

Article

Astrotourism—Exceeding Limits of the Earth and Tourism Definitions?

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Abstract: Emerging forms of alternative or even niche tourism represent a dynamic trend in tourism development. Astrotourism is completely off the beaten path. The aim of this study is to provide a deeper insight into this phenomenon. It strives to reveal motivations, experiences, and perceptions of its participants. It also aspires to propose its complex definition as an activity including both terrestrial astrotourism and space tourism. It is suggested to perceive it not only as a form of alternative and/or niche tourism, but also that of mass and professional tourism. To reach these objectives, the authors analyzed relevant published studies and astrotourism products presented on relevant websites and social media. They elaborated the collected secondary data by mental mapping and the comparative analysis of terrestrial and space tourism products. Moreover, the authors collected primary data through a survey with open-ended questions addressed to persons interested in astrotourism and through semi-structured interviews with terrestrial astrotourism participants and personalities. The results provide insight into both the specificity and variability of astrotourism and their typical products, as well as a discussion of their future trends. They also bring a motivation spectrum for the astrotourism participants and benefits perceived by them.

Keywords: astrotourism; space tourism; terrestrial astrotourism; tourism participant motivation; archaeoastronomy



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1. Introduction

Cosmic phenomena have attracted people's attention since prehistoric times, as evidenced by cave paintings, statues, myths and related narrative arts as well as ancient calendars and sacred sites, apparently associated with the observation of cosmic phenomena [1–9]. At the same time, knowledge of ancient astronomical observations and sites is constantly evolving dynamically by means of experimental archeology [10], aerial archeology, geophysical methods, such as GPR (Ground Penetrating Radar also called georadar; [11]), 3D reconstructions [8] and computer simulations [6,12,13]. The purpose of using ancient sacred sites for astronomical observations is verified by virtual applications [5]. Archaeoastronomy can also be a method of searching for probable sites of ancient monuments [14].

Astronomy as a science dedicated to observing and explaining cosmic phenomena is also important for the development of today's society, as documented [15] for Nepal. In addition to people's natural interest in the universe, tourism motivated by cosmic phenomena as well as discovering and experiencing outer space can be perceived as a reflection of how significantly human knowledge, agriculture, medicine, architecture, arts, psychology as well as the emotional and spiritual world have been linked to the perception and cognition of the universe since the times of ancient civilizations [3,9]. The development of astronomical observations, fascinating recent discoveries about the universe, the capacity of observatories and planetariums to provide quality experiences [16–18] thus create a strong motivation to travel. The opening of the gates of space for both state and private flights in the upper atmosphere and into the near universe represents another,

very specific motivation to travel [19–26]). Another one is the legacy of ancient civilizations and cosmology-based knowledge transmitted by indigenous peoples [9,27]. This knowledge of nature and universe is a part of the intangible heritage, protected by UNESCO. On its “Portal to the Heritage of Astronomy”, UNESCO [28], namely its “Astronomy and World Heritage Thematic Initiative”, describes in detail the perception of astronomical heritage as a vital part of human cultural heritage. The history of these UNESCO activities is described in Reference [29].

Astronomical phenomena, knowledge of the universe (e.g., Reference [30]), cosmic tours into the stratosphere and near universe (e.g., Reference [31]) and virtual tourism motivated by discovering space (e.g., Reference [32]) are considered among typical attractions, motivations and activities of astrotourism. Many authors (e.g., References [30,33–35]) use a narrower definition of astrotourism as they limit astrotourism to terrestrial astrotourism. According to References [31,36], astrotourism can be classified as a part of special-interest tourism (SIT), alternatively labelled as niche tourism [37]. However, as Ma, Kirilenko and Stepchenkova [38] have proved by analyzing a large amount of data from the 2017 Great American Solar Eclipse, the number of observers of unique astronomic events better corresponds to mass tourism. According to Reference [39], observing the night sky with the naked eye can also be perceived as a part of mass tourism in many destinations. In many countries—such as Chile [40], Indonesia [35], Serbia [41], Spain [42], the Philippines [43], South Africa [44–47], Tanzania [48], and Polish-Slovak Borderland [49], astrotourism is considered to be an important factor supporting local tourism development.

The Czech Republic is a relatively small country. Still, it boasts dozens of observatories equipped with state-of-the-art technology and is home to many professional and amateur astronomers and enthusiasts dedicated to astronomy and astrotourism. This situation, in addition to the long-term professional interest in the sustainability of established and emerging forms of tourism, stimulated the authors’ interest in conducting the research presented in this study. The aforementioned ambiguities regarding astrotourism definition and its relationship to mass tourism and SIT represent a gap to be filled by this article. Furthermore, the dynamic development of astrotourism in recent years will be discussed, including technological progress in space tourism [22,25,50] as well as the background and spectrum of motivations for participation in these activities.

2. Literature Review

2.1. *Astrotourism—State-Of-Art*

Since the emergence of modern tourism in the mid-19th century, the development of transportation has catalysed tourism. The other catalysts include the growing leisure fund and the related lifestyle change as well as the growing capacity of destinations to accommodate large numbers of visitors. At the same time, tourism has become an important economic activity. For example, Towner and Wall [51] described the conditions for the development of seaside resorts. Many destinations and even states became heavily, even essentially dependent on tourism, which turned out to be very risky long before the COVID-19 crisis. The undesirable impacts of mass tourism (e.g., References [52–54]) are documented by research and intensively discussed and reflected in managerial practice, especially that in protected areas [55]. While sustainability represents a serious transformation challenge for the mass tourism industry [56,57] as well as for smart destinations [58], there is also alternative tourism attracting an increasing number of participants. The latter includes specific/ niche tourism [59] and—in the context of COVID-19 and increased popularity of astrotourism—virtual tourism [32,60–62]. However, as shown by the connection with intermediaries, some forms of astrotourism have the character of mass tourism. Some tour operators offer organized trips to observe astronomical phenomena such as a total solar eclipse or auroras, and visits world-leading observatories. They guarantee their clients complete timetable security, which is the same practice as the one that applies to standard tours. This includes relocation to a selected destination, accommodation, catering, possible entry reservations, a local English-speaking guide and other essentials. A person who

purchases such a holiday package does not need to deal with organisational matters at all and can devote him/herself fully to observation, gaining new knowledge and experience.

2.2. Search for Definition

Specific activities of astrotourism currently include traveling to experience astronomical phenomena (see a map of such phenomena in Europe [63]) such as solar eclipses [35,38], auroras [64] and traveling to observe space objects on dark sky sites with minimal light pollution [64]. The astrotourist is perceived as a person who values uniqueness of such phenomena, as they bring him/her satisfaction, a sense of freedom and calm [64]. This part of astrotourism can be perceived as sustainable. According to Weaver [65], who describes this part of astrotourism as celestial ecotourism, its character is close to ecotourism. Other astrotourism activities include space journeys in the form of flights to the stratosphere [25] or space itself [66], but also visits to space rocket launch sites, self-discovery in the form of visits to scientific astro-exhibitions, observatories, planetariums, expert lectures on astronomy and cosmology, and meeting astronauts. Virtual reality also belongs to astrotourism, adequately substituting real travels into the stratosphere and beyond, thanks to its trusted simulation of space and spaceflight.

Astrotourism consists of two basic parts, in which all the above activities can be integrated-space tourism and terrestrial astrotourism [45,64], which include astronomical tourism. Both space tourism [32] and terrestrial astrotourism can take the form of virtual astrotourism.

2.3. Space Tourism

Space tourism currently consists of five main components-stratospheric flights, sub-orbital flights [50,67], low-orbit space flights [68], virtual flights (simulators, virtual reality, e.g., References [32,69,70]), and observation of spacecraft launches on spaceports. The last one represents a form of mass tourism with thousands to hundreds of thousands observers, either attracted by sheer curiosity and respect for cosmonauts, or genuine enthusiasts. This is the result of the “golden age of cosmonautics” in the 20th century [71], when human penetration of space culminated in the first landing on the Moon in 1969 and systematic exploration of the universe and remote sensing of the Earth from its orbit. Figure 1 summarizes major events in space tourism and indicates the directions of its development in the near future. This scheme is based on and supplemented by a review of studies that reflect various stages of space tourism development.

