ASTRONOMY IN IRAN FROM ANCIENT TIMES UNTIL NOW

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Today Iran has long witnessed the great scientific efforts in most scientific fields in every period of history. Astronomy is one the disciplines that have always been considered in this country and great Iranian scholars have studied it and sometimes achieved valuable results.

Below are just a few of the outstanding Persian astronomer (1)

Abolvafa Buzjani

Mathematician and astronomer who was born in Buzjan, Neyshabur in 940 AD, Buzjani's Scientific book: "The manufacturer needs of business Engineering"[1].

Buzjani's great Astronomical book, "*A*lmagest" or "*A*lkamel" that follows Ptolemy's Almagest. It is possible that this worh, from which only a smal part has remined, be exactlly his "Zig-al-Vazeh", which is based on his and his colleagues observations. By completing spherical trigonometry tool, Buzjani facilitate the solution of its problems. He applied tangents theorem to the solution of spherical right triangle. Abu Rayhan Biruni attributed the priority in proving to him. One of the first Proofs of general theorem of sinuses to solve the non-rectangular triangles was developed by Buzjani. He died in 997 AD. To celebrate him, the crater Abul Wáfa on the Moon is named after him.

Omar Khayyám

He was a Persian polymath, scholar, mathematician, astronomer, philosopher, and poet(18 May 1048 – 4 December 1131). He wrote a book about solving cubic equations callled "Message in the proofs of algebra questions[2]".

Khayyam, at the behest of the Seljuk Malik Shah and the help of astronomers of his time corrected the calendar and adjusted it based on a new sciece (Jalali calendar) which is the basis of current Iranian calendar. Jalali calendar is one of the most accurate calendar synchronized with the tropical year. Jalali year is 365,2421875 days and its accuracy is one day in every 88, 574 years.

At the same time, he wrote his most important and influential mathematics work, "Letter to explain confiscations Euclid[3]" in which he describes parallel lines and the doctrine of proportion.

Khayyam, as an astronomer and mathematician has many important research and writing, among them, "Treatise on Demonstration of Algebra" in which he derived general methods for solving cubic equations and even some higher orders.

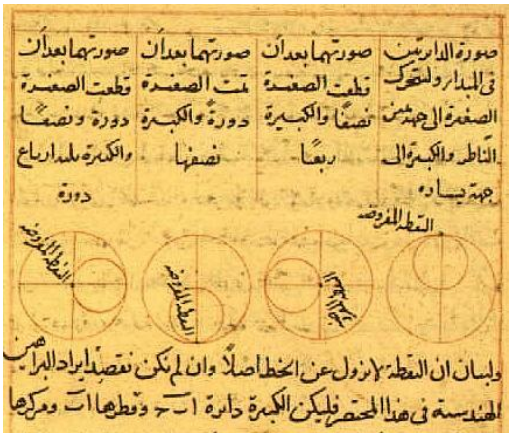

Image nr. 1 and 2 *inscription in explanation of Nasir Tusi couple and Tusi Commemorative stamp issued in Azerbaijan in 2009*

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[1] الهندسه الاعمال من الصانع اليه يحتاج فيما

[2] المقابلة و الجبر مسائل علي البراهين في رسالة

[3] اقليدس مصادرات من اشكال ما شرح في رسالة)

Nasir al-Din al-Tusi

Khawaja Muhammad ibn Muhammad ibn Hasan Tūsī, better known as Nasīr al - Dīn Tūsī, was a Persian polymath, architect, philosopher, physician, scientist, theologian and Marja Taqleed.

He was born in 1201 AD in Jahrod, Qum. Some of his outstanding works are: "As Avicenna Tips", "Nazareth ethics", "Customs Almtlmyn, Ruzhalqlob, Tjrydalmntq", "Tula thesis and an ax". He is one of the developers of trigonometry. În the 16th century, his trigonometry books were translated into French. With the support of the Mongol Khan, he founded the observatory in Maragha and a library containing about forty thousand books. He died in 1274 AD. A 60 kilometers crater in the southern hemisphere of moon is named after Nasir al-Din al-Tusi. An asteroid that was discovered in 1979 by Russian astronomer, Nikolai Astfanvych Chrnykh, was also named after him.

