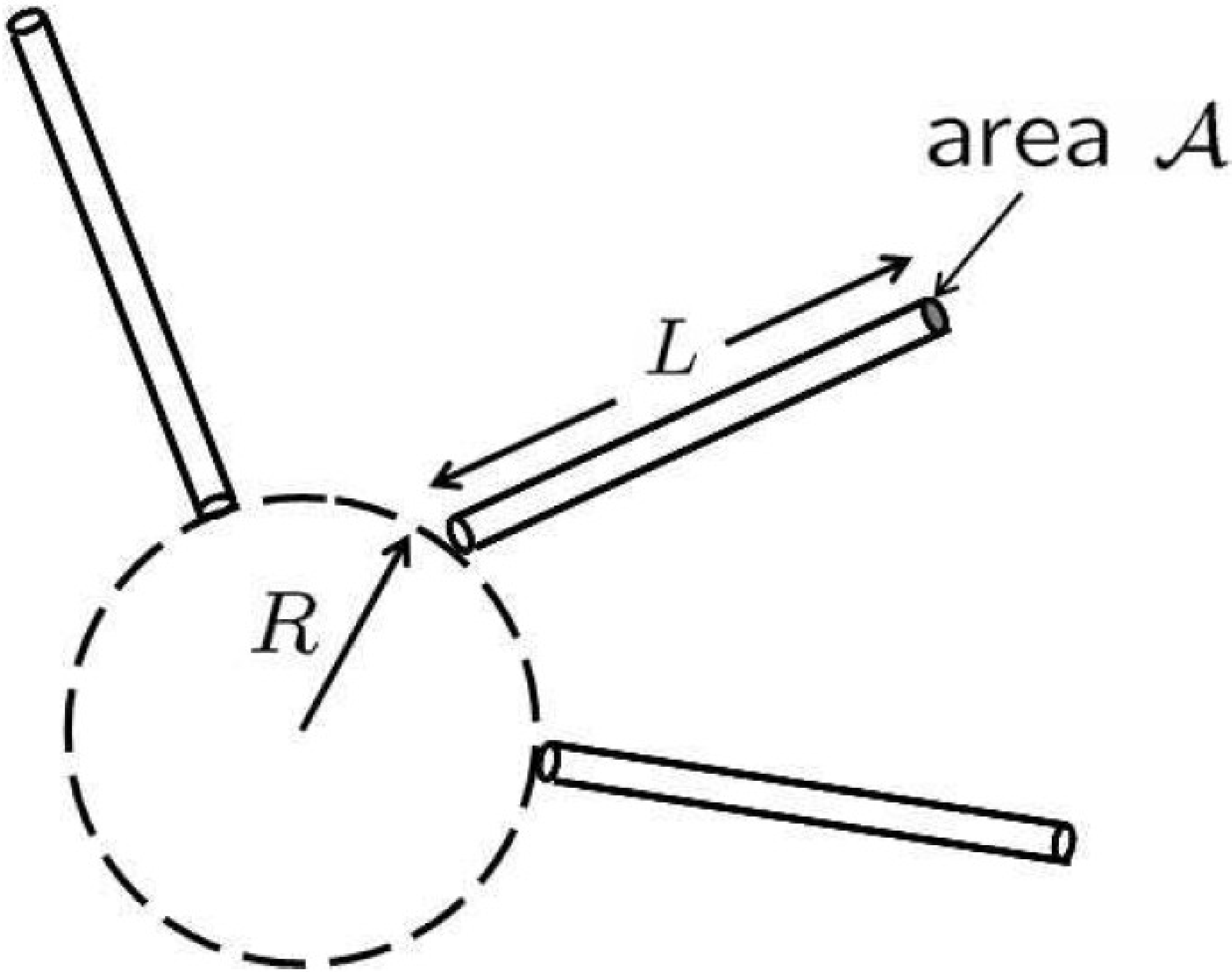


Fig. 1.— A simple model of WHIM filaments converging to some critical radius R of a cluster; at this radius the surface cover factor by the filaments reaches the maximum value of f_0 mentioned in the text. Each filament has length L, cross sectional area $\mathcal{A}$, and is optically thin to soft X-rays.

