Journal of Astrobiology and Outreach

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Dr. Jean Schneider

Biography

- He is a Promoter of the exoplanet search with the CNES satellite CoRoT (1990-93) Co-discoverer of CoRoT-7 b, the first super-Earth with measured radius.
- Co-proposer of the Darwin proposal (ESA) PI of the Super-Earth Explorer (SEE-COAST) proposal (ESA).
- He has developed various aspects of the characterization of exoplanets: spectroscopy of transits (1993), search for satellites (1999), search for rings (2004), search for additional planets by timing of transits (2002).
- Has developed a new method to detect exo-moons by direct imaging (2007).
- He has introduced the concept of “cometary tails” of exoplanets (1998). He is editor of the website exoplanet.eu.

Research Interests

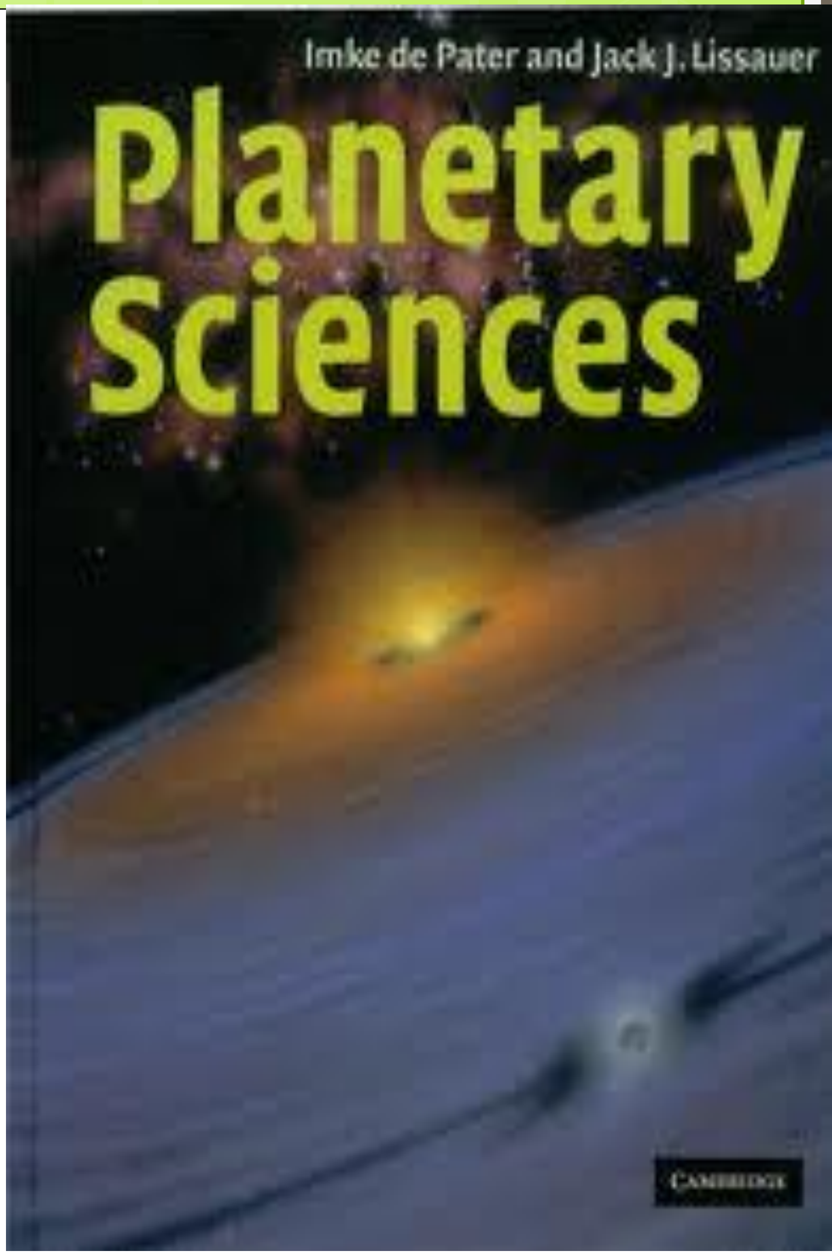
- Philosophical Aspects of Astrobiology
- Planetary Protection
- Planetary Atmosphere

Recent Publications

Origin and formation of planetary systems; Alibert, Y.; Broeg, C.; Benz, W.Schneider Jean; (2010. Astrobiology, 10(1), pp. 19–32.

