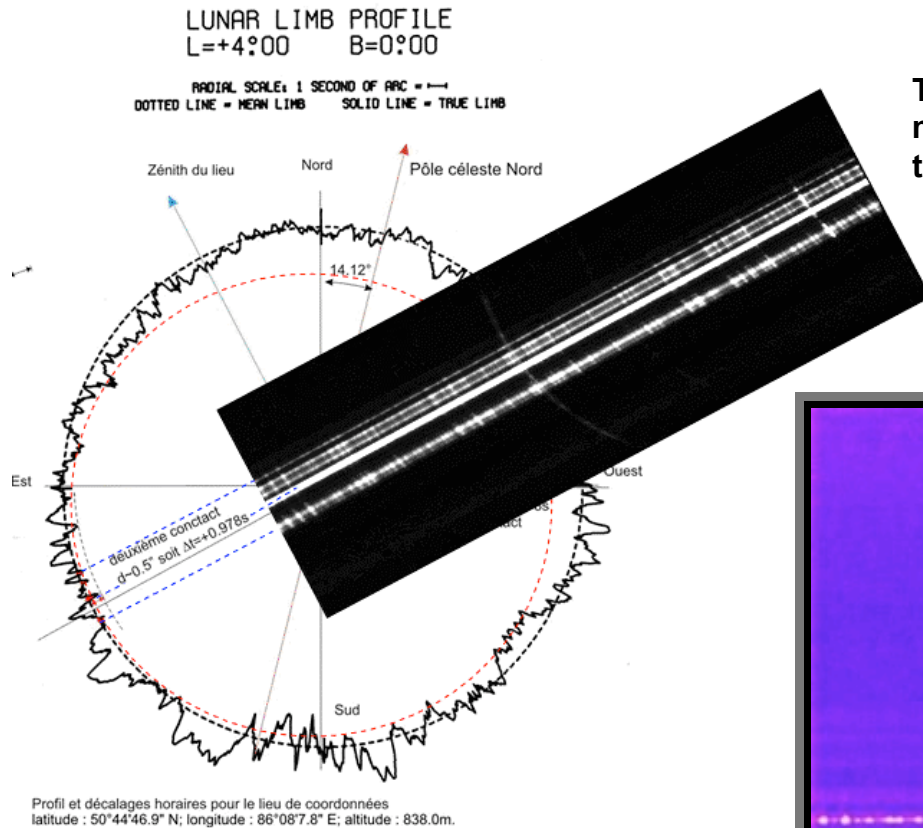


Solar diameter measurements at total eclipses and the variations of the chromospheric shell

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- The occultation of the Sun by the Moon is done outside the Earth Atmosphere :
by precisely timing the contacts, the value of the solar diameter can be deduced
(ephemerides)
(First attempt made in 1984 by Koutchmy and Sarrazin)
- Continuum and lines profiles variations of fluxes at the limb were obtained during the
2008 and the 2009 solar eclipses : flash spectra at fast frame rate
- Transit method tested on the 33 cm refractor of the Paris Observatory with a pupill of
diameter $D \gg R_0$ after an « astro-solar » $d=3,8$ neutral filter
Also : on the T 120 cm reflector at OHP and the T 45 cm reflector at Locarno
- In addition : Study of the chromosphere thickness and analysis of the variations of
the « magnetic » ovalisation along the solar cycle

