OUTLINE

1. **Bremsstrahlung examples**
   a. Galaxy cluster
   b. HII regions
2. **Synchrotron radiation:**
   a. Total emitted power
   b. Spectrum
   c. Polarization

1. **Synchrotron radiation:**

   a. Total emitted power

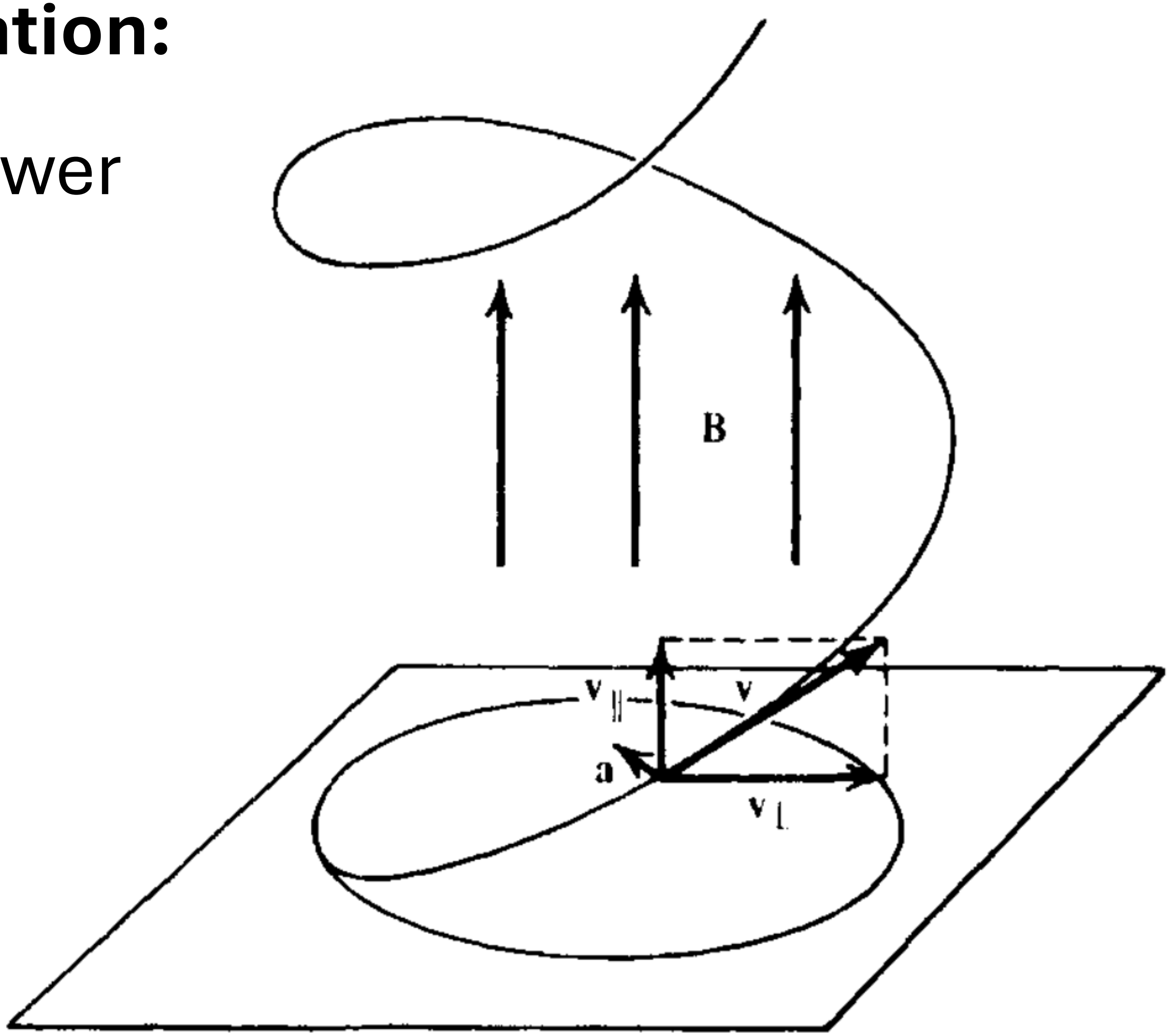

Figure 6.1 Helical motion of a particle in a uniform magnetic field.

