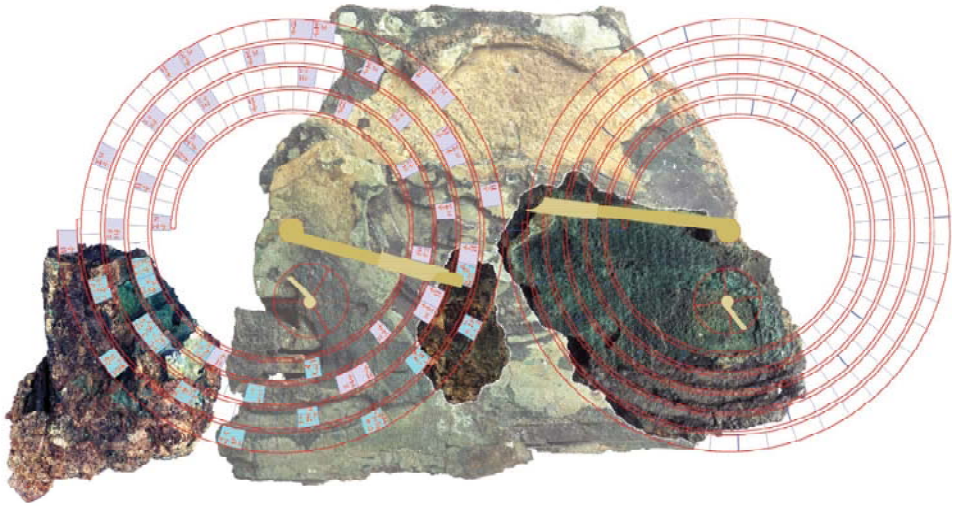
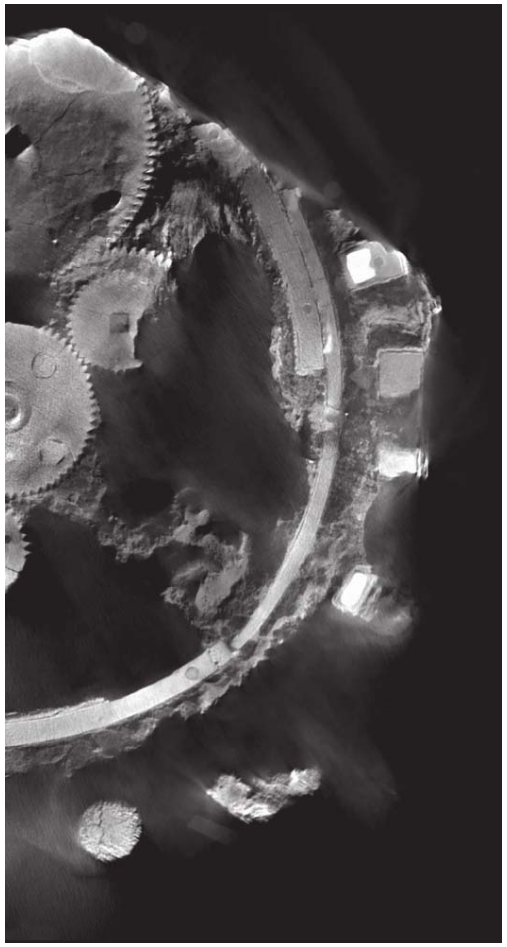
ANTIKITERA MEHANIZAM

