End of sabbatical viewgraphs:

Cosmic SF from X-rays.

CDF-S → PLE small hint s.l.

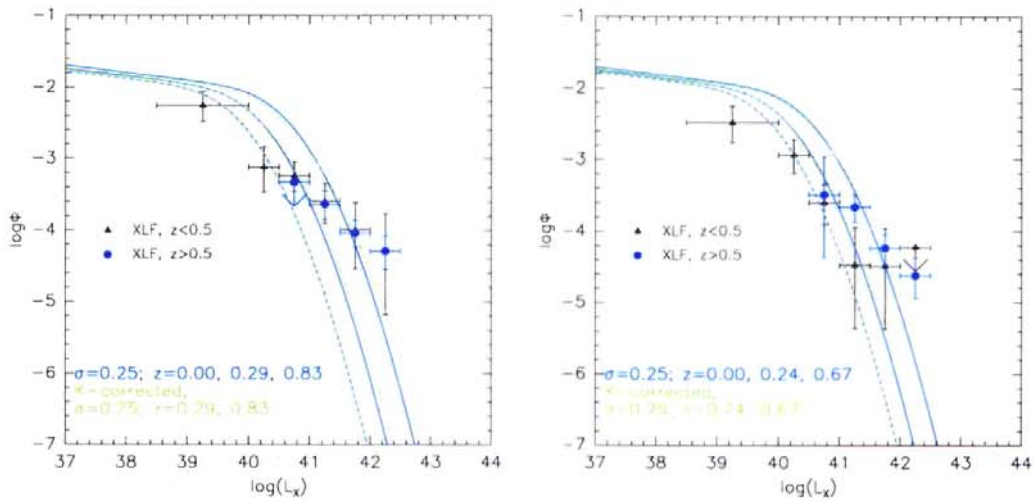
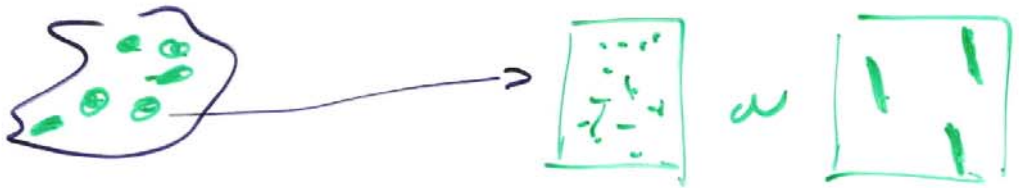


Fig. 2.— Soft X-ray LF derived with galaxies selected spectroscopically from the CDF-N (left) and CDF-S (right).

N, Ptak, Hasinger, Gilli, Rosati, Tozzi, ...

TOP TEN Qs Assoc. with Metallicity in ICM

1. Coarse Graining + Fine Graining



even in $f(P,\gamma)$

→ Cluster, Also = Ions ---
? Multi-phase, mass exchange, diffusion
? Passive scalar - diffuse like smoke
B / metal diffusion / conduct

? Turbulent Mixing
? Blast waves, winds, --

2. Clusters X-ray selected RDCS, Chandra, --

- No evolution → $z \sim 1.3$ $\sigma_8 = 0.8$
  L-T, N(M), ---
- Metallicity $Z \sim 0.3 Z_\odot$ out to $z = 1.3$
  Tozzi et al
- 1252 Rosati et al Chandra/XMM Deep
  $z \sim 1.3$ Fe smoothly distributed over cluster
- Scale groups important
- Metals injected by Massive galaxies (?) α/Fe
  Dwarfs (?)

