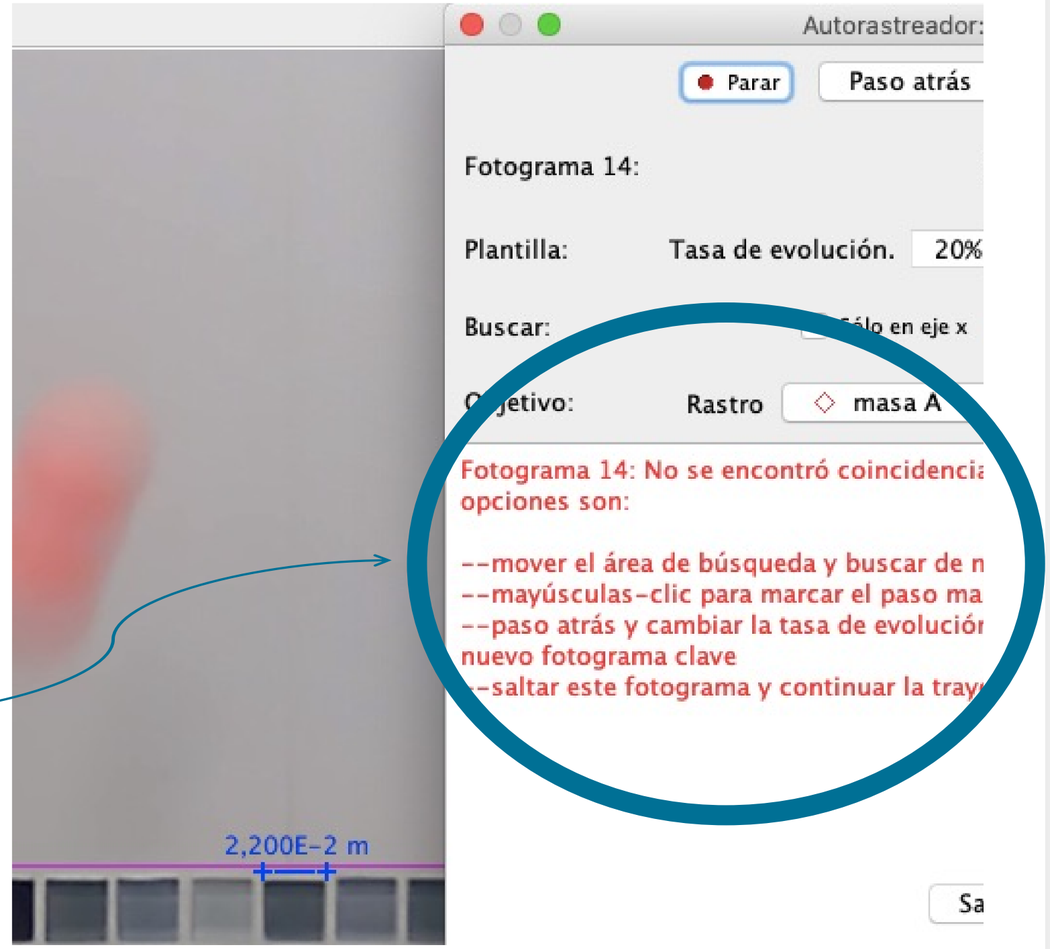
FIND THE TRAJECTORY OF POINTS



- Find the path of points [Buscar] to generate the points
- It is usually automatic, but if at any time the object is not detected, search for the trajectory with the following:

Shift [⇧] + Left mouse button



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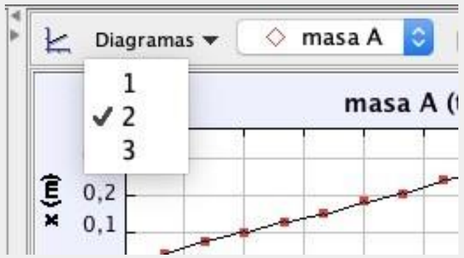
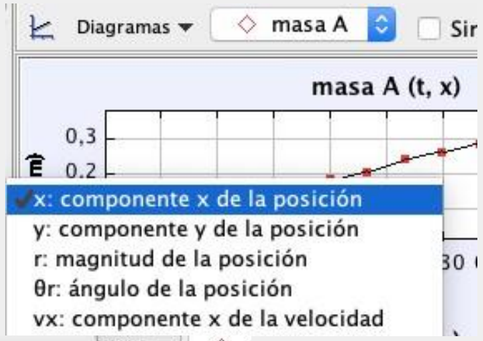
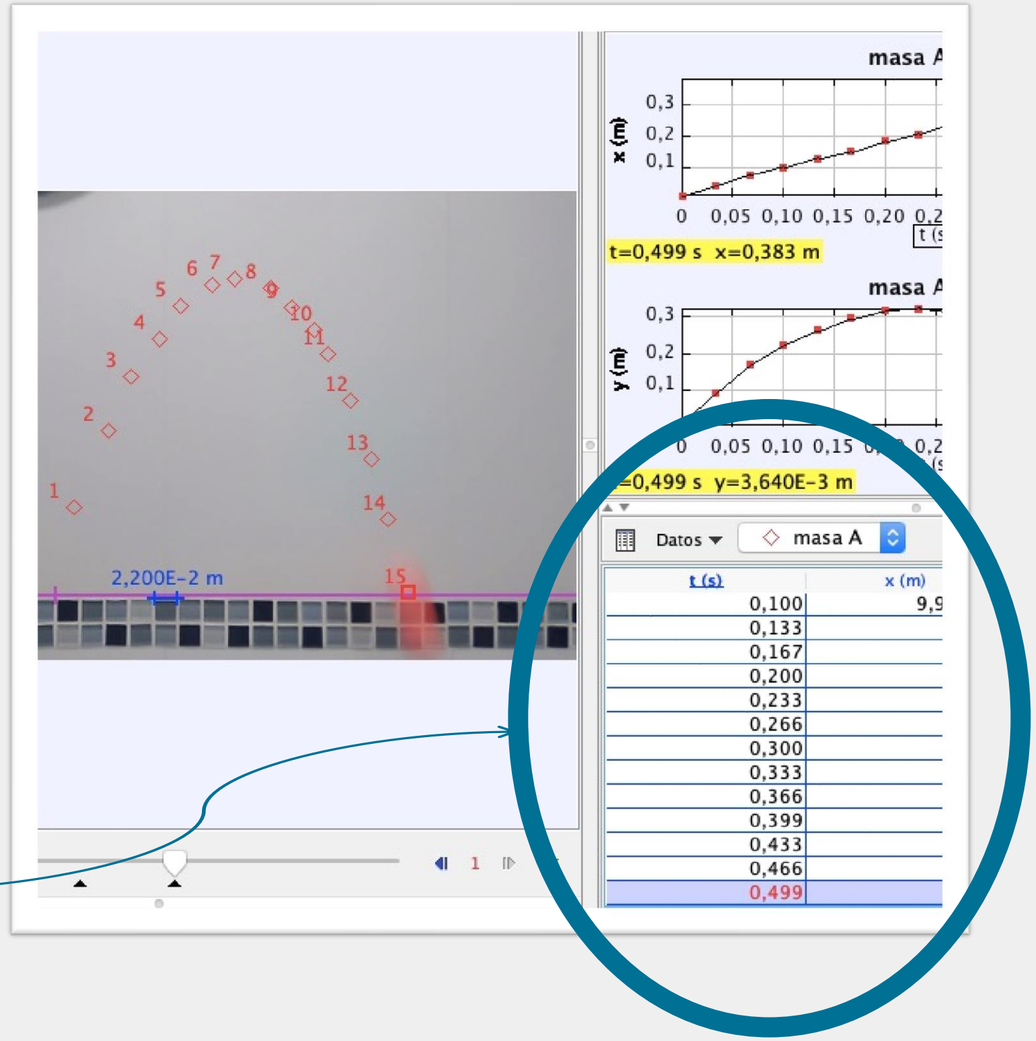
IDENTIFIED DATA