drevna astronomska naprava





Dejan Urošević

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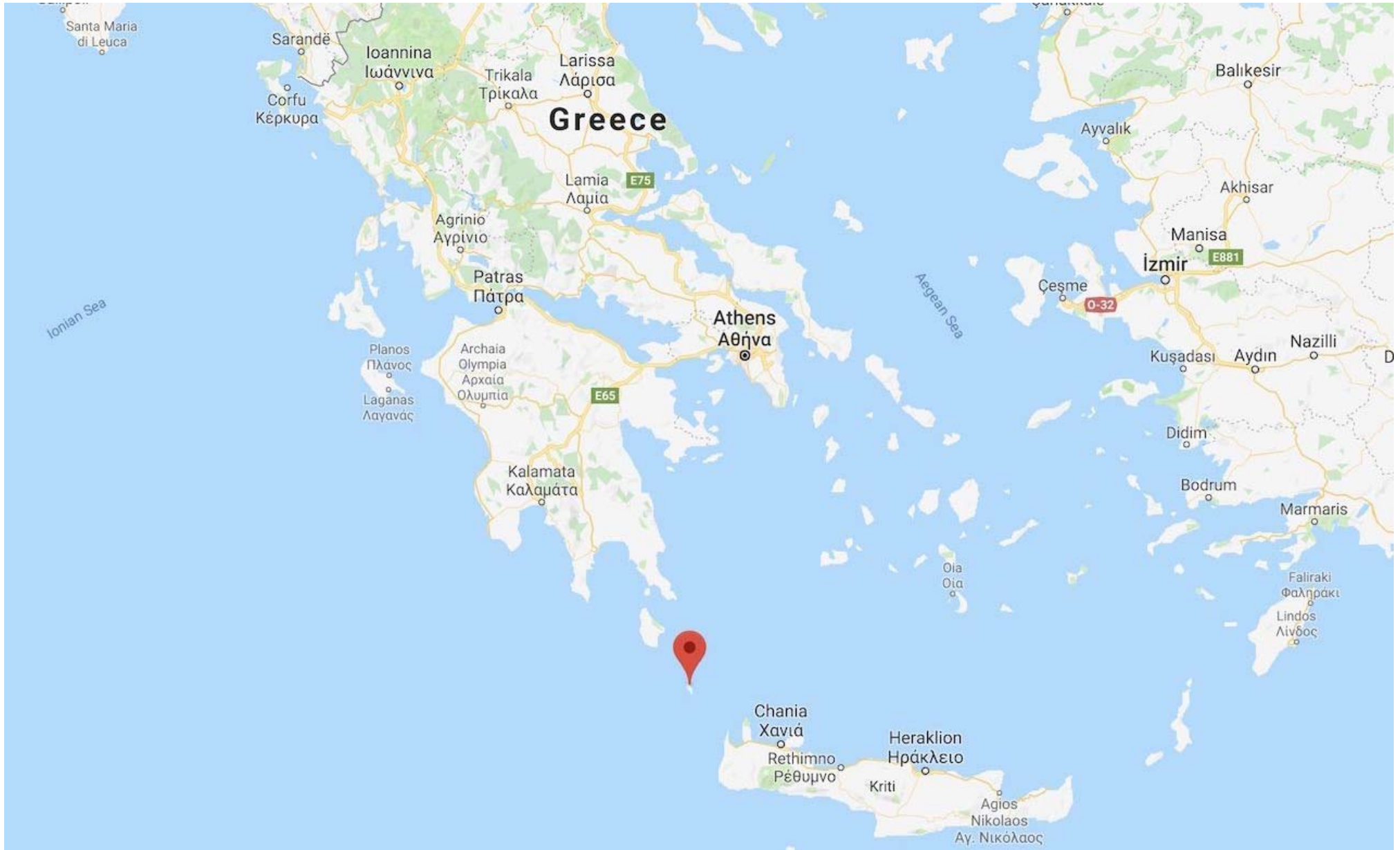
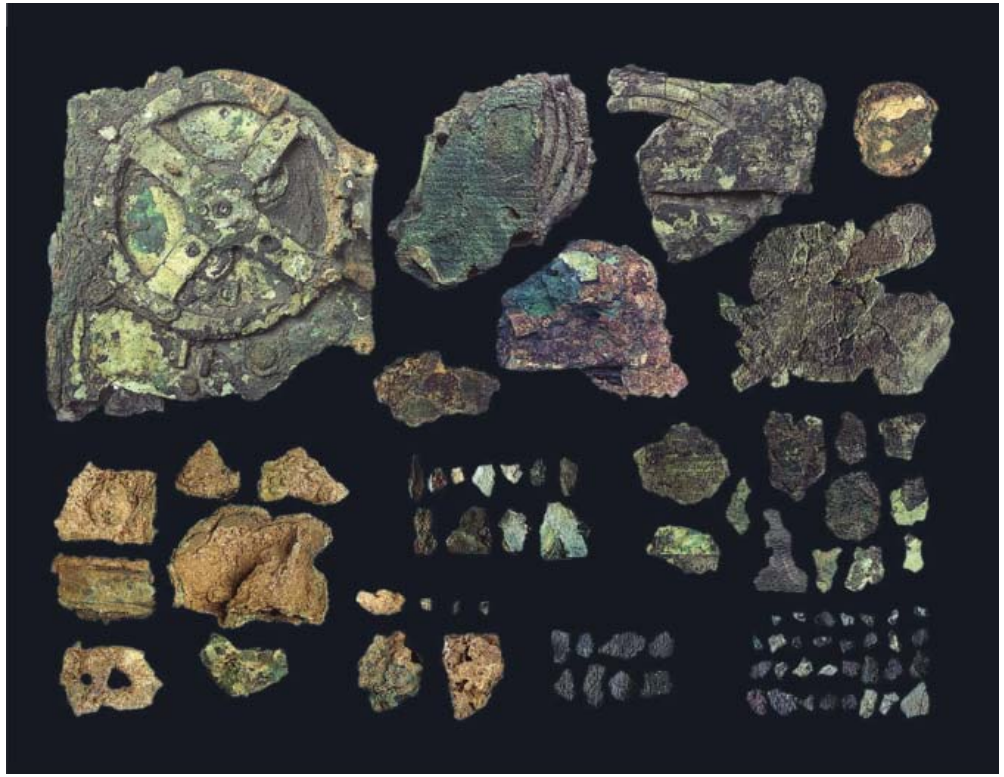
Seminar Katedre za astronomiju, 14. novembar 2023.


Santa Maria di Leuca
Sarandë
Ioannina
Ιωάννινα
Trikala
Τρίκαλα
Larissa
Λάρισα
Corfu
Κέρκυρα
Greece
Balıkesir
Ayvalık
Lamia
Λαμία
E75
Akhisar
Agrinio
Αγρίνιο
Manisa
İzmir
E881
Patras
Πάτρα
Çeşme
O-32
Ionian Sea
Athens
Αθήνα
Aegean Sea
Nazilli
Kuşadası
Aydın
Planos
Πλάνος
Archaia
Olympia
Αρχαία
Ολυμπία
Laganas
Λαγανάς
E65
Didim
Kalamata
Καλαμάτα
Bodrum
Marmaris
Oia
Οία
Faliraki
Φαληράκι
Lindos
Λίνδος
Chania
Χανιά
Heraklion
Ηράκλειο
Rethimno
Ρέθυμνο
Kriti
Agios
Nikolaos
Αγ. Νικόλαος


