

# *Last time...*

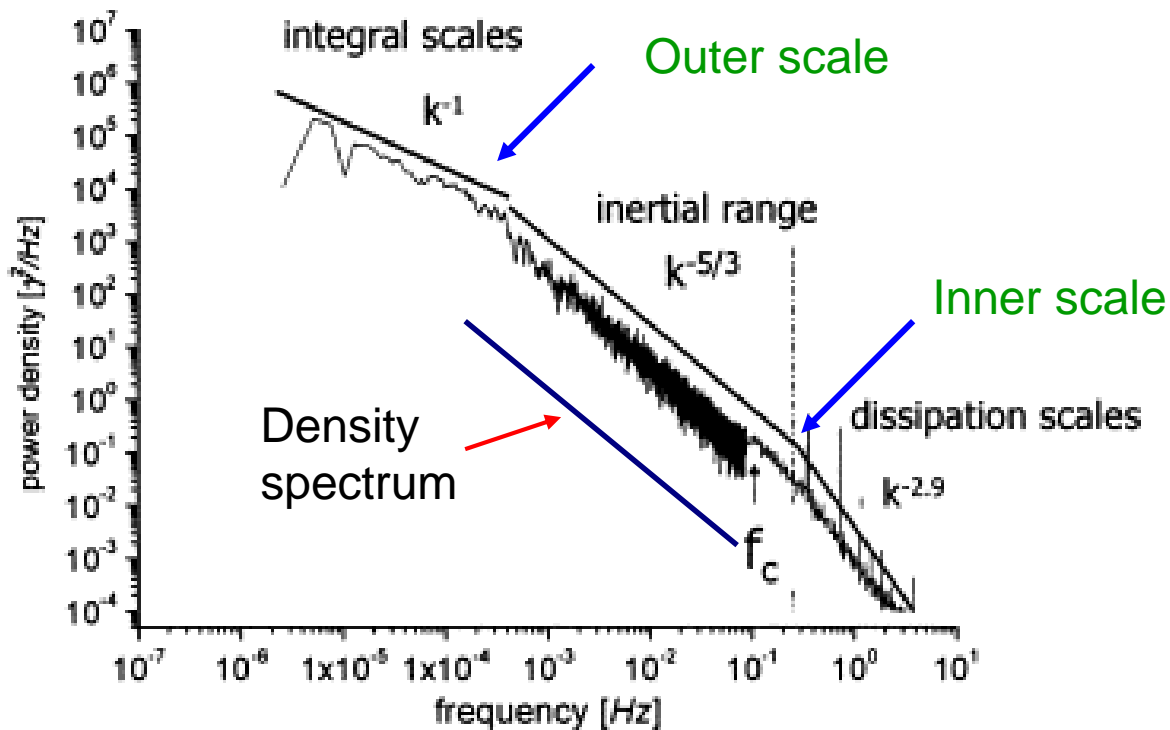
- Solar wind turbulence
  - Energy spectrum
  - Dimensional analysis
- Heliosphere & termination shock
- Voyager 1 + 2
  - Messages to us & from us
  - Magnetic fields of planets

# *Lecture 37*

- Fourier synthesis
  - Tophat function
- Center-to-limb variation
  - Connection with  $\mu$
  - Other pleasures on the way
- What else can go into the report
  - Relation to other work
  - Where to go from here

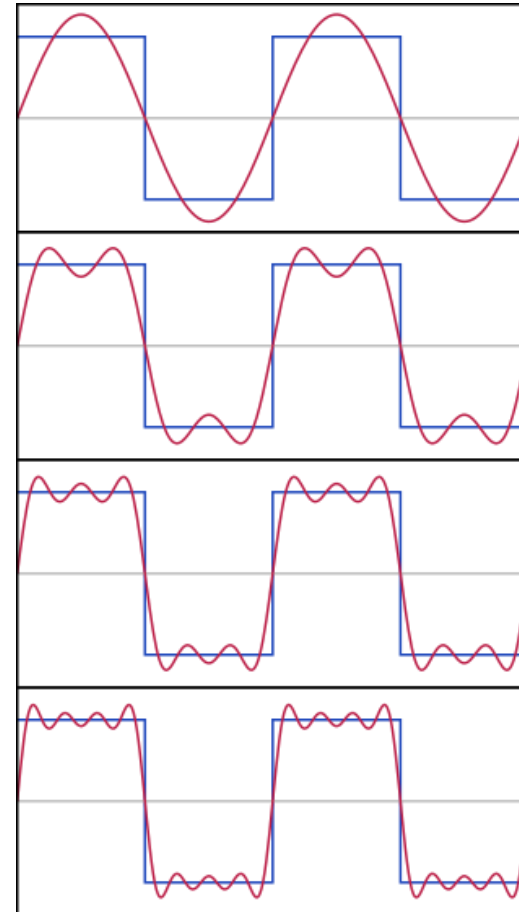
# Turbulence spectra measured directly in the solar wind

