Observational Round with Galileoscope during 17th IOAA

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Galileoscope

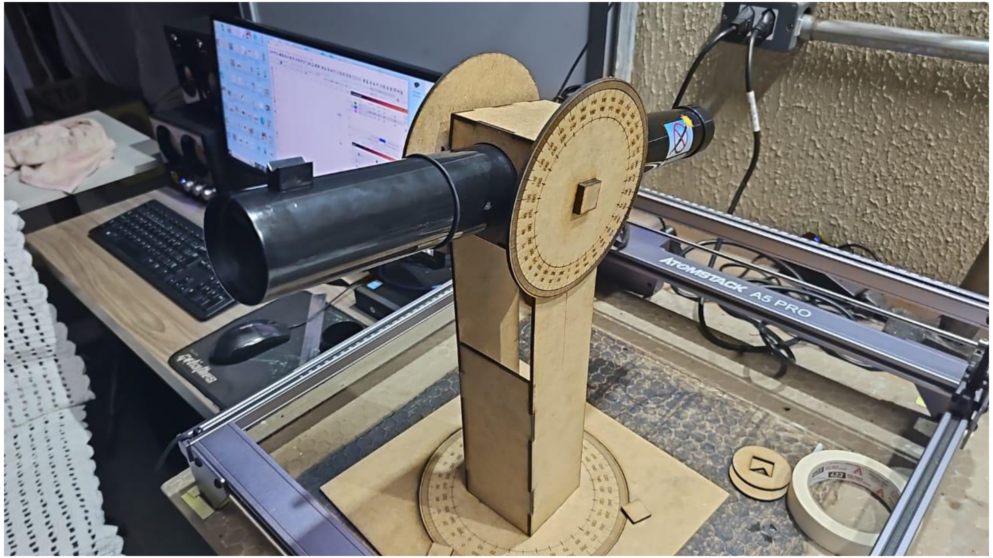
In 2009, to celebrate the International Year of Astronomy and the 400th anniversary of Galileo's first telescopic observations, the Galileoscope was created.

A portable and low-cost refractor telescope, designed to democratize access to amateur astronomy.

Galileoscope alt-az-mount

In order to complete the tasks, an easy to use altazimuth mount with graduated circles was developed for the Galileoscope.

Some prototypes of the altazimuth mount were produced for use in outdoor tests, covering scenarios involving real and simulated celestial targets.



Objective

The objective of this test is to assess skills in telescope aiming, scale reading, calculation, and the use of a star chart.

The target

Due to the high dependency on weather conditions for conducting the Observational Round and the time available for its completion, the test coordination has decided to conduct it using a fixed target.

The target (a small, yellowish light) has been positioned and prepared to be visible to everyone as a bright star. This will eliminate the need to turn off the hotel lights for alignment and measurement.

The target

Aiming the target

Student movement

All students together until 8 pm

Restaurant (1) ➡ Observation tables (2)

Observation tables (2) ➡ Examination Hall (3)

Examination Hall (3) ➡ Kiosk (4)

All students together until 11:40 pm

Student movement

Estimated time (~3 hours)

From the restaurant (1) to the kiosk (4)

1st round (40 students): from **8:30 pm** to 10:00 pm

2nd round (40 students): from 8:50 pm to 10:20 pm

3rd round (40 students): from 9:20 pm to 10:40 pm

4th round (40 students): from 9:40 pm to 11:00 pm

5th round (40 students): from 10:00 pm to 11:20 pm

6th round (33 students): from 10:20 pm to **11:40 pm**

Horizontal Coordinates to Equatorial Coordinates

To incorporate a real target location aspect into the artificial target test, a simulated sky recognition question has been included using a star map. The parameters of the artificial star are adjusted to make it appear as a real object at a specific date and time.

To achieve this, all tables will be calibrated to mark the corresponding azimuth for each altitude of the fixed target. This altitude varies depending on the distance of the observation table.

Horizontal Coordinates to Equatorial Coordinates

Chosen location: Porto Alegre City

- ϕ = 30° 01’ S
- λ = 51° 10’ W

Chosen star: Alpha Hydri

- Constellation: Hydrus
- Right Ascension: 01h 58m 45.87s (29,69113°)
- Declination: −61° 34′ 11.7″ (-61,56991°)

Horizontal Coordinates to Equatorial Coordinates: A(z)

Calculation of the Azimuth: $\cos A = (\text{sen } \delta - \cos z \ \text{ sen } \phi)/(\text{sen } z \cos \phi)$

Altitude	sin (delta)	cos z	sin (phi)	sin z	cos (phi)	=	cos A	A
17	-0,879398724	0,292372	-0,50025	0,956305	0,86588		-0,88539	152
16,5		0,284015		0,95882			-0,8881	153
16		0,275637		0,961262			-0,89088	153
15,5		0,267238		0,96363			-0,89372	153
15		0,258819		0,965926			-0,89664	154
14,5		0,25038		0,968148			-0,89961	154
14		0,241922		0,970296			-0,90266	155
13,5		0,233445		0,97237			-0,90577	155
13		0,224951		0,97437			-0,90895	155
12,5		0,21644		0,976296			-0,91219	156
12		0,207912		0,978148			-0,9155	156
11,5		0,199368		0,979925			-0,91888	157
11		0,190809		0,981627			-0,92232	157

Horizontal Coordinates to Equatorial Coordinates: A(z)

Calculation of the Azimuth: $\cos A = (\mathrm{sen}\ \delta - \cos z\ \ \mathrm{sen}\ \phi)/(\mathrm{sen}\ z \cos \phi)$

Each table will be adjusted to the corresponding altitude of the target.