ANEK LINES

- ronilac Elias Stadiatis, 1900.
- nađena 82 fragmenta



- Nacionalni arheološki muzej u Atini

Astronomski ciklusi ustanovljeni od strane drevnih civilizacija

- Sotisova perioda (traje 1460 godina); 19. jul 139. g.n.e. – 3x1460 -> 19. jul 4241. p.n.e. -> 238. p.n.e. – Kanopski edikt
- Saros (18 godina i 11 dana; 242 drak. m. ≈ 223 sin. m. ≈ 19 drak. g. ≈ 6585 d.) – Kidinu i prethodnici
- Metonov ciklus (19 godina; 235 sin. m. ≈ 254 sid. m.) – 432. p.n.e

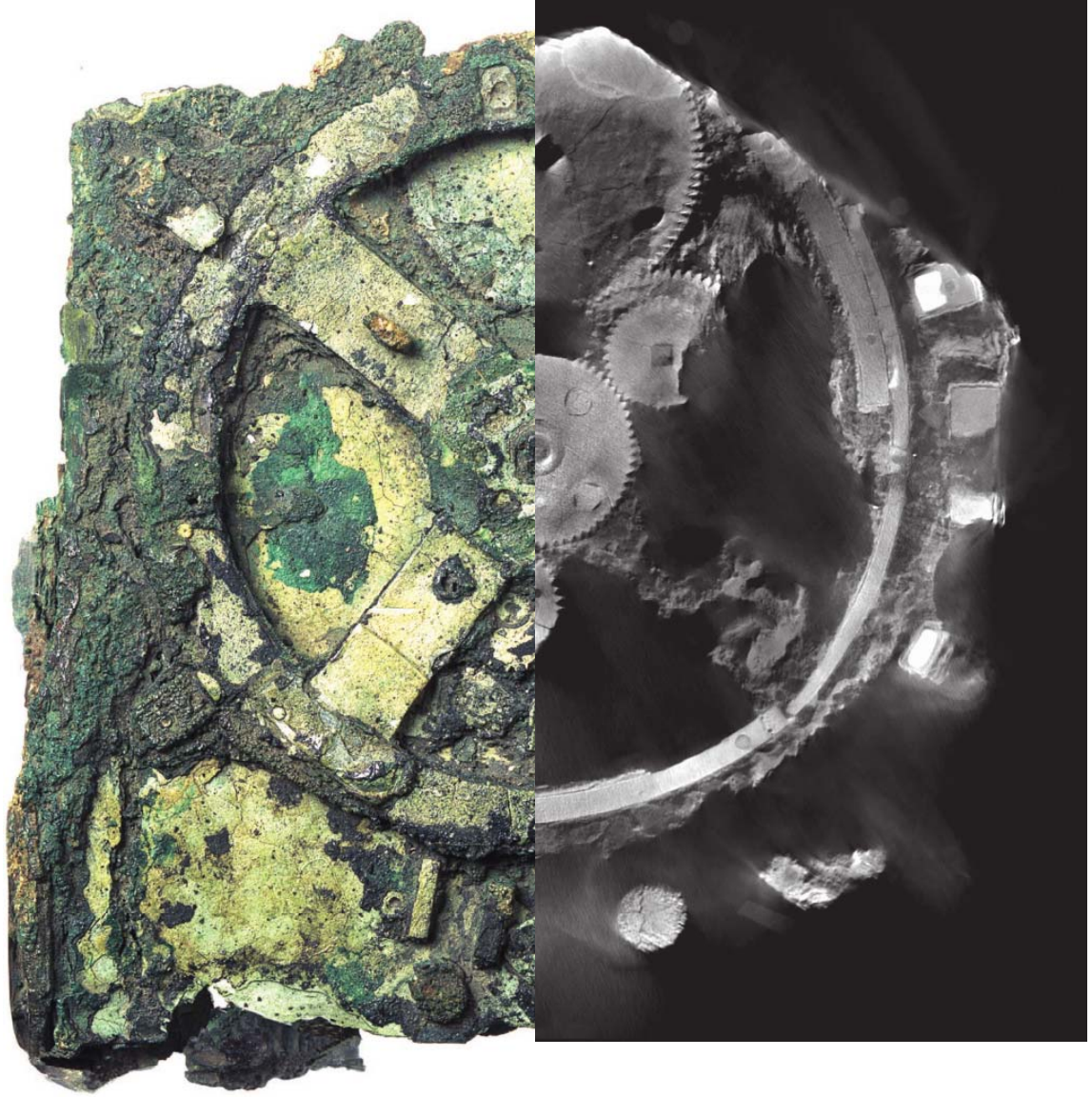
- nemački filolog **Albert Rehm** – čita ugravirane brojeve 19 (zlatni broj) i 76; (1905-1906) – prvi razumeo ovaj mehanizam kao mašinu za računanje
- na istom fragmentu nalazi broj 223

- fizičar, koji se bavio istorijom nauke, **Derek J. de Solla Price** objavljuje 1974, posle 20 godina istraživanja

- „Gears from the Greeks: The Antikythera Mechanism—A calendar computer from ca. 80 BC.“; Trans Am. Phil. Soc. New Ser. 64, 1–70 (1974); reprinted by Science History Publications, New York (1975)

- Ciceron (106-43 pne) pominje sličnu mehaničku napravu dizajniranu od strane Arhimeda (287-212 pne)

- dvodimezionalna X-zračna skeniranja: 30 različitih zupčanika (27 u glavnom fragmentu i 3 u zasebna 3 fragmenta)



D. J. de S. Price: 254 siderička meseca, 235 sinodičkih meseci u 19 godina – zupčanici sa 38 i 127 zuba (Metonov ciklus)

- **Wright and Brumley** (1990): trodimenzionalna X-zračna linearna tomografija – krucijalni napredak u broju zuba u zupčanicima i njihovom 3D rasporedu

