# Note on technology for SPIRE dichroics and filters

**Matt Griffin**
**3 December 1998**

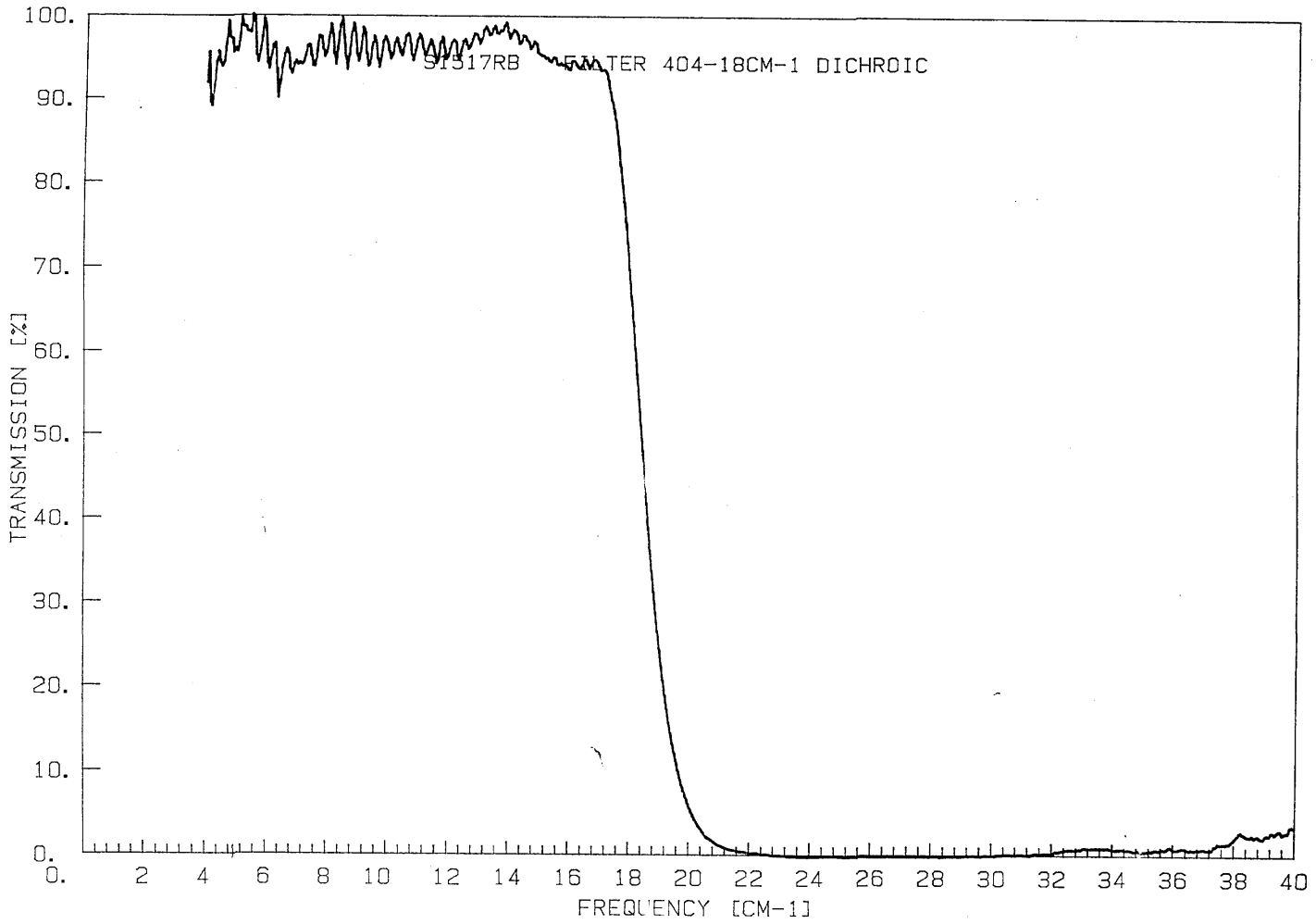
This note is in response to an action (SPIRE-STP-2) still open from the FIRST proposal evaluation.

The QMW group, which will provide the filters, dichroics and polarisers for SPIRE has capabilities to make such components in the 50 μm - 3 mm region. These devices can be operated at helium temperature and cycled repeatedly from low temperature to 300 K. Components have been flown on a number of space instruments (including the ISO LWS, Cassini CIRS and Mars 96), and have been used in many ground-based instrument, including SCUBA.

The technology uses evaporated metal mesh structures (0.1 μm thick) supported on very thin (1-4 μm) Mylar or Polypropylene substrates. This has the advantage that any 2-D mesh pattern can be made using standard photolithographic facilities. Three basic mesh types are used: an inductive grid comprising of a regular 2-D array of square holes, a capacitative grid comprising a regular array of metallic squares and a resonant grid which is made both capacitative and inductive by joining the squares on all four sides with thin metal strips. These patterns can be used to make either low pass (capacitative type), high pass (inductive type filter) or a bandpass (resonant type) filters. Furthermore, by using a specially developed transmission line model based on the geometrical parameters of these mesh types, the spectral response of plane parallel stacks of these meshes can be accurately modelled. A simple geometric scaling of mesh and spacer parameters allows for the precise positioning of the spectral edge or bandpass. Using these techniques, and high quality chrome-on-glass masters to provide the basic mesh patterns, band-pass, low pass and high pass filters and dichroics can be fabricated. The agreement between theory and experiment is excellent, allowing mesh geometry requirements and mesh spacing to be accurately predicted before manufacture.

The diagram shows the response profile of the SCUBA dichroic which has an edge at 18 $cm^{-1}$ (550 μm). Similar performance is envisaged for the SPIRE dichroics.

The traditional design supports the meshes with the precise spacings by using accurate spacer rings and a rigid outer support ring. Improved filter manufacture techniques employing self-supporting filters and dichroics with metal mesh grids embedded in polypropylene are now being developed and will be used in SPIRE if the performance is equivalent. These will have similar performance characteristics but will not require the rigid support rings and so will be lighter and smaller for a given clear aperture.


91517RB FILTER 404-18CM-1 DICHROIC
TRANSMISSION [%]
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
0. 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
FREQUENCY [CM-1]