

Contribuições dos Amadores na Astronomia

Da Construção do Telescópio à Espectroscopia

Rogério Marcon (Departamento de Física Aplicada - DFA/IFGW)

Distinção entre amadores e profissionais

A partir do final do **séc XVII** – Criação das sociedades científicas – **Royal Society** (Inglaterra-1660) baseada na obra “ **Nova Atlântida** “ de Francis Bacon .
Academia Real de Ciências (França – 1666), Academia de Ciências de Berlin (Alemanha- 1770)

Mais tarde , no **séc XIX**, ocorre a profissionalização da ciência e o cientista profissional aparece subsidiado por instituições publicas e/ou privadas.

Especialização e profissionalização

Os ingleses oferecem resistência a profissionalização da atividade científica e consideram a **remuneração um demérito para a atividade.**



Sede da Royal Society em Londres

Os amadores rotineiramente atuam onde os observatórios profissionais já não mais o fazem.



Monte Palomar (5m)



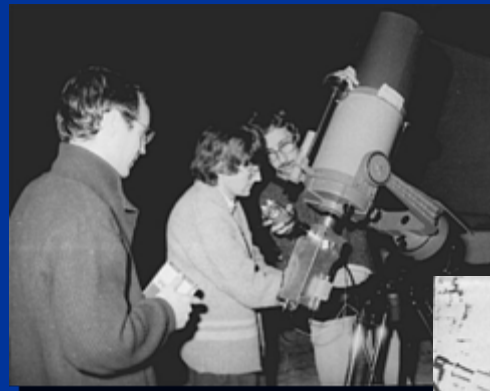
Keck (2x10m)



VLT (4x8m)



Jack Newton



Christian Buil e o primeiro CCD amador



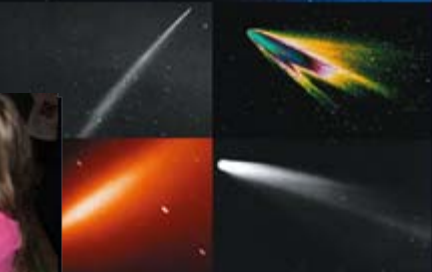
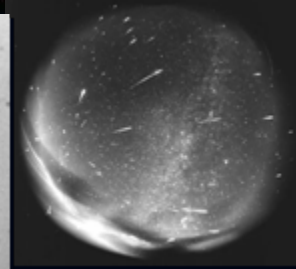
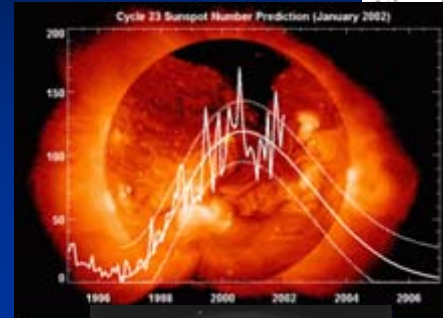
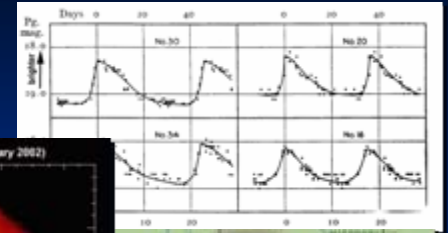
R. Marcon

Áreas de atuação possíveis com fornecimento de dados observacionais:

- Estrelas variáveis
- Ocultações de estrelas por asteróides
- Observação de atividade solar
- Descoberta de cometas e asteróides
- Meteoros
- Observação de supernovas
- Espectroscopia

Atividades de popularização da Astronomia :

- Astrofotografia
- Construção de Instrumentos – ATM
- Preservação da qualidade do céu noturno



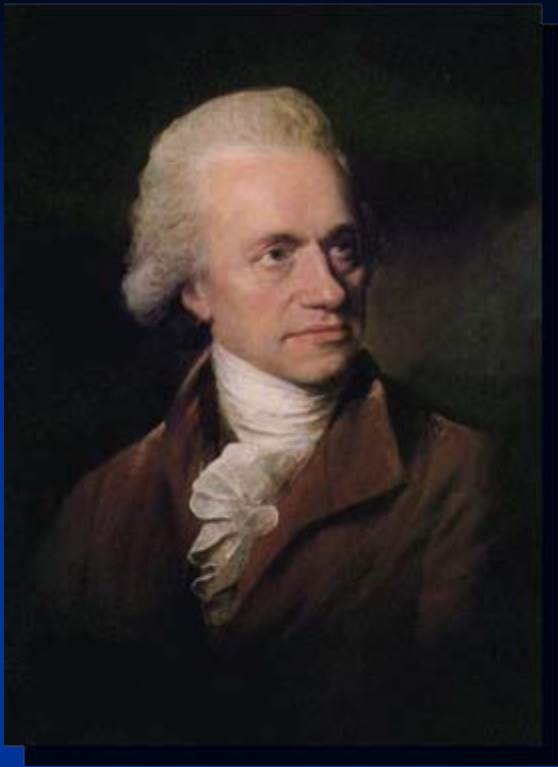
Atuação individual ou associados em clubes e/ou associações de amadores

- **ALPO** Association of Lunar and Planetary Observers, USA
- **BAA** British Astronomical Association, England - The Lunar section
- **UAI** Unione Astrofili Italiani, Italia
- **LIADA** Liga Ibero-Americana de Astronomia
- **APAA** (Associação Portuguesa de Astronomos Amadores)
- **AAVSO** American Association of Variable Stars Observers, USA
- **VSnet** Variable Stars Net, Japan
- **IBVS** Information Bulletin on Variable Stars
- **AFOEV** French Association of Variable Star Observers
- **ASSA** The Astronomical Society of South Australia
- **Istituto Copérnico** - Argentina



REDE DE ASTRONOMIA OBSERVACIONAL

www.rea-brasil.org

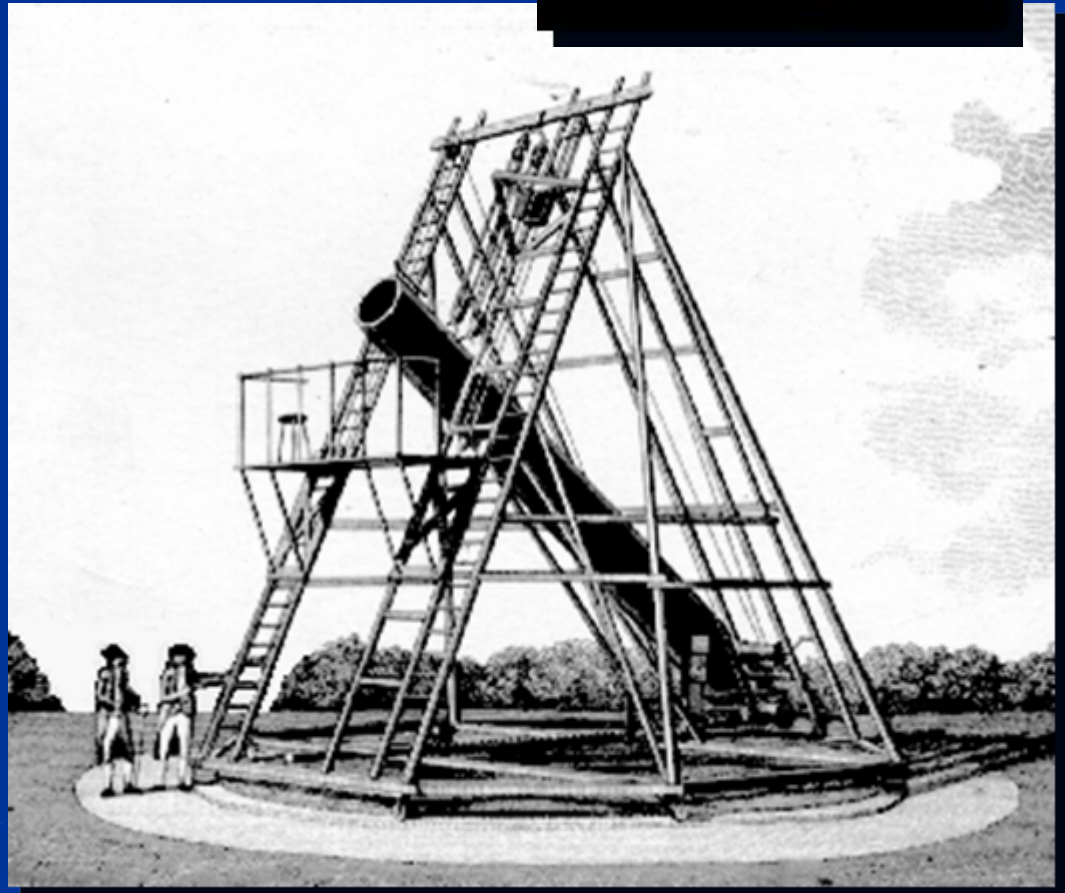


William Herschel
(1738-1822)

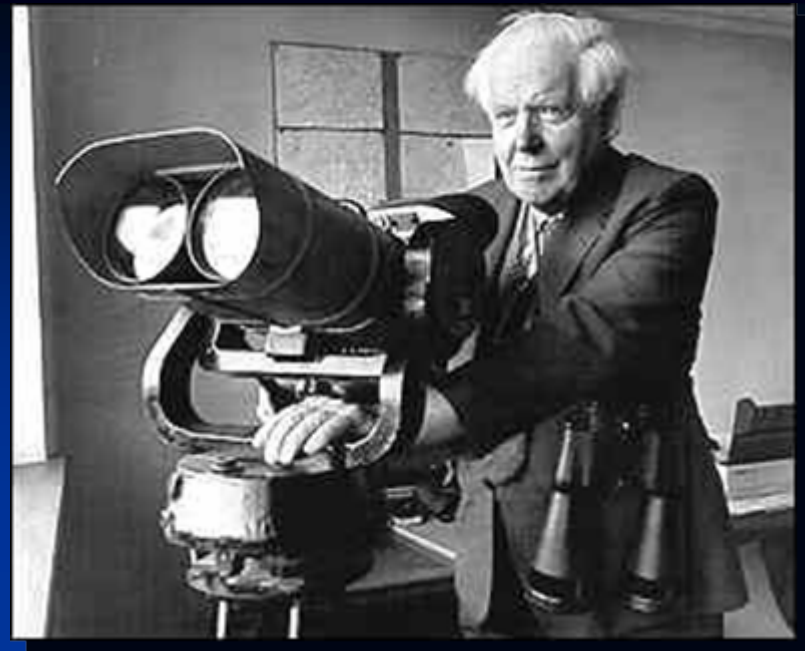


Descoberta de Urano, movimento intrínseco do Sol através do espaço em 1783. Observou cuidadosamente o movimento de sete estrelas e demonstrou que estas convergiam para um ponto fixo (que interpretou como sendo o ápex solar).

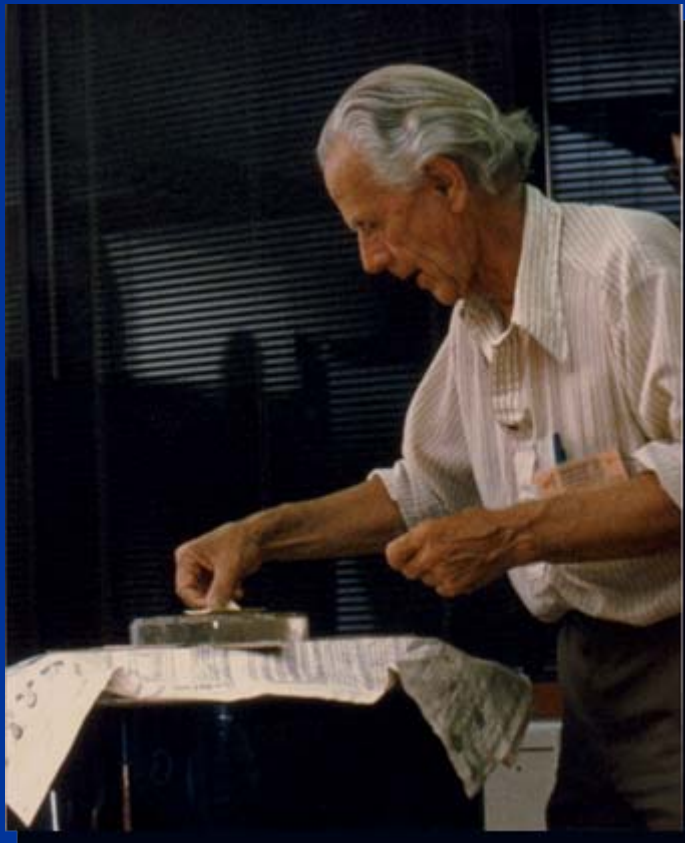
Construção de Instrumentos



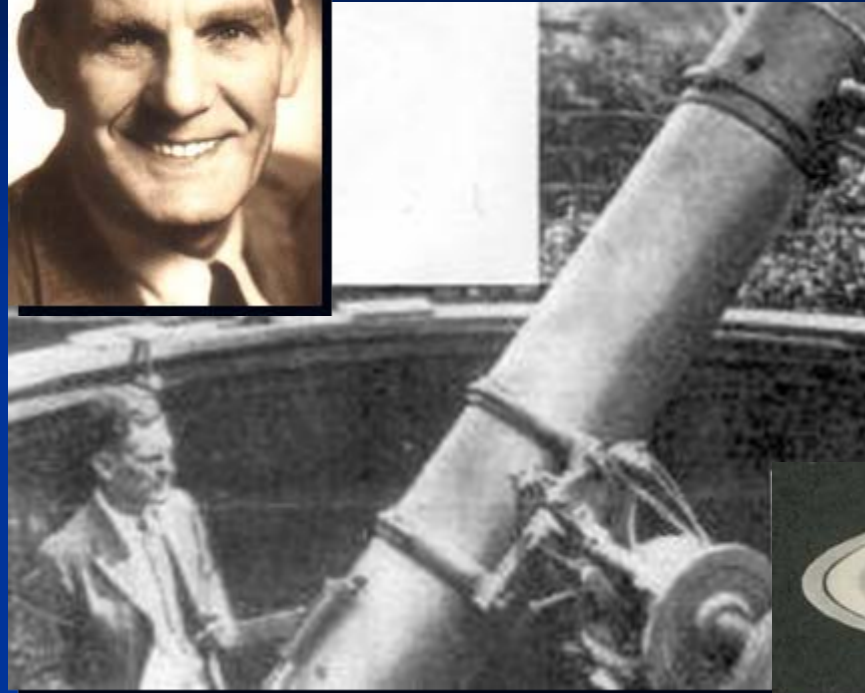
George Alcock, Descobridor
de cometas e novas



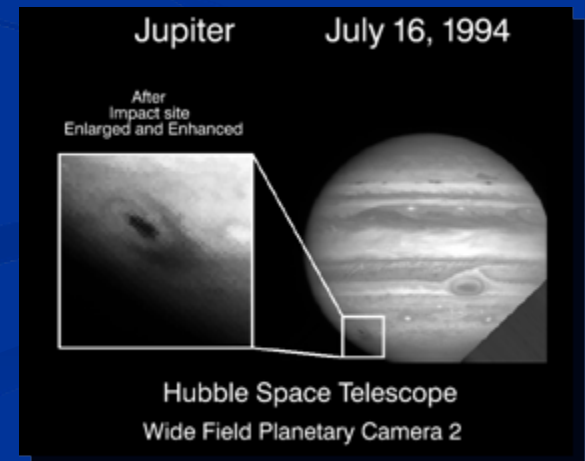
John Dobson, construtor de instrumentos
e divulgador da Astronomia em São Francisco.
Popularização dos telescópios Newtonianos de
grandes diâmetros



Will Hay Ator e comediante americano, descobriu os white spots na atmosfera de saturno

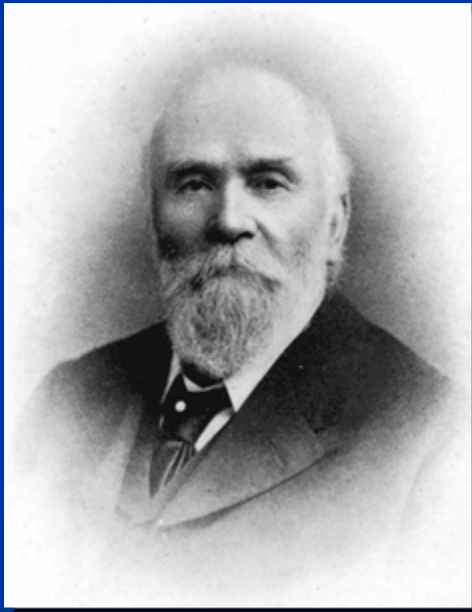
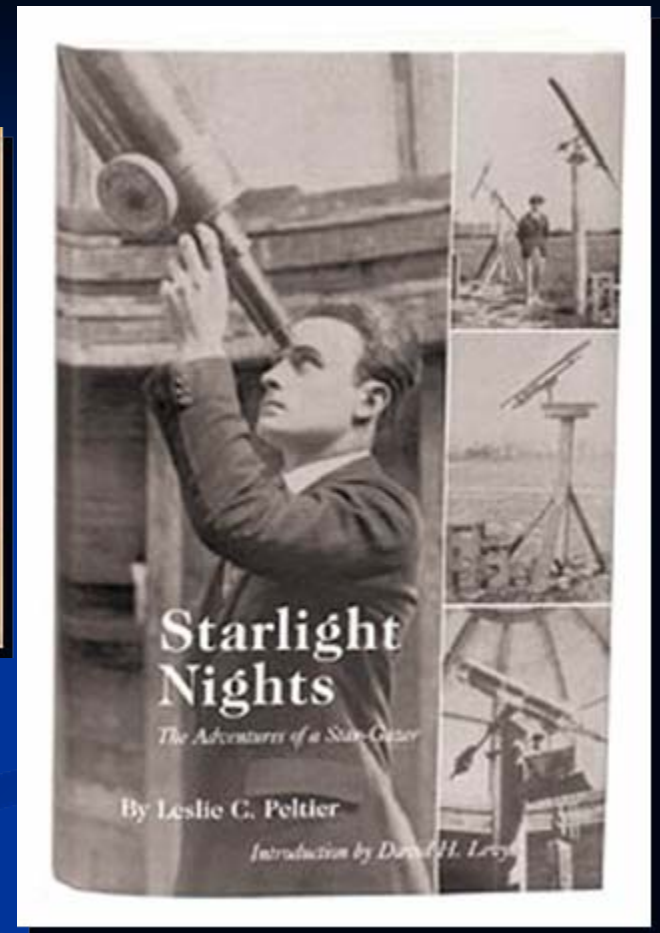


David H. Levy
Descobridor de cometas que inclui o Shoemaker-Levy 9

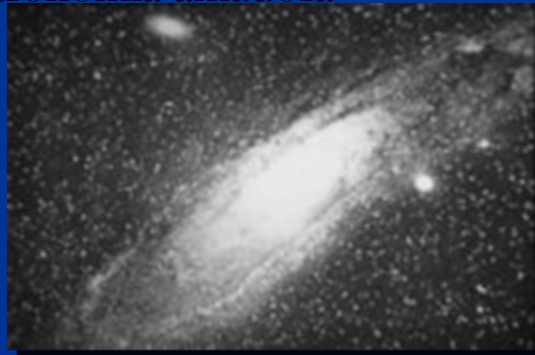


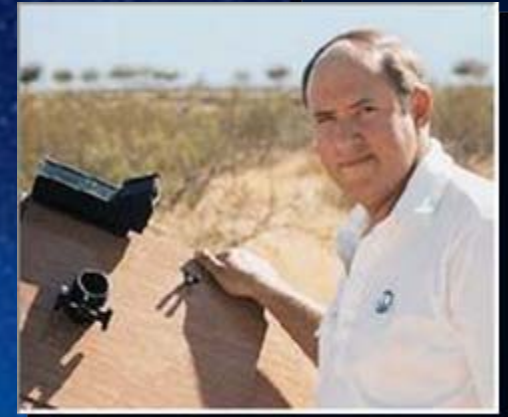
Leslie Peltier

Descobridor de cometas
e observador de estrelas
variáveis

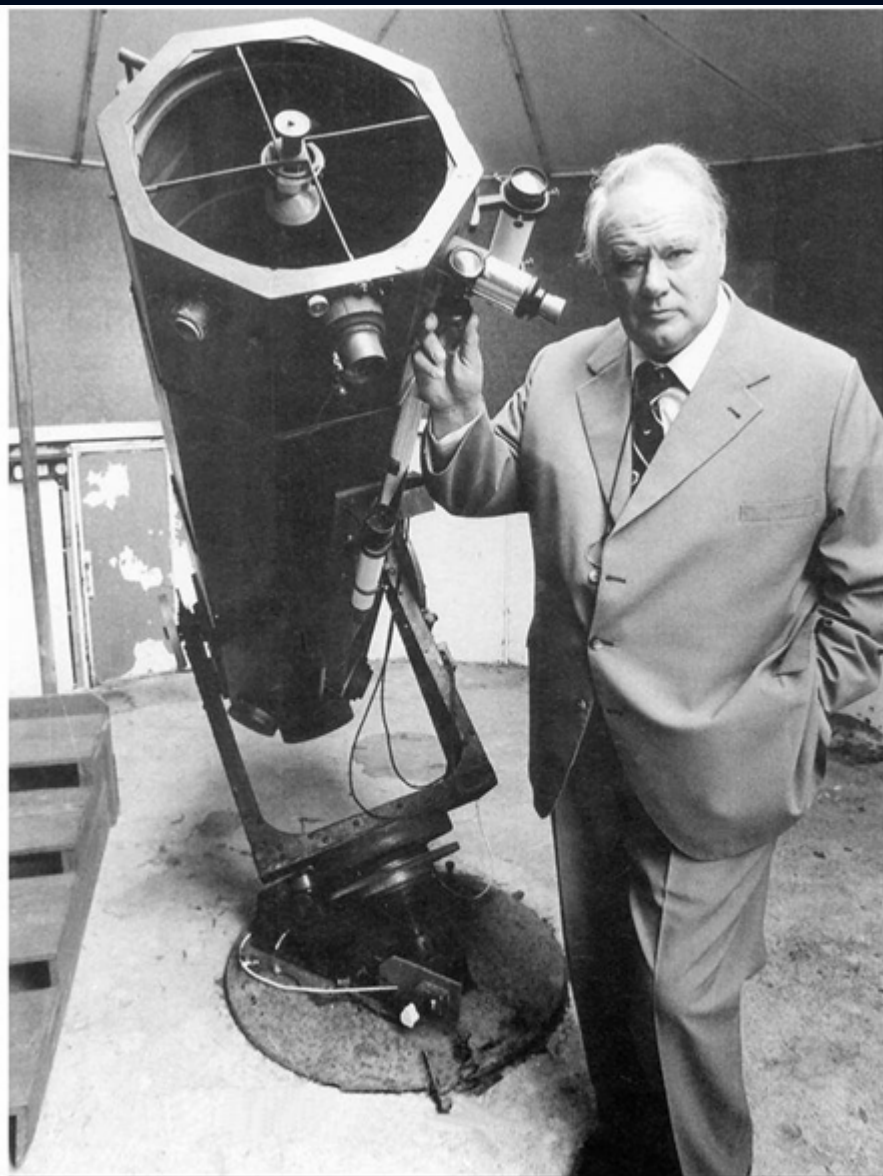


Isaac Roberts Pioneiro na
aplicação da fotografia na
Astronomia amadora





Thomas Bopp e **Alan Hale**. Descobridores do cometa Hale Bopp em 1997



Sketches and observations made by:-

Sir Patrick Moore



Brian May e
Patrick Moore

Sir Patrick Moore,

Apresentador do programa de rádio na BBC inglesa *The Sky at Night* e autor de inúmeros livros de divulgação de Astronomia



Robert Owen Evans

Pastor da Uniting Church na
Australia.

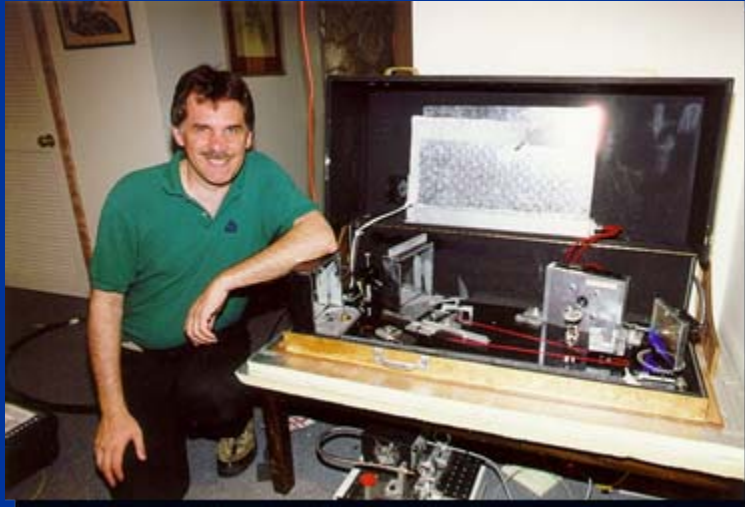
Descobridor de mais de 33
supernovas através da memorização
dos campos visuais observados ao
telescópio



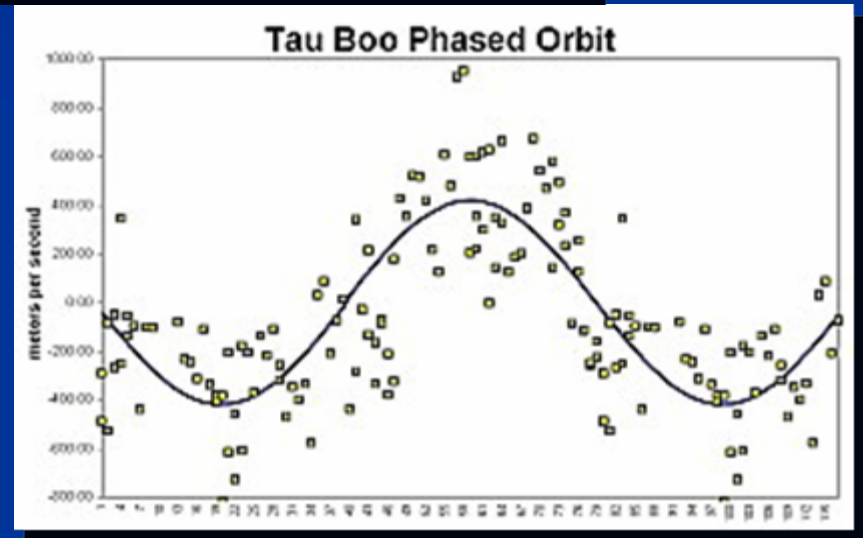
Tonny Vanmunster



Exoplanetas por
Fotometria
fotoelétrica



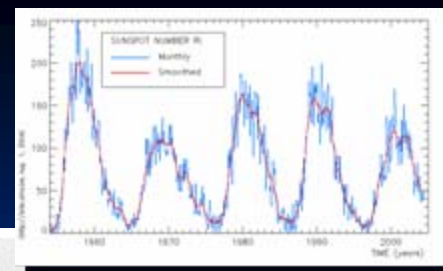
Tom Kaye



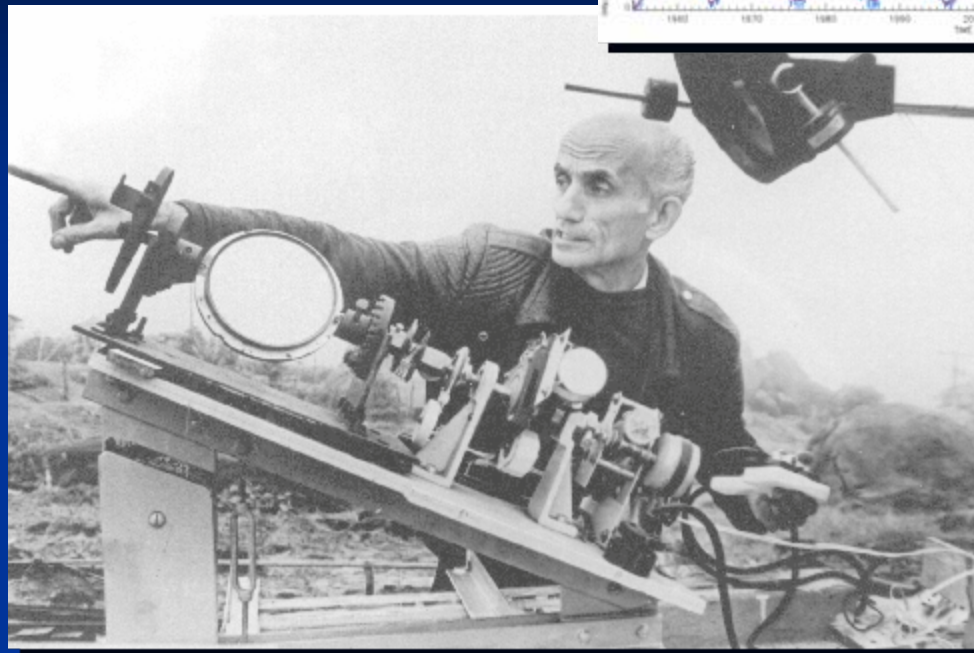
Exoplanetas por
medida de
velocidade radial

No Brasil...