- **Freeth et al.** (2006, Nature, 444, 587): trodimenzionalna mikrofokusna X-zračna kompjuterizovana tomografija (X-ray CT)

- zupčanik sa 223 zuba – Saros

- četiri nova zupčanika koja opisuju neravnomernosti kretanja Meseca (zbog eliptičnosti putanje)

- zupčanici koji su opisivali epicklično kretanje Meseca su bili u sprezi sa velikim zupčanikom sa 223 zuba

X-ray CT slika napravljena 2005: ova strana, lista planetarnih krugova; druga strana uputstvo za upotrebu Antikitera mehaničke naprave

- tokom 2016. pročitani su X-ray CT skeniranjem brojevi: 462 u sekciji za Veneru i 442 u sekciji za Saturn

- konstruktori Antikitere su znali da: 289 sinodičkih perioda Venera izvrši za 462 godine, a Saturn 427 sinodičkih perioda za 442 godine

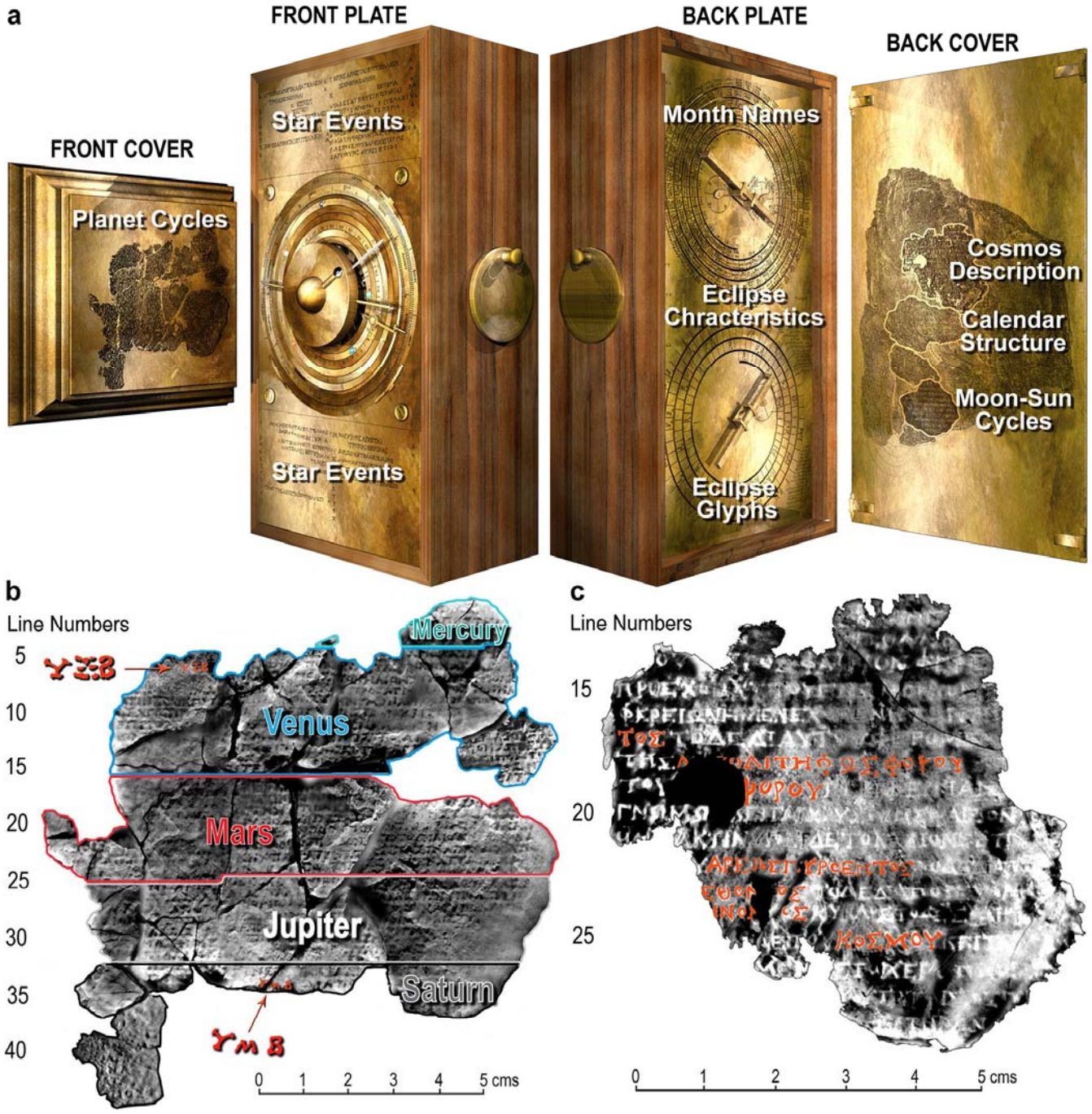
- X-ray CT uređajem je izdvojen zupčanik sa 63 zuba: koristi se za predviđanje putanja Merkura i Venere