Magnetic  
power  
spectrum



R. Bruno, B. Bavassano, Ad Sp. Res. 35, 939, 2005

# Lect. 12: could you explain Fourier analysis?



$$f(t) = \sum_{n=1}^{\infty} a_n \underbrace{\sin(2\pi n / P) t}_{\omega_n}$$

## [SAO/NASA ADS Astronomy Abstract Service](#)

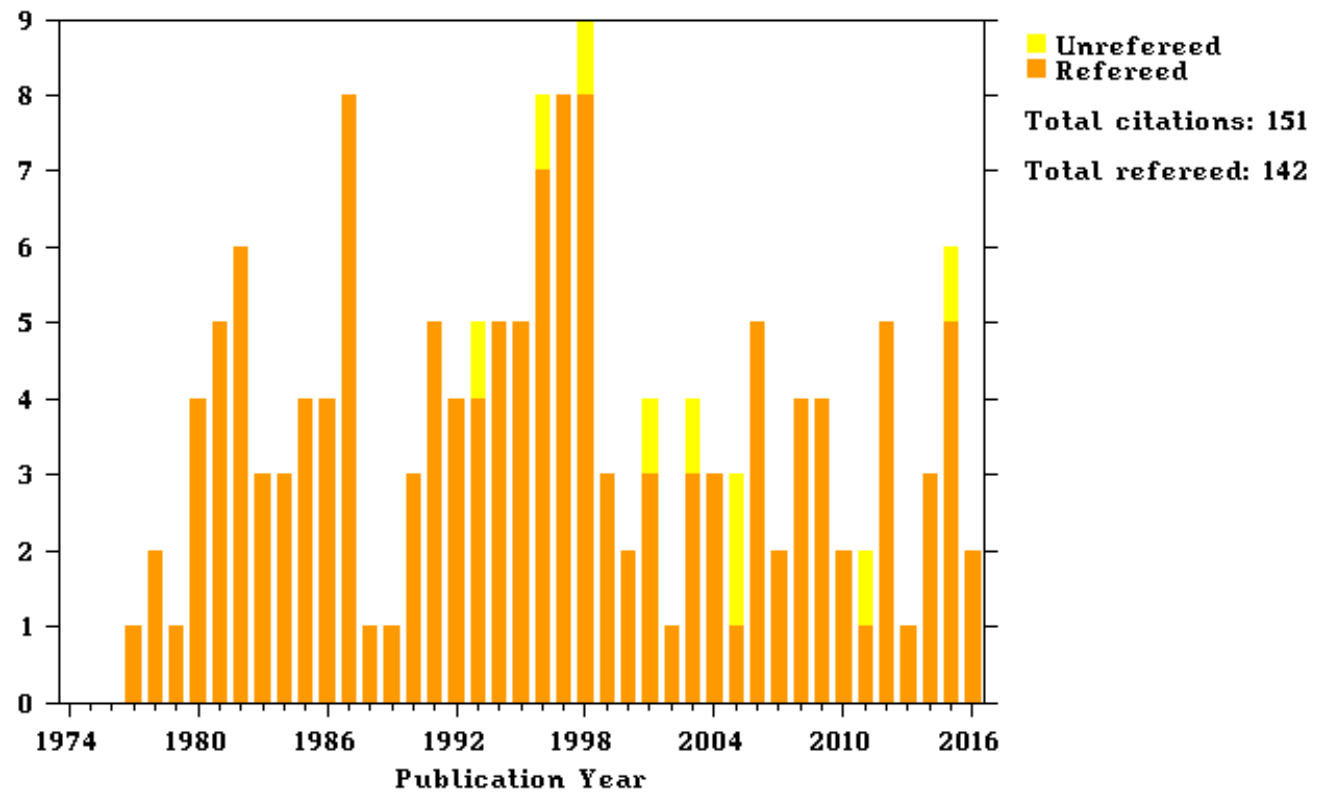
- [Find Similar Abstracts \(with default settings below\)](#)
- [Full Refereed Journal Article \(PDF/Postscript\)](#)
- [Full Refereed Scanned Article \(GIF\)](#)
- [References in the article](#)
- [Citations to the Article \(151\) \(Citation History\)](#)
- [Refereed Citations to the Article](#)
- [Also-Read Articles \(Reads History\)](#)
- [Translate This Page](#)

**Title:** Solar limb darkening. I - At wavelengths of 3033-7297  
**Authors:** [Pierce, A. K.](#); [Slaughter, C. D.](#)  
**Affiliation:** AA(Kitt Peak National Observatory, Tucson, Ariz.), AB(Kitt Peak National Observatory, Tucson, Ariz.)  
**Publication:** Solar Physics, vol. 51, Jan.-Feb. 1977, p. 25-41. ([SoPh Homepage](#))  
**Publication Date:** 02/1977  
**Category:** Solar Physics  
**Origin:** [STI](#)  
**NASA/STI** Limb Darkening Solar Limb Solar Spectra Spectroheliographs Spectroscopic Telescop

