Hobe

Space Law

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by

Stephan Hobe

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To the memory of my parents

Foreword

Why another book on space law? This is a very legitimate question. There are many good books on the market, which range from a depiction of space law from the early days of space-law making to the present day. This book represents an attempt to portray space law in a handy form and to provide the reader with the essential tools to understand the legal framework of human activities in outer space. With this, it is hoped that this work will complement the other treatises on space law in a welcome way.

Born out of the experience of my teaching in Beijing, Beirut, Cologne, Gujarat, Dhaka, Paris, Pretoria, Sofia, Vienna and Warsaw where I am regularly engaged, I thought it may be useful to draft something based on the relevant technological and scientific background of space law and to describe the history of space law and its central concepts in a concise way. In doing so, emphasis was given to describing the general legal picture in as complete a way as possible rather than following each argument of the discussion in full depth. The entire book thus is an attempt to highlight the "grand dessin" of the legal framework for human activities in outer space.

The endeavor to write a book of this caliber requires helping hands. First and foremost, I would like to thank my assistant Ms Rada Popova who, with her in-depth knowledge and extreme dedication as well as her enthusiasm, was very helpful in the process of writing and completing this book from the beginning. Regarding the technical part, namely the astrophysical details, Dr. Christian Fromm, University of Frankfurt, has conducted the necessary checks, which I gratefully acknowledge. Finally my secretary, Ms Daniela Scholz, has typed up the entire manuscript with her usual diligence. Student assistants Ms Hanna Keller, Mr Jonathan Badstieber, Mr Niklas Kaupert, Ms Lara Gräwe, Mr Michel Küppers, Ms Lisa Schöttmer and Mr Julian Zaschke also assisted in proofreading the text. It is, however, important to mention that I alone take full responsibility for any flaws and inaccuracies.

The book is dedicated to the memory of my parents who with their love laid the basis for everything. Unfortunately, I cannot undertake the promised trip to the Moon hotel with them anymore.

Critical and constructive comments can be directed to Stephan Hobe, Institute of Air Law, Space Law, and Cyber Law, University of Cologne, Albertus-Magnus-Platz, 50923 Köln, stephan.hobe@uni-koeln.de.

Cologne, February 2019 Stephan Hobe

Contents

Foreword VII
Literature XV
List of abbreviations XVII
Table of figures XXI

CHAPTER 1
SOME ASTROPHYSICAL AND MECHANICAL FACTS:
5 MINUTES PHYSICS AND MECHANICS

I. Outer space, the universe and what man can regulate 1
1. The universe — it is incomprehensively big 1
2. Our Earth space environment — the Sun and its planets 3
3. Space medicine 3
4. What can we learn from this?
(outer space as an environment adverse to humans) 5
II. How to go to outer space (orbital mechanics) 5
1. Orbital mechanics 5
2. Problems by leaving the Earth 7
3. Launching a rocket into outer space 7
4. Launchers 10
5. Reusable launch vehicles 11
6. Spaceports 11
III. Outer space in the legal sense — an attempt of a definition 12
1. Where does outer space begin? 13
2. The grey area: mesospace 14
3. Outer space — a proposal for a definition 15

CHAPTER 2
CONCRETE APPLICATIONS

I. Space transportation/launchers 17
II. Satellites 19
1. Broadcasting by satellites/satellite communications 20
2. Navigation satellites 20
3. Remote sensing by satellites 22
4. Small satellites and CubeSats 23
III. Space stations 24
IV. Space tourism 26
V. Unmanned spacecraft 26

CHAPTER 3
HISTORY OF SPACEFLIGHT

I. Before 1957 29
II. After 1957 32

CHAPTER 4
HISTORY OF SPACE LAW

I. Early writings 40
II. Space law making in UNCOPUOS 41
III. The three phases of space law making 42
IV. Space law making outside the United Nations 45
1. Conference on Disarmament 45
2. UNIDROIT Space Assets Protocol 46
3. Space Debris Mitigation Guidelines 46
4. National space legislation 47
V. Other normative sources of space law 47
VI. The characteristics of space law 47
VII. The history of space law in a contemporary perspective 49

CHAPTER 5
SPACE LAW AS SELF-CONTAINED REGIME OR PART OF PUBLIC INTERNATIONAL LAW (ARTICLE III OST)?

