Astronomy 421 – Final Exam Winter 2009

Part I (25 points)

You were all given a handout on the last day of class concerning age estimates of old simple stellar populations (aka globular clusters), extracted from Salaris & Cassisi, Evolution of Stars and Stellar Populations (John Wiley & Sons, Ltd, West Sussex, England, 2005). It would really help you adequately answer these questions (basically the same as given in the handout with a few modifications) if you read the seminal paper from Sarajedini, Chaboyer, and Demarque, 1997, PASP, 109, 1321. Each question is worth 5 points.

1. Why would the magnitude level of the horizontal branch be "essentially constant with age"?

2. To effectively use the ΔV method, the theoreticians want observations of globular clusters that have lots of RR Lyrae stars on the horizontal branch. Explain why.

3. To effectively use the ΔV method, the photometry of the clusters needs to be consistent between that of the horizontal branch and red giant branch and the turn-off and lower main sequence. That is, all observations need to be accurately transformed to the same filter system. Why would this be required. (This has echoes of Astronomy 480 and 481.)

4. Discuss why the $\Delta(B-V)$ method should work.

5. What determines the temperature and luminosity of a star when it is on the horizontal branch? (There are a couple of papers listed in Part II that discuss this explicitly.) Start first with a couple of your OWN hypotheses, and then review the literature. Try searching under "morphologies horizontal branch," "second parameter horizontal branch stars," if you don't find what you need within the listing in Part II.

CollectIt: https://catalysttools.washington.edu/collectit/dropbox/anamunn/5245

All documents should be uploaded there. It is fine with me if you do each part and/or each critique separately and upload them as you finish. The deadline is Friday, March 20, 11 pm, but I'd really appreciate it if you didn't wait until then to upload everything. I'll be nicer if the parts trickle in so I can spread out the grading.

Part II (75 points) follows on the next page.

Part II – Critiquing scientific papers

Introduction

As part of your journey towards becoming a renowned, respected, revered astronomer, you will be publishing the results of your research in a peer-reviewed astrophysical journal. Most scientific journals allow very little leeway concerning the format of your paper. Requirements for submitting your first paper (OK, some of you already have) to The Astrophysical Journal can be found at http://www.iop.org/EJ/journal/apj. The instructions go on forever without ever indicating what can be defined as a superb scientific paper. This part of the final will give you an opportunity to "peer review" a few papers.

Instructions

Following are the general instructions for writing your critique of a scientific paper on astronomical observations and/or theory. Your writing should be in **narrative** form, and not just chopped-up responses to the questions posed in these instructions. Each critique will be evaluated under the guidelines that follow. (NOTE: Not all of these need apply to your chosen papers.)

1) Have you addressed all or most of the points (out of those applicable) given in these instructions? <15 pts>
2) Does your critique show evidence that you carefully read the paper and really did some critical thinking about what was presented? <5 pts>
3) Did you pull in at least one theoretical principle that we have been discussing and studying so far and relate it directly to the observations made by the authors of the paper? <5 pts>

The top of your paper should have your name and the complete information about the paper you are critiquing: title, authors, affiliations, journal reference.

Guidelines (you need do "only" 3 critiques):

For a ~10-page paper (± 2 pages), your critiques should be about 1 page long, using single spacing, 1" margins, 12-pt font. These papers count for **1** critique unless otherwise indicated.
For a ~20 page paper (± 4 pages), your critiques should be about 2 pages long, using single spacing, 1" margins, 12-pt font. THESE PAPERS COUNT FOR **2** CRITIQUES!

Please recall the 4 "Cs" of writing: Clear, Concise, Complete, Contained.

Summary of the scientific content of the paper

- Does the introduction give relevant background information?
  - What is the major hypothesis?
  - What is the main purpose for doing this study?
  - Is the procedure or method clearly stated?
- Summarize the techniques used in the study, giving the rationales for using those techniques.
  - Were the techniques a means to produce a specific result or the mechanism used to observe/record results
  - What controls, theoretical considerations, observation protocal were followed?

o Describe the results of the observations

o Are all graphs and tables set up so that they clearly and comprehensibly explain the rsults?

- Pick what you consider to be the most important 1 or 2 figures or tables. What was the major conclusion of each figure and/or table you chose?
- Describe one or two other results not pulled out into a figure or table.

o In the summary or conclusion part of the paper, do the authors address any problems with their research, or explore how they might do things differently the next time? Do they consider what future research might be done to further answer the question? If so, summarize briefly. If not, comment on whether this distracted from the impact of the paper.

Putting the study into a larger context

o Summarize the information the authors used to put their study into the context of the broader scientific knowledge.

o How did the study relate to previous work? How did this study fit into the "big picture"? In particular, draw in the teoretical material we've studied so far this quarter (you may have already done so under one of the items above) and your knowledge of how the theory (models) work together with observations.

