

Lab 5 Star Spectra

Vocabulary: absorption spectrum, binary star, blueshift, Cepheid variable, emission spectrum, giant star, nebula, redshift, spectrum, star

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. What happens when light goes through a prism? It is bent, or refracted, by the angles and plane faces of the prism and each wavelength of light is refracted by a slightly different amount.

This band of colors is called a **spectrum**.

2. A rainbow is an example of a spectrum. What is the sequence of colors in a rainbow?

Red, orange, yellow, blue, indigo, violet

Gizmo Warm-up

The interior of a **star** produces a continuous spectrum of light, like a rainbow. Cooler gases in the outer layers of the star absorb certain wavelengths of light, causing dark lines to appear in the spectrum. The resulting **absorption spectrum** can tell astronomers a great deal about the star.

1. On the *Star Spectra* Gizmo, turn on **Show labels**. Select **star 1** to see its absorption spectrum.

How many lines do you see in the spectrum? five



2. Drag the **Hydrogen** spectrum next to the **Star spectrum** so that the edges line up. Do some of the lines on the two spectra match up? Yes four lines on the spectrum do line up
3. Drag the **Helium** spectrum next to the **Star spectrum**. Do some lines match? Yes some do match
4. Try out the other available spectra. Do any others have lines that match? No
5. Which elements have contributed to the spectrum of **star 1**? Hydrogen and helium

Note: The elements in a star's spectrum do not necessarily reflect what the star is made of. The absorption spectrum is mostly determined by the surface temperature of the star.

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Proceedings of the 5th International Conference on Big Data Analytics for Cyber-Physical System in Smart City—Volume 1 Mohammed Atiquzzaman, Neil Yen, Zheng Xu, 2025-02-01 This book gathers a selection of peer reviewed papers presented at the 5th Big Data Analytics for Cyber Physical System in Smart City BDCPS 2023 conference held in Fuyang China on December 28 29 The contributions prepared by an international team of scientists and engineers cover the latest advances and challenges made in the field of big data analytics methods and approaches for the data driven co design of communication computing and control for smart cities Given its scope it offers a valuable resource for all researchers and professionals interested in big data smart cities and cyber physical systems *Highlights of Astronomy: Volume 14* Karel van der Hucht, 2008-01-21 Recording the proceedings of the IAU XXVI General Assembly this volume of the IAU Highlights of Astronomy covers virtually all aspects of modern astrophysics as discussed by 2400 participants from 73 countries Notably the common aspects of astrophysical phenomena known to exist in widely differing interstellar environments is thoroughly examined providing fertile cross correlation from one specialisation to another This text highlights the importance of the triennial IAU General Assemblies in bringing together the work of observers and theoreticians in widely different fields but working towards a common goal understanding the physics of the Universe Together with the Proceedings of the IAU Symposia 235 240 this volume examines all of the astrophysics presented at the General Assembly Remote Instrumentation and Virtual Laboratories Franco Davoli, Norbert Meyer, Roberto Pugliese, Sandro Zappatore, 2010-03-10 Accessing remote instrumentation worldwide is one of the goals of e Science The task of enabling the execution of complex experiments that involve the use of distributed scientific instruments must be supported by a number of different architectural domains which inter work in a coordinated fashion to provide the necessary functionality These domains embrace the physical instruments the communication network interconnecting the distributed systems the service oriented abstractions and their middleware The Grid paradigm or more generally the Service Oriented Architecture SOA viewed as a tool for the integration of distributed resources plays a significant role not only to manage computational aspects but increasingly as an aggregator of measurement instrumentation and pervasive large scale data acquisition platforms In this context the functionality of a SOA allows managing maintaining and exploiting heterogeneous instrumentation and acquisition devices in a unified way by providing standardized interfaces and common working environments to their users but the peculiar aspects of dealing with real instruments of widely different categories may add new functional requirements to this scenario On the other hand the growing transport capacity of core and access networks allows data transfer at unprecedented speed but new challenges arise from wireless access wireless sensor networks and the traversal of heterogeneous network domains The book focuses on all aspects related to the effective exploitation of remote instrumentation and to the building complex virtual laboratories on top of real devices and infrastructures These include SOA

and related middleware high speed networking in support of Grid applications wireless Grids for acquisition devices and sensor networks Quality of Service QoS provisioning for real time control measurement instrumentation and methodology as well as metrology issues in distributed systems

The Solar System Michael A. Seeds, 2007 Helps students use astronomy to understand science and use science to understand what we are Fascinating and engaging this text illustrates the scientific method and guides students to answer these fundamental questions What are we And how do we know