Horizontal Coordinates to Equatorial Coordinates: HA(z)

Calculation of the hour angle HA: sin HA = (-sin z sin A) / cos δ

Altitude	sin z	sin A	cos (delta)	=	sin HA	HA	or	
17	0,956304756	0,464857	0,476086006		-0,93375	-69,0271	249,0271	16:36:07
16,5	0,958819735	0,459653			-0,92573	-67,7779	247,7779	16:31:07
16	0,961261696	0,454243			-0,91716	-66,5143	246,5143	16:26:03
15,5	0,963630453	0,448619			-0,90803	-65,2352	245,2352	16:20:56
15	0,965925826	0,44277			-0,89833	-63,9396	243,9396	16:15:45
14,5	0,96814764	0,436687			-0,88803	-62,6264	242,6264	16:10:30
14	0,970295726	0,430358			-0,8771	-61,2945	241,2945	16:05:11
13,5	0,97236992	0,423772			-0,86552	-59,9424	239,9424	15:59:46
13	0,974370065	0,416913			-0,85327	-58,5687	238,5687	15:54:16
12,5	0,976296007	0,409768			-0,8403	-57,1717	237,1717	15:48:41
12	0,978147601	0,402318			-0,82659	-55,7496	235,7496	15:43:00
11,5	0,979924705	0,394544			-0,81209	-54,3004	234,3004	15:37:12
11	0,981627183	0,386425			-0,79676	-52,8216	232,8216	15:31:17

Horizontal Coordinates to Equatorial Coordinates

Sidereal Time calculation for each Altitude: ST = RA + AH

Altitude	RA	AH	=	TS	
17	29,691125	249,0271		278,7182	18:34:52
16,5		247,7779		277,4691	18:29:53
16		246,5143		276,2054	18:24:49
15,5		245,2352		274,9263	18:19:42
15		243,9396		273,6307	18:14:31
14,5		242,6264		272,3175	18:09:16
14		241,2945		270,9856	18:03:57
13,5		239,9424		269,6335	17:58:32
13		238,5687		268,2598	17:53:02
12,5		237,1717		266,8628	17:47:27
12		235,7496		265,4407	17:41:46
11,5		234,3004		263,9915	17:35:58
11		232,8216		262,5128	17:30:03

Horizontal Coordinates to Equatorial Coordinates

Sidereal Time calculation for each Altitude: ST = RA + AH

The Sidereal Time will be provided for each table.

Aiming or not (10 min - 30 points)

The student will find the telescope in the neutral position: horizontal and pointing towards the end of the runway.

Steps to be taken by students:

1. Point the telescope at the target
2. Center and focus the image
3. Read the altitude of the target on the corresponding scale
4. Write the altitude on the answer sheet
5. Read the azimuth of the target on the corresponding scale
6. Write the azimuth on the answer sheet
7. Write the sidereal time of your table on the answer sheet

Aiming or not (10 min - 30 points)

The student has 10 minutes to complete the task.

If a student is **unable** to take the measurements, either due to lack of skill or time, the measurement corresponding to their table will be provided to them.

In this case, the student **will lose** the points corresponding to that stage of the test.

After taking the measurements, students will move to the Examination Hall to perform the calculations for converting altazimuthal measurements into equatorial coordinates.

Data conversion (30 min - 70 points)

During the data conversion, the student must find almost the same right ascension and declination of a real star. These coordinates will be used to identify this star on the Star Chart, as well as the constellation to which it belongs:

- Right Ascension: 01h 58m 45.87s (29,69113°)
- Declination: −61° 34′ 11.7″ (-61,56991°)
- Constellation: Hydrus
- Name of the star: Alpha Hydri

Data conversion (30 min - 70 points)

Steps to be taken by students:

1. convert Altitude into Zenith distance (5 points)
2. calculate Declination (15 points)
3. calculate Hour Angle (5 points)
4. calculate Right Ascension (15 points)
5. identify the star on the star chart (10 points)
6. identify the name of the star (10 points)
7. identify the constellation (10 points)

Data conversion (30 min - 70 points)

These formulas will be given to students:

$$\text{sen}\,\delta = \cos z\,\text{sen}\,\phi + \text{sen}\,z\cos\phi\cos A$$

$$\text{sen}\,H = (-\text{sen}\,z\,\text{sen}\,A)/\cos\delta$$

$$\cos H = (\cos z\cos\phi - \text{sen}\,z\,\text{sen}\,\phi\cos A)/\cos\delta$$

The supervisor

Each table will have a supervisor who will ensure that the table is not tampered with and that the setup is not damaged.

The supervisor **will not assist** the student in making the aiming or in reading the scales.

The star chart solution