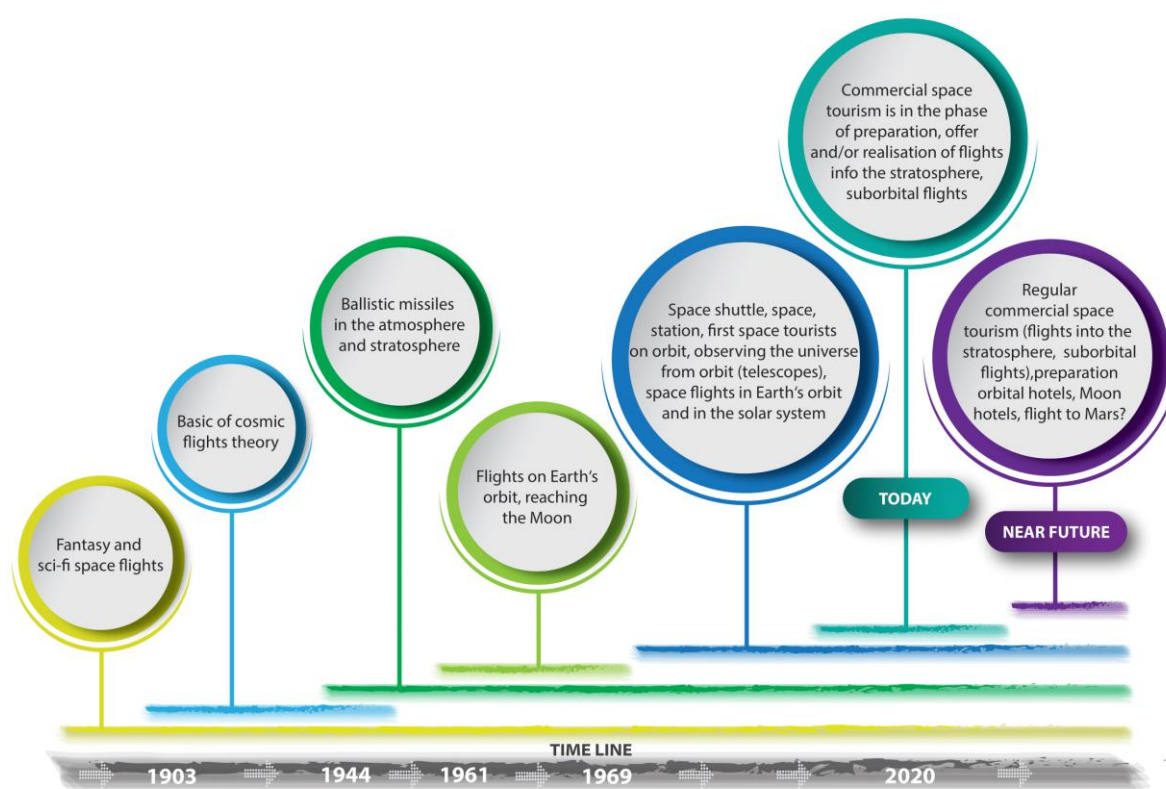


Figure 1. Major milestones of space tourism, past, present and near future. Source: Own, inspired by References [21,23,24,50,71–74].

In addition to the analysis of technologies for flights into the stratosphere including suborbital flights (e.g., References [25,50]), for orbital flights and for cheaper low orbit travels (including space elevator, e.g., Reference [73]), these studies focused on the motivation for space flights [21,75,76], on determining preferences for different variants of offered flights [21,76], historical context, services and perspectives of space tourism [19,20,69,72,77–79], and on the future development of this segment [25,50,74,75]. A significant output of the research by Crouch et al. [75] showed that a large percentage of high-income people are interested in space tourism. This research also indicated that, among the most important factors influencing the choice of type of space tourism product, belong the high price flexibility of demand, the nationality of the provider, the physical requirements put on the client, the size of the flight/flight comfort and the level of pre-flight preparation requirements. These results were followed by research by Reddy, Nica and Wilkes [75]. Their research confirmed the influence of the above-mentioned factors and added the perception of risk as another important factor. Furthermore, these authors included, among other factors, the type of launch and design of the spacecraft, location of spaceports, duration, and insurance. These authors also determined the main motivational factor for participation in space tourism-intentional need for adventure and exploration. While the first flights within space tourism were orbital flights, Chang [50] concluded in his analysis that suborbital flights will be developed as a priority in the near future after 2020. At the same time, the ideas of transport by supersonic aircraft and suborbital flights over long distances are also being developed (e.g., Reference [67]). However, as Forganni [80] points out, the legal problems of suborbital flights still need to be resolved.

The following overview shows that spaceports, typically offering not only observations of rocket launches, but also museums and other products, are considered destinations or attractions of space astrotourism.

Cape Canaveral, Florida, called Florida's Space Coast, is a well-known site of operations for space exploration under the NASA, connected to the Apollo program (first lunar

landing flight), shuttle launches, International Space Station, deep space exploration, etc. Kennedy Space Center Visitor Complex offers visitors astronaut training simulators, the Air Force Space and Missile Museum, the Mercury 7 Monument, Launch Complex 34, the memorial site for the crew of Apollo 1, NASA's Space Shuttle Program, Mars Rover, IMAX theater, and Hubble space telescope theater [81,82].

Cosmodrome Baikonur (Kazakhstan) is the world's first and largest operational space launch facility, connected with Sputnik 1, Yuri Gagarin, Soyuz rocket, and International Space Station. It offers visitors rocket launch observation, hotels and a small museum [83].

Centre Spatial Guyanais (France) is mainly used by The European Space Agency (ESA). It offers visitors a space museum and rocket launch observation [84].

The general history of space flights and its research can be admired in the National Air and Space Museum (Washington, DC, USA). It is one of the most visited museums in the world (around 7 million visitors annually from 2001 to 2018; [85]). The museum offers visitors guided tours through the exhibition about the history of spaceflight and astronomy. It also includes a public observatory and part of the exhibition uses virtual reality [86].

2.4. Terrestrial Astrotourism

Various astronomical phenomena have the potential to attract the attention of common tourism participants, according to References [35,43], especially the solar and lunar eclipse, meteor shower, sunsets in picturesque natural settings (e.g., sea, high mountains) and Mars opposition. These striking phenomena are relatively easy to observe regarding technical support and facilities.

2.4.1. The Solar Eclipse Driven Travelling

Observing a solar eclipse represents a unique experience that can be realised only several times in a lifetime. Horálek [87], unlike NASA [88], which describes only three types of solar eclipses (a total solar eclipse, a partial solar eclipse, an annular solar eclipse—ANN), classifies the solar eclipse into four types: a total solar eclipse; the ring solar eclipse; the hybrid solar eclipse; and a partial solar eclipse. A total solar eclipse is the rarest of these solar phenomena, it occurs in a belt of totality wide on the surface of the Earth at most 270 km and tourists are willing to travel for it even at a distance of thousands km. Observing a total solar eclipse can become a mass tourism occasion [35] if it passes through relatively accessible territories.

2.4.2. The Auroras Driven Travelling

Mackowiak [89] describes the aurora as an astronomical “colour” (e.g., green, red) phenomenon that occurs when high energetic particles penetrate the upper atmosphere (hundred kilometres above the Earth's surface) and collide with nitrogen and oxygen atoms and molecules. Aurora is most often observed in areas of higher latitudes, that is to say, the pole regions, further afield in the states of Scandinavia, Iceland, Canada, Alaska. Forecasts, monitoring and other detailed information on auroras are available at various professional websites, operated e.g., by NASA (www.nasa.gov), or Czech Astronomical Society (www.astro.cz). In recent years, individual as well as organized or unorganized group traveling to see auroras has emerged in the tourism market. There are even mobile applications, such as Aurora Forecast, showing the user the estimated strength/activity (on a scale of 1–10) of the aurora, including the indication where the glow should occur.