1. Synchrotron radiation:

b. Spectrum

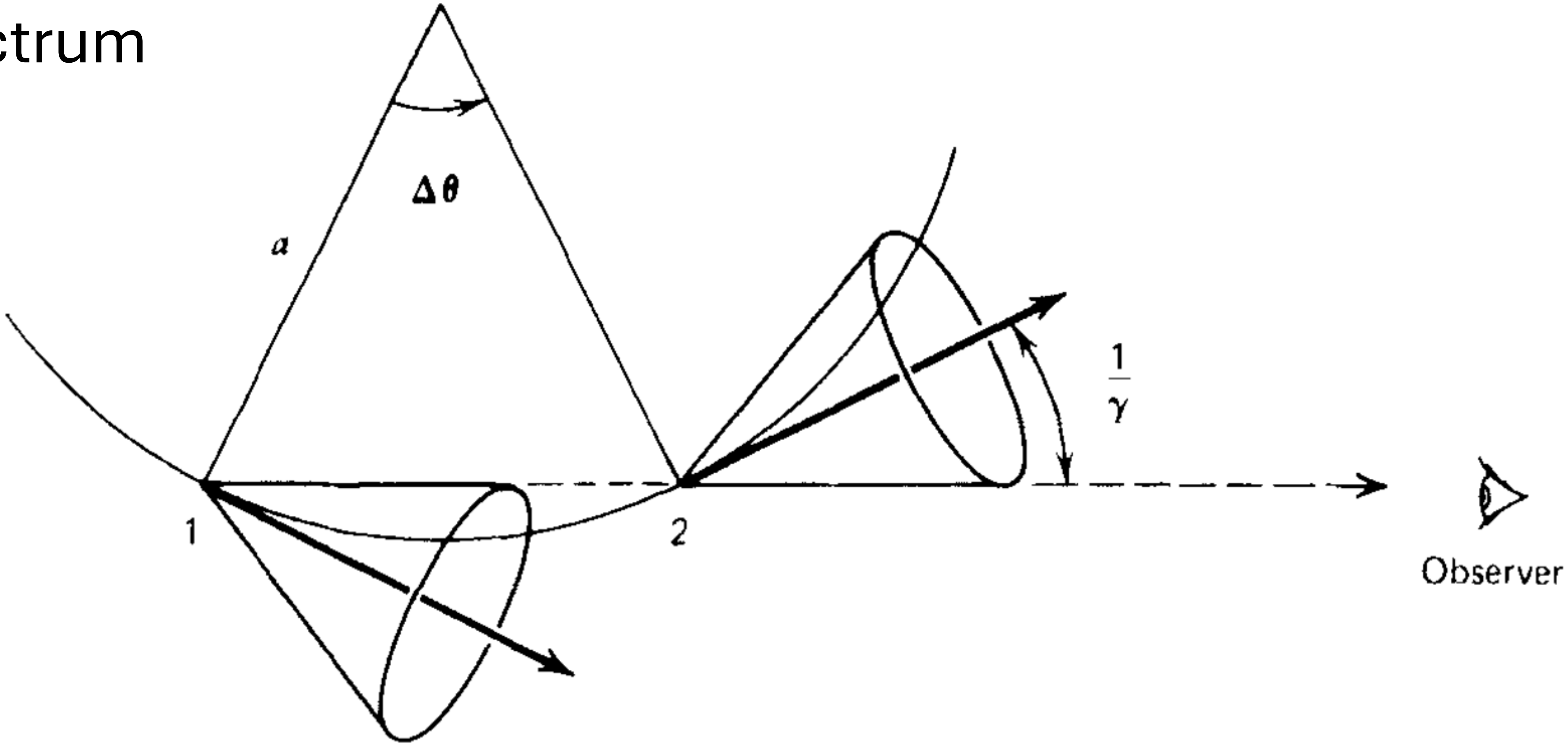

Figure 6.2 ***Emission cones at various points of an accelerated particle's trajectory.***

1. Synchrotron radiation:

b. Spectrum

- Particle is instantaneously at the origin at time t'
- Particle trajectory is in x-y plane, with velocity **v** along the x axis at time t'
- a = radius of curvature of trajectory
- $\boldsymbol{\epsilon}_\perp$ and $\boldsymbol{\epsilon}_\parallel$ are the polarization axes
- $\boldsymbol{\epsilon}_\perp$ unit vector along y axis
- $\boldsymbol{\epsilon}_\parallel = \mathbf{n} \times \boldsymbol{\epsilon}_\perp$
- **n** and $\boldsymbol{\epsilon}_\parallel$ are in the x-z plane