Critique

o Did you find anything wrong? Were there any problems noted as a result of the techniques used, the presentation of the figures or tables, the clarity of the presentation, or the conclusions drawn from the data?

o Were appropriate controls done? Are these observations reproducible? This category may or may not apply to the paper you are critiquing. For astronomy, it is usually the validity of the statistical analysis chosen to interpret the data, or the physics drawn in to support the theory.

o If you found no problems or were not able to identify any, what ***specifically*** do you think the authors did right? What did you gain from the paper?

Papers to choose from (you need 3 critiques total):

Radiative Transfer and Line Formation
Humphreys, Davidson, Ruch, & Wallerstein, 2005, **High-Resolution, Long-Slit Spectroscopy Of VY Canis Majoris: The Evidence For Localized High Mass Loss Events**, The Astronomical Journal, 129:492–510 (2)
Colosimo, Adriani, et al., 2008, **A simple Radiative Transfer model for the atmosphere of Saturn from the Cassini/VIMS observations**, Mem. S.A.It. Suppl. Vol. 12, 66 (1)
Bongard, Baron, Smadja, Branch, Hauschildt, 2008, **Multilayered Spectral Formation In Type Ia Supenovae Around Maximum Light**, The Astrophysical Journal, 687:456-465 (1)
Ramírez, Allende Prieto, Lambert, 2008, Granulation in K-type dwarf stars I. Spectroscopic observations, A&A 4921, 841-855 (2)
Cowan, Sneden, et al, 2005, **Hubble Space Telescope Observations of Heavy Elements in Metal-Poor Galactic Halo Stars**, The Astrophysical Journal, 627:238-250 (2 because of complexity)
Star Formation
Kun, Prusti, Nikolic, Johansson, Walton, 2004, **The IC 2118 association: New T Tauri stars in high-latitude molecular clouds**, A&A 418, 89-98 (1)
Green, Hartmann, et al, 2006, ***Spitzer* IRS Observations Of FU Orionis Objects**, The Astrophysical Journal, 648:1099-1109 (1)

Watson, Kemper, et al, 2004, **Mid-Infrared Spectra of Class I Protostars in Taurus**, The Astrophysical Journal Supplement Series, 154:391-395 (1)
Meeus & McCaughrean, 2005, **Using near-IR spectroscopy to classify substellar candidates in the Trapezium Cluster**, Astronomische Nachrichten, Vol.326, Issue 10, p.977-980 (1) http://www3.interscience.wiley.com/journal/60500255/home
Palla and Stahler, 2002, **Star Formation in Space and Time: Taurus-Auriga**, The Astrophysical Journal, 681:1194-1203 (1)
Stellar Pulsation
Bono, Caputo, Castellani, 2006, **Stellar pulsation and evolution: a stepping-stone to match reality**, Mem. S.A.It. Vol. 77, 207 (1)
Nardetto, Groh, Kraus, Millour, and Gillet, 2008, **High-resolution spectroscopy for Cepheids distance determination IV. Time series of Hα line profiles**, A&A 489, 1263-1269 (1)
Star death
Doyle, Balick, Corradi, and Schwarz, 2000, **The Evolving Morphology of the Bipolar Nebula m2-9**, The Astronomical Journal, 119:1339-1344 (1)
Kwok, Chong, Koning, Hua, and Yan, 2008, **The True Shapes of the Dumbbell and the Ring**, The Astrophysical Journal, 689:219-224 (1)
Stanghellini, Shaw, Villaver, 2008, **The Magellanic Cloud Calibration of the Galactic Planetary Nebula Distance Scale**, The Astrophysical Journa, 689:194-202 (1)
Globular Clusters
Yong, Grundahl, Nissen, Jensen, and Lambert, 2005, **Abundances in giant stars of the globular cluster NGC 6752**, A&A 438, 875-888 (1)
King, Bedin, Piotto, Cassisi, Anderson, 2005, **Color-Magnitude Diagrams and Luminosity Functions Down to the Hydrogen-Burning Limit III. A Preliminary Hubble Space Telescope Study of NGC 6791**, The Astronomical Journal, 130:626-634 (1)
Brown, Ferguson, et al, 2004, **Age Constraints for an M31 Globular Cluster from Main-Sequence Photometry**, The Astrophysical Journal, 613:L125-L128 (1)
Girardi, Bressan, Bertelli, & Chiosi, 2000, **Evolutionary tracks and isochrones for low- and intermediate-mass stars: From 0.15 to 7 M_{sun}, and Z=0.0004 to 0.03**, A&ASS, 141, 371-383 (2)
Catelan, Stetson, et al, 2006, **Deep HST Photometry of NGC 6388: Age and Horizntal-Branch Luminosity**, The Astrophysical Journal, 651:L133-L136 (1)
Beccari, Lanzonie + 25 more, 2008, **The Blue Straggler Population in the Globular Cluster M53 (NGC 5024): A Combined HST, LBT, and CFHT Study**, The Astrophysical Journal, 679:712-719 (1) [We didn't study blue stragglers, but this is a very interesting paper.]

If you feel overwhelmed, remember that I'll have to read or have read all of the ones you all choose!