研究生课程教学大纲（Syllabus）

<table>
<tr><td>课程代码
Course Code</td><td>ASTR8405</td><td>*学时
Teaching Hours</td><td>48</td><td>*学分
Credits</td><td>3</td></tr>
<tr><td rowspan="2">*课程名称
Course Name</td><td colspan="5">（中文）从地球到系外文明</td></tr>
<tr><td colspan="5">（English）From Earth to Extraterrestrial Civilization</td></tr>
<tr><td>*授课语言
Instruction Language</td><td colspan="5">英语</td></tr>
<tr><td>*开课院系
School</td><td colspan="5">物理与天文学院</td></tr>
<tr><td>先修课程
Prerequisite</td><td colspan="5">四大力学，微积分，线性代数</td></tr>
<tr><td rowspan="2">授课教师
Instructors</td><td>姓名 Name</td><td>职称 Title</td><td colspan="2">单位 Department</td><td>联系方式 E-mail</td></tr>
<tr><td>冯发波、Masahiro Ogihara、谭先瑜</td><td>副教授</td><td colspan="2">李政道研究所</td><td>ffeng@sjtu.edu.cn</td></tr>
<tr><td>*课程简介（中文）Course Description</td><td colspan="5">课程定位：
本课程适合于物理和天文专业以及其他理科专业的高年级本科生和研究生。本课程填补了物理与天文学院的课程体系在行星科学方面的缺失，相比于传统的物理和天文课程更能够培养不同专业的学生进行交叉综合研究的能力，响应了国家十四五规划以及自然科学基金对交叉学科的重视。

教学目标：
1. 介绍行星科学，特别是系外行星科学，的最新发展和动向；
2. 以系外行星科学作为平台来培养学生在动力学、化学、观测和仪器、统计学、太阳系科学、空间科学、相对论物理、地球科学乃至古气象学等方面进行交叉研究的能力；
3. 激发学生对系外行星科学的兴趣，开阔学生的科学视野和思路；
4. 通过实践课程掌握行星探测的基本技术，并具有把这些技术运用到其他领域的能力。

主要教学内容：
1. 地球科学：简略介绍地球的形成与演化、动力学、气候等;
2. 太阳系：简略介绍太阳系内类地及非类地行星以及其他小天体的特征和动力学;
3. 系外行星：探测技术、分类、动力学、大气、内部结构、形成与演化;
4. 系外生命和文明：宜居带、其他影响行星宜居性的因素、生命信号探针、搜索外星文明的信号、恒星际航行等。
5. 课程实践：学习并掌握系外行星探测的五种方法</td></tr>
<tr><td>*课程简介（English）Course Description</td><td colspan="5">Course orientation:
This course is suitable for the senior undergraduates or graduates majoring in physics, astronomy, and other areas in natural science. This course fills in the lack of planetary science in the curriculum system of the School of Physics and Astronomy. It is more able to develop students' interdisciplinary skills compared with traditional courses. This is also consistent with China's 14th five-year plan and the NFSC which emphasizing the importance of interdisciplinary studies.

Teaching goal:
1. Introduce the basics and the frontiers of planetary science, especially exoplanetary</td></tr>
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<tr><td></td><td colspan="5">science;
2. Use exoplanetary science as a platform to develop students′ skill of synthesizing their knowledge and skills on classical dynamics, chemistry, astronomical observation, instrumentation, statistics, solar system science, space science, relativity physics, Earth science, and even paleoclimatology;
3. Stimulate students′ interest in exoplanetary science and interdisciplinary research, and broaden their scientific horizons and ideas;
4. Through hands-on practice, students will master the exoplanet detection techniques, and have the ability to adapt these techniques for other applications.

Teaching content:
1. Earth Science：briefly introduce the formation and evolution of the Earth, the dynamics of Earth′s climate and geology, climatology, etc;
2. Solar System: briefly introduce the features and dynamics of the terrestrial and non-terrestrial planets as well as other minor bodies in the Solar System;
3. Exoplanet: introduce the detection techniques, planet characterization, planet dynamics, planet atmosphere, planet internal structure, planet formation and evolution;
4. Extraterrestrial life and intelligent: habitable zone, factors influencing planet habitability, biosignatures, search for extraterrestrial intelligent, interstellar travel, etc.
5. Hands-on practice: learn and know how to detect exoplanets through five different techniques</td></tr>
<tr><td rowspan="9">*教学安排
Schedules</td><td>周次
Week</td><td>教学内容
Content</td><td>授课学时
Hours</td><td>教学方式
Format</td><td>授课教师
Instructor</td></tr>
<tr><td>1</td><td>Earth′s internal structure, atmosphere, activity, formation and evolution, climate change, orbital dynamics, Moon</td><td>3</td><td>讲课</td><td>冯发波</td></tr>
<tr><td>2-3</td><td>Terrestial planet, non-terrestial planets, formation and evolution of the Solar System, Solar System dynamics, minor bodies, Oort cloud, motion in the Galaxy, interstellar object visiting the Solar System</td><td>6</td><td>讲课</td><td>Masahiro Ogihara</td></tr>
<tr><td>4-6</td><td>Radial velocity, transit, microlensing, astrometry, direct imaging, advantage and disadvantage of various methods, synthetic use of different methods</td><td>9</td><td>讲课</td><td>冯发波</td></tr>
<tr><td>7-9</td><td>How to detect atmosphere, formation and evolution of atmosphere, the influence of atmosphere on planet habitability</td><td>9</td><td>讲课</td><td>谭先瑜</td></tr>
<tr><td>10-12</td><td>Population synthesis, structure of exoplanetary system, formation and evolution of exoplanetary system</td><td>9</td><td>讲课</td><td>Masahiro Ogihara</td></tr>
<tr><td>13</td><td>How to measure planet density, the relation between density and internal structure, influence of internal structure and habitability</td><td>3</td><td>讲课</td><td>谭先瑜</td></tr>
<tr><td>14</td><td>Detection methods, frontiers, exo-life occurrence rate, relation between exo-life and planet habitability，origin of life</td><td>3</td><td>讲课</td><td>谭先瑜</td></tr>
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	15	Detection methods, Drake equation, SETI frontiers, Fermi paradox, Breakthrough initiative, feasibility of interstellar travel	3	讲课	冯发波
	16	Presentations given by students	3	报告	Masahiro Ogihara，谭先瑜
*考核方式 Grading Policy	**课堂表现和签到（30%）+期末考试（70%）**				
*教材或参考资料 Textbooks & References	参考资料: 1. Murray, Carl D., and Stanley F. Dermott. Solar system dynamics. Cambridge university press, 1999. 2. Perryman, Michael. *The exoplanet handbook*. Cambridge University Press, 2018. 3. Seager, Sara. Exoplanets. 2010. 4. Deeg, Hans J., and Juan Antonio Belmonte, eds. Handbook of exoplanets. Springer, 2018.				
备注 Notes	本课程为研究生 3 学分选修课，授课学时为每周 3 节课、3 学时。				

备注说明：

1．带*内容为必填项；

2．课程简介字数为 300-500 字；教学内容、进度安排等以表述清楚教学安排为宜，字数不限。