$$S(b) = \frac{2 f_0 n_e^2 R^2}{b} \tan^{-1}\left(\frac{b}{\sqrt{R^2 - b^2}}\right), \text{ for } b < R;$$

$$\text{and } S(b) = \frac{f_0 n_e^2 \pi R^2}{b}, \text{ for } b \geq R$$

$$M_{\mathrm{WHIM}} = 4.25 \times 10^{14} \left(\frac{n_e}{10^{-3}\ \mathrm{cm}^{-3}}\right)^{-3} \left(\frac{f_0}{0.5}\right) \left(\frac{L}{5\ \mathrm{Mpc}}\right) \left(\frac{R}{2\ \mathrm{Mpc}}\right)^2 \mathrm{M}_{\odot}$$

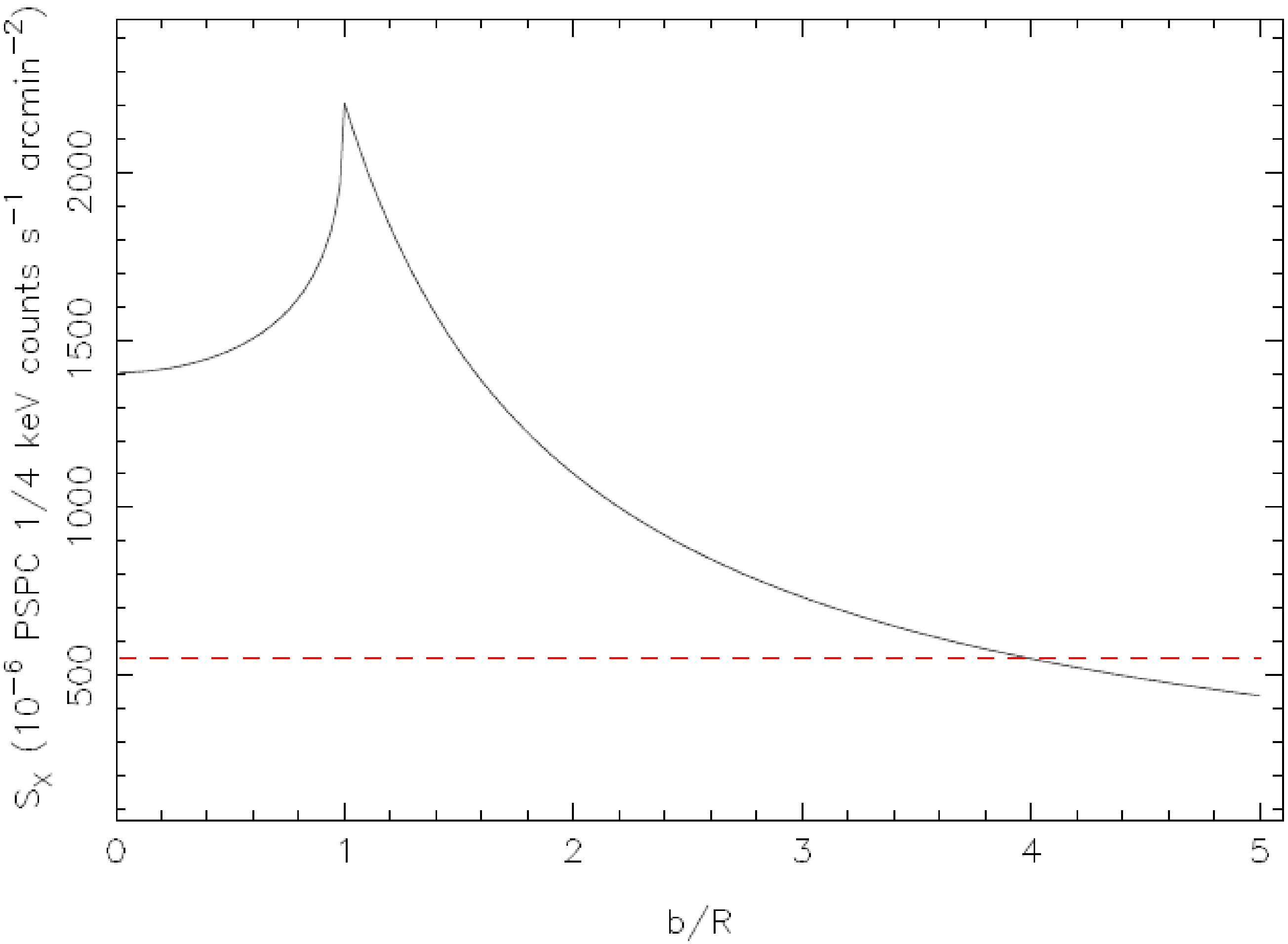
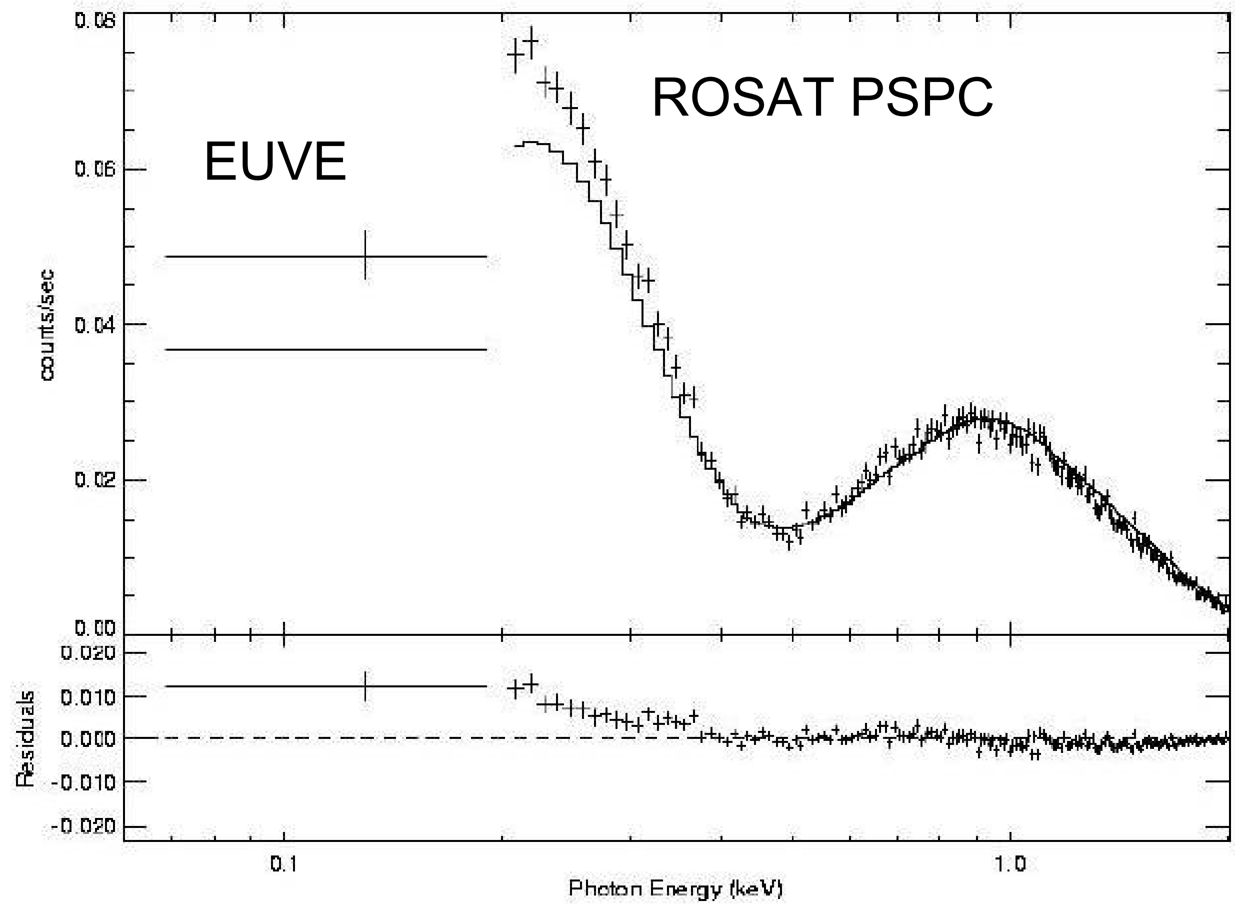