I. Self-contained regimes and international law 51
II. Space law as *lex specialis* to general international law 53

CHAPTER 6
SOURCES OF SPACE LAW

I. The first phase of space law making (until 1979) 58
1. The Outer Space Treaty of 1967 (107 ratifications as at 1.1.2019) 58
a) The freedoms of outer space 59
b) Legal status of outer space 59
c) Applicability of general international law 59
d) Peaceful uses of outer space 59
e) Article V OST 59
f) Article VI OST 59
g) Article VII OST 60
h) Article VIII OST 60
i) Article IX OST 60
2. The Rescue Agreement of 1968 (96 ratifications as at 1.1.2019) 61
3. The Liability Convention of 1972 (95 ratifications as at 1.1.2019) 61
4. The Registration Convention of 1975 (68 ratifications as at 1.1.2019) 62
5. The Moon Agreement of 1979 (18 ratifications as at 1.1.2019) 62
II. The second phase of space law making: UN GA Resolutions on particular human activities in outer space (1982–1996) 62
1. UN GA Resolution on Direct Broadcasting by Satellites 62
2. UN GA Resolution on Remote Sensing by Satellites 63
3. UN GA Resolution on Nuclear Power Satellites 63
III. The third phase of space law making: UN GA Resolutions as means of interpretation of existing principles/concepts entailed in the treaties on space law (1996–2013 and ongoing) 63
1. The Space Benefits Declaration of 1996 63
2. UN GA Resolution on the "Launching State" 64
3. UN GA Resolution on Registration Practice 65
4. UN GA Resolution on National Space Legislation 65
5. The UNCOPUOS Space Debris Mitigation Guidelines of 2007 66

6. The Space Assets Protocol of March 2012 to the 1999 Cape Town Convention 67
7. Other documents with relevance for normative regulation 67

CHAPTER 7
MAIN LEGAL CONCEPTS OF SPACE LEGISLATION

I. The Non-Appropriation Principle (Article II OST) 69
II. The Freedom of Exploration and Use (Article I, para 2 OST) 74
III. The Freedom of Scientific Investigation (Article I, para 3 OST) 75
IV. The Principle of the Peaceful Uses of Outer Space (Article IV OST) 76
V. The Principle of Astronauts as Envoys of Mankind/Astronauts in Distress (Article V OST and the 1968 Rescue Agreement) 77
VI. Activities of Non-Governmental Entities (Article VI OST and UN GA Resolution 68/74 on National Space Legislation) 78
VII. The Principle of Liability for Space Activities (Article VII OST and the Liability Convention and UN GA Resolution 59/115 on the "Launching State") 79
1. International liability 82
2. Ultrahazardous activities 82
VIII. The Principle of Registration (Article VIII OST, the Registration Convention and Resolution 62/101 on Registration Practice) 85
IX. The Principle of Jurisdiction and Control (Article VIII OST) 87
X. Environmental Protection of Outer Space (Article IX OST) 88
Annex:
On-orbit transfer: A legal challenge for the existing main legal concepts of space legislation 90

CHAPTER 8
SPECIFIC LEGAL REGIMES

I. The legal regime for commercial uses of outer space 93
1. General aspects 93
2. Examples 96
3. The legal regime contained in the Moon Agreement of 1979 97
II. Military activities in outer space — the principle of peaceful uses as contained in Article IV OST 100
1. Use of military systems in outer space 100
2. The legal regime for the military uses of outer space 103
3. Other relevant instruments 106
III. The legal regime of environmental protection in outer space 107
1. An overview on the sources 107
2. The use of nuclear power sources 109
3. The problem of space debris 111
IV. Trade and finance aspects of space activities 118
1. International trade aspects of space activities 119
2. Legal mechanisms for facilitating the financing of space activities 121
3. Satellite applications and investment law 123