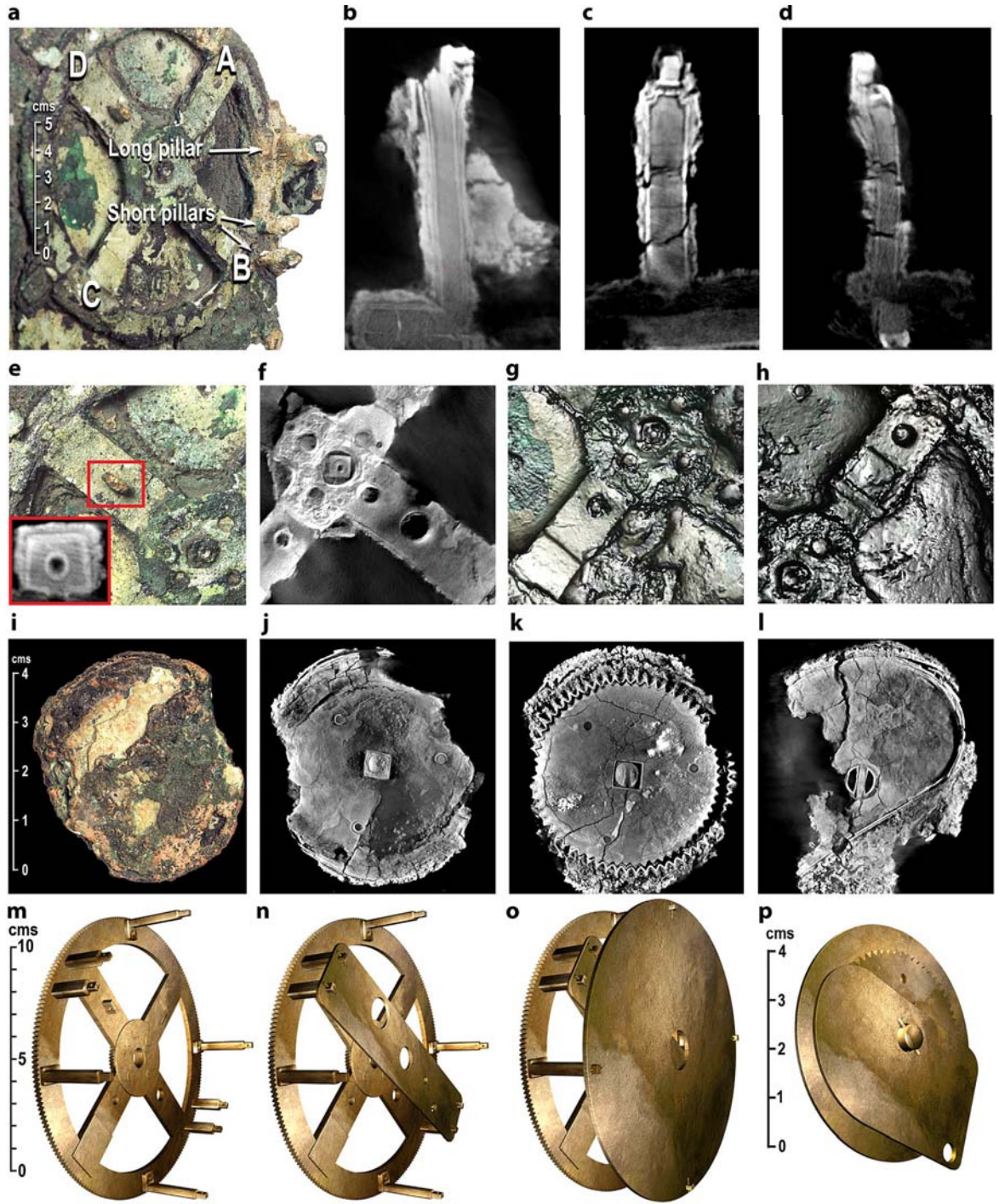
• sistem zupčanika koji su međusobno spregnuti može da prikaže položaje svih sedam pokretnih nebeskih tela vidjivih golim okom u nekom budućem ili prošlom vremenu

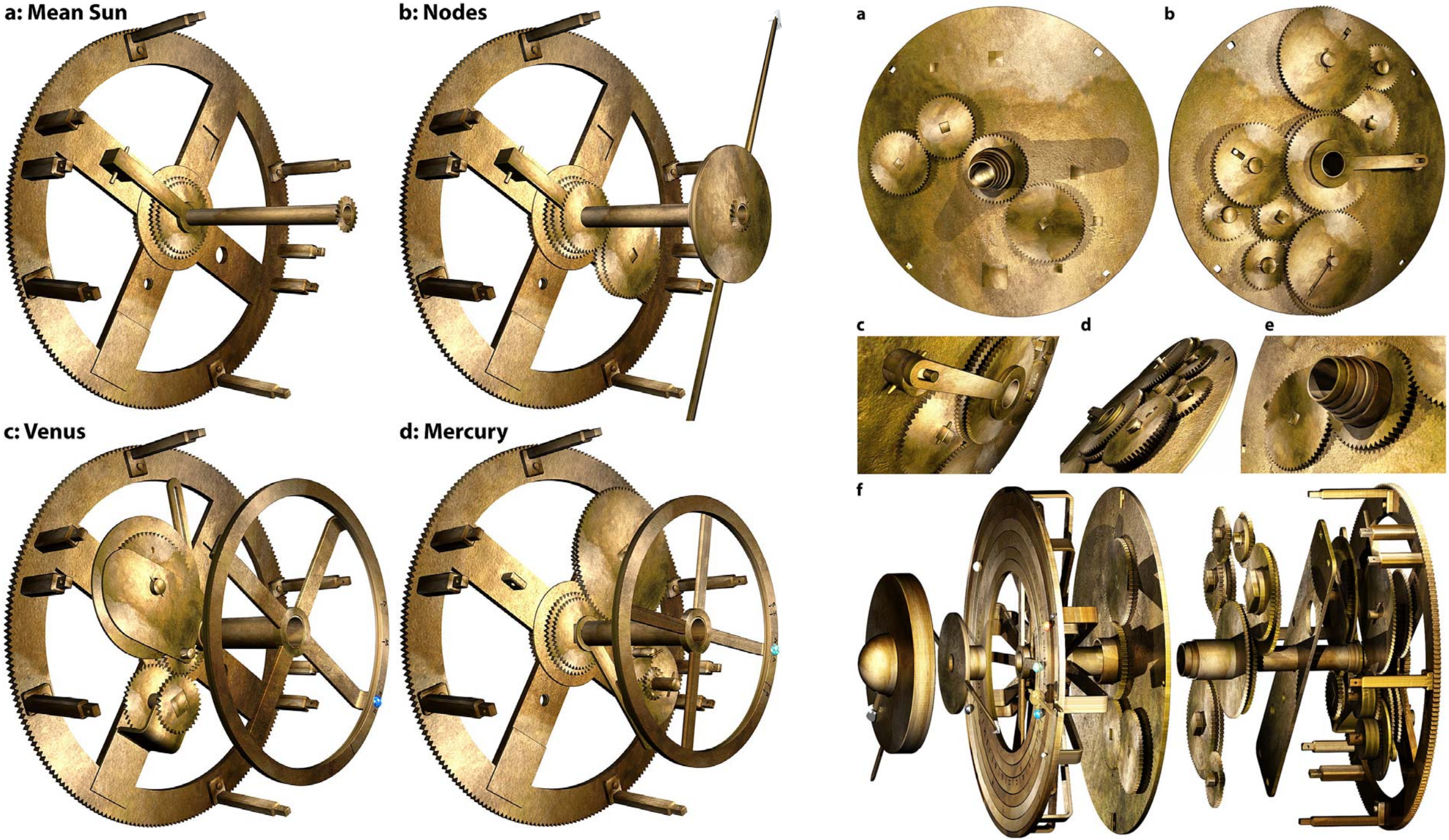
• predvidi buduća pomračenja Sunca i Meseca i odredi kada su se desila ona koja su prošla