Ghiyāth al-Dīn Jamshīd Masūd al-Kāshī (c. 1380 Kashan, Iran – 22 June 1429 Samarkand, Transoxania).

Among his astronomical works are the Observatory of Samarkand and developing two horoscope. The first horoscope was written in Samarkand and was named Kashani horoscope.

The second horoscope was prepared after writing the first horoscope and named Khaghani horoscope. His books include: "Brief in astronomy", "HP Alsma' or dissertation Kmalyh", "The Treatise of Chord and Sine" and "Treatise on Astronomical Observational Instruments". He calculated the amont of some important mathematical values such as the number "$\boldsymbol{\pi}$" with unprecedented accuracy and seventeen nearly decimal in "The Treatise of Chord and Sine" and surprisingly, the result of his calculation is different with the today results only in seventeenth digit.

One of the other innovative work of Ghiyāth al-Dīn in mathematics is the extraction of Nth root of numbers. His method of working was the same way that Europeans found later in the nineteenth century and refered to as Ruffini-Horner method. Among his other works in mathematics are: "Key account" and "summarize the key in the arithmetic".

Image nr. 3 and 4 *Samarkand observatory, which was established by* ***Ghiyāth al-Dīn***

Iran's observatories (2)

Kashan University Observatory: (51º8'26"E - 33º58'18.74"N) Altitude : 1735 m (3)

Now, eleven optical instruments and three imaging instruments are the most important astronomical tools in this observatory constitutes. Automatic observatory dome with four and a half meters in diameter has been made in double glazed form that covers the main observatory telescope. 16-inch SCHMIDT-CASSEGRAIN TELESCOPE is located inside it, currently known as one of the largest active telescopes in Iran.

Six telescopes in a variety of different sizes with a diameter of 4.8 inch to 12 inch and four giant binoculars are other optical instruments in this collection. A CCD camera device, a CCD video device and a digital camera, with the capability of astronomical imaging, constitute imaging

tools of Observatory. Promotion and teaching astronomy in academic level and astronomical research are among the most important objectives of this observatory[4].

Nasir al-Din al-Tusi observatory in Tabriz (46º 21'45.55"E - 37º52'5.88"N)

Tusi Observatory, which is located at the top of the Bilindy mountain in the slopes of Mount Sahand at a height of 2538 meters above sea level is about 30 kilometers south of the city of Tabriz, officially opened in September 1363 and was utilized accordingly. The observatory has three telescopes :

1.Cassegrain reflecting telescope with 60 cm diameter, and magnification of 825 (the largest telescope of Iran) and with equipment such as: Electronic control table, different Eyepieces, 15 cm guide camera, Electronic focuser, spectroscopy micrometers string and so on.

2. Reflecting telescope with 40 cm diameter and magnification of 550 and with equipment such as: different Eyepieces, 15 cm guide camera, photometers and amplifier.

3. Refracting telescope with 15 cm diameter and magnification of 350 and with equipment such as: equipment for observing the Moon, planets and stars, photographic equipment and various filters, including $H\alpha$ filters for solar research and micro photometer. Solar Physics Laboratory (solar cidro acetate): Refractor telescope with a 35 cm diameter mirror, that send an image of sun to a miror equipped with two engines to make a real picture of sun[5].

Iranian Space Agency Observatory, Mahdasht Center: (50º47'8.5"E - 35º45'52.3"N) Altitude: 1198 m the telescop of this observatory is 16-inch mid- Cassegrain with a focal ratio of f/10 in 4 meters and 10 centimeters focal length which has the capability of full observing celestial bodies. And a 90 mm Coronado solar telescope which is used for observation of the Sun's atmosphere. The observatory is located in Mahdasht, Karaj, 70 kilometers west of Tehran. Mahdasht center is one of the ground stations receiving satellite images.