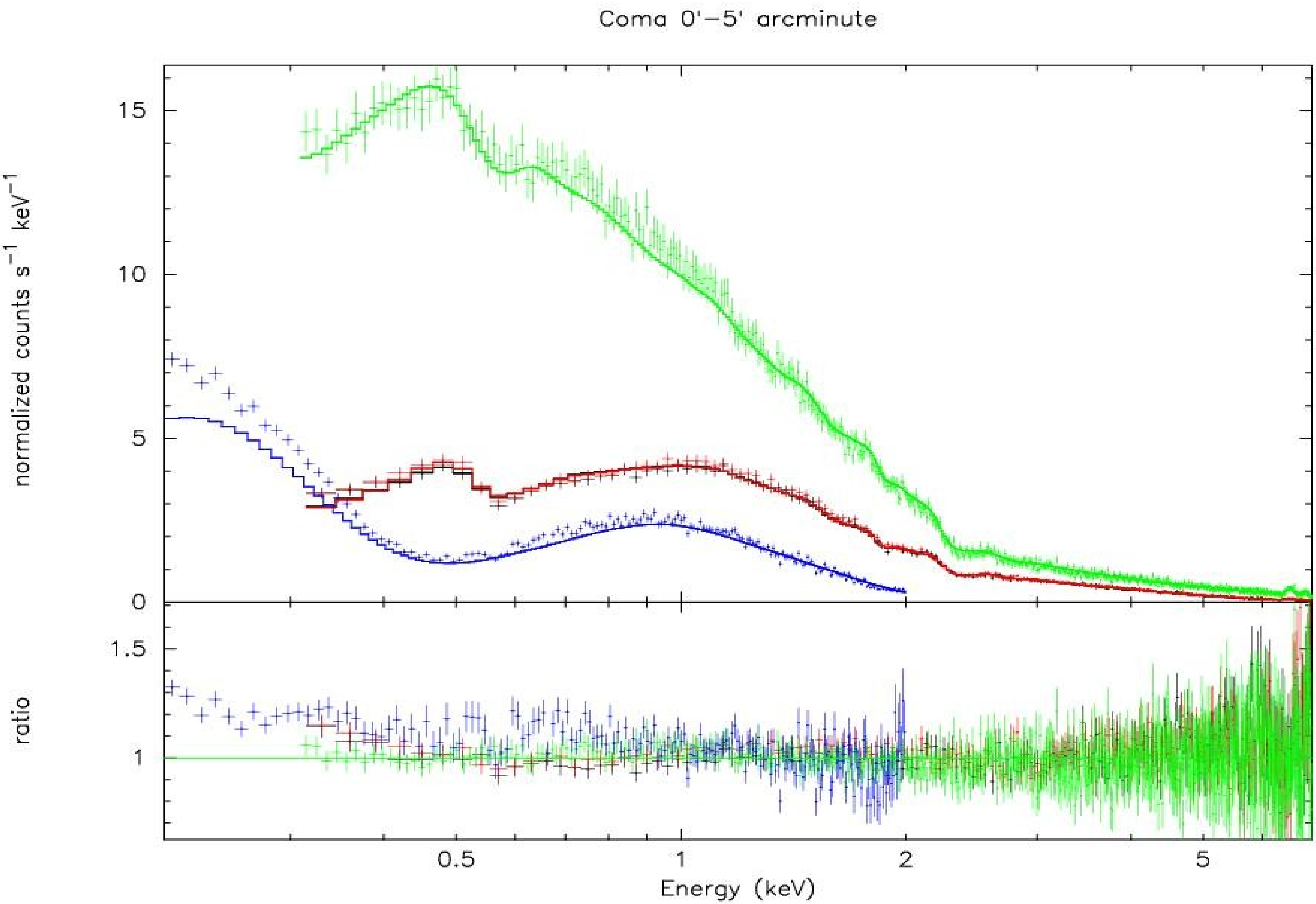
Fig. 3.— Intensity of the filament emission following the model of Section 3. The surface brightness has been multiplied by the average effective area $A_{eff} \simeq 150$ cm^2 of the PSPC instrument in the 1/4 keV band (R2 band, Snowden et al. 1998), in order to compare this detector-dependent intensity to the value measured by Bonamente et al. (2003) in the neighborhood of the Coma cluster (shown as the red dashed line).