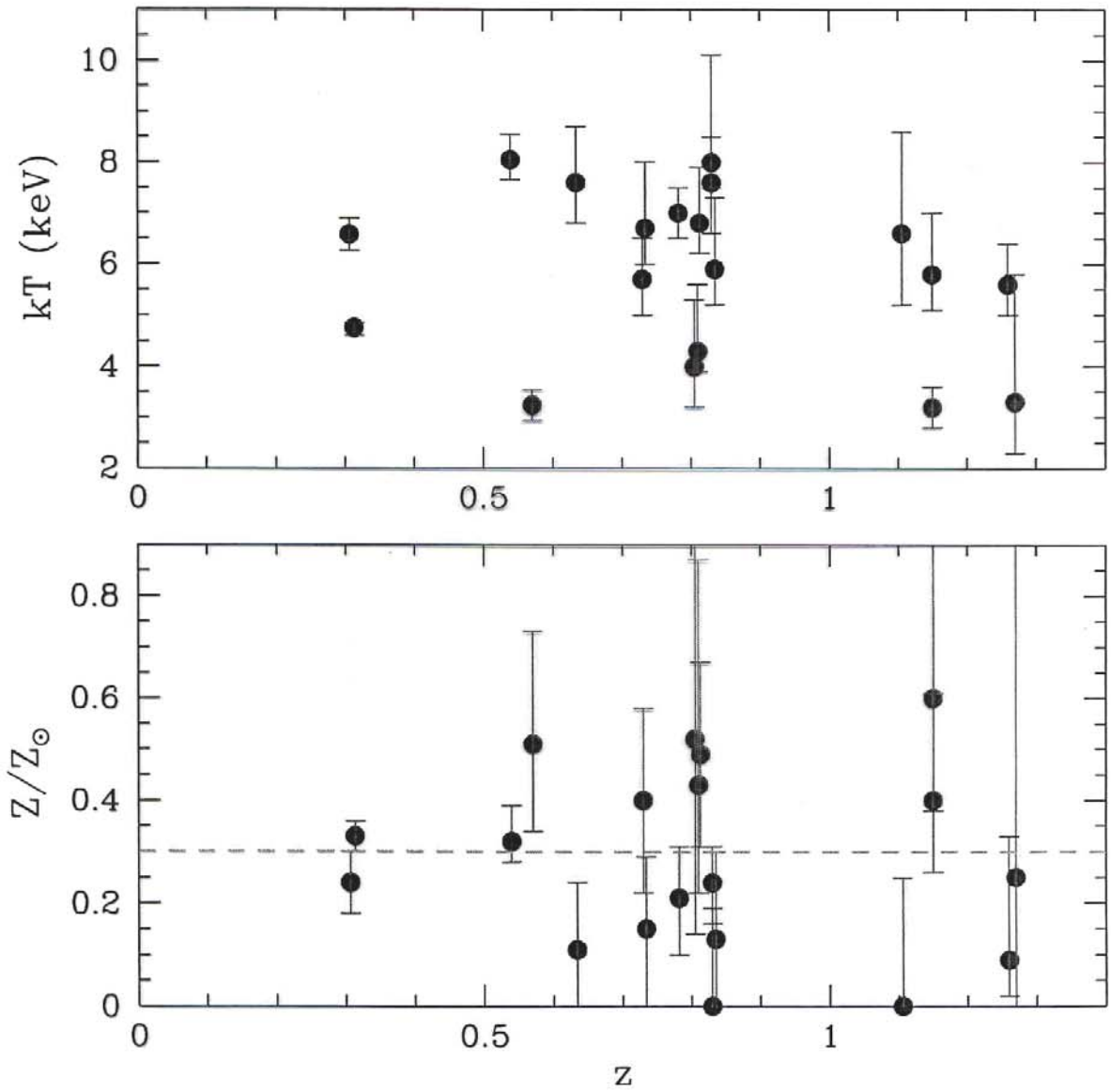


Fig. 1.— Temperature (upper panel) and Fe abundance (lower panel) vs redshift for the 18 clusters in the sample. Error bars refer to 1 σ c.l. computed for one interesting parameters. The metallicity is given in units of the solar Fe abundance as measured by Anders & Grevesse (1989)