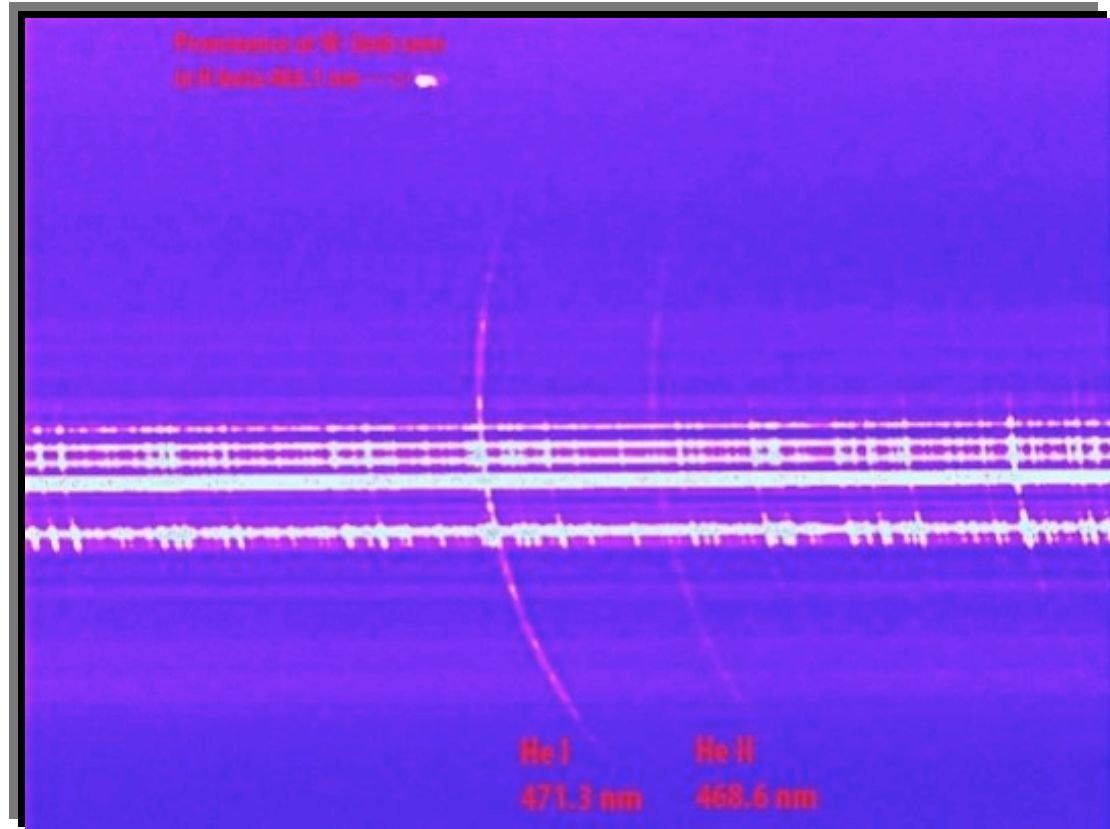
I-1) The flash spectra and the lunar profile, (Solar eclipse of the 1st August 2008 observed in Altaï)



True continuum
measured between
the emission lines

Images taken during the 2nd contact, showing
the importance of the details of the lunar profile