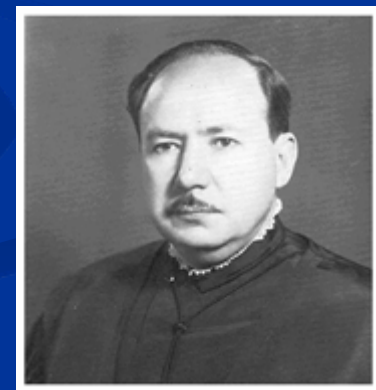
Jean Nicolini (1922-1991)
Membro da AAA e fundador do
Observatório do Capricórnio em 1948



Rubens de Azevedo
1921-2008



Sociedade Brasileira dos
Amigos da Astronomia
(SBAA), Ceará 1947



Aristóteles Orsini e a AAA em São Paulo



O Prof. Aristóteles Orsini, Presidente da AASP e Diretor do Planetário foi o grande incentivador da introdução da Rádio-Astronomia no Brasil

“Rádio-astrônomos” pioneiros do Ibirapuera

Alfredo Duberger
Carlos Ancede Terra
Eurico Moises Kulb
Eronides Aguirre Lopes
Gumercindo Lobato
Isaac Gruber
Luis Eduardo Lima
Nilto Waldige
Pierre Kaufmann
Plínio D`Andréa
Rodolpho Vilhena de Moraes
Sigfried Turner
Walter Pruks

Iniciadores



Pierre Kaufmann
(Nome Real)



Plínio D'Andréa



Alfredo Duberger

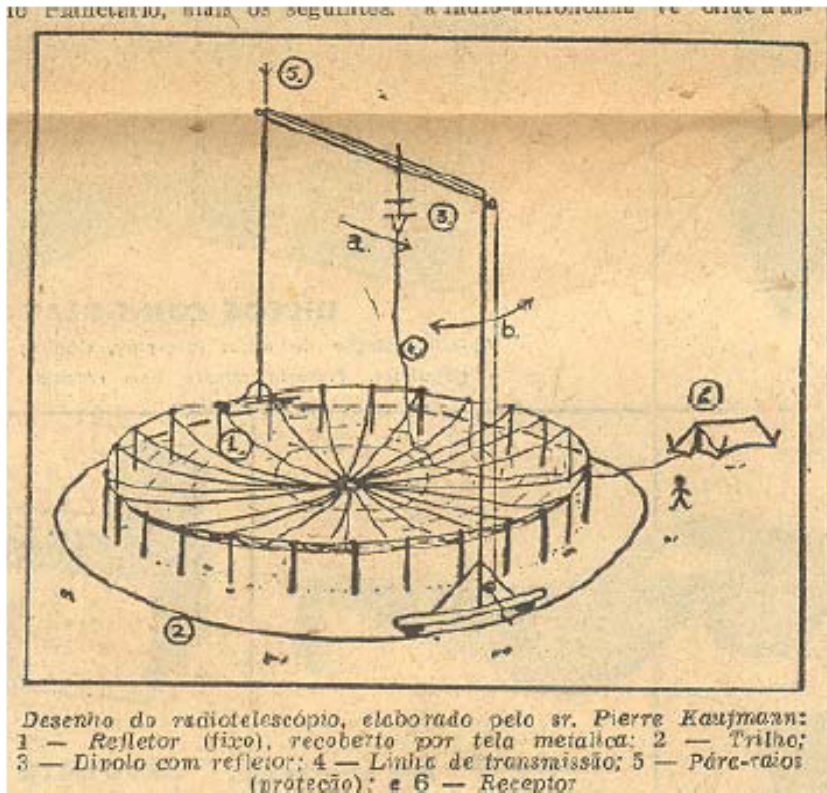
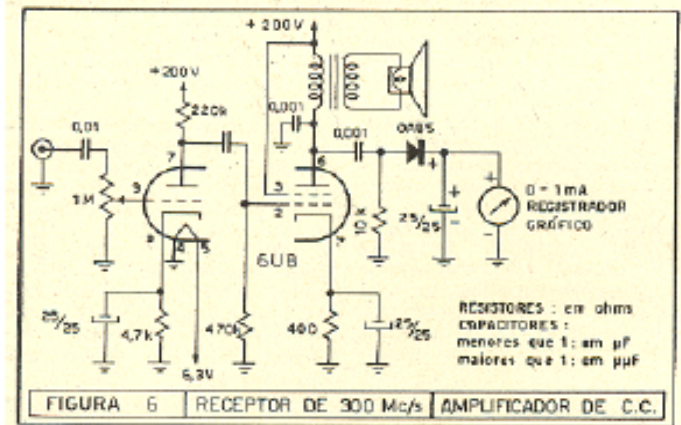
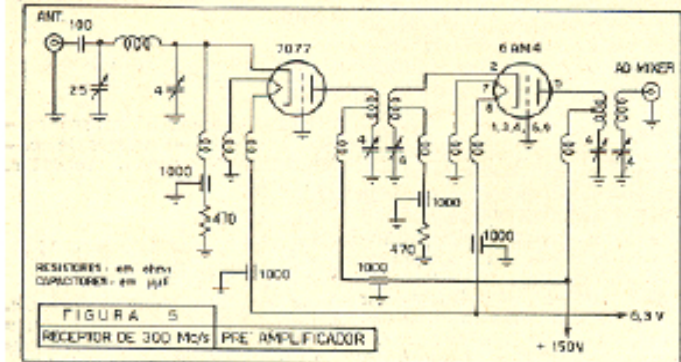
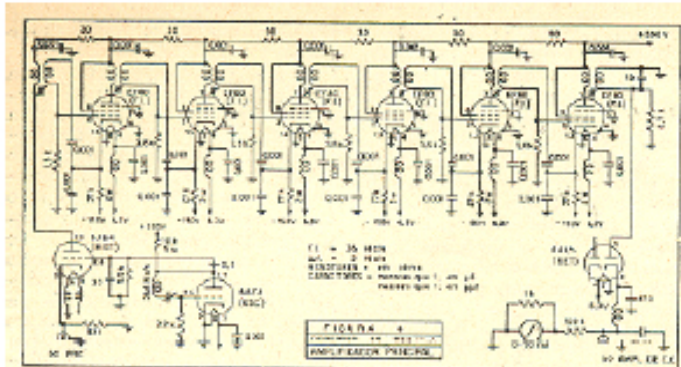
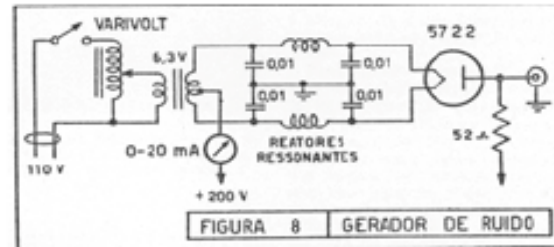
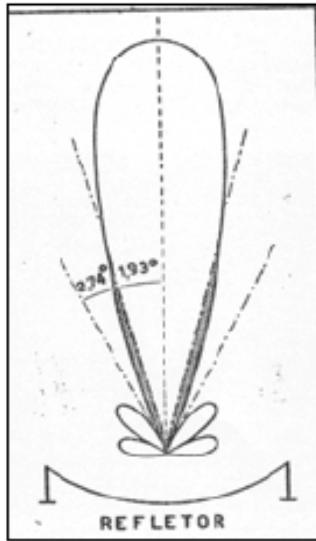


Rodolpho Vilhena de Moraes



Carlos Ancede Terra

Primeiro rádio-telescópio brasileiro

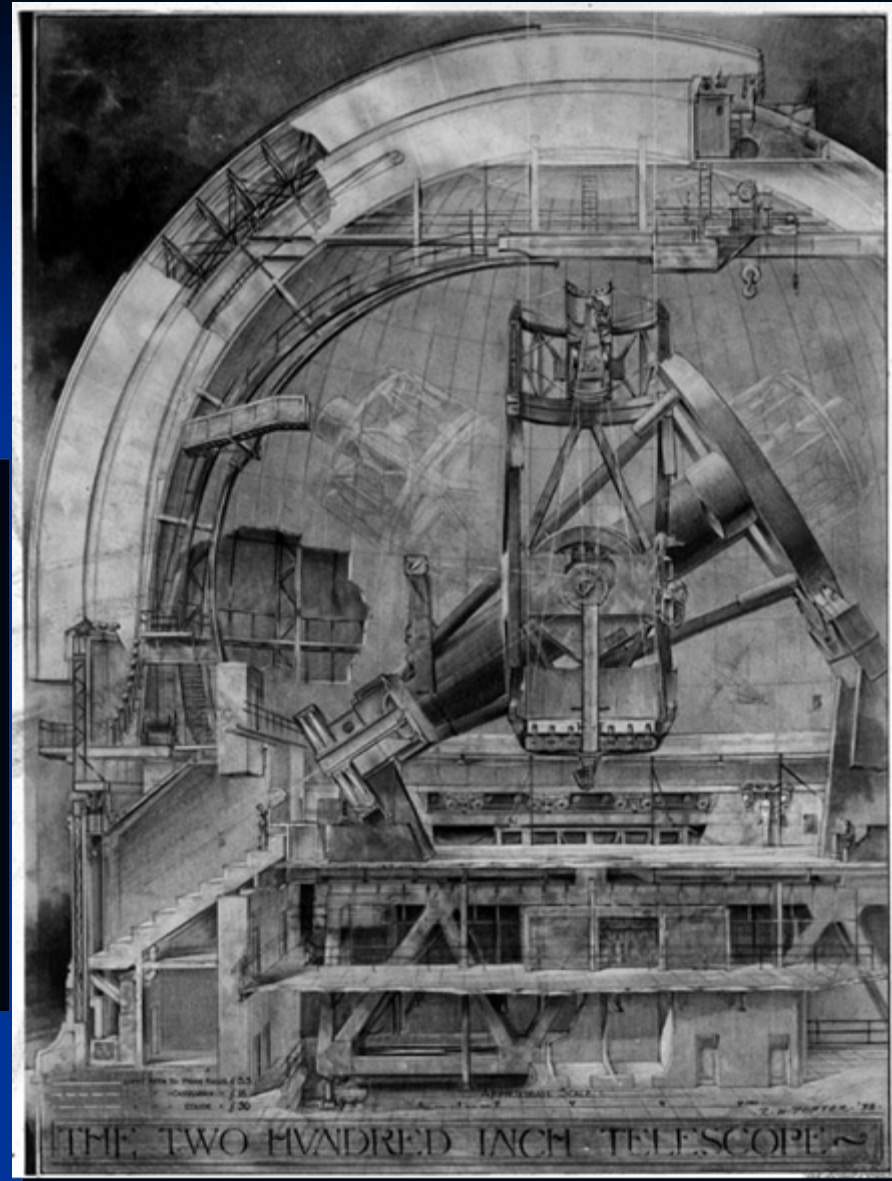


O Movimento ATM (Amateur Telescope Making)

Russell W. Porter (1871-1949) fundador da Stellafane e pioneiro no movimento amateur telescope making". Ou “ faça você mesmo o seu telescópio”



Sítio em Springfield denominado “ Stellafane “ sede da convenção anual de ATMs



Projeto do telescópio de 5 metros de Monte Palomar (R.W.Porter)

Artigo de Albert G. Ingalls, editor da revista Scientific American de novembro de 1925 mostrando o trabalho do grupo de Springfield

THE EIGHTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, NOVEMBER, 1925

"The Heavens Declare the Glory of God"

How a Group of Enthusiasts Learned to Make Telescopes and Became Amateur Astronomers

By Albert G. Ingalls

WHY not make your own telescope?" said Mr. R. W. Porter, the telescope maker, as the waiter in a famous Broadway chop house started for the kitchen with our order. "Astronomy would mean a lot more to you if you did."

We had met to talk about Porter's hobby, astronomy. I had already heard quite a lot about this versatile man whose whole life had centered about the study of the stars. In his earlier years he had spent a dozen winters in the Arctic as astronomer, topographer and artist. Three years he had been with Peary, three more with Fiata in Franz Josef Land, and two years with Cook, who Porter says certainly did not climb Mt. McKinley. Other seasons he spent in northwestern Canada and in unknown Labrador. During all those years in the Far North where the Arctic stars fairly snap in the cold clear air, he was studying astronomy.

Now he had settled down in the picturesque manufacturing village of Springfield, Vermont, tucked away in a deep valley in the foothills of the Green Mountains, where, as everyone in the mechanical industry knows, a famous type of flat turret lathes is made. Here he had fired a score of men with his own keen enthusiasm for the stars and had organized them into a group which is perhaps unique—mechanists by day, amateur astronomers by night.

"You'd have no trouble in making a good telescope," he assured me.

"I could make the mounting all right," I replied, "but when it came to making the optical parts I'd be out of it. Only a handful of men in the world are skilled enough to do that fine work."

"You come up to Springfield, where I live," he laughed, "and I'll show you a good many home-made telescopes, made in spare time by men who knew nothing about it when they began. They'll tell you how any amateur—even an editor—can make his own telescope for less than fifty dollars, providing he's reasonably handy and will take pains. And it will be a real telescope, fit for serious work, not just a toy or a makeshift."

The "Poor Man's Telescope"

He went on to tell me how in the Vermont village a group of men, most of them mechanics in the local machine shops, had banded together to study the stars; how each one had made and mounted his concave mirror; how they had later pooled their efforts and built a sort of combined clubhouse, lodge and observatory on the top of a mountain near their homes. Here they gathered when the week's work was done, to study the stars. "The Telescope Makers of Springfield," they call their club, and none may join who has not made his own telescope.

When summer rolled around, I went to Springfield, as Porter had suggested, and there the amateur astronomers told me how they had learned their new avocation.

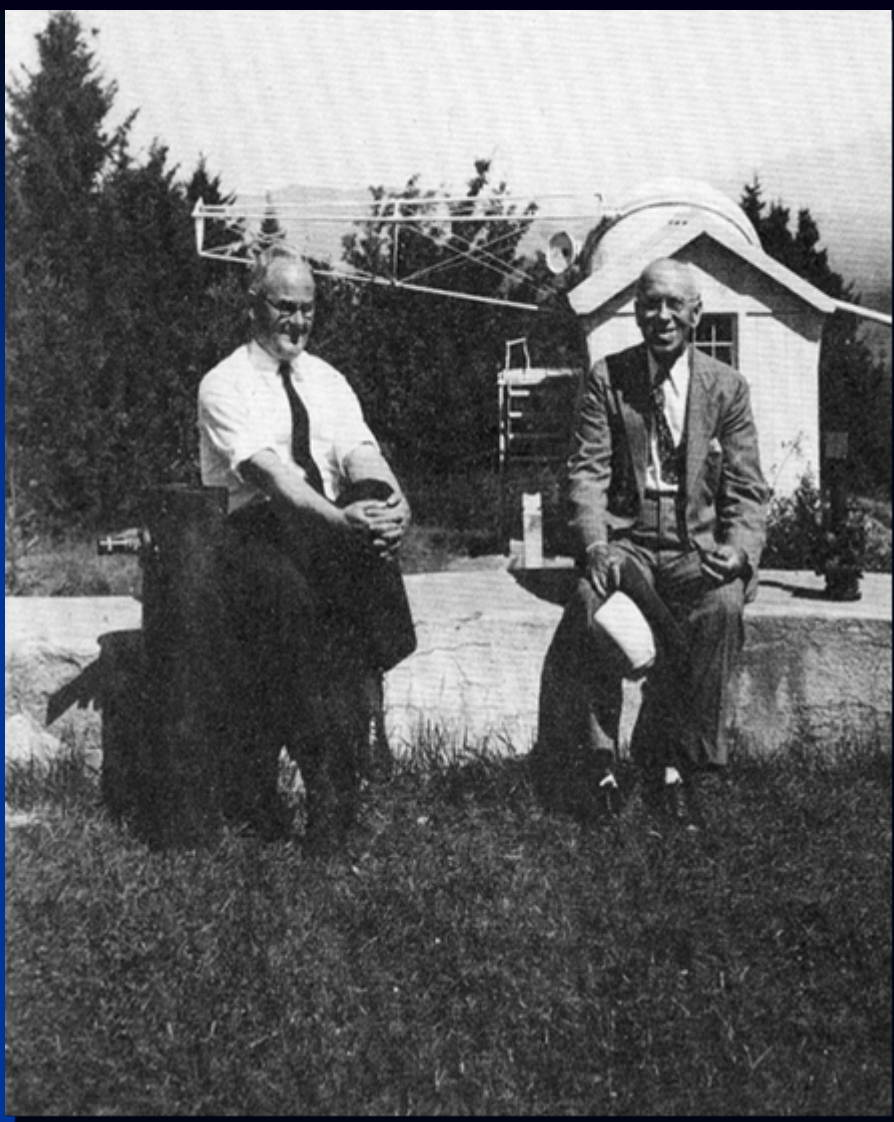
There are two common types of telescopes, the refractor and the reflector. The refractor is the ordinary type that everyone knows. It is like a big spyglass; you look through it, the light actually passing through its lenses. For serious amateur work such a telescope, having an objective lens four inches in diameter, is very valuable, but it costs several hundred dollars to buy, while the ordinary amateur cannot hope to make it himself.

But the reflector works on a different principle. It is a shorter, thicker instrument having a large, round, concave mirror in its lower end. The light coming from a star strikes this concave mirror and is reflected upward in a converging cone. Near the upper end of the big tube, which is open at the top, a small diagonal mirror or sometimes a three-sided prism of glass is mounted in such a position that the cone of light reflected by the large mirror is intercepted and is turned at right angles toward the eyepiece in the side of the telescope. Owing to the fact that the light does not pass through the glass as in the other type of telescope, the mirror does not have to be made of optical glass—simply ordinary thick plate glass; and since the mounting of



ON THE SPRUCE-CLAD SUMMIT OF BRIGGS MOUNTAIN THE VERMONT ASTRONOMERS HAVE BUILT THEIR STELLAR FAN. A SEVENTY-FIVE FOOT WHEAT TELESCOPE PROJECTS THE SUN'S IMAGE ON A SCREEN INDOORS

In this type of telescope, no tube is required. The light from the sun is reflected by the concave mirror, then passed mirror B, to an equally large concave, paraboloidal mirror mounted on a fixed pier at A. Thence the light converges through a circular opening just above the top mirror, and focuses on the screen, C, where the observers study the sun's image.



AMATEUR TELESCOPE MAKING

ALBERT G. INGALLS, Editor
Associate Editor, Scientific American

With contributions by
RUSSELL W. PORTER
Optical Associate, Jones & Lamson Machine Co.

PROF. CHARLES S. HASTINGS, Ph.D.
Professor Emeritus of Physics, Yale University

REV. WILLIAM F. A. ELLISON, F.R.A.S.
Director of Armagh Observatory

DR. GEORGE ELLERY HALE, Sc.D.
Honorary Director, Mt. Wilson Observatory

DR. ELIHU THOMSON, Ph.D.
Director Thomson Research Laboratories,
General Electric Co., Lynn, Mass.

CLARENDON IONS

JOHN M. PIERCE
Director of Vocational Training,
Springfield, Vt., High School

A. W. EVEREST

With a Foreword by
DR. HARLOW SHAPLEY
Director, Harvard College Observatory

SCIENTIFIC AMERICAN PUBLISHING CO.

1928

Albert G. Ingalls e R.W.Porter em
Stellafane. Frontispício da primeira
edição do ATM



Primeira
Convenção em
1925 em
Stellafane



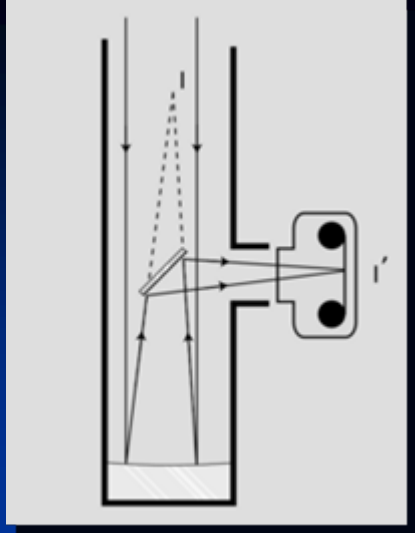
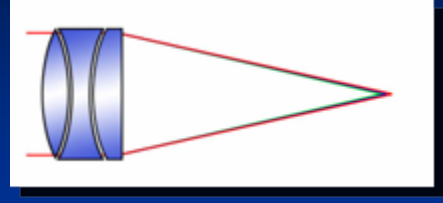
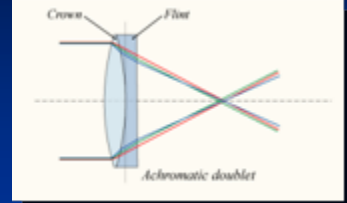
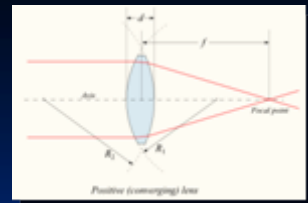
Convenção de 2007 em
Stellafane reunindo uma
grande variedade de
telescópios construídos à mão
por entusiastas



O Telescópio :

Refrator

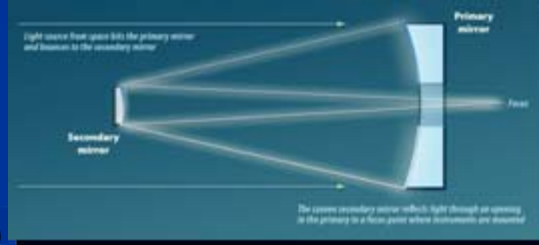
- Lente Simples
- Acromático
- Apocromático



Refletor

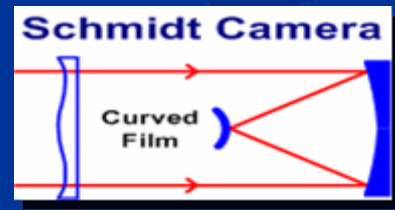
- Newtoniano
- Cassegrain

- Clássico (prim.Par, Sec. Hyperb)
- Dall-Kirkhan (prim. Elipsoide prolato, sec esf.)
- Ritchey-Chrétien (prim hyp, sec hyperb)
- Pessmann-Camichel (prim esf, sec. Elip. Oblato)



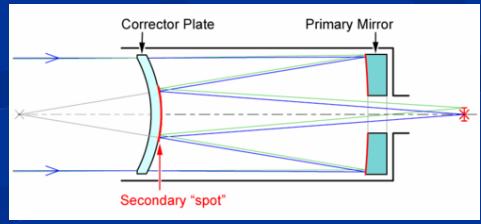
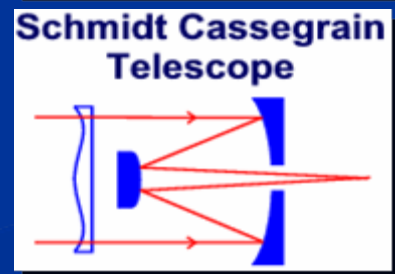
Schmidt Cameras

- Clássica
- Wright



Catadióptricos

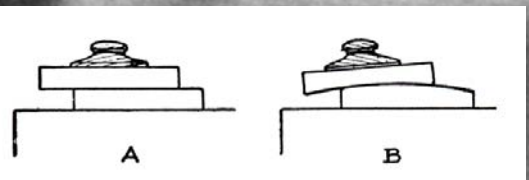
- Schmidt Cassegrain
- Schmidt Newtoniano
- Maksutov



Corretores de campo



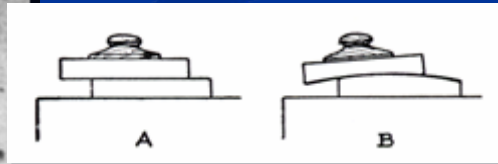
Desgaste do espelho do telescópio



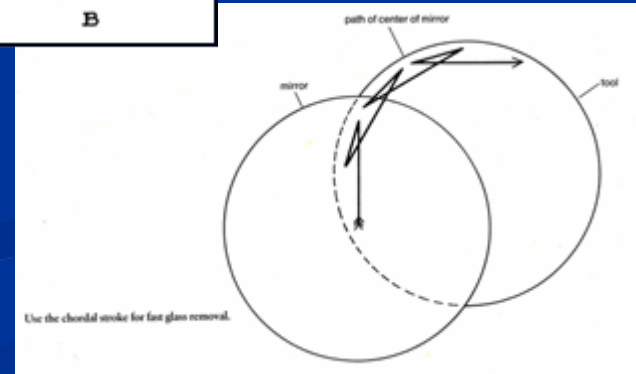
Abrasivo: Carbetto de Silício ou Óxido de Alumínio
60,120,320,400,600,1000 e 2500 mesh



Kit fornecido na década de 30 por John Pierce em Stellafane



Movimentos de desgaste e polimento do espelho primário



Construção de um polidor de breu.

O material é fundido sobre o vidro ferramenta e os canais são abertos



O polimento é feito com uma suspensão de Óxido de Cério ou Ferro em água

Os movimentos são idênticos aos do desgaste



Teste de Foucault

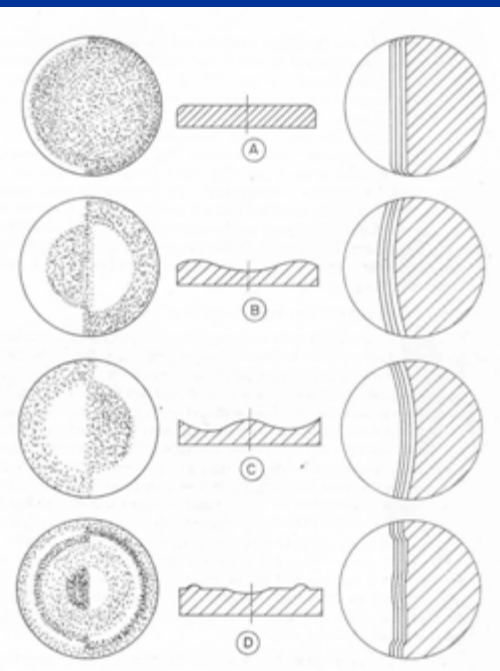
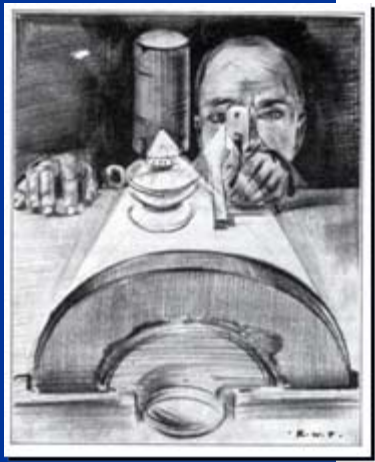
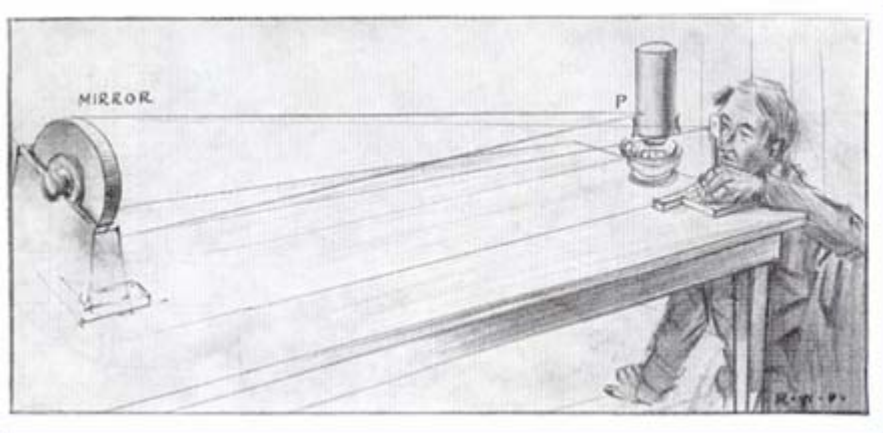
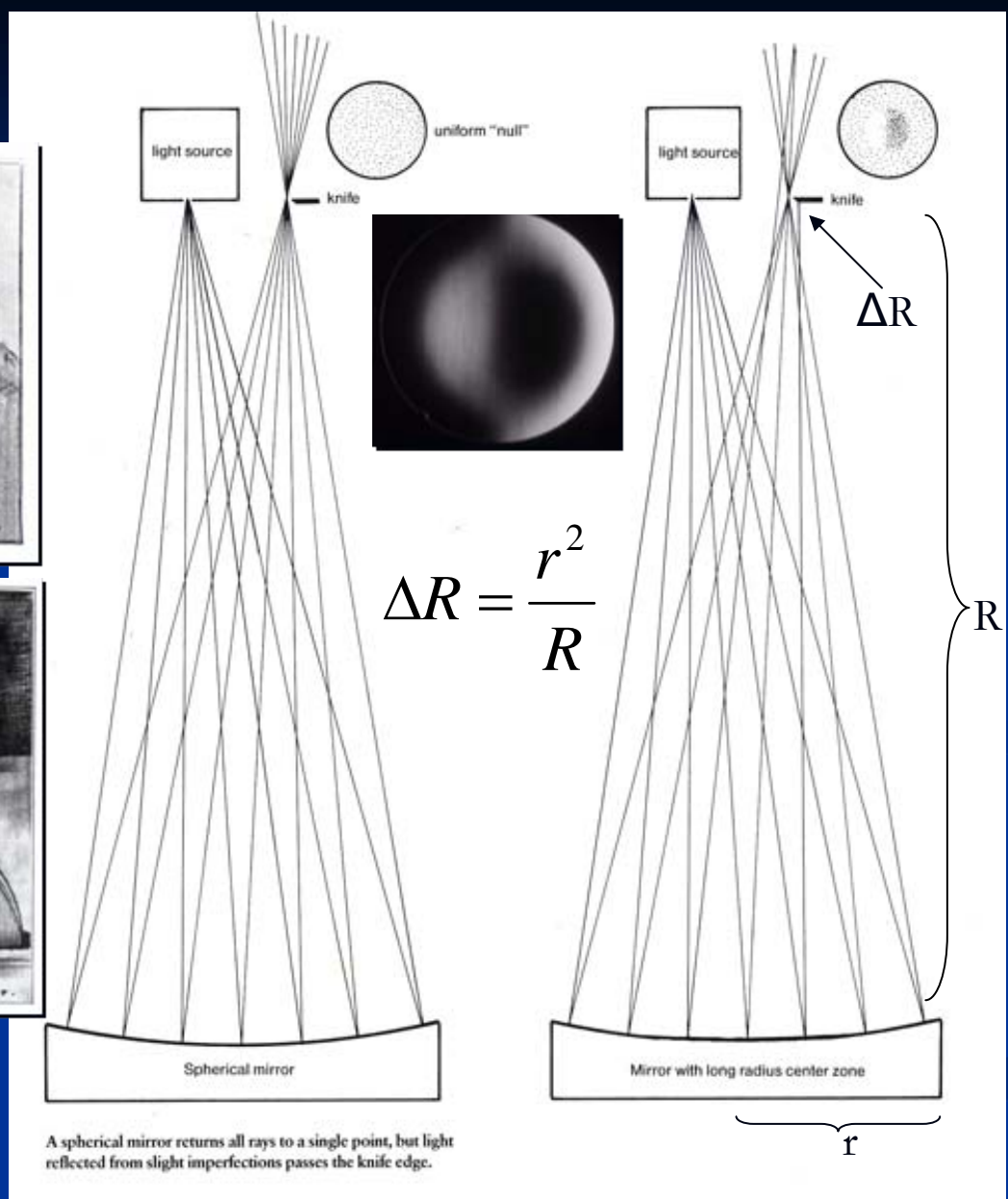


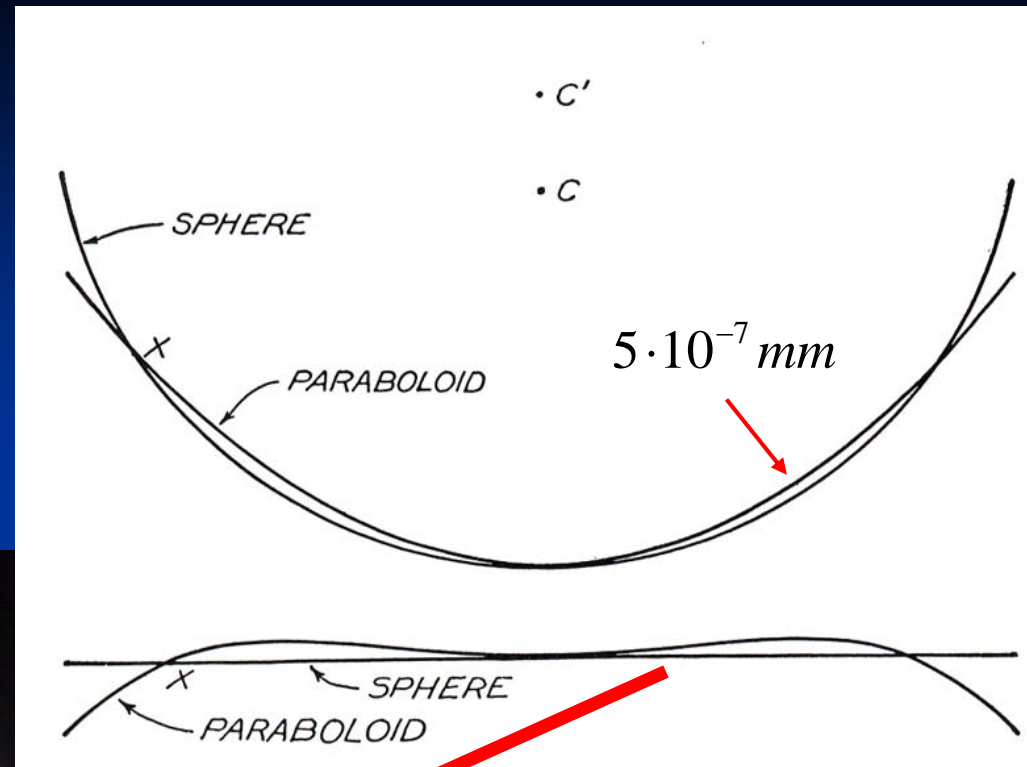
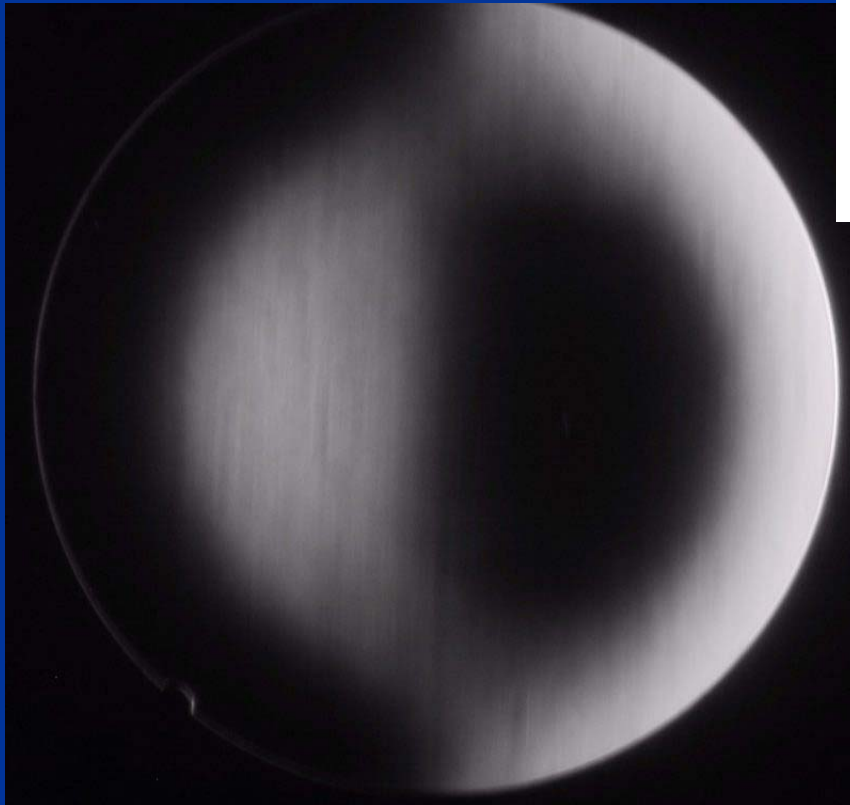
Fig. 18. Examples of figures of revolution. The figures on the left show the Foucault pattern, the ones in the centre show the corresponding surface with respect to the reference sphere and the figures on the right show the fringe patterns.