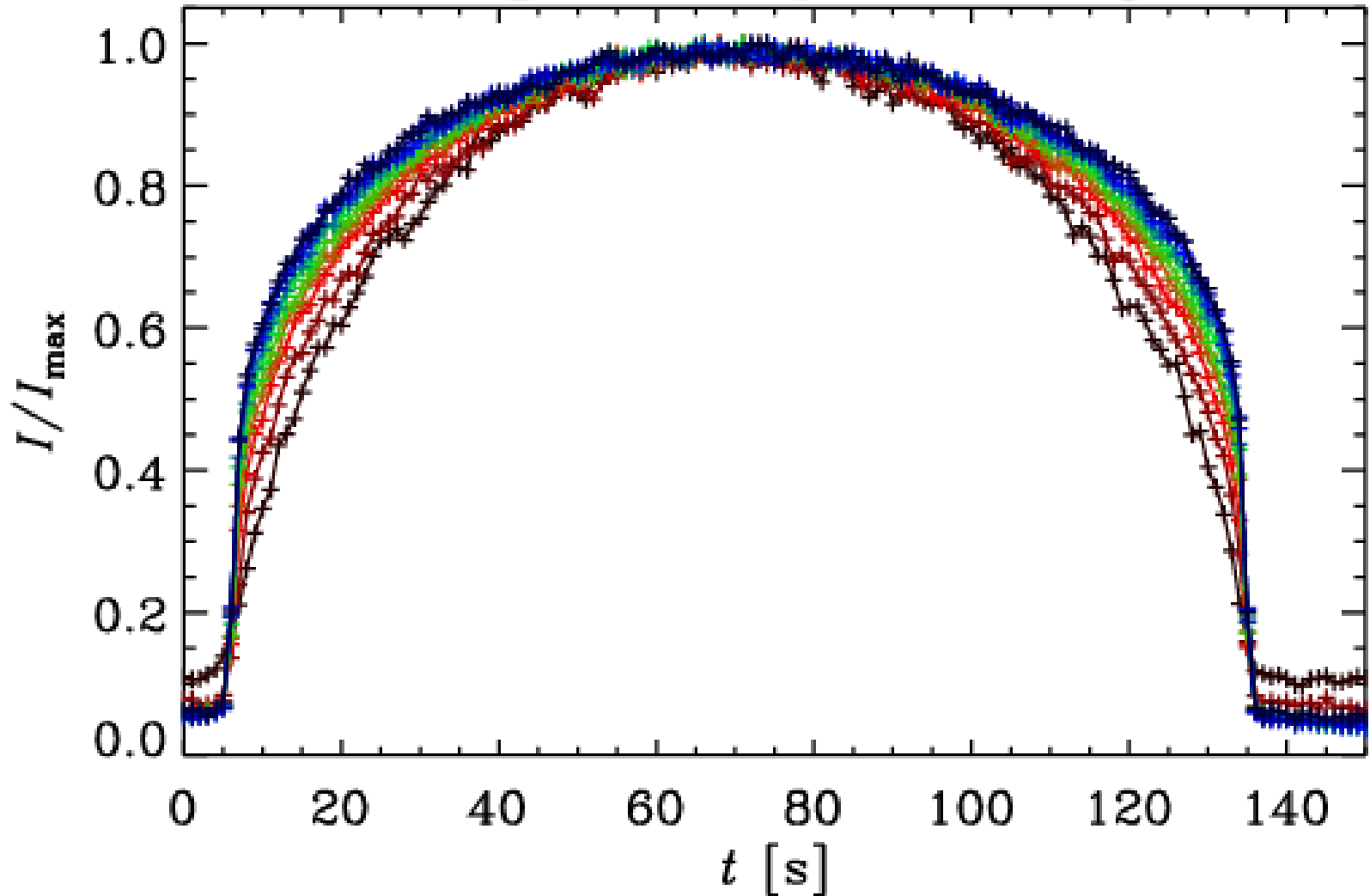
## Citations history for [1977SoPh...51...25P](#) from the ADS Databases

The Citation database in the ADS is **NOT** complete. Please keep this in mind when using the [ADS Citation lists](#).

