Crowding (and Edge) Factors in the MOS design

(2nd draft,v1, S. Arribas, 30-June-99)

1 Introduction

The aim of this document is to make a first attempt at quantifying the crowding (and edge) factors which impose an upper limit on the maximum number of galaxies that can be simultaneously observed with a MOS design.

This is an internal document for discussion within the ESA NGST-SST and IFS-MOS trade-off study team.

2 The problem

If galaxies are relatively close together, they cannot be simultaneously observed with the MOS design as their spectra overlap. This problem is skematically shown in figure 1. Note that in IFS this problem never occurs as the spectra are better ordered on the detector.

The fraction of galaxies whose spectra overlap in a MOS design will depend on:

1.1) The galaxy density (number counts)

1.2) The galaxy size (slit length/spectra width)

1.3) The spectra length

In addition, according to the MOS design, a galaxy close to the edge of the FOV will have part of its spectrum outside the detector. This basically depends on:

2.1) The detector size

2.2) Spectrum length (and width)

3 The Method and data sources

The calculations were done generating galaxies at random positions, with the observed densities (number counts) and sizes, and analysing the conflicts on the detector. The code maximizes the number of galaxies which can be simultaneously observed.

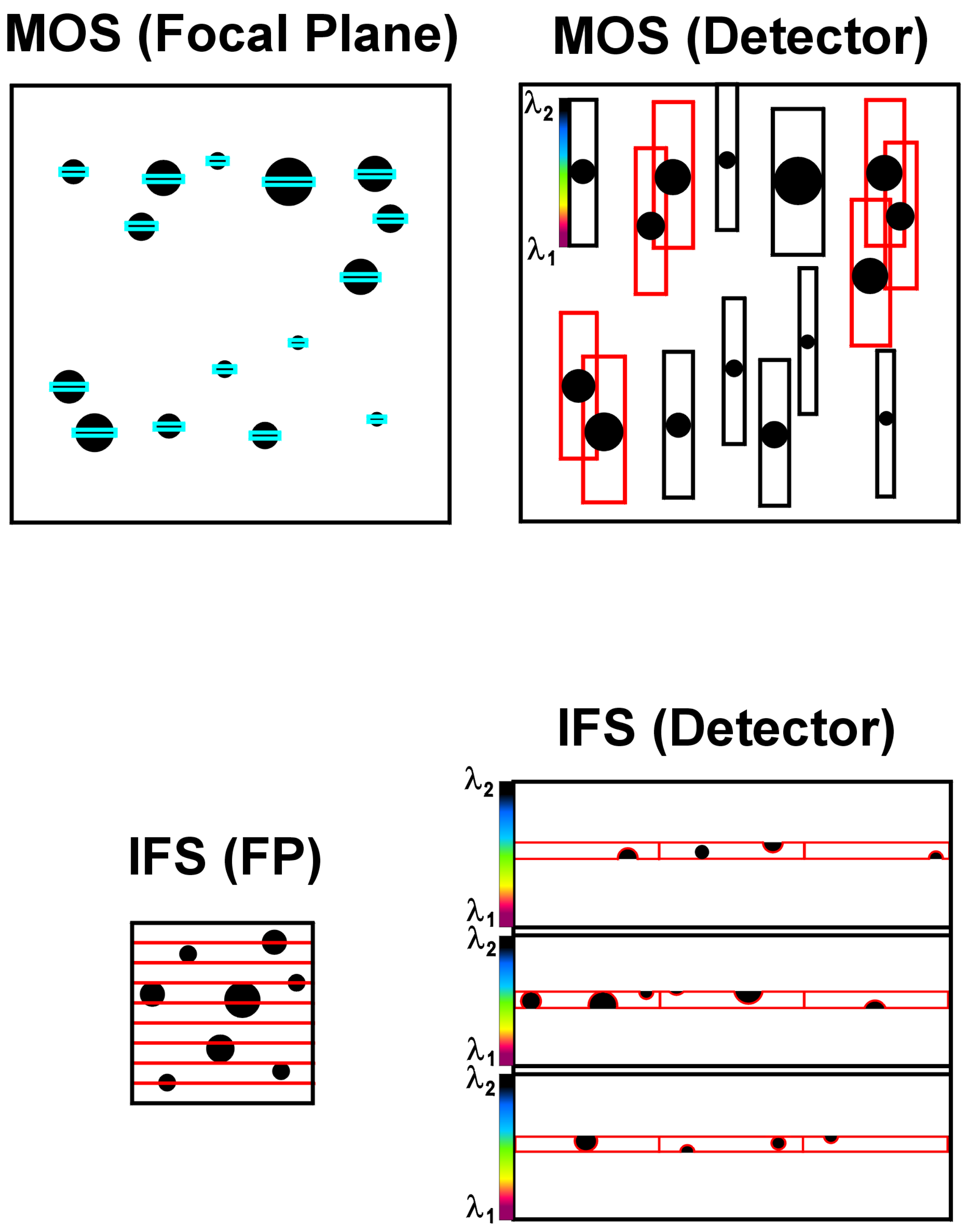

Figure 1: Ilustration of how some some spectra overlap in the MOS design. This type of problem never ocurrs in the IFS.

The basic information used follows:

1.1) Density of galaxies:

Bershady et al. (ApJ, 505, 50, 1998; Keck for K < 23)
Thompson et al. (AJ, 117, 17, 1999; NICMOS-HDF for $H_{AB} < 28.8$)
HDF-S at http://www.stsci.edu/ftp/science/hdfsouth/catalogs.html

These number counts were corrected for completeness according to Thompson et al. Note that for some programs with a large rate of clustering these average values may understimate the actual densities.