2.4.3. The Starry Skies Driven Travelling

As it has been increasingly analyzed in recent years [90–92] and according to the Ministry of the Environment of the Czech Republic [93], light pollution represents a significant problem for living nature, human health as well as for both amateur and professional astronomical observations. Light pollution negatively affects indigenous cosmologic knowledge and navigation skills [94] as well as observation options at many observatories (e.g., Mount Wilson observatory; Caltech and Palomar Observatory). Moreover, the combination of light

pollution and air pollution by emissions (e.g., The Royal Observatory, Greenwich) affects the functionality of observatories with a greater or exclusive focus on providing products for visitors, as shown by the example of Mount Wilson Observatory. Furthermore, the chapter titled Comparative Analyses of Observatories describes an example of the Royal Observatory, Greenwich. In the U.S.A., Mount Wilson Observatory (called Solar Observatory) cannot be used for observing deep space due to light pollution. It offers guided tours for groups and individuals behind the scenes engineering tours of two telescopes, cosmic café, concerts, and expert lectures [95,96].

Regarding the travelling motivated by astronomical observations, the level of light pollution is not only monitored [97] and predicted (e.g., Reference [98]) as a condition for astrotourism, but a new tourist attraction has also emerged—a destination of dark sky (e.g., dark-sky tourism in national parks in the USA on the Colorado Plateau, Reference [99]). The most visible result of the International Dark-Sky Association initiative called “the International Dark Sky Communities Program” is an existence of more than 120 certified sites, which declare protecting their territories against light pollution through public education and responsible lighting policies [100]. The importance of protecting the dark night sky was endorsed declaratively in La Palma, Canary Islands, Spain in 2007 and as the “Declaration in Defense of the Night Sky and the Right to Starlight”.

Many national parks, as areas boasting naturally dark skies, are planning or developing various astronomical observation programs [101,102]. Observation conditions in the Atacama Desert and in the surrounding Andean region of Chile, Peru and Bolivia are unique in the world. This is evidenced not only by the location of the most important European observatory (European Organization for Astronomical Research in the Southern Hemisphere-ESO), but also by offering night sky observations for tourists at various sites in Chile and Bolivia (e.g., San Pedro de Atacama). Projects to protect the dark night sky have also been developed there [100,103,104].

2.4.4. Ancient Astronomical Observatories and Sacred Sites

Ancient civilizations were significantly associated with the observation and interpretation of the universe and left many structures used in all probability for astronomical observations, or at least related to astronomical knowledge. Such megalithic structures and other sites whose archaeoastronomic purpose is the subject of research and verification are located in Mexico (Palenque; El Caracol, Chichen Itza; Mayan pyramids, etc.), Guatemala (Mayan pyramids), Peru (Chankillo; Machu Picchu, Cuzco), Egypt (Abu Simbel, Nabta Playa), USA (Bighorn Medicine Wheel), Canada (Majorville Medicine Wheel), China (Gaocheng; Beijing), Ireland, Great Britain (Stonehenge, Brodgar), India, Spain and Portugal (Seven-stone Antas), Montenegro (Kokino), Germany (Goseck circle), Cambodia (Angkor Wat), Kazakhstan (Steppe Geoglyphs), Malta (Temples of Mnajdra), Sweden (Gotland Grooves) and other countries [95,105]. Such structures (e.g., Mayan pyramids) feature astronomical phenomena.

An example of a sacred place with a strong *genius loci* used for astronomical observations is the pre-Columbian archaeoastronomical site El Infiernito (Figure 2), which is located near Villa de Leyva, Colombia, a community with well preserved authenticity. The iconic Stonehenge (UK) as a UNESCO heritage is the most famous and most visited megalithic building in the world (mass tourism-guided tours, tourism infrastructure, 1.6 million visitors annually) and probably also one of the oldest sacred places to observe the sky [95,106].



Figure 2. Ancient astronomical site El Infiernito, Colombia. Source: Zelenka, 2010.

3. Materials and Methods

The aim of this manuscript is to contribute to the ongoing process of astrotourism conceptualization by determining its common features and internal variability as well as by proposing the complex definition of the astrotourism meaning. To provide the currently missing complex definition of this emerging type of tourism and indicate its overlapping with other tourism forms, the below described qualitative research was carried out. Its main intention was to enable deeper understanding of who is an astrotourist and how to characterize this special tourism segment. For this reason, the following framing research questions were formulated. What activities based on what motivation an astrotourist realizes and what types of phenomena (must-see astrotourism attractions) is s/he looking for? What are the most favoured destinations and why? What benefits and risks associated with astrotourism are perceived as the most important? How relevant is for an astrotourist the problem of light pollution and how much is the Dark Sky Park attractive to her/him?

The secondary research was based on the literature review and content analysis of relevant resources, including social media and webpages of astrotourism facilities. The primary research applied the ground theory method [107,108] and consisted of the qualitative survey and the semi-structured interviewing. In order to understand astrotourism motivation, content and trends, these two approaches were combined—a questionnaire survey with open-ended questions and semi-structured interviews with prominent experts in the field and those interested in astrotourism. Regarding the set of open-ended questions, they were sent to the target group of persons who had been participating in astrotourism for more than a decade and more than three times a year. It was distributed to respondents in three different ways. The questionnaire was created through Survio.cz facility and was posted for 30 days on an astrological forum [109]. It was also posted on two Facebook groups dedicated to traveling driven by the aurora observation. Finally, it was sent directly by email to the persons renowned for their practice of astrotourism. The

questionnaire contained a total of nine questions focused on the respondents' motivation to participate in terrestrial astrotourism, the astronomical phenomena they are looking for and their astrotourism related experiences. In total, 39 responses were obtained from this questionnaire investigation. The results of this survey helped formulate questions for the semi-structured interviews, which followed after the qualitative analyses of survey results.

The semi-structured interviews were realized by Skype or MS Teams after previous appointment agreement with the informant. Each interview was attended by all three authors, one of them was asking questions and the others were taking notes [108] (pp. 107–130), and controlling the technical quality of the transmission. With the previous consent of the informants, the interviews were also recorded through the skype interface/facility. The interviews lasted approximately 40–60 min and the authors let the informant bring his/her ideas, points of view, opinions and further context when responding to the questions. In order to apply the process of theoretical sampling [108] (pp. 134–147), the first batch of informants was indicated on the basis of their fame as astrotourists. These informants recommended other ones. Interviewing of the second batch of informants, based on newly emerging meanings and categories from the first batch, progressed until the saturation point, where no new information related to the research seemed to appear. The saturation point was identified by means of analysing the recorded content of each new interview comparing it with the previous one. The interview questions are listed in Appendix A.

Data obtained from the interviews were first analysed and then synthesized in repeated cycles until the point of theoretical saturation followed by the theoretical model creation. Each recorded interview including the related notes was subject to the open coding process, conducted by all the authors. Each of them individually identified the meaning units and then determined more general categories that were relevant to the research questions [108] (pp. 295–308). The discussion of their respective outputs was followed until they reached a consensus. This approach enhanced the objectivity of data analysis process. The results of the open coding process are depicted in Table 1, where the identified meaning units and categories are interpreted. Then, axial coding [107] followed, in which the identified categories were interrelated to reveal the context and background of astrotourism motivations as well as astrotourism distinction and position regarding the other tourism forms. In order to understand the causality of astrotourism emergence and development, causal conditions for participation on it as well as relevant intervening conditions (external factors) were identified. The process of axial coding was supported by the results of the open-ended questionnaire survey. As a result of selective coding, the theoretical model was created (Figure 3), where the core category [108] (pp. 188–189) was related to the most important categories. This core category brings the storyline of astrotourism, around which the most important identified and interpreted categories are structured [108] (pp. 188–189). The notes and results from the open-ended questionnaire were used for precision in the process of creation and description of the final model of astrotourism definition. Due to the situation caused by the SARS-CoV-2 epidemic, it was not possible to make full use of the possibilities offered by qualitative research to understand the nature and variability of the phenomenon of astrotourism. The necessity to conduct semi-structured interviews by videoconferencing has reduced, albeit to a small extent, the ability to empathize with the informant. The very significant potential of participatory observation and that of field discussions of focus groups could also not be exploited for better understanding the depth and forms of astrotourism.

Table 1. Open coding outputs.

