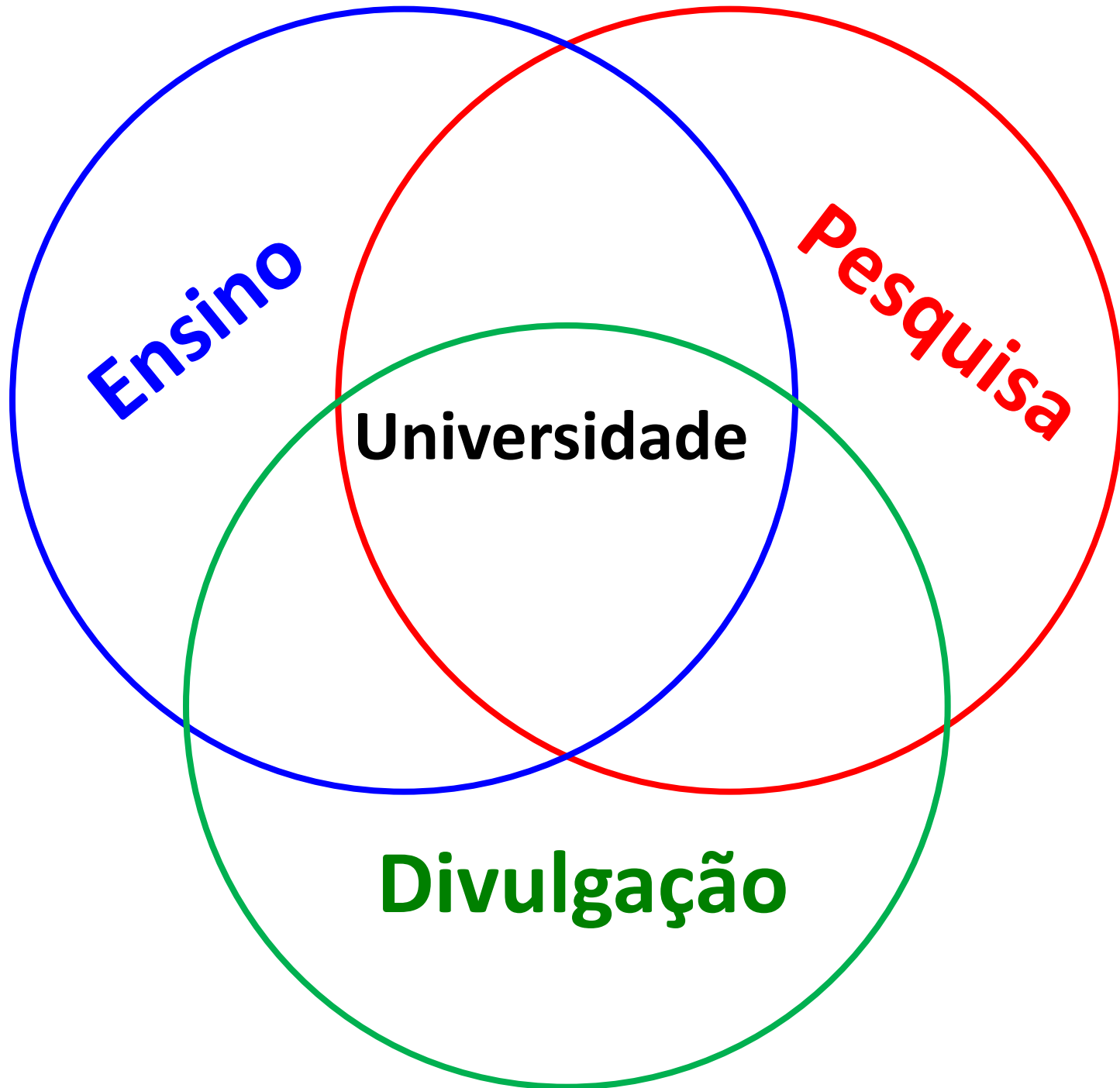# Dicas para fazer iniciação científica em Astrofísica no Brasil e no exterior

Prof. Dr. Jorge Meléndez

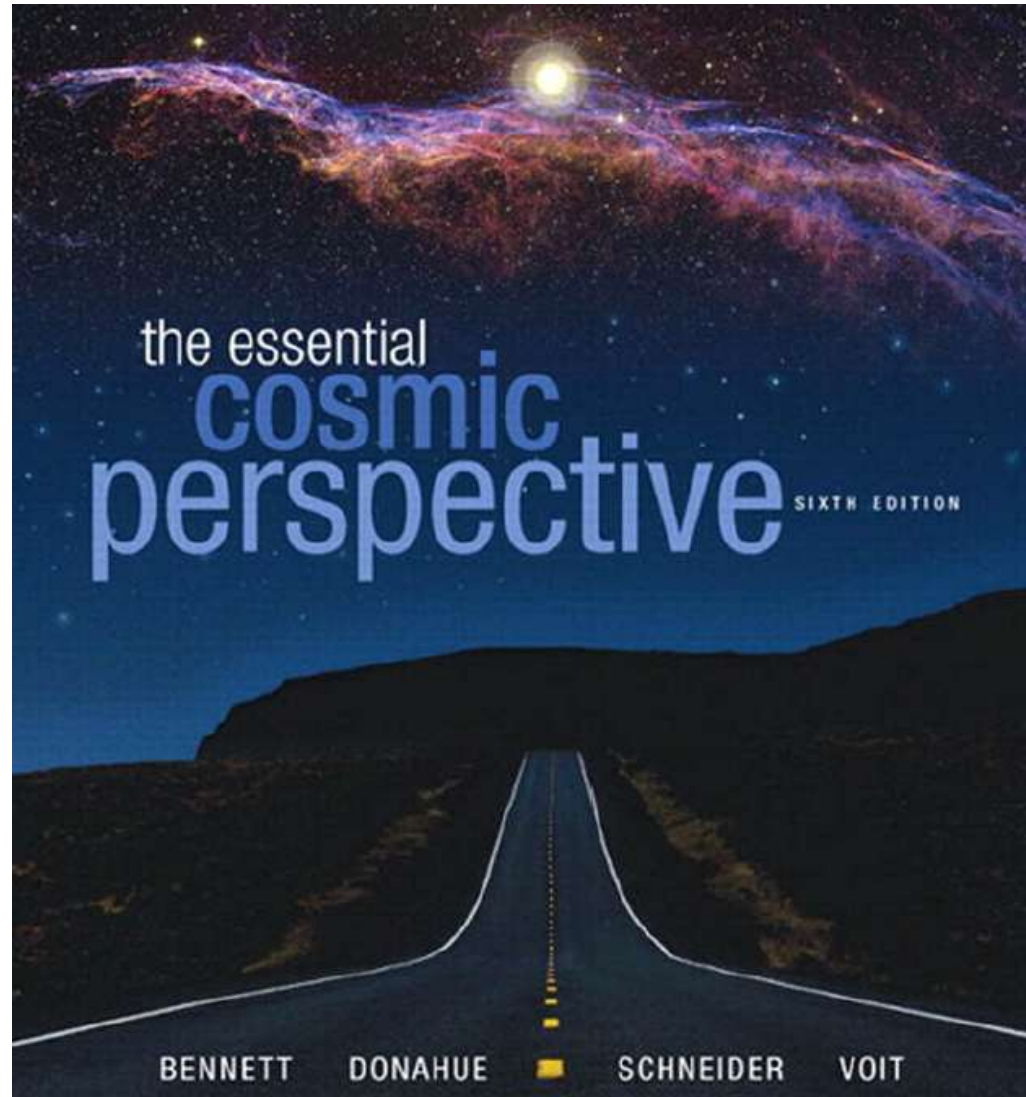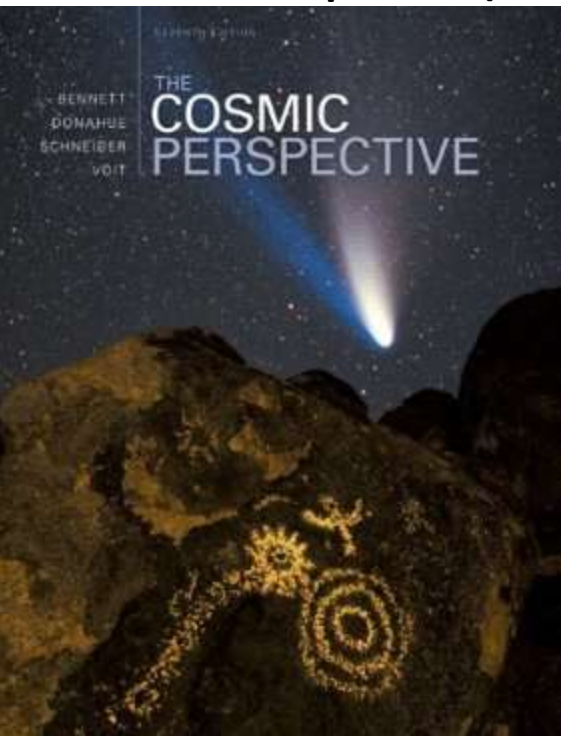Departamento de Astronomia, IAG/USP

São Paulo, 7/3/2013

Dica #1

- Conheca melhor as diversas técnicas de estudo e as diferentes áreas da Astronomia.

The Essential Cosmic Perspective (6th Edition), 2011
Jeffrey O. Bennett, Megan O. Donahue, Nicholas Schneider and Mark Voit

The Cosmic Perspective (7th Edition), 2013

Tipos de trabalho em Astronomia

- Pesquisa: observacional, teórica, instrumentação
- Ensino (didática)
- Divulgação
- **Melhor ainda, tentar fazer tudo junto!**

Pesquisa observacional

European Southern Observatory

Pesquisa teórica

Prof. Alex

Profa. Bete

Divulgação e Ensino

ciência

24/10/2012 - 05h00

Estudo vislumbra primeiro planeta "brasileiro"

SALVADOR NOGUEIRA
COLABORAÇÃO PARA A **FOLHA**

Recomendar 138   +1 5

Um grande estudo liderado por um pesquisador da Universidade de São Paulo está muito perto de encontrar os primeiros planetas "brasileiros" fora do Sistema Solar.

Jorge Meléndez, do IAG (Instituto de Astronomia, Geofísica e Ciências Atmosféricas), chefia o grupo internacional responsável pelo trabalho, que tem por objetivo decifrar como surgem as diversas arquiteturas possíveis para um sistema planetário.

Para tanto, ele obteve 88 noites de observação no telescópio de 3,6 m do ESO (Observatório Europeu do Sul) em La Silla, Chile.
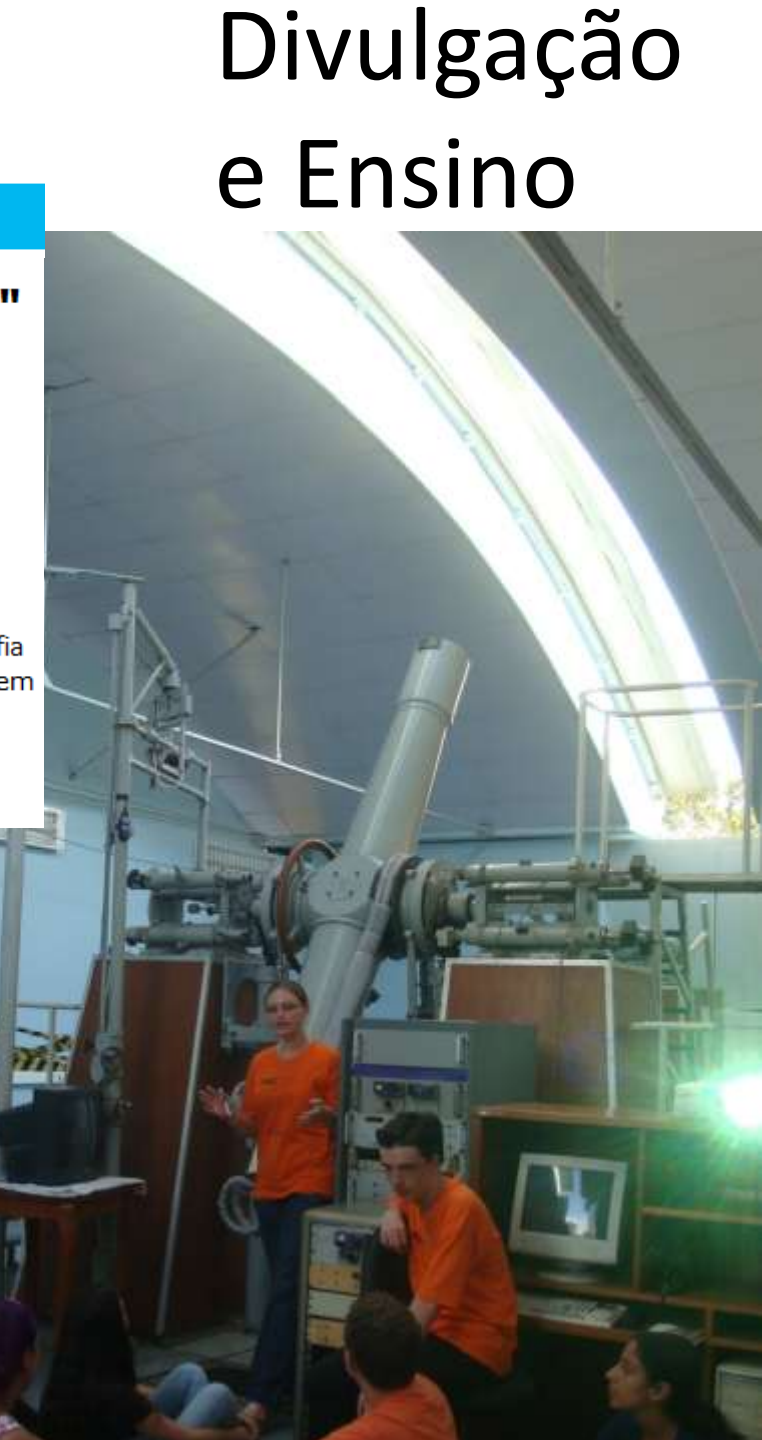
Astronomia para a 3ª idade

Período
18/05 à 22/06/10
(terças e quintas-feiras),
das 14 às 16h20

Informações e inscrições
De 15/03 à 30/04/10
pelos telefones: 3091-2710/2814/2800
no horário comercial
(das 8 às 12h e das 13 às 17h)
www.astro.iag.usp.br/tercidade.htm

Número de vagas
50

Realização
Instituto de Astronomia, Geofísica e
Ciências Atmosféricas da
Universidade de São Paulo - IAG-USP

Curso de Difusão Cultural - Programa Universidade Aberta à Terceira Idade

Áreas da Astronomia pelos mensageiros da informação: principalmente fótons

- **Raios Cósmicos**
- **Neutrinos**
- **Ondas gravitacionais**
- **Meteoritos, rochas lunares, …**

Gamma-ray
X-ray
Ultraviolet
Visible
Infrared
Sub-mm
Microwaves
Radio waves
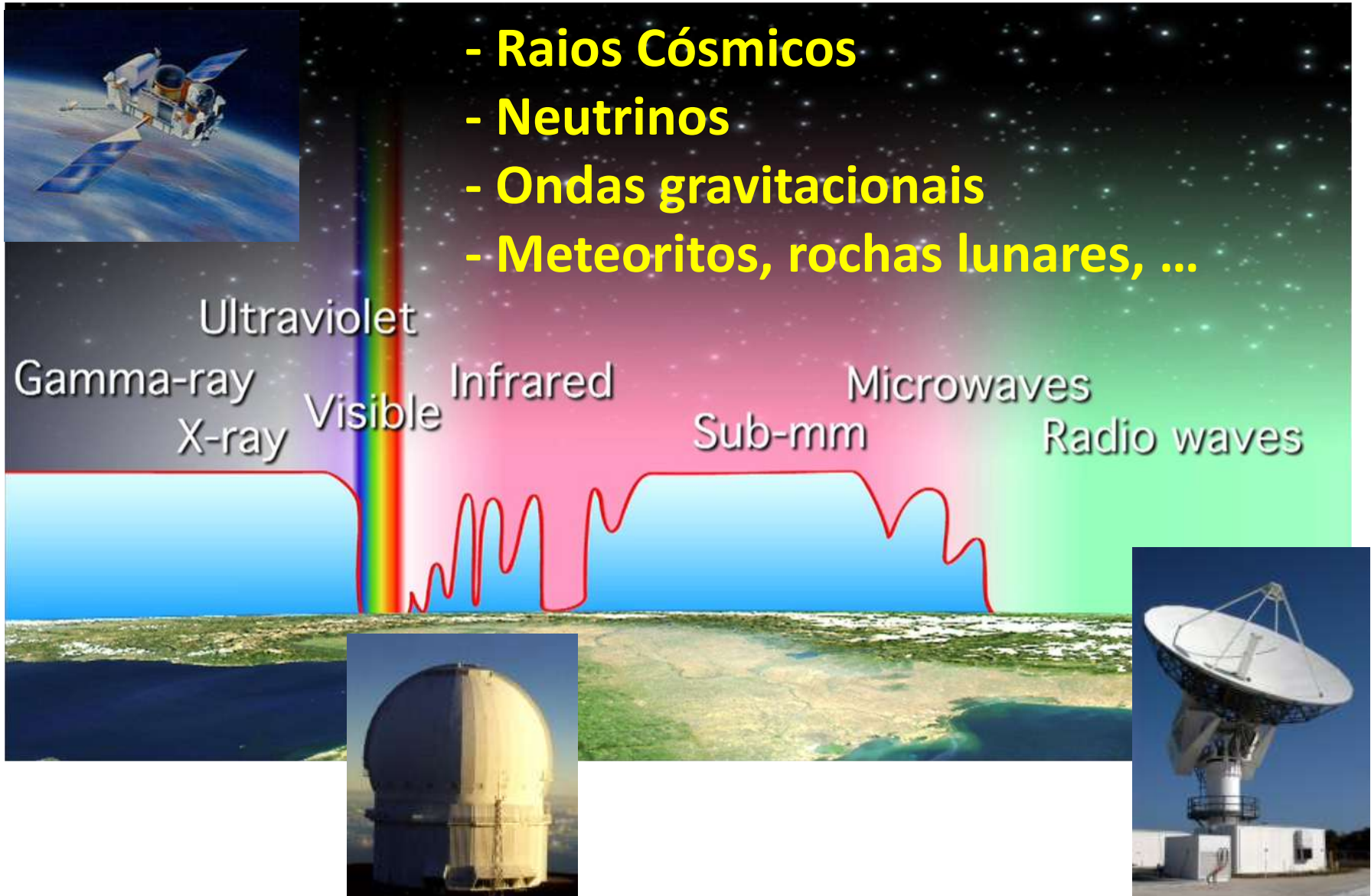
Áreas da Astronomia pela técnica observacional

Fotometria, Espectroscopia, Polarimetria, Sismologia, Interferometria, Astrometria, Coronografia, etc.
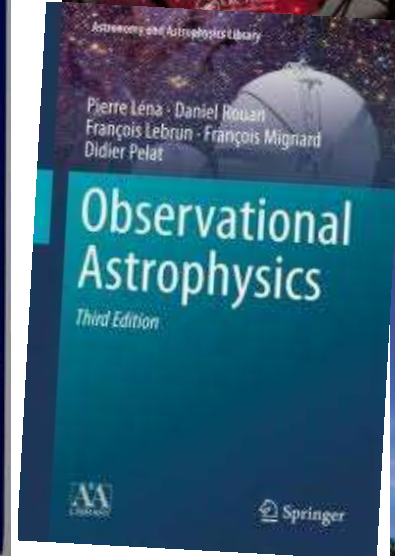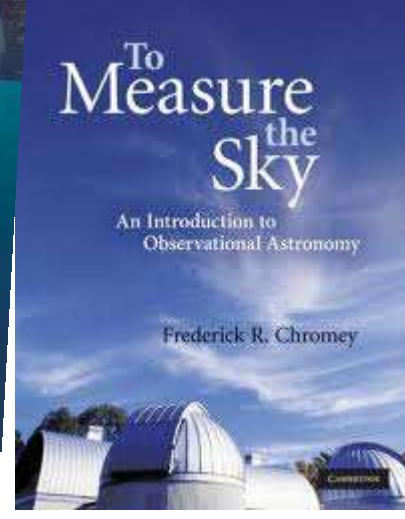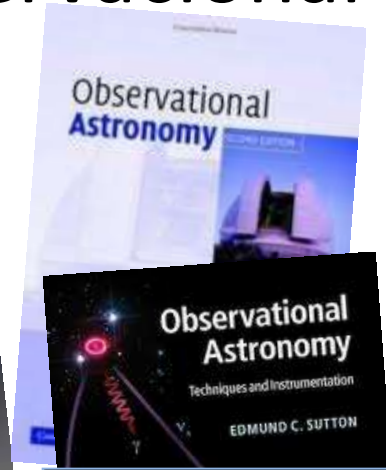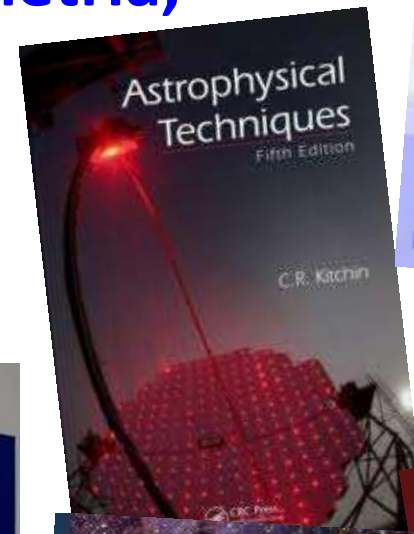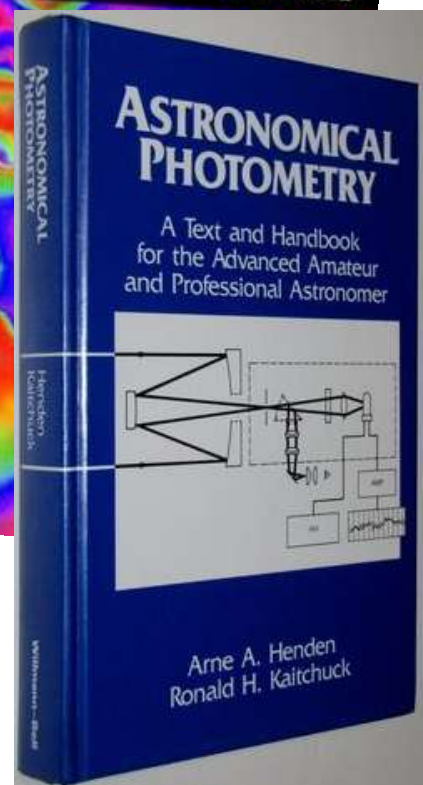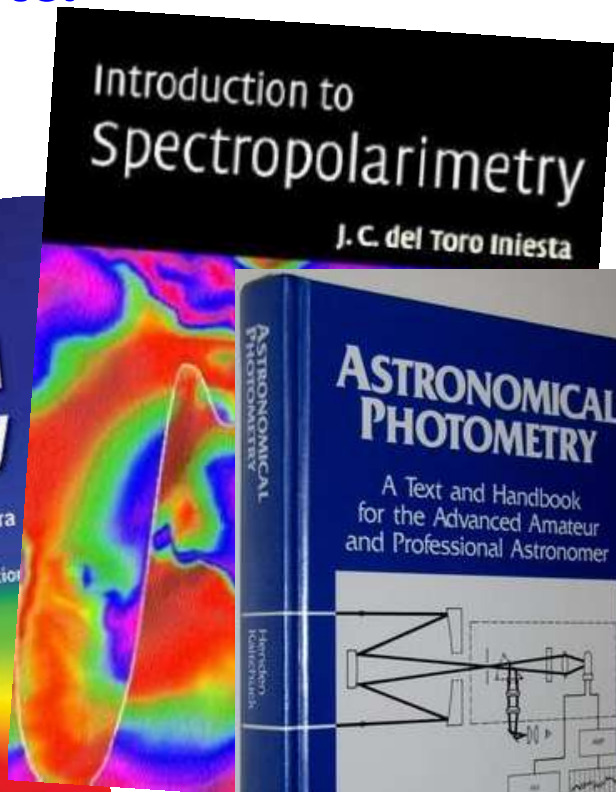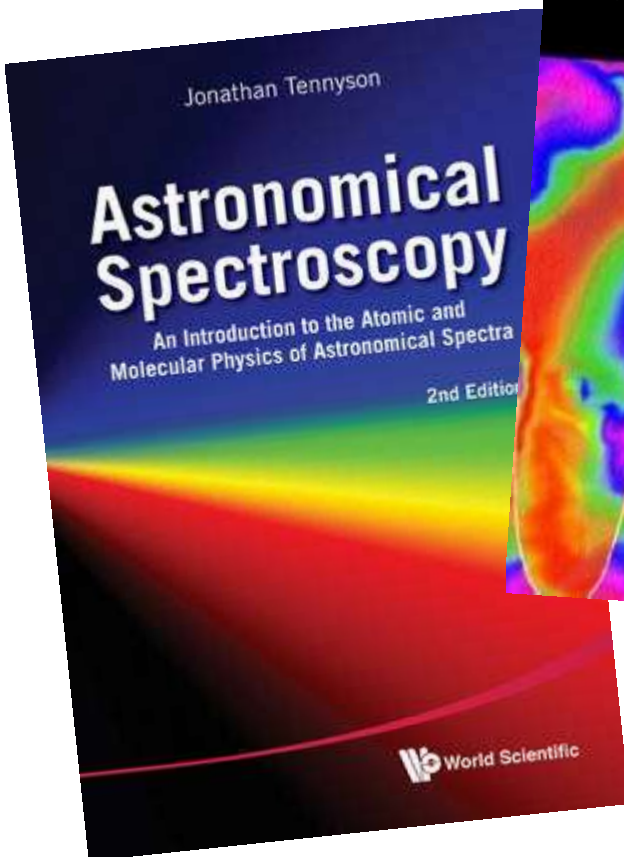
Áreas da Astronomia pelo objeto de estudo
Planetas, estrelas, galáxias

Áreas da Astronomia: PLANETAS

Planetas, luas, asteroides, cometas

Planetas fora do sistema solar: exoplanetas

Áreas da Astronomia: ESTRELAS

Diagrama Hertzsprung-Russell

luminosity (solar units)

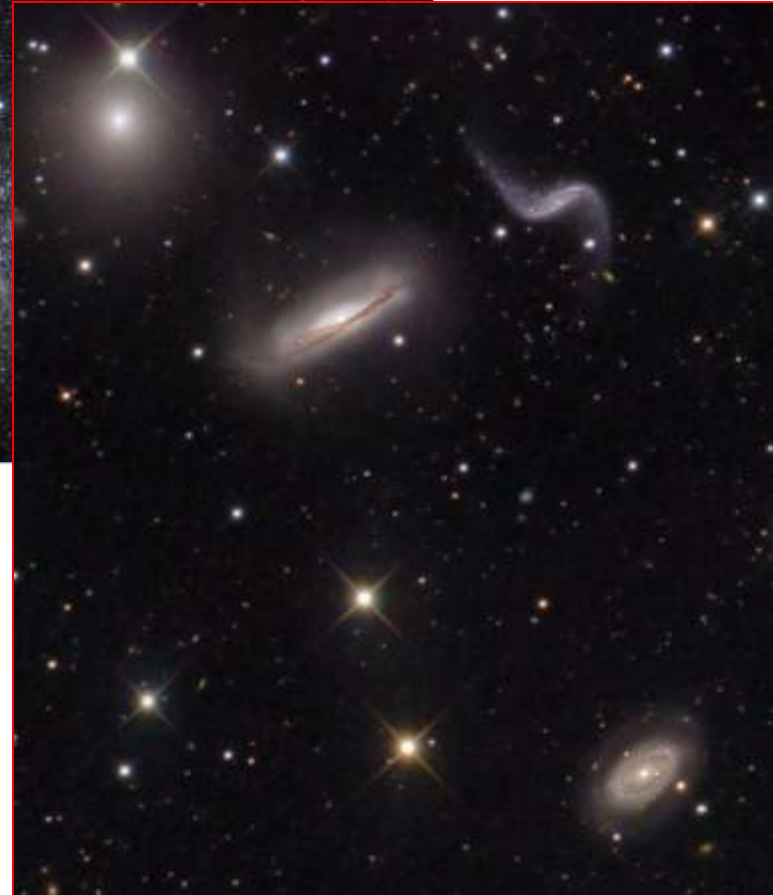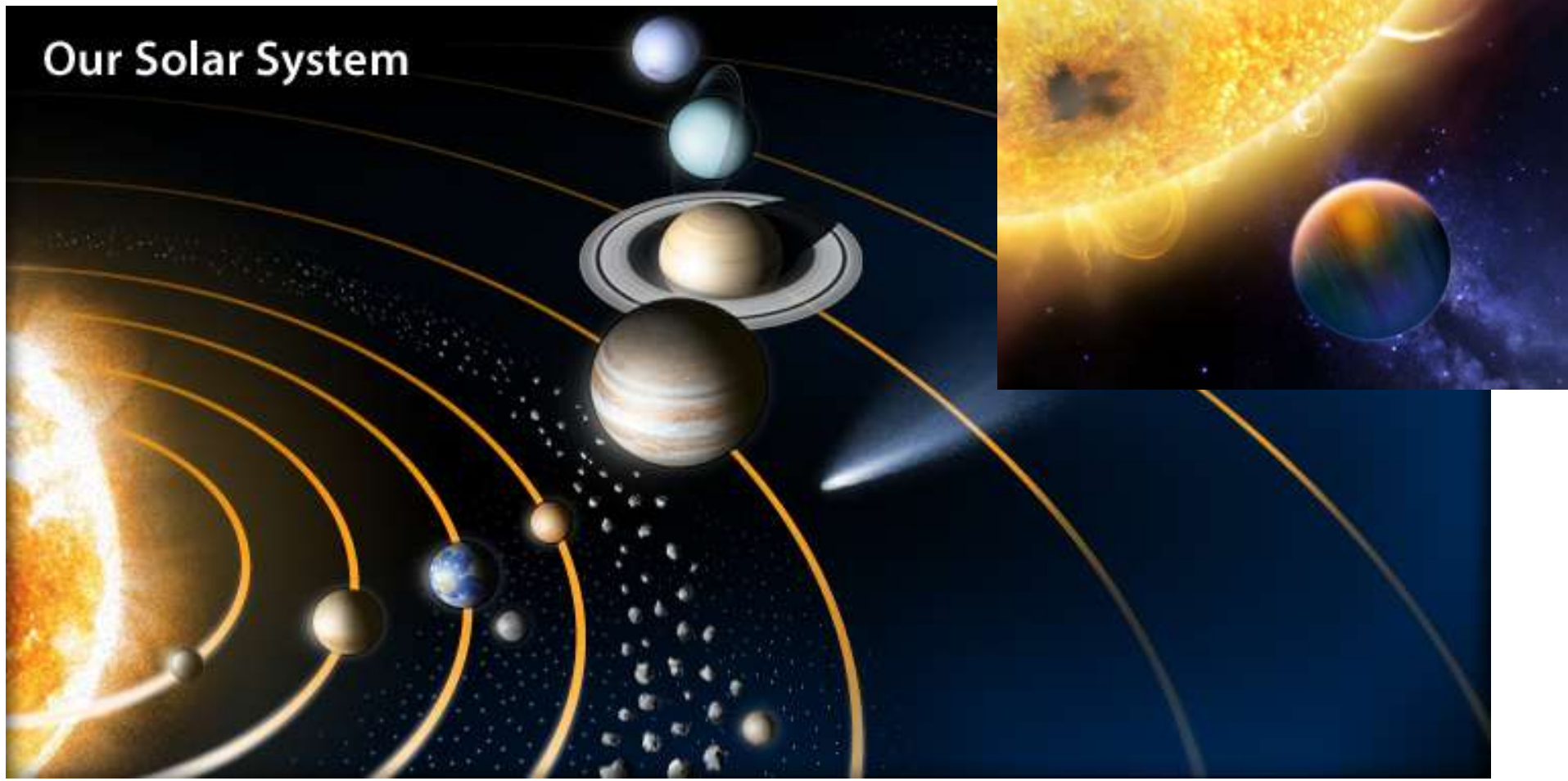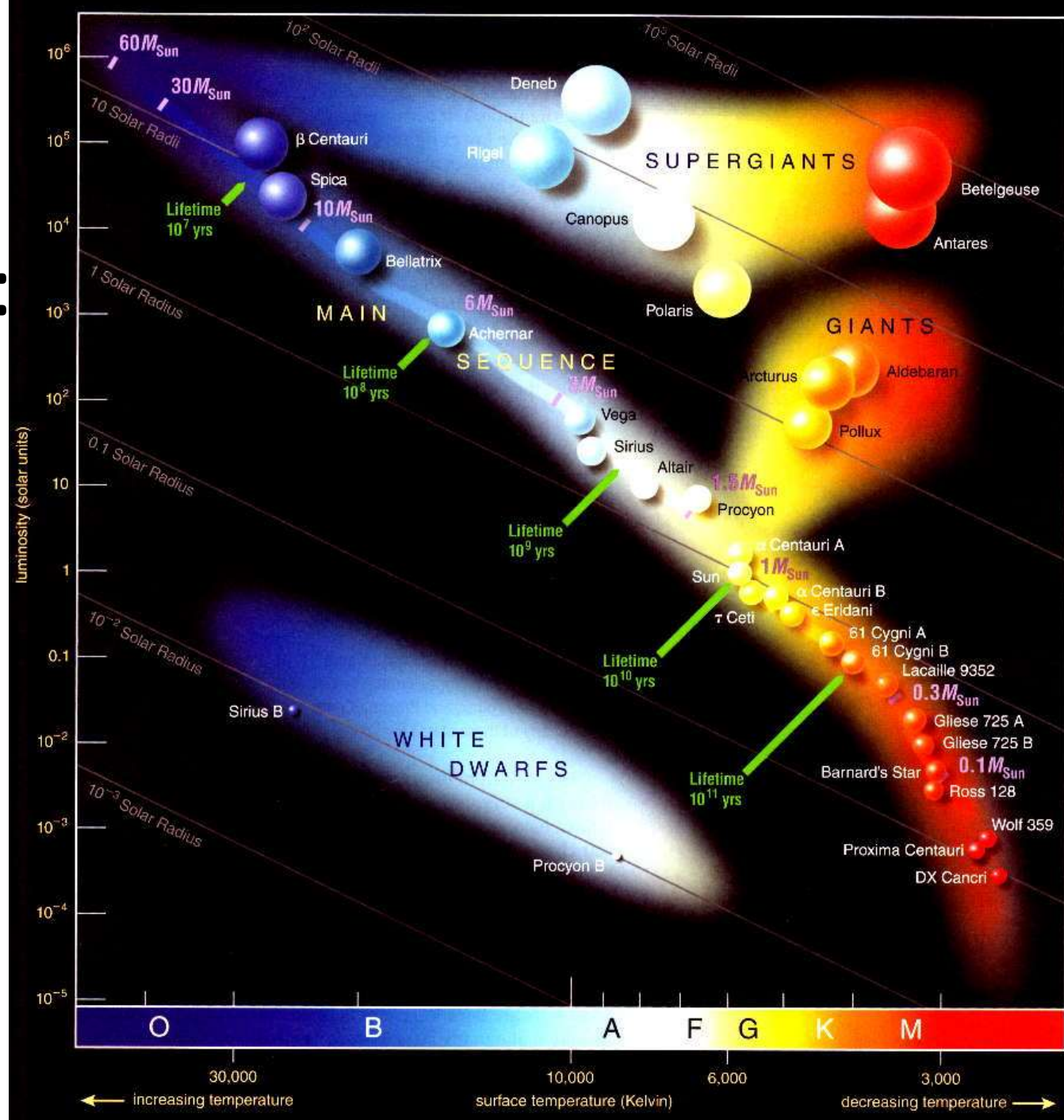|		
10^6	**60M_{Sun}**	10^2 Solar Radii
10^5	**30M_{Sun}** β Centauri	Deneb
	10 Solar Radii Spica	Rigel SUPERGIANTS
10^4	Lifetime 10^7 yrs **10M_{Sun}**	Canopus Betelgeuse Antares
10^3	1 Solar Radius Bellatrix **6M_{Sun}**	
10^2	MAIN Achernar	Polaris GIANTS
	Lifetime 10^8 yrs SEQUENCE **3M_{Sun}**	Arcturus Aldebaran
10	0.1 Solar Radius Vega Sirius Altair **1.5M_{Sun}**	Pollux
1	Procyon α Centauri A **1M_{Sun}**	
	Lifetime 10^9 yrs Sun 10^{-2} Solar Radius	α Centauri B ε Eridani
0.1	τ Ceti	61 Cygni A 61 Cygni B Lacaille 9352 **0.3M_{Sun}**
10^{-2}	Sirius B WHITE Lifetime 10^{10} yrs	Gliese 725 A Gliese 725 B
	DWARFS 10^{-3} Solar Radius	Barnard's Star **0.1M_{Sun}** Ross 128
10^{-3}	Lifetime 10^{11} yrs	Wolf 359 Proxima Centauri
10^{-4}	Procyon B	DX Cancri
10^{-5}	O B A F G K M	

increasing temperature → 30,000 10,000 6,000 surface temperature (Kelvin) 3,000 ← decreasing temperature
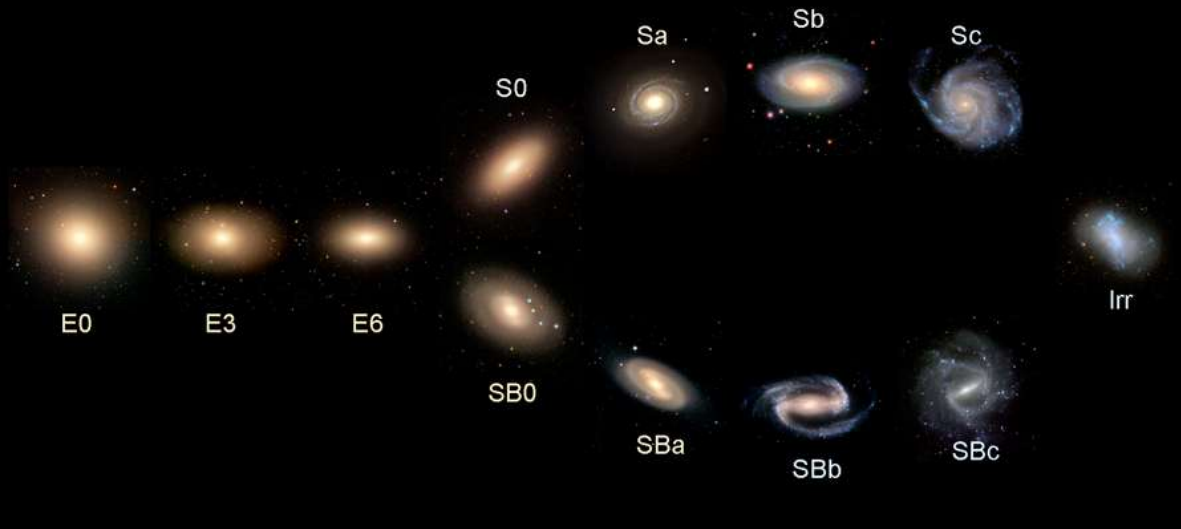
Áreas da Astronomia:
MEIO INTERESTELAR
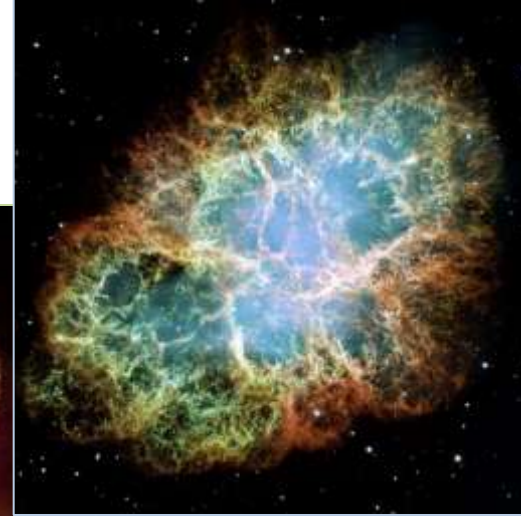
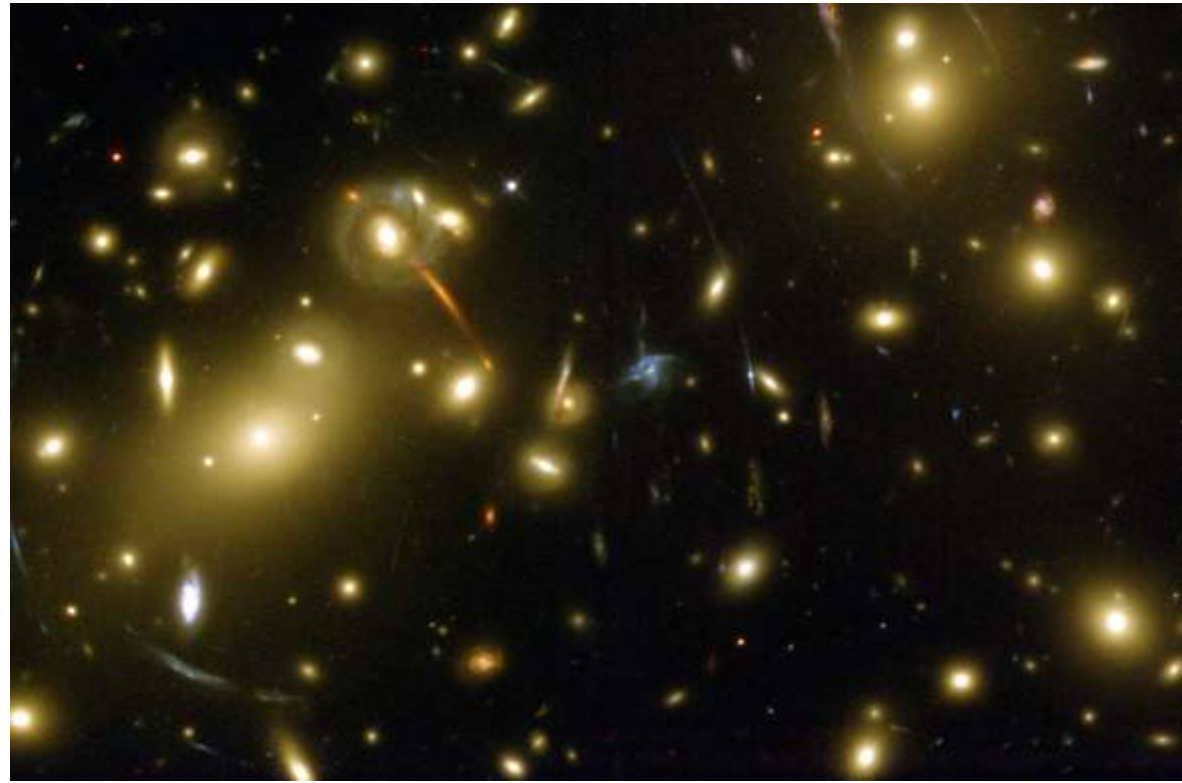# Áreas: Astronomia Galáctica (Via Láctea)

Aglomerados estelares; Populações estelares; Evolução química; Formação; Dinâmica, SFR, ...
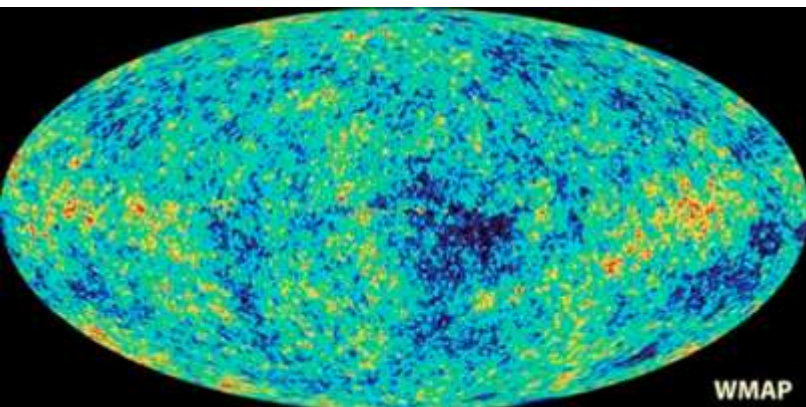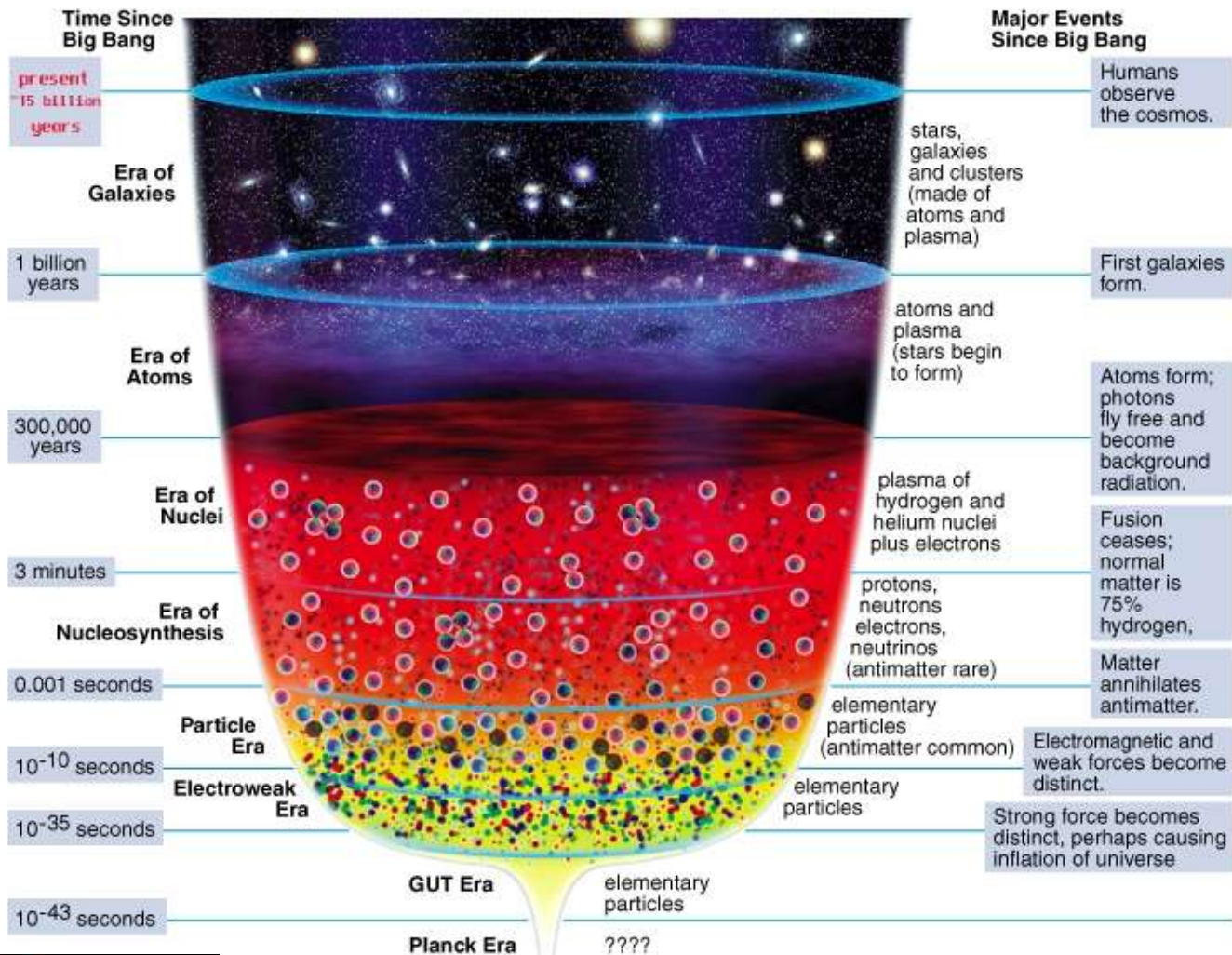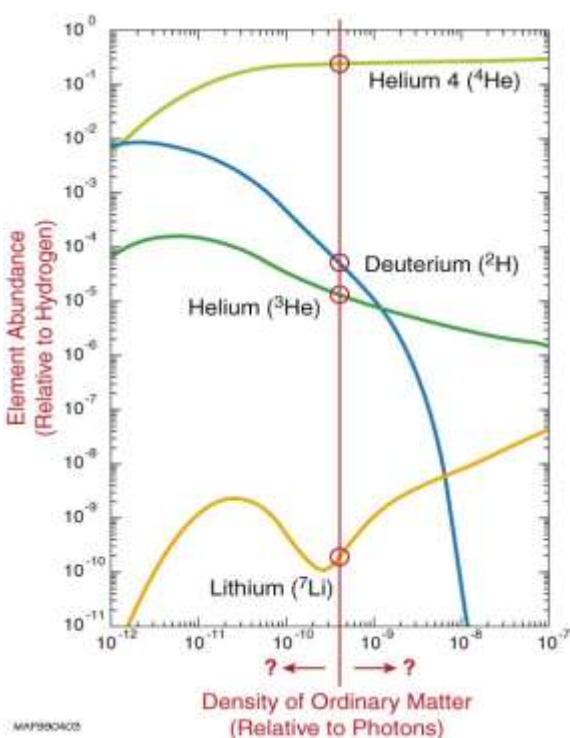
Hubble's Galaxy Classification Scheme
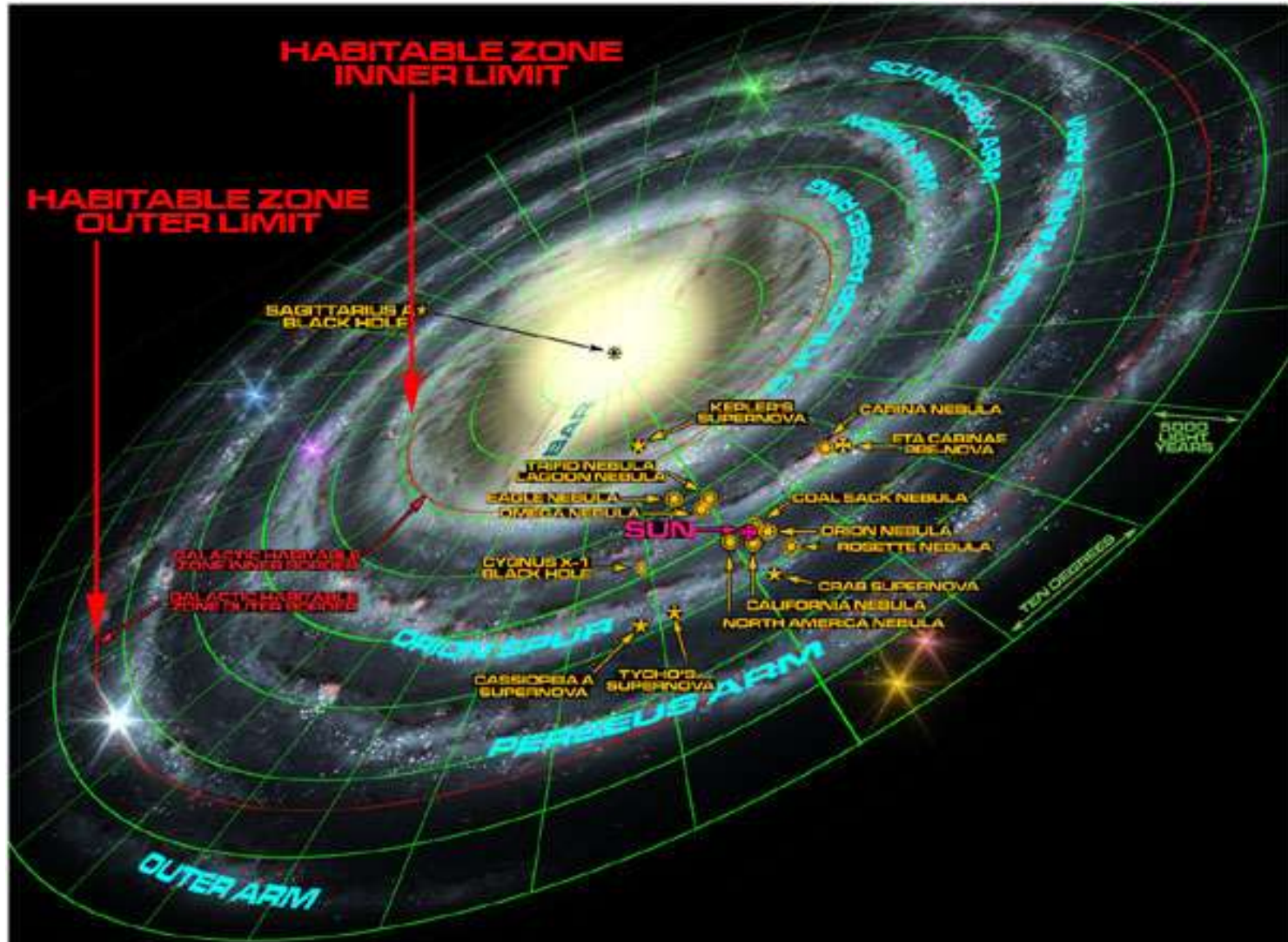
Áreas:
Astronomia
Extragaláctica

Big Bang

Áreas: Cosmologia

É importante conhecer diversas áreas.
Exemplo: *Zona habitável na Galáxia*

Dica #2

- Aprenda o básico do linux (sistemas ubuntu, etc)
- ***ls, cd, mkdir, cp, mv, rm, chmod, more, tail***, etc.

Uso de bases de dados, e.g., SIMBAD

http://simbad.u-strasbg.fr/simbad/sim-fid

Dica #3

- Existem diversos comandos no linux que podem facilitar muito a sua vida, p.ex.: ***cat, grep, awk***. Por exemplo, copiar 1a e 3a colunas de um arquivo

7041.907	0.0829	-2.995	0.0	14.	0.0	(3,0)R	5.5		7041.907	-2.995
7044.129	0.0838	-2.995	0.0	14.	0.0	(3,0)R	5.5		7044.129	-2.995
7046.431	0.0938	-2.926	0.0	16.	0.0	(3,0)R	6.5		7046.431	-2.926
7050.849	0.0950	-2.926	0.0	16.	0.0	(3,0)R	6.5		7050.849	-2.926
7052.458	0.1064	-2.868	0.0	18.	0.0	(3,0)R	7.5		7052.458	-2.868
7055.964	0.0613	-2.959	0.0	16.	0.0	(3,0)R	6.5		7055.964	-2.959
7055.989	0.0615	-2.959	0.0	16.	0.0	(3,0)R	6.5		7055.989	-2.959
7059.141	0.1079	-2.867	0.0	18.	0.0	(3,0)R	7.5		7059.141	-2.867
7059.221	0.0728	-2.894	0.0	18.	0.0	(3,0)R	7.5		7059.221	-2.894
7059.992	0.1206	-2.816	0.0	20.	0.0	(3,0)R	8.5		7059.992	-2.816
7060.836	0.0732	-2.894	0.0	18.	0.0	(3,0)R	7.5		7060.836	-2.894
7063.513	0.0859	-2.838	0.0	20.	0.0	(3,0)R	8.5		7063.513	-2.838
7067.059	0.0865	-2.839	0.0	20.	0.0	(3,0)R	8.5		7067.059	-2.839
7068.885	0.1004	-2.790	0.0	22.	0.0	(3,0)R	9.5		7068.885	-2.790
7068.917	0.1224	-2.815	0.0	20.	0.0	(3,0)R	8.5		7068.917	-2.815
7069.085	0.1365	-2.769	0.0	22.	0.0	(3,0)R	9.5		7069.085	-2.769
7069.924	0.1184	-2.970	0.0	14.	0.0	(3,0)R	5.5		7069.924	-2.970
7074.352	0.1198	-2.969	0.0	14.	0.0	(3,0)R	5.5		7074.352	-2.969
7074.653	0.1013	-2.791	0.0	22.	0.0	(3,0)R	9.5		7074.653	-2.791
7075.393	0.1164	-2.747	0.0	24.	0.0	(3,0)R	10.5		7075.393	-2.747
7076.787	0.1305	-2.906	0.0	16.	0.0	(3,0)R	6.5		7076.787	-2.906
7079.707	0.1540	-2.727	0.0	24.	0.0	(3,0)R	10.5		7079.707	-2.727
7080.104	0.1385	-2.768	0.0	22.	0.0	(3,0)R	9.5		7080.104	-2.768
7081.529	0.1317	-2.905	0.0	16.	0.0	(3,0)R	6.5		7081.529	-2.905
7083.086	0.1340	-2.708	0.0	26.	0.0	(3,0)R	11.5		7083.086	-2.708
7083.685	0.1176	-2.748	0.0	24.	0.0	(3,0)R	10.5		7083.685	-2.748

awk '{print $1,$3}' arquivo.txt > saida.txt

Dica #4
(especialmente para alunos de 3o e 4o ano)

- Aprender uma linguagem de programação (p.ex. *fortran, c, python, idl, shell script*) pode ampliar (e muito) as suas possibilidades.

for, do, while, if, else

- O pacote **IRAF** pode ser útil para análise de dados.

Dica #5

- Não se preocupe muito com o tema de pesquisa. Alias, é uma otima oportunidade para experimentar diversas áreas ou para conhecer melhor um potencial orientador para uma pós-graduação

Exemplo: Iván Ramírez (UNMSM, Peru). Gostava de **Galáxias** mas após iniciação científica em **Estrelas** gostou da área e decidiu trabalhar em **Astrofísica Estelar na pós-graduação** ... **nos Estados Unidos**

Dica #6

- Como escolher orientador? Conheca um pouco mais sobre ele:

- Procure se o professor tem página web.

- Pergunte a outros orientados do professor

- Procure o currículo lattes:

http://lattes.cnpq.br/

- Procure as publicações do professor no ADS:

http://adsabs.harvard.edu/abstract_service.html

Sitemap   What's New   Feedback   Basic Search   Preferences   FAQ   HELP

Check out **ADS Labs** !

| Send Query | Return Query Form | Store Default Form | Clear |

Databases to query: ☑ **Astronomy**   ☐ **Physics**   ☑ **arXiv e-prints**

Authors: (Last, First M, one per line)   ☑ **SIMBAD** ☑ **NED** ☑ ADS **Objects**
☐ **Exact name matching**   **Object name**/**position search**
☐ **Require author for selection**   ☐ **Require object for selection**
(⦿ OR ○ AND ○ **simple logic**)   (Combine with: ⦿ OR ○ AND)

Melendez, J.

Publication Date between [   ] [   ] and [   ] [   ]
                         (MM) (YYYY)   (MM) (YYYY)

FILTERS

Select References From:
○ **All bibliographic sources**   ☐ Select only **articles**
⦿ **All refereed articles**
○ **All non-refereed publications**

Selecionar opção "refereed articles" para publicações arbitradas

Primeiro olhar por data (default), depois por citações

Query Results from the ADS Database   Go to bottom of page

Selected and retrieved **74** abstracts.

Sort options

Sort by citations

#	Bibcode	Score	Date	List of Links
	Authors	Title		Access Control Help

1 ☐ 2013A&A...549A.147B   1.000   01/2013   A   E F   X   D   R C   O U

Bensby, T.; Yee, J. C.; Feltzing, S.; Johnson, J. A.; Gould, A.; Cohen, J. G.; Asplund, M.; Meléndez, J.; Lucatello, S.; Han, C.; and 13 coauthors

Chemical evolution of the Galactic bulge as traced by microlensed dwarf and subgiant stars. V. Evidence for a wide age distribution and a complex MDF

2 ☐ 2012ApJ...761...16C   1.000   12/2012   A   E F   X   R C   S   U

Casagrande, L.; Ramírez, I.; Meléndez, J.; Asplund, M.

The Infrared Colors of the Sun

3 ☐ 2012ApJ...757..164R   1.000   10/2012   A   E F   X   D   R C   S   U

Ramírez, I.; Meléndez, J.; Chanamé, J.

Oxygen Abundances in Low- and High-α Field Halo Stars and the Discovery of Two Field Stars Born in Globular Clusters

4 ☐ 2012A&A...543A..29M   1.000   07/2012   A   E F   X   D   R C   S   U

Meléndez, J.; Bergemann, M.; Cohen, J. G.; Endl, M.; Karakas, A. I.; Ramírez, I.; Cochran, W. D.; Yong, D.; MacQueen, P. J.; Kobayashi, C.; Asplund, M.

The remarkable solar twin HIP 56948: a prime target in the quest for other Earths

5 ☐ 2012ApJ...752....5R   1.000   06/2012   A   E F   X   R C   U

Ramírez, I.; Michel, R.; Sefako, R.; Tucci Maia, M.; Schuster, W. J.; van Wyk, F.; Meléndez, J.; Casagrande, L.; Castilho, B. V.

The UBV(RI)$_C$ Colors of the Sun

2734 citações para 74 artigos arbitrados; Média de 37 citações por artigo

Query Results from the ADS Database

Go to bottom of page

Selected and retrieved **74** abstracts. Total citations: **2734**

Sort options ▼

#	Bibcode	Cites	Date	List of Links								
	Authors	Title		Access Control Help								
1	2005ApJ...626..465R	214.000	06/2005	A	E F	X		R C	S		O U	
	Ramírez, Iván; Meléndez, Jorge	The Effective Temperature Scale of FGK Stars. II. T_{eff}:Color:[Fe/H] Calibrations										
2	2010A&A...512A..54C	157.000	03/2010	A	E F	X	D	R C	S		O U	
	Casagrande, L.; Ramírez, I.; Meléndez, J.; Bessell, M.; Asplund, M.	An absolutely calibrated T_{eff} scale from the infrared flux method. Dwarfs and subgiants										
3	2005AJ....129..303C	119.000	01/2005	A	E F	X	D	R C	S		U	
	Cohen, Judith G.; Meléndez, Jorge	Abundances in a Large Sample of Stars in M3 and M13										
4	2004ApJ...615L..33M	119.000	11/2004	A	E F	X		R C	S		U H	
	Meléndez, Jorge; Ramírez, Iván	Reappraising the Spite Lithium Plateau: Extremely Thin and Marginally Consistent with WMAP Data										
5	2005A&A...443..735C	118.000	11/2005	A	E F	X	D	R C	S		O U	
	Coelho, P.; Barbuy, B.; Meléndez, J.; Schiavon, R. P.; Castilho, B. V.	A library of high resolution synthetic stellar spectra from 300 nm to 1.8 μm with solar and α-enhanced composition										
6	2005ApJ...626..446R	98.000	06/2005	A	E F	X	D	R C	S		O U	
	Ramírez, Iván; Meléndez, Jorge	The Effective Temperature Scale of FGK Stars. I. Determination of Temperatures and Angular Diameters with the Infrared Flux Method										

Índice h (*h-index*) e índice *m.*

Para isso usar ordenar por citações (h-index: #ordem = #citações)

29 ☐ 2003A&A...411..417M	35.000	12/2003	A	E F	X	D	R C	S		U H

Meléndez, J.; Barbuy, B.; Bica, E.; Zoccali, M.; Ortolani, S.; Renzini, A.; Hill, V.

Gemini-Phoenix infrared high-resolution abundance analysis of five giants in the bulge globular cluster NGC 6553

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30 ☐ 2010A&A...509A..20R	33.000	01/2010	A	E F	X	D	R C S		U

Ryde, N.; Gustafsson, B.; Edvardsson, B.; Meléndez, J.; Alves-Brito, A.; Asplund, M.; Barbuy, B.; Hill, V.; Käufl, H. U.; Minniti, D.; and 3 coauthors

Chemical abundances of 11 bulge stars from high-resolution, near-IR spectra

---

31 ☐ 2007ApJ...659L.161C	32.000	04/2007	A	E F	X	R C S	U

Cohen, Judith G.; McWilliam, Andrew; Christlieb, Norbert; Shectman, Stephen; Thompson, Ian; Melendez, Jorge; Wisotzki, Lutz; Reimers, Dieter

A New Type of Extremely Metal-poor Star

m-index = h-index/#anos_publicando

m = 32/13,5 anos = 2,4

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32 ☐ 2004ApJ...615.1042M	32.000	11/2004	A	E F	X	R C	U H

Meléndez, Jorge

A Low Solar Oxygen Abundance from the First-Overtone OH Lines

---

33 ☐ 2006ApJ...641L.133M	31.000	04/2006	A	E F	X	R C S	U

Meléndez, Jorge; Dodds-Eden, Katie; Robles, José A.

HD 98618: A Star Closely Resembling Our Sun

---

34 ☐ 2004ApJ...609..417R	31.000	07/2004	A	E F	X	R C S	U H

Ramírez, Iván; Meléndez, Jorge

Cooler and Bigger than Previously Thought? Planetary Host Stellar Parameters from the Infrared Flux Method

h-index = 32

Também existem potenciais orientadores fora do IAG

- IF/USP
- Mackenzie: p.ex. Sol, exoplanetas
- UNICSUL: p. ex. Populações estelares
- UNESP: cosmologia

Vantagens de fazer IC sem bolsa

- Pode "testar" por alguns meses se realmente gosta do projeto

- Pode experimentar diversos orientadores em projetos mais curtos (3 – 6 meses)

- Poderá ser considerado no futuro para solicitação de bolsa pelo orientador

- Dica: por exemplo fazer IC de dezembro a fevereiro/março e se gostar pedir ao orientador solicitação de bolsa PIBIC em março-abril

Bolsas: USP, FAPESP

- **Fique atento às datas para bolsas PIBIC da USP (período de inscrição de 18/02/2013 a 26/04/2013, para começar em agosto 2013)**
- Outras bolsas: por ex. INCT-A (18/3 e outros)
- Bolsas de outros projetos USP
- Bolsas FAPESP individuais
- Bolsas FAPESP de projetos temáticos

Iniciação Científica no Exterior

- Aproveitar "verão" (nosso inverno) para fazer iniciação científica no exterior. Tb verão *Aussie*

- Diversas oportunidades nos Estados Unidos, Europa, Austrália

- Vantagem: geralmente o pagamento é bom, US$400-600 por semana.

- Dificuldade: geralmente só tem apoio para passagem aérea dentro do país, mas às veces tem apoio para alunos de fora (p.ex., STScI)

- **Também é possível fazer estagio de IC no exterior usando bolsas BEPE da FAPESP**

Iniciação Científica no Exterior: Europa

http://www.strw.leidenuniv.nl/summerstudents/

Ótima oportunidade para alunos do último ano da graduação e do mestrado

The Leiden/ESA Astrophysics Program for Summer Students (LEAPS)

Leiden Observatory and ESA are pleased to welcome applications for the inaugural edition of the LEAPS program. LEAPS is an opportunity for students with an interest in astronomy and astrophysics to perform a 10-12 week summer research project in collaboration with a research scientist from Leiden Observatory or ESA. The program is open to all students not currently engaged in a Ph.D. program, although we are most interested in students at the senior-undergraduate or masters level who are enthusiastic about research in astrophysics. Students will be selected for the program based on their academic achievements and research potential, and will be matched to staff projects based on what they indicate their scientific interests to be. Research at Leiden Observatory and ESA takes place on a diverse array of topics (see below), and student projects will likely consist of anything from the analysis of data from world-class telescopes, to large computer simulations, to hands-on work in the astrochemistry laboratories.

Projects will begin in June 2013 and end before mid-September 2013. We expect to make as many as 10 appointments this year, depending on interest and the matching of projects to students interests and skills. Details can be found below.

Fully-complete applications received by **March 15, 2013, 23:59 CET** will receive full consideration

Iniciação Científica no Exterior: Estados Unidos

- Para IC nos Estados Unidos procure no google por "REU" (*Research Experiences for Undergraduates*), ou melhor ainda "*REU Astronomy*"

- Fique atento às datas. Alguns programas não aceitam estudantes estrangeiros ou não pagam a passagem aérea.

- No geral as inscrições são aprox. em Jan-Fev (ou até março) para começar o estagio em Junho ou Julho

Iniciação Científica no Exterior
http://www.stsci.edu/institute/smo/students/current

US$600/week
+ travel
+ 1/3 housing

Iniciação Científica no Exterior
Space Telescope Sciente Institute 2003
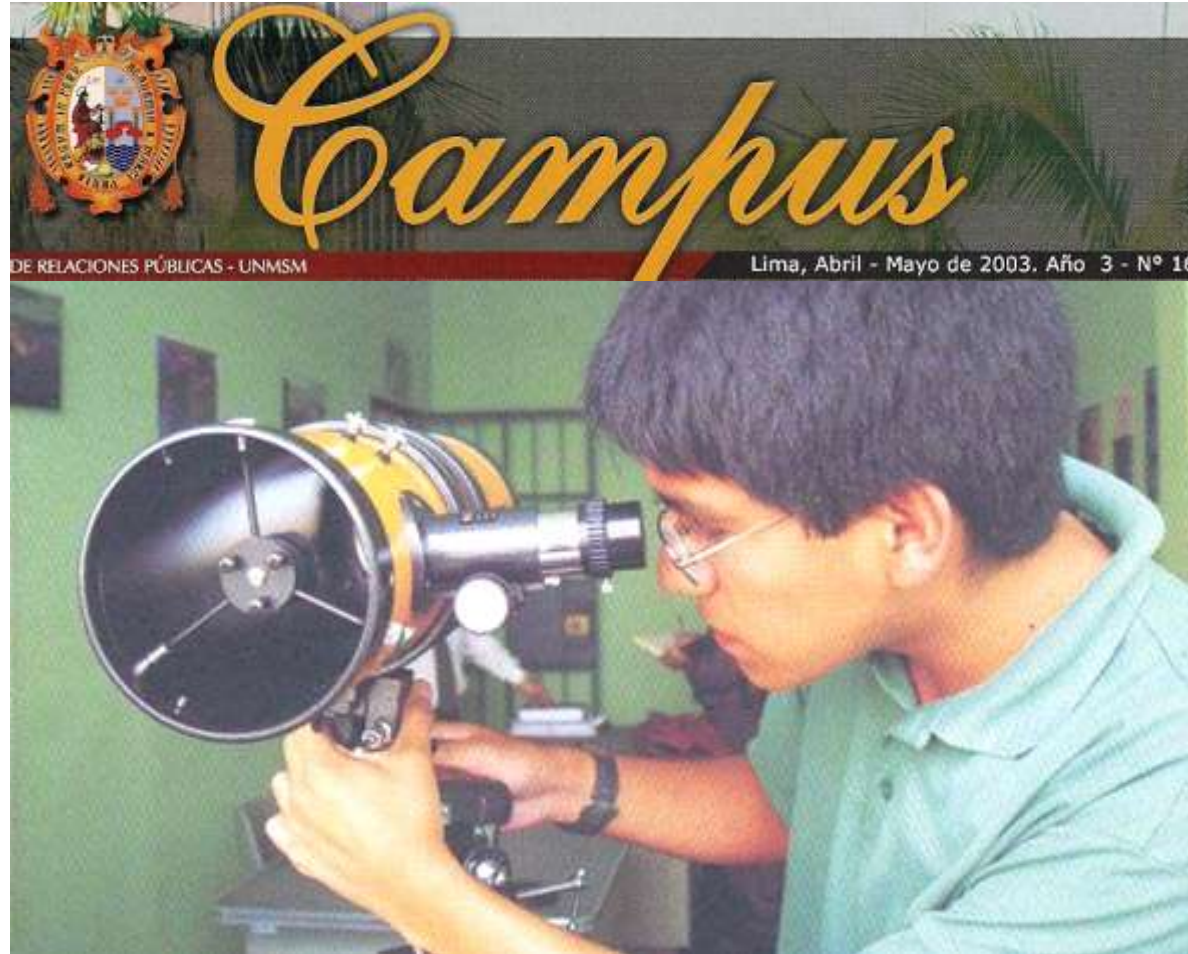
Iván Ramírez: meu estudante peruano selecionado
para estagio de IC no *Space Science Telescope Institute*

Austrália
http://www.aao.gov.au/students/aaosf.html

| Astronomy | Instrumentation | Observing | Images |

AAO Student Fellowship Program

DEADLINE: 15/2/2013 ou 31/8/2013

Applications for AAO Student Fellowships are now being accepted.

We are now accepting applications for the June - September 2013 program. Applications should be submitted, following the detailed instructions below. The deadline for applications is **15 February 2013**.

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How to apply
Frequently asked questions
Astronomy Research at the AAO
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Introduction

Opportunities exist for undergraduate students who have completed not less than 2 years of full time course work in Astronomy, Astrophysics, Applied Physics, Engineering, Mathematics or related subjects to work at the Australian Astronomical Observatory on research projects under the individual supervision of AAO staff astronomers. In addition to astronomical research, a major part of the Observatory's core business is astronomical instrumentation for optical/infrared telescopes, and studentships are available in this area as well. This provides good opportunities for students who seek experience in photonics, electronics, software, mechanical and systems engineering, and benefits from the AAO's close ties to astrophotonics research groups at Macquarie University and the University of Sydney.

Historically the AAO Student Fellowship program (akin to internship programs elsewhere) has catered primarily to UK students during their summer break (the Australian winter), and to Australian students during their summer break. However, the AAO is keen to expand

Student fellowships
at the
Australian Astronomical Observatory
and
Gemini South Observatory

Opportunities exist for science and engineering students with at least two years undergraduate experience to carry out 10–12 weeks of paid research at the Australian Astronomical Observatory in Sydney or at the Gemini South Observatory in Chile.

Application deadline:
31 August

Full details and application procedure:
http://www.aao.gov.au/students

http://astronomy.swin.edu.au/study/vacstudents.html

Centre for Astrophysics & Supercomputing

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Vacation Scholarships in Astronomy at CAS

The Centre for Astrophysics & Supercomputing (CAS) accepts applications for Vacation Scholarships from enthusiastic university students with excellent scholastic records who are in the last, or second last, year of their undergraduate or Honours/Masters degree.

With 16 research faculty and more than 30 post-docs and PhD students, CAS is a vibrant, friendly environment for studying most fields of astronomy. Swinburne astronomers have guaranteed access to the twin Keck 10-m Telescopes in Hawaii - the world's premier optical observatory - and CAS owns and operates one of Australia's most powerful supercomputers - The Green Machine. We also develop advanced immersive 3D data visualization facilities and create 3-D animations and movies promoting and explaining astronomy to the broader community.

Swinburne's Hawthorn campus is situated in a lively, urban setting just minutes by public transport from Melbourne's city centre.

Our Vacation Scholarship program aims to provide undergraduate students with some insight into how exciting research is and how it is conducted. Students will join a research project, or maybe help start a new one, in one of the many areas of astronomy in which CAS staff and post-docs are experts. The various projects on offer are listed below. Projects can involve all aspects of astronomical research, from proposing or carrying out new telescope observations, to analysing some of the data or conducting theoretical calculations or advanced simulations. Many previous students have eventually published peer-reviewed research articles on some of their Vacation Scholarship research.

Applications can be made at any time throughout the year. We particularly encourage applicants to work over the summer months, December to February.

This program is open to undergraduates at Australian & New Zealand universities. Applications from students outside of Australia & New Zealand with exceptional scholastic records may also be considered.

Scholarships will generally last between 6 and 10 weeks, to be negotiated between the student and their nominated supervisor. Vacation Scholars are paid a tax-free stipend of $500 per week. CAS will also pay for one return trip from within Australia & New Zealand to Melbourne for eligible students.

Applications should include the following:

- A cover letter (see below for further information);
- A copy of your official academic record, including an explanation of the grading system used;
- Your Curriculum Vitae;
- Any supporting documentation of previous research.

Applicants should also ask a lecturer or supervisor at their current university to send a letter of recommendation. This should be sent by the lecturer/supervisor directly; applicants should not include reference letters in their own application.

Applications and reference letters should be emailed to Dr. Thibault Garel (tgarel@astro.swin.edu.au) with the above information attached

Australian National University

http://rsaa.anu.edu.au/study/undergraduate-research/summer-research

Usually only from Australia and NZ, mas se tiver interesse pode entrar em contato

What about

Iniciação Científica + Artigo em revista internacional + Divulgação ? Tudo isso em 3-4 meses !

Katie Dodds-Eden fez isso, sob minha orientação de dezembro/2005 a março/2006 na Australian National University

Segunda gêmea solar identificada em 2006: HD 98618

HD 98618: A STAR CLOSELY RESEMBLING OUR SUN[1]

JORGE MELÉNDEZ,[2] KATIE DODDS-EDEN, AND JOSÉ A. ROBLES

Research School of Astronomy and Astrophysics,
Mount Stromlo Observatory

- Projeto de iniciação científica de Katie Dodds-Eden
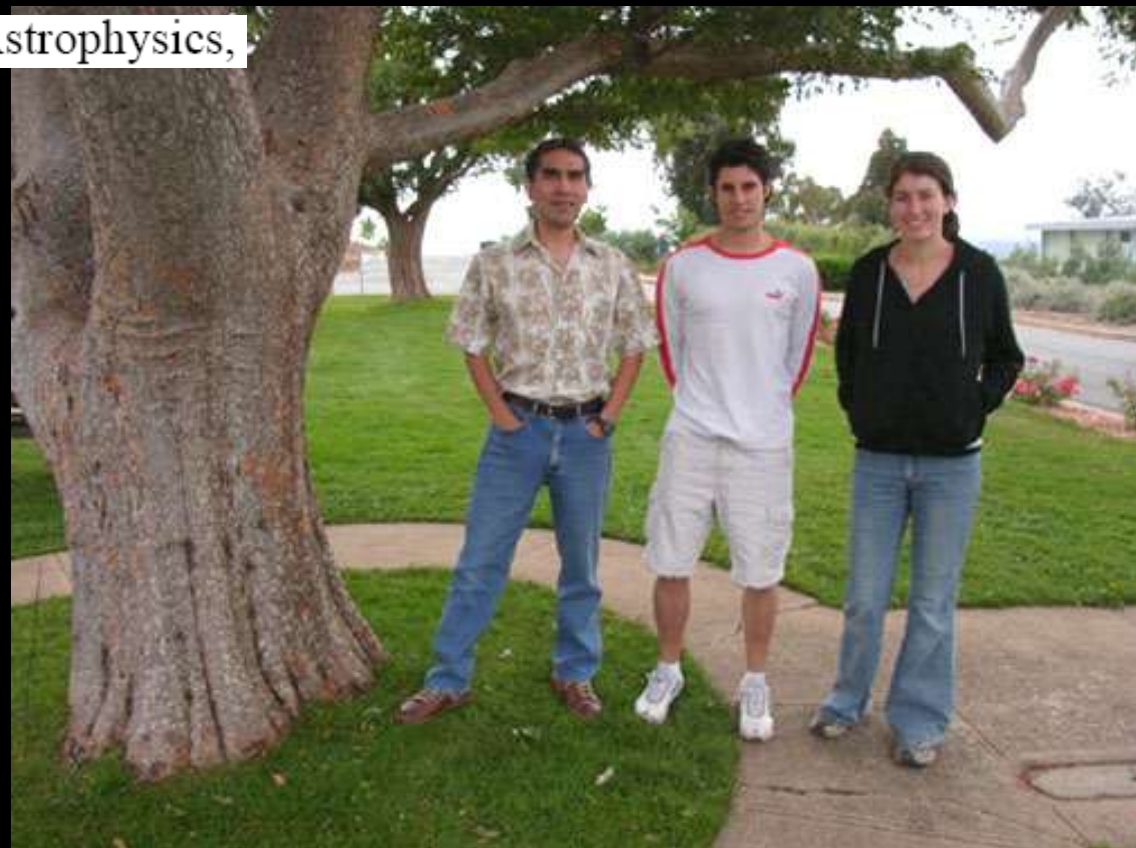
Destaque na imprensa de projeto de IC da Katie