**Citations/Publication Year for 1977SoPh...51...25P**

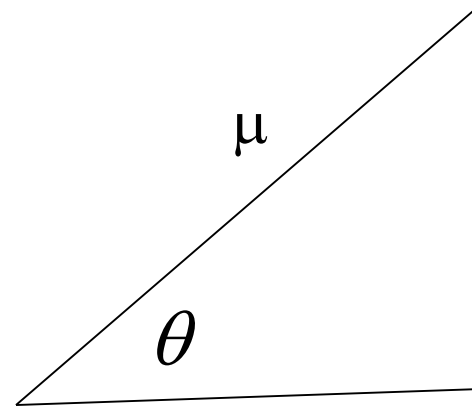


# *Letting sun pass by*

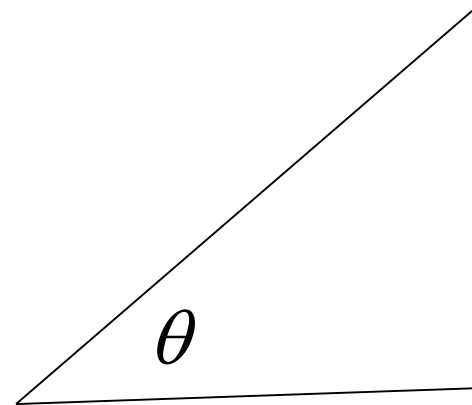


# Geometry

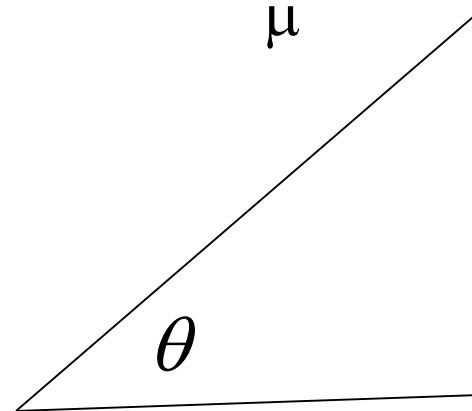
$$\mu = \cos \theta$$



A.



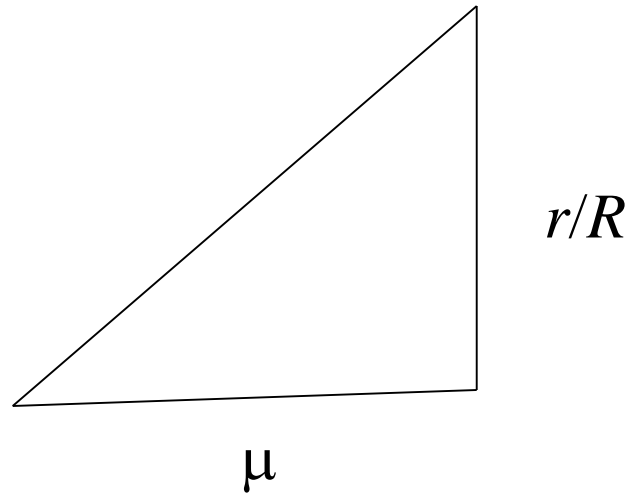
B.



C.