A spherical mirror returns all rays to a single point, but light reflected from slight imperfections passes the knife edge.

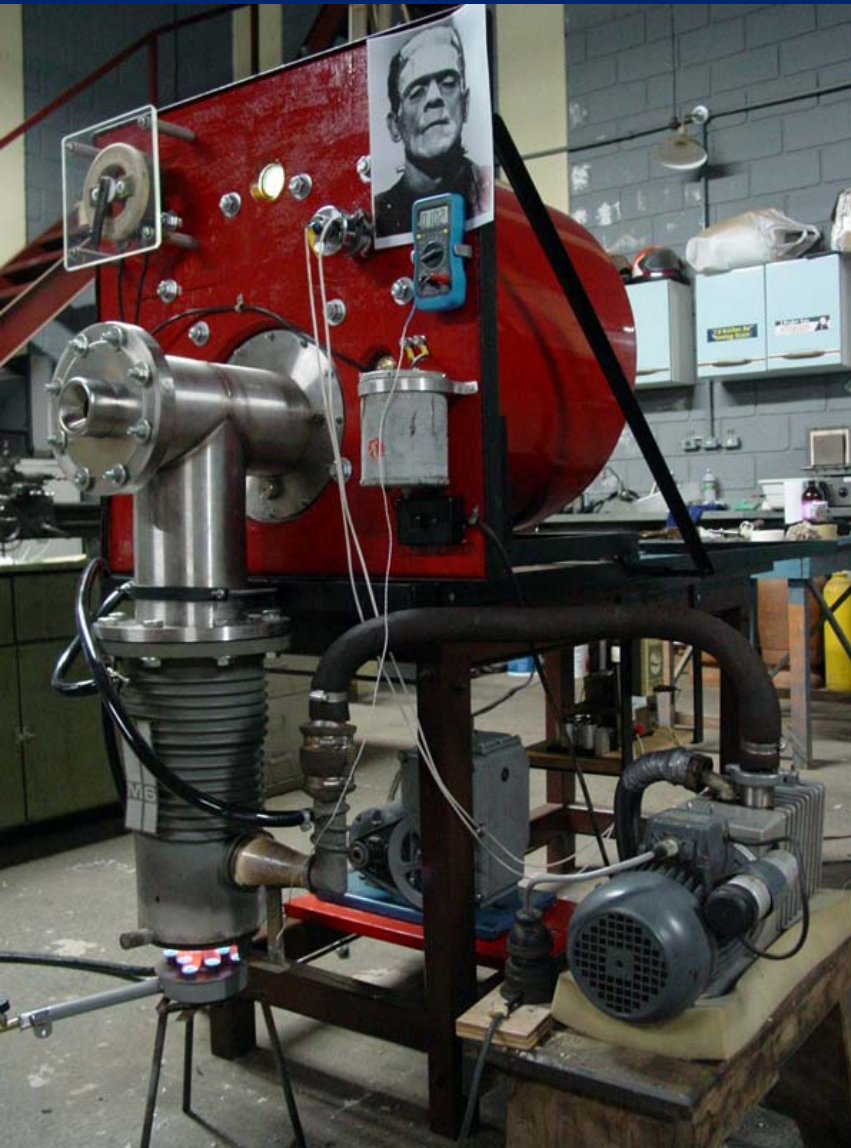
Diferença entre o esferóide e o parabolóide de revolução.

Aspecto final do parabolóide de revolução no teste de Foucault

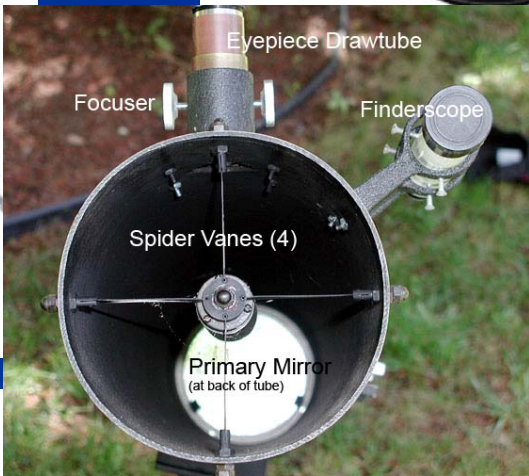
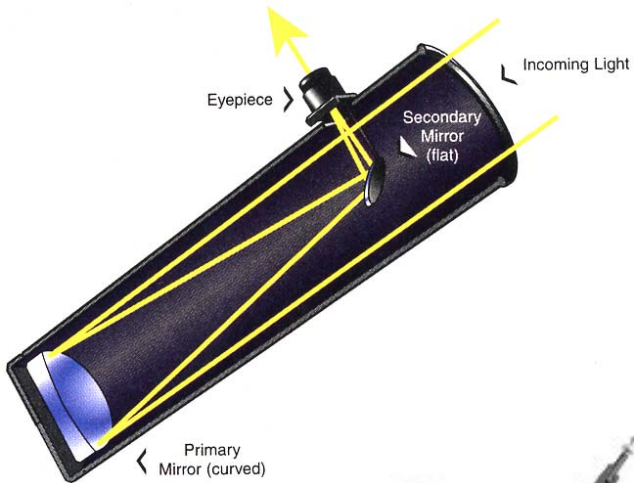


A passagem de uma forma para outra é conseguida apenas com alguns movimentos do polidor. O material retirado equivale a uma espessura de 0,5 milionésimo de milímetro

Aluminização em Alto Vácuo



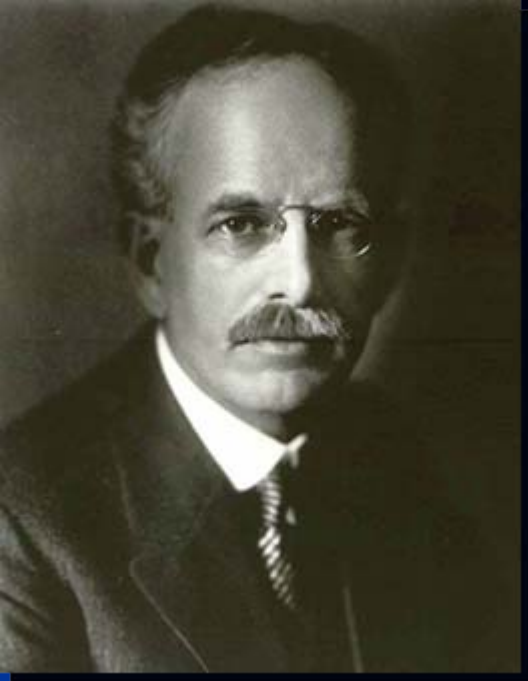
A última etapa de construção do espelho é a cobertura metálica que pode ser feita quimicamente com prata ou alumínio evaporado em alto vácuo



Detalhes construtivos do espelho secundário plano e porta-ocular



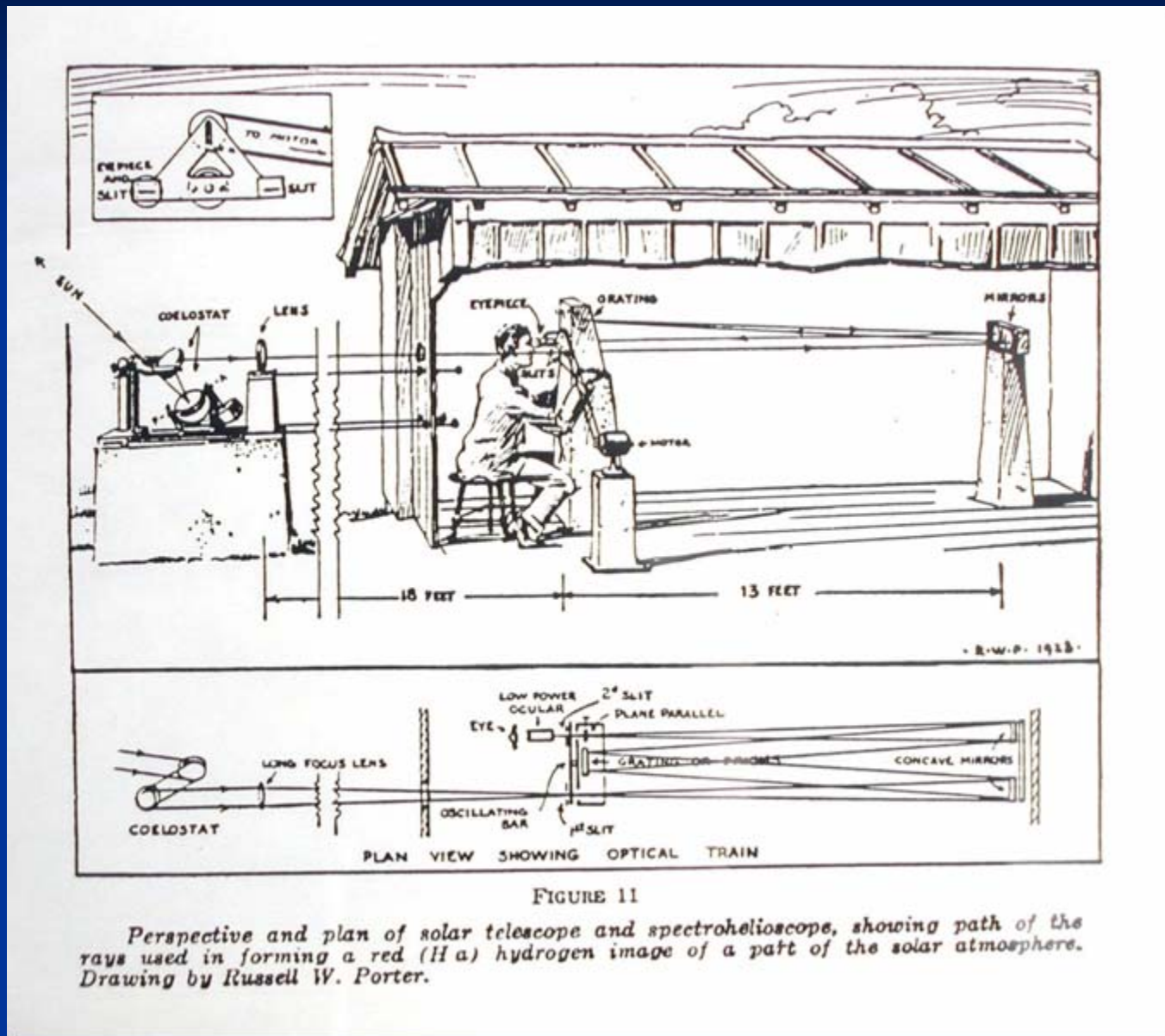
Montagem Equatorial



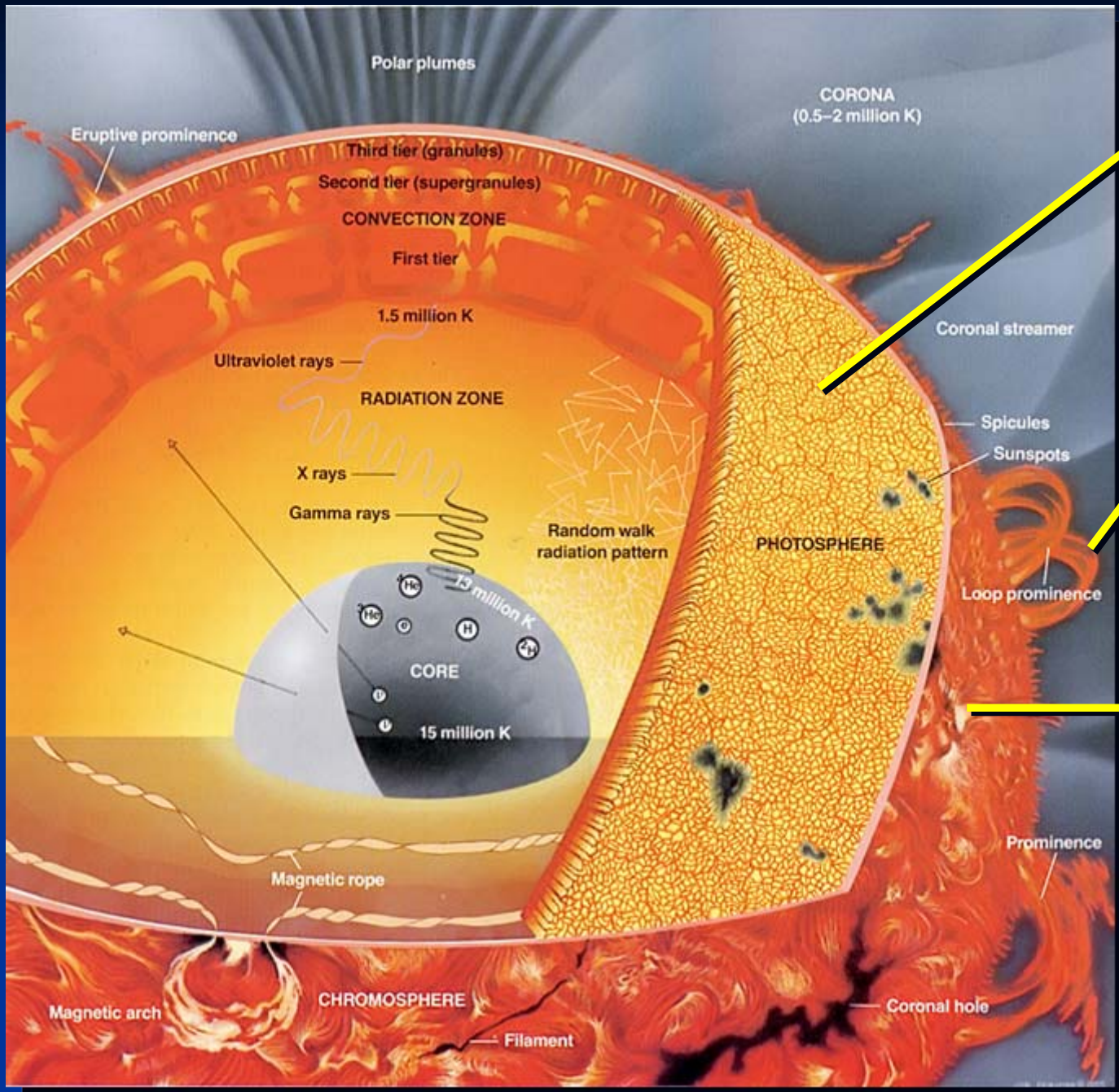
George Ellery Hale e os Astrônomos Amadores

George Hale (1868-1938)

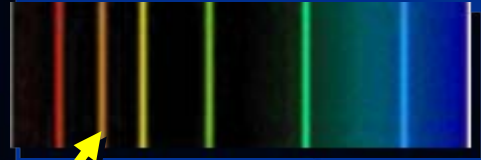
Desenho publicado no ATM Vol.1 por sugestão de G.Hale mostrando o espectroheliógrafo



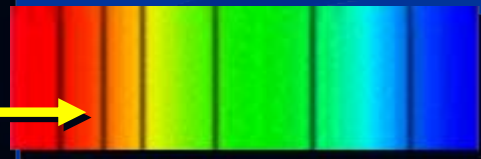
Estrutura Solar



Espectro contínuo
Corpo Negro a 5500K



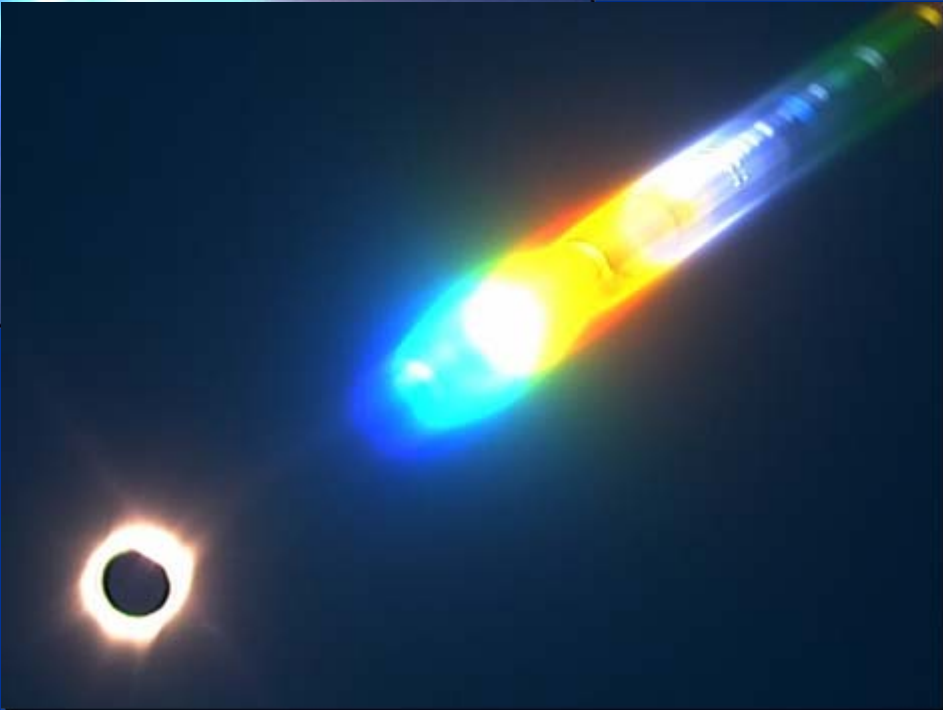
Espectro de emissão
cromosférico



Espectro do disco solar
tal como visto da Terra



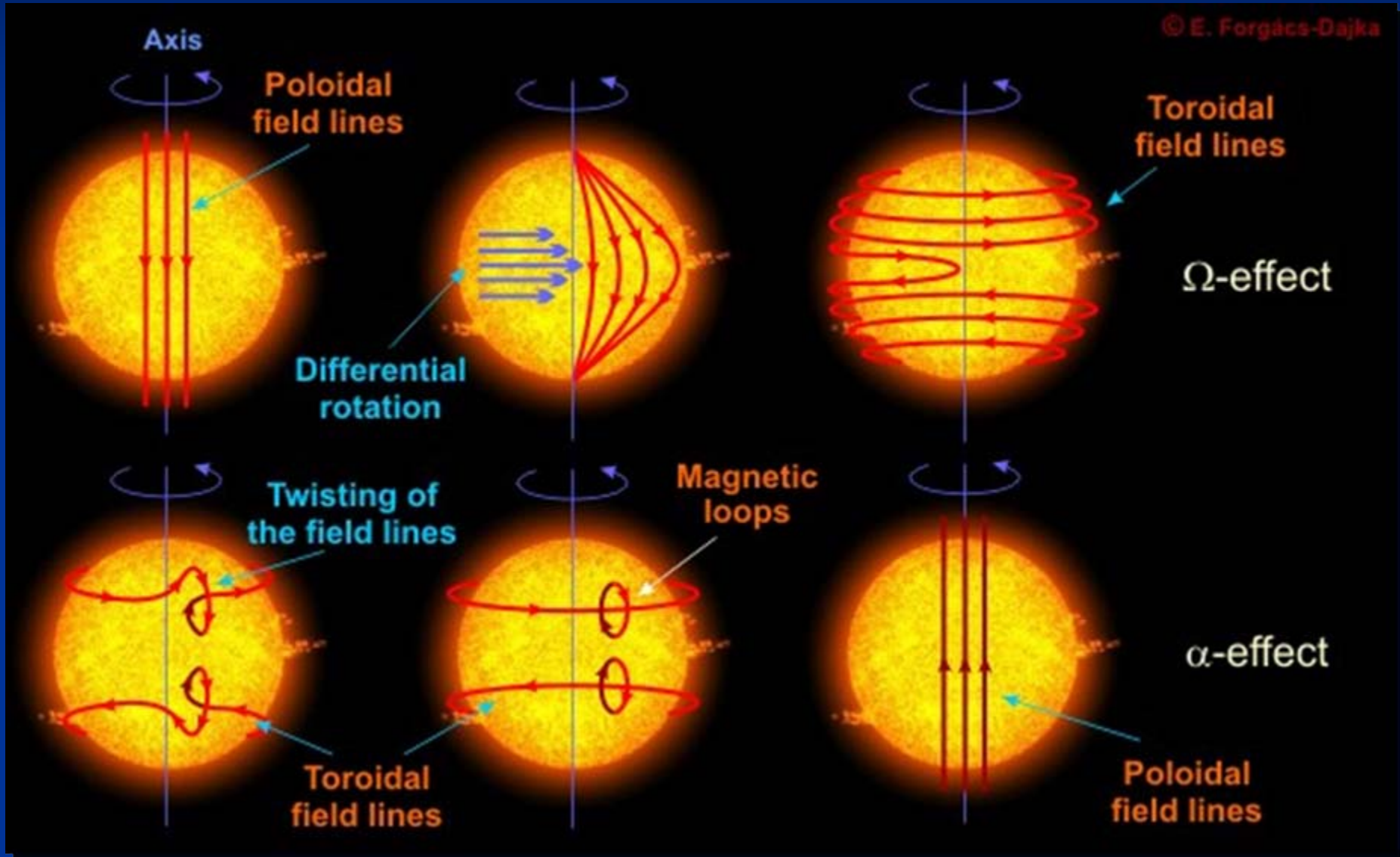
©2001 F. Espenak, www.MrEclipse.com



Flash spectrum
durante um
eclipse total solar



Teoria do Dínamo solar para explicação dos ciclos solares de 11 e 22 anos (ciclo de Hale)



Ciclos solares desde a invenção do telescópio até hoje

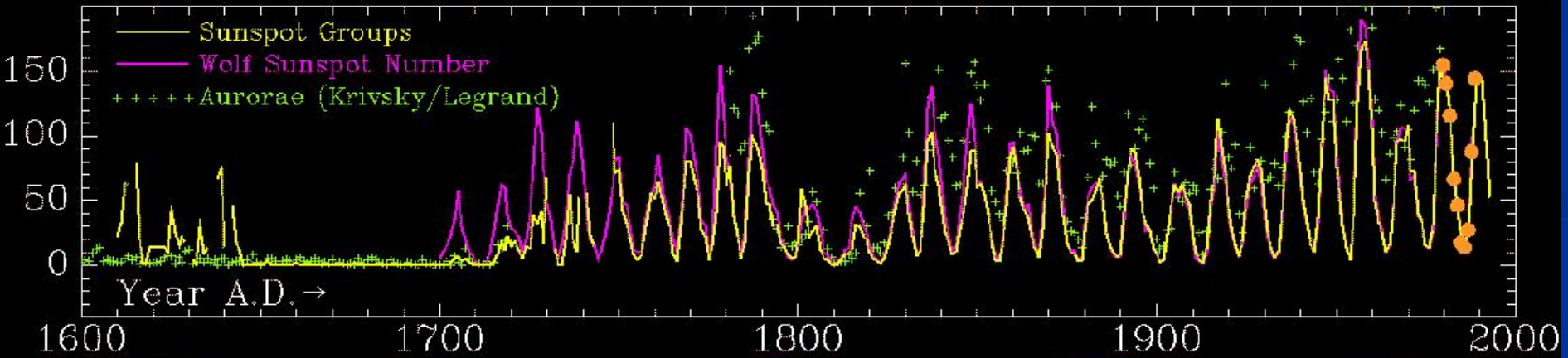
11 Aug 1980

14 Aug 1981

23 Aug 1982

11 Aug 1983

14 Aug 1984



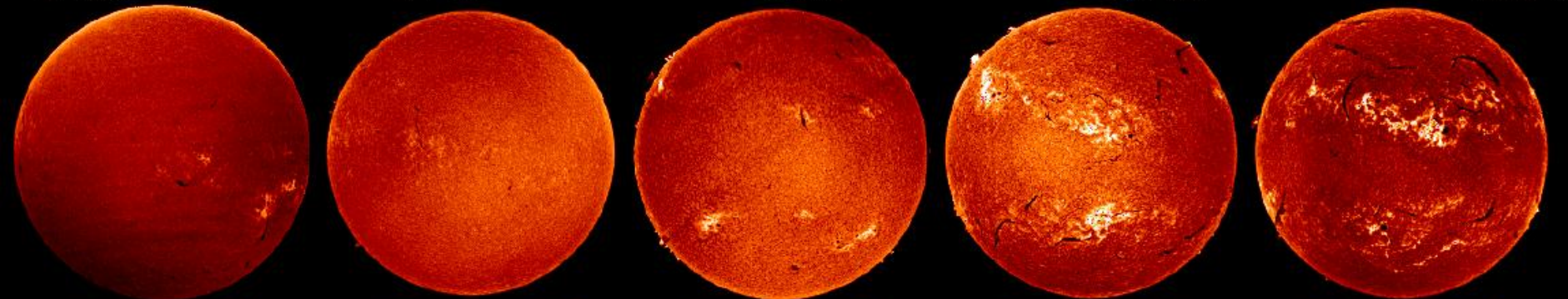
10 Jul 1985

15 Aug 1986

24 Jul 1987

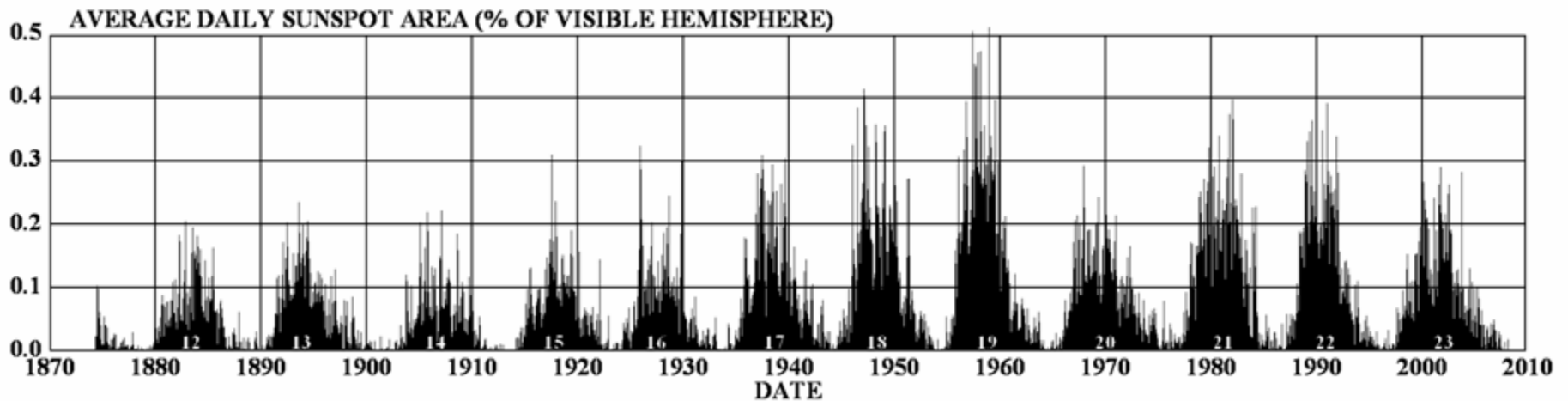
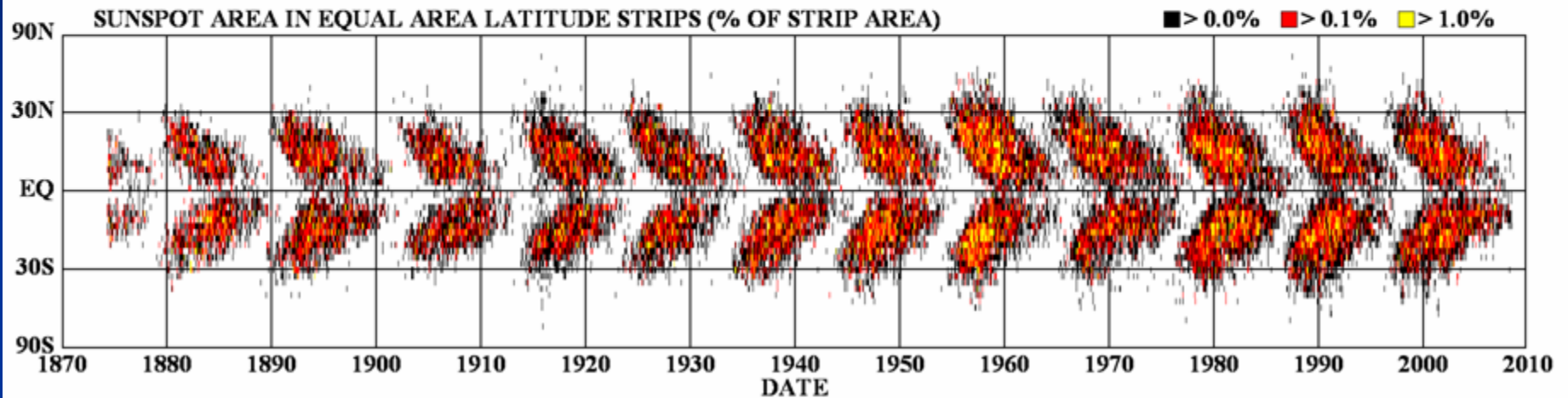
29 Jul 1988

18 Aug 1989



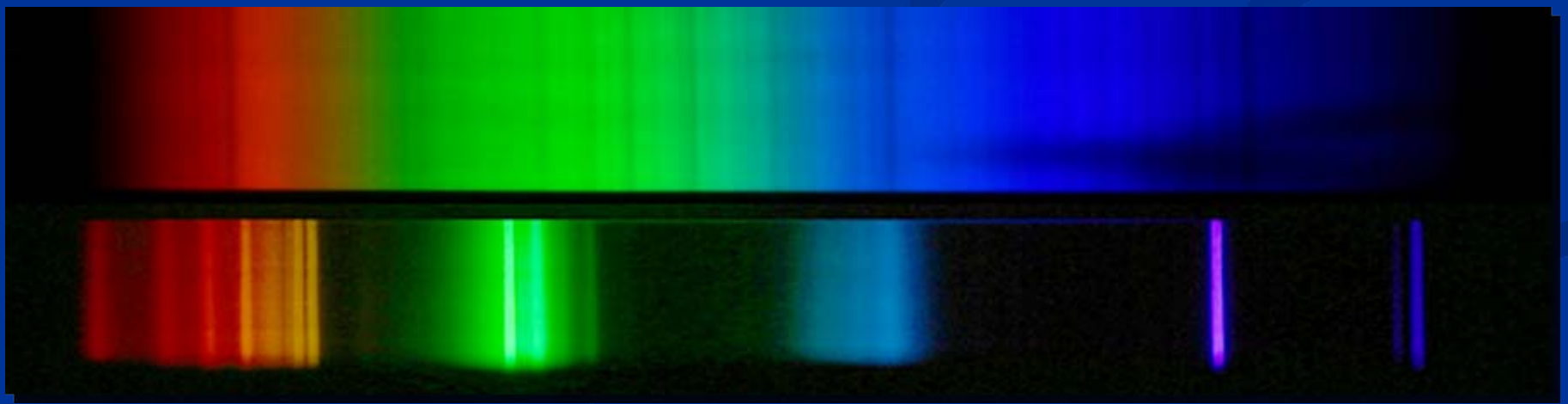
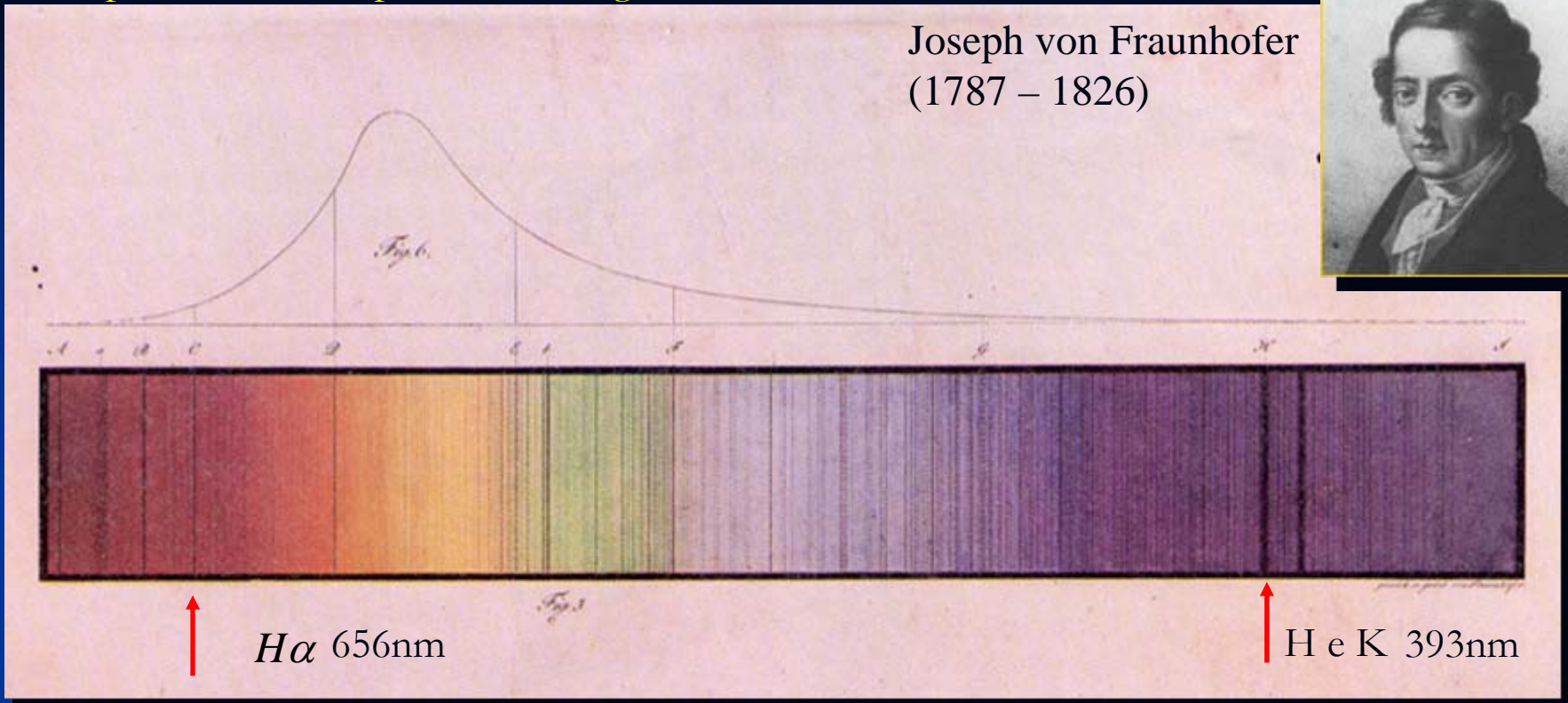
Sol , uma estrela variável...