University of Zanjan Observatory: (48º23'41.34"E - 36º40'35"N) altitude: 1598 m

Zanjan University Observatory astronomical equipment are as follows:

1. 16 - inch Meade Schmidt-Cassegrain reflecting telescope with EQ Mount, with fixed concrete base (main telescope observatory).
2. 8-inch Meade Schmidt Cassegrain reflecting telescope with Alt-Azimuth Mount.
3. Newtonian 8 inch Sky Watcher Telescope with EQ Mount and EQ4 Engine.
4. Newtonian 8 inch Oriun telescope with Dobsonian mount.
5. Schmidt-Cassegrain 5 inch Celectron reflecting telescope with EQ Mount, engine- equpted and desktop.
6. Digital Camera model Canon EOS40D with 35-135 mm tele-objective.
7. Zenith 122 model analog camera with a 300 mm tele-objective.
9. CCD Deep Sky Imager
10. CCD MEADE - PICTOR[6]

Iranian National Observatory (under construction) (51º19'6.95"E - 33º40'26.13"N) altitude: 3572.3 m. Iranian National Observatory will be equipped with a refractor telescope in medium scale and four meters class. The main telescope of Iranian National Observatory (INO340) has a mirror with a diameter of three meters and forty centimeters, and although such telescope in the world, is in the middle-class telescopes, but it will be the most powerful optical telescope in Iran and the region. Several advanced and sensitive detector are included in this telescope, so that in feature the telescope will have active participation in many international activities.

Telescope Optics

Iranian National Observatory is equipped with a Ritchie-Chretien telescope with focal ratio of 11 that provide a 20 arcmin field of view to do various astronomical activities. Each 3 other

[4] Website: http://www.uko.ir/
[5] http://www.tabrizu.ac.ir
[6] http://www.znu.ac.ir/observatory

output of this telescop covers 8 arcmin from the sky. The telescope's primary mirror is an integrated mirror with a diameter of 3.4 m, a thickness of 18 cm and a focal ratio of 1.5, thus the telescope structure will be small. The secondary mirror of the telescope with a diameter of 60 cm leads reflected light from the primary mirror of the telescope to the outside.

The mirror moves are controlled by a 6 base holder. Since Ritchie-Chretien optical systems, have a hyperbolic secondary mirror, this mirror is designed and built in this way[7].

Iran is one of the vast country in the world which is located in (25º3' to 39º47' north) and (44º 5' to 63º18' east). Iran is located in high latitudes. One of the features of high latitudes is clear difference between the seasons. Iran is a country of four seasons.

In light scattering maps, some parts of Iran are completely dark. The state of sky in different seasons, as well as some of the best areas for observing are as follow:

The following information and images are related to the mid-season, 24 o'clock and prepared to central desert of Iran (51º E, 34º N) coordinate (4).

The names of the constellations of spring:

Draco, Leo, Bootes, Lupus, Corvus, Scutum, Scorpius, Libra, Crater, Ursa Minor, Ursa Major, Coma Berenices, Corona Borealis, Canes Venatici, Virgo, Leo Minor, Lynx, Pegasus, Lacerta, Lyra, Vulpecula, Sagitta, Delphinus, Cepheus, Aquila, Norma, Ophiuchus, Hercules, Serpens, Sculptor, Equuleus, Cassiopeia, Cygnus, Capricornus, Camelopardalis, Sagittarius, Corona Austrina.

The names of the constellations of the summer:

Auriga. Aries, Cepheus, Corona Borealis, Cassiopeia, Cetus, Camelopardalis, Draco, Eridanus, Lacerta, Lynx, Ursa Major, Andromeda, Perseus, Leo Minor, Pisces, Taurus, Aquila, Delphinus, Auriga, Hercules, Equuleus, Lyra, Vulpecula, Triangulum, Pegasus, Boötes, Aquarius, Grus, Ophiuchus, Microscopium, Piscis Austrinus, Sculptor, Sagittarius, Serpens, Sagitta, Scutum, Leo.

