

UČNI NAČRT PREDMETA / COURSE SYLLABUS							
<b>Predmet:</b>		Astronomija					
<b>Course title:</b>		Astronomy					
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field		<b>Letnik</b> Academic year		<b>Semester</b> Semester	
Magistrski študijski program Matematika		ni smeri		1 ali 2		prvi in drugi	
Master's study programme Mathematics		none		1 or 2		first and second	
<b>Vrsta predmeta / Course type</b>				izbirni			
<b>Univerzitetna koda predmeta / University course code:</b>				M2721			
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike študija</b>	<b>Samost. delo</b> Individ. work	<b>ECTS</b>	
60		30			120	7	
<b>Nosilec predmeta / Lecturer:</b>				prof. Tomaž Zwitter			
<b>Jeziki / Languages:</b>		<b>Predavanja / Lectures:</b>		slovenski/Slovene			
		<b>Vaje / Tutorial:</b>		slovenski/Slovene			
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>			
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>			

<p>Zgodovinski uvod: osnove koledarja, mrki, oblika, velikost in razdalje Zemlje, Lune in Sonca, razdalje v Osončju, spreminjanje hitrosti vrtenja Zemlje, prestopna sekunda.</p> <p>Orientacija po nebu: koncept nebesne krogle, izreki za krogelni trikotnik, izračun višine in azimuta, trenutka vzhoda/zahoda, kulminacije, časa nad obzorjem, uvedba zvezdnega časa, popravki: lom, aberacija, precesija, paralaksa, lastno gibanje.</p> <p>Navidezno gibanje Sonca: koordinate, pravi in srednji Sončev čas, obsevanost, nastop letnih časov.</p> <p>Astronomski teleskopi: leča, zrcalo, sestavljanje 2 elementov, tipi teleskopov, zbiralna moč, merilo slike, svetlost slike, globinska ostrina, povečava, postavitve teleskopov.</p> <p>Digitalni detektorji: njihova velikost, prezentacije slik, fotometrični filtri.</p> <p>Astronomske magnitude: navidezna in absolutna magnituda, osnovna obdelava fotometričnih opazovanj.</p> <p>Osnove astronomske spektroskopije: spektrograf, merljive količine.</p> <p>Sonce kot tipična zvezda: masa Zemlje in Sonca, njuna povprečna gostota, izsev, efektivna temperatura, površinski težnostni in rotacijski pospešek.</p> <p>Struktura Soncu podobnih zvezd: hidrostatično ravnovesje, dinamični čas, središčni tlak in temperatura, utemeljitev privzetka idealnega plina, politropni model, virialni teorem, termični čas, prozornost snovi, ocena proste poti fotonov, sevalni in konvekcijski prenos energije.</p> <p>Starost zvezd: primer Zemlje in Sonca, jedrske reakcije, njihova stabilnost in nuklearni čas,</p>	<p>Historical introduction: basis of calendar, eclipses, size and distances of the Earth, Moon and Sun, distances in the Solar system, rotational period of the Earth, leap second.</p> <p>Positional astronomy: concept of celestial sphere, spherical trigonometry, calculation of altitude and azimuth, culmination, time above horizon, sidereal time, effects of atmospheric refraction, aberration, precession, parallax and proper motion.</p> <p>Solar apparent motion: coordinates, mean and true Solar time, illumination, occurrence of seasons.</p> <p>Astronomical telescopes: lens, mirror, combining the two elements, types of telescopes, light collecting power, image scale, image brightness, depth of field, magnification, telescope mounts.</p> <p>Digital detectors: their size, image presentation, photometric filters.</p> <p>Astronomical magnitudes: apparent and absolute magnitude, basics of reduction of photometric observations.</p> <p>Basics of astronomical spectroscopy: spectrograph, measurable quantities.</p> <p>The Sun as a typical star: mass of the Earth and Sun, their average density. Solar luminosity, effective temperature, surface gravity and rotational acceleration.</p> <p>Structure of Solar-like stars: hydrostatic equilibrium, dynamical time-scale, central pressure and temperature, justification of calculation with ideal gas, polytropic model, virial theorem, thermal time-scale, optical opacity, free path of photons, energy transport with radiation and convection.</p> <p>Ages of stars: the case of the Earth and the Sun,</p>
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<p>odvisnost izseva od mase za Soncu podobne zvezde, Eddingtonov izsev.</p> <p>Razvoj zvezd: nastanek in Jeansova masa, faza orjakinj, končne faze razvoja, odvisnost razvoja od mase.</p> <p>Opazovanje razvoja: Hertsprung-Russellov diagram, zvezdne kopice, merjenje razdalj, spektri kemijskih elementov v zvezdnih atmosferah v odvisnosti od temperature, kemične sestave, radialne hitrosti in težnostnega pospeška, prekrivalne spektroskopske dvojne zvezde, opazovanje končnih stopenj razvoja zvezd.</p> <p>Medzvezdni prostor: absorpcija v plinu in prahu, vrste meglic, opazljive lastnosti.</p>	<p>nuclear fusion, its stability and timescale, dependence of luminosity on mass for Solar-like stars, Eddington luminosity.</p> <p>Evolution of stars: formation and Jeans mass, giant phase, final stages of evolution, dependence of evolution on mass.</p> <p>Observation of stellar evolution: Hertzsprung-Russell diagram, star clusters, distance measurement, spectra of chemical elements in stellar atmospheres, their dependence on temperature, chemical composition, radial velocity and gravity, eclipsing spectroscopic binaries, observations of final stages of stellar evolution.</p> <p>Interstellar medium: absorption in gas and dust, types of nebulae, observable properties.</p>
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#### **Temeljni literatura in viri / Readings:**