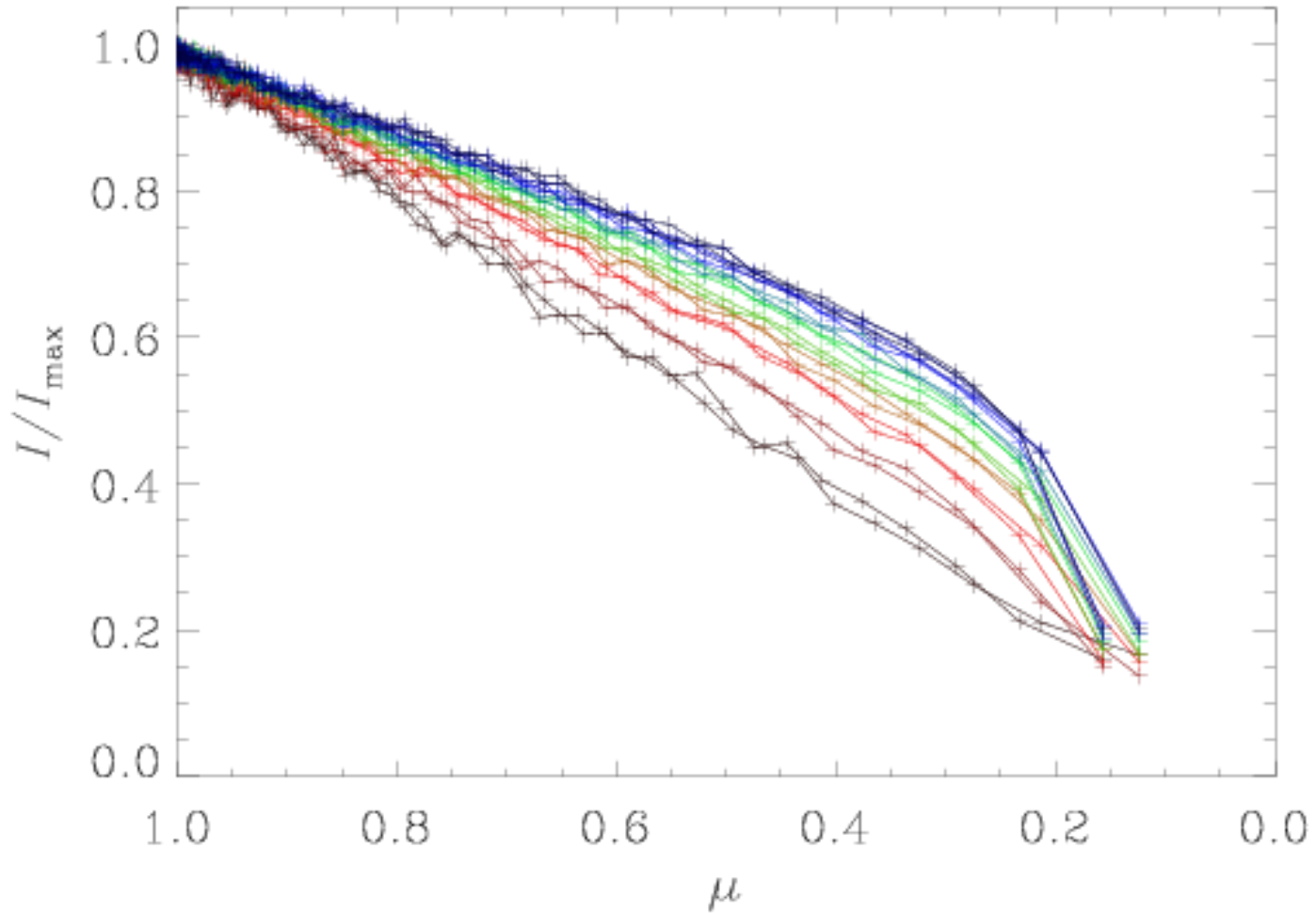


# Geometry



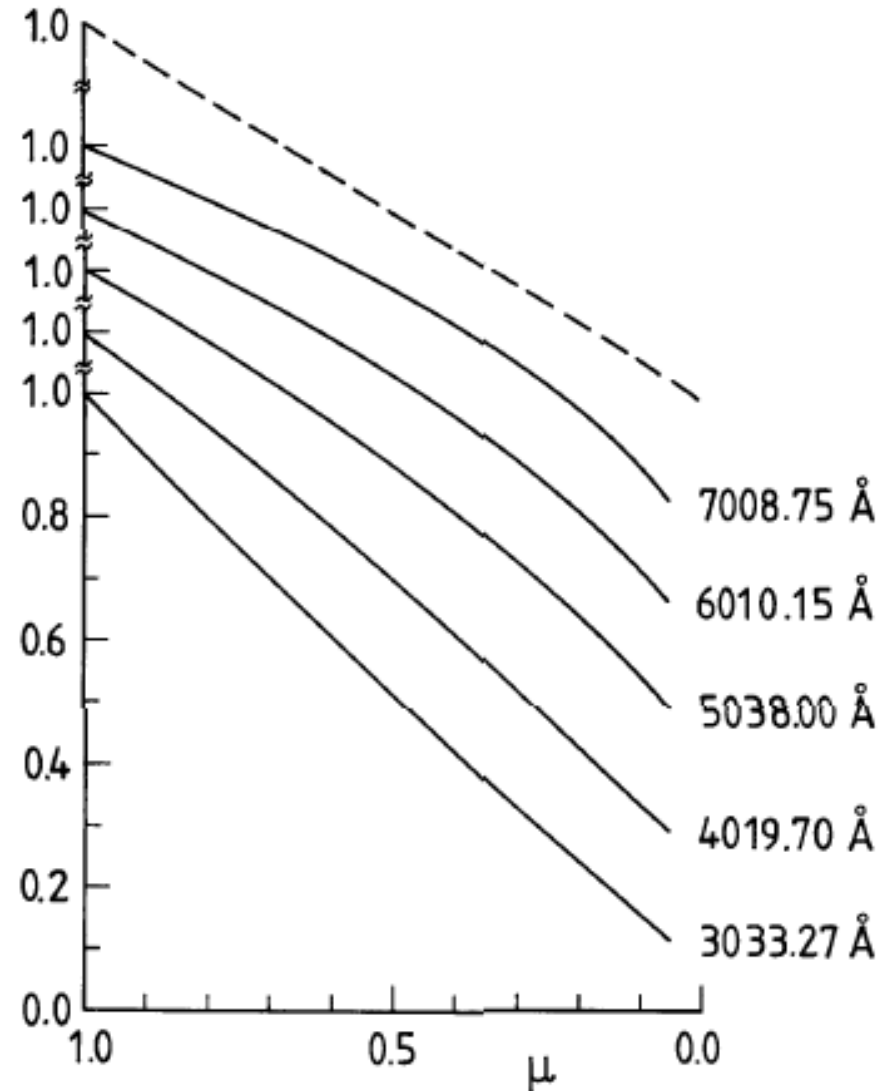