You can identify the points detected in the video frames:

- You can select which data to see
- You can choose which graphs to display

USING TRACKER

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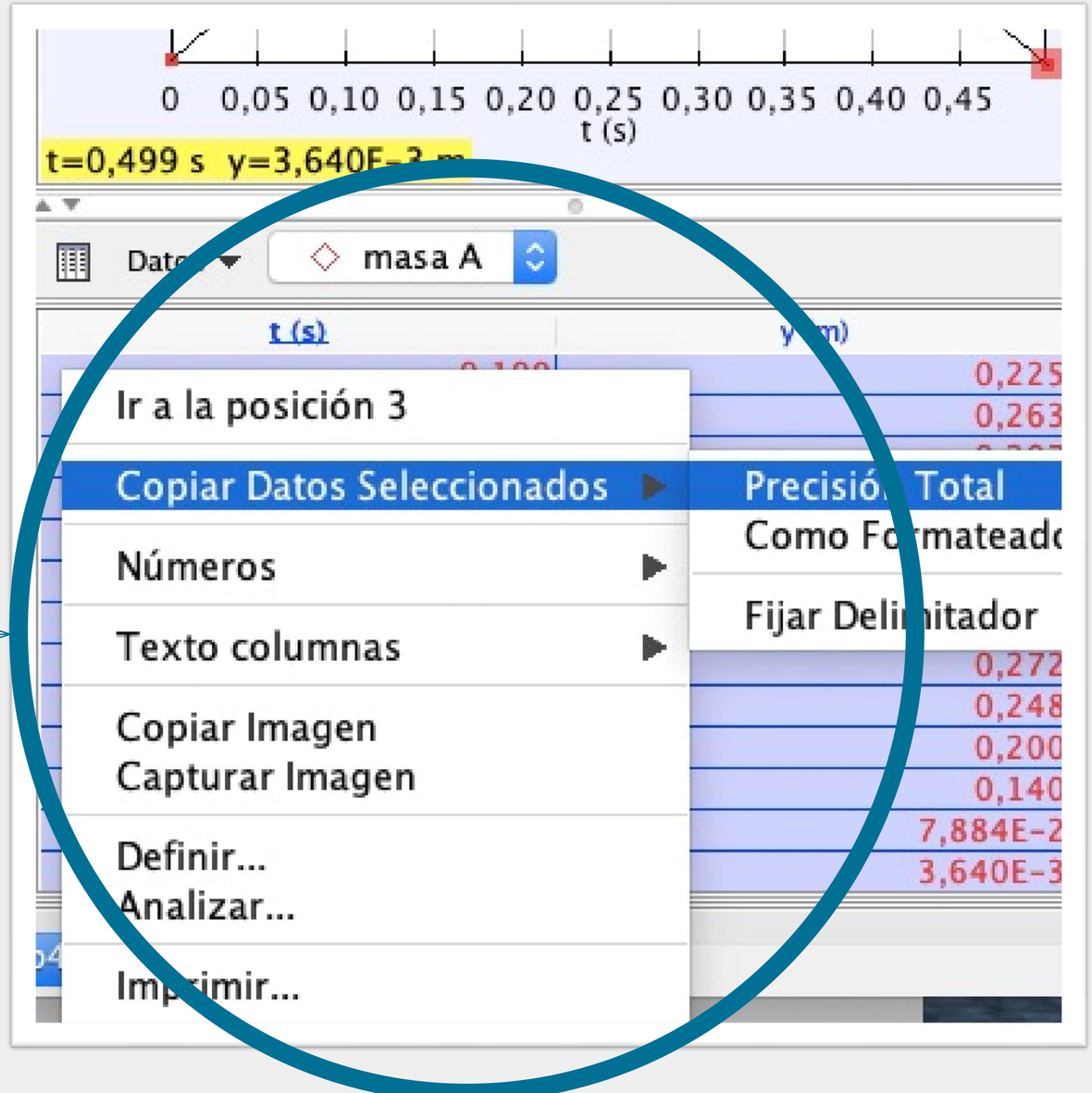
EXPORT DATA