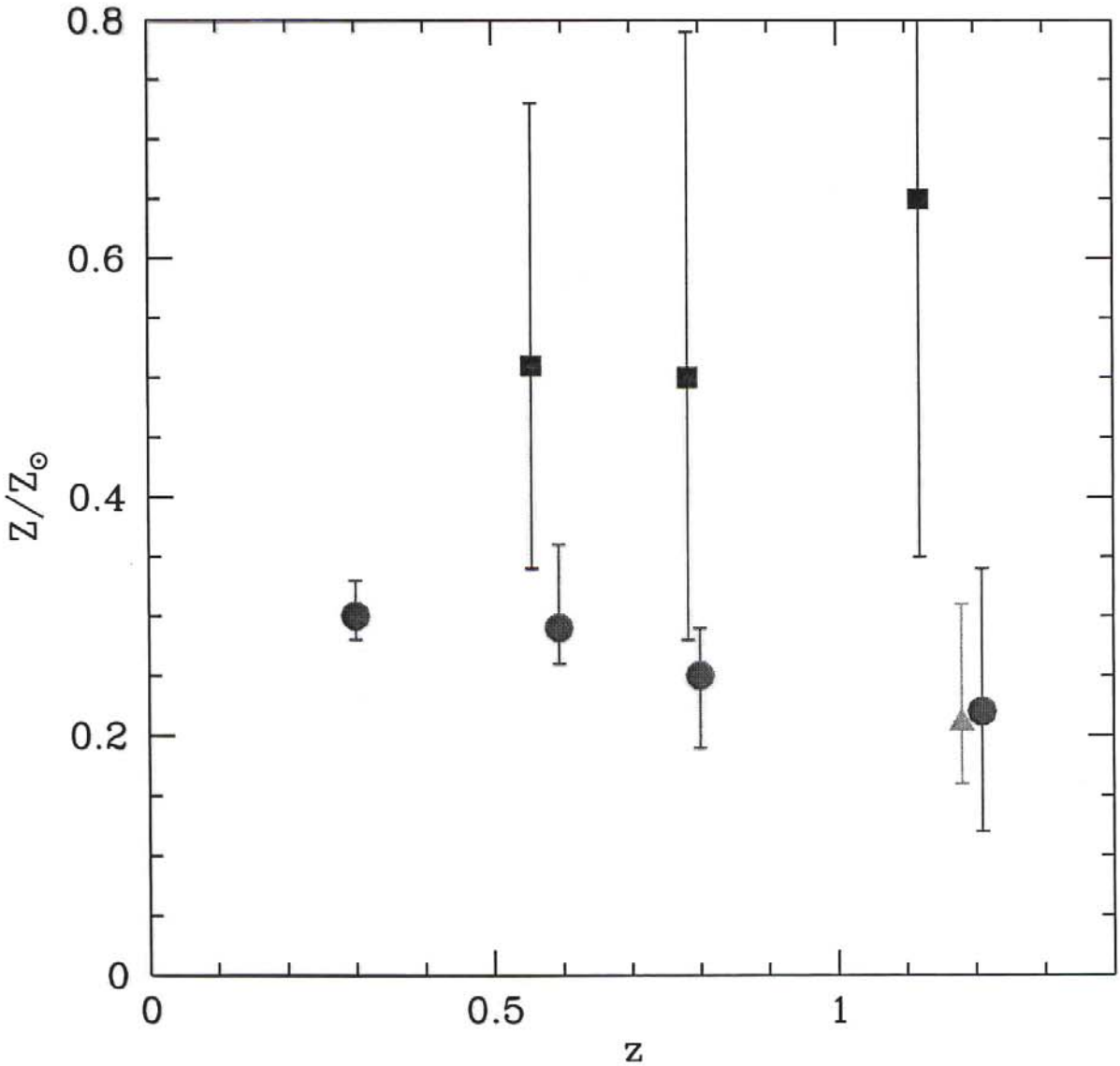


Fig. 5.— Average metallicity as a function of the redshift for the four bins defined in the text, for clusters with $kT > 5$ keV (solid circles) and $kT < 5$ keV (solid squares). For the highest redshift bin ($z \sim 1.2$), we have only an upper bound from the three clusters with $kT > 5$ keV, while we measure the iron abundance only for RXJ1053 ($kT \simeq 4$ keV). The triangle is the combined fit of all the clusters at $z > 1$ irrespective of the temperature. Error bars refer to 1σ c.l.

