logN-logS
A Measuring Stick for the Universe

Vinay Kashyap (CfA)

$\log_{10}(N>S)-\log_{10}(S)$

cumulative number of sources detectable at a given telescopic sensitivity

$S = [\text{ergs s}^{-1}\text{ cm}^{-2}]$

N = number of sources brighter than S

simple example

uniformly distributed source population

$$n(\vec{\mathbf{r}}) = n_0$$

all sources have same intrinsic luminosity

$$f(L) = \delta(L - L_0)$$

for telescope sensitivity *S*, source will be detectable to

$$d = \sqrt{\frac{L_0}{4\pi S}}$$

number of sources within this distance

$$N(< d) \equiv N(> S) = \frac{4\pi}{3} n_0 d^3 \propto S^{-\frac{3}{2}}$$

simple example

uniformly distributed source population

$$n(\vec{\mathbf{r}}) = n_0$$

all sources have same intrinsic luminosity

$$f(L) = \delta(L - L_0)$$

for telescope sensitivity *S*, source will be detectable to

$$d = \sqrt{\frac{L_0}{4\pi S}}$$

number of sources within this distance

$$N(< d) \equiv N(> S) = \frac{4\pi}{3} n_0 d^3 \propto S^{-\frac{3}{2}}$$

simplified general case

$$N(>S) = d\Omega \int_0^\infty dL' \; f(L') \int_0^R dr \; r^2 \; n(r)$$

$$S = \frac{L'}{4\pi R^2} e^{-\tau(R)}$$

cosmology makes it more complicated

typical case

a set of detected sources with observed counts

$$\{Y_i, i = 1..M\}$$

with associated detector location, background, exposure

$$\{(x_i, y_i, Y_i^b, \epsilon_i), i = 1..M\}$$

background and exposure determine detection threshold

$$\mathcal{S}_i(Y_i^b, \epsilon_i)$$

detection probability is usually tabulated

$$Pr(\mathcal{I}(\lambda_i) = 1|\mathcal{S}_i)$$

Problem: Model N(>S) as a single power-law
or broken power-law

logN-logS

Next up:
Andreas Zezas (Univ. of Crete)