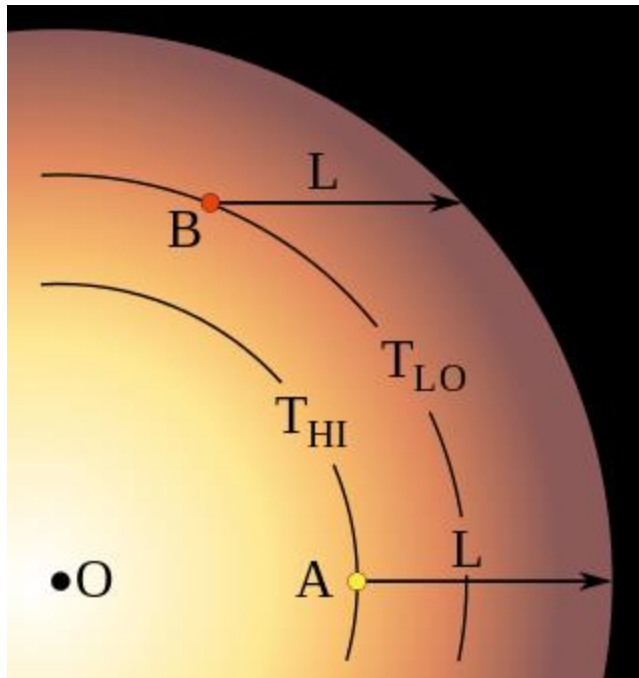
$$\mu = \sqrt{1 - (r/R)^2}$$