CHAPTER 9
NATIONAL SPACE LEGISLATION

I. Article VI, para 1, sentence 2 OST and UN GA Resolution 68/74 of 2013 as the legal basis for national legislation 127
II. Examples for national space laws 130
1. France 131
2. Russia 132
3. USA 132
III. Possible model legislation 133
1. The ILA model law of 2012 133
Annex:
The ILA Model Law as adopted by the Biannual ILA Conference 2012 in Sofia 134
2. UN GA Resolution 68/74 on National Legislation 142

CHAPTER 10
LEGAL REGULATION FOR SPECIFIC SPACE APPLICATIONS

I. Satellites 143
1. Direct broadcasting by satellites 143
a) The allocation of frequencies by the ITU 143
b) The legal regime for direct broadcasting by satellites 147
2. Remote sensing by satellites 149
3. The use of nuclear power sources on board satellites 153
4. Navigation satellite systems (GPS, GALILEO, GLONASS, BEIDOU) 154
a) Organizational structure of the different GNSS systems 155
b) The Global Navigation Satellite System (GLONASS) 156
c) GALILEO 156
d) The Chinese BeiDou-2 System 157
5. Other navigation systems 157
6. Some liability issues 158
II. The legal regime for the recovery of resources from celestial bodies 158
1. Current development 158
2. The basic legal order for recovery of the resources from celestial bodies 159
3. National initiatives 164
a) USA 164
b) Luxembourg 164
c) Assessment 165
4. The Solution: Creation of an International Legal Order 165
III. Space tourism/non-orbital flights 166
IV. The use of the International Space Station 169
1. The Beginnings 169
2. Legal basis 170
3. Legal elements of cooperation in outer space 170
a) Jurisdiction, control and property rights 170
b) User regime 171
c) Intellectual property 171
d) Crew: obligations and responsibilities 171
e) Criminal jurisdiction 172
f) Liability 172
4. Assessment and perspectives 172

V. Launching services 173
1. National launch acts 173
2. Launch service agreements 174
a) Cross-waivers of liability 175
b) Best efforts clauses 176
c) Insurance clauses 176
VI. Spaceports 177
1. Factual background and examples 177
2. Legal regulation for spaceports 178

CHAPTER 11
INTERNATIONAL AND REGIONAL INSTITUTIONALIZED COOPERATION IN HUMAN ACTIVITIES IN OUTER SPACE

I. The United Nations 181
II. The International Telecommunication Union (ITU) 183
III. The World Trade Organization (WTO) 187
IV. The International Institute for the Unification of Private Law (UNIDROIT) 188
V. Intelsat/Inmarsat/Eutelsat/Intersputnik/Arabsat 188
VI. The European Space Agency (ESA) 191
VII. The World Intellectual Property Organization (WIPO)/the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) 193
VIII. Arianespace, Airbus and (ex-)Spot Image 194
IX. Non-governmental organizations with relevance for space law making 195
1. The International Institute of Space Law (IISL) 195
2. The International Law Association (ILA) 195
3. The European Centre for Space Law (ECSL) 195

CHAPTER 12
SETTLEMENT OF DISPUTES

I. Dispute settlement as the ultimate goal for the regulation of conflicts 197
II. Dispute settlement mechanisms in space law 198
1. The Cosmos 954 Case of 1978 199
2. Provisions in the treaties on space law relevant for dispute settlement 202
3. Other instruments 203
III. Conclusion 207

CHAPTER 13
PERSPECTIVES

I. Uncertainty about the legal sources — a basis for the future? 209
II. Increasing commercialization — a change of the (legal) perspective — of space legislation? 212
III. From space tourism to space transportation as an upcoming activity 213
IV. Guaranteeing a clean environment for the future — the problem of space debris remediation 214
V. Space traffic management as the main challenge of the immediate future 216
VI. Cyber law 218
VII. Exploration of the universe and space colonization 220

UNITED NATIONS TREATIES ON OUTER SPACE

A. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies 225
B. Agreement on the Rescue of Astronauts, the Return of Astronauts and Return of Objects Launched into Outer Space 231
C. Convention on International Liability for Damage Caused by Space Objects 235
D. Convention on Registration of Objects Launched into Outer Space 243
E. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies 248
F. United Nations treaties depositary information 256

Index 257

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The following list encompasses the literature that serves at giving a comprehensive description of the development of space law.