(the visual method or the photometric single detector
assumes a circular profile)

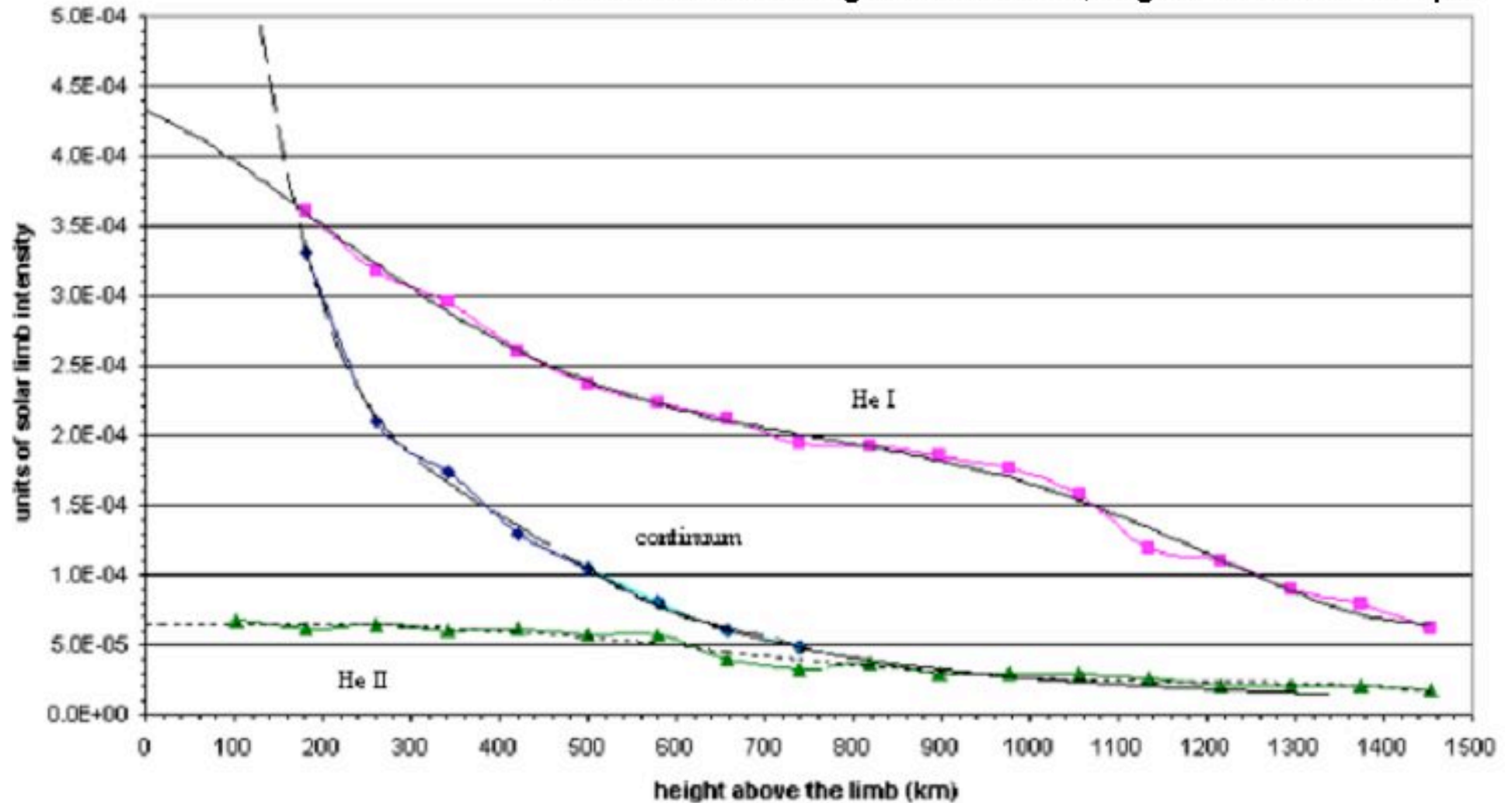
Flash spectra of the 1st August 2008
2nd contact
25 frames/secondes @ 470+/-5 nm
Transmission grating-objectif 600 gr/mm
Refractor of 50 mm diam
and 600 mm of focal length