Concept (Category)	Meaning Units	Properties (Meaningfulness)	Dimensions (Capture of Variability)
the attraction of space and the bodies in it as a central concept	• solar eclipse • starry sky (stars, comets, planets) • Aurora • meteorite swarms • the Moon	• the astonishment that the view of cosmic events and bodies evokes, leads to purposefulness in the realization of the desire to experience observation • the Moon also as a problem for observing the starry sky	The extent to which the destination is only a place to observe (the destination is actually the universe, a specific observed object, a phenomenon) and what kind of place it is, the way the tourist can get there and his/her stay in it (terrestrial attributes of the destination can even be a disruptive element!).
interest in objects, which is related to the knowledge of the universe	• relics, buildings, craters • astro observatories, museums • artefacts and reminiscences of personalities associated with space research or authors of fantasy/sci-fi works	searching, experiencing and understanding the connections between cosmic phenomena and the conditions for their observation and discovery	Degree of knowledge of the historical, anthropological, artistic and scientific context of the discovery and observation of the universe.
specifics of astrotourism infrastructure (background)	• location (on the edge of settlements, etc.) • specific time mode • conditions and equipment for observation	Spatio-temporal and content adaptation of the offer of astro-tourist accommodation facilities	A range from small family businesses trying to meet the individual requirements of astrotourists to larger specialized businesses, set up especially for astrotours with both their equipment and human capital.
way of participating in astrotourism	• travel to observe cosmic phenomena • visits to observatories, spaceports, historic buildings, etc. • travel to see the remnants of the impacts of space bodies (craters)	a form of realization of the fulfillment of desire, based on specific motivation	Observing current space and terrestrial phenomena and visiting related infrastructure, observing the consequences of past phenomena as well as artefacts reflecting the observation of these phenomena in the (ancient) past.
nature on the Earth as part of the universe	• love, admiration for nature • the link between the impacts of space bodies (craters) and the evolution of life • the influence of events in space on terrestrial events • the coexistence of natural wonders on Earth and the universe	perception of the connection between nature and man with the universe, harmony, understanding of such connections	The perception of this connection from various positions-scientific, environmental, aesthetic, artistic, spiritual.
incentives and motivation for astrotourism	• interest in astronomy • parents, teachers, astronomical circles • fantasy, sci-fi literature • interest in traveling or the need to travel (the sky is not dark enough at home)	awakening of interest in space usually in childhood, later strengthened by the study or example of prominent personalities or community of interest	Study stimulus like natural curiosity and interest in knowledge, inspiration by astro-personalities.

Table 1. Cont.

Concept (Category)	Meaning Units	Properties (Meaningfulness)	Dimensions (Capture of Variability)
intersection with other forms of tourism	- cognitive, scientific - adventurous, expeditionary - gastronomic - ethnotourism - geotourism - sports - virtual	A diverse range of forms of tourism that enable an experience more or less related to space	Various forms of tourism, including scientific-cognitive and hedonistic.
Experience enhancement	- unique scenery, exotics - group observation-debate, sharing experience and knowledge - capturing the observed phenomenon by taking photos (preserving the memory and sharing the experience) - Aesthetics-art	capturing the observed is the immortalization and deepening of the experience and the exotic backdrop on Earth makes it more attractive	The degree to which an astronomical phenomenon is a pure capture (scientifically precise) of a phenomenon, or capturing emotions, artistic representation. The degree to which photography enhances the experience, from the extreme of pure observation to the photographer-astrotourist.
sharing the experience	- exhibitions, lectures, discussions, popularization events (also for children) - books - interpretation tools, aids	shared experience brings a feeling of success, usefulness, fulfillment, self-realization	The pure joy of sharing experience and/or knowledge, the joy of success (admiration), as well as commercial benefit (exhibitions, astro-expeditions).
sustainability of astrotourism	- tourism tours (mass tourism) and devaluation of the experience - space travel - light pollution on Earth and in its orbit (Starlink) - cosmology of indigenous communities	fear of the form that astrotourism could take, and concerns about increasing light pollution	The degree of organization of astrotourism-mass character, loss of responsibility, impacts on nature and (in the future) the universe. The cosmology of indigenous communities and the “interconnectedness” of their secular and religious activities with cosmic events are gradually declining.
astrotourists as a community	- sharing experiences, photos, knowledge, tips - mutual motivation and inspiration - the meaning/role of the knowledgeable and recognized person - group travel-cycling, expeditions abroad - social networks, forums, blogs - together against light pollution - degree of community connectivity	the glue of the community is the common interest in the universe and the ability and willingness to enrich each other with knowledge and experience	Strongly connected groups of “real and regular astrotourists” (colleagues, friends), loosely connected communities (important personalities and those interested in astrotourism with trips, such as children’s groups), professional forums and virtual communities.

Table 1. Cont.

Concept (Category)	Meaning Units	Properties (Meaningfulness)	Dimensions (Capture of Variability)
darkness	• perception of rarity, beauty, threat to dark sky • parks of dark sky • astrotourists are not afraid of it • sleeping under the starry sky • southern sky as an ideal • darkness as part of natural cycles	darkness is understood not only as a natural and necessary part of life, but also as goods in short supply and a basic condition of astrotourism—the impulse to travel, there is a need to move to the place where it is	Love for darkness, arts, aesthetics and romanticism, interest in mystical and scientific aspects, the need for legislative protection (the rights of people as well as other creatures to the dark sky) for future generations.
acquiring the knowledge of and understanding the observed phenomenon	• creation of interpretation boards • visits to observatories • popularization events • interest in understanding the starry sky, usually since childhood • study or self-study of astrology	the desire to know is part of the desire to travel to observe and the desire to capture people's attention	Degree of significance attached to understanding the observed phenomenon. A continuum from scientific approaches to a mere fascination for beauty.
experience	• targeting knowledge • travel back in time • adventure • exotics • romance • genius loci • authenticity • uniqueness • transience	the basic attribute of the astrotourism experience is its volatility/unrepeatability and inviolability of observed phenomena, gaining the insight, understanding the context, touching another course of time	Activity/passivity rate. The degree of complexity of senses (also smells, sounds). The role of spatio-temporal context (landscape, nature, history, ethnography, rituals, legends) and possible connection of observation of astro phenomena with trips/exploring the surroundings and the country (cultural, social and other experiences).
personality traits of an astrotourist	• determination to fulfill one's dreams • purposefulness • searching for an unusual experience • relationship with nature • extent to which astrotourism is a need	Astrotourism requires the astrotourist's commitment, changes in his/her lifestyle, to some extent the astrotourist feels obliged to accept sacrifices as astrotourism is his/her need. For a professional astrotourist, astronomy and observing celestial phenomena (often as the meaning of life) places high demands on the knowledge and precision of observation/photography.	The importance of astrotourism in the emotional, cognitive and social life of an astrotourist, including astronomy and observing celestial phenomena as the meaning of life, astronomy as a significant complement to another professional focus (e.g., geology), occasional attention to astronomy and significant celestial phenomena.

The purpose of the overview of important dark sky destinations of terrestrial astrotourism is to present identified astrotourism destinations and their most popular types. Due to the important role of observatories, both primary and secondary research of selected observatories included the comparative analysis of characteristics of the offer to visitors, mission priority, composition of visitors, use of social media and annual attendance. The authors used various information, including website content, communication and presentation on social media, professional articles on the Internet, and personal communication with the persons who regularly visit observatories, to collect relevant data and compare offered products and other characteristics. The Brno Observatory and Planetarium was selected as a representative of observatories of national importance [110]. The Royal Observatory, Greenwich, Great Britain, famous for its specific location right on the zero meridian, was

picked as a representative of frequently visited and world-known observatories [111]. The popular and well-known Del Teide Observatory located in the Canary Islands and part of the European Southern Observatory, La Silla Observatory, located in the Chilean Atacama Desert, were chosen to represent world-renowned observatories [112,113].