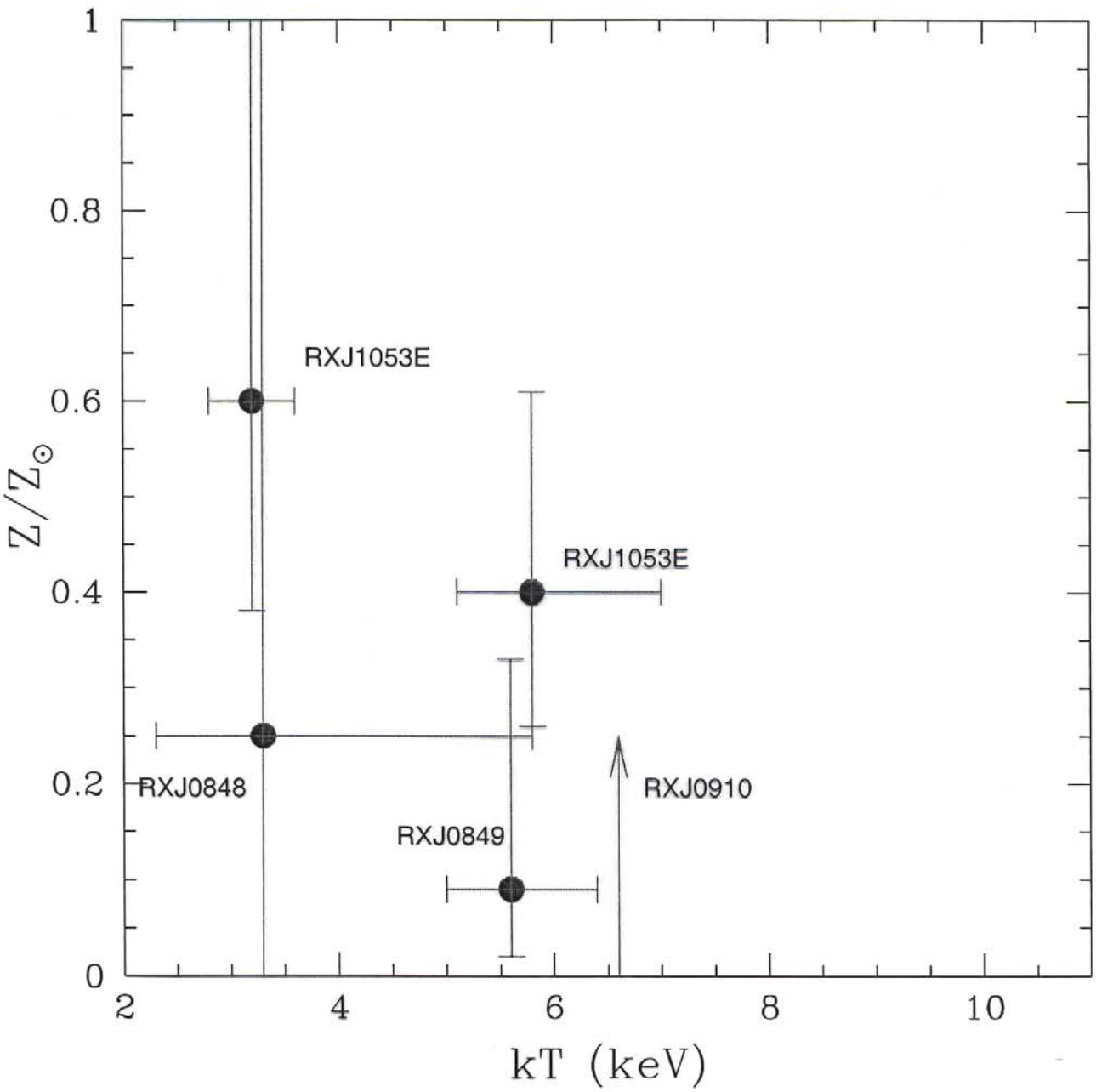


Fig. 4.— Temperature–metallicity plot in the redshift range $1.1 < z < 1.3$ for the 4 clusters observed with Chandra and XMM. We obtain a positive detection of the Fe abundance only for RXJ1053 (observed only with XMM), and upper limits for the other three clusters. Error bars refer to 1σ c.l. for one interesting parameter. The metallicity is given in units of the solar Fe abundance as measured by Anders & Grevesse (1989).