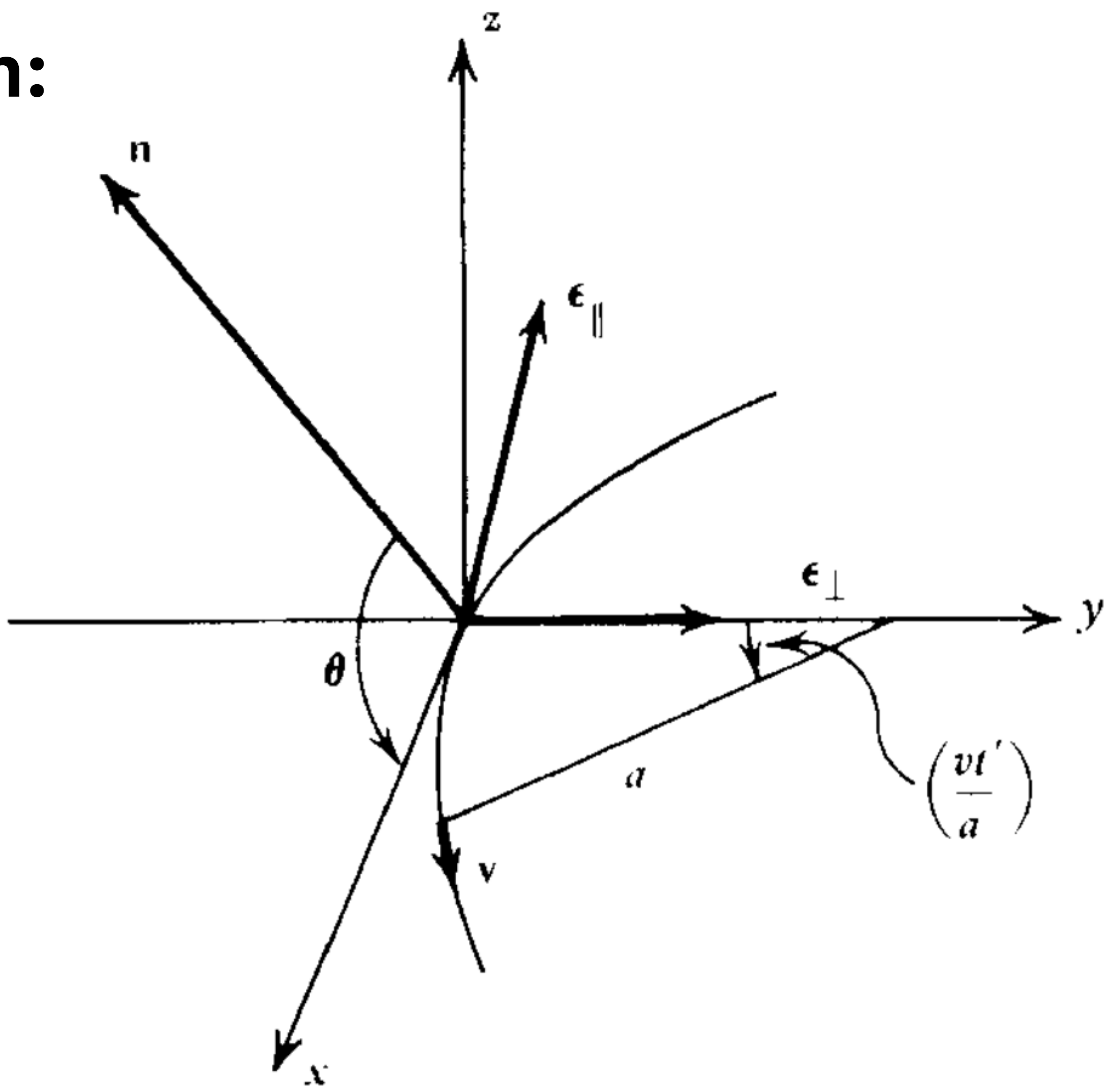

***Figure 6.4** Geometry for polarization of synchrotron radiation. At t = 0, the particle velocity is along the x axis, and a is the radius of curvature of the trajectory.*

