UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè		
ACADEMIC YEAR	2022/2023		
MASTER'S DEGREE (MSC)	PHYSICS		
INTEGRATED COURSE	SPACE WEATHER		
CODE	22425		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	FIS/06		
HEAD PROFESSOR(S)	REALE FABIO	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	REALE FABIO	Professore Ordinario	Univ. di PALERMO
CREDITS	6		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**REALE FABIO** Tuesday 12:30 14:30 Ufficio, Via Archirafi 36 Thursday 12:30 14:30 Ufficio, Via Archirafi 36		

DOCENTE: Prof. FABIO REALE

PREREQUISITES	Prerequisites to attend classes and to successfully achieve the objective of the course are: knowledge and application of physics law and fundamental concepts of classical physics, quantum mechanics, astronomy, astrophysics, and mathematics.
LEARNING OUTCOMES	- Knowledge and comprehension of fundamental physical processes of space weather, focusing on either theoretical and observational aspects. - Being able to solve problems of space weather physics, and to embed the acquired knowledge on other topics and more general scenarios. - Become able to autonomously perform physics assessments on space weather and related systems and how techniques used in this field can be applied to similar systems. - Being able to communicate with accurate and technical language the content of the course. - Become an independent learner in space weather using english text books and recent scientific publications
ASSESSMENT METHODS	The final assessment consists of an oral exam: the student will be asked to describe various components of space weather, to identify its physical mechanisms, managing both observational and modelling aspects. The test will assess the competences of the students, their capacity to apply them, and to communicate them effectively and accurately. The evaluation will follow this pattern: - basic knowledge of the topics of the course, with some sufficient capacity of analysing, applying concepts, and presentation: grade 18-21; - decent knowledge of the topics of the course, with decent analysis, application, and presentation: grade 22-25; - good knowledge of the topics of the course, with good analysis, application, and presentation: grade 26-28; - full and deep knowledge of course topics, with complete and mature view of both theoretical and experimental aspects, deep mastery in applying this knowledge and developing related arguments with deep logical and scientific rigor, excellent expository skills: grade 29-30L.
TEACHING METHODS	Teaching will take place with traditional lectures. Teachers will present topics using either graphic and electronic supports and focusing on both theoretical and observational aspects. The discussion on various topics will take place stimulating and driving a discussion with students, in order to have an interactive lesson and thus improving the analytical skills of the students. Beside suggested textbooks, students will be offered more texts and scientific publications in English as additional studying.

MODULE
SUN-EARTH INTERACTION

Prof. FABIO REALE

SUGGESTED BIBLIOGRAPHY

Space Physics, An Introduction to Plasmas and Particles in the Heliosphere and Magnetospheres, KALLENRODE MAY-BRITT, Springer, ISBN: 9783642058295

AMBIT	20901-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	51
COURSE ACTIVITY (Hrs)	24

EDUCATIONAL OBJECTIVES OF THE MODULE

Objective of the module is the competence on the fundamentals of Sun-Earth interactions and Space Weather. Topics will be addressed to inspire critical thinking on the issues, and competence on both theoretical and observational aspects.

SYLLABUS

Hrs	Frontal teaching
2	Space Weather: introduction to definitions, operations, applications, phenomena
4	Space Weather Environment: solar wind, Parker spiral, topology of the solar magnetic field.
5	Sources of Space Weather: solar magnetic field reconstruction, helicity, PFSS, magnetic skeletons and current sheets.
5	Perturbations of Space Weather: CME and ICME models, Stealth CMEs, drag model.
2	Interaction with Eart magnetosphere: wind, auInterazione con la magnetosfera terrestre: wind, ICME, aurorae, and magnetospheric waves.
4	Sun and Earth climate: Solar influence on climate, the faint young Sun paradox, Total and Spectral Solar Irradiance, Solar magnetic variability, Milankovitch cycles and Earth's orbit, Solar modulation of Cosmic Rays, Stratospheric ozone and solar spectral variability.
2	Consequences of Space Weather: Power grids, Communications disturbances, astronaut's wellbeing.

MODULE
SOLAR PHYSICS

Prof. FABIO REALE

SUGGESTED BIBLIOGRAPHY

Priest, E. (2014). Magnetohydrodynamics of the Sun. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139020732

AMBIT	20901-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	51
COURSE ACTIVITY (Hrs)	24

EDUCATIONAL OBJECTIVES OF THE MODULE

Objective of the module is the competence on the fundamentals of Solar Physics instrumental to the comprehension of the topics related to the Sun-Earth interaction, and thus Space Weather. Topics will be addressed to inspire critical thinking on the issues, and competence on both theoretical and observational aspects.

SYLLABUS

Hrs	Frontal teaching
2	Elements of solar structure
2	Elements of solar atmosphere
2	Elements of solar corona
3	Solar activity: cycle ,sunspots, active regions
4	Flares: phenomena, magnetic reconnection, particles acceleration
4	Eruptions, jets, and coronal mass ejections
2	Detection of exoplanets and star noise: what we learn from the Sun
5	MHD models: fundamentals, radiative transport, confined and non confined models