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Space Policy (since 1985), published by Elsevier.

Yearbook on Space Policy (since 2008), edited by the European Space Policy Institute and published by Springer.

List of abbreviations

ACAS	Airborne Collision Avoidance System
Art.	Article
ASAT	Anti-Satellite Weapons
BITs	Bilateral investment treaties
CFR	Code of National Regulations
CJEU	Court of Justice of the European Union
CNES	Centre National d'Ètudes Spatiales
CoD	Conference on Disarmament
DLR	German Aerospace Centre
Doc.	Document
DSB	Dispute Settlement Body
e.g.	for example
EAC	European Astronaut Centre
EASA	European Aviation Safety Agency
ECHR	European Court of Human Rights
ECSL	European Centre for Space Law
ed./eds.	Editor/editors
edn	Edition
ELDO	European Launch Development Organization
ENMOD	Environmental Modification Convention of 1976
ESA	European Space Agency
ESAC	European Space Astronomy Centre
ESCAT	European Centre for Space Applications and Telecommunications
ESOC	European Space Operations Centre
ESRIN	European Space Research Institute
ESRO	European Space Research Organisation
ESTEC	European Space Research and Technology Centre
etc.	*et cetera*
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUTELSAT	European Telecommunications Satellite Organization
FAA	Federal Aviation Administration
ff.	the following pages
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GEO	Geostationary orbit
GGE	Group of Governmental Experts
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HAPS	High Altitude Pseudo Satellites
IAA	International Academy for Astronautics
IADC	Inter-Agency Space Debris Coordination Committee

List of abbreviations

Ibid.	*Ibidem*
ICBM	Intercontinental Ballistic Missiles
ICAO	International Civil Aviation Organization
ICC	International Criminal Court
ICJ	International Court of Justice
ICTY	International Criminal Tribunal for Yugoslavia
IGA	Intergovernmental Agreement
IISL	International Institute of Space Law
ILA	International Law Association
ILC	International Law Commission
IMO	International Maritime Organization
IMSO	International Mobile Satellite Organization
IRBM	Intermediate-range ballistic missiles
ISS	International Space Station
ITLOS	International Tribunal for the Law of the Sea
ITSO	International Telecommunications Satellite Organization
ITU	International Telecommunications Union
JAXA	Japan Aerospace Exploration Agency
LEO	Low Earth orbit
lit.	*litera*
MEO	Medium Earth orbit
mn	Marginal number
MRBMs	Medium-range ballistic missiles
no.	number
NASA	National Aeronautics and Space Administration
NPS	Nuclear power sources
OST	Outer Space Treaty
para	paragraph
PAROS	Proposed Prevention of an Arms Race in Space
PCA	Permanent Court of Arbitration
PCIJ	Permanent Court of International Justice
PNTBT	Partial Nuclear Test Ban Treaty
p./pp.	page/pages
Rep.	Report
Res.	Resolution
ROSCOSMOS	Roscosmos State Corporation for Space Activities
SDR	Special Drawing Rights
SETI	Search for Extraterrestrial Intelligence
SRBMs	Short-range ballistic missiles
SSA	Space Situational Awareness
STM	Space Traffic Management
UK	United Kingdom
UN	United Nations
UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNCLOS	United Nations Convention on the Law of the Sea
UNGA	United Nations General Assembly

UNIDROIT	International Institute for the Unification of Private Law
UNOOSA	United Nations Office for Outer Space Affairs
USA	United States of America
USSR	Union of Soviet Socialist Republics
VCLT	Vienna Convention on the Law of Treaties
WIPO	World Intellectual Property Organization
WRC	World Radiocommunication Conference
WTO	World Trade Organization

Table of figures

Chapter 1

The Solar system:
https://en.wikipedia.org/wiki/Solar_System#/media/File:Planets2013.svg

Ground tracks for different satellite orbits: by kind permission of Dr. Christian Fromm