Export the data to Excel or GeoGebra by selecting the data in the spreadsheet and, with the Right Button of the mouse, giving Copy with Total Precision:



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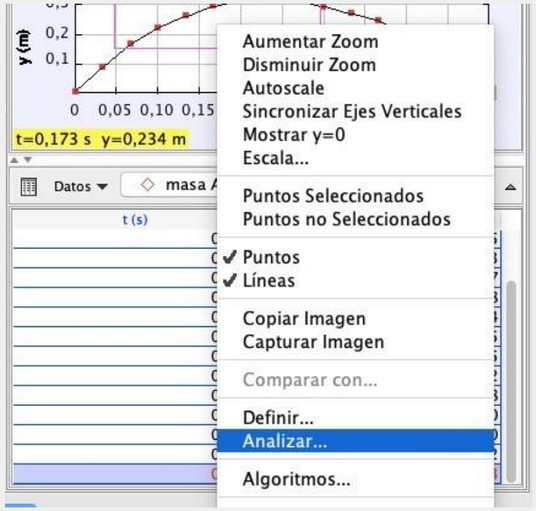
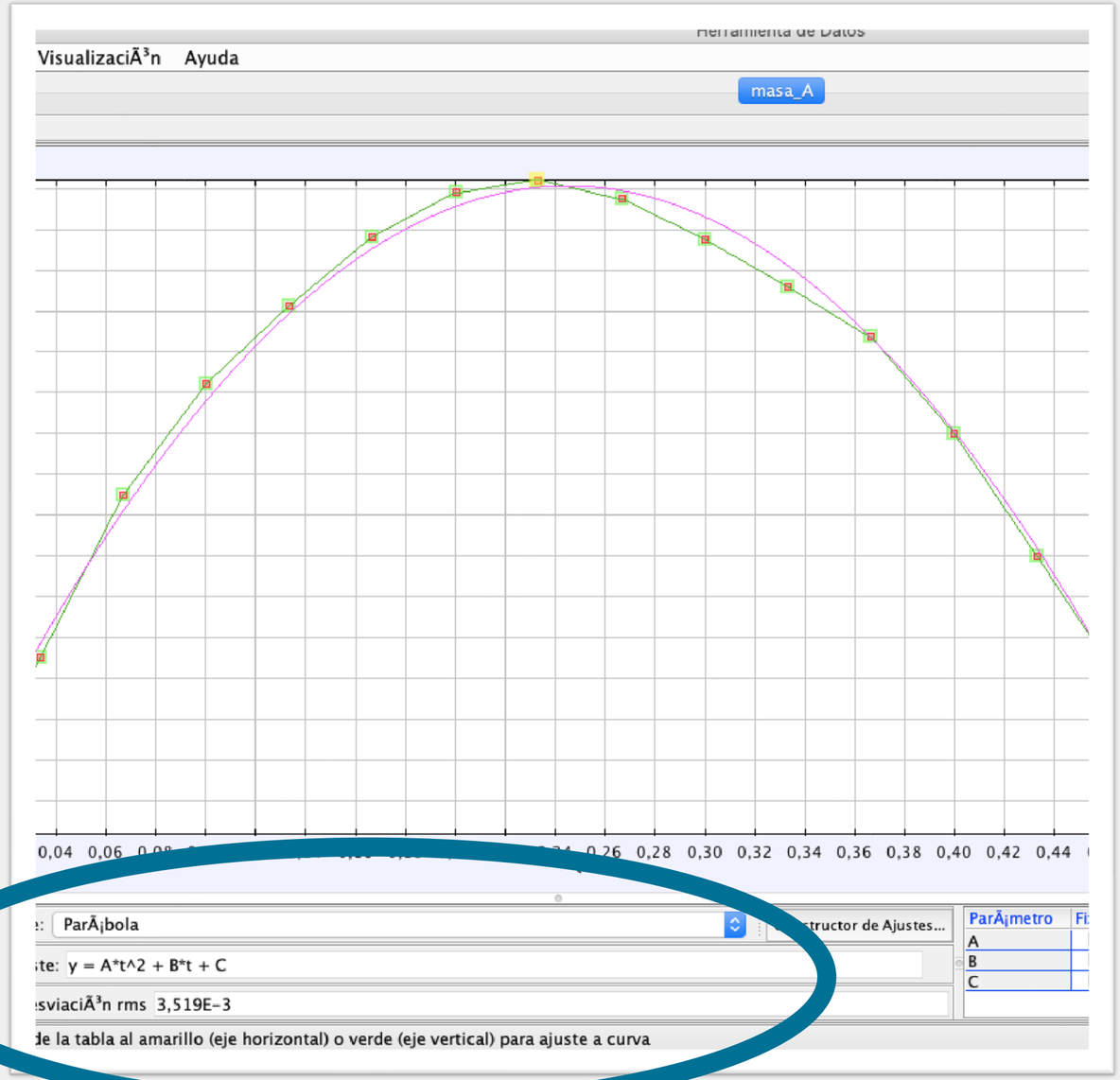
OBTAIN THE CURVE OF THE TRAJECTORY



