Dear all,

I too have been thinking about the contrast problem recently and agree wholeheartedly with Jeremy's formulation of the basic problem:

At R=1000, one octave of spectrum projects to a solid angle of about 5E-6 square degrees on the sky. Hence at a surrounding surface density of 2E4 objects per square degree there is a 10% chance that the spectrum of a given target object will somewhere be superposed by the leaked attenuated spectrum of an adjacent object somewhere outside the slit.

Based on sources of K-band counts from the literature (different from those quoted by Jeremy), I too find that the critical density of 2E4 objects per square degree is reached at K_AB~20-21 at high (b>30) galactic latitudes (stars and galaxies) and at K_AB~16 near the galactic plane (stars only).

This is all in near-perfect agreement with Jeremy's findings.

Where I don't entirely agree with Jeremy, however, is in how he derives the corresponding requirement on the contrast.

There is a fundamental difference w.r.t. the MacKenty/Regan analysis of the other aspect of the problem, the suppression of the "undispered" but attenuated extra background light. In the latter case, the contaminating additional background component floods the detector in a uniform manner and can along with the other background sources be measured in a given exposure and accurately subtracted from the source spectrum. Hence as analyzed by Mike Regan, the key consideration in this case is indeed the net loss in S/N given the expected magnitude of the other sources of detector noise.

However, for the more serious problem of overlapping leaked spectra from adjacent bright objects outside the slit, the contamination affecting a given target spectrum is localized in nature and can generally speaking not be measured in the image and can therefore not be disentangled from the source spectrum in any amount of exposure time - regardless of the detector and sky background. The key consideration here is therefore to suppress the unwanted contaminating signal to a level well below the signal from the faintest sources that one wishes to observe.

The DRM proposal driving the NIRSPEC science and design in the high galactic case is Simon Lilly's notorious DRM 7 which aims to obtain R=1000 spectra of thousands of high redshift galaxies down to K_AB=27.

Hence if we formulate the contrast requirement to state that we want
less than 10% of our faintest source spectra to be contaminated by a spurious overlapping spectrum exceeding 10% of the source signal itself, the inferred contrast requirement using the critical source count numbers from above is: \( \sim 27 - 20 + 2.5 = 9.5 \) mag - equivalent to a contrast of at least 6000.

I do not agree with Jeremy, however, that this required contrast comes on top of that required to suppress the extra background (although this is indeed true in Jeremy's way of looking at things).

Nonetheless, it would seem clear to me that the contrast requirement even in the "best" high galactic latitude case is of order 10000 or better.

In fact, by my reckoning, the situation in the low galactic case is even more dire than presented by Jeremy - given that the galactic science needs to go every bit as faint as the extragalactic science does (Mike Meyer's DRM 16 to the explore the sub-stellar extension of the initial mass function in clusters is a poignant case in point).

Hence in this case the required contrast per the same criteria as above rises to: \( \sim 27 - 16 + 2.5 = 13.5 \) mag, equivalent to a contrast as high as 250000.

So in summary, I really can't see how we can possibly back off from an absolute rock-bottom requirement of 10000 for the contrast without completely jeopardizing the NGST science case as specified in the DRM - with an aperture mask more transparent that this we might as well go slitless ;-).

I look forward to discussing these issues with you all next week in Toulouse.

Regards,

-pj