Organizations and Strategies in Astronomy Andre Heck, 2012-12-06 We have arrived at the third volume of this useful series on Organizations and Strategies in Astronomy OSA It contains seventeen articles on a wide range of topics from virtual observatories astronomy organizations in various communities Czech Republic Slovak Republic South Africa and the role of ground stations in space observatories to quality assurance in UK higher education In this foreword I shall give some views on ideas expressed in this volume in particular from my personal experience when I was project officer for the Canada France Hawaii Telescope CFHT Let me first remind readers that present and future astronomy is increasingly dependent on high level management Not everybody knows that the scheduling of the Hubble Space Telescope is performed by a neural network software called SPIKE described in the stimulating workshop New Observing Modes for the Next Century partly reported in OSA Volume II by 1 Robson New observing facilities in space or on the ground are so complex that they need highly qualified engineers and rigorous management procedures Each observing hour on the Very Large Telescope VLT facility is worth about EUR 7 000 including the amortization of the capital expenses over 30 years This does not leave much room for amateurism neither in the time allocation procedures nor in the daily telescope control

Learning Together Through Peer Instruction: A Comprehensive Guide for Astronomy Lecturers Pasquale De Marco, 2025-04-16 In the ever evolving landscape of education peer instruction stands out as a transformative teaching method that actively engages students in the learning process fostering deeper understanding and critical thinking skills This comprehensive guide provides astronomy lecturers with a wealth of resources and strategies to implement peer instruction effectively in their courses Discover the power of peer instruction and its benefits for both students and instructors Learn how to get started with peer instruction and overcome common challenges Delve into the art of crafting thought provoking conceptual questions that spark discussion and promote deeper learning Explore effective strategies for implementing peer instruction activities in the classroom both in traditional and online environments This book also addresses the importance of using technology to enhance peer instruction from online platforms and interactive tools to digital assessment and feedback mechanisms It provides guidance on assessing student learning through effective assessments and constructive feedback to help students grow and improve To foster a supportive and collaborative learning environment the book explores strategies for building a community of learners fostering collaboration and cooperation among students and creating a positive classroom climate It also discusses how to adapt peer instruction for diverse learning environments including large classes online and hybrid courses and

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Astronomy: The Human Quest for Understanding Dale A. Ostlie, 2022-09-07 Since humans first looked up at the stars astronomy has had a particular ability to stir the imagination and challenge the thinking of scientists and non scientists alike Astronomy The Human Quest for Understanding is an introductory astronomy textbook specifically designed to relate to non science majors across a wide variety of disciplines nurture their curiosity and develop vital science based critical thinking skills This textbook provides an introduction to how science operates in practice and what makes it so successful in uncovering nature s secrets Given that the study of astronomy dates back thousands of years it is the ideal subject for tracing the development of the physical sciences and how our evolving understanding of nature has influenced and been influenced by mathematics philosophy religion geography politics and more This historical approach also illustrates how wrong turns have been taken and how the inherent self correcting nature of science through constant verification and the falsifiability of truly scientific theories ultimately leads us back to a more productive path in our quest for understanding This approach also points out why as a broadly educated citizenry students of all disciplines must understand how scientists arrive at conclusions and how science and technology have become central features of modern society In discussing this fascinating and beautiful universe of which we are a part it is necessary to illustrate the fundamental role that mathematics plays in decoding nature s mysteries Unlike other similar textbooks some basic mathematics is integrated naturally into the text together with interpretive language and supplemented with numerous examples additional tutorials are provided on the book s companion website Astronomy The

Human Quest for Understanding leads the reader down the path to our present day understanding of our Solar System stars galaxies and the beginning and evolution of our universe along with profound questions still to be answered in this ancient yet rapidly changing field *Computer Support for Collaborative Learning* Gerry Stahl, 2002 Proceedings of CSCL 2002 meeting in Boulder Colorado January 7 11 2002 **Development and Management of Virtual Schools** Catherine Cavanaugh, 2004-01-01 Virtual schools are a result of widespread changes in knowledge about learning in available technology and in society Virtual schooling is growing in popularity and will continue to attract students because of the benefits it offers over traditional schooling Stakeholders in virtual schools need information to guide their decisions For the foreseeable future virtual schools will continue to meet diverse student needs and to evolve in response to further change Development and Management of Virtual Schools Issues and Trends brings together knowledge of virtual schools as a reference for scholars and other groups involved in virtual schools The chapters review best practice from concept and development through implementation and evaluation

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