Extract of the spectral sequence obtained in the vicinity of the 2nd
contact, to show new lines seen in **emission**. Average of 10 spectra

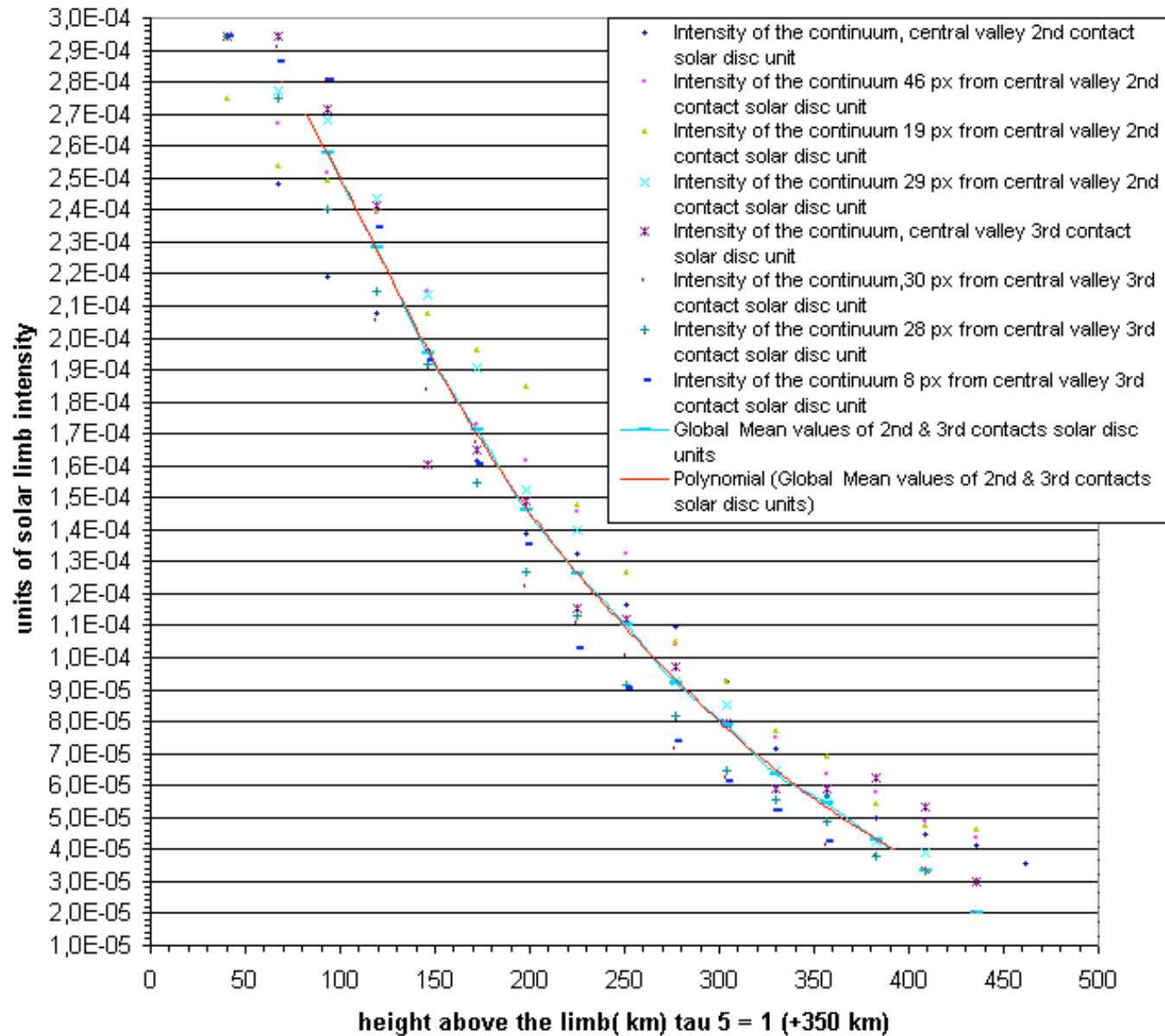
I-2) Continuum flux variations obtained during the 2nd contact at the 1st August 2008 solar eclipse in Siberie