SPICES: Spectro-Polarimetric Imaging and Characterization of Exo-planetary Systems

Time, Quantum Mechanics and the Mind/Body Problem


Imke de Pater and Jack J. Lissauer
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Planetary Atmospheres

"For the first time in my life, I saw the horizon as a curved line. It was accentuated by a thin seam of dark blue light – our atmosphere. Obviously this was not the ocean of air I had been told it was so many times in my life. I was terrified by its fragile appearance."

Ulf Merbold (1941 –)
German Astronaut

The Planets

- There are 8 planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune (mercury nearest and Pluto farthest from the Sun) that revolve around Sun in their specific orbits, which lie more or less in the Sun's equatorial plane.
- There are moons or natural satellites, which revolve around planets.
- It is natural to think that planetary bodies have evolved from the Sun and the moons from their central bodies. However earth's moon has been found to be older than earth and has its own history of evolution.
- The biggest planet Jupiter is more akin to Sun than to other planets. In fact Mercury, Venus and Mars show surface features similar to our moon.
- The planets can be divided into two categories.
- The inner planets: Mercury, Venus, Earth, Mars which have densities of the order of 5 or more and sizes comparable to that of earth.

- **The outer planets (Jupiter, Saturn, Uranus, Neptune) quite large in size and have low densities ≈ 1.5 (Jupiter like hence called Jovian planets).**
- **In our planetary system there are bodies which have little or no atmosphere and magnetic field (Moon, Mercury)**
- **bodies which have substantial atmospheres but very little or no magnetic field (Venus and Mars) and bodies having both atmosphere and intrinsic magnetic field (Earth, Jupiter)**
- **The solar flux expected at the orbit of planet outside its atmosphere, its albedo (measure of the reflectance of the surface) and effective computed temperature T_{eff} are listed in Table 3.**
- **Actual temperature would depend on the presence or absence of atmosphere, sunlit or dark condition etc. For earth the actual temperature 288 K is warmer than the effective temperature.**

Table 1: Planetary Data

Planet	Mean radius km	Mean density $gmcm^3$	Average distance from Sun AU	Length of year- days	Rotation period- days	Inclination degree
Mercury	2439	5.42	0.39	88	58.7	<28
Venus	6050	5.25	0.72	225	-243	<3
Earth	6371	5.51	1.00	365	1.00	23.5
Mars	3390	3.96	1.52	687	1.03	25
Jupiter	69500	1.35	5.2	4330	0.41	3.1
Saturn	58100	0.69	9.5	10800	0.43	26.7
Uranus	24500	1.44	20	30700	-0.89	98.0
Neptune	24600	1.65	30	60200	0.53	28.8

