

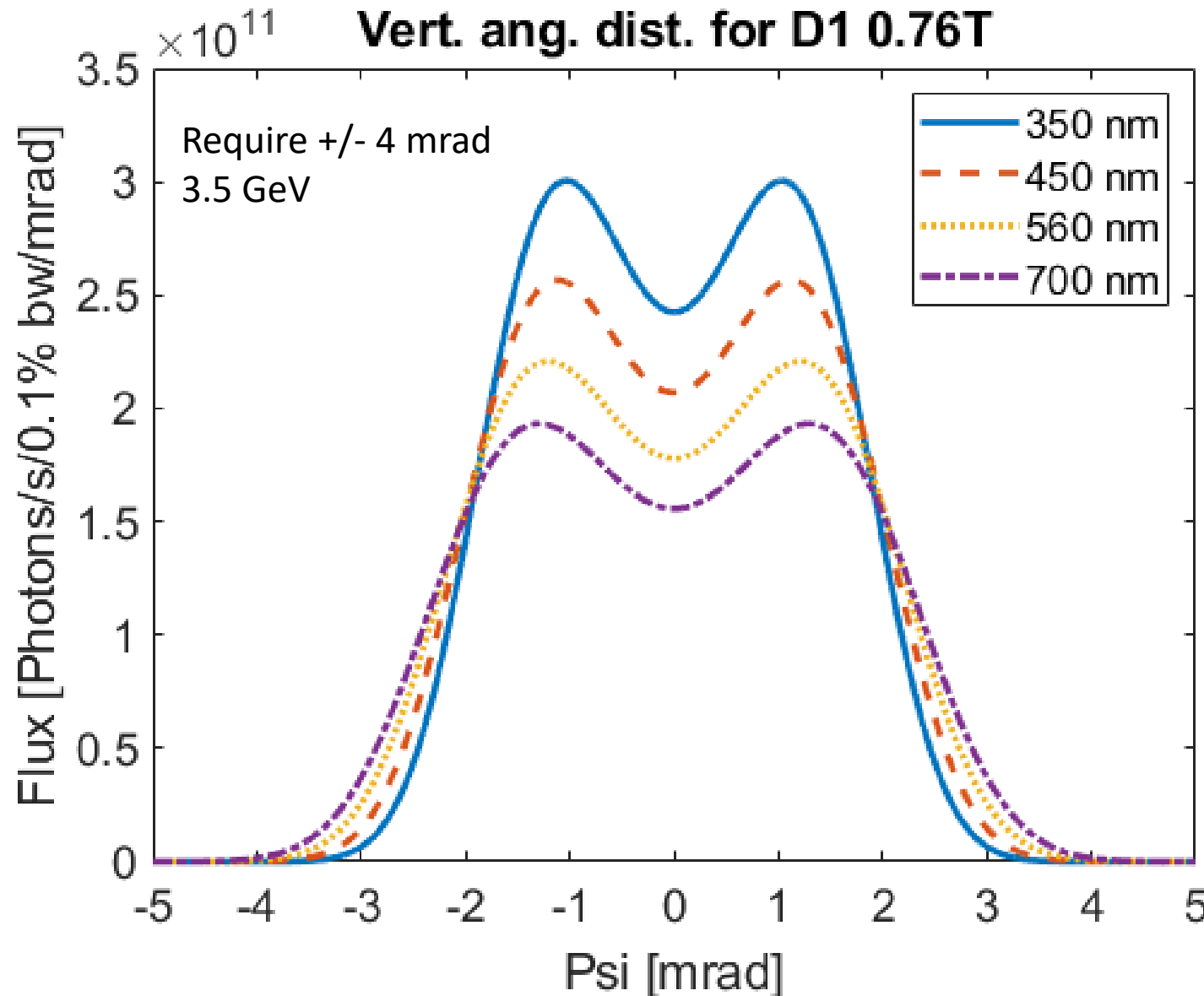
Diamond-II: Visible Light Extraction

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Diagnostics Group

Requirements

- Extract both upper and lower lobes of synchrotron radiation from dipole sourcepoint.
- Wavelength range: UV (<300nm) – visible (700 nm)
- Propagate from sourcepoint, through shield wall to optics lab (B01 cabin) with at least 1 chicane
- Maintain wavefront quality
 - Shortest path length
 - As few folding mirrors as possible
- Provide suitable beam for diagnostics systems:
 - Streak camera
 - Fill pattern monitor
 - Pi-pol or interferometer

Spectral - Angular Distribution



NB:

Require a slightly larger vertical acceptance to prevent diffraction from clipping.

XOP

<http://www.esrf.eu/Instrumentation/software/data-analysis/xop2.4>

Extraction Mirror Options