Mathematical modelling to obtain the curve equation that best fits the trajectory of the object:

- With the right button, we click on the data or a graph and choose "Analyze", selecting the "Type of Adjustment“.



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USING TRACKER

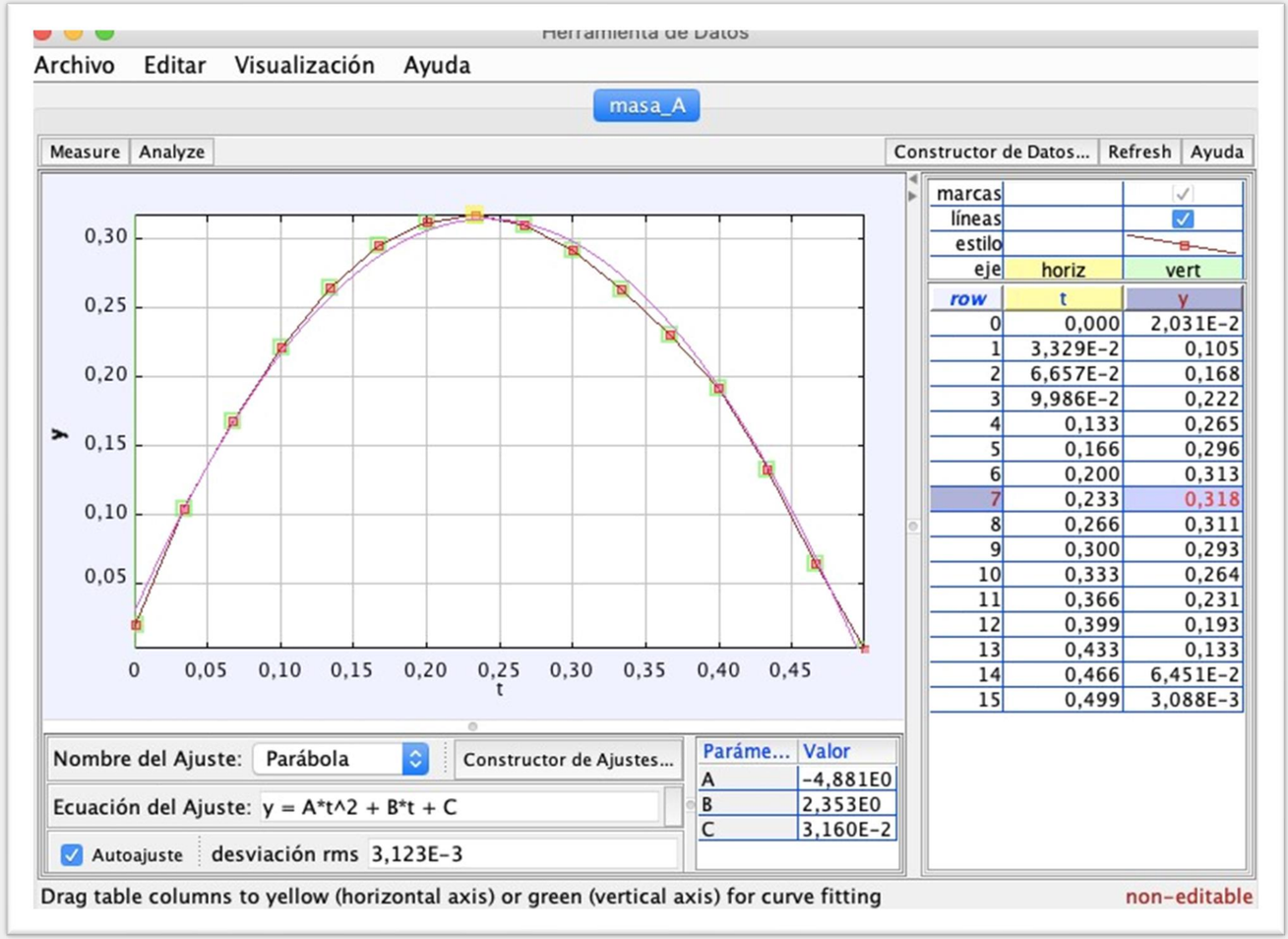
OBTAIN THE CURVE OF THE TRAJECTORY

The parabolic movement, also known as an oblique throw, consists