Mean continuum, He I and He II lines in solar limb units
As a function of the height above the limb, August 1st 2008 solar eclipse



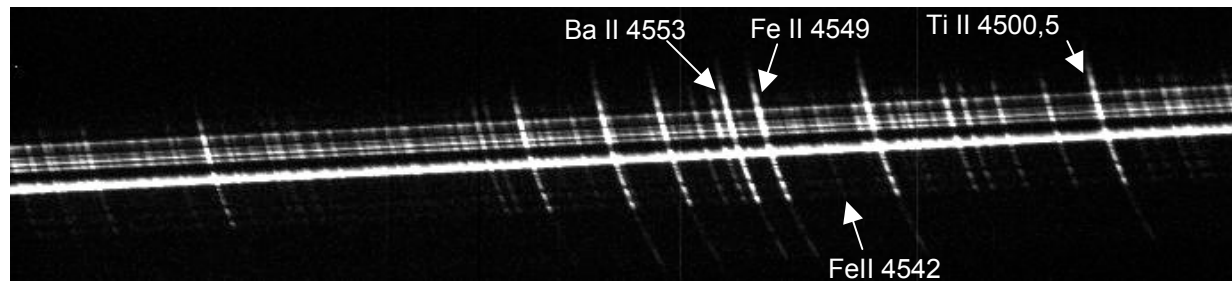
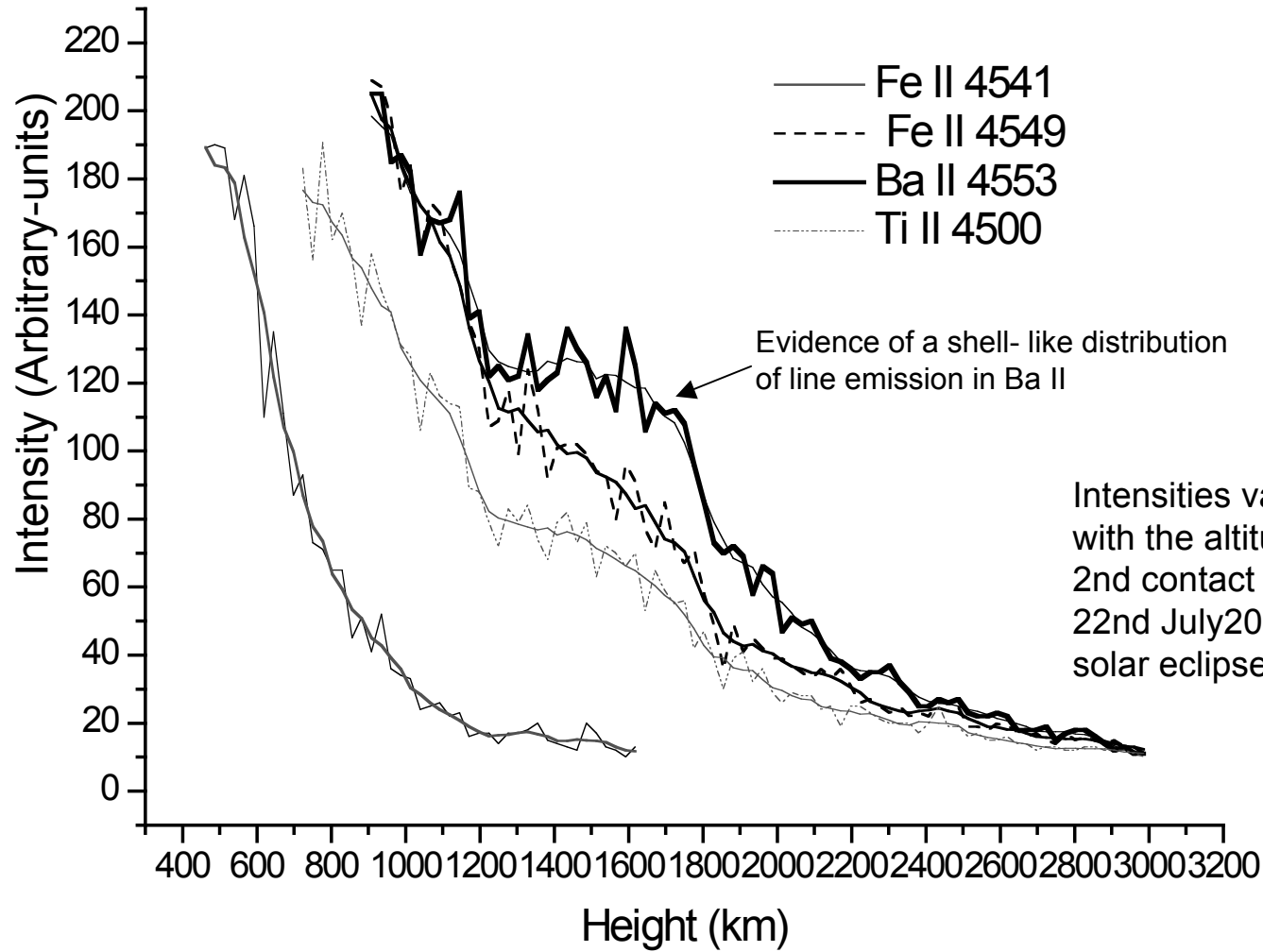
25 frames/s correspond to a 15,9 km spatial sampling. Watec camera 8 bit CCD-video