DAILY SUNSPOT AREA AVERAGED OVER INDIVIDUAL SOLAR ROTATIONS



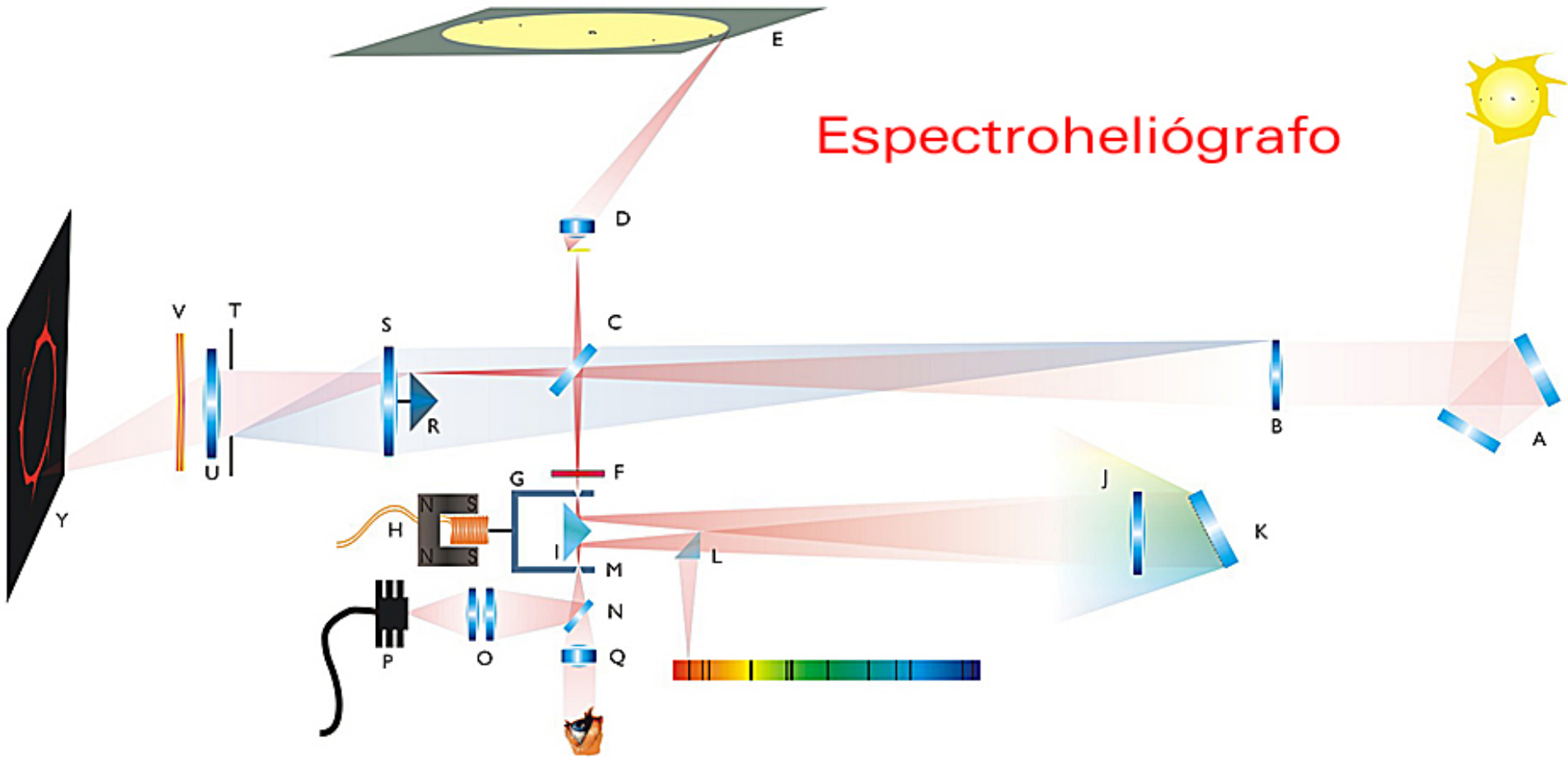
Principais linhas do espectro solar segundo Fraunhofer

Joseph von Fraunhofer
(1787 – 1826)



Espectro solar e o espectro das lâmpadas de iluminação pública a base de vapor de Hg

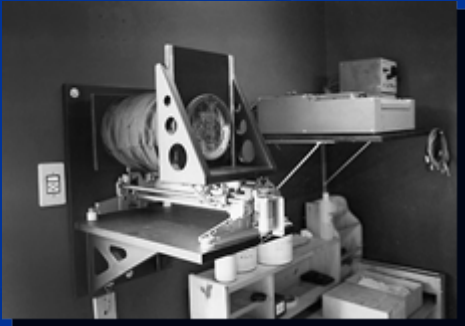
Espectroheliógrafo



Fendas de entrada e saída



Vista geral

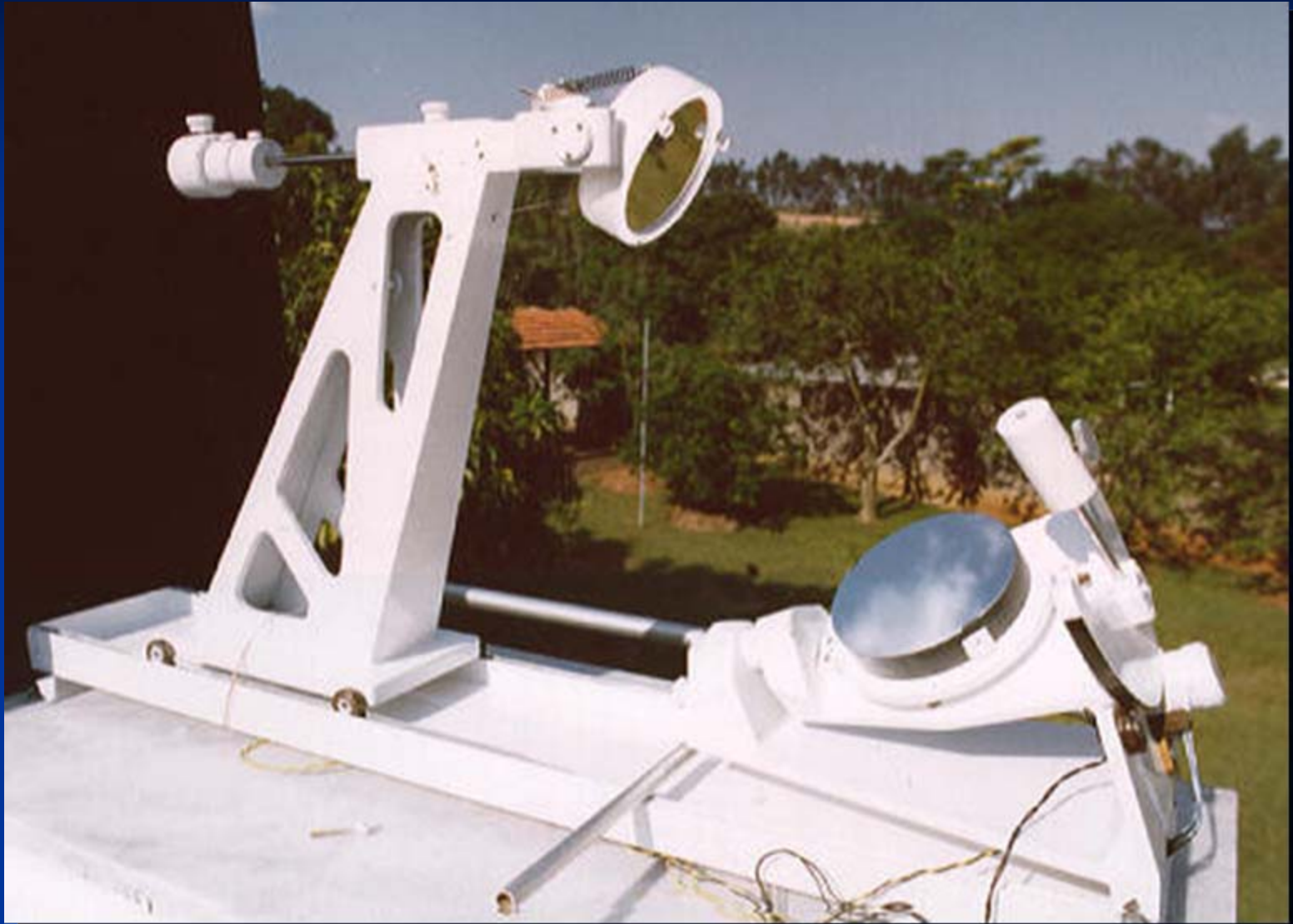


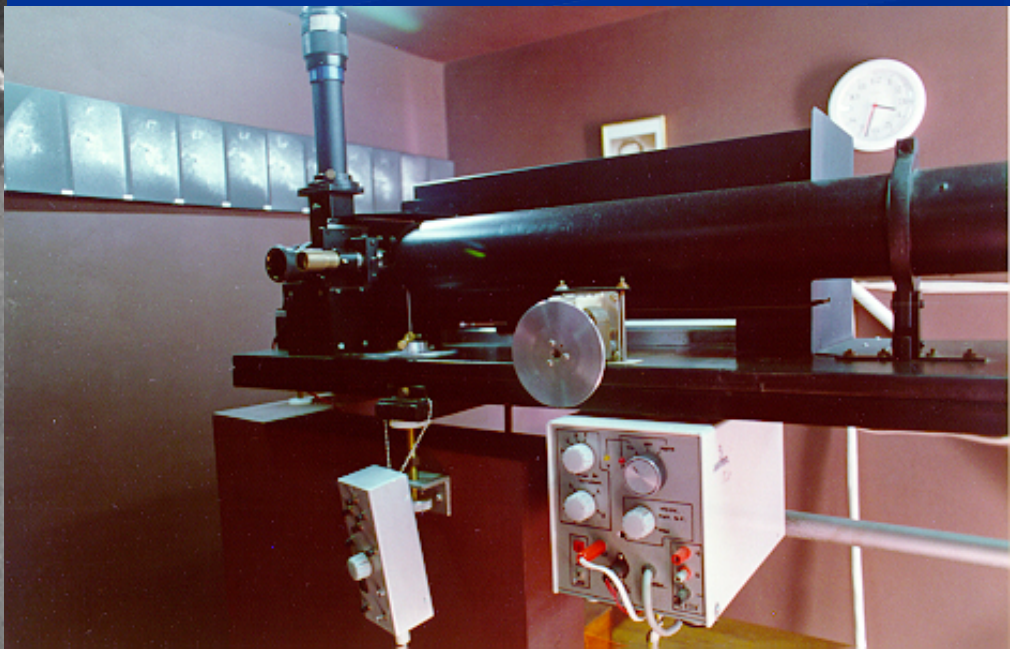
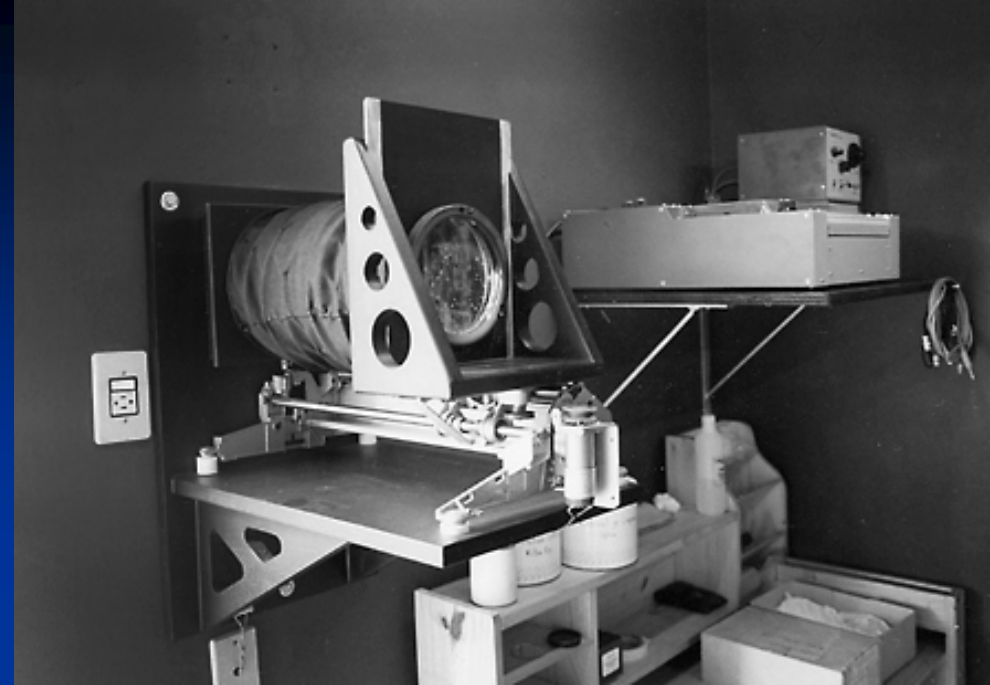
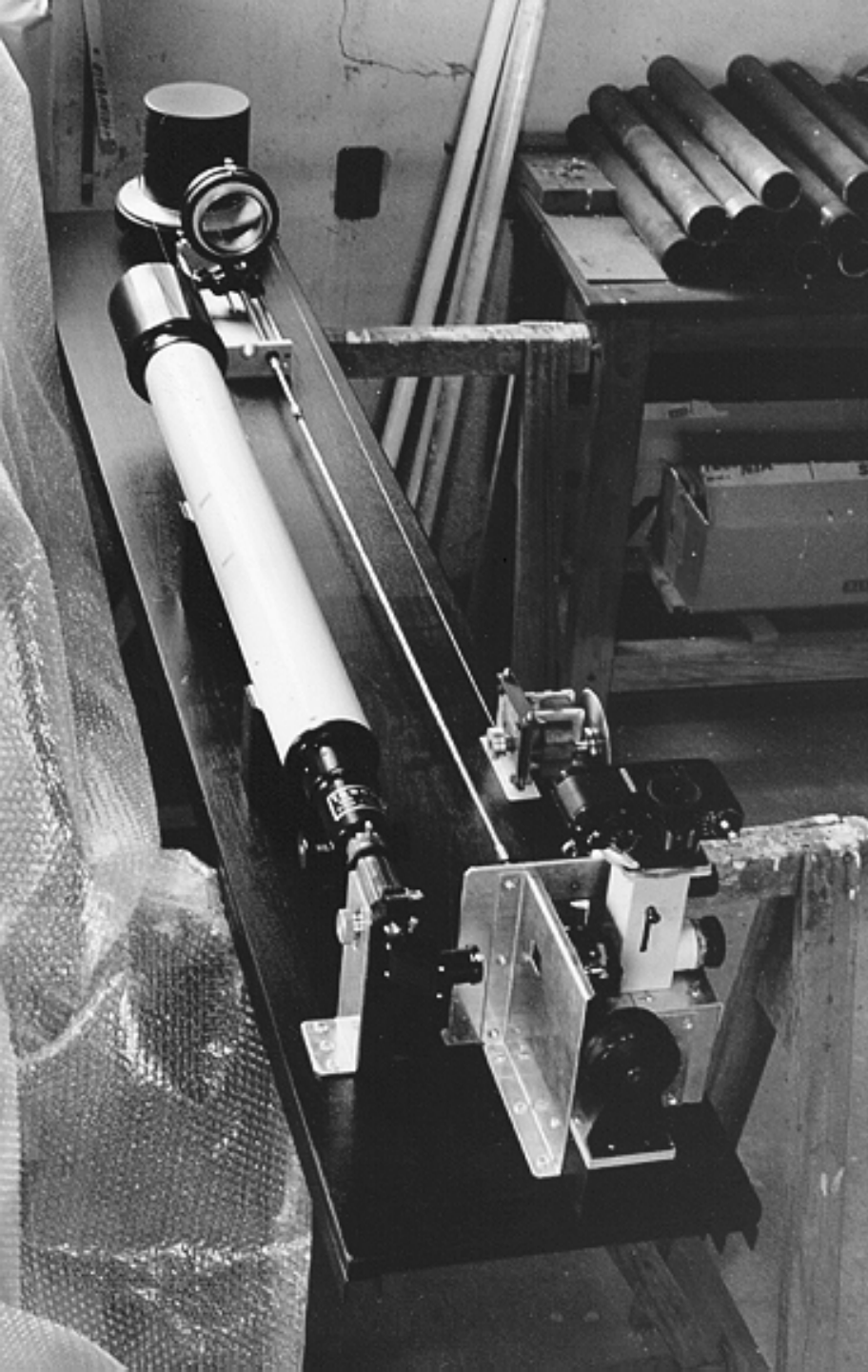
Objetiva



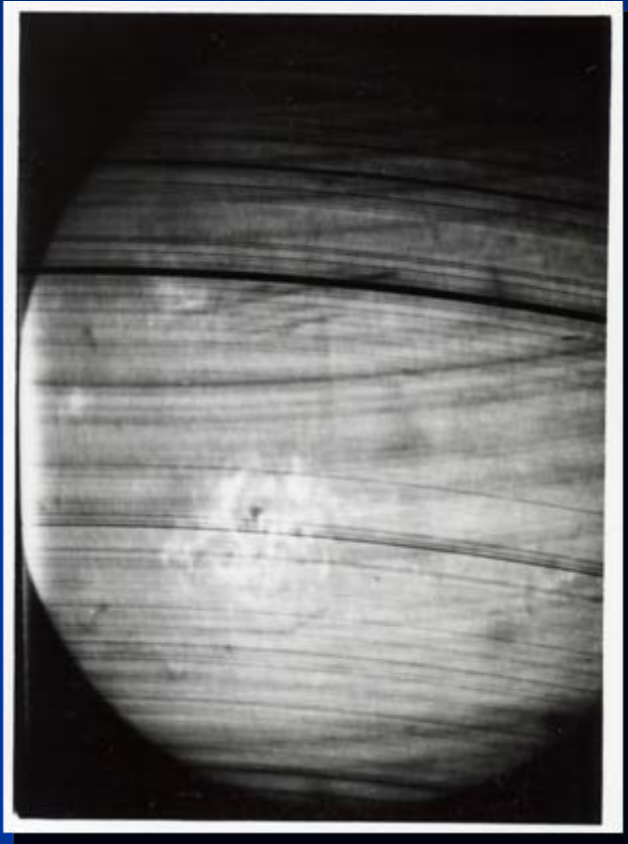
Celostato

Celostato 150mm Observatório Solar Bernard Lyot - Campinas – SP (1999)





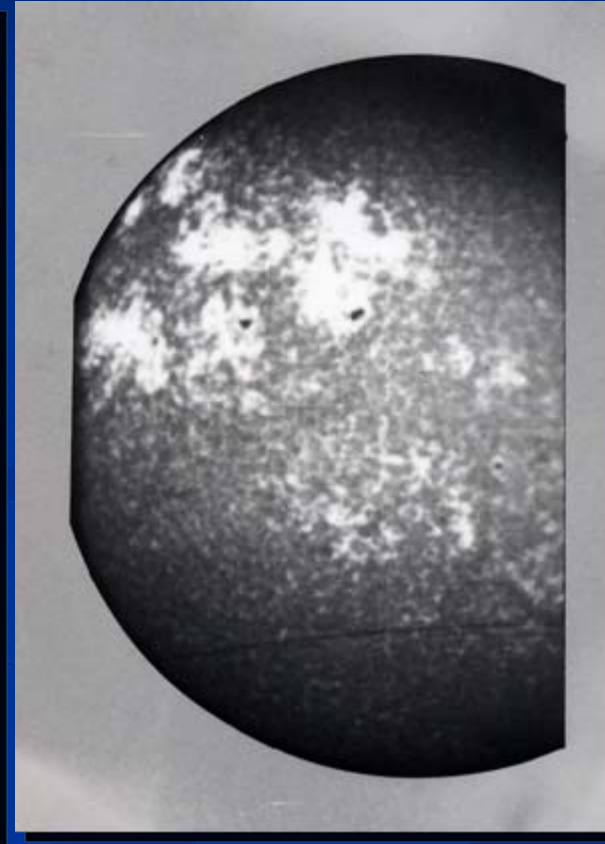
Primeiros Resultados em Outubro de 1991



656 nm Hidrogênio

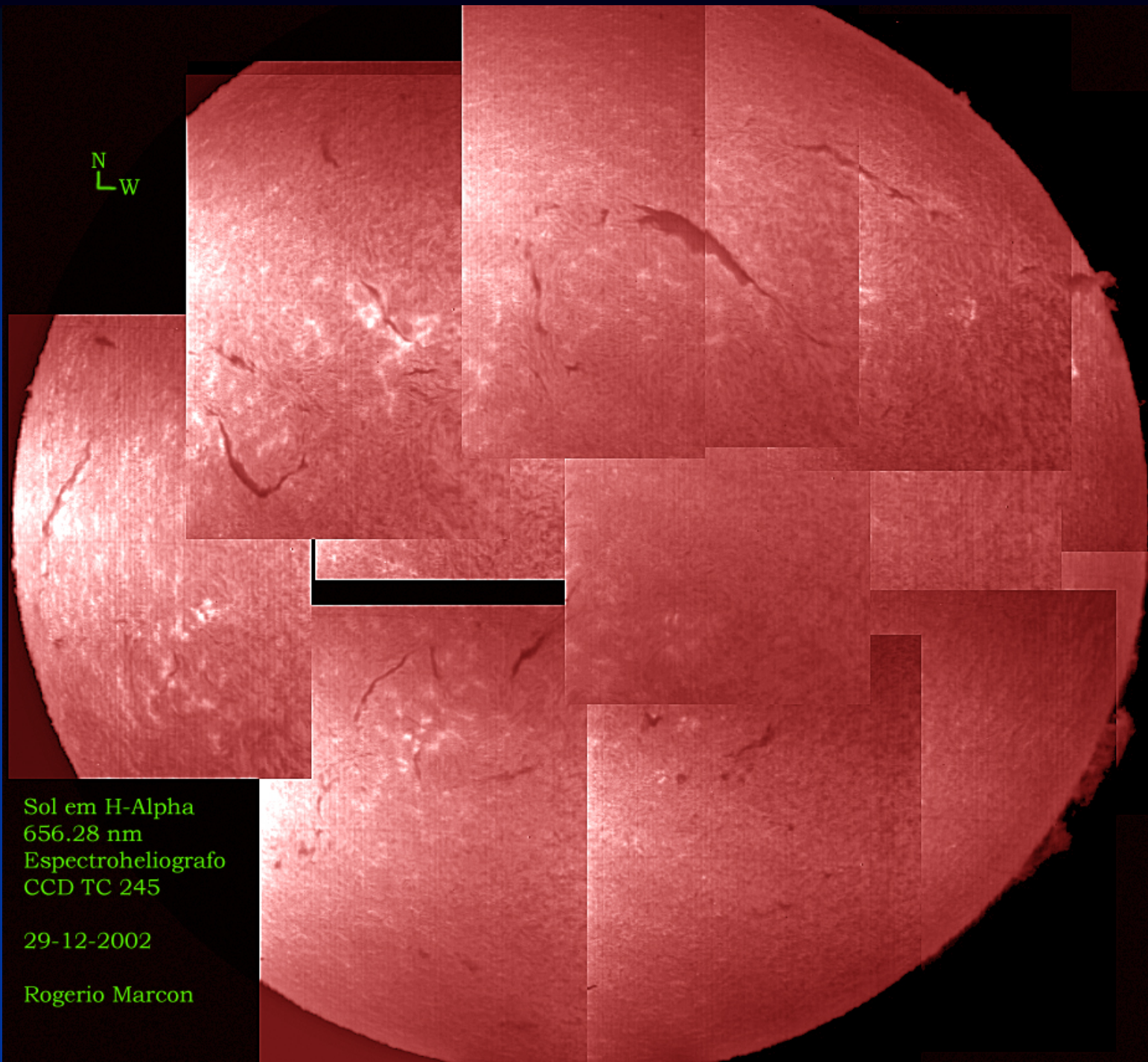


656nm Hidrogênio



393 nm Cálcio

Mosaico de
imagens
compondo o
disco solar
obtidas com
câmera CCD em
656nm

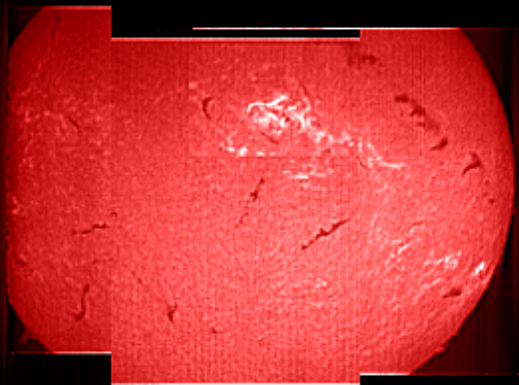


Sol em H-Alpha
656.28 nm
Espectroheliografo
CCD TC 245

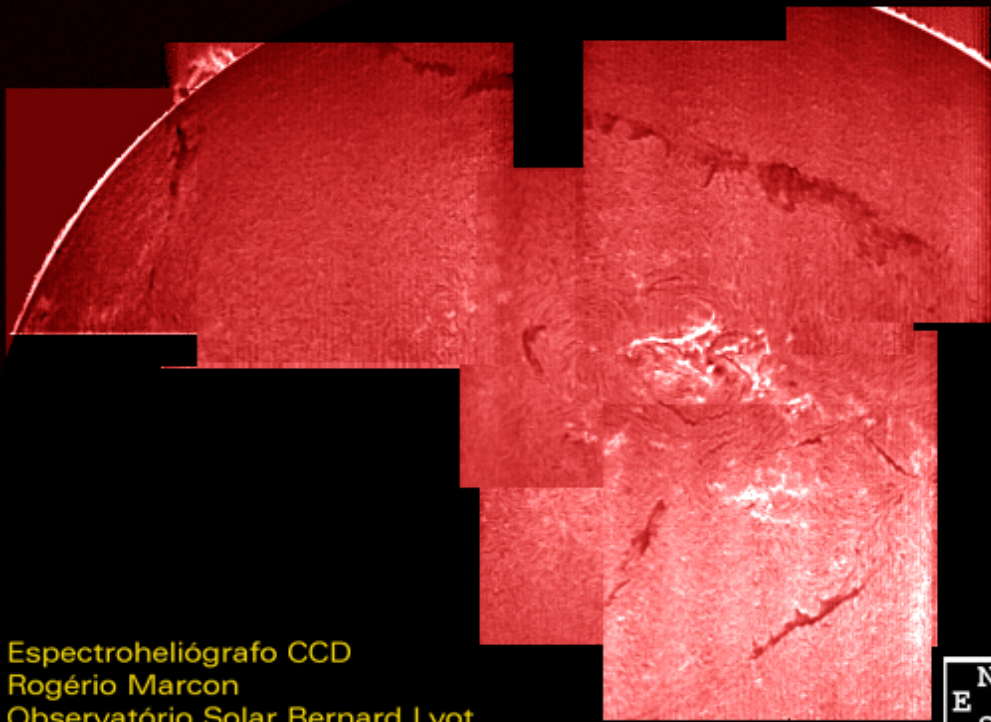
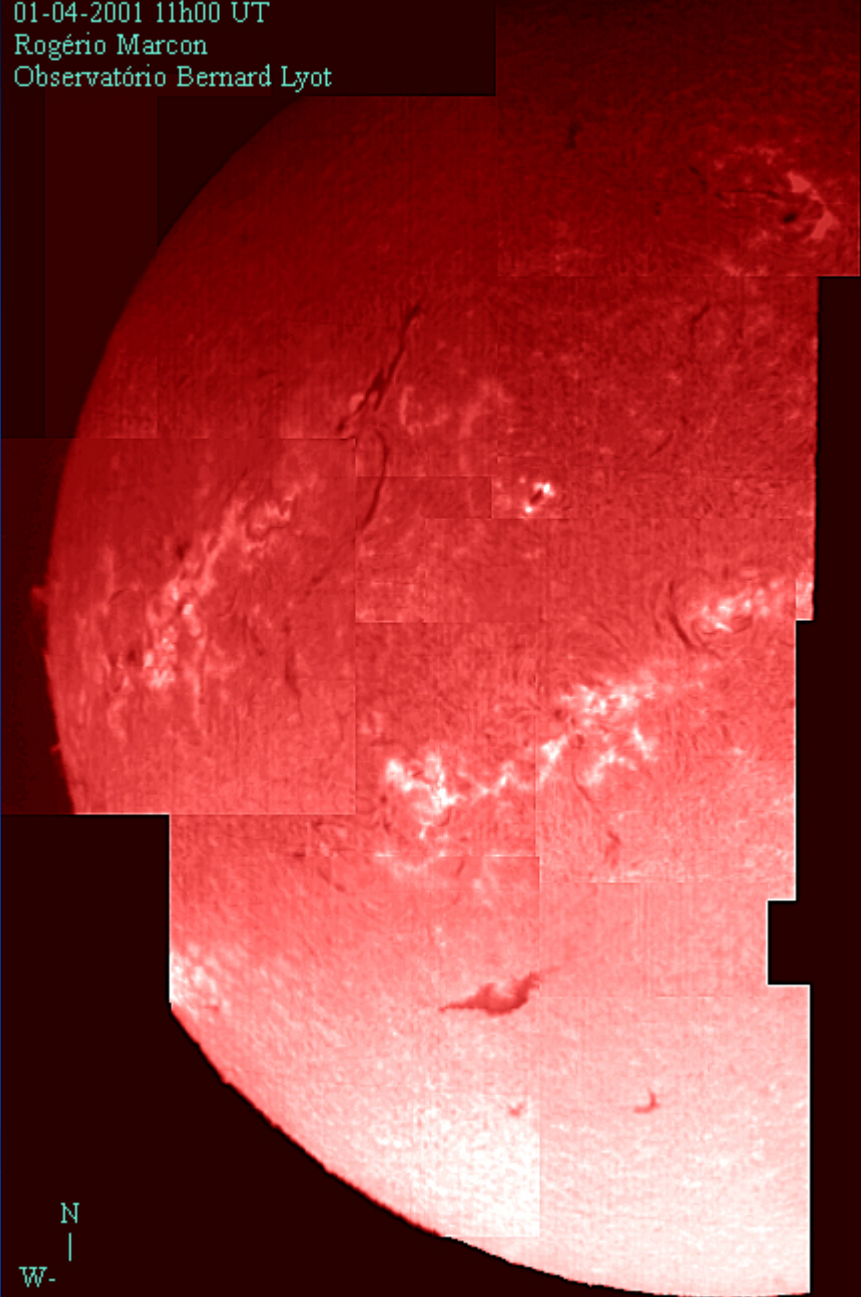
29-12-2002