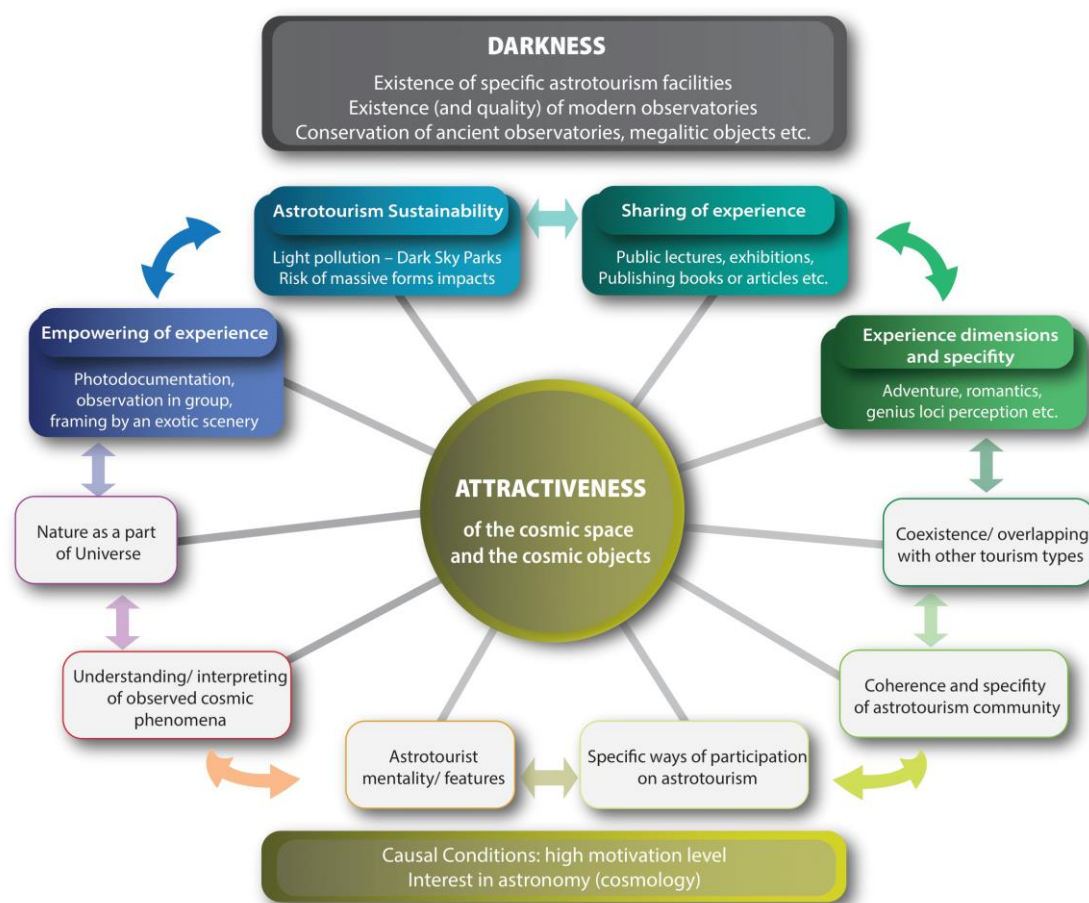


Figure 3. Model of the astrotourism phenomenon.

4. Results

The synergic combination of secondary and primary qualitative research resulted in the complex picture of astrotourism, which provides understanding the essence of this phenomenon as well as its various dimensions. The outputs of interviewing and questionnaire survey determined categories (concepts) of astrotourism as a result of the coding process (Table 1).

The axial and selective coding resulted in the final model of astrotourism as a new tourism phenomenon (Figure 3). The attractiveness of the universe and the objects inside it represents the central category (concept) of astrotourism, while others revolve around it. The latter include categories (concepts) linked to experience (empowering, sharing, specificity, cognitive and sensual aspects), astrotourist mentality (community and specificity), nature perceived as a part of the universe, astrotourism overlapping with other tourism forms, and last but not least, sustainability. These categories (concepts) are briefly characterised by describing their common features and variability of their meaning units. Variability is expressed by various dimensions and forms which the meaning units can take. As travelling to the sites with the best natural conditions for observing cosmic objects is the most popular astrotourism activity, the “darkness” category was classified as the basic intervening condition of the astrotourism realisation. Darkness seems to be the most

important astrotourism asset as the participants are ready to travel substantial distances to reach a really dark sky. However, the high motivation level and interest in astronomy and/or cosmology represents the key causal condition for astrotourism.

The baseline of the presented results is the output of the qualitative research on astrotourism background motivation, content and trends, which is then further analysed in interviews with long-term astrotourists who visited or planned to visit dark sky destinations. As an attraction in itself and a prerequisite to observation of space objects, the dark sky was the central motive of the interviews. The four selected observatories are compared by means of comparative analysis as places visited (in two cases also en masse) for astrotourism purposes.

Astrotourism is perceived as travelling to observe astronomical phenomena with a preference to travel into dark sky areas away from the effects of light pollution, for instance, into the mountains, deserts, or observatories. Surprisingly, astrotourism is not associated with space traveling. Typically, astrotourism is a hobby which has nothing to do with one's profession or level of education. There is a wide range of factors and motivations that make people engage in astrotourism. Among the most common ones are the possibility to observe the dark sky and a new knowledge of astronomy, astrophotography, unremarkable experiences, a sense of calm, freedom and joy. At the same time, unremarkable experiences, knowledge, a sense of joy and freedom are regarded as positives derived from the practice of astrotourism. In the context of tourism sustainability, there is fear that the mediation and promotion of astro destinations can cause progressive harm. Among the major problems related to astrotourism belongs bad weather, peculiar timetable and financial challenge, or uncomfortable transportation of heavy and expensive instruments like telescopes.

4.1. Relation of Astrotourism to Mass and Alternative Tourism

As illustrated in Figure 4, in accordance with the results of research by various authors and based on the authors' own research results, astrotourism belongs to the category of specific-interest (niche) tourism. At the same time, some astrotourism activities may take the form of professional, virtual or even mass tourism.

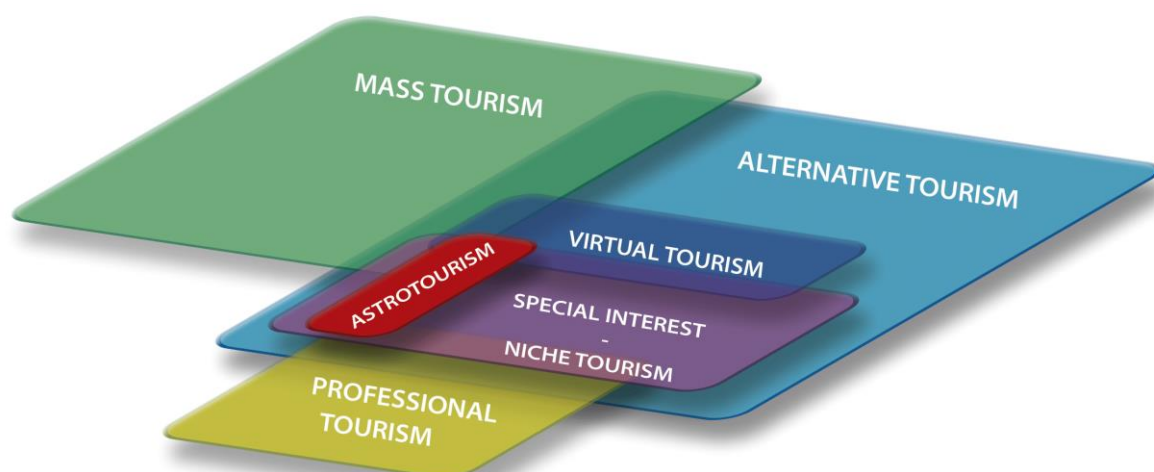


Figure 4. Position of astrotourism in relation to other forms of tourism. Source: Inspired by References [31,36–39], completed and specified on the basis of the authors' own research.

4.2. Astrotourism Activities and Astrotourism Mental Map

Astrotourism can be described as an activity that allows people to experience, and in some cases, even understand the surrounding universe, and its principles. It can bring the perception of one's position and movement in space, the "tininess" of man in the perspective of the entire universe, and transcendence of oneself as a terrestrial being.

The astrotourism experience is based on human admiration, imagination and respect for space phenomena and it allows one to enjoy the value and beauty of silence at night, in darkness with the sight of a clear sky full of stars (the dark sky is an attraction in itself, Reference [114]). The assertion that the dark sky attracts tourists as a virgin phenomenon has been endorsed. Furthermore, the dark sky, unspoilt by artificial light, represents the most important condition for the realization of astrotourism. Breakthrough inventions are associated with travelling to space, e.g., Apollo, International Space Station (ISS). On the other hand, however, beliefs and the entire culture of ancient civilizations are intrinsically connected to the universe and its dynamics.