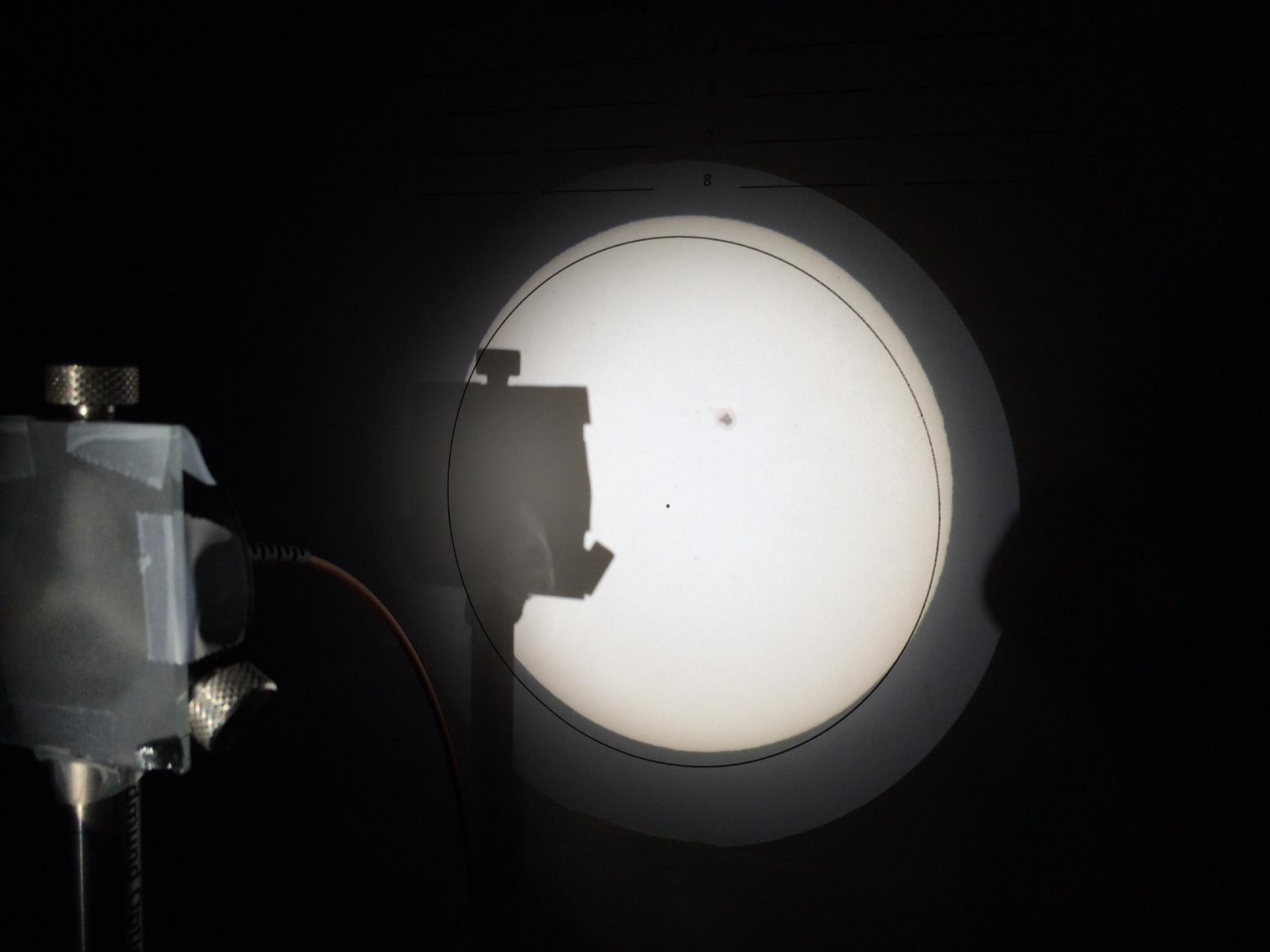
# $\mu$ dependence



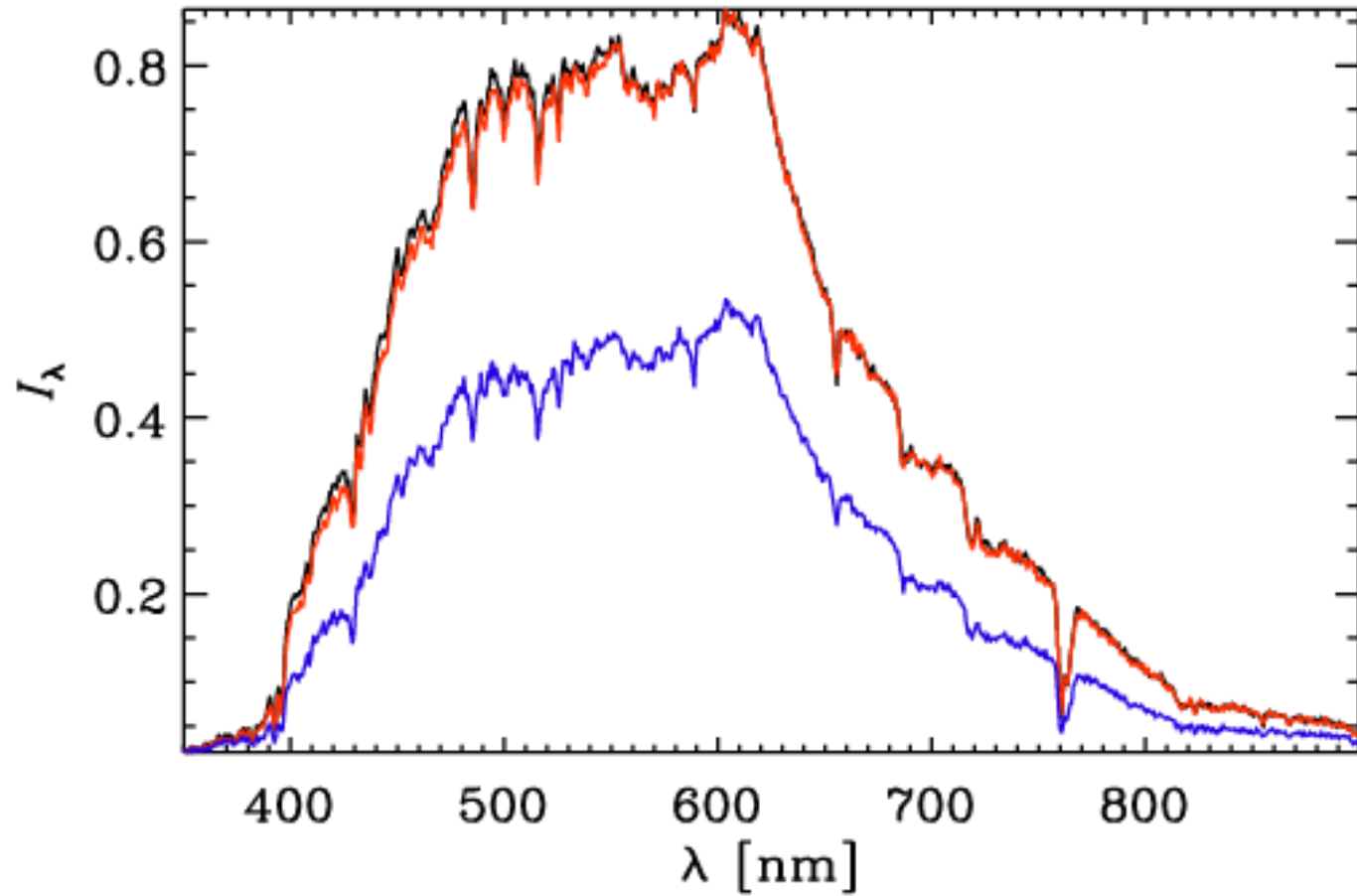
# Limb darkening

- Stix Sect. 4.3.1
- See deeper





# *Sunspot*



A circular orange field with a fine, grainy texture. Two small, dark, circular spots are visible. The spot on the left is slightly larger and has a reddish-brown hue. The spot on the right is smaller and appears as a dark brown or black dot. The labels '2533' and '2532' are printed in white text below each spot, respectively.

2533

2532

# *What else can go into report?*

- Literature search
  - History
  - earlier work
- Setup, description
- Results, details
- Conclusions, where to go from here
- References



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 )

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

Enter Title Words

Require title for selection

(Combine with:  OR  AND  simple logic  boolean logic)