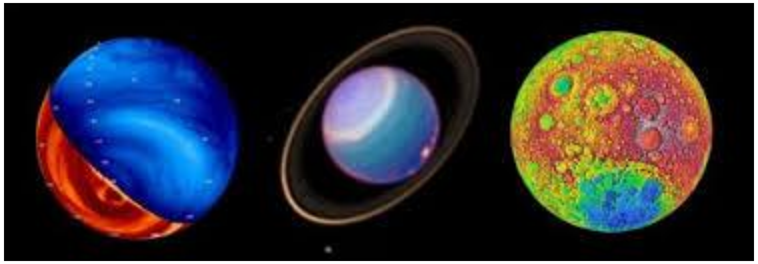


Table 2: Other planetary parameters

Planet	Area Earth=1	Mass Earth =1	Gravity Earth =1	Escape Vel. m/s	Atmosphere
Mercury	0.15	0.05	0.37	4.3	Trace?
Venus	0.9	0.81	0.89	10.4	CO_2 (96%) +N_2 (3.5%) + SO_2 (130 ppm)
Earth	1.0	1.0	1.0	11.2	N_2 (78%) + O_2 (21%) +Ar (.9%)
Mars	0.3	0.11	0.39	5.1	CO_2 (95%) + N_2 (2.7%)
Jupiter	120	318	2.65	60.0	H_2 (86%), H_e (14%), CH_4 (0.2%)
Saturn	85	95	1.65	36.0	H_2 (97%), H_e (3%), CH_4 (0.2%)
Uranus	14	14	1.0	22.0	H_2 (83%), H_e (15%), CH_4 (2%)
Neptune	12	17	1.5	22.0	H_2 (79%), H_e (18%), CH_4 (3%)

Table 3: Effective temperature of planets

Planet	Solar flux 10^{16} erg/cm^2/s	Albedo	T_{eff} (^{o} K)
Mercury	9.2	0.06	442
Venus	2.6	0.71	244
Earth	1.4	0.38	253
Mars	0.6	0.17	216
Jupiter	0.05	0.73	87
Saturn	0.01	0.76	63
Uranus	0.004	0.93	33
Neptune	0.001	0.84	32

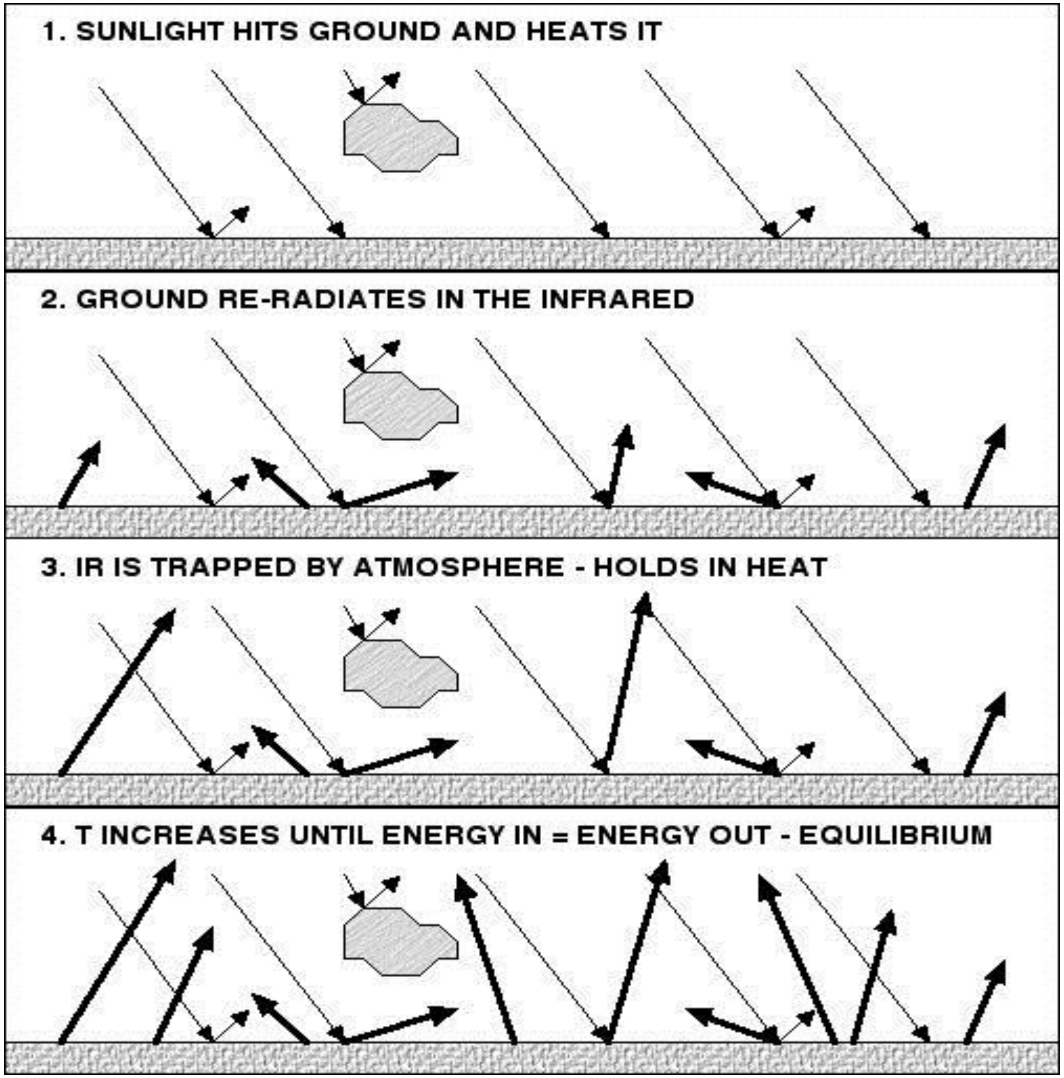
Table 4: Magnetic field parameters of planets