Terrestrial astrotourism (or astronomic tourism) can be described as travelling with the intention to participate in the following activities [3,4,30,45,64,95]:

- amateur observation of astronomical phenomena,
- professionally supported amateur observation of astronomical phenomena (e.g., astronomical programs in Cabo de Gata-Níjar UNESCO Global Geopark),
- acquaintance with professional equipment for astronomical observations,
- presentation and visualization of cognition of space in planetariums,
- collection of meteorite fragments,
- visiting places with impact craters (e.g., the crater in the Ries UNESCO Global Geopark in Germany or the Barringer Crater in Arizona)
- search for artefacts of ancient astronomical and/or sacred places connected with ancient observation and rituals related to cosmic phenomena, based on (spi)ritual activities
- night tours offering experience of travelling controlled by indigenous knowledge (e.g., navigation practiced by the desert/sea nomads).

The mental map of astrotourism phenomenon (Figure 5) complements the verbal definition of astrotourism.

4.3. Dark Sky Destinations

An important condition for sought-after astrotour destinations is a sufficient distance from larger settlements and adequate accessibility. Therefore, they are typically found in desert areas (the Atacama Desert, Anza-Borrego Desert State Park, Antarctica), island destinations (e.g., the Canary Islands, Hawaii, the Maldives), large protected areas (especially national parks-e.g., Bryce Canyon NP, Grand Canyon NP, Snowdonia NP) or mountain areas (The Himalayas, The Altiplano of south Bolivia). The dark sky is protected informally, locally and nationally by declared parks and dark sky reserves. Increasingly, according to the rules of the International Dark-Sky Association, the following types are announced and certified [100]: International Dark Sky Reserves, International Dark Sky Parks, International Dark Sky Communities, International Dark Sky Sanctuaries, Urban Night Sky Places, and since 2020 a new category Dark Sky Friendly Developments of Distinction.

Examples of selected astrotour destinations as representatives of selected astronomical destination types and also observatories located in them are briefly described below, which, in addition to space research, are also open to astrotourists. The output of a comparative analysis of observatories follows.

Bryce Canyon National Park (USA) boasts one of the darkest skies in USA, it is certified as an International Dark Sky Park and it cooperates with the Salt Lake Astronomical Society. There are on offer well-developed astronomy programs for visitors during day and night (100 programs annually), including the Annual Astronomy Festival. 20,000 astrotourists visit Bryce Canyon NP annually, which represents 1% of the total number of visitors [115,116].

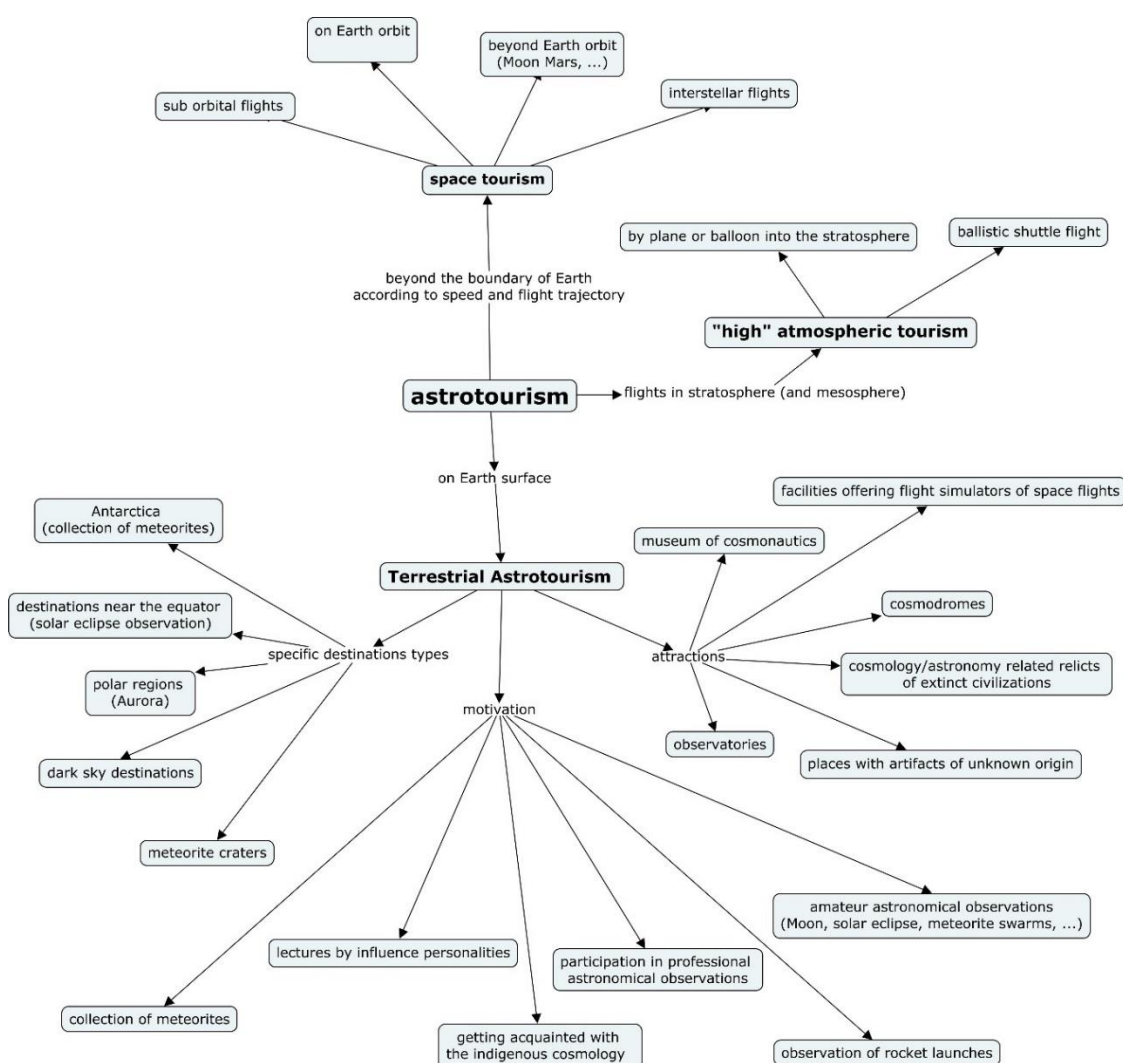


Figure 5. Mental map of astrotourism. Source: Inspired by References [3,4,30,31,45,64,95], completed and specified on the basis of the authors' own research.

The Atacama Desert in Chile is sought after by amateur and professional astronomers as the driest place in the world with minimal light pollution. The Southern European Astronomical Observatory (ESO) is also based here, with La Silla, Paranal and Chajnantor observatories offering tours of the observatory premises, expert lectures and special guided tours for school groups [18,112]. San Pedro de Atacama, as the largest public observatory in Chile, is the most sought-after destination. Programs here are oriented on popularization of astronomy among the general public, there are also individual or organized (Star tours) observations of the night sky, telescope rental is possible as well [117].

The Canary Islands have with their minimal light pollution ideal conditions for amateur astronomy, and astronomical observatories Teide Observatory on Tenerife and Roque de los Muchachos on La Palma forming the European Northern Observatory have been built here [17]. Moreover, special projects for the night sky protection have been implemented [17]. As it is a mass tourism destination, travel agencies or hotel resorts offer special programs to observe the starry sky and guided tours (especially for school groups) to observatories offering expert lectures, visitors can get acquainted with the equipment of observatories and use it [118].

4.4. Comparative Analyses of Observatories

Based on analyses of the web pages and social media of all four selected observatories (Observatory and Planetarium in Brno-Box 1, The Observatory del Teide-Box 2, La Silla Observatory-Box 3, Royal Observatory, Greenwich-Box 4) it was revealed that they share a common goal, which is to popularise astronomy and cosmology among the general public.

Box 1. Observatory and Planetarium in Brno, Czech Republic. Source: [110].

Brno Observatory and Planetarium was established in 1954. With its gradual technical development, modern concept and its programs connected with many top scientists, it has become an example of a centre for popularization of science at the highest level with a range of programs focusing on astronomy, astrophysics, astrobiology, and cosmonautics as well as lectures and presentations from other disciplines. Currently, for astronomic programs, the projection hemispherical area of the planetarium is equipped with stereoscopic projection with a resolution of up to 25 million pixels. There are only two other planetariums in Europe with the same equipment. Astronomy is popularized by means of expert lectures and astronomical programmes (2000 events a year), including the simulation of a flight into space, the experience of a science-fiction story, the knowledge of the secrets of the microworld, or an insight into the future of the Solar system and universe. Lectures are filmed and regularly posted on the YouTube channel's website [119].