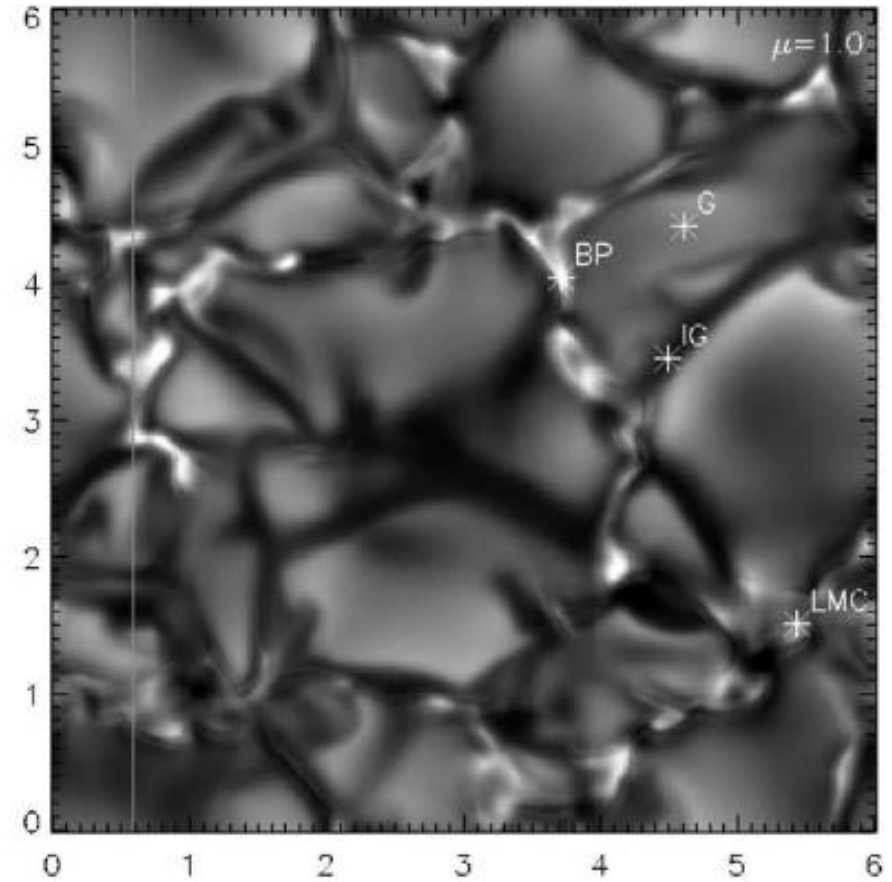
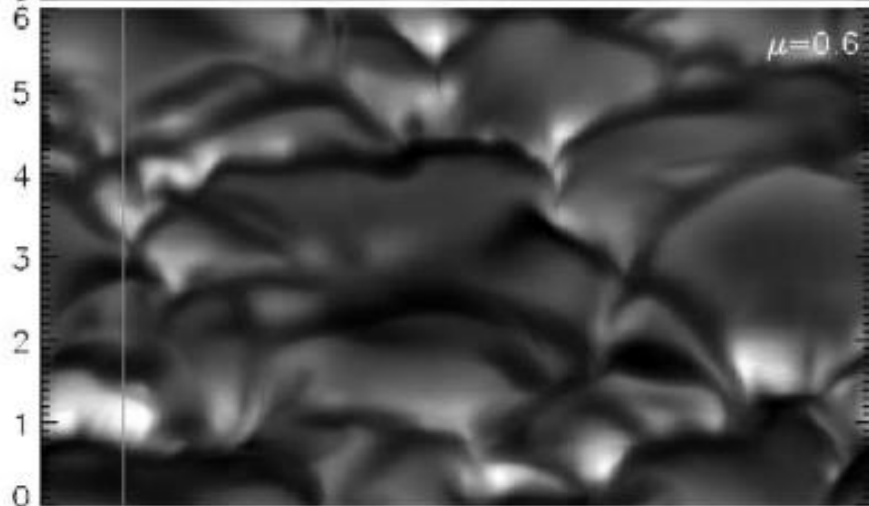
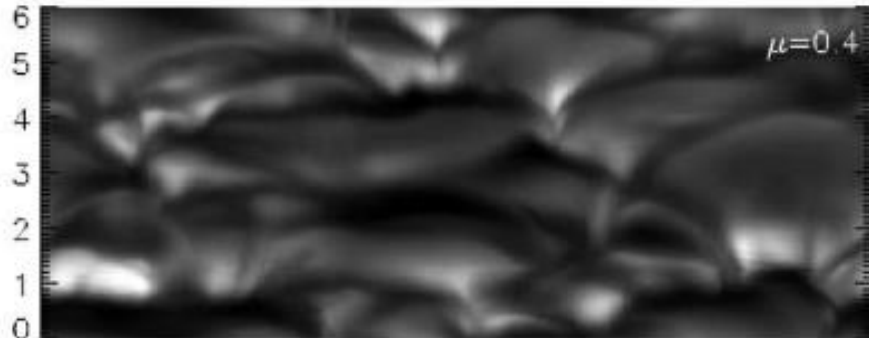
Enter Abstract Words/Keywords

Require text for selection

(Combine with:  OR  AND  simple logic  boolean logic)



# *Relation to simulations*



Carlsson et al. (2004)

# Lect.3, relation to opacity

Leading order  $I_\nu = B_\nu$

Insert

$$\cos \theta \frac{dB_\nu}{dr} = -\rho \kappa_\nu (I_\nu - B_\nu)$$

so

$$I_\nu = B_\nu - \frac{\cos \theta}{\rho \kappa_\nu} \frac{dB_\nu}{dr}$$

Interested in flux

$$\int_{4\pi} I_\nu \cos \theta d\Omega = 2\pi \int_{-1}^1 I_\nu \cos \theta d \cos \theta$$

# *What we learned today*

- Fourier synthesis
  - Tophat function
- Center-to-limb variation
  - Connection with  $\mu$
  - Other pleasures on the way
- What else can go into the report
  - Relation to other work
  - Where to go from here