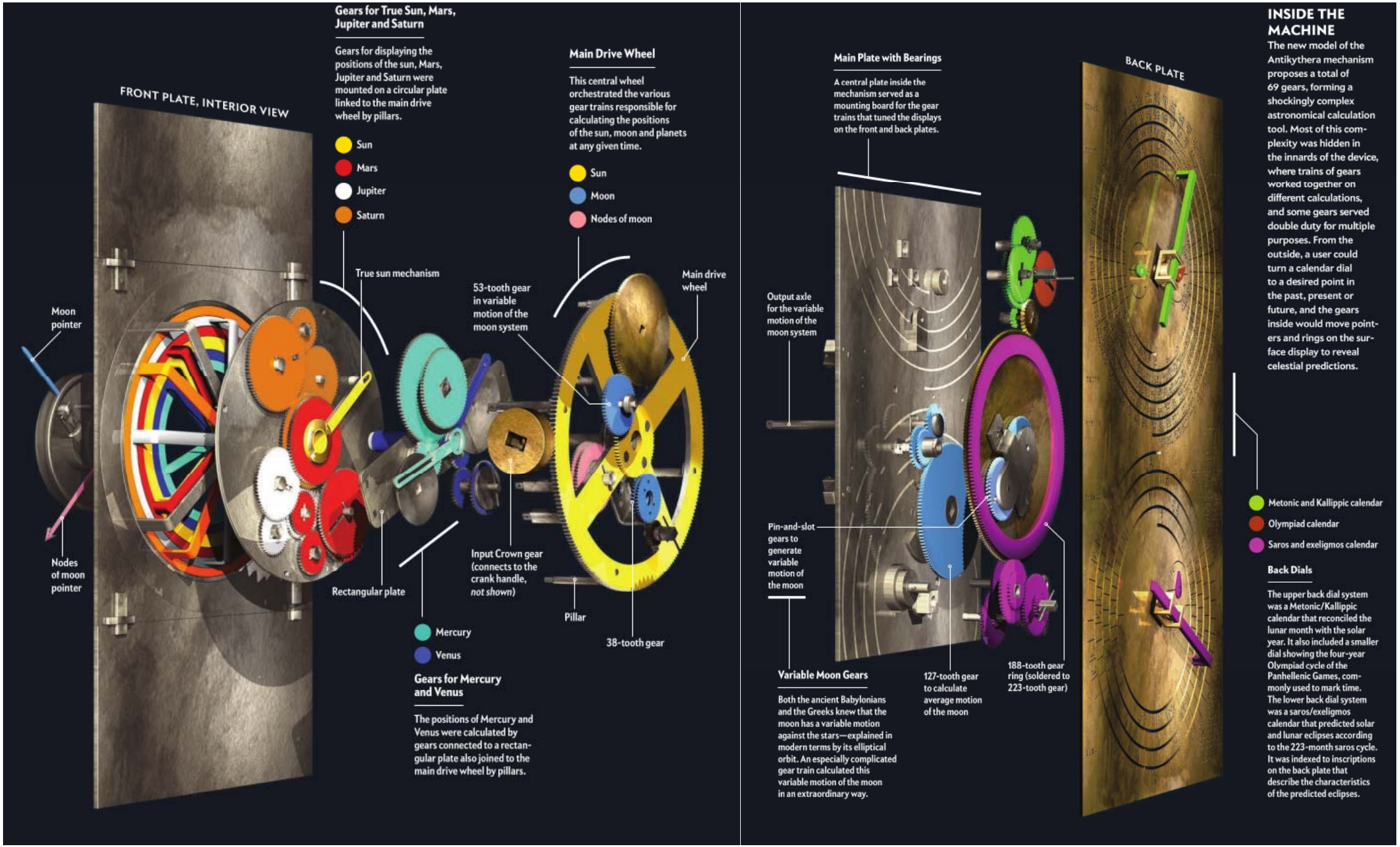
• najnoviji rezultati istraživanja objavljeni su u **Freeth et al.** (2021, Scientific Reports, 11:5821)