I-3) Continuum variations obtained during the 2nd & the 3rd contact at the 22nd July 2009 solar eclipse in China



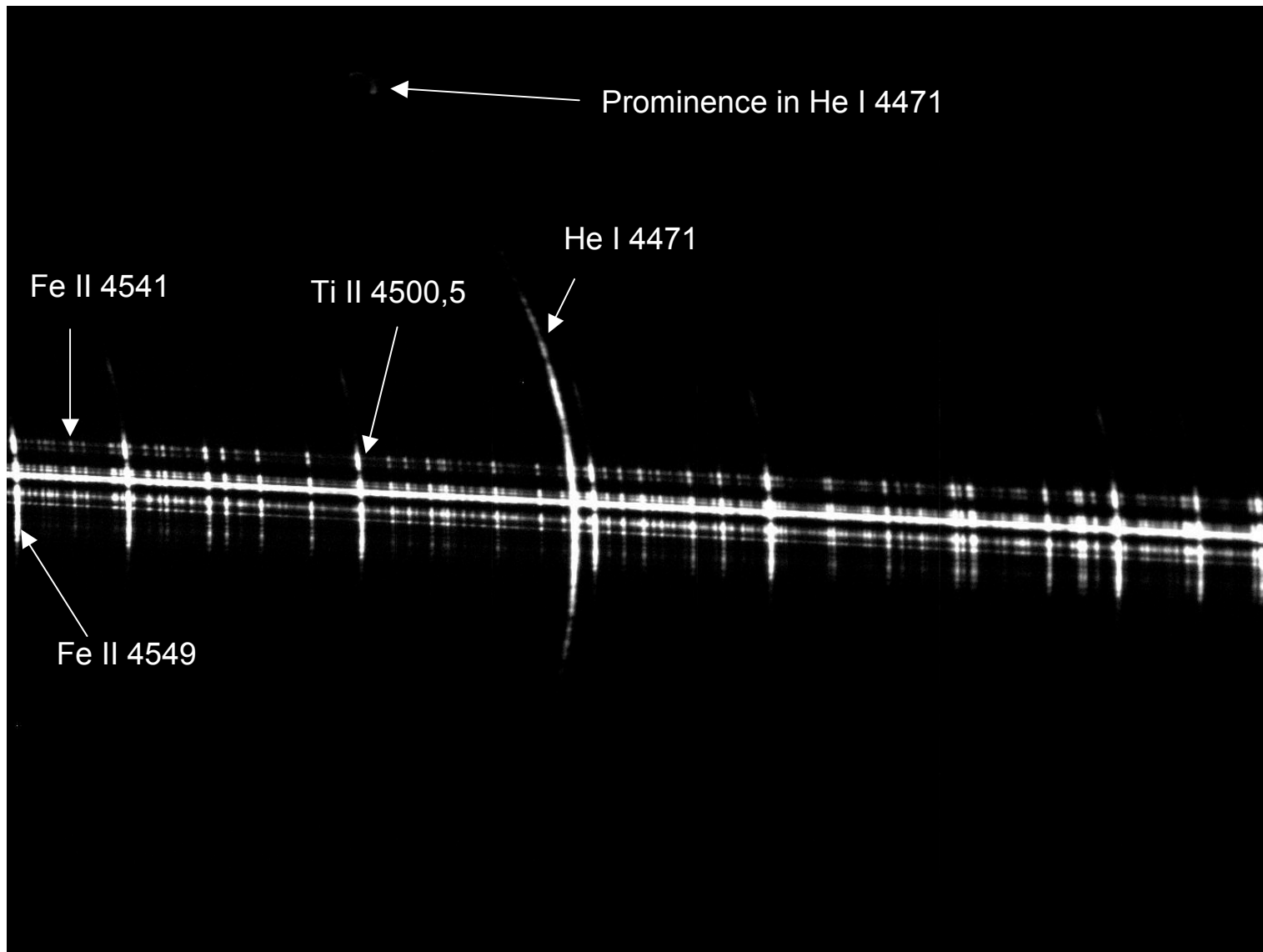
15 frames/s CCD Lumenera 12 bit Gain 10 Sampling of 26,3 km/frame, frog attenuation

I-4) Spectral lines at the 2nd contact of July 22nd 2009 total solar eclipse in China



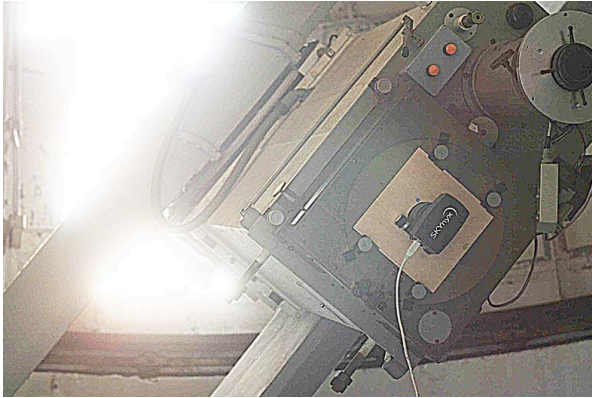
5 stacked flash spectra at the 2nd contact
 Frame rate of 15 images/s with a CCD Lumenera camera.
 Spectral lines around 454.1 nm

I- 5) Results of 3rd contact of the 22 July 2009 solar eclipse, Tianhuanping, China

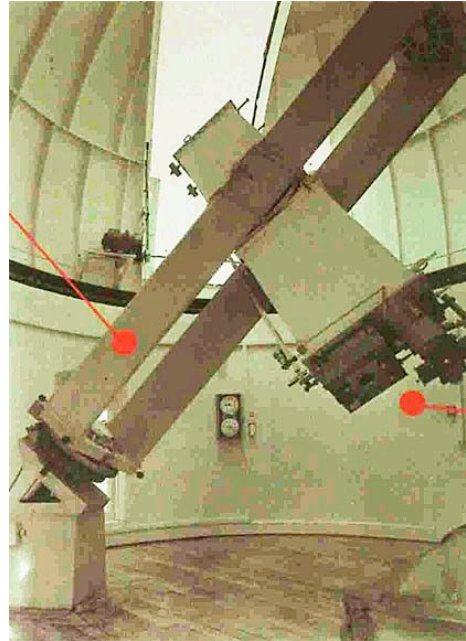


Same optical setup, 6 stacked frames, region of 447,1 nm of neutral Helium

II-1) Tests of the Astrosolar film filter and the CCD camera on the 33 cm diameter refractor, under the « la Carte du Ciel » dome of the Observatoire de Paris