The main elements of a launcher: Kalina Hristova

ESA Vega rocket:
https://de.wikipedia.org/wiki/Vega_(Rakete)#/media/File:Sentinel-2_and_vega.jpg

ESA Ariane 5 rocket:
https://de.wikipedia.org/wiki/Ariane_5#/media/File:Ariane_5ES_with_ATV_4_on_its_way_to_ELA-3.jpg

Sojuz rocket:
https://de.wikipedia.org/wiki/Datei:Sojuz_TMA-9_into_flight.jpg#file

Launch sites (active and historic ones): by kind permission of Dr. Christian Fromm

Chapter 2

The V-2 rocket:
https://en.wikipedia.org/wiki/V-2_rocket#/media/File:Fus%C3%A9e_V2.jpg

Space Shuttle Challenger:
https://no.wikipedia.org/wiki/Fil:STS-51-L_-_Space_Shuttle_Challenger_on_the_Crawler-Transporter.jpg

Falcon 9:
https://de.wikipedia.org/wiki/Falcon_9#/media/File:Iridium-1_Launch_(32312419215).jpg

Exemplary earth observation satellite: Kalina Hristova

Navigation satellite constellation (averagely with approx. 24-30 satellites): Kalina Hristova

International Space Station: Kalina Hristova

Skylab space station:
https://de.wikipedia.org/wiki/Skylab#/media/File:Skylab_(SL-4).jpg

The MIR space station:
https://en.wikipedia.org/wiki/Mir#/media/File:Mir_Space_Station_viewed_from_Endeavour_during_STS-89.jpg

Chapter 3

Hermann Oberth:
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https://de.wikipedia.org/wiki/Robert_Goddard#/media/File:Dr._Robert_H._Goddard_-_GPN-2002-000131.jpg

Table of figures

Wernher von Braun:
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Schematic of a V2-A4 rocket:
https://commons.wikimedia.org/wiki/File:V-2_rocket_diagram_(with_English_labels).svg

V2 rocket launched from Peenemünde:
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Soviet engineer Sergei Korolev with the first satellite Sputnik 1 in 1957:
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Juri Gagarin:
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Neil Armstrong on the Moon working at the Apollo 11 lunar module "Eagle" on July 20, 1969, photographed by Buzz Aldrin:
https://de.wikipedia.org/wiki/Apollo_11#/media/File:Apollo11-Aldrin-Ausstieg.jpg

Edwin E. 'Buzz' Aldrin on the surface of the Moon during the Apollo 11 extravehicular activity (EVA) photographed by astronaut Neil Armstrong whose reflection can be seen in the reflection on Aldrin's helmet:
https://de.wikipedia.org/wiki/Buzz_Aldrin#/media/File:Aldrin_Apollo_11.jpg

Skylab 4 during its last mission in 1979:
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The Space Shuttle fleet: Columbia, Challenger, Discovery, Atlantis, Endeavour:
https://en.wikipedia.org/wiki/Space_Shuttle_orbiter#/media/File:Shuttle_profiles.jpg

The International Space Station:
https://en.wikipedia.org/wiki/International_Space_Station#/media/File:International_Space_Station_after_undocking_of_STS-132.jpg

SpaceShipOne and WhiteKnight One in flight, 2004:
https://de.wikipedia.org/wiki/SpaceShipOne#/media/File:SpaceShipOne_Final_Flight_Sept_2004_photo_D_Ramey_Logan_(cropped).jpg

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https://de.wikipedia.org/wiki/SpaceShipTwo#/media/File:White_Knight_Two_and_SpaceShipTwo_from_directly_below.jpg

Chapter 4

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The UN Headquarters in Vienna, Austria, where the sessions of UNCOPUOS and its two committees are taking place annually:
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Chapter 8

Three stage Intercontinental ballistic missile (ICBM): Kalina Hristova

Parabolic trajectory of an ICBM: Kalina Hristova

The UN Headquarters in Vienna, Austria, where the sessions of UNCOPUOS and its two committees are taking place annually: https://en.wikipedia.org/wiki/United_Nations_Office_at_Vienna#/media/File:Vienna_International_Centre.jpg

Chapter 10

The mechanism of remote sensing: Kalina Hristova

An exemplary satellite navigation system: Kalina Hristova

Launch sites (active and historic ones): by kind permission of Dr. Christian Fromm

Chapter 11

Overview: Rada Popova

Overview: Rada Popova

Overview: Rada Popova

Chapter 12

PCA Rules: Rada Popova

"To confine our attention to terrestrial matters would be to limit the human spirit."