Rogério Marcon

Sol em H-Alpha
16 de Julho de 2002
15:00 UT



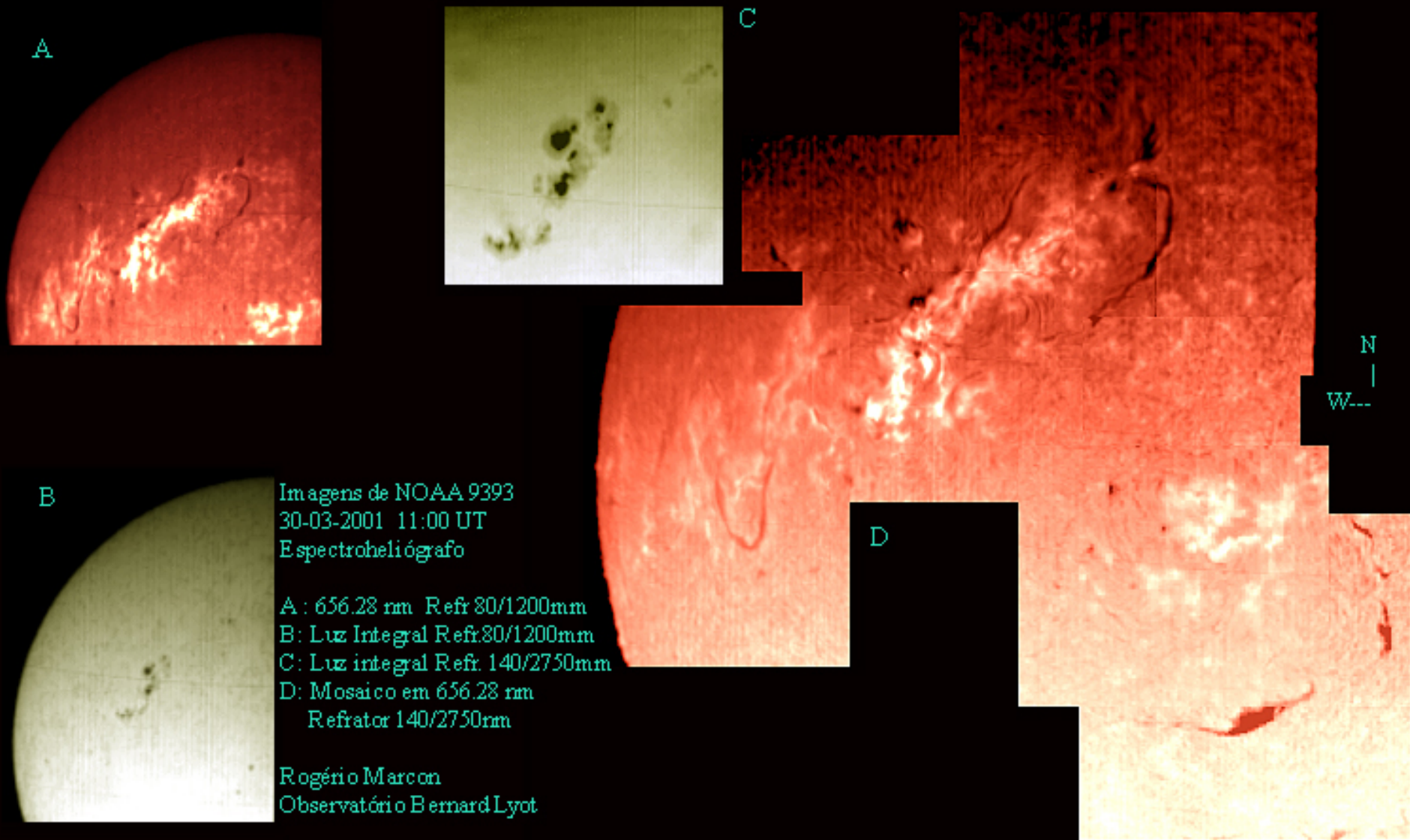
Sol em 656.28 nm
Espectroheliógrafo
Refr. 140/2750mm
01-04-2001 11h00 UT
Rogério Marcon
Observatório Bernard Lyot



Espectroheliógrafo CCD
Rogério Marcon
Observatório Solar Bernard Lyot

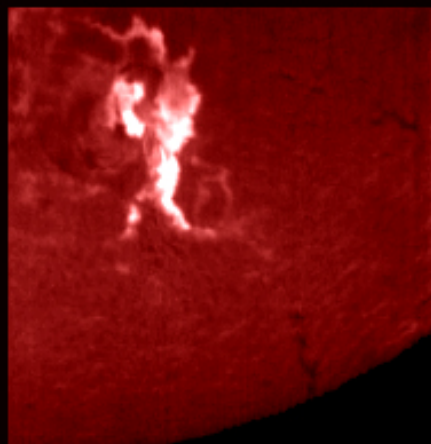


Comparação entre imagens monocromáticas e visível integral



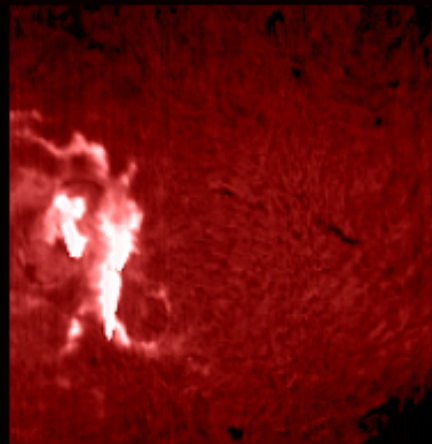
Solar Flare NOAA9632 24-09-2001

Rogério Marcon
Observatório Solar Bernard Lyot
Espectroheliógrafo H-Alpha CCD



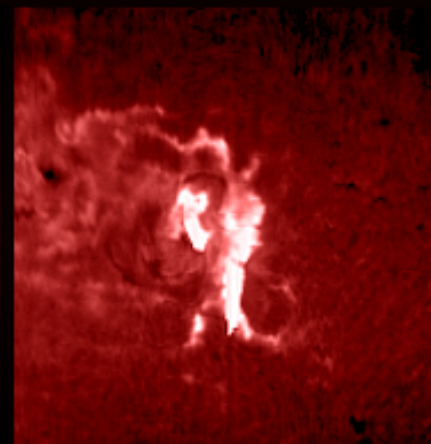
10:40 UT

656.28nm



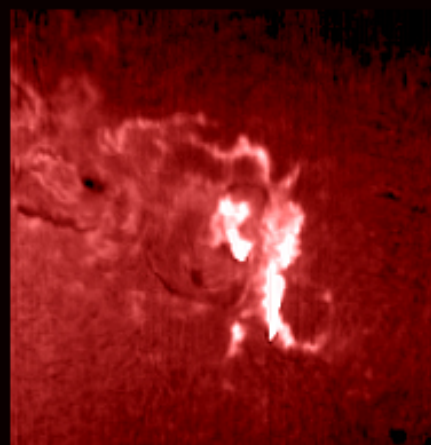
10:45 UT

656.28nm



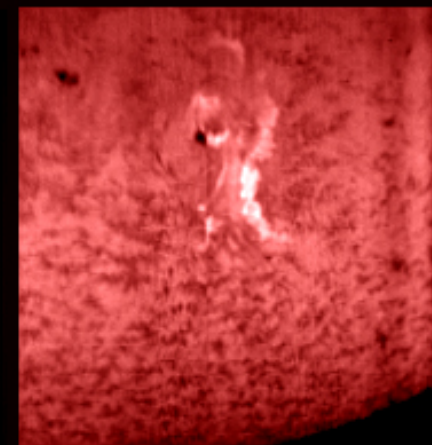
10:49 UT

656.28nm



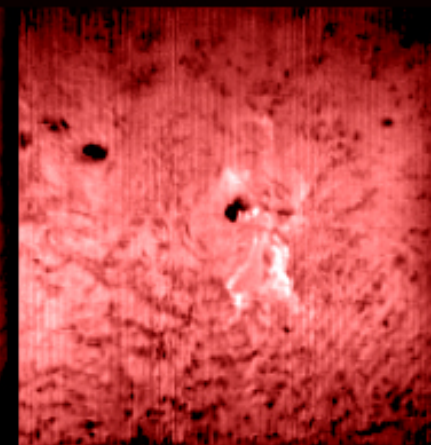
10:55 UT

656.28nm



11:05 UT

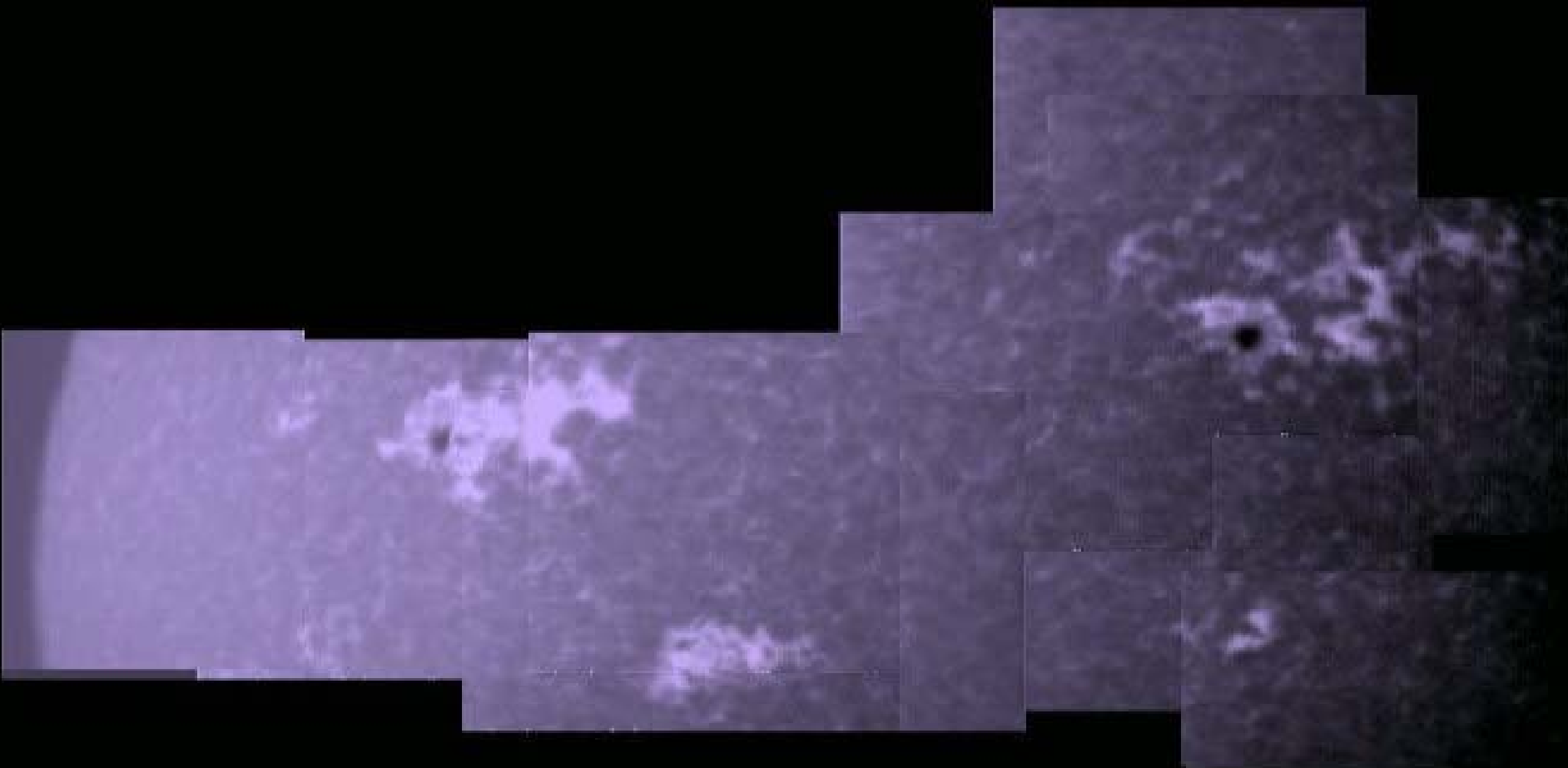
656.21nm



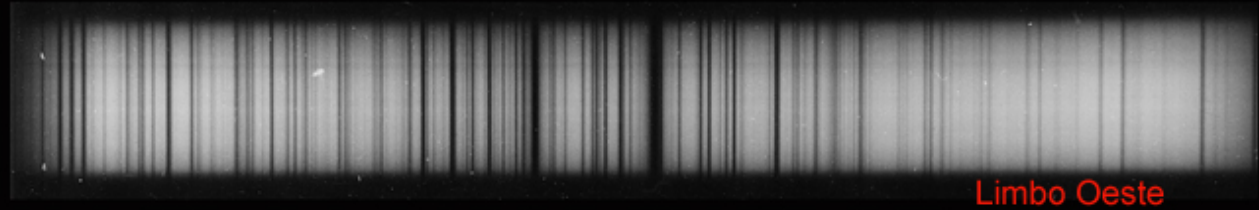
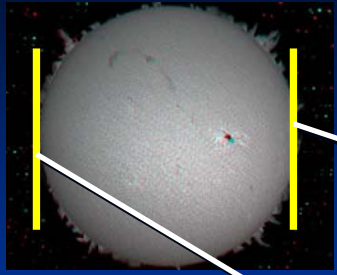
11:10 UT

656.21nm

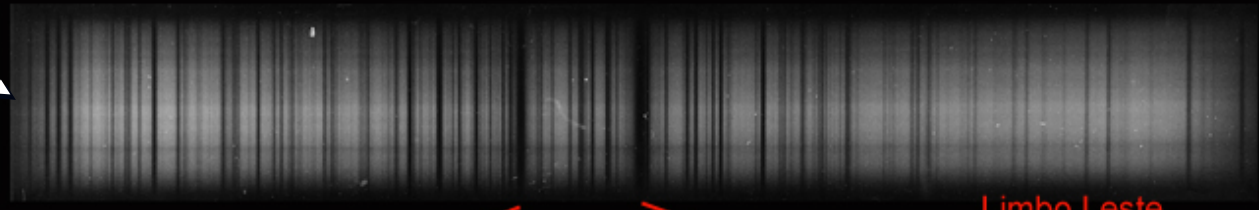
Imagem na luz de Cálcio (393nm) mostrando supergranulação e “ praias” de cálcio.



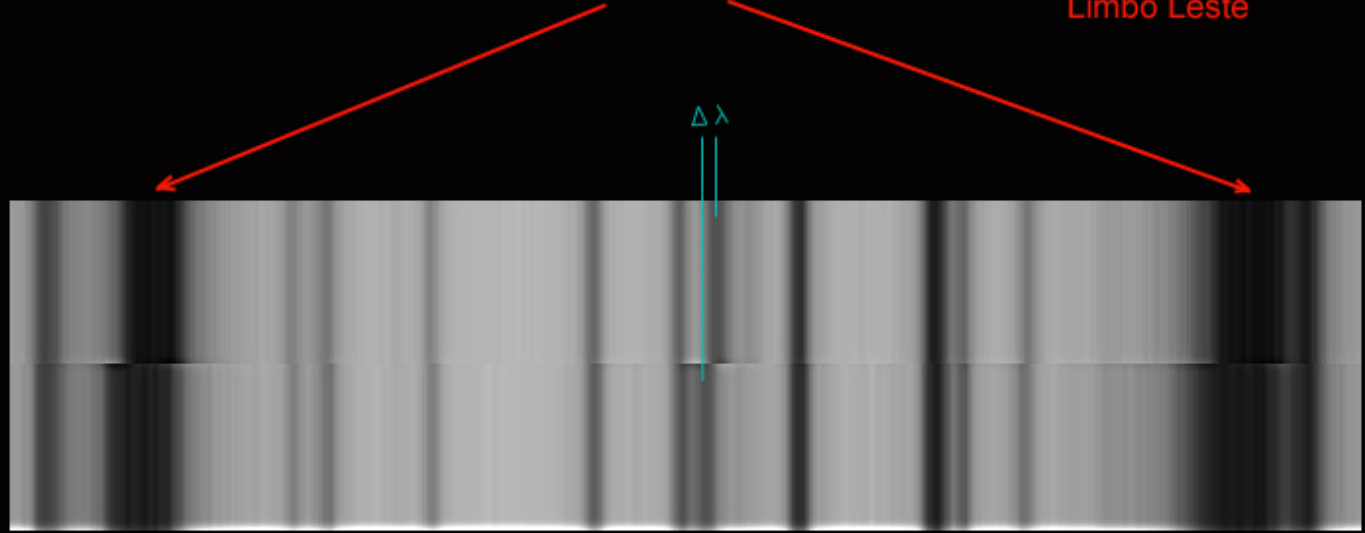
Deslocamento das Linhas Espectrais Devido a Rotação Solar Efeito Doppler-Fizeau



Limbo Oeste



Limbo Leste



Na1 (D2) 588.9973nm atm Ni1 589.2883nm atm Na1 (D1) 589.5940nm

Experimento de medida da velocidade radial dos limbos Leste e Oeste solares. O valor de $0,07\text{\AA}$ e uma velocidade linear de $1,8\text{km/s}$ para o equador solar

Espectrógrafo R=170000

Filtros para Hidrogênio baseados em Etalons e filmes finos



Filtro Daystar
 $H\alpha$ 0,5Å

Filtro Coronado
SM40

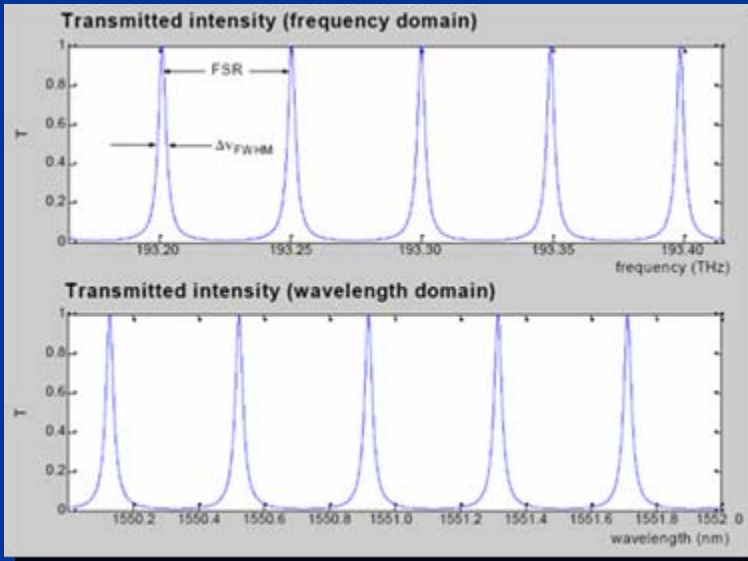
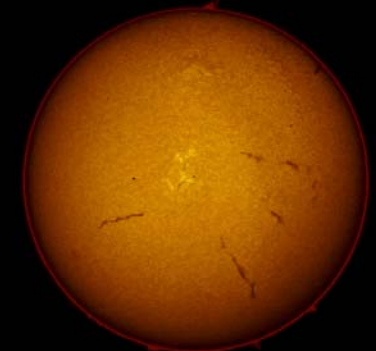
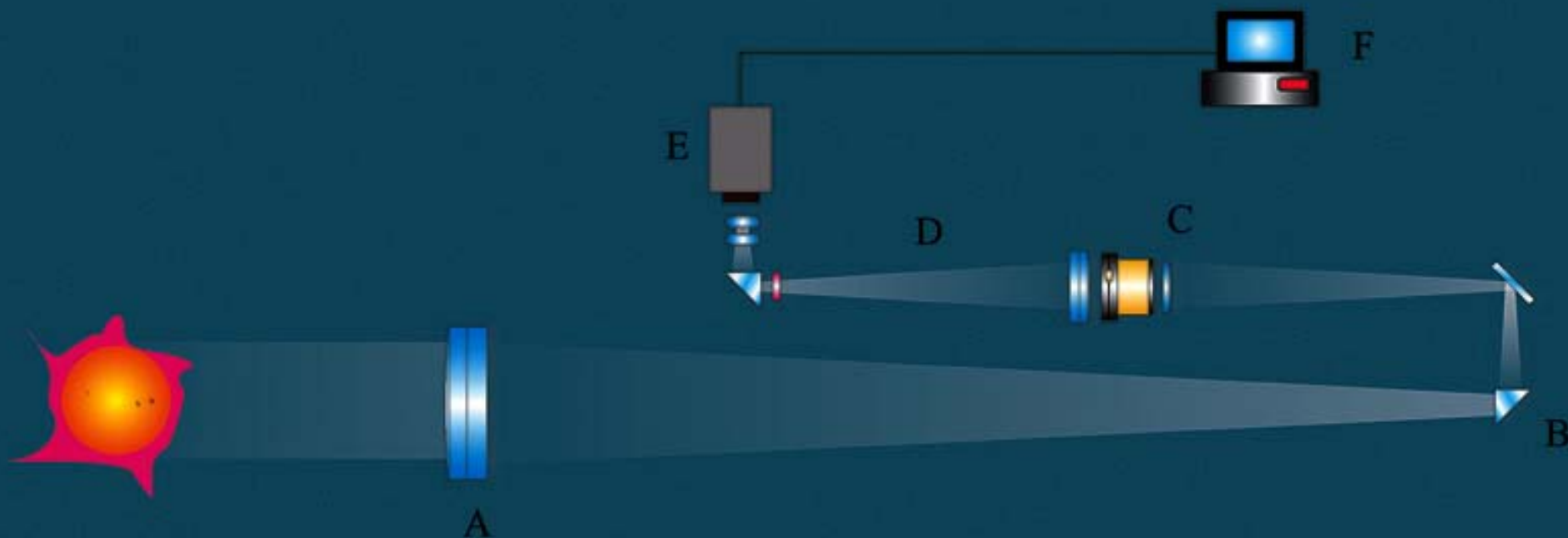


Imagem produzida pelo uso convencional do filtro



Esquema óptico para obtenção de alta resolução com filtro pequeno

Refrator duplo para imagens H-Alpha em alta cadencia



A-Objetiva Acromatica 150mm f/15

B-Prismas e espelhos

C-Lente Plano convexa simples e filtro Fabry-Perot 0.06 nm em 656.3nm

D-Refrator 60mm f/15

E- Camera LU-075 USB 2.0

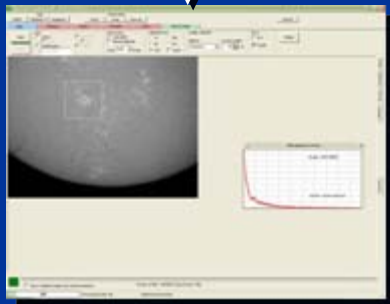
F- Sistema de aquisição de imagens



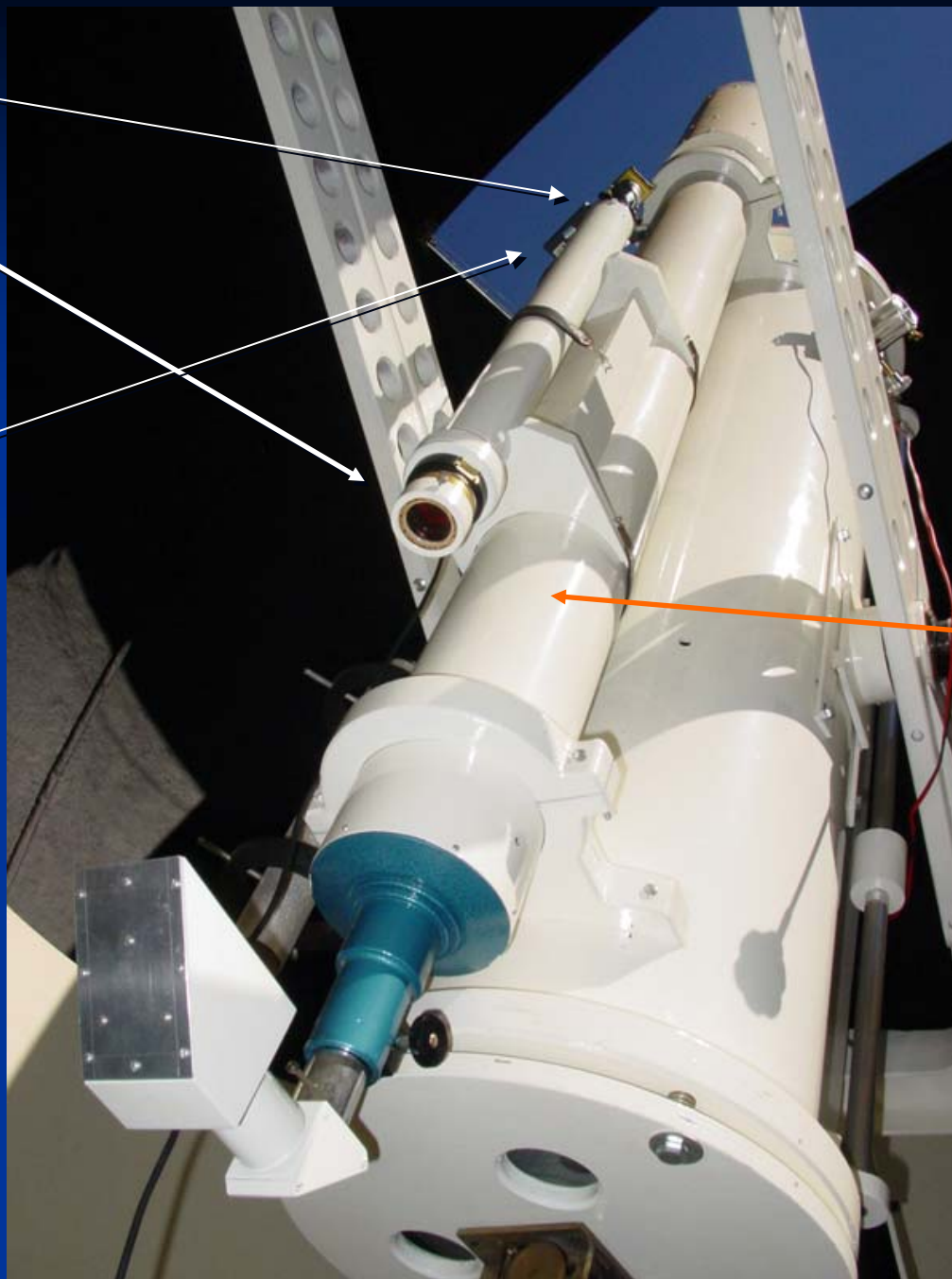
Filtro SM40



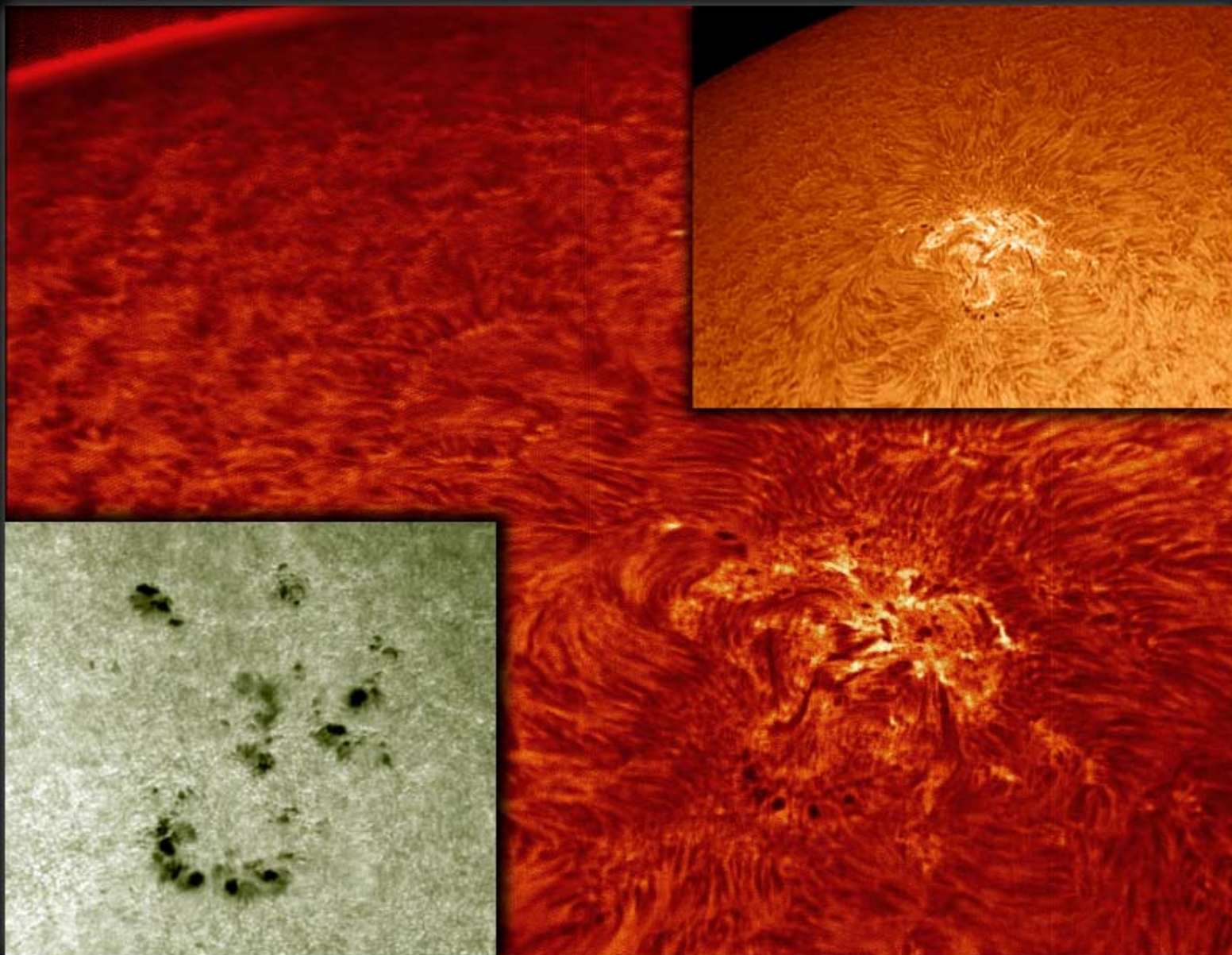
Webcam
USB 2.0



Programa de
tratamento de
imagens e soma de
frames
REGISTAX

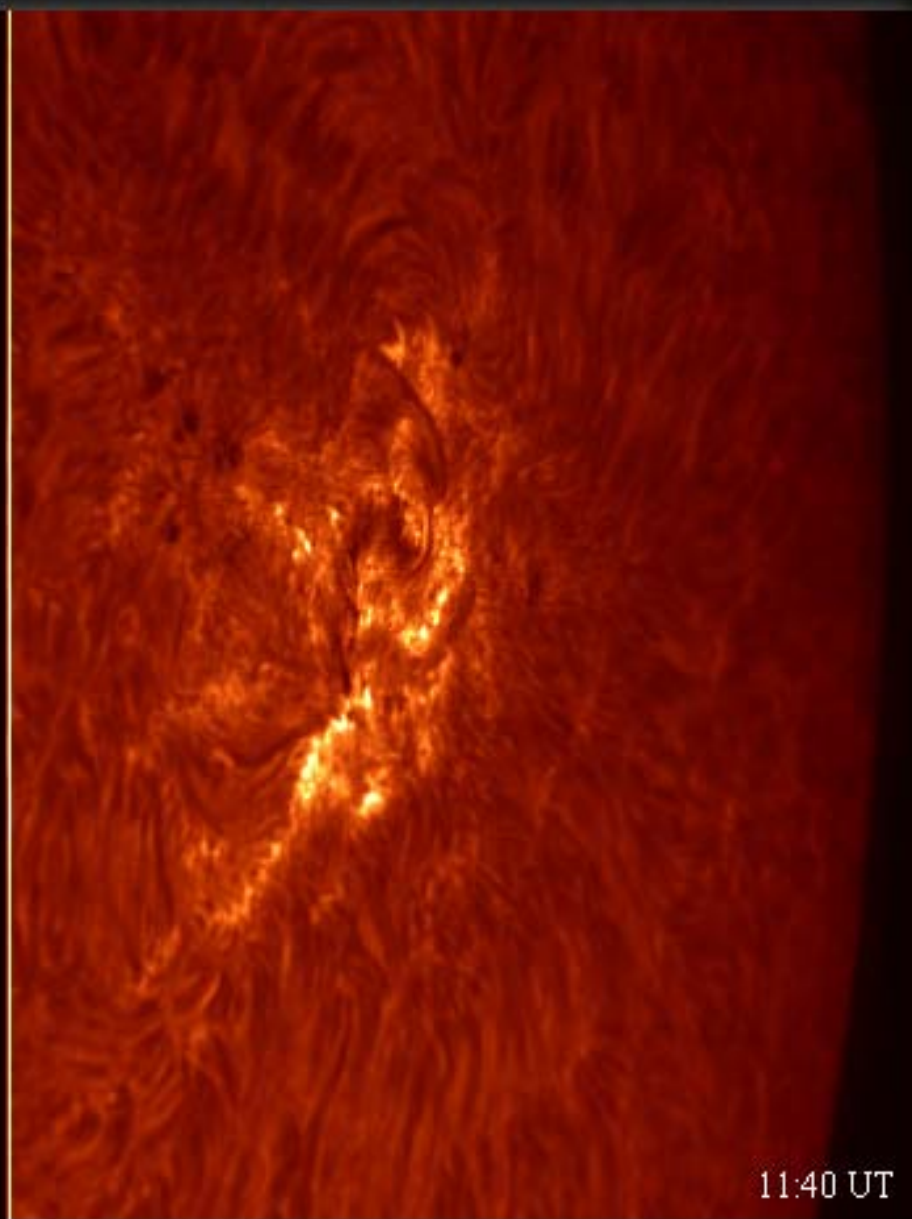
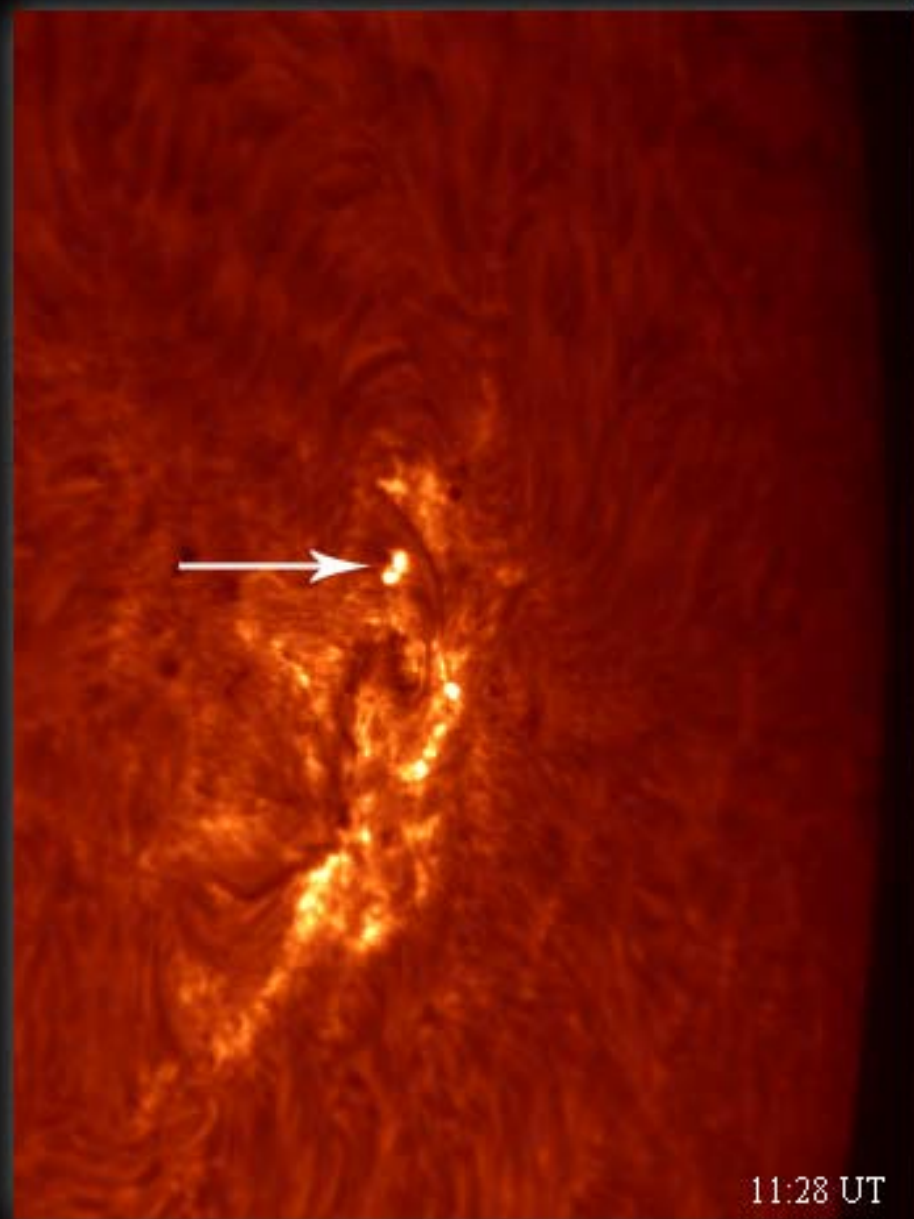