Box 2. Teide Observatory, Tenerife, Canary Islands, Spain. Source: [113,118].

The Canary Islands are a highly attractive place for astrotourism thanks to its geographical location and clarity of the protected sky. Teide Observatory (Observatorio del Teide) is located 2390 m above sea level and it was established by the Instituto de Astrofísica de Canarias (IAC), similarly to the Observatorio Roque de los Muchachos. Both these observatories form the European Northern Observatory and wield tools and telescopes belonging to some sixty institutions from more than twenty countries. Teide Observatory's mission is to promote and implement astrophysical research, develop related technologies, disseminate astronomical knowledge, collaborate with universities and schools, train astrophysics personnel, manage observatories and their facilities, and promote relationships with national and international scientific communities. It is open to the lay and professional public during the year, in a paid scheme as well as in the form of open days. There are individual and group tours on offer, led by an expert lecturer/astronomer from the observatory, available on advance booking. Visitors learn basic information about the company's mission, can use local telescopes and it is explained to them what they are used for. Teide Observatory cooperates with the Instituto de Astrofísica de Canarias in spreading astronomical knowledge among the general public and school groups, using for these purposes a centre with a capacity of up to forty places.

Box 3. La Silla Observatory, Chile. Source: [18].

La Silla Scientific Astronomical Observatory, lies at an altitude of 2400 m in Chile's Atacama Desert, which is the driest place on the planet and boasts one of the darkest skies in the world. Therefore, it has become a popular destination for professional and amateur astrotourists. It is a part of the European Southern Observatory (ESO), together with Paranal Observatory and Llan de Chajnantor Observatory. It has brought an overwhelming number of scientific discoveries to the world and kept on the front line of astronomical research. The premises of the observatory are, as it is with other similar centres, open to the general public. Journalists, science columnists, producers, but also classical tourists and school collectives visit the observatory. Tours, which are free of charge, are guided by local expert guides on Saturdays. "ESO's main mission, laid down in the 1962 Convention, is to provide the state-of-the-art research facilities to astronomers and astrophysicists, allowing them to conduct front-line science in the best conditions" [18]. As a complementary activity there is an effort to popularize and generate interest in astronomy among both students and adults. The aim is to explain to people that the dark sky needs to be protected and not taken for granted.

Box 4. The Royal Observatory, Greenwich. Source: [95,111].

The Royal Observatory, Greenwich (London, UK) is specific for the Prime Meridian. It is probably the most significant representative of all observatories, whose professional astronomical observations have ended due to air pollution (including light pollution) and are now serving the visiting public. This observatory has the UNESCO World Heritage status and offers visitors night sky observation, astronomical-themed exhibits, including possibility to touch the real meteorite, to participate in astro events, planetarium shows, and astronomy courses.

As illustrated in Table 2, the selected observatories differ in type according to their mission, priorities, basic characteristics of the offer for visitors, types of visitors, and substantially in annual attendance. The main mission of both Teide Observatory and La Silla Observatory, as well as for other observatories active in international scientific research,

is to provide suitable working conditions for astronomers. They are therefore located in remote areas, away from people's homes and light pollution on mountaintops and in places with low humidity, since the drier the air, the better the conditions for observation. Conversely, the Royal Observatory, Greenwich, Brno Observatory and Planetarium and other commercial observatories and planetariums specializing mostly in expert programs for the local public and tourists, are situated in suburbs as well as city centres as easily accessible places with a good commuting distance. They also have two to three orders of magnitude higher attendance compared to observatories with international scientific research. All observatories are active on social media and Brno Observatory and Planetarium regularly places high-quality lectures from many scientific disciplines on YouTube.

Table 2. Comparative analyses of observatories. Source: References [18,110–113].

Observatory	Mission Priority	Basic Characteristics of the Offer for Visitors	Composition of Visitors	Social Media	Annual Attendance
Brno Observatory and Planetarium	To popularise astronomy and cosmology and other sciences	Expert lectures, digital demonstration of cosmic phenomena, exhibitions of astronomical-themed exhibits	Mostly general public, school groups, amateur astronomers	Website, Facebook, YouTube, Twitter	150,000 in 2019, general public
Teide Observatory	international astronomical research, protection of the night sky	Expert lectures about the observatory's mission and its equipment	Professional and amateur astronomers, scientists, school groups, general public	Website, Facebook, YouTube, Twitter, Instagram, LinkedIn, Flickr, Vimeo, Daily motion, blog	Almost 9000 in 2018; general public and astronomy experts as well
La Silla Observatory	international astronomical research	Expert lectures, exhibitions of astronomical-themed exhibits, exploration of some telescopes	Mostly professional astronomers, scientists, amateur astronomers, journalists, general public	Website, Facebook, YouTube *, Twitter Pinterest	4000 in 2019; general public and astronomy experts as well
Royal Observatory, Greenwich	To popularise astronomy and cosmology, space exploration	Two galleries—to see the royal astronomer's suites, The Octagon Room—to observe the sky, exhibitions of astronomical-themed exhibits, to touch the real meteorite, astronomy courses	Mostly general public, school groups	Website, Facebook, Instagram, Twitter, TripAdvisor	2.65 million (together with museum)

* in the frame of European Southern Observatory (ESO).

4.5. Contribution to the Astrotourism Conceptualisation

The achieved contribution to the conceptualisation of astrotourism is documented in the following areas (Table 3): core activities, external structure, internal structure and segment profile.

Table 3. Conceptualisation comparative analysis.

	State-Of-Art Concept	Proposed Concept
Core activities	Astrotourism is mostly perceived only as celestial tourism (observation of the night sky), sometimes associated with favourable conditions for observation (dark sky tourism), respectively observation of the night sky as part of mass tourism (naked-eye astronomy). Some authors determine it more broadly as terrestrial astrotourism, involving in addition to observation other activities, such as visits to ancient observatories.	A comprehensive approach to the concept of astrotourism has been introduced, including in addition to the observation of the night sky (celestial tourism, dark sky tourism, naked-eye astronomy) also other forms of terrestrial astrotourism and space tourism. The crucial conceptualisation storyline of astrotourism consists in including all forms of human acquaintance with the universe. These include observation, direct experience (various forms of space tourism), visits to space-related artefacts, such as impact craters, meteorite relicts, visits to past and present observation sites, exploration of sacred places and knowledge associated with indigenous cosmology, as well as visits to spacecraft and space shuttle launch sites.
External structure	Astrotourism is described mainly as a part of special-interest tourism (SIT)/niche tourism.	It was documented within the conceptualization process that astrotourism (not only within its broad definition, but also in its sub-forms such as naked-eye astronomy) can also take the form of mass tourism (solar eclipse tours, observation of rocket launches, visits to astronautics museums and certain observatories).
Internal structure	Due to its spectacularity, great attention is paid to space tourism.	Research results have shown that space tourism in its current form does not represent a very important motivation for an astrotourist (mainly because of its price). However, a more detailed analysis indicates several potentially interesting areas, such as stratosphere flights, aircraft weightlessness simulations, virtual reality simulators and probably stratospheric transport aircraft in the future.
Segment profile	Research on the profile of an astrotourist has not been carried out yet.	Qualitative research has defined the spectrum of activities of an astrotourist, his/her motivation, preferences, an extraordinary cohesion inside the astrotourist community, a strong connection between astrotourism and perception of nature, the main threat factors for celestial tourism.

The authors propose a comprehensive definition of astrotourism. Astrotourism represents a specific form of tourism focused on exploring and enjoying the universe with one's own senses by observing both night and day sky. It includes experiencing the manifestations of the Earth's contact with the surrounding universe, such as impact craters or aurora borealis, acquaintance with current and past observation techniques as well as with places of take-offs and flights into space and flights into the stratosphere, on the border of space and into space. In addition to this, astrotourism can take the form of temporal coexistence with indigenous peoples with the aim to reach some level of understanding the indigenous knowledge regarding the universe and cosmology as well as related sacred places. Current scientific knowledge also plays an important role in astrotourism activities, such as trips to planetariums. Astrotourism can be divided into space tourism and terrestrial astrotourism. The latter includes celestial tourism, dark sky tourism, naked-eye astronomy and other activities. Astrotourism includes forms of niche and mass tourism (Figure 4), a wide range of individual and an increasing number of organized activities (Figure 5 and Table 1). The model in Figure 3 brings a holistic picture of the complexity of astrotourism phenomenon. This model captures the cognitive, sociological, psychological, spiritual and environmental aspects of astrotourism and indicates its significant transcendence beyond the commercial approach to tourism.