Steven Hawking

CHAPTER 1
SOME ASTROPHYSICAL AND MECHANICAL FACTS: 5 MINUTES PHYSICS AND MECHANICS

This chapter will provide a short background of the technical nature of space-related activities as a prerequisite for understanding the need for and the relevance of their legal regulation. As it is impossible to impose rules applying to the whole universe, it is necessary to delimit the scope of application of legal rules and confine them to the space which mankind can use and explore — currently, the solar system.

I. Outer space, the universe and what man can regulate

1. The universe — it is incomprehensively big

It is unavoidable for any person who wants to responsively occupy him or herself with space law to learn something about the basic astrophysical facts on the functioning of outer space.

Whereby it is clear that space legislation refers to human activities in outer space, it is interesting to see that nowhere in space legislation a definition of outer space has been provided.

The problem will be approached by just giving a basic idea of the meaning of the notion "outer space". It is important to understand that a possible meaning of this notion could be the universe. So far relatively little is known about the universe as such. If one leaves the Earth and its atmosphere, one would arguably reach outer space. Here, already the first problem becomes clear: there is no physical border between airspace and outer space. Moreover, it is neither legally, nor scientifically determined where outer space starts. If one takes the altitude where an object would remain in orbit without directly being dragged back by the gravitational force of the Earth, this would approximately be at an altitude of about 130 kilometers above Earth's surface. At the same time, about 80–84 km is the maximum altitude where enough air density is available to sustain an airplane in linear flight.

Thus, it is currently estimated that in an altitude between 80 and 130 kilometers above the Earth's surface the atmosphere ends and outer space begins. However, it must also be taken into account that these altitudes may vary depending on the development of flight technology — modern airplanes might sustain higher speed and higher altitude and even be constructed as aerospace

objects which can use both airlift and engine thrust for their motion and thus be operable in layers of or above the atmosphere which are not relevant for air flight.

In order to comprehend the dimensions which one is confronted with when observing the universe, the measure of a light year (ly) is used. It describes the distance within the universe and the solar system. One light year is the distance light can travel in one year at 300,000 kilometers/second. Conveyed as a formula, it looks like this:

$$\text{ly} = \text{c.t. } 9.46 \times 10^{15}\text{m}$$

Using this measure, a dimensional description of the location of the Sun and the solar system becomes possible. Our Sun is only one of 100 million or even more stars in the Milky Way galaxy and with its solar system, it is about 28,000 light years distant from the galaxy center. The solar system lies within one of the spiral arms of the Milky Way which slowly revolves around its galaxy's center. The time it would take the Sun to revolve around the center of the galaxy once (about 230 million years), is sometimes called a galactic or a cosmic year. In these dimensions, the Milky Way is about 13.2 billion years old, our solar system is about 5 billion years old and the Earth is approximately 4.6 billion years old.

In order to give some comparative ideas of dimensions, it is important to know that the size of the Milky Way is estimated to be 120,000 ly across (from edge to edge), that the largest distance which a man-made object has travelled is 0.002 ly, that so far around 50 billion planets are estimated to be in our Milky Way, of which 2341 have been already detected.[1]

Overview of the scales in the universe

- The observed universe is estimated to be 78 giga-ly.
- The Milky Way is estimated to be 120 kilo-ly in size.
- The solar system is 1.5 ly across.
- Largest distance a human-made object travelled: 0.002 ly.
- Estimate of the number of planets in inhabitable zone: 50 mio.
- 5 % of the universe consists of baryonic matter; the remaining 95 % are 'dark matter'.

[1] Available online: https://www.nasa.gov/kepler/discoveries (last accessed 9 January 2019).