FABRY-PEROT SPECTROGRAPHS FOR VLT's

Guy Monnet
Observatoire de Lyon
F-69230 Saint Genis Laval

Four Reasons are advocated to stress the interest of Fabry-Perot Spectrographs (F.P.S.) as potentially useful instruments for the future Very Large Telescopes :

- Reasonably wide spectrum of Astronomical uses
- Good use of Telescope area
- Relative cheapness
- Versatility

1- Astronomical Field

The first F.P.S. was built and used by Buisson et al. 1914 on various emission lines in the Orion nebula. The concept, however, was then praticaly brought to a standstill, until 1951, with its rediscovery by Courtès, under the tradename "Focal Reducer". It was then extensively used especially, by Courtès and its group at the Observatoire de Marseille, to study emission lines in a large number of Galactic HII regions. Thanks to technological advances, the F.P.S. domain was then extended :

- to large Nearby Galaxies (Courtès et al. 1967), owing to more stable etalons (using molecular contact spacers).
- to all d <10 Mpc late type galaxies (De Vaucouleurs and Pence 1973 GALAXYMETER), thanks to Image Tube detectors and to the systematic use of multiexposures, with a displacement of the object, relative to the Fabry-Perot rings between two successive exposures.
- to virtually any extended or point-like emission region, irrespective of its distance, with the use of Fabry-Perot scanning, coupled to a two dimensionnal detector.

The concept is due to Tully 1974, who used a somewhat primitive version with an Image Tube detector, for a comprehensive study of Messier 51. The present day working models are the Taylor and Atherton 1979 TAURUS, the Boulesteix et al 1981 CIGALE - both with 2D photon counting detectors- and the Roesler et al 1981 F.P.S. which uses a CCD.

These modern F.P.S. are the most efficient Instruments to measure 2D radial velocity fields and line ratios in Emission regions : Classical HII regions - Supernovae remnants and Shell Nebulae - Nuclear and Extended emissions - Planetary Nebulae - etc... They have been until now restricted

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to the visible range, but will probably soon enter in the Infrared domain, with the advent of 2D Infrared Detectors up to approximately 20μ.

However it must be stressed that preliminary data, with Long Slit Spectrographs, are usually required, prior to Fabry-Perot work : the radial velocity range inside the object must be (roughly) khnwn, for a proper choice of the Interference filter and of the etalon order.

The Use of F.P.S. have been so far restricted to emission regions only, but there is probably no basic reason that prevent their use for extended absorption regions - i.e. to study 2D radial velocity fields from selected absorption lines in galaxies. This could well be mastered well in time for the first V.L.T.

2- Performances

- Large 2D field,1' x 1' of arc for a 18 m. Telescope. This is 500 times larger than the typical field of a Long Slit Spectrograph.
- High Sensitivity.

Typical Values for a 1" of arc region are :
Emission Measure = 10 cm $^{-6}$ pc, with a Signal/Noise = 8 in 6 Hours with a 3.6 m. Telescope.
This scales as the Mirror area d^2, which lends to a S/N ∿8 in 15 min. with a 18 m. VLT.
The gain will be much larger than d^2, if the V.L.T. gets subarcsecond imaging capability.
F.P.S. coupled to a V.L.T. will thus give access to (at least) a huge number of emission regions, in a reasonable time. The sensitivity, attained is much larger than that of Radio Telescopes on recombination lines (and even on thermal continuum sources).

3- Cost

F.P.S. are basically scale invariants, as one particular instrument can well be used with a Telescope of any size (from 6 mm. to 5 m. in the author's experience). The etalon diameter can usually be limited to reasonable values ∿50 mm. - Moreover F.P.S. are much less sensitive to flexures than grating Spectrographs, as only the etalon - detector connection must be accurately maintained during the exposure.

The actual cost (without the detector) mainly depends on the degree of automation - which must be rather complete for a Large Telescope - but is at most ∿ 60,000 1984 $.