Refrator
Acromático
150mm f/15

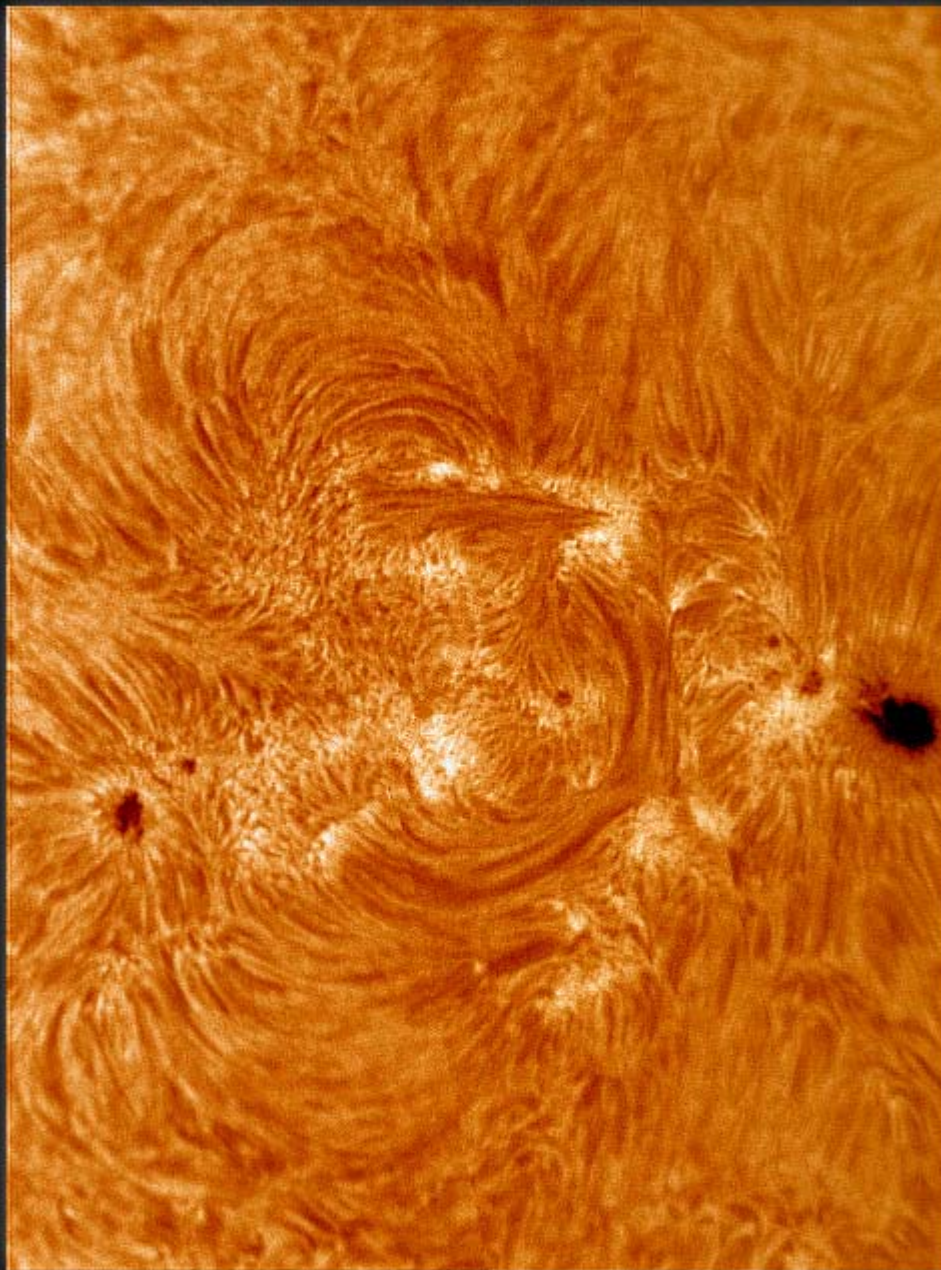


AR978 Dec 15 2007 12:00 UT. Upper Right and Center : H-Alpha , 150mm refractor , CORONADO SM40 filter, 3000 frames stacked. Botton Left : White Light , 150mm refractor , CANON 20Da , single frame with Herschel Edge and green filter , 1/2500s.

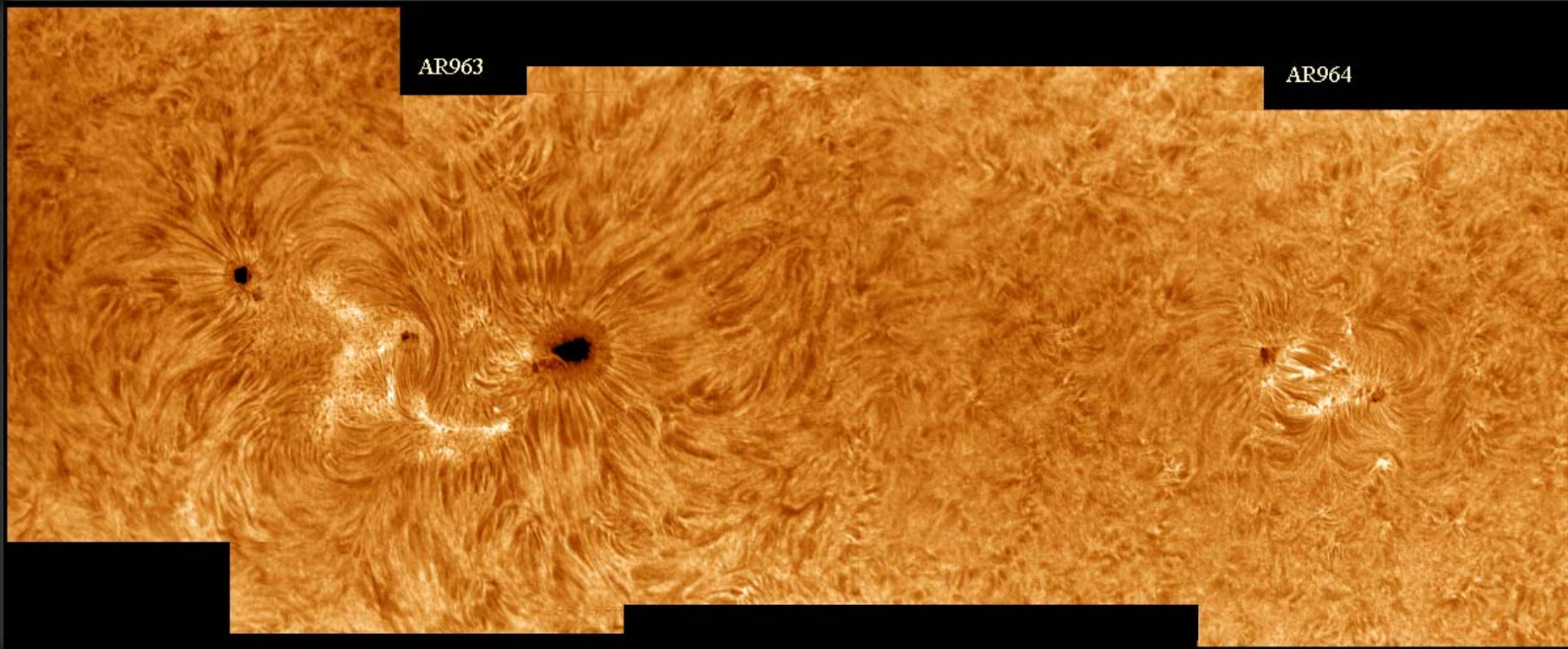
Rogério Marcon - Campinas - SP-BRAZIL



Small flare in AR978 Dec 16 2007 , 11:28 UT , H-alpha CORONADO SM40 filter, 150mm refractor,
Rogerio Marcon - Campinas - SP - Brasil



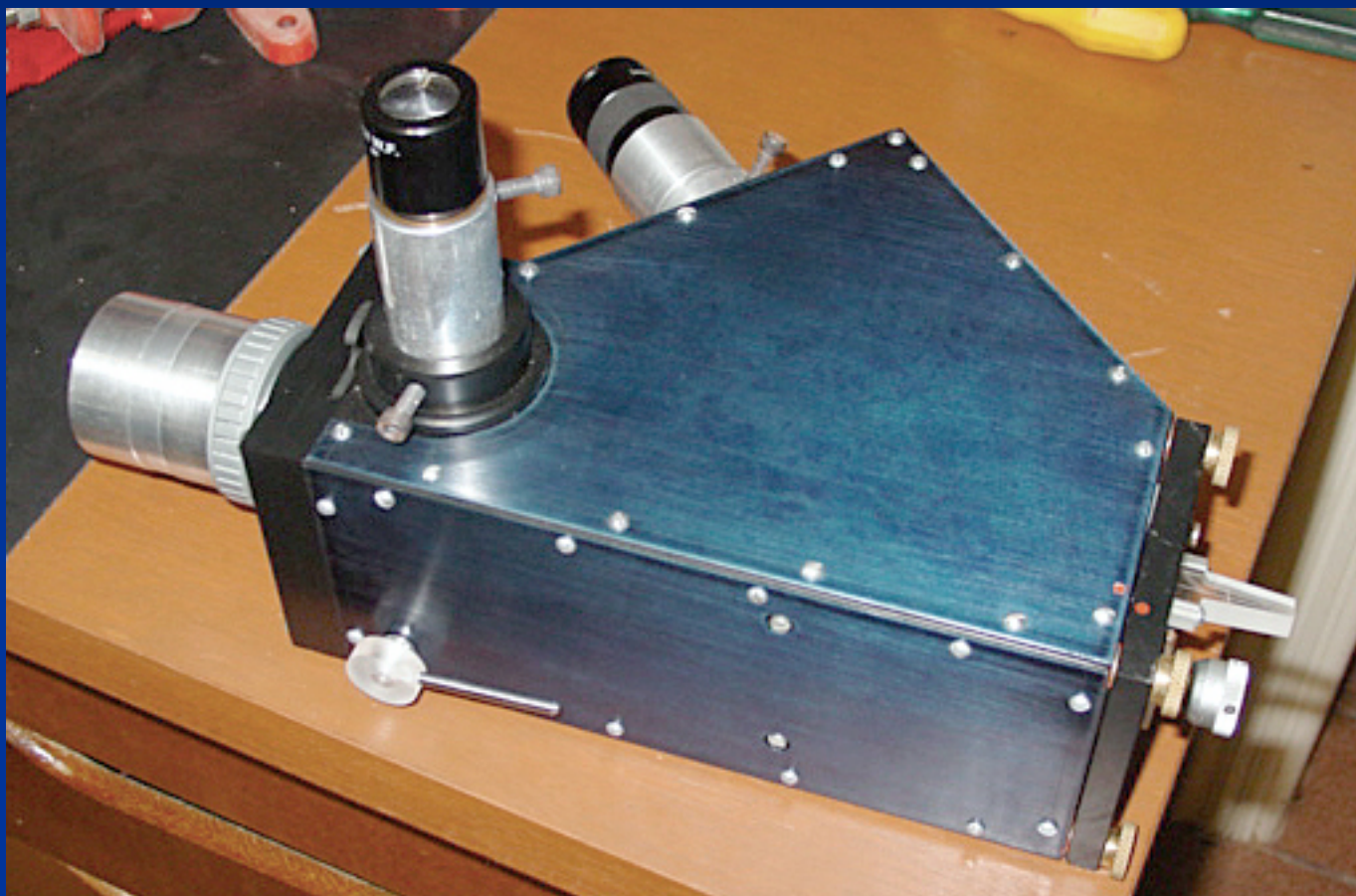
AR963 H-Alpha Coronado SM40/BF10 150mm refractor July, 15 2007 13:00UT
Rogerio Marcon Campinas - SP - Brazil



AR963 and AR964 Coronado SM40/BF 10 H-Alpha filter 150mm Double Refractor 3000 frames in REGISTAX LUMENERA Skynyx 2.0 Monochrome
Rogerio Marcon July 13 2007 13:00 UT Campinas - SP - Brazil

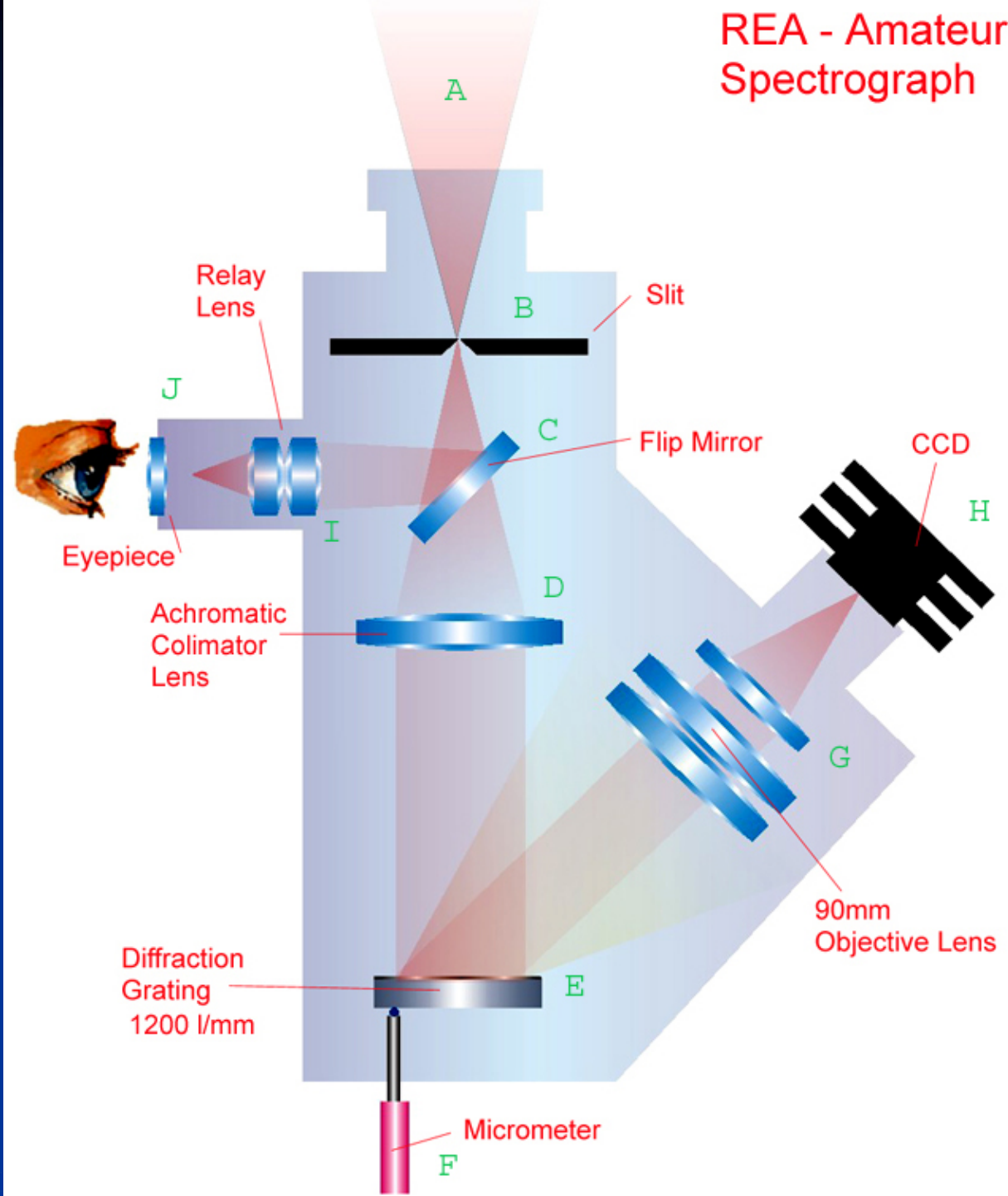
Novo campo para o amador ...

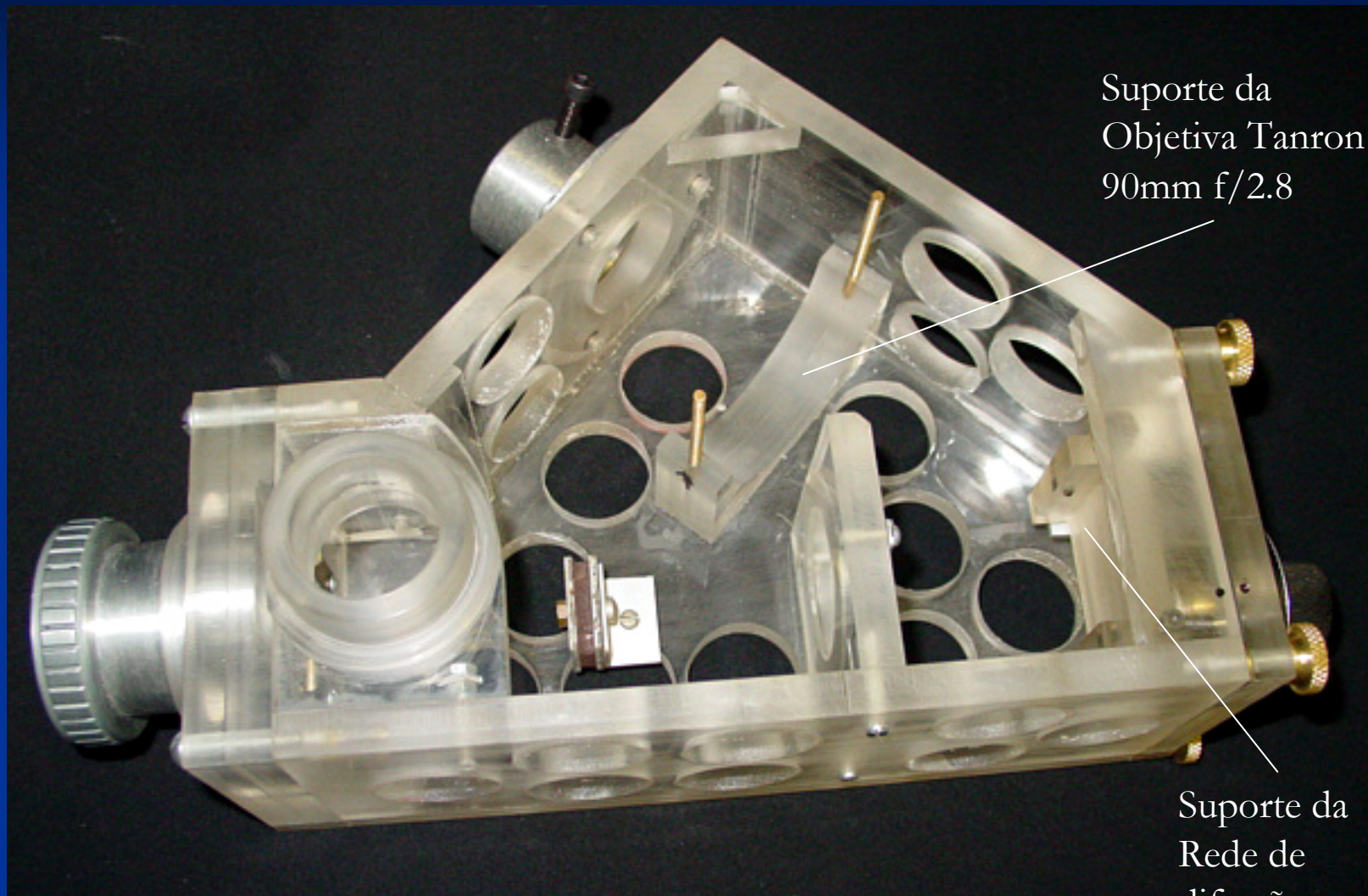
Espectroscopia Estelar



Espectrógrafo
montado em
torno de uma rede
de difração com
1200l/mm com
50x50mm , uma
objetiva de
máquina
fotográfica e uma
lente de binóculo.

REA - Amateur Spectrograph





Suporte da
Objetiva Tanron
90mm f/2.8

Suporte da
Rede de
difração

Estrutura interna em Plexiglass para alívio de peso

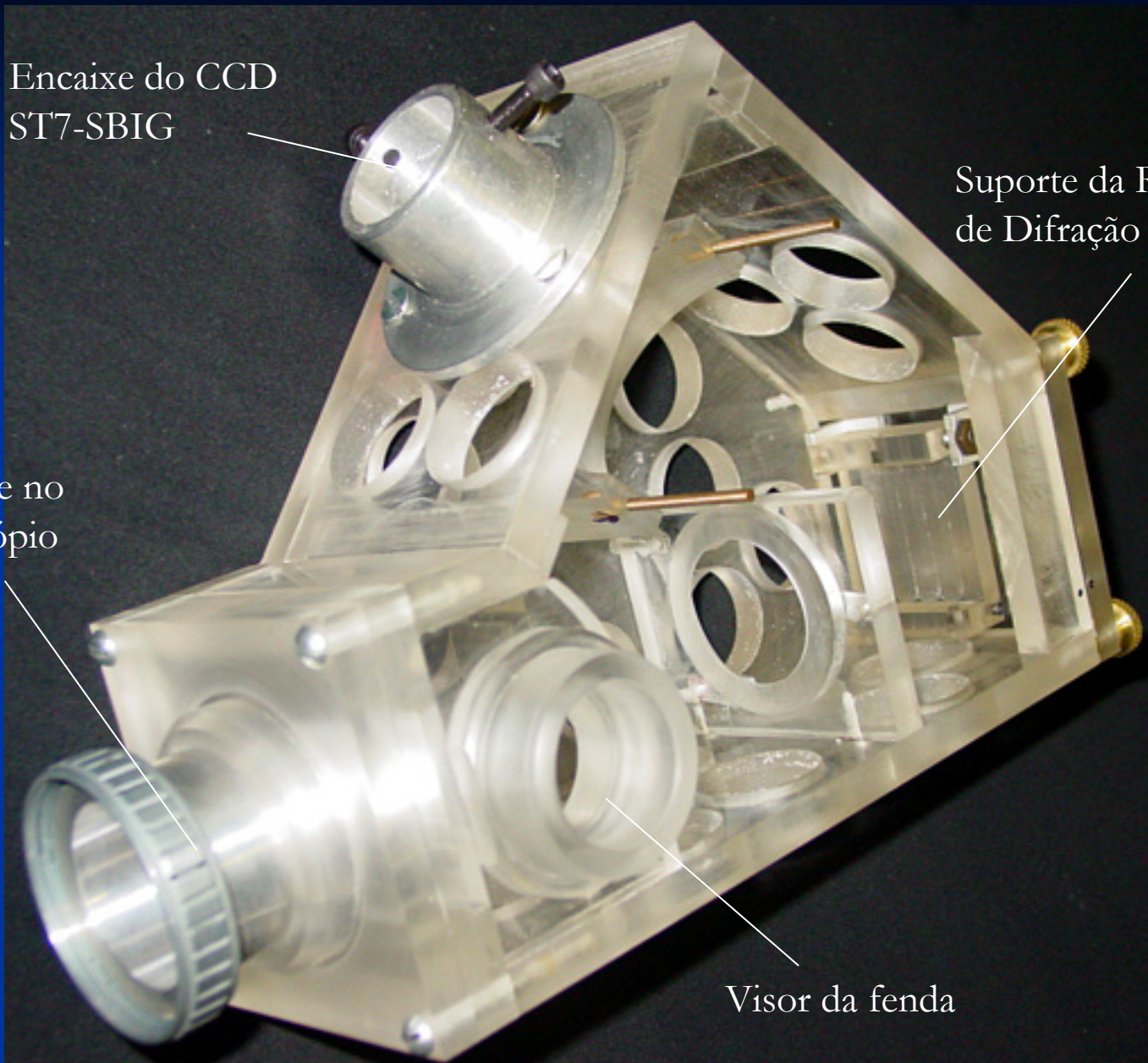
Encaixe do CCD
ST7-SBIG

Suporte da Rede
de Difração

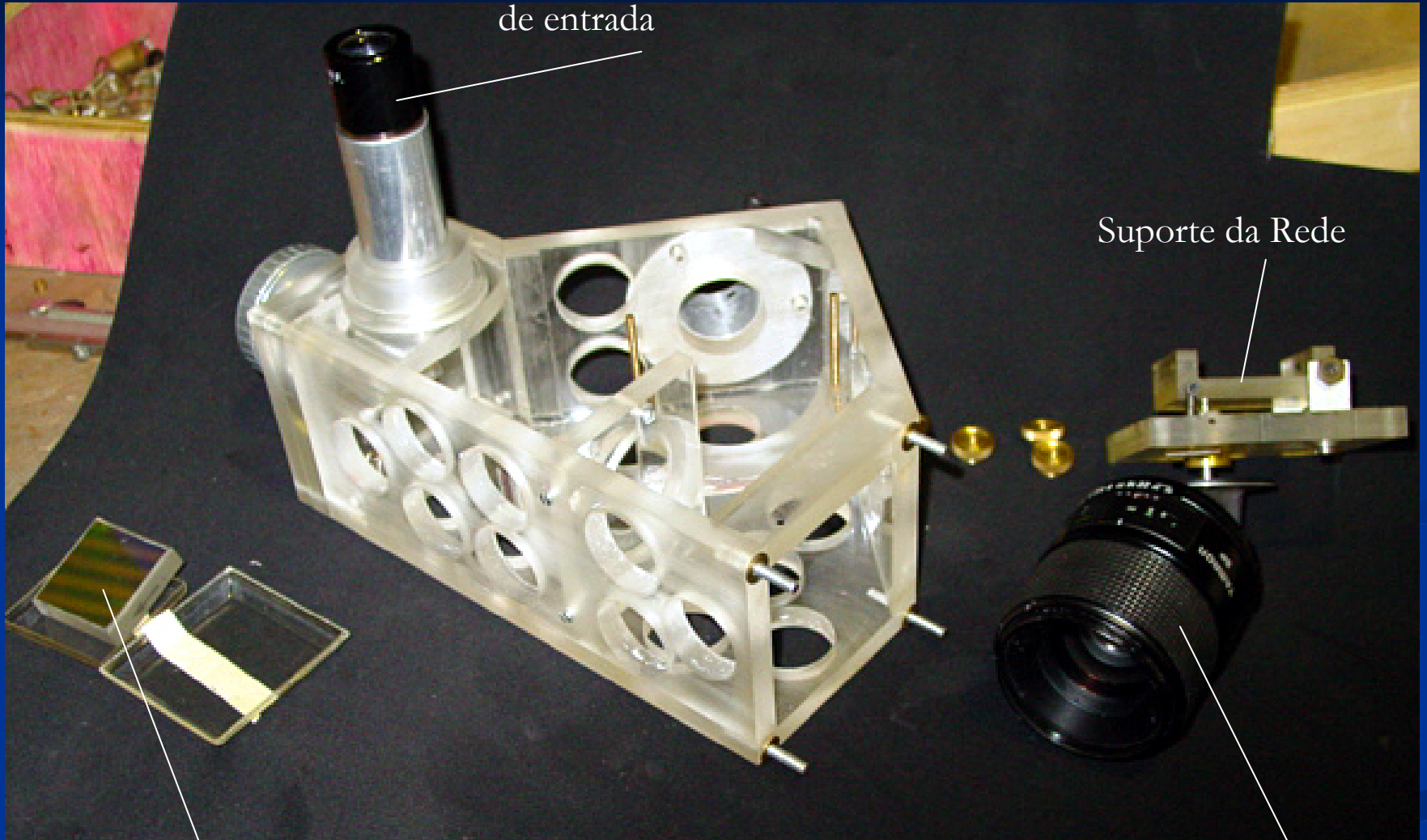
Estrutura
interna do
Espectrógrafo
CCD

Encaixe no
Telescópio

Visor da fenda



Ocular para
Observação da fenda
de entrada



Suporte da Rede

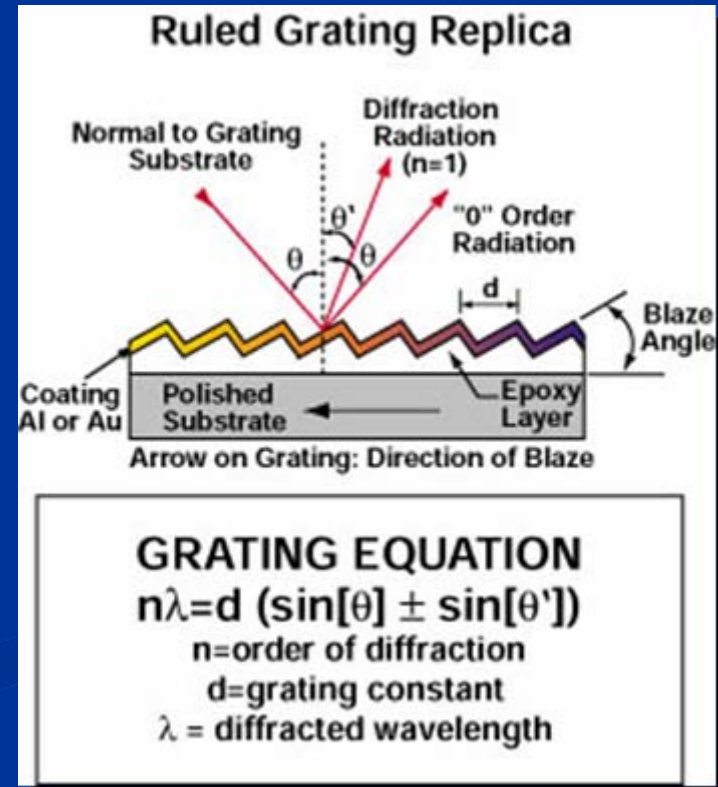
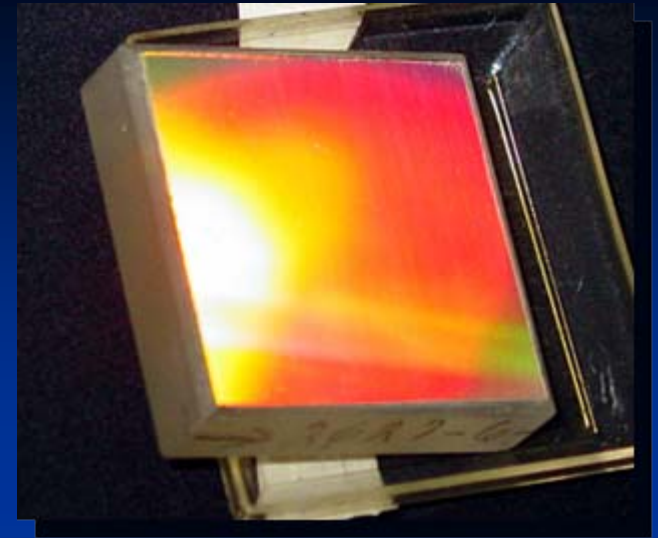
Rede de Difração
1200l/mm Edmund
Scientific

