High resolution monochromator for synchrotron radiation based on flat VLS-gratings

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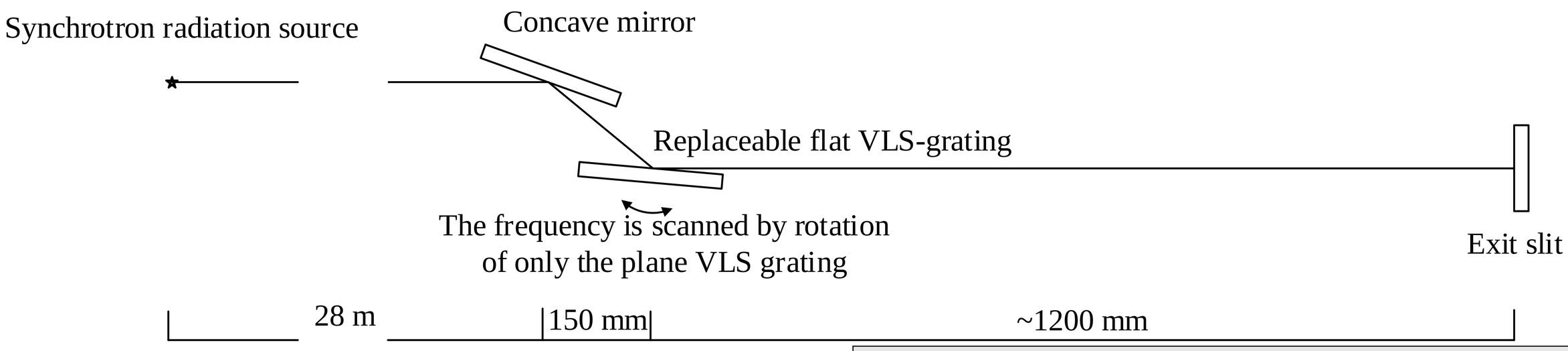

We present the design of a high-resolution plane-VLS-grating soft X-ray and VUV monochromator of synchrotron radiation for the 125 – 4200 Å spectral range.

Geometric features of the scheme:

- Source to Optic elements distance – 28 m
- Optic elements should set compact
- Optic elements to exit slit distance – 1200 mm

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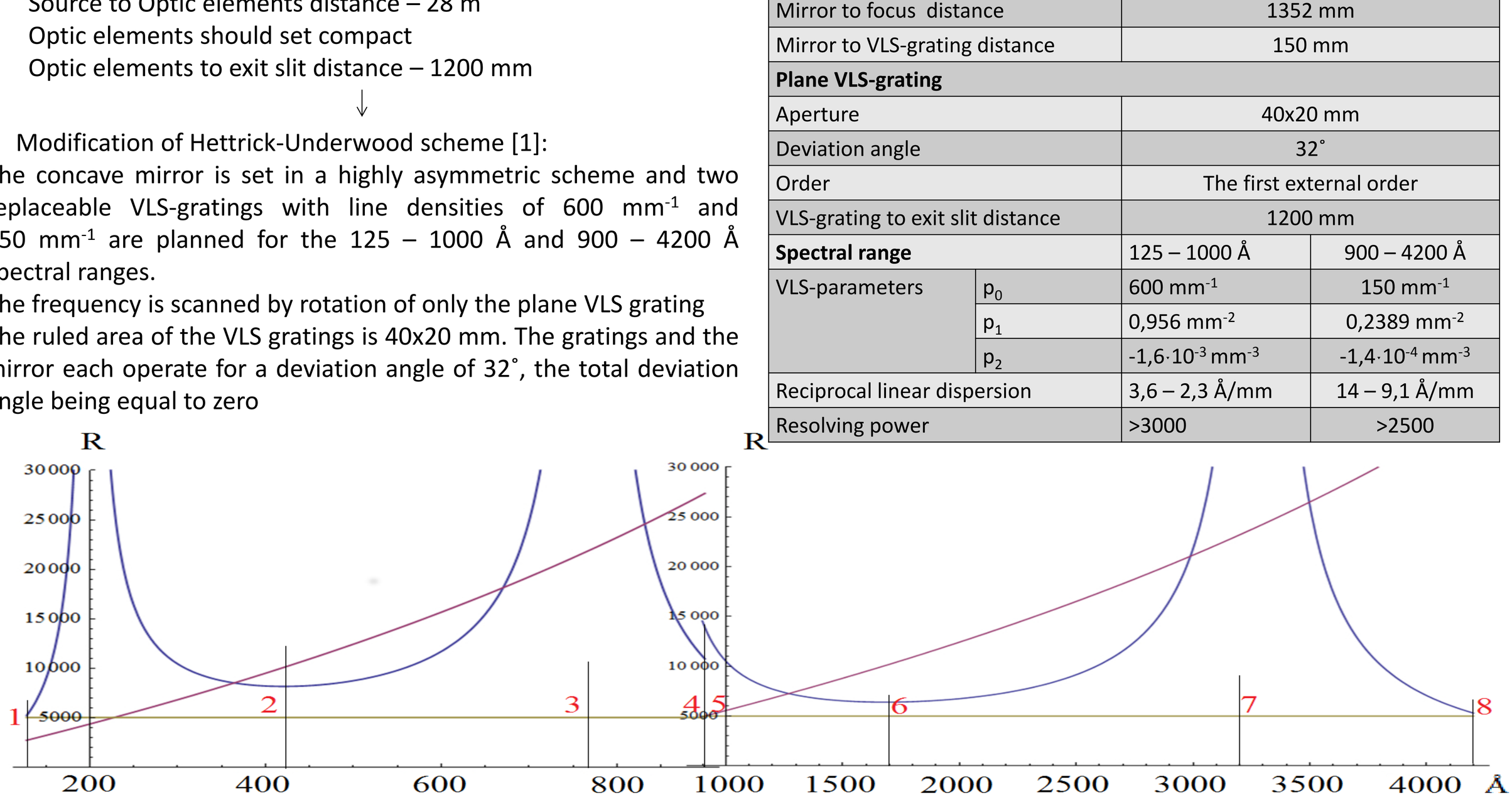
Modification of Hettrick-Underwood scheme [1]:

The concave mirror is set in a highly asymmetric scheme and two replaceable VLS-gratings with line densities of 600 mm^{-1} and 150 mm^{-1} are planned for the 125 – 1000 Å and 900 – 4200 Å spectral ranges.

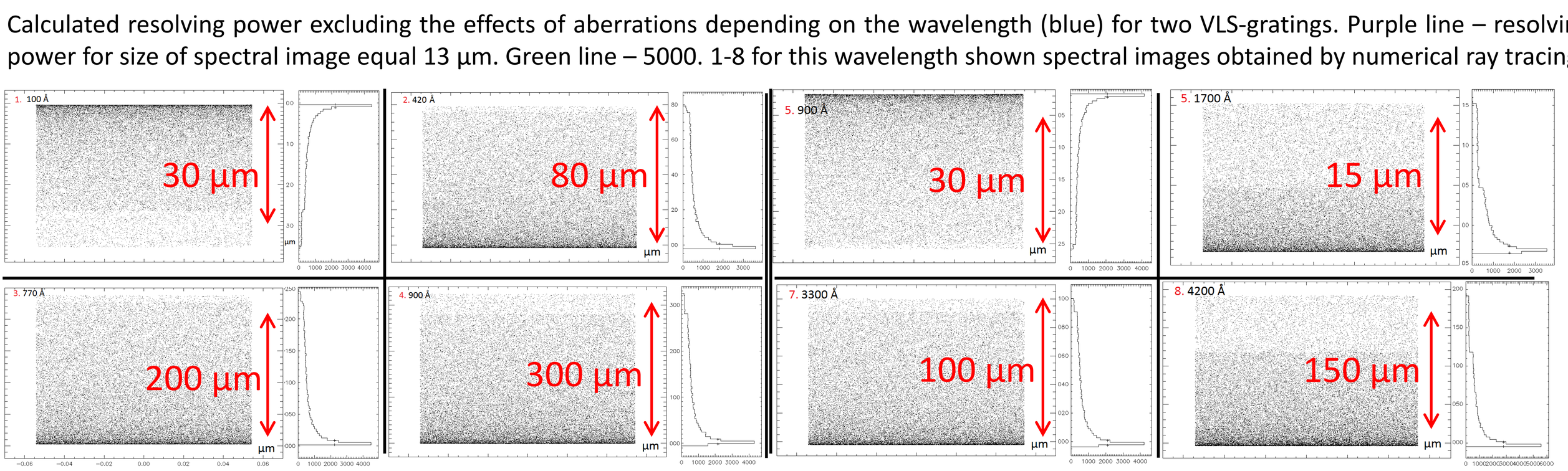
The frequency is scanned by rotation of only the plane VLS grating

The ruled area of the VLS gratings is 40x20 mm. The gratings and the mirror each operate for a deviation angle of 32˚, the total deviation angle being equal to zero

Concave mirror			
Curvature		9356 mm	
Aperture		D=50 mm	
Angle of incidence		74 ˚	
Source to mirror distance		28000 mm	
Mirror to focus distance		1352 mm	
Mirror to VLS-grating distance		150 mm	
Plane VLS-grating			
Aperture		40x20 mm	
Deviation angle		32˚	
Order		The first external order	
VLS-grating to exit slit distance		1200 mm	
Spectral range		125 – 1000 Å	900 – 4200 Å
VLS-parameters	p_0	600 mm^{-1}	150 mm^{-1}
	p_1	0,956 mm^{-2}	0,2389 mm^{-2}
	p_2	$-1{,}6\cdot10^{-3}$ mm^{-3}	$-1{,}4\cdot10^{-4}$ mm^{-3}
Reciprocal linear dispersion		3,6 – 2,3 Å/mm	14 – 9,1 Å/mm
Resolving power		>3000	>2500



Calculated resolving power excluding the effects of aberrations depending on the wavelength (blue) for two VLS-gratings. Purple line – resolving power for size of spectral image equal 13 µm. Green line – 5000. 1-8 for this wavelength shown spectral images obtained by numerical ray tracing.



[1] Hettrick, M. C., Underwood, J. H., Batson, P. J., & Eckart, M. J. (1988). Resolving power of 35,000 (5 mA) in the extreme ultraviolet employing a grazing incidence spectrometer. *Applied optics*, *27*(2), 200-202.

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