of throwing a body with a speed that forms an angle α with the horizontal. The equation y(t) is:

$$y = y_0 + v_0 \cdot \sin(\alpha) \cdot t - \frac{1}{2} \cdot g \cdot t^2$$

As g=9.8 m/s^2, the coefficient A of the parabola is expected to be -4.9.

In our case, A=-4,81



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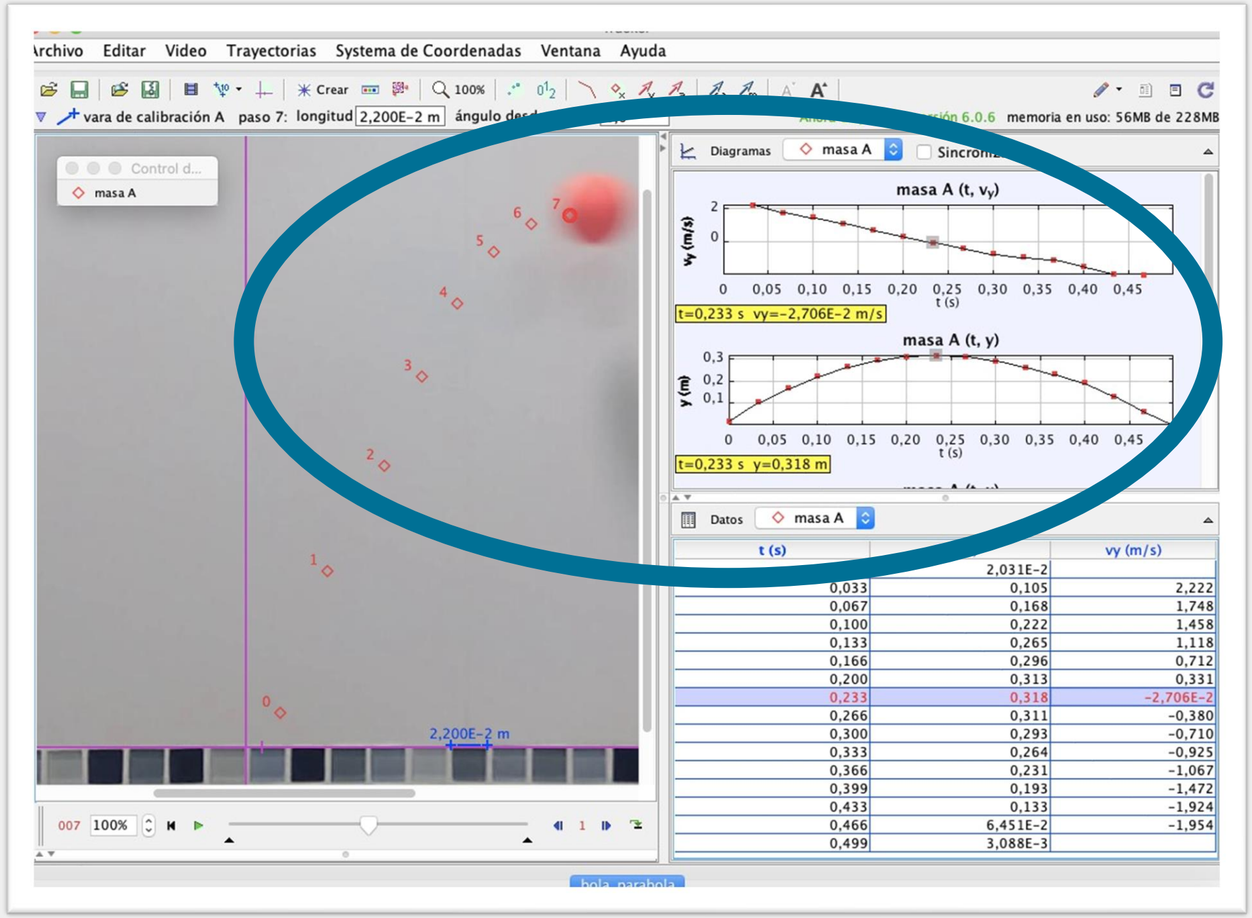
SOLVING OUR INITIAL PROBLEM (OBTAINING THE MAXIMUM HEIGHT)