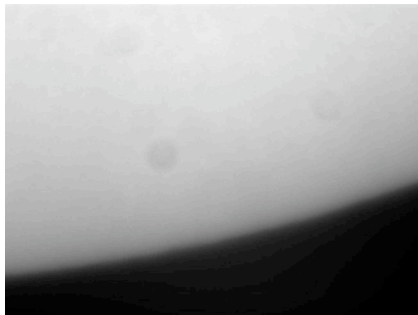
View of the CCD caméra at the focus of the refractor



General view of the motorized instrument



View of the mounting of the solar filter film
Astrosolar Density = 3,8



Raw image of the solar limb obtained at the 33 cm refractor, $D \gg R_0$ unprocessed

- Orientation of the solar limb motion with the pixel axes of the CCD caméra
- chronodating

Transit Method, for studying :
The sensibility of solar diameter structures measurements
The extreme limb structures, penombra of spots, faculae...

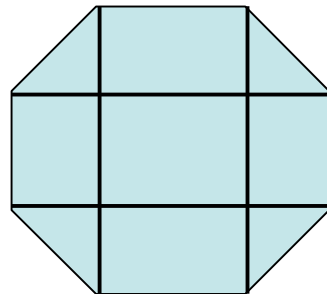
**II-2) Future : adapt this method on the T 120 cm reflector
of the Observatoire de Haute Provence (OHP)**