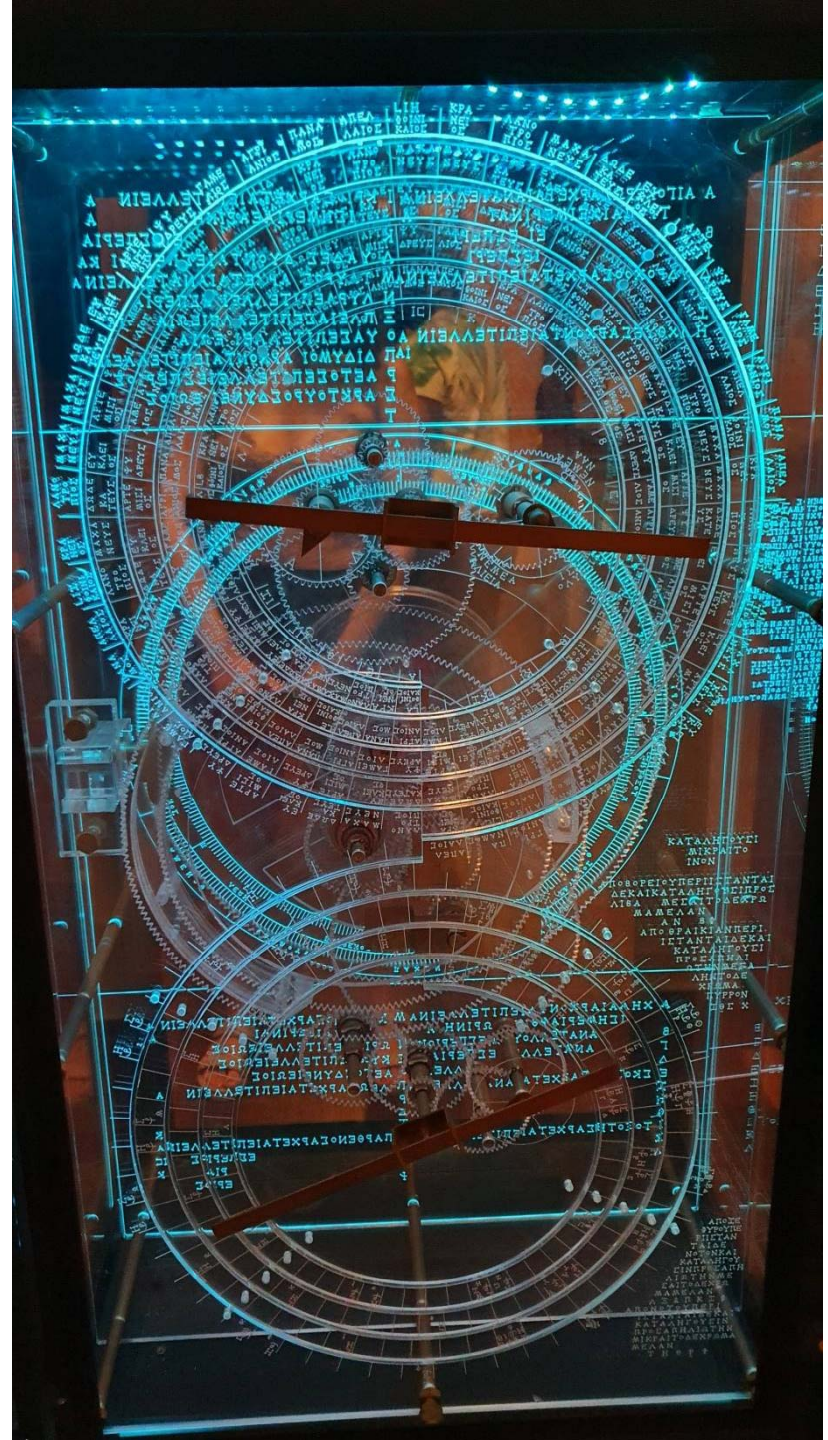
• sažeto u preglednom članku **Freeth** (Sci. Am, Januar 2022)


a
FRONT PLATE
BACK PLATE
BACK COVER
FRONT COVER
Planet Cycles
Star Events
Star Events
Month Names
Eclipse Chracteristics
Eclipse Glyphs
Cosmos Description
Calendar Structure
Moon-Sun Cycles
b
Line Numbers
5
10
15
20
25
30
35
40
Mercury
Venus
Mars
Jupiter
Saturn
0 1 2 3 4 5 cms
c
Line Numbers
15
20
25
0 1 2 3 4 5 cms