<p>H. Karttunen et al.: Fundamental Astronomy, Fifth Edition, Springer, 2007.</p> <p>R.M. Green: Spherical astronomy, Cambridge University Press, 1993.</p> <p>F. H. Shu, The Physical Universe. University Science Books, 1982.</p> <p>A. Čadež: Fizika zvezd, DMFA, 1984.</p> <p>Gordon Walker: Astronomical observations: an optical perspective. Cambridge University Press, 1987.</p> <p>T. Zwitter: Pot skozi vesolje, Modrijan, 2002.</p> <p>Presekova zvezdna karta, DMFA, 2000, Spikina vrtljiva zvezdna karta.</p> <p>Naše nebo, astronomske efemeride, DMFA, 2012-.</p>
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**Cilji in kompetence:**

**Objectives and competences:**

Seznanitev z osnovami astronomskih opazovanj, s fenomenologijo objektov in pojavov v vesolju ter fizikalno sliko razumevanja vesolja in raznolikostjo pri tem uporabljenih pristopov, ki se vklaplajo v širšo sliko našega vedenja o svetu v katerem živimo.

Mastering of basics of astronomical observations, phenomenology of objects and processes in the Universe and understanding of the Universe using laws of physics. This connects to a wider picture of the world we live in.

**Predvideni študijski rezultati:**

Znanje in razumevanje: Razumevanje osnov fizikalne slike vesolja in kako smo do nje prišli, zavedanje omejitev našega znanja.

Uporaba: Abeceda znanja astronomije in astrofizike, primeri univerzalnosti fizikalnega pristopa in inventivnosti pri meritvah v težavnih pogojih.

Refleksija: Vesolje je polno zelo raznovrstnih okolij, ki pa jih lahko razumemo s fizikalno matematičnimi pristopi, ki smo jih razvili.

Prenosljive spretnosti - niso vezane le na en predmet: Kritično vrednotenje informacij, primeri obdelave digitalnih podatkov, pridobivanje spretnosti uporabe matematično-fizikalnega znanja pri reševanju odprtih problemov.