The names of the constellations of autumn:

Auriga, Andromeda, Aries, Cepheus, Columba, Canes Venatici, Cancer, Canis Major, Canis Minor, Camelopardalis, Caelum, Cassiopeia, Cetus, Cygnus, Draco, Eridanus, Fornax, Lacerta, Leo, Leo Minor, Lynx, Lepus, Orion, Puppis, Perseus, Pegasus, Pisces, Sculptor, Triangulum, Taurus, Pictor, Ursa Major, Ursa Minor, Gemini, Monoceros.

The names of the winter constellations:

Cassiopeia, Cepheus, Corona Austrina, Ursa Minor, Camelopardalis, Auriga, Lynx, Ursa Major, Canes Venatici, Leo, Coma Berenices, Cancer, Gemini, Canis Minor, Perseus, Monoceros, Orion, Taurus, Canis Major, Pyzxis, Puppies, Sextans, Leo Minor, Lyra, Draco, Coma Berenices, Virgo, Corvus, Crater, Hydra, Ursa Minor, Cepheus, Libra, Serpens, Antlia, Vela, Corona Borealis, Boötes, Ursa Major, Leo Minor, Centaurus.

The introduction of appropriate areas for observation and photography (5)

Many astronomers believe that the sky with +6 Limiting magnitude is ideal for observing, while in Iran there is also much darker skies. In some parts of Iran there may be no light source for hundreds of miles. In this paper, the Bortle scale is also used to express the quality of sky areas. It should be noted that there is a very dark areas in Iran but due to ruggedness, they are not easily usable. So, a few of the key areas that have relatively good security and are easy to reach are introduced:

Bahabad Desert and Naybandan Wildlife Sanctuary (57º30'6.68"E - 32º22'46.86"N) altitude: 1031 m.

These two deserts are adjacent to each other , Bahabad desert is less dusty than Naybandan but both are the same in term of darkness, and if there is no dust, the Limiting magnitude of sky is higher than 7.