3. Role and Evolution of SNe Ias.
General SN evolution, Fe ↑
Nature of Ias. Precursors, flames?
Time delay parameter $\tau \sim 0.3 \leftrightarrow 3$ Gyr

Enrichment of Fe

2v 1-2,3

Generic high SnIa rate
~~several/yr~~ 10 SNu

Massive clusters (information)
at $z > 1$
SNIa rate > several/yr/massive cluster

→ • Enrichment
• Nature of Ias (τ)
• Calibration of Systematic Errors
dynamics of Λ from Ias.

4. Phase space density in halo.
M31 / M33 / Galaxy.

→ Eggen : Select on kinematics
metals ←
(colour)
History of stream development evolution
fn of age dating by metals
2IC version
Fe/H-W-4 says
II in Es

Metallicity - Morphology. Kinematic
component
"Disks", "Cool" Structures in E's.

* • Bulgeless Disks, Disk/less Bulges.

$\dot{M}_{tot}$ — $\dot{M}_{gas} + \dot{M}_{stars}$ — similar
M33 M31
e.g. e.g.

5. "Secular" evolution: Metallicity, Markers.

Kinematics, component evolution

Tracked by metals α/Fe [Type II, Type Ia]

τ S

Bars, disk heating → bulges, oval distortions, outflows, ---- , infall

→ secular changes in metal, dynamics, --

Disk ↑ bulge v. different rapid, early Bulge

6. Phase transition for ISM fn of metallicity, Z, etc.

DLA's (Wolfe, Prochaska, ~) $10^{-2} Z_\odot$, $z\sim3$

Theory spreads o.N. $10^{-1} Z_\odot$ $z\sim1$

Depends on J

Change mode of Star Formation → Massive Stars (today style)

Need Z ↑ for mol clouds to cool, shield + form. But [Dust!]

Multi phase turbulent calculations

Gerhard et al

Wada + M. --

Quite different behaviour of cold phase as fun of $n, \sigma, \ldots, z \ldots$

7. Fossil History in Gal.

Fe/H "floor" $\sim 10^{-4}$

2 * Fe/H $\sim 10^{-5.3}, 5.5$

- Qian & Wasserburg (2002)
- Norris ...
- Hegen + Woosley (2003)

early enrichment

not yet understood

effects of ISM.

see Figures

Metallicity History of U

z

10-20 Reionization

First stars

$Z \sim 10^{-5}$, 100 $M_\odot$ | γ phase transition

$Z \sim 10^{-4}$, 1 $M_\odot$

First gals, QSOs, BHs, --- GRBs + Hypernovae!

6 SNe II ↓ r process

Dwarf enrichment ↓

4 AGB s process ↓

3 LBG, wide F/BS

2 QSOs, DLAs, ... Old Red massive gals + place.

SNe Ias ↓

L.E.? 1.5 Gyr

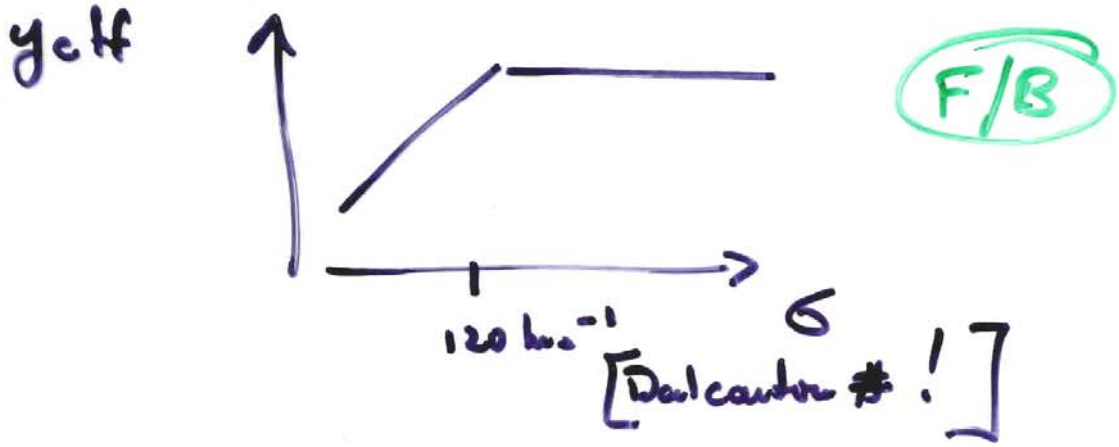
1 Clusters with Fe Kol → $Z \sim 0.3\ Z_\odot$