**Intended learning outcomes:**

Knowledge and understanding: Understanding of the basics of the physical picture of the Universe, its foundations, and acknowledging its present limitations.

Application: Basic knowledge of astronomy and astrophysics, experience of the universality of physics, experience of inventive measurements in difficult conditions.

Reflection: The Universe contains most diverse environments, but it can be understood with physics and mathematics as we know it.

Transferable skills: Critical evaluation of information, examples of manipulation of digital data, experience in the use of apparatus of mathematics and physics to solve open problems.

**Metode poučevanja in učenja:**

Predavanja, računske in praktične vaje, izdelava projektnih nalog.

**Learning and teaching methods:**

Lectures, computational and practical exercises, astro-lab reports.

**Načini ocenjevanja:**

Delež (v %) /

Weight (in %) **Assessment:**

pisni izpit oziroma kolokvij, izdelava projektne naloge, ustni izpit.		written exam, presentation of astro-lab report, oral exam.
Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	50 % 50 %	Grades: 1-5 (fail), 6-10 (pass), according to University rules.

#### Reference nosilca / Lecturer's references:

Tomaž Zwitter:

- D'ODORICO, Sandro, ZWITTER, Tomaž. Evidence that the compact object in SS433 is a neutron star and not a black hole. *Nature*, ISSN 0028-0836. [Print ed.], 1991, let. 353, str. 329-331 [COBISS.SI-ID 64129]
- MUNARI, Ulisse, ZWITTER, Tomaž. Equivalent width of Na I and K I lines and reddening. *Astronomy & astrophysics*, ISSN 0004-6361, 1997, let. 318, št. 1, str. 269-274 [COBISS.SI-ID 87681]
- ZWITTER, Tomaž, CASTELLI, Fiorella, MUNARI, Ulisse. An extensive library of synthetic spectra covering the far red, RAVE and GAIA wavelength ranges. *Astronomy & astrophysics*, ISSN 0004-6361, 2004, let. 417, št. 3, str. 1055-1062 [COBISS.SI-ID 220801]
- PRŠA, Andrej, ZWITTER, Tomaž. A computational guide to physics of eclipsing binaries. I. Demonstrations and perspectives. *The Astrophysical journal*, ISSN 0004-637X, 2005, let. 628, št. 1/1, str. 426-438 [COBISS.SI-ID 239489]
- ZWITTER, Tomaž, RE FIORENTIN, Paola, MATIJEVIČ, Gal, VIDRIH, Simon, et al. The radial velocity experiment (RAVE): second data release. *The Astronomical journal*, ISSN 0004-6256, 2008, let. 136, št. 1, str. 421-451 [COBISS.SI-ID 309377]
- BREDELLES, Maarten A., ZWITTER, Tomaž, et al. Distance determination for RAVE stars using stellar models. *Astronomy & astrophysics*, ISSN 0004-6361, 2010, let. 511, št. A90, str. 1-16 [COBISS.SI-ID 344961]
- MATIJEVIČ, Gal, ZWITTER, Tomaž, et al. Exploring the morphology of RAVE stellar spectra. *The Astrophysical journal*, supplement series, ISSN 0067-0049, 2012, letn. 200, št. 2, str. 1-14 [COBISS.SI-ID 393601]
- KOS, Janez, ZWITTER, Tomaž. Properties of diffuse interstellar bands at different physical conditions of the interstellar medium. *The Astrophysical journal*, ISSN 0004-637X, 2013, vol. 774, issue 1, article id. 72, str. 1-16 [COBISS.SI-ID 417409]
- ŽERJAL, Maruška, ZWITTER, Tomaž, MATIJEVIČ, Gal, et al. Chromospherically active stars in the RAdial Velocity Experiment (RAVE) Survey : I. The catalog. *The Astrophysical journal*, ISSN 0004-637X, 2013, vol. 776, issue 2, article id. 127, str. 1-12 [COBISS.SI-ID 418945]