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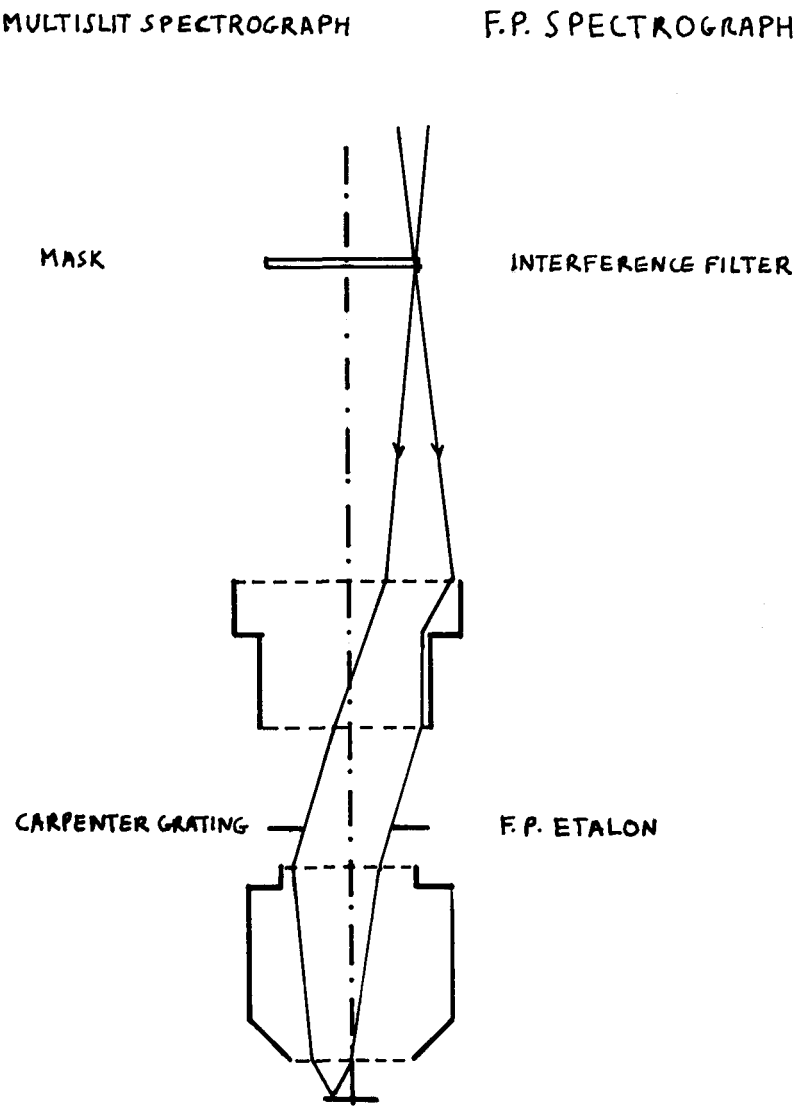
4- Versatility

The focal Reducer concept (see fig.), readily lends itself to many other uses. The most important are :

- Monochromatic or Wide Band Imagery, obtained simply by taking away the etalon.

- MultiSlit Spectroscopy, through the insertion of a (direct vision) Carpenter grating in the pupil plane in lieu of the etalon, and of a mask in the focal plane to select the objects.

This is illustrated in the poster presented by Fort et al., who have recently obtained simultaneously the spectra of > 40 stellar objects in the 6' of arc field of the C.F.H. focal reducer.



https://doi.org/10.1017/S0252921100108619 Published online by Cambridge University Press

REFERENCES

Boulesteix, J., Georgelin, Y., Marcelin, M. and Fort, J., 1981, IAU Colloquium n° 67, Zelenchuk, Ed. Reidel, p. 223.

Buisson, H., Fabry, Ch. and Bourget, H., 1914, Astrophys. J. 40, 241.

Carranza, G., Courtès, G., Georgelin, Y., Monnet G., Pourcelot, A. and Astier, N., 1968, Ann. Astrophys. 31, 63.

Roesler, F., Oliversen, R., Scherb, F., Lattis, J., Williams, T., York, D., Jenkins, E., Lowrance, J., Zucchino, P., and Long, D., 1982, Astrophys. J. 259, 900.

Taylor, K. and Atherton, P., 1980, Mon. Not. R. astr. Soc. 191, 675.

Tully, R., 1974, Astrophys. J. Suppl. Ser. n° 251, 27, 415.

Vaucouleurs, G. and A. de, and Pence, W., 1974, Astrophys. J. Lett. 194, L 119.