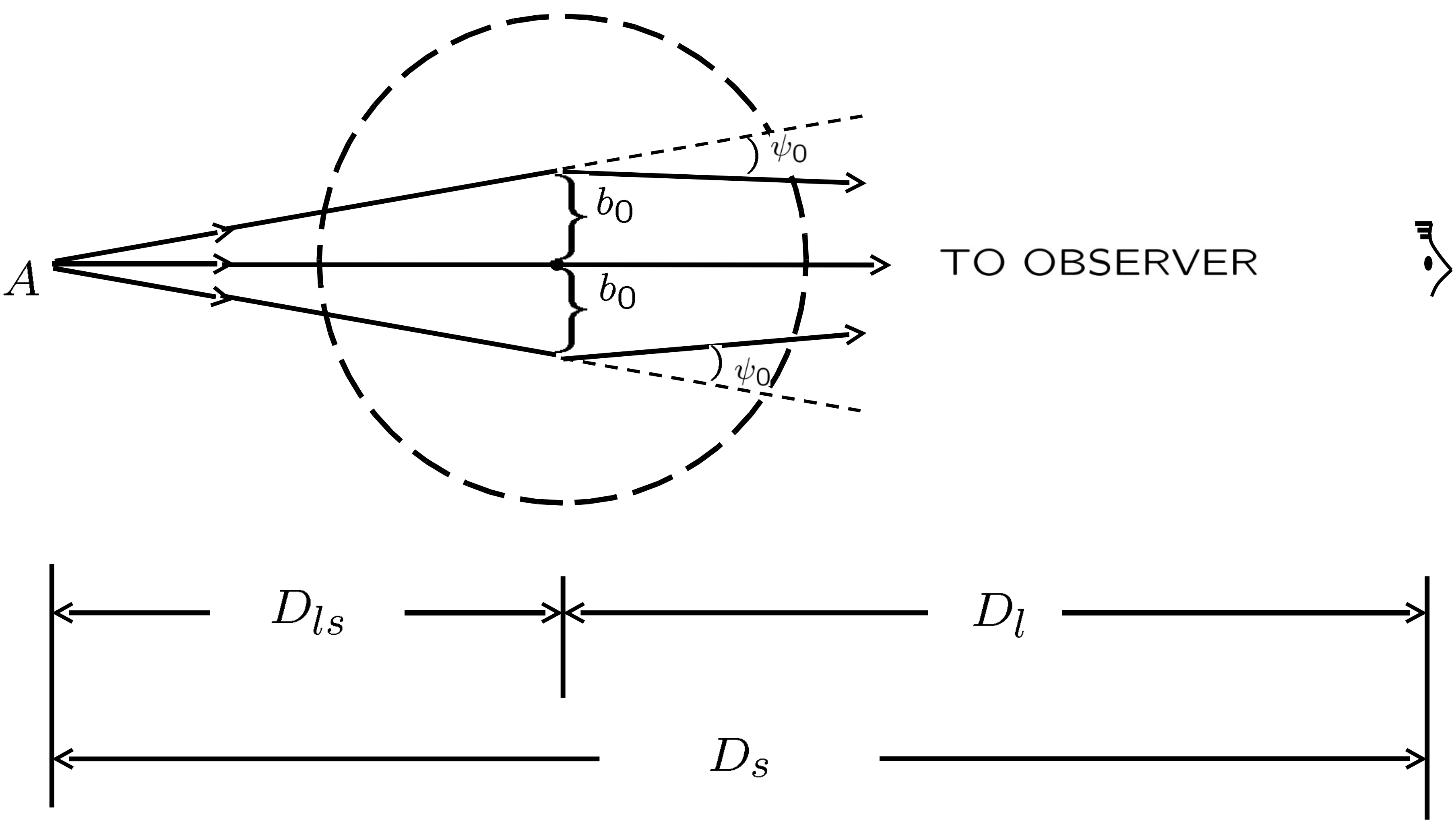
Coma Cluster 6' – 9' ROSAT and EUVE DS



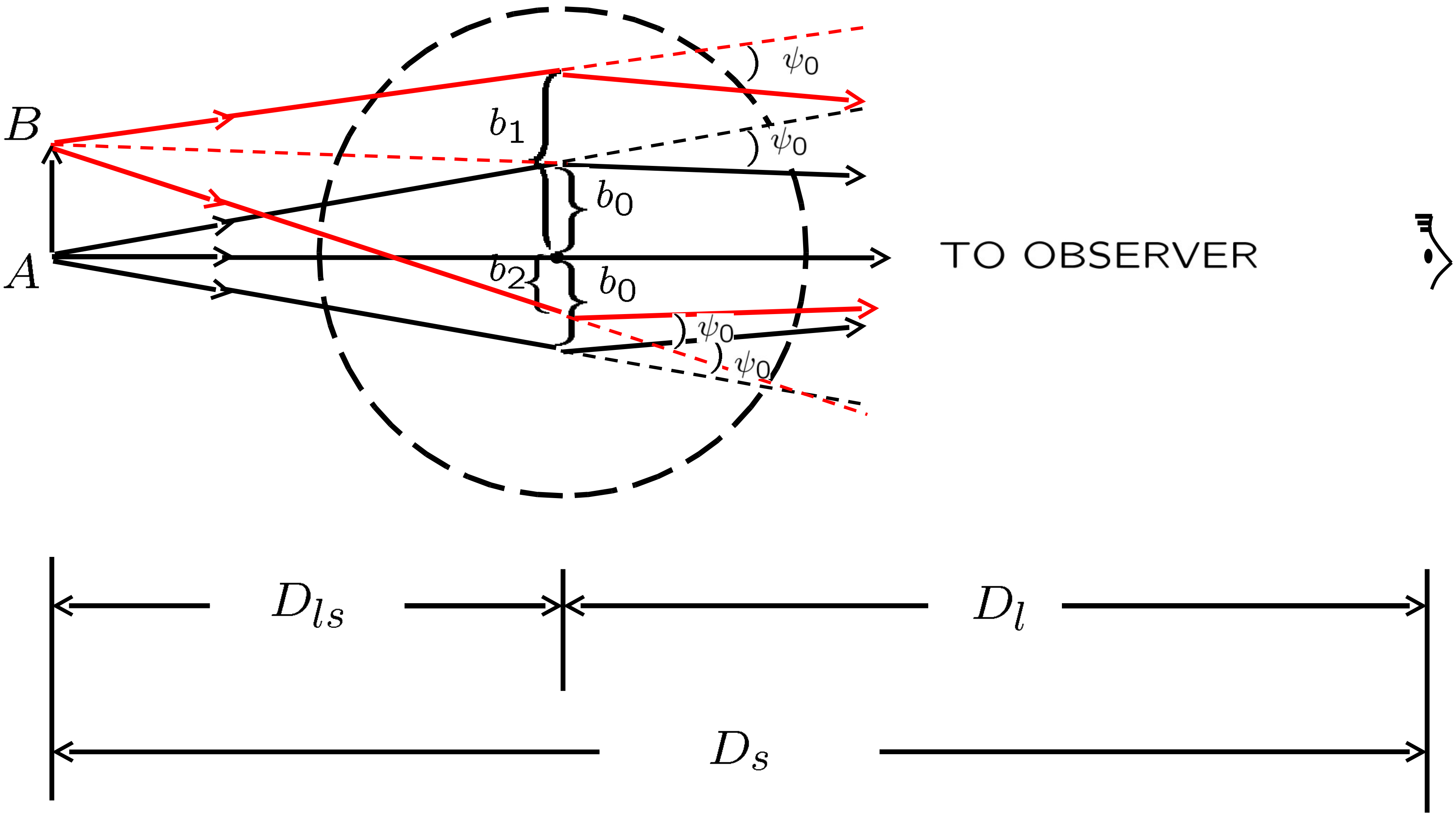
Solid line is the expected emission spectrum of the hot ICM at kT = 8.7 +/- 0.4 keV and A = 0.3 solar, as measured by ASCA.