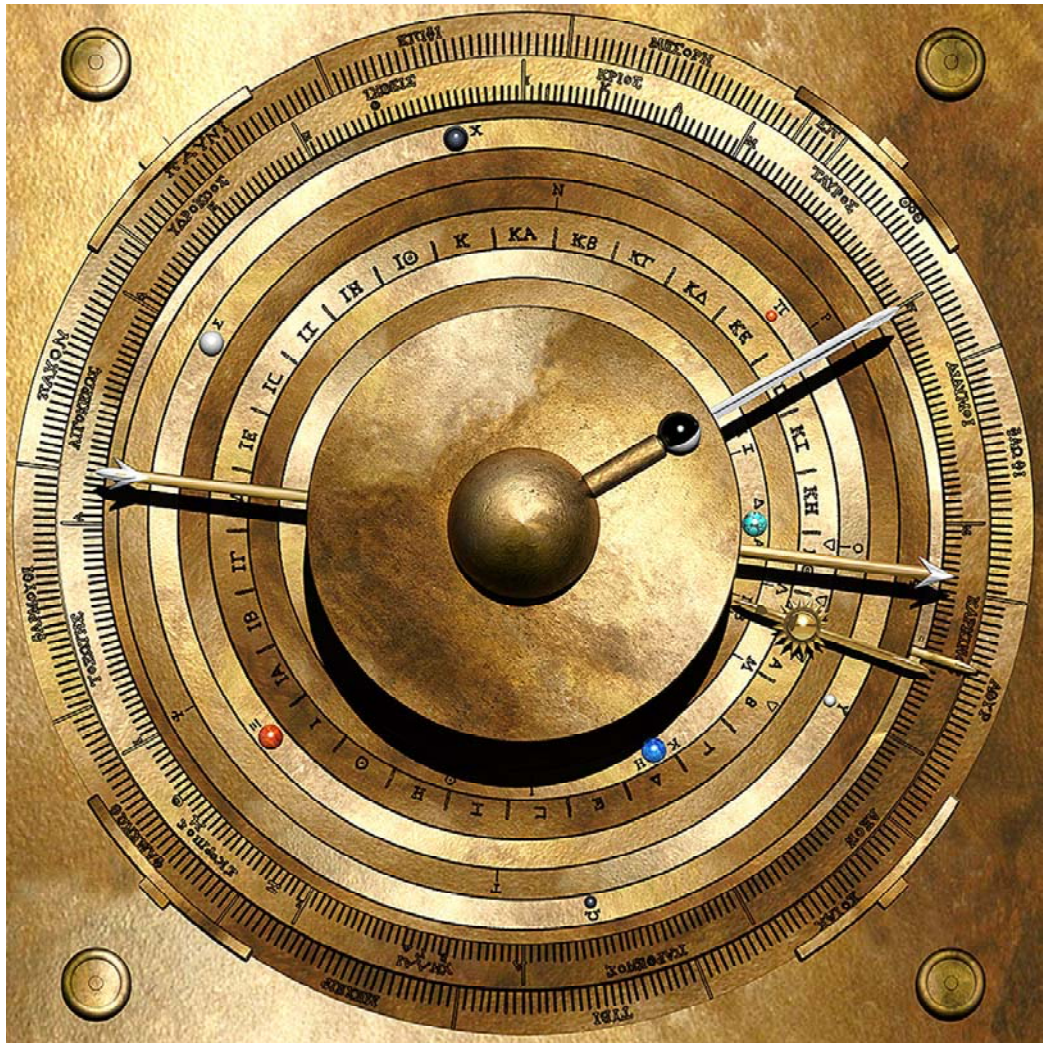

a
D
A
cms
5
4
3
2
1
0
Long pillar
Short pillars
B
C
b
c
d
e
f
g
h
i
cms
4
3
2
1
0
j
k
l
m
cms
10
5
0
n
o
p
cms
4
3
2
1
0


a: Mean Sun
b: Nodes
c: Venus
d: Mercury
a
b
c
d
e
f


FRONT PLATE, INTERIOR VIEW
Gears for True Sun, Mars, Jupiter and Saturn
Gears for displaying the positions of the sun, Mars, Jupiter and Saturn were mounted on a circular plate linked to the main drive wheel by pillars.
Sun
Mars
Jupiter
Saturn
Main Drive Wheel
This central wheel orchestrated the various gear trains responsible for calculating the positions of the sun, moon and planets at any given time.
Sun
Moon
Nodes of moon
True sun mechanism
Main drive wheel
53-tooth gear in variable motion of the moon system
Moon pointer
Nodes of moon pointer
Rectangular plate
Input Crown gear (connects to the crank handle, not shown)
Pillar
38-tooth gear
Mercury
Venus
Gears for Mercury and Venus
The positions of Mercury and Venus were calculated by gears connected to a rectangular plate also joined to the main drive wheel by pillars.
Main Plate with Bearings
A central plate inside the mechanism served as a mounting board for the gear trains that tuned the displays on the front and back plates.
BACK PLATE
Output axle for the variable motion of the moon system
Pin-and-slot gears to generate variable motion of the moon
Variable Moon Gears
Both the ancient Babylonians and the Greeks knew that the moon has a variable motion against the stars—explained in modern terms by its elliptical orbit. An especially complicated gear train calculated this variable motion of the moon in an extraordinary way.
127-tooth gear to calculate average motion of the moon
188-tooth gear ring (soldered to 223-tooth gear)
INSIDE THE MACHINE
The new model of the Antikythera mechanism proposes a total of 69 gears, forming a shockingly complex astronomical calculation tool. Most of this complexity was hidden in the innards of the device, where trains of gears worked together on different calculations, and some gears served double duty for multiple purposes. From the outside, a user could turn a calendar dial to a desired point in the past, present or future, and the gears inside would move pointers and rings on the surface display to reveal celestial predictions.
Metonic and Kallippic calendar
Olympiad calendar
Saros and exeligmos calendar
Back Dials
The upper back dial system was a Metonic/Kallippic calendar that reconciled the lunar month with the solar year. It also included a smaller dial showing the four-year Olympiad cycle of the Panhellenic Games, commonly used to mark time. The lower back dial system was a saros/exeligmos calendar that predicted solar and lunar eclipses according to the 223-month saros cycle. It was indexed to inscriptions on the back plate that describe the characteristics of the predicted eclipses.



Antikitera: astronomska mehanička naprava



HVALA NA PAŽNJI!