1. Synchrotron radiation:

b. Spectrum

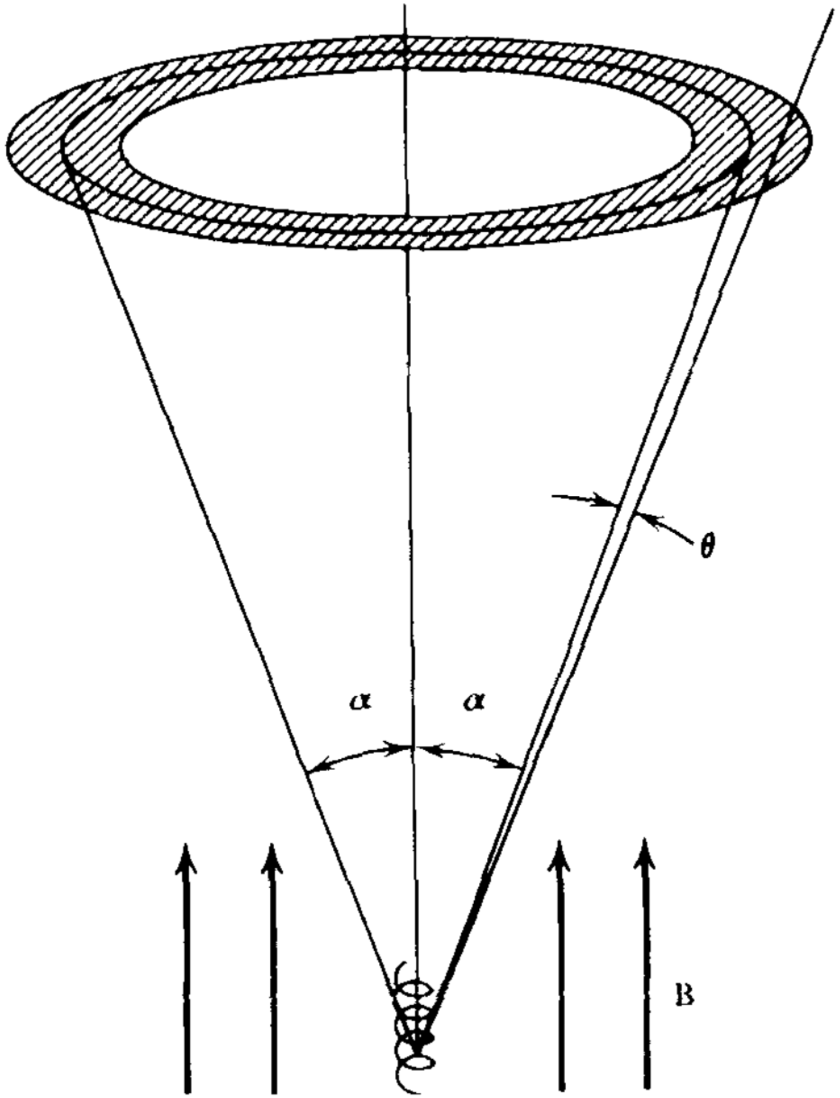

Figure 6.5 Synchrotron emission from a particle with pitch angle α. Radiation is confined to the shaded solid angle.