Central soft excess (no background issues) for Coma





ψ_0
b_0
A
TO OBSERVER
b_0
ψ_0
D_{ls}
D_l
D_s



ψ_0
ψ_0
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b_0
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TO OBSERVER
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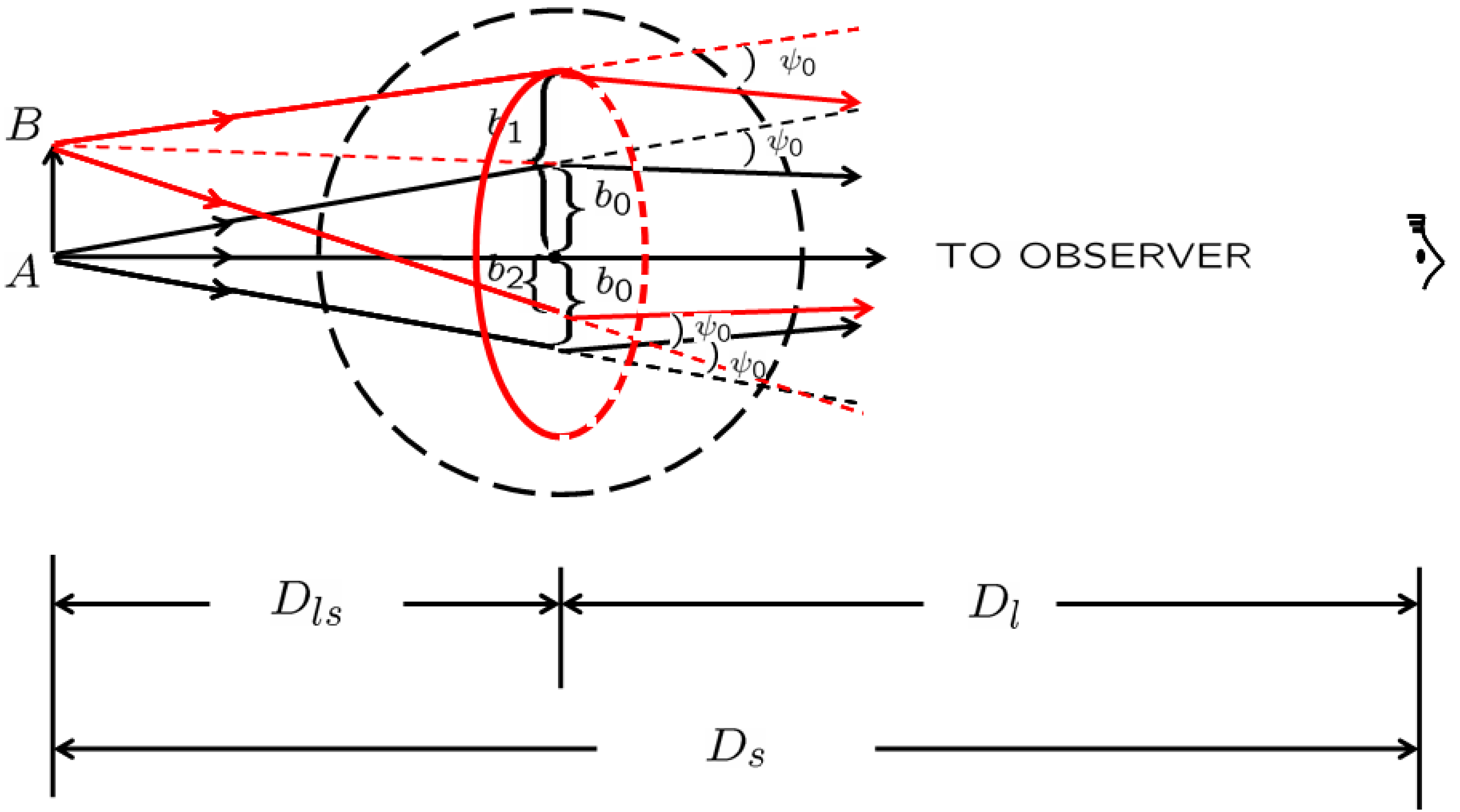
D_s