Le télescope de 120cm



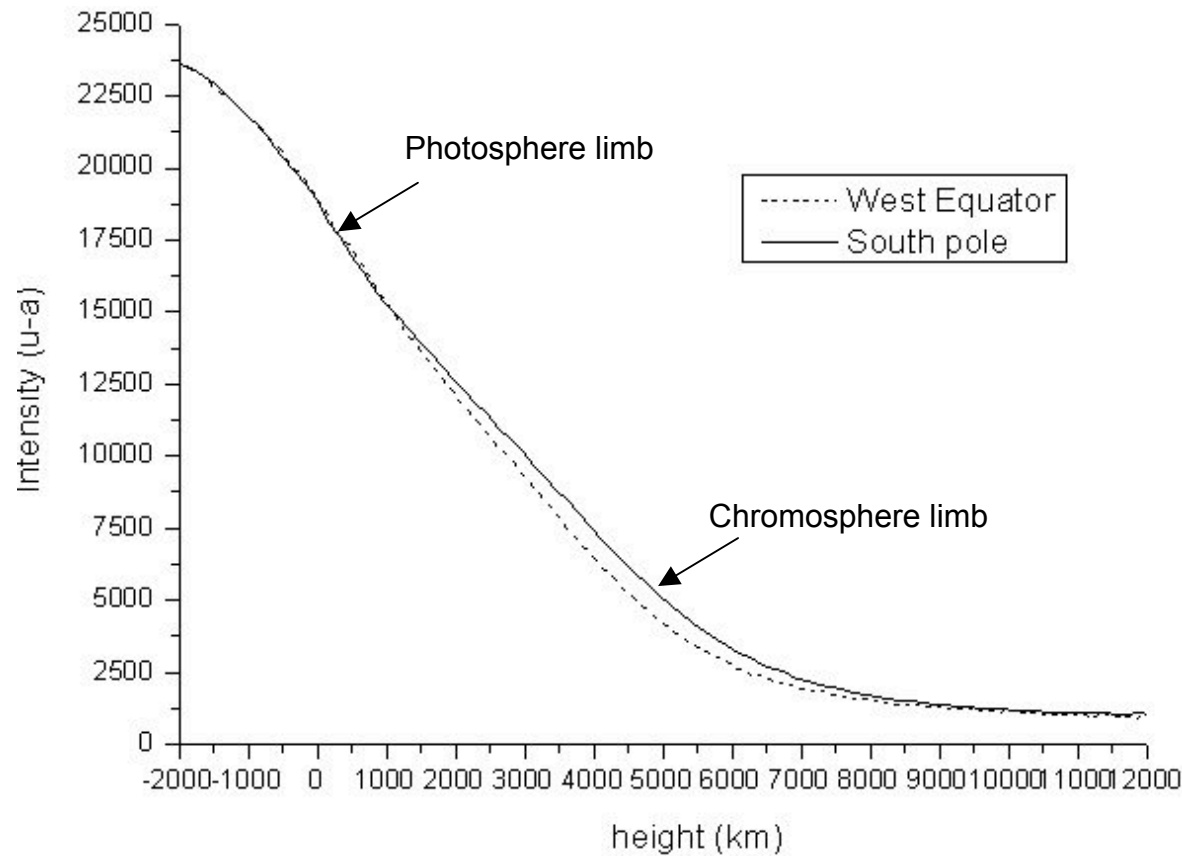
Photos (c) Ministère de la Culture

General view of the equatorial motorized T120 cm reflector

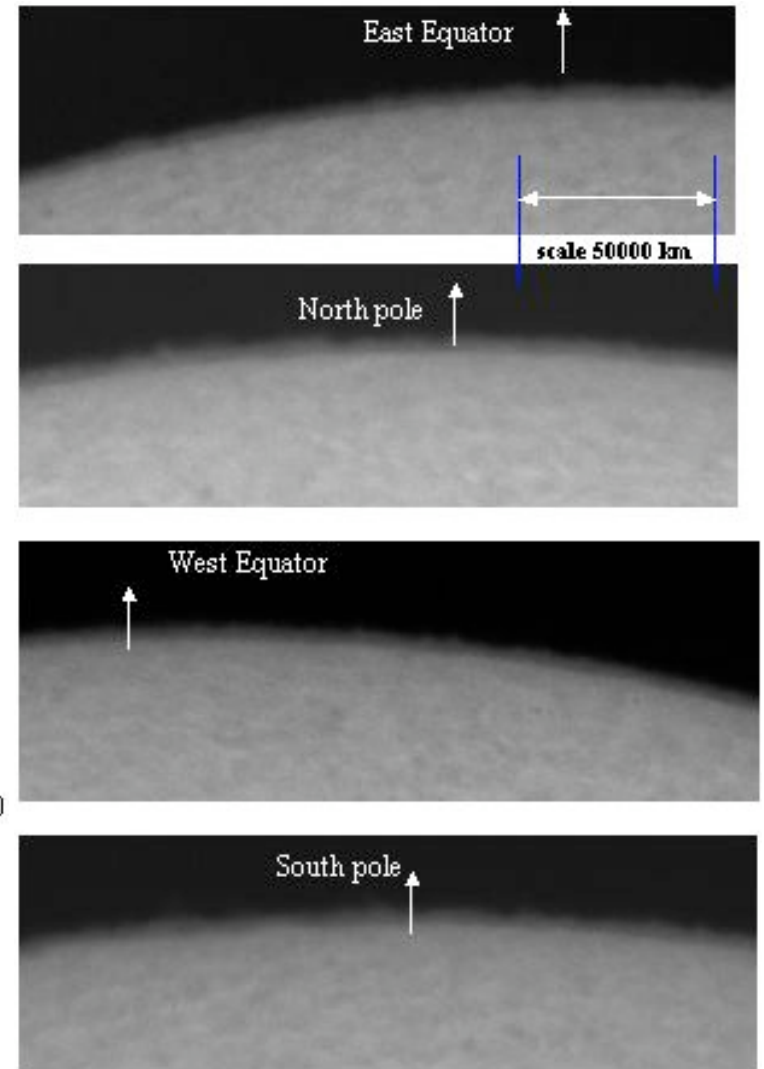


Mounting of the solar filter

III) Study of the ovalisation (prolateness) and the thickness of the chromosphere



Recent (2009) Intensity profiles of the chromosphere after integration of 80 radial rows
Chromosphere thickness 4700 km average
shows a 400 +/- 100 km of difference between the South pole and the West equator
South pole higher than equatorial regions



Images taken on March, 18th 2009
150/1500 mm Fluorite refractor with
a 90 mm Fabry-Perot filter for chromospheric
fringe measurements

IV) Summary

Solar limb profiles well observed at solar eclipses :

- Advantage of the flash spectra :
true continuum can be measured between the faint lines
- Allows a more « precise » evaluation of the solar diameter (free of lines emission)
- Chronodating of the frames using the GPS time
- 2010 Eclipse in french Polynesie: new measurements of the continuum and of the Helium lines using flash spectra

- Solar diameter measurements using the transit method at the 33 cm refractor :

- prototype not yet operational
- Need of image processing; datation during acquisitions
- Use of the Astrosolar film

- **Effects of the chromosphere ovalisation (prolateness) well measured and confirmed by measurements outside of eclipses**

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