6.4 ⊙

Sloan. Environment studies, no dependence

0 Fossil Record, Stellar Pops

8. Garnett Diagram



? winds out flow [former]

? Change in ISM [Wada + N. 2004]

? Change in SF efficiency

Mitch: Positive F/B vs Negative F/B

Joe:

Looking is Better than Simulating

C. Martin $\dot{M}_w$, v_w, T_v diagram

F/B flow

*hunt

NGC 1569

```
<< Graphics`Graphics`
```

Mass fraction of dense gas for Log-Normal PDF

3-D plot of the mass fraction (rho > 10^5) as a function of average density and dispersion of the PDF

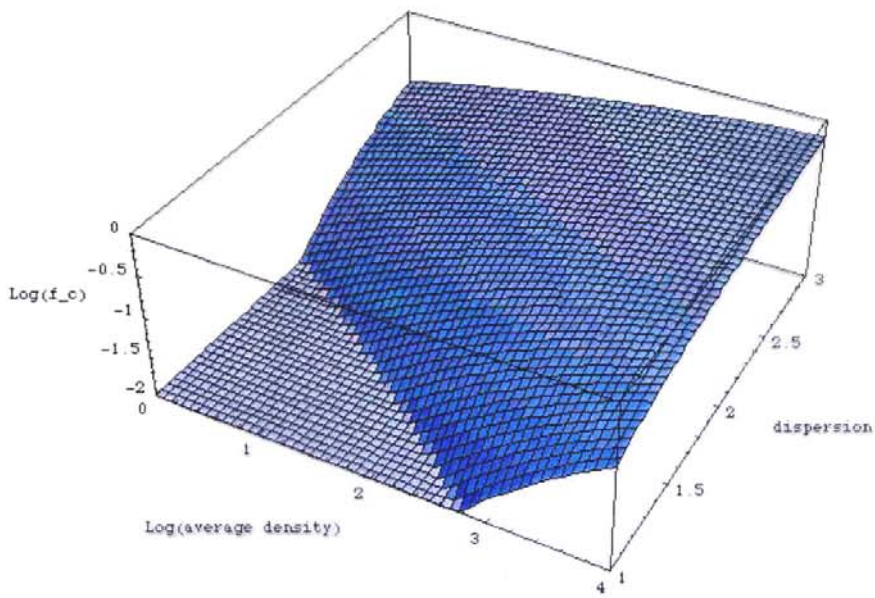
In[330]:=

$$z[ra\_, rc\_, s\_] := \frac{\text{Log}[rc / ra] - s^2/2}{2\, s\, \sqrt{2}}$$

ra : averange density, rc : core density, s : dispersion

In[337]:=

```
Plot3D[Log[10, (1 - Erf[z[10^b, 10^5, s]])/2], {b, 0, 4}, {s, 1, 3}, PlotPoints → 50, PlotRange → {-2, 0},
 AxesLabel → {"Log(average density)", "dispersion", "Log(f_c)"}]
```



Out[337]=

```
- SurfaceGraphics -
```

Contour plot of the mass fraction (rho > 10^5)

9. Enrichment History of IGM

CIV few δ

little evolution

CIV, Si, --- DLAs $z \sim 2-4$

"Patchy" HeII underground in Lyα forest

Where are all metals? + when? + how?

In galaxies

$\sim$

IGM - which phase

- Warm phase OVI
- Collisional ~ photoionized

10. IMF

Need parameter space sensitivity

Why get not 2's if IMF main issue?

? get 1 z — Orion or Taurus-Burnham? w Eaton and Graham... or other methods?

⇒ MCMC analysis
Bayesian priors

c.f. CMB

perhaps, more precise + robust statements, even humbler

Could vary strongly (choose) "top heavy" etc.