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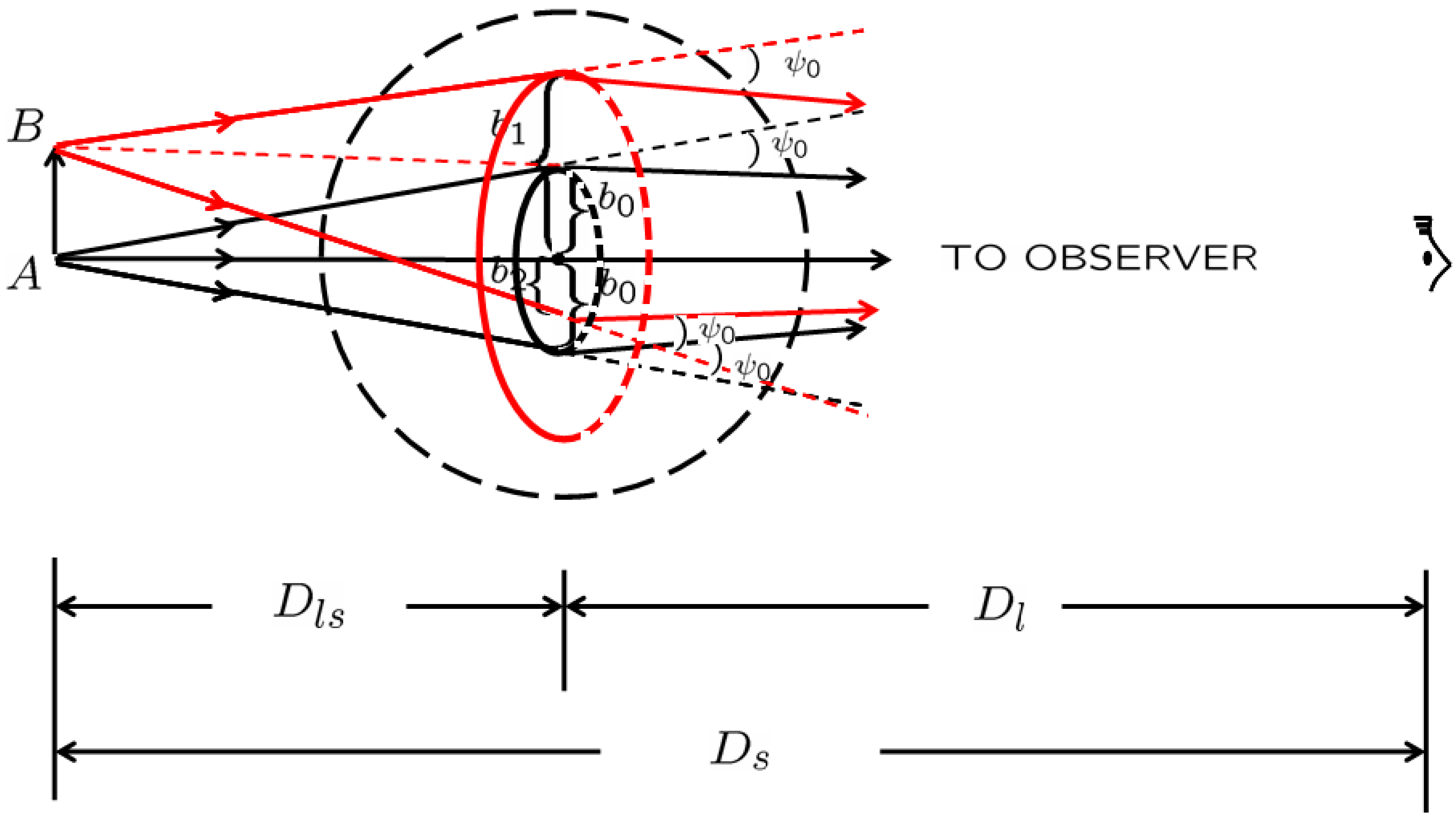

B
A
b_1
b_0
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TO OBSERVER
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D_s

$$p = \pi n a^2 \ell = 12 \left(\frac{n}{1.56 \times 10^{-4}\ \mathrm{Mpc}^{-3}} \right) \left(\frac{a}{0.5\ \mathrm{Mpc}} \right)^2 \left(\frac{\ell}{1\ \mathrm{Gpc}} \right) \%$$

Ω_b^{obs} = mass density of observed baryonic (ordinary) matter

For the present-day universe ($z=0$):

$$\Omega_b^{obs} = \Omega_* + \Omega_{HI} + \Omega_{H_2} + \Omega_{X\text{-rays}}^{clusters} \simeq 0.0068$$

Ω_b = total mass density of baryonic matter

This is constrained by the observed abundance of primordial D from spectra of high z quasars:

$$\Omega_b = 0.039 \pm 0.002 \quad (H_0 = 70 \text{ km s}^{-1} \text{ Mpc}^{-1})$$

Ω_m = total mass density of all matter

Ω_Λ = " " " " " energies ($E = mc^2$)

Shall present ample evidence for $\Omega_m = 0.35 \pm 0.1$, $\Omega_\Lambda = 0.6 \pm 0.15$

so that:

- $\Omega \simeq 1$, the universe is flat
- $\Omega_m \simeq 10\Omega_b \Rightarrow$ dark matter
- $\Omega_\Lambda > 0 \Rightarrow$ cosmological constant

Late 1990s