5. Discussion

5.1. Observatories–Their Role

The wide range of programs for visitors, state-of-the-art equipment, expert lectures, high attendance and motivational role for astrotourists demonstrate the important role of observatories for the general public (e.g., the Royal Observatory, Greenwich and Brno Observatory and Planetarium). However, the analysis also further showed that world-class observatories such as Teide Observatory and La Silla Observatory, in addition to creating an adequate environment for astronomers, astrophysicists and other experts involved in a variety of astronomical investigations, also seek to widely popularize astronomy.

By offering a variety of products in the form of expert lectures, astronomy courses, or exhibitions of astronomical-themed exhibits, all the observatories examined seek to ignite people's interest in astronomy and persuade them to take up astrotourism and make them understand that a sky full of stars is now more precious than gold.

5.2. Astrotourism Sustainability

The research revealed that regarding astrotourism sustainability matters, the emergence and high increase of light pollution represents a serious threat for astrotourism as the core astrotourism activity is the observation of cosmic objects in the night sky. However, the massive astrotourism development is perceived as potentially dangerous by astrotourists themselves. The astrotourists also recognize the strong interconnection between nature and the universe as another powerful sustainability aspect. They regard space pollution by artificial objects and cosmic waste as unsustainable. Observatory staff [120] agree with the view that high levels of light pollution should make people recognize the need to preserve the last places on the planet suitable for observing astronomical phenomena.

Due to the consumption of chemical fuel, space tourism at the current stage of technological development (with the exception of virtual astrotourism) has significant impacts on not only the consumption of non-renewable resources (Figure 6), but also on environmental pollution and contributes to global warming [121]. In this context, the proposed conceptual planning of sustainable space tourism [122] is very difficult and so far, unrealistic.

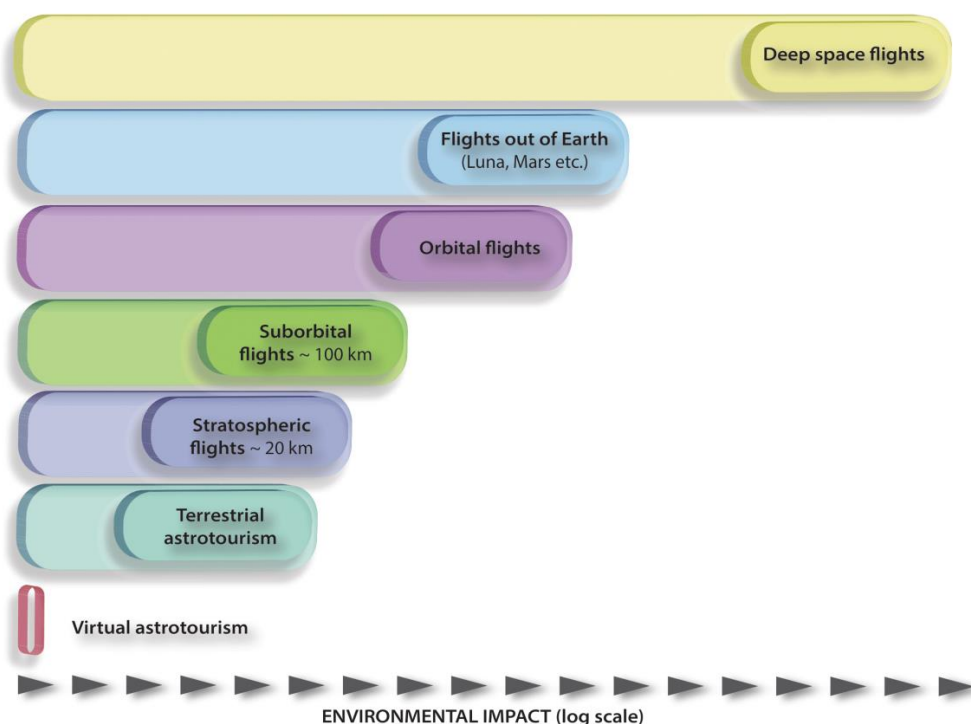


Figure 6. The degree of unsustainability of various forms of astrotourism. Source: Own processing, based on References [123,124].

As Figure 6 schematically suggests, terrestrial astrotourism, when it includes flights to distant destinations (e.g., observations of total solar eclipses), is characterized by environmental impacts, although significantly lower than suborbital and orbital flights. Conversely, the effects of terrestrial astrotourism at the observation site can be compared to ecotourism [65]. Similarly, astrotourism brings considerable benefits, including the spread of positive experiences, knowledge and awareness of the need to protect the environment (typically promoting approaches that reduce light pollution).

6. Conclusions

The results enhance the understanding of astrotourism essence, with a focus on the specificity of astrotourism and astrotourists. The typical astrotourism activities are amateur and/or professionally supported observations of astronomical phenomena realized, e.g., in the frame of celestial ecotourism [65] and/or dark sky tourism [64]; presentation and visualization of cognition of space in planetariums and visiting museums of space. The main phenomena that interest astrotourists motivated mainly by observing the dark sky and its cosmic objects include solar eclipse, starry sky (stars, comets, planets), Aurora, meteorite swarms, and the Moon as the object of observation and at the same time as a source of light background). Among the favourite astrotourism destinations are the Atacama Desert and sites in the surrounding Andean region of Chile, Peru and Bolivia [117], the Canary Islands [42,118], the Hawaiian Islands, Colorado Plateau [99], cosmodromes [81–86] and “Aurora destinations” (Scandinavia, Iceland, Canada, Alaska; [64]). In addition to these destinations with top conditions for astronomical observations, the astrotourism activities are developed in many other destinations with appropriate conditions for observation—in mountainous areas [49,124], in rural areas [42,44–48] and on other islands [35,43]. To conclude, astrotourism is not just a promising tourism niche emerging in the tourism market, but it also represents substantial potential for environmental education, nature and space protection. It makes people think of the universe as a part of nature and vice versa. For example, astrotourists view light pollution as not only something that disturbs their astrotourism experience, but also as a serious problem for sound functioning of the ecosystems of the planet Earth.

The public media pay special attention to space tourism, including descriptions of new technologies, approaches, and concepts (e.g., References [25,50]). If the development of supersonic aircraft flying in the stratosphere were successfully completed (e.g., Reference [125]), it would lead to an experiential connection between tourism and space tourism.

The astrotourism research is in its initial phase. There are therefore diverse possibilities for its progress. Regarding this particular qualitative research, it would be useful to go deeper if the Covid pandemic situation allows, by employing both the participatory observation and focus group discussions.

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Appendix A

Materials for Guided Interviews with Astronomers/Astrotourists.

1. Explain to the informant what the research is about and how astrotourism was defined for the purposes of the research.
2. Find out which activities belonging to astrotourism the informant wants to do, or whether he misses something in the initial list of activities linked to astrotourism.
3. Discuss the individual activities the informant labels in the interview as belonging to astrotourism. Make him or her say where and how each of them is realized.
4. When and especially why did he or she start doing these activities? What has motivated him or her to do them up to this day? (family, friends, colleagues, books, night sky view, movies, documents, story/fate of celebrities).
5. What is his or her deepest experience of astrotourism and why?
6. What is his or her greatest desire/challenge/goal in terms of experience in astrotourism in the future? What is he or she afraid of and why?
7. Does he have a personal role model in astrotourism? If so, why this person?
8. How important is it for him to share his experiences? With whom and in what ways? Is it part of his or her experience on the spot and after the return home (social networks)? What is the importance of passing on knowledge and feelings?
9. Does he or she feel there are any values common to all (interested) astrotourists? Which values are they and why?
10. Does the informant feel that astrotourism is something specific and unique compared to other forms of tourism?
11. What is his or her opinion and relation to dark sky parks?
12. Which persons does he or she consider to be the leading/important personalities of astrotourism?

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