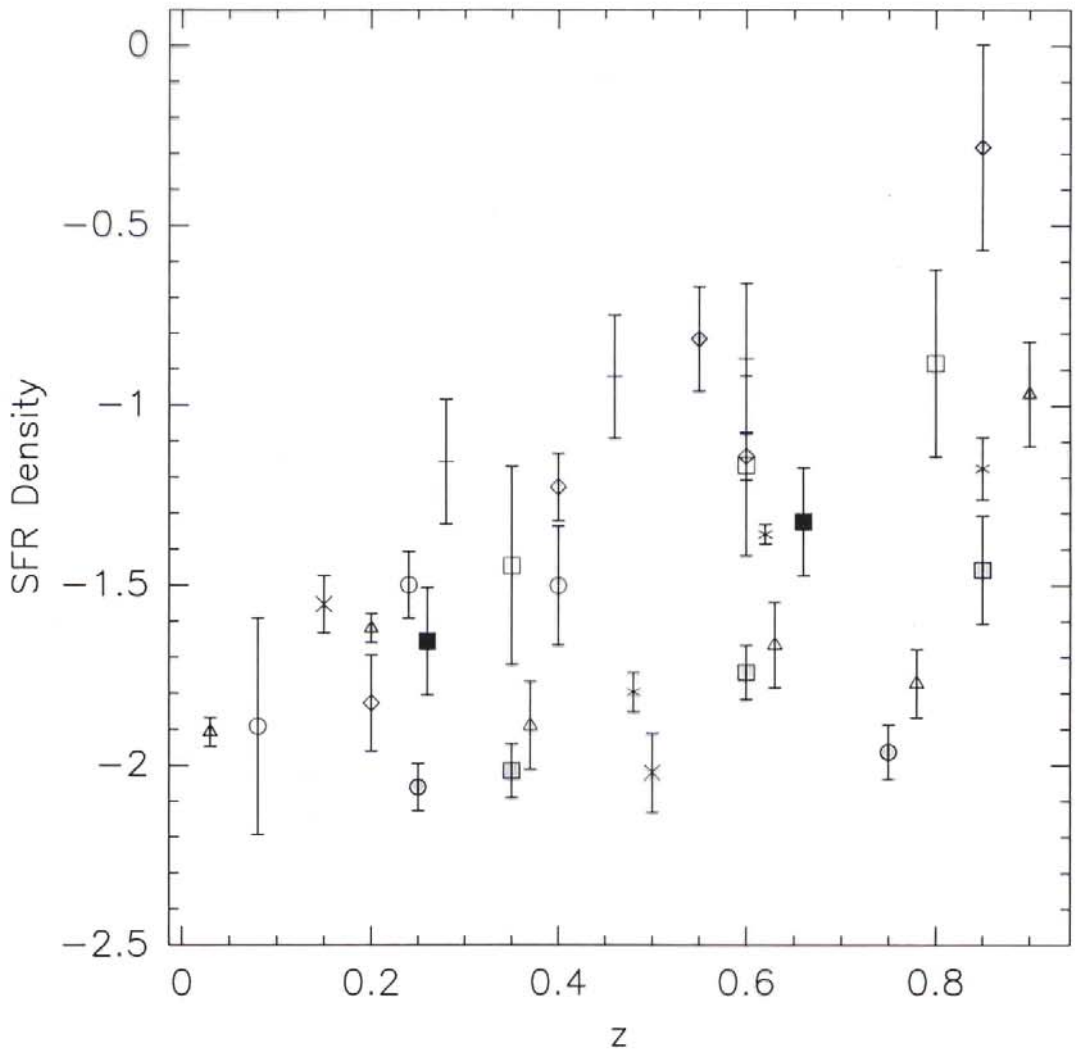


Fig. 7.— Compilation of SFR densities from Hogg (2003), including the X-ray points for z=0.25 and z=0.75 from this work. The X-ray points are shown with black filled boxes. Refs.: grey filled boxes: Lilly et al. (1996); asterisks: Hammer et al. (1997); grey filled diamonds: Rowan-Robinson et al. (1997); diamonds: Hogg et al. (1998); triangles: Cowie et al. (1999); squares: Flores et al. (1999); crosses: Mobasher et al. (1999); pluses: Haarsma et al. (2000); circles: Jones & Bland-Hawthorn (2001); grey filled circles: Lanzetta et al. (2002); grey filled triangles: combined Hα sample (see Hogg 2003).