[7] http://ino.org.ir/

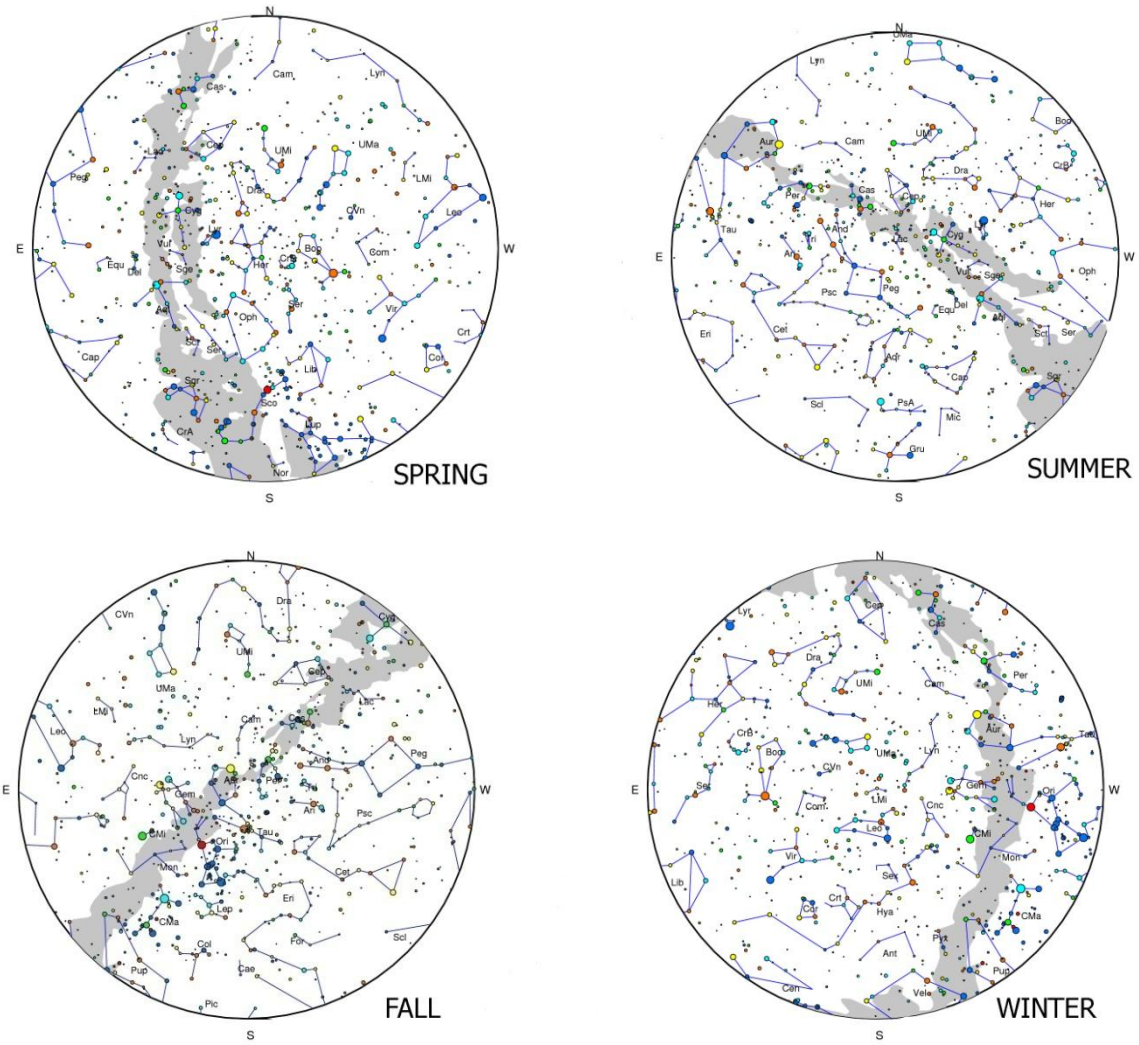

Image nr. 5 *Sky seen from Iran country*

There is no light pollution across the horizon. Gegenschein light is seen and Venus, in its elongation make a shadow on the earth. In Bortle scale, the sky ranking is 2. Tourist attractions Bahabad path include: Yazd, Bafg and Bahabad historical monuments, Desert and mountain together in Bahabad, Haloxylon forest and wildlife of Bahabad, and in the Tabas path, one can see the following attractions: Old villages, Morteza Ali Spring with beautiful valley, Cal Jenny strange valley, Nice texture of Nayband village and the Wildlife of the area.

Bashagard region (57º54'5.13"E - 26º27'29.44"N)

One of the remotest areas in the South East of the country. Bashagard city located in the East of Hormozgan Province and is next to the province Sistan and Baluchestan. The only problem in the area is high atmospheric cloudiness, humidity and dust. Although the darkness of this area is very high but its Limiting magnitude is rarely more than 6/5. However, if there is no problem with weather conditions, Limiting magnitude may reach to 7. The ranking of sky , in Bortle sclae, is equal to 3. Its tourist attractions include Minab recreational beaches and mangrove forests. Hormoz and Qeshm, traditional houses Bashagard which are made by palm trees and a small observatory near Minab.

Kurgaz, Mohammadabad village: (55º10'21.92"E - 33º28'41.56"N) altitude: 586 m

The village is located in the north of Khor. The village has no permanent inhabitants electricity system and is in complete darkness.the existence of proper shelter and sanitary and dusty roads has made it an ideal place for observing and astrophotography. In the southof five-point dome, the light of Khor to farokhi is seen, and in the rest of the horizon,there is a relatively good darkness. The Limiting magnitude is about 6.7 to 6.8. the existence of palm groves along the starry sky, is a good

subject for photography. Its tourist attractions include Nain and Anarak Historical monuments, the Egyptian desert and camel rides.

Image nr. 5 and 6 *Milky Way in the sky of Naybandan and dark horizon of Naybandan desert*

Maranjab desert: This desert covers wide range of Iran's central desert (51º48'41.48"E - 34º18'0.89"N) altitude: 813.9 m. This desert is located near the city Aran Bidgol, In some areas, it can be a good sky for observing and photographing.