It can be seen how at the vertex of the parabola, where the maximum height is reached, the v_y component of the velocity is zero (in our case, almost zero -0.02706)



t (s)		vy (m/s)
	2,031E-2	
0,033	0,105	2,222
0,067	0,168	1,748
0,100	0,222	1,458
0,133	0,265	1,118
0,166	0,296	0,712
0,200	0,313	0,331
0,233	0,318	-2,706E-2
0,266	0,311	-0,380
0,300	0,293	-0,710
0,333	0,264	-0,925
0,366	0,231	-1,067
0,399	0,193	-1,472
0,433	0,133	-1,924
0,466	6,451E-2	-1,954
0,499	3,088E-3	

USING TRACKER

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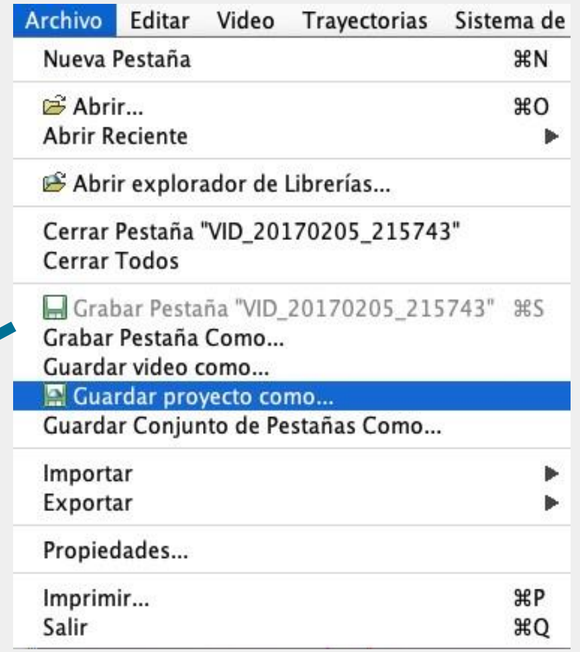
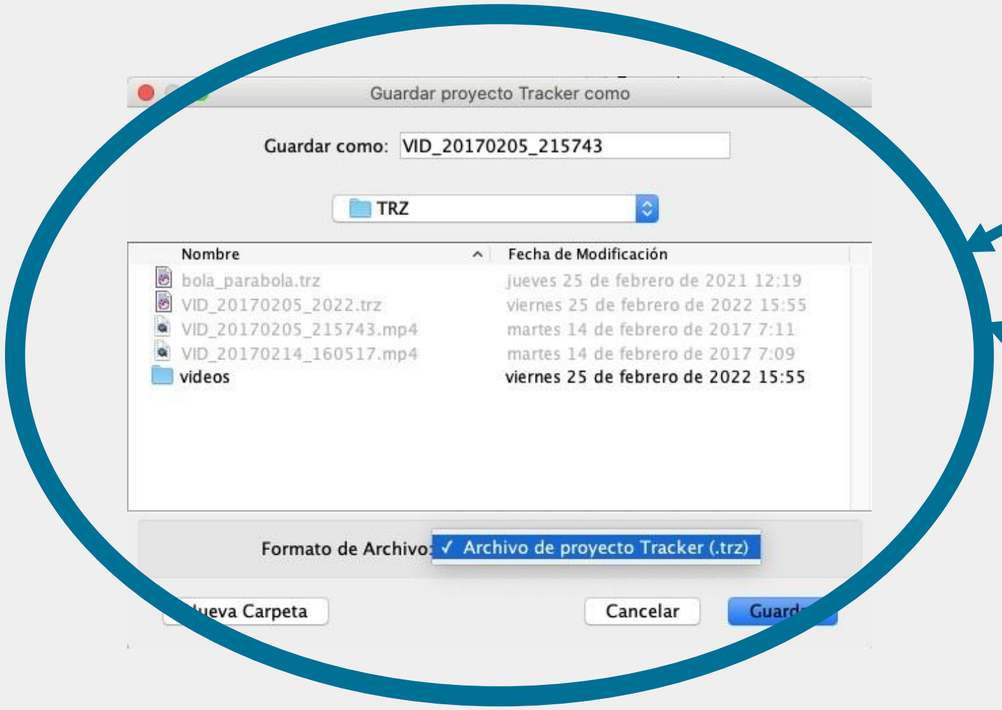
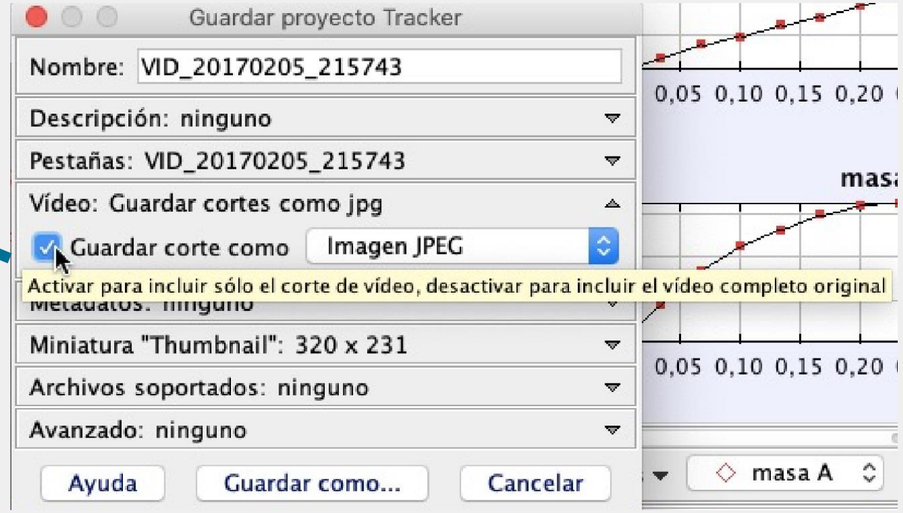
SAVE OUR PROJECT IN TRACKER: CREATION OF A .TRZ FILE

there are many options to save our project, export it, and save the video clip, among others







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Thank you