Planet	Magnetic dipole moment Me	Core radius km	Magnetic dipole tilt degrees	Magnetic dipole offset in planetary radii
Mercury	3.1×10^{-4}	~1800	2.3	0.2
Venus	$<5 \times 10^{-5}$	~3000	-	-
Earth	1	3485	11.5	0.07
Mars	3×10^{-4}	~1700	(15-20)	-
Jupiter	1.8×10^{4}	~52000	11	0.1
Saturn	0.5×10^{3}	~28000	1.5 ± 0.5	< 0.05
Uranus		-	58.6	0.3
Neptune	-	-	46.8	0.55

Table 5: Composition of dry air by volume at the earth's surface

N_2	O_2	Ar	CO_2	Ne	He	Kr
78.09%	20.95	0.93	0.03	0.0018	0.00053	0.0001

Greenhouse effect



According to Professor Jean's research interest

- Planet formation is closely connected to star formation and early stellar evolution. Stars form from collapsing clouds of gas and dust. The colapse leads to the formation of a central body, the protostar, which contains most of the mass of the cloud, and a circum-stellar disk, which retains most of the angular momentum of the cloud.
- In the Solar System, the circumstellar disk is estimated to have had a mass of a few percent of the Sun's mass.

- Most of the work on giant planet formation has been per-formed in the context of the core accretion mechanism, so its strengths and weaknesses are better known than those of the disk instability mechanism, which has only recently been subjected to serious investigation.

- With time and improved detection methods, the diversity of planets and orbits in exoplanetary systems will definitely increase and help to constrain the formation theory further. In this work, we review the latest state of planetary formation in relation to the origin and evolution of habitable terrestrial planets.

- It is important to characterize the po- tential host systems for terrestrial planet-finding missions like Darwin and provide a target sample that is likely to bracket the diversity of planetarysystems to contain a sufficient number of terrestrial planets.

There are three major problems in planet-formation theories:

First: the qualitative problem of planetesimal formation, the process of which is not clear today.

Second: the qualitative problem of migration that could become a quantitative one when migration-rate esti- mates are too high.

Third: The purely quantitative formation timescale is- sue, which may be solved by improving the physics included inplanet-formation models.

This is the case, for example, when including the consequences of planetary migration within the protoplanetary disk.

Furthermore, if the dust present inside the planetary envelope settles down to the planet's core, this may reduce the opacity and the for- mation timescale.

Basic Principles of Planet Formation

- Pre-planetary disks are rotating structures in quasi-equi- librium.
- The gravitational force is balanced in the radial di- rection by the centrifugal force augmented by the gas pressure, while in the vertical direction it is balanced by the gas pressure alone.
- The gravitational force is mostly related to that of the central star.
- The self-gravity due to the disk itself remains weak in comparison.

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