Image nr. 7 and 8 *Photo by: akbar mohebi_ alone under starry night, location: maranjab desert. Right: mesr desert. Photo by: amir shahcheraghian*

The dome light pollution of cities Aran Bidgol, Kashan, Qom and Tehran decrease the ranking of sky in term of darkness (Optical dome of Kashan: 30º, Tehran: 20º, Qom: 20º). The Limiting magnitude, in darker areas and in the absence of dust, is about 6.3. Its tourist attractions include: Special desert vegetation, camel ride, fish farming lake in the heart of the desert, historical building of Kashan and Aran Bidgol, Tepe Sialk, a large ancient archeological site (a tepe or Turkish tappeh, "hill" or "mound") in a suburb of the city of Kashan (Sialk City, the first human civilization), the 1500 years old underground city of Nooshabad.

Photographers and observers choose a large areas of Iran for their astronomical activities, in this article, only in a few regions were mentioned. Other areas include the National Observatory's site (around the peaks of Kolah Barfi and Grgsh), Gavkhuni wetland surrounding areas, desert Egypt in Iran, around Fasa and… explanation about them is beyond the scope of this text.

Bibliography:

1. Source: scientist, No. 557
2. For specification of Observatory, their official website is useed and in other cases, information related to the observatory has been confirmed by experts in these centers.
3. All the features mentioned in this article are calculated using http://www.bahesab.ir/map (which is based on the google maps API programming), and google earth.
4. Photos are obtained from the website
http://astroclub.tau.ac.il/skymaps/monthly/index.php
5. In some parts of the section, the article darkest regions of Iran, by Mr. S. Alidusti , Iranian Observational scholar activists, have been used.

ASTRONOMIA ÎN IRAN DIN CELE MAI VECHI TIMPURI PÂNĂ ÎN PREZENT

Astăzi Iranul a dovedit de mult timp marile eforturi ştiinţifice în cele mai variate domenii din fiecare perioadă istorică. Astronomia este una din disciplinele căreia i s-a acordat atenţie în această ţară şi elevii mai mari din Iran au studiat şi au obţinut rezultate valoroase.

Cele mai importante personalităţi ce au marcat istoria ştiinţei şi astronomiei din Iran au fost: Abolvafa Buzjani, Omar Khayyám, Nasir al-Din al-Tusi şi Ghiyāth al-Dīn Jamshīd Masūd al-Kāshī.

Observatoarele astronomice din Iran

1.*Observatorul Astronomic al Universităţii din Kazan.* Este format din 11 instrumente optice şi un telescop principal - SCHMIDT-CASSEGRAIN de 16 inch. Acesta este, în prezent, cel mai mare observator astronomic din Iran.

2. *Observatorul Nasir al-Din al-Tusi din Tabriz*. Este situat pe muntele Bilindy la o altitudine de 2538 m deasupra nivelului mării. Observatorul Tusi se găseşte la circa 38 de km sud de oraşul Tabriz.

3. *Observatorul Astronomic al Agenţiei Spaţiale Iraniene*. Se află la o altitudine de 1198 m şi are în dotare un instrument principal SCHMIDT-CASSEGRAIN de 16 inch.

4. *Observatorul Astronomic al Universităţii din Zanjan*. Altitudine: 1598 m. Are mai multe instrumente optice în dotare, printre care şi un instrument Meade (SCHMIDT-CASSEGRAIN) de 16 inch.

5. *Observatorul Astronomic Naţional Iranian* (este în construcţie). Va fi echipat cu un telescop reflector de 3,4 m şi va deveni cel mai mare observator din Iran. Acesta va intra în categoria telescoapelor terestre mari şi va fi destinat cercetării ştiinţifice din domeniu.

Iranul este una din cele mai întinse ţări din lume, este poziţionată la o latitudine înaltă, una din caracteristici este diferenţa clară dintre anotimpuri. Iranul este o ţară cu patru anotimpuri. De asemenea, Iranul are foarte multe zone nepopulate, unde poluarea luminosă este foarte scăzută, există chiar un cer negru, ideal pentru astronomi. Cel mai bun exemplu este deşertul Bahabad şi Rezervaţia Naybandan Wildlife.