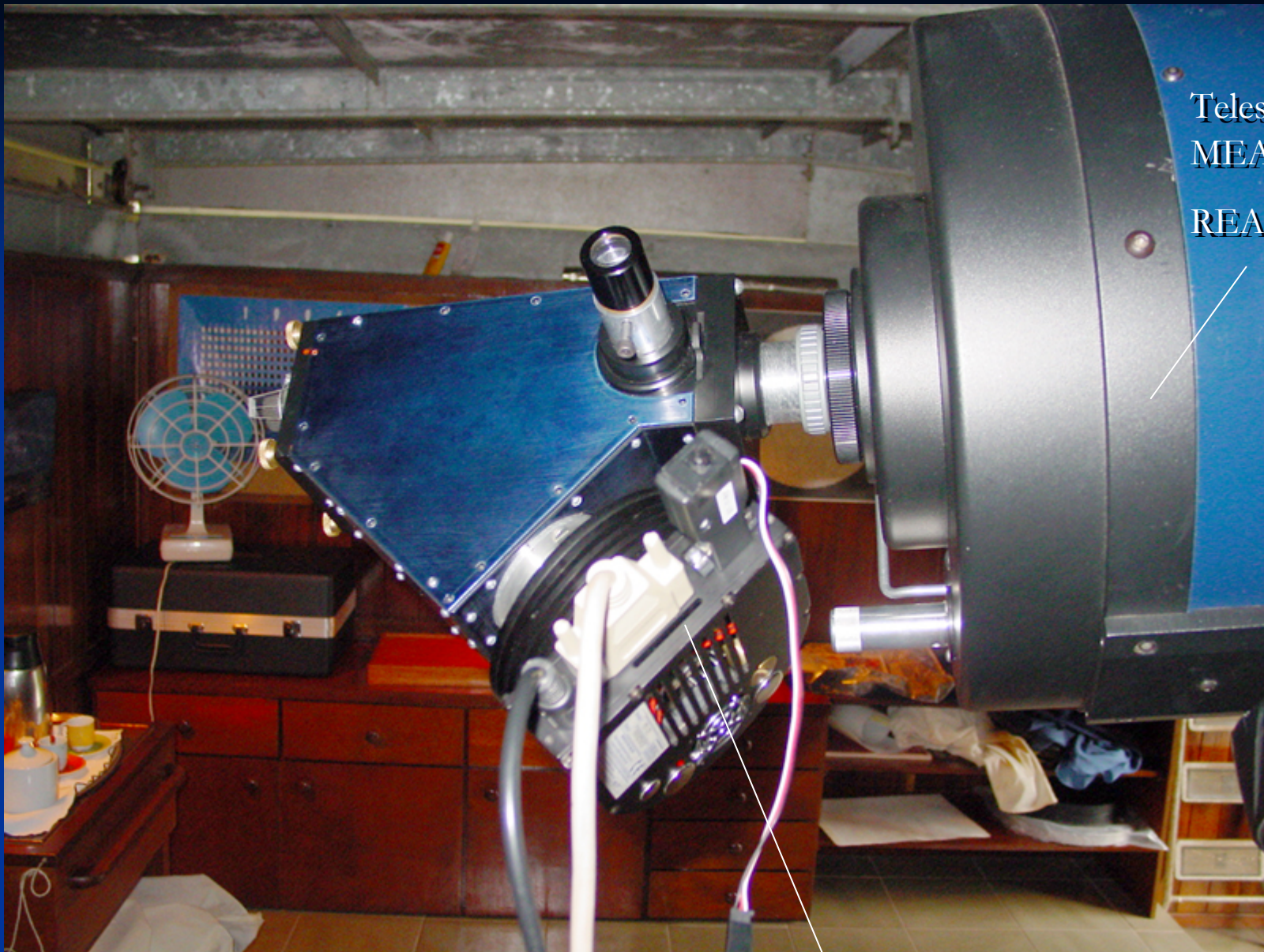
Objetiva Tanro 90mm f/2.8

Redes de Difração são elementos ópticos compostos de linhas regularmente espaçadas capazes de difratar a luz incidente em diferentes direções .

As direções dependem do espaçamento das linhas e do comprimento de onda da luz.

Atuam como elementos dispersivos em espectrógrafos e monocromadores





Telescópio
MEADE SCT 12"

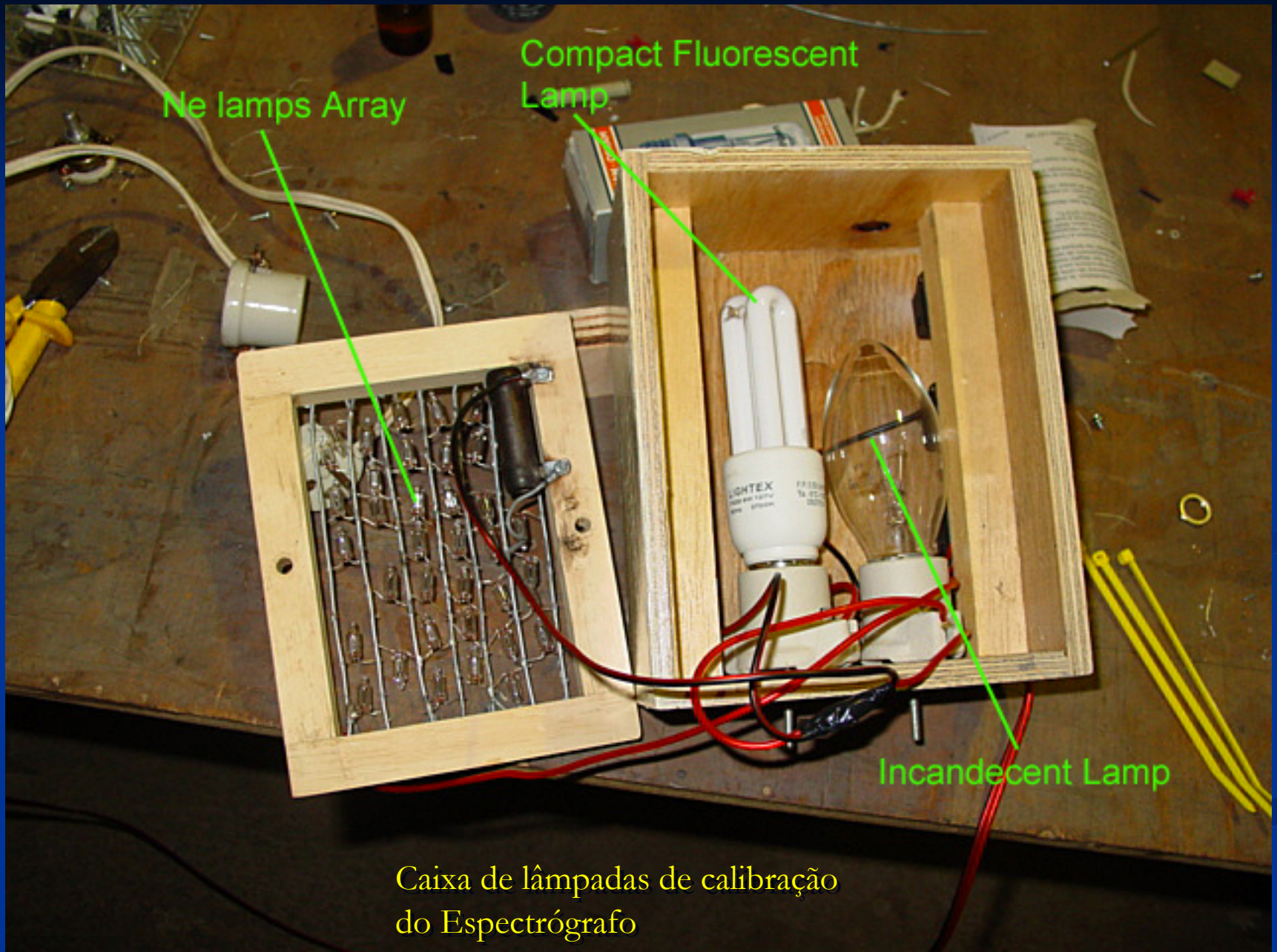
REA

Espectrógrafo
acoplado a
telescopio

Camera CCD ST7 SBIG

Espectrógrafo na terceira campanha de observações de Eta Carinae no observatório de Cierro Mammalhuca Vicuña – Chile (2003)



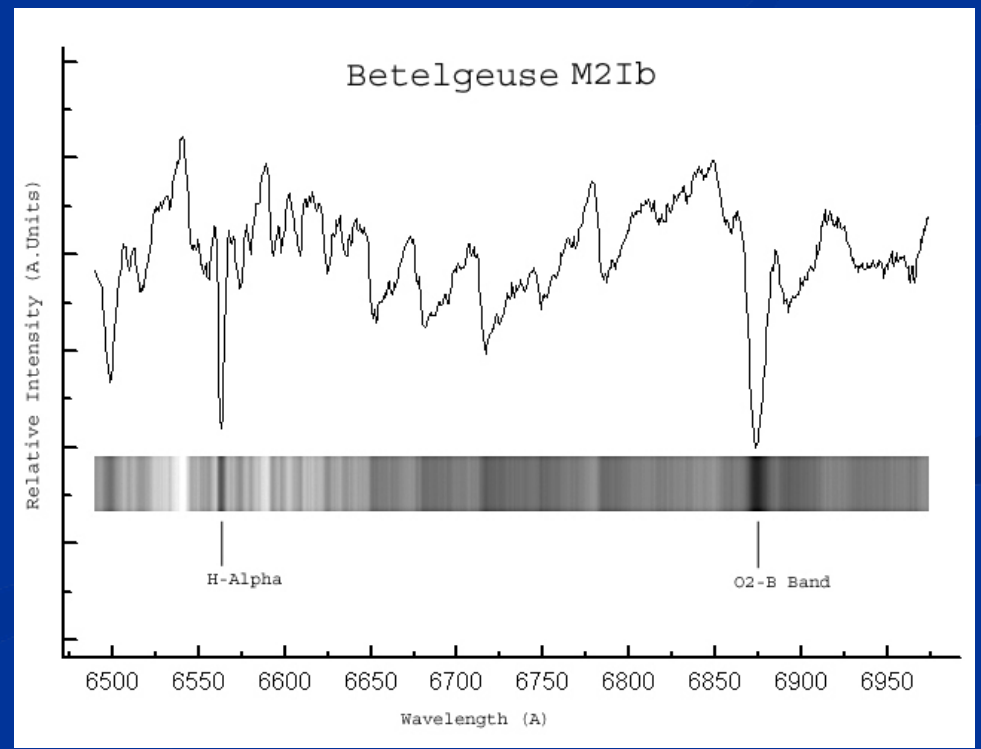
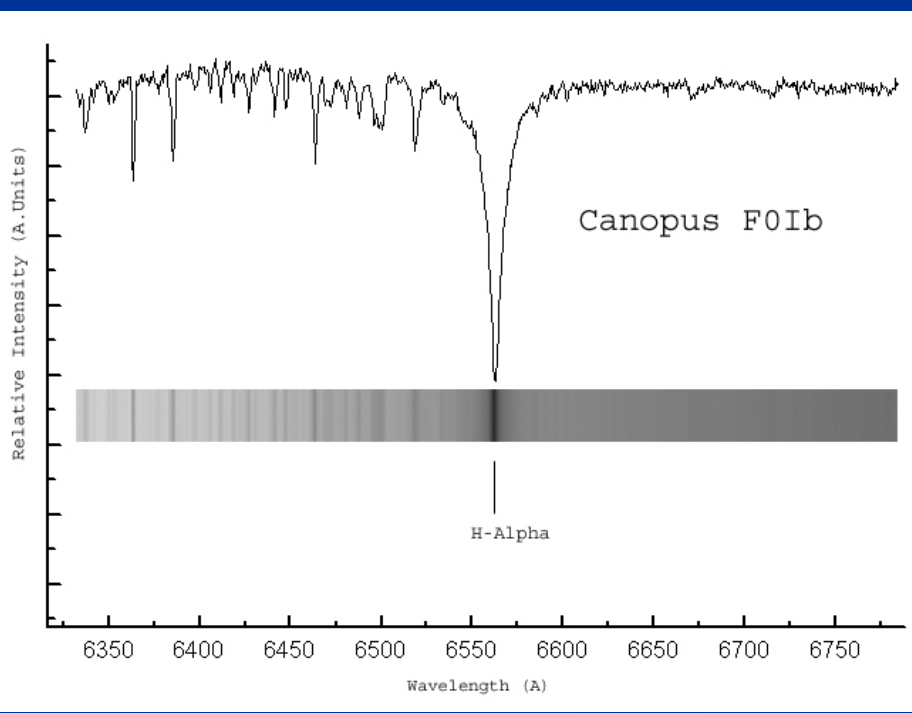
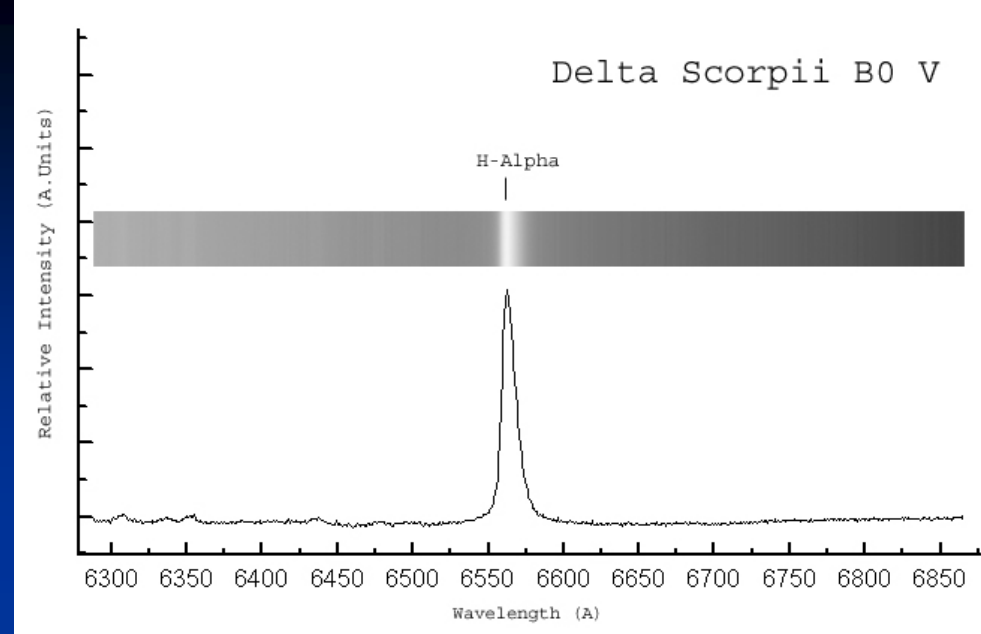
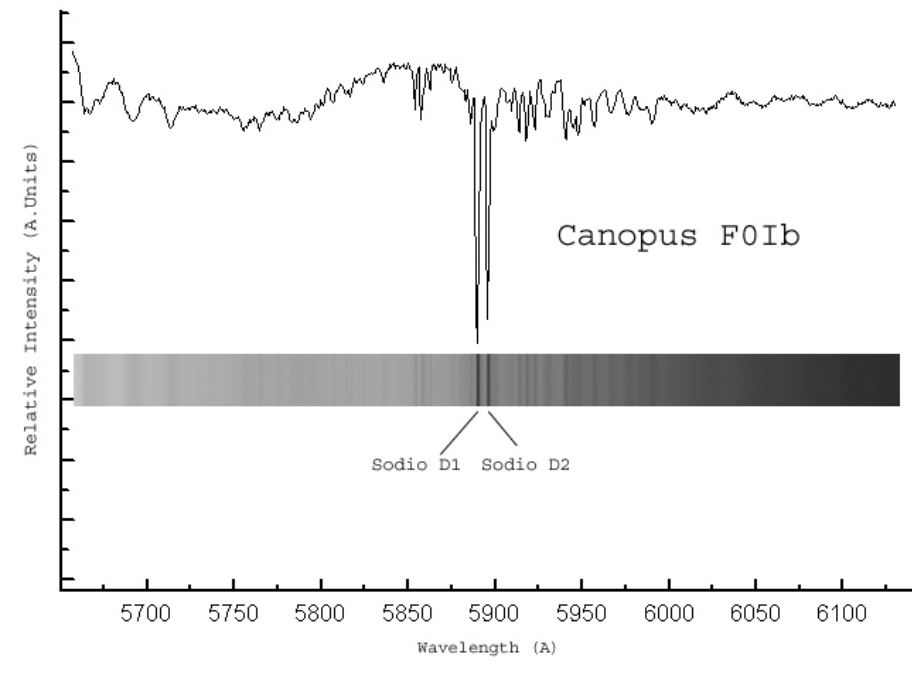


Ne lamps Array

Compact Fluorescent Lamp

Incandescent Lamp

Caixa de lâmpadas de calibração do Espectrógrafo



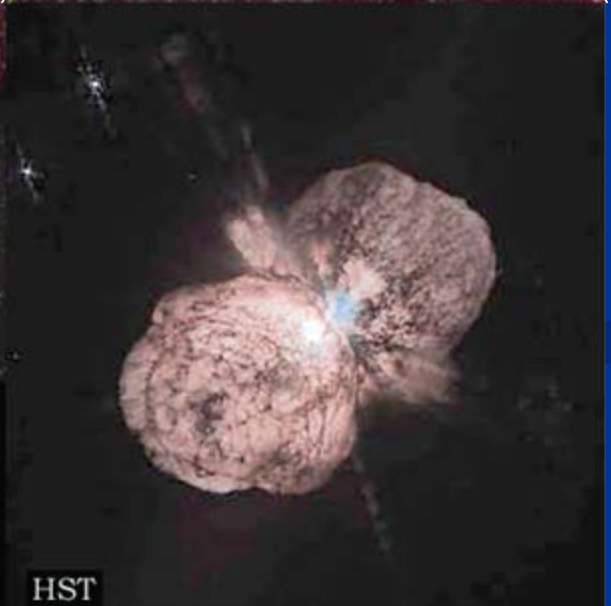
Eta Carinae Position



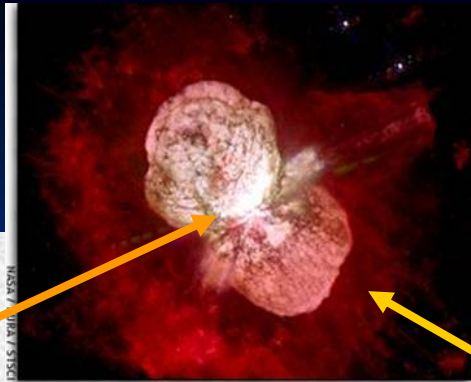
© J.C. Diniz



R. Marcon



HST



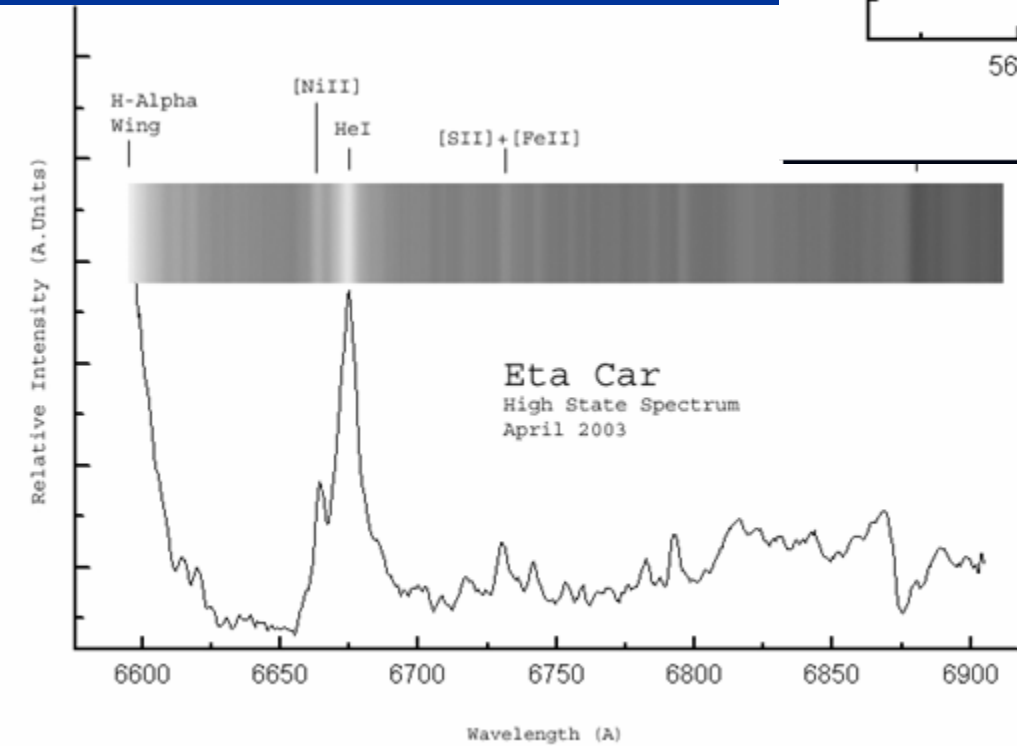
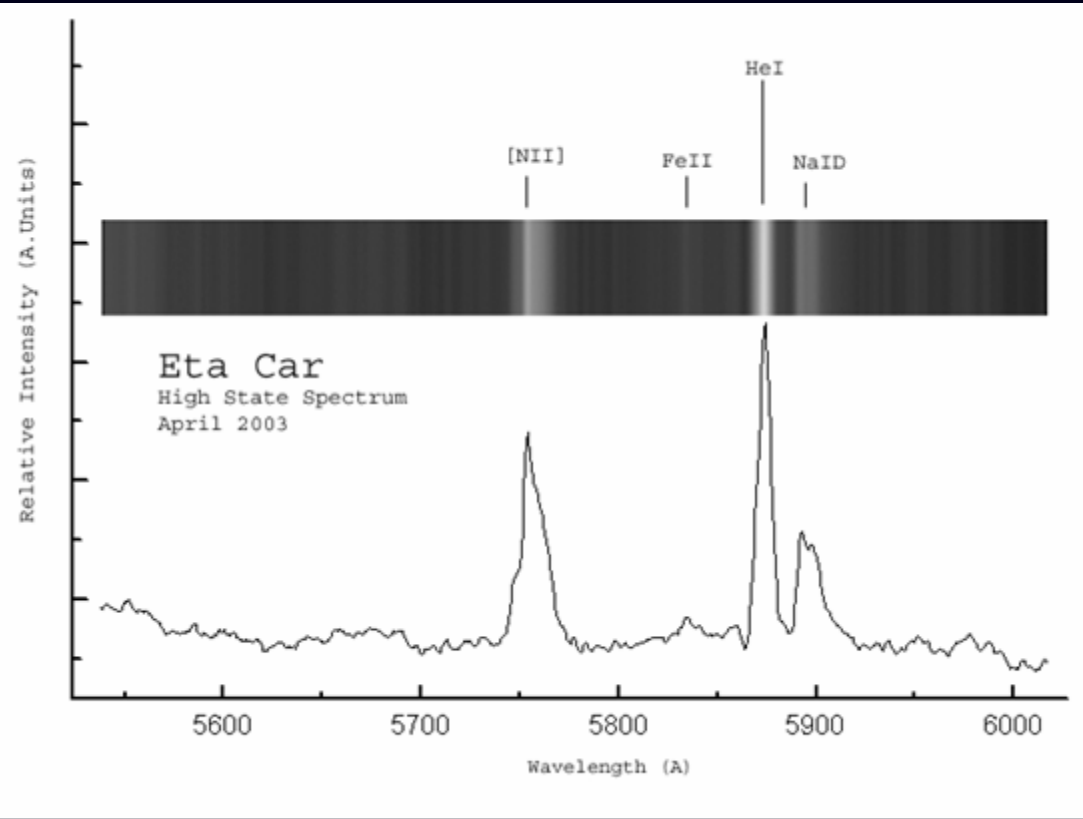
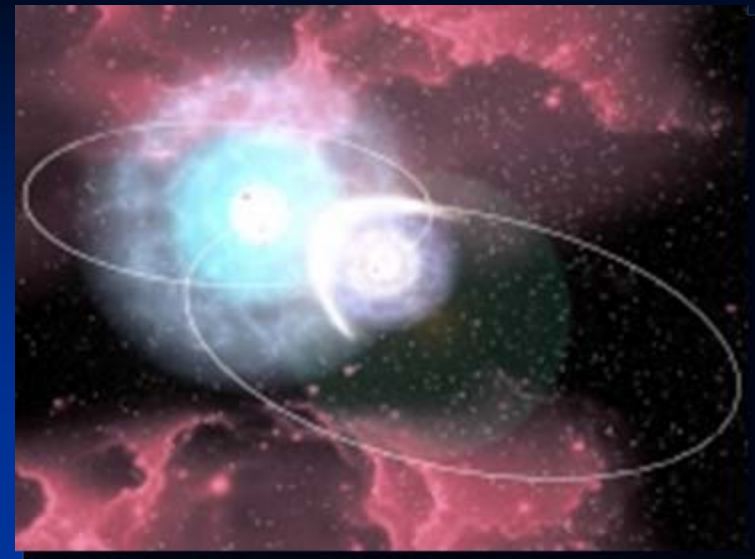
Eta Car numbers

The central object

Radiative power: 5 000 000 x Sun
Wind power: 100 000 000 x Solar wind
Born masses: 110 + 40? x Sun (2 stars)
Present masses: ~70 + 30? x Sun
Distance: 7 500 light-years
Age: 2.56 Myr (Sun ~ 5 Gyr)
Total lifetime: ~3 Myr (Sun ~12 Gyr)
Temperature: ~16 000 + ~30 000 K
Radius (brightest star): ~ 1 A.U.
Periastron distance: ~ 4 A.U.

The Homunculus

Geometry: bipolar lobes + equatorial "jets"
Inclination (major axis): tilted by 57deg from our line-of-sight towards the plane of the sky
Size (major axis): 500 x Solar System
Total mass (gas+dust): 2 x Sun
Mass in dust grains: 1000 x Solar System's planets
Density (gas): >10 000 particles/cm ³
Age - Bipolar flow = 157 years
Expansion velocity - bipolar flow = 650 km/s equatorial "jets" = 40-1500 km/s
Dust temp: 300 °C near the star, -150 °C in the lobes
Myr = million years, Gyr = billion years, 1light-year ~ 9 000 000 000 000 km, radiative power of the Sun ~40 billion Megatons/sec



Linhas de HeI e NiII em Eta Carinae obtidas pelo espectrógrafo CCD antes do evento do eclipse da estrela companheira.