1. Synchrotron radiation:

b. Spectrum

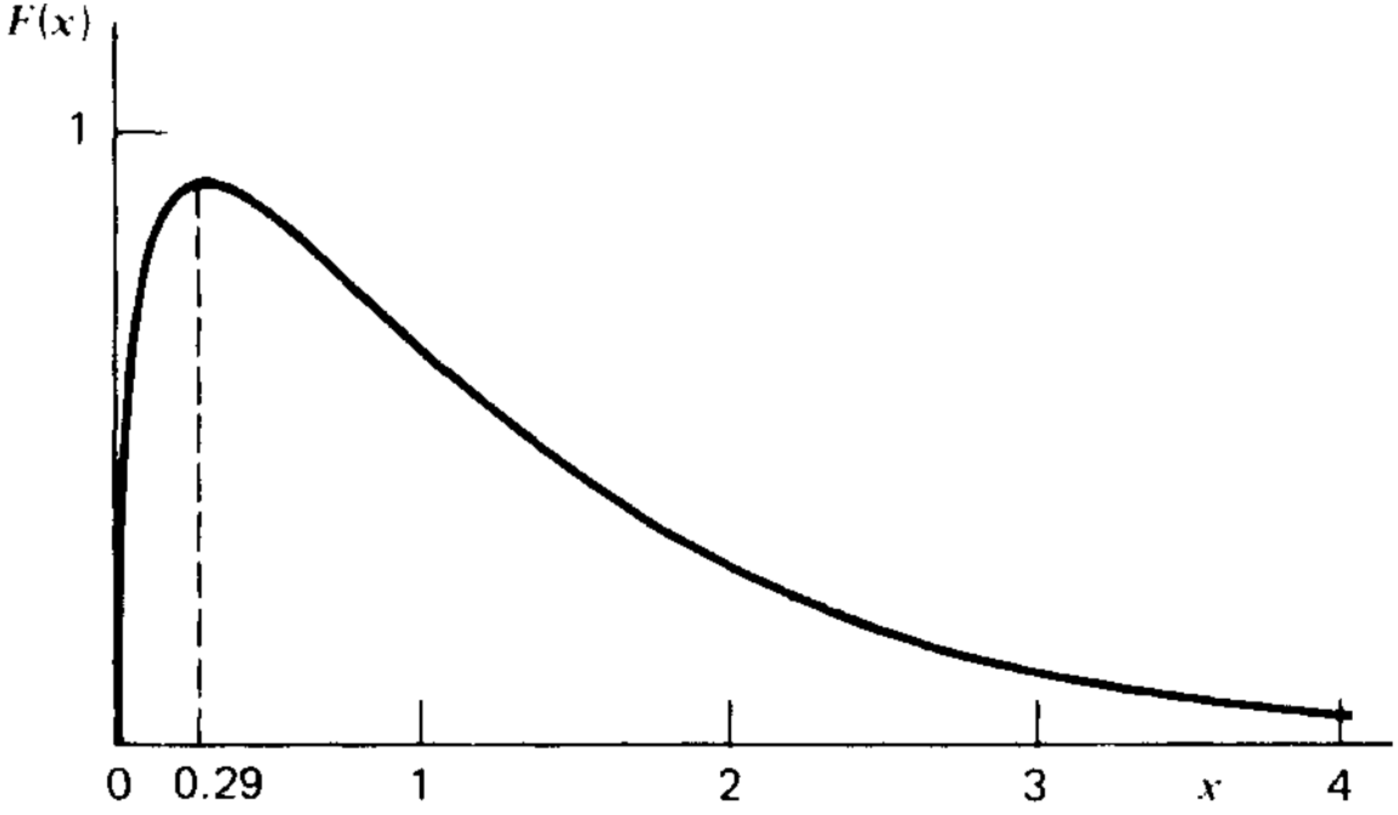

Figure 6.6 ***Function describing the total power spectrum of synchrotron emission. Here $x = \omega/\omega_c$. (Taken from Ginzburg, V. and Syrovatskii, S. 1965, Ann. Rev. Astron. Astrophys., 3, 297.)***

OUTLINE: **Synchrotron radiation**

a. Spectrum (Part II)

b. **Polarization**

c. Self-absorption

d. Power-law energy distribution:

i) Radiative transfer

ii) Linear polarization

OUTLINE: **Synchrotron radiation**

a. Spectrum (Part II)

b. Polarization

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d. Power-law energy distribution:

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OUTLINE: **Synchrotron radiation**

a. Spectrum (Part II)

b. Polarization

c. Self-absorption

d. **Power-law energy distribution:**

- i) Radiative transfer
- ii) Linear polarization

d. Power-law energy distribution

Table of functions of slope *s* of the electron energy distribution

s	τ_m	c_1	c_2	$\langle(\sin\psi)^{(s+1)/2}\rangle$	$\langle(\sin\psi)^{(s+2)/2}\rangle$
1.5	0.25	1.01×10^{-18}	2.29×10^{12}	0.75	0.69
2.0	0.48	3.54×10^{-14}	1.17×10^{17}	0.72	0.67
2.5	0.69	1.44×10^{-9}	6.42×10^{21}	0.69	0.64
3.0	0.88	6.3×10^{-5}	3.5×10^{26}	0.67	0.62

For values of *s* not listed here, logarithmic interpolation will give reasonable approximations to c_1 and c_2.

So, e.g., $\log c_1(s = 1.7) \approx \log c_1(s = 1.5)] + \frac{1.7-1.5}{2.0-1.5}[\log c_1(s = 2.0) - \log c_1(s = 1.5)] = -16.178$,

$\rightarrow c_1(s = 1.7) \approx 10^{-16.178} = 6.6\times10^{-17}$