1.2) Galaxy sizes :

Yan et al. (ApJ, 503, L19, 1998; HST-parallel for H < 24.5)
Thompson et al (AJ, 117, 17, 1999; NICMOS-HDF for $H_{AB} < 28.8$)

Two values for the slit length were taken: 4 x $r_{1/2}$, and 6 x $r_{1/2}$

1.3) Spectra length

The spectrum is considered to be 222 pixels long. This is the spectrum length for the IFS-LR mode (=2K/9).

2.1) Detector size

4K x 4K

Results and comments

Figure 2 (top). Fraction of galaxies below a certain K_{AB} magnitude (discontinuous line) and per unit of magnitude (continuous line) which can be simultaneously observed are presented for a slit length of 4 x $r_{1/2}$.

Figure 2 (bottom). Same as Figure 2 (top) for a slit length of 6 x $r_{1/2}$.

Note that the lines are somewhat wavy due to statistical errors.

These curves include the edge factors which amount to $\sim$ 5.5 per cent.

Although the cumulative case may seem meanless here, it should be taken into account that <u>the IFS always works in cumulative mode</u>.

Note that these results correspond to mean densities and mean sizes at a given magnitude. For specific programs these values can be rather different.

(Please, send any comments to Santiago Arribas at sam@ll.iac.es)

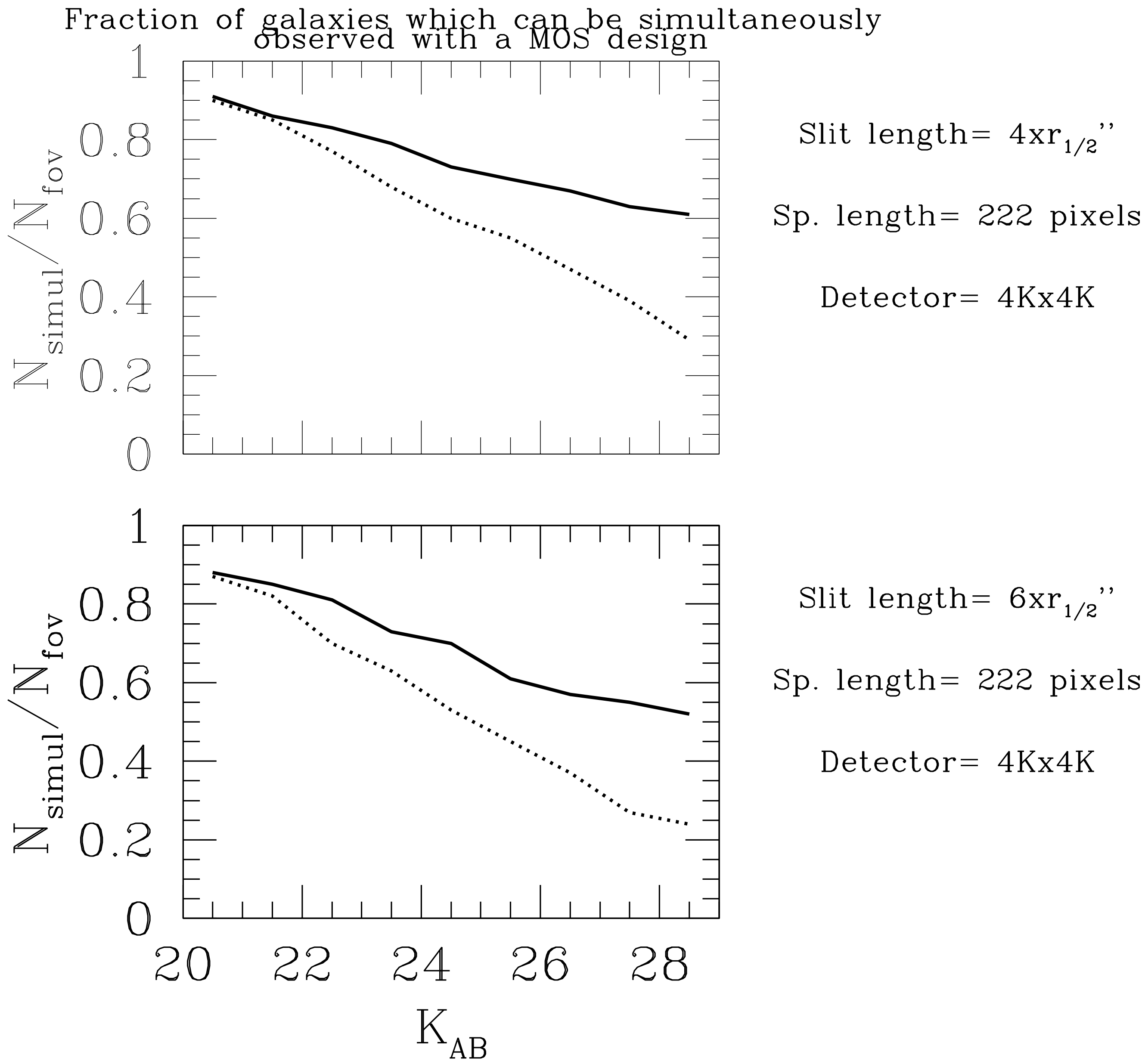

Figure 2: Fraction of galaxies that can be simultaneously observed with a MOS design (top: for a slit length of 4 x $r_{1/2}$: bottom: for a slit length of 6 x $r_{1/2}$. For the continuum line N represents the number of galaxies per unit of magnitude. The discontinous line represents the cumulative case (i.e. N is the number of galaxies below a given magnitude)