Apagão ocorre a cada 5.53 anos
(Daminelli, A. – IAG / USP)

Eta Car - Região espectral 6526 – 6900 Angstrom

Abril 03, 2003



Junho 11, 2003



Junho 26, 2003



Eta Car - linhas de H α + HeI 6678
Região espectral 6526 - 6800 Å
2003 : Abril 03 (rosa), Junho 11 (azul), Junho 26 (verde)

6563.4345

6678.691

6540

6580

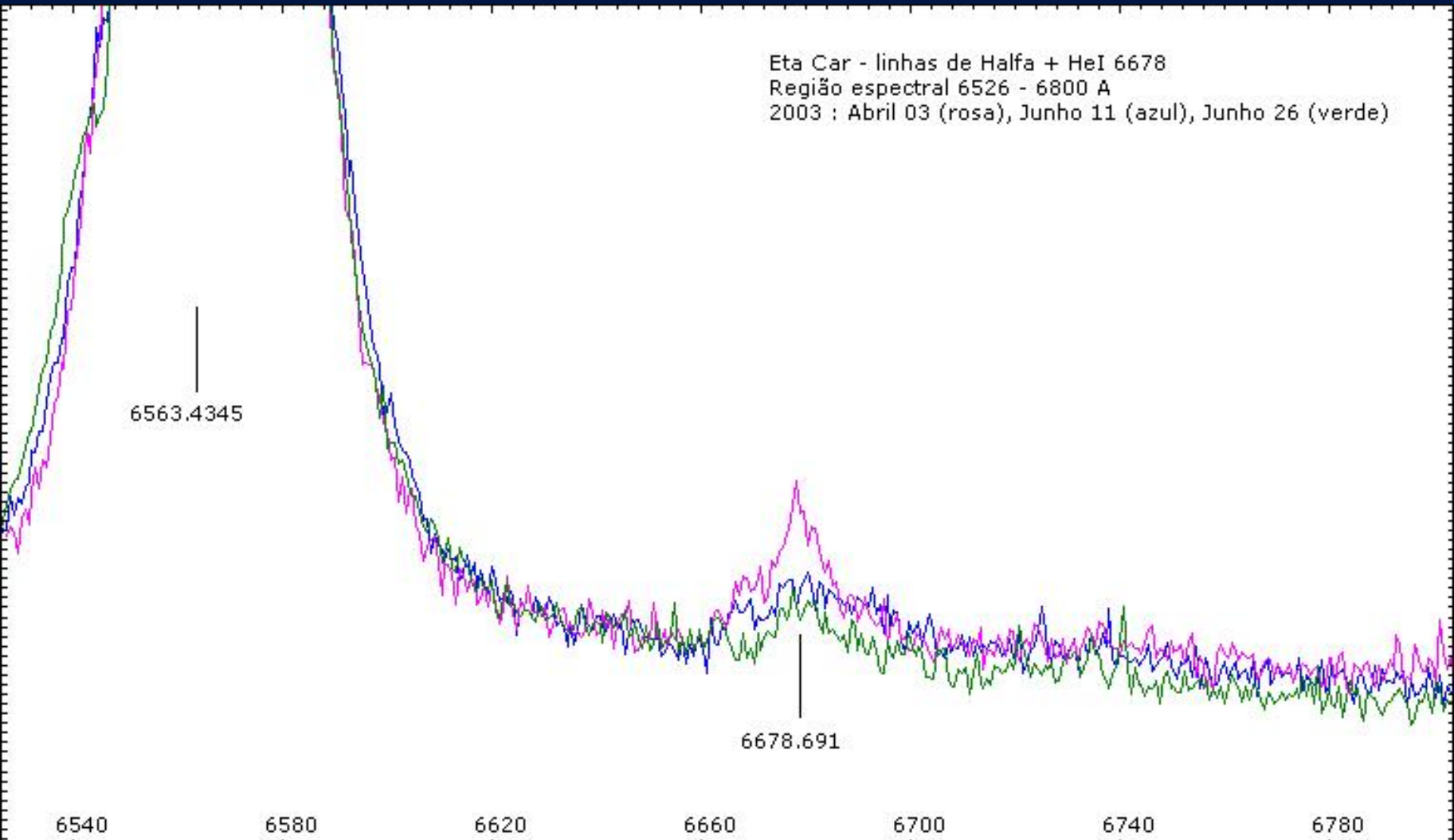
6620

6660

6700

6740

6780



Eta Car - Região espectral 5660 – 6000 Angstrom

Abril 03, 2003



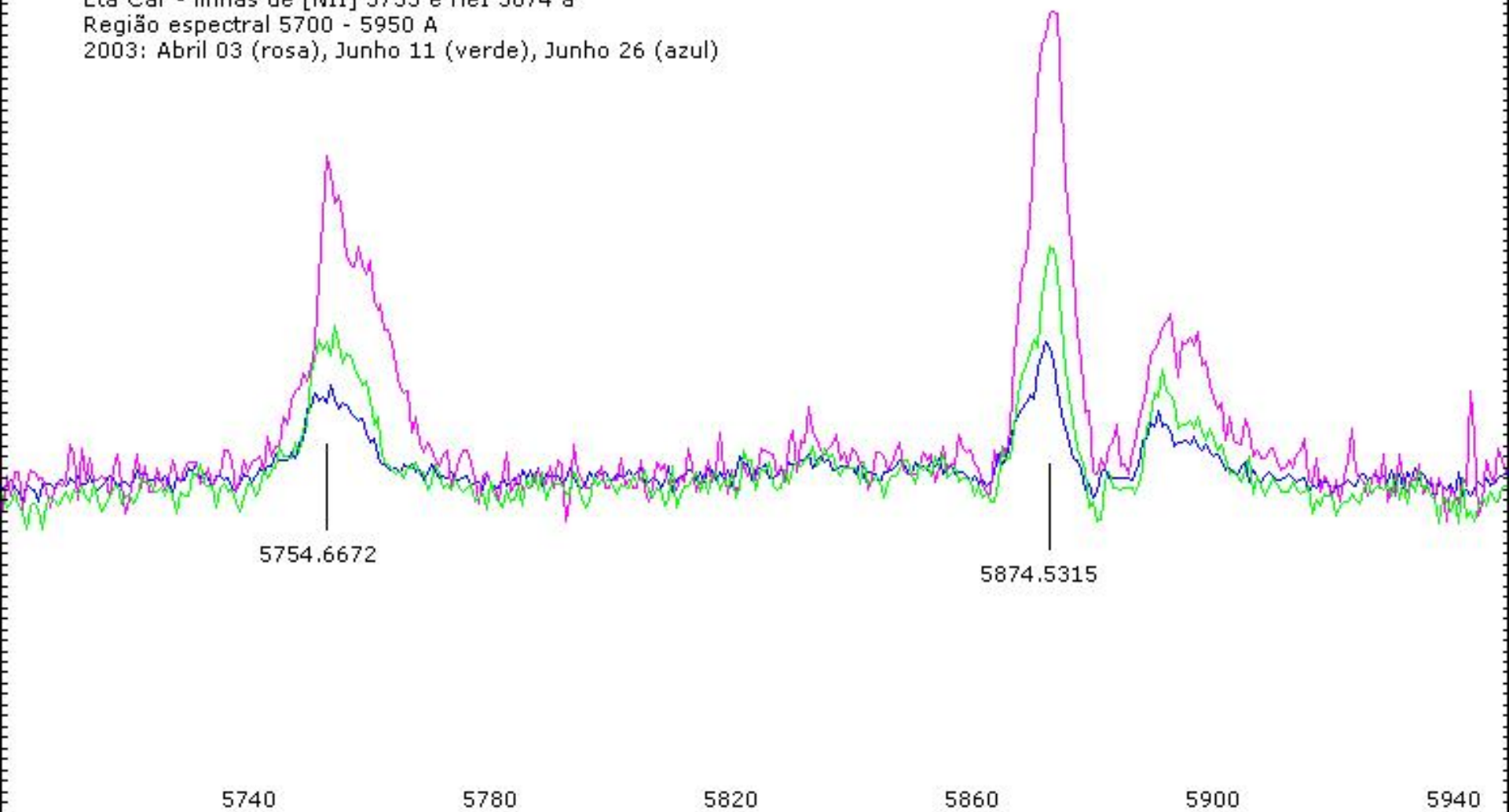
Junho 11, 2003



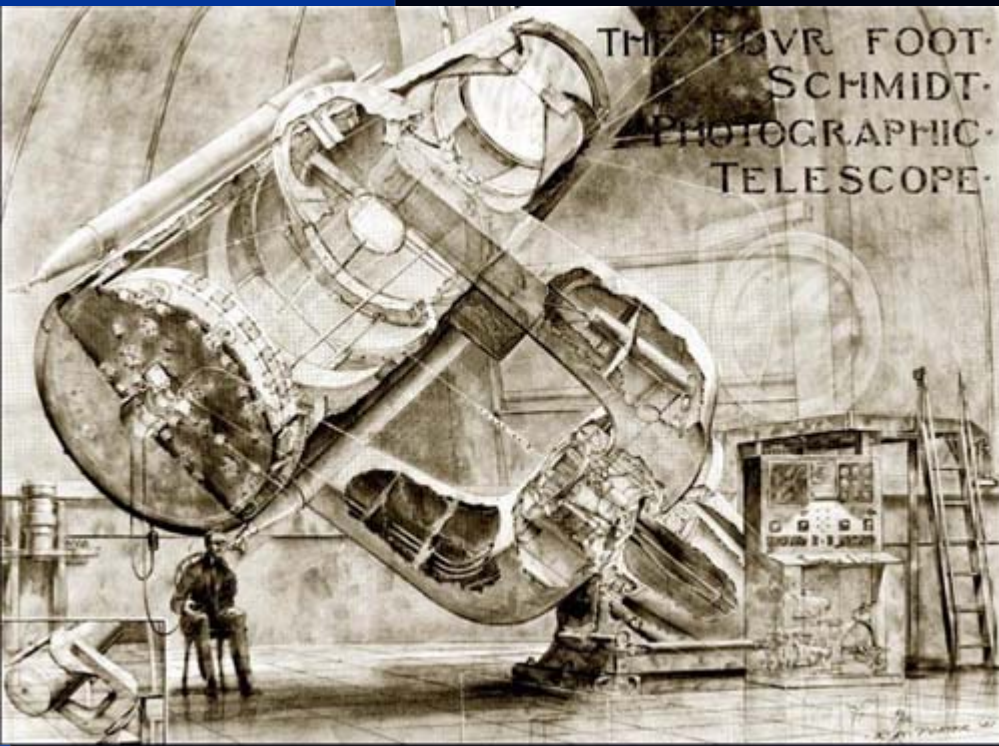
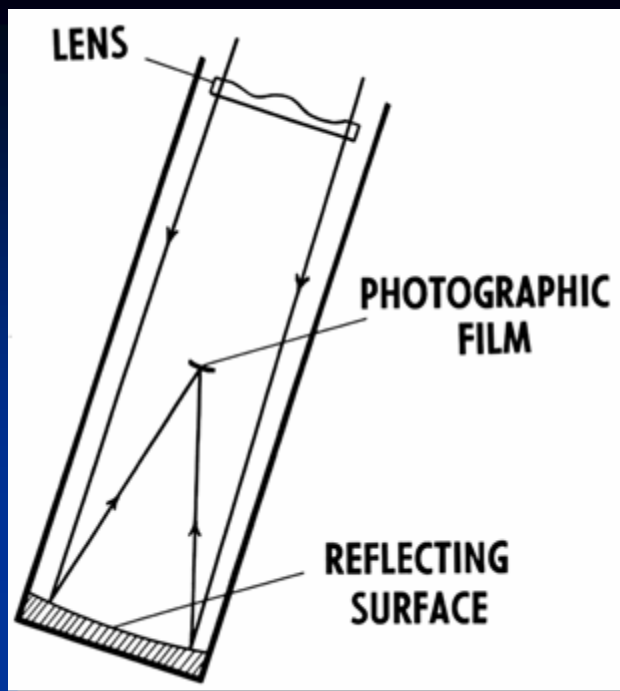
Junho 26, 2003



Eta Car - linhas de [NII] 5755 e HeI 5874 a
Região espectral 5700 - 5950 Å
2003: Abril 03 (rosa), Junho 11 (verde), Junho 26 (azul)



Câmera Schmidt

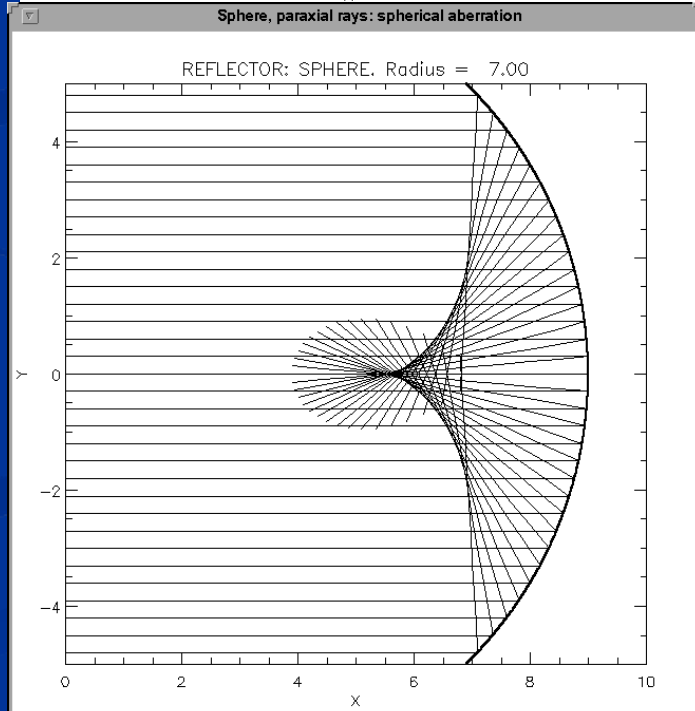
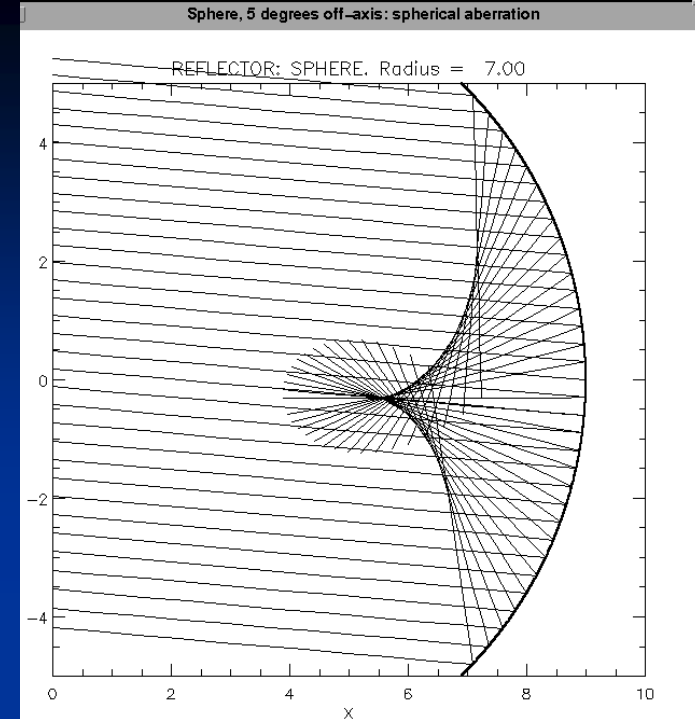


Necessidade de mapeamento preciso em grandes campos

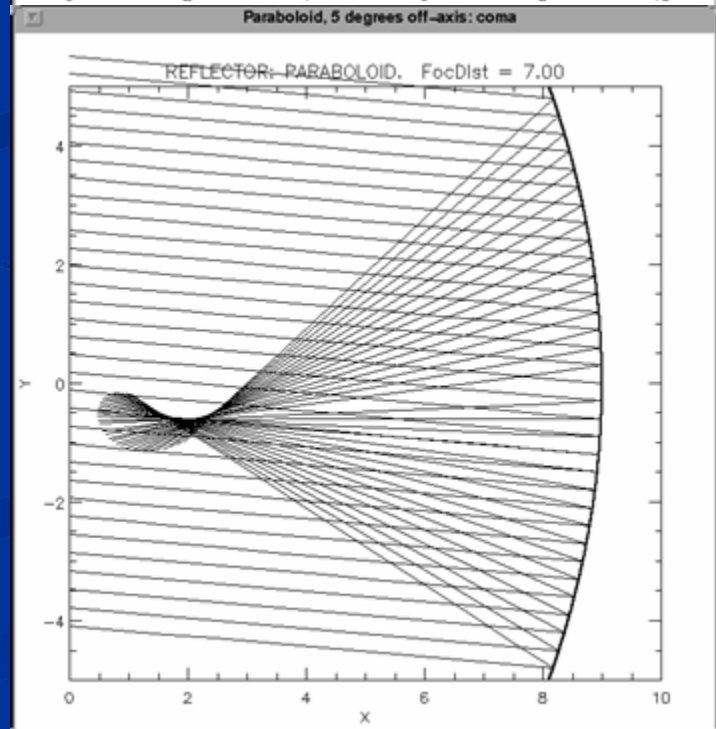
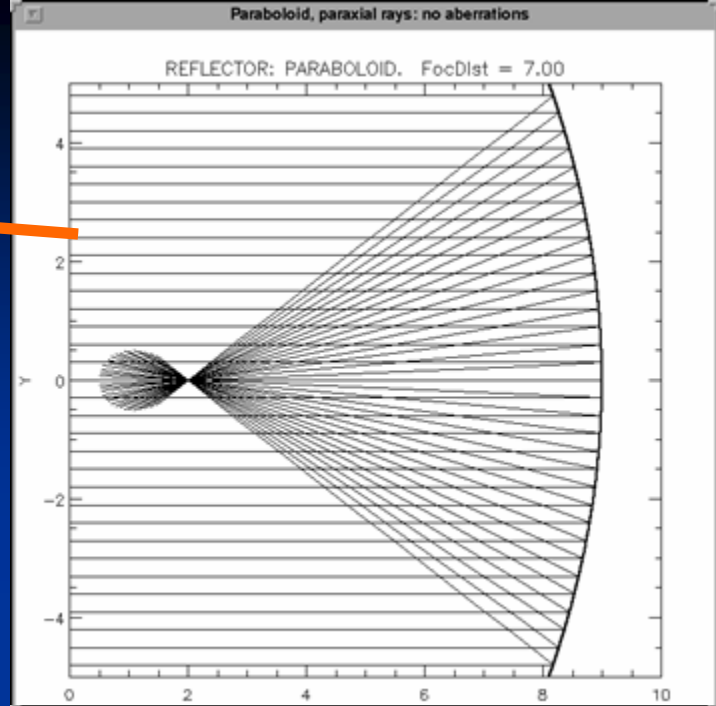
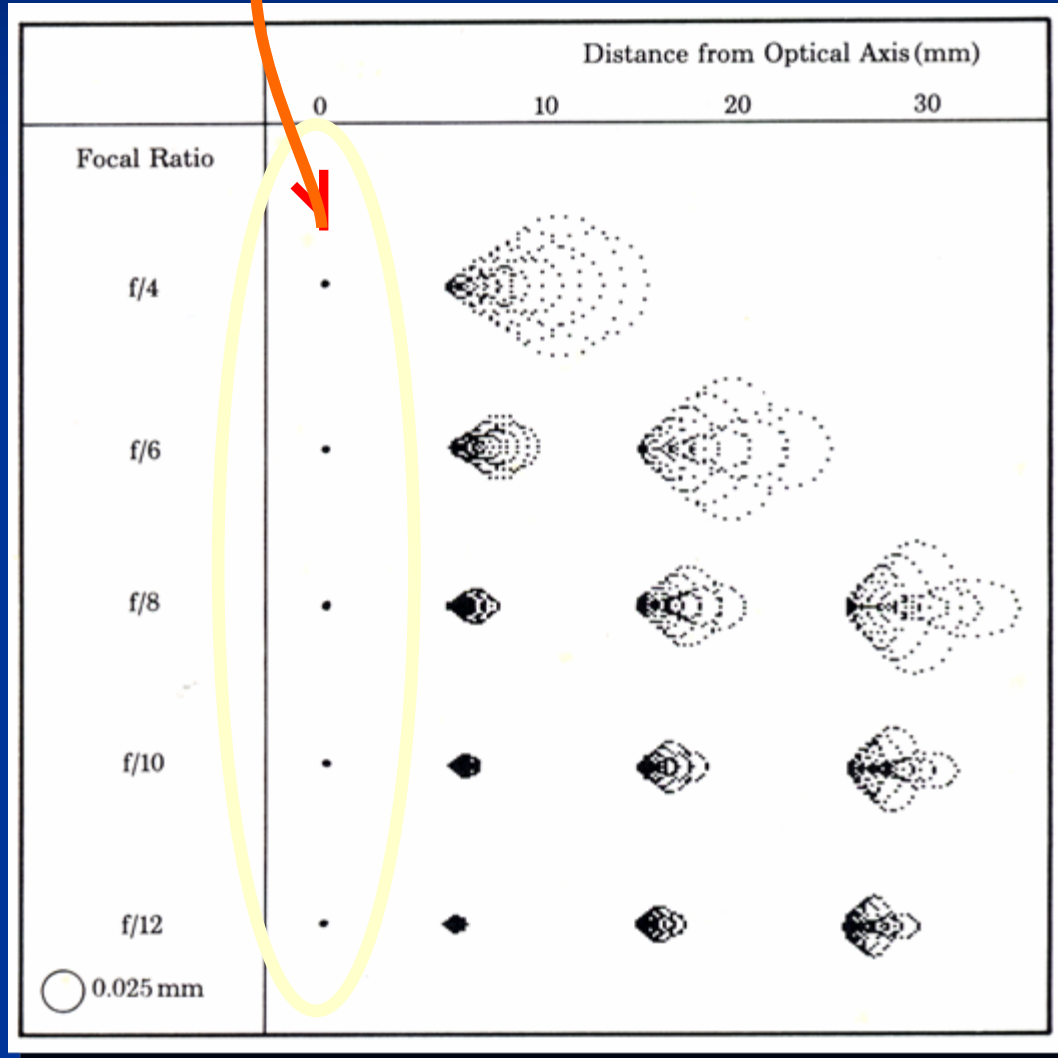
Grandes campos são cobertos por espelhos esféricos devido a sua simetria em relação ao raio de curvatura, no entanto tem **ABERRAÇÃO ESFÉRICA**

Espelho Esferico	Color	Off-axis Distance (mm)			
		0	10	20	30
200 mm f/3 $R_F = -600$ mm	R				
	B				
	V				
200 mm f/2 $R_F = -400$ mm	R				
	B				
	V				

0.025 mm

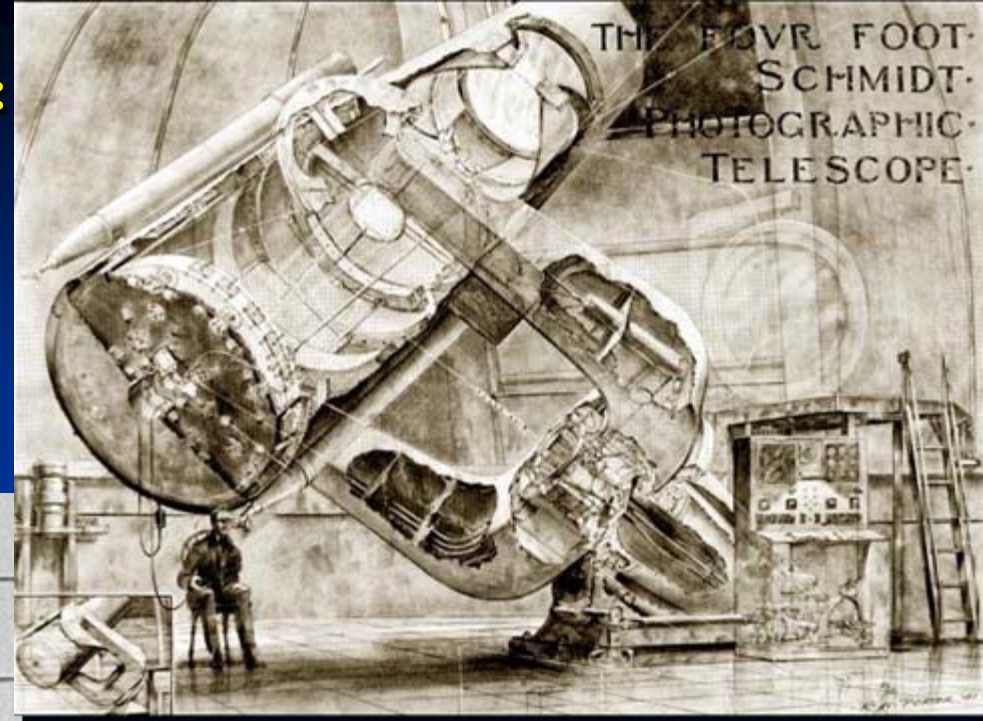
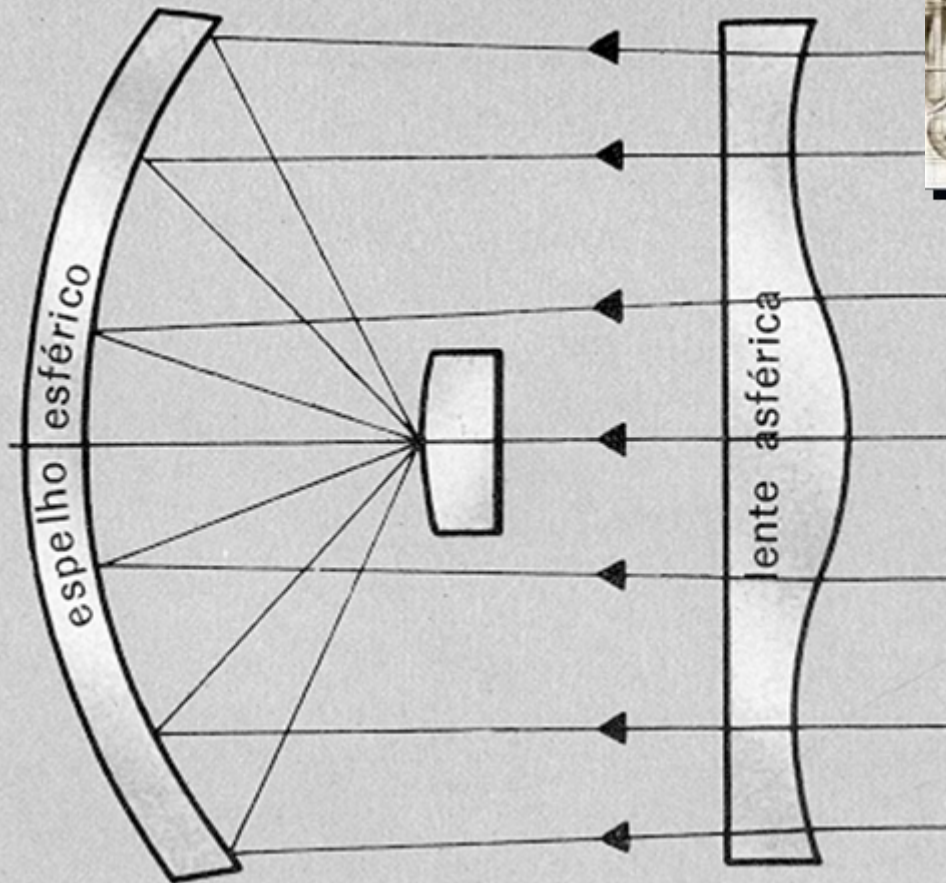


Espelhos parabólicos produzem imagens nítidas, mas não trabalham bem com grandes campos, apresentam aberração de COMA



A Solução de Bernhard Schmidt :

A lente corretora asférica colocada no raio de curvatura do espelho esférico corrige a aberração esférica preservando os grandes campos



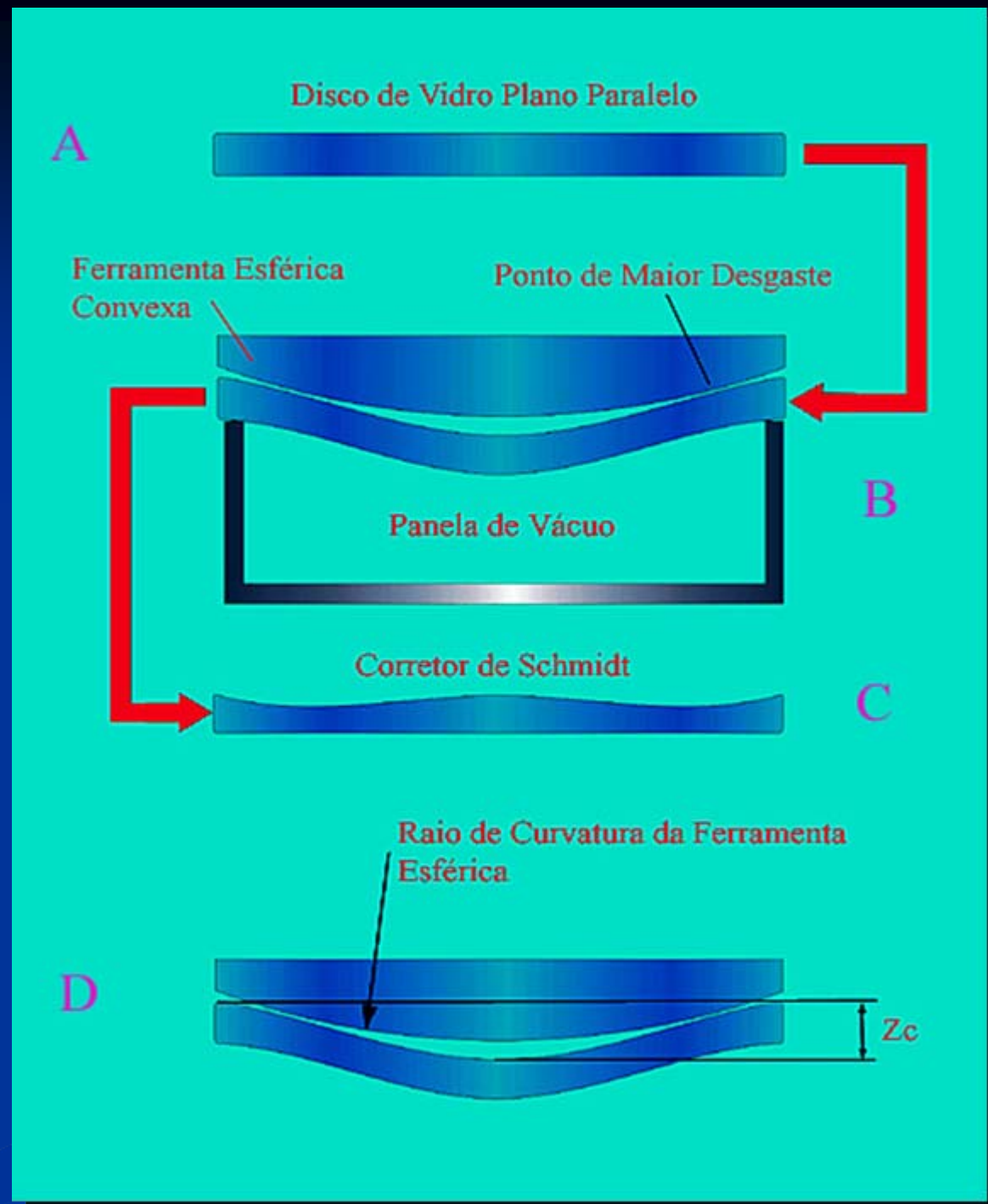
Desvantagens:

- Difícil acesso à superfície focal
- Superfície focal convexa
- Muito sensível a variações de foco devido a alta luminosidade (relação f/D)

Schmidt desenvolveu um engenhoso método de produção da curva asférica por desgaste sob deformação produzida através da aplicação de vácuo parcial em um lado do corretor



Bernhard Schmidt 1879-1935



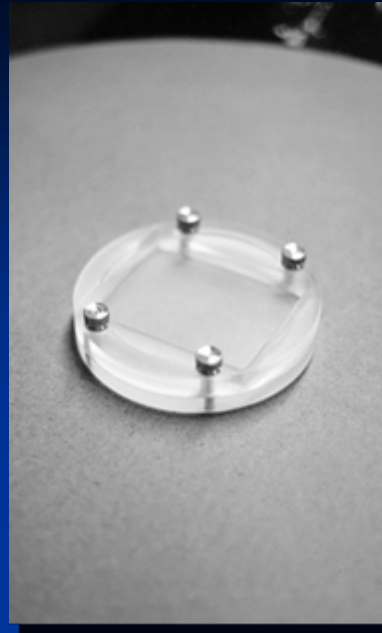
Cálculo do raio de curvatura da ferramenta esférica de desgaste

$$R = \frac{8F^3}{d^2}$$

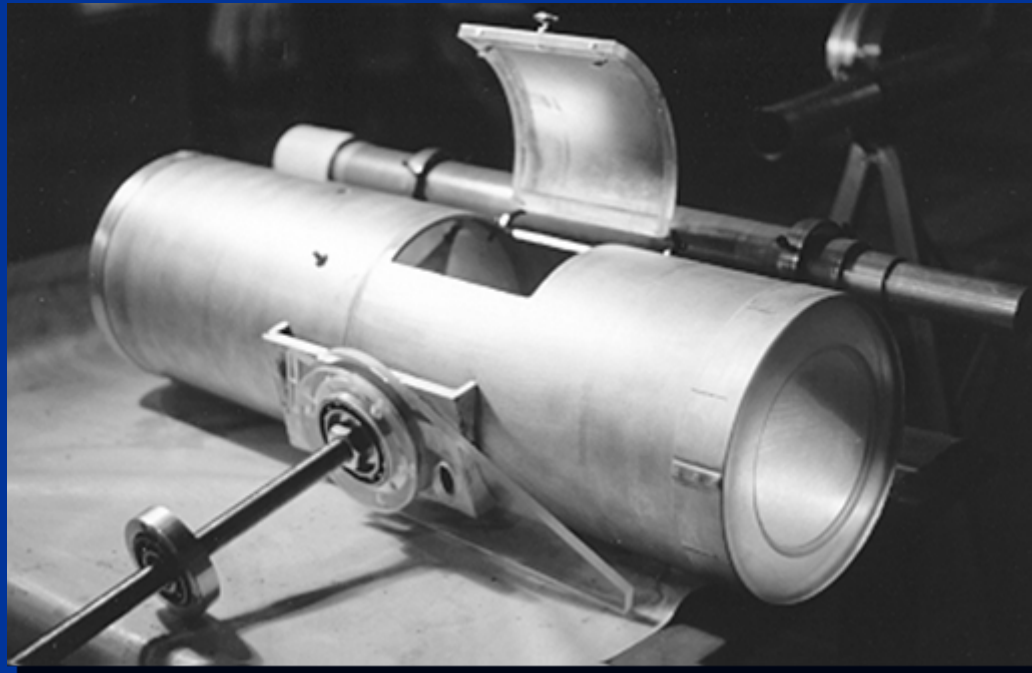
Para $F=420\text{mm}$, $d=200\text{mm}$ temos um raio de curvatura para a ferramenta esférica de 14,81 metros. A deformação da placa sob vácuo tem uma amplitude de apenas 0,34mm, insuficiente para a ruptura. O método é aplicável até relações de $F/d = 1.5$



Suporte convexo do filme de 6x7cm e sistema de circulação de ar seco no interior do tubo.



Tubo de alumínio e abertura para carregamento do filme



Schmidt em Caldas - MG

Região de Ophiucus mostrando a
nebulosa escura Barnard 72 e
Snake nebula. →

Abaixo, Região cental em Órion
mostrando Alnitak, Alnilan e
Mintaka com o complexo de
nebulosas de Órion (M42) e
cabeça de cavalo ↓



Constelação de Musca e a
nebulosa escura. Também é
visível o aglomerado globular
NGC 4372



Nebulosa Cabeça de Cavalo em Órion



Astrofotografia

Com a extinção dos filmes convencionais a base de prata, as câmeras digitais tomam seu lugar com algumas vantagens...

Tempos de exposição curtos, alta sensibilidade e possibilidade de tratamento numérico das imagens em softwares especiais



Canon 20Da – Série especial para Astronomia



Telescópio Newtoniano 450mm f/4.5 R.Marcon 1998



NGC5128 Centaurus A Radiogaláxia em Centauro R.Marcon 4x5min Cannon20Da



52 Cygni e Nebulosa Resto de Supernova na constelação de Cisne



Nebulosa escura Cabeça de Cavalo em Órion



Nebulosa da Lagoa em
Sagittarius



Nebulosa Planetária Helix - Aquarius



Nebulosa do Caranguejo - Taurus



Aglomerado Globular Ômega Centauri



Galáxia Espiral M83 em Hydra



Galáxia Espiral M66 em Leão

Referências na Web :

Stellafane - ATM

<http://stellafane.org/>

Rede de Astronomia Observacional

<http://www.rea-brasil.org/>

Espectroscopia, CCD e Astronomia

<http://www.astrosurf.com/~buil/>

Rogério Marcon

<http://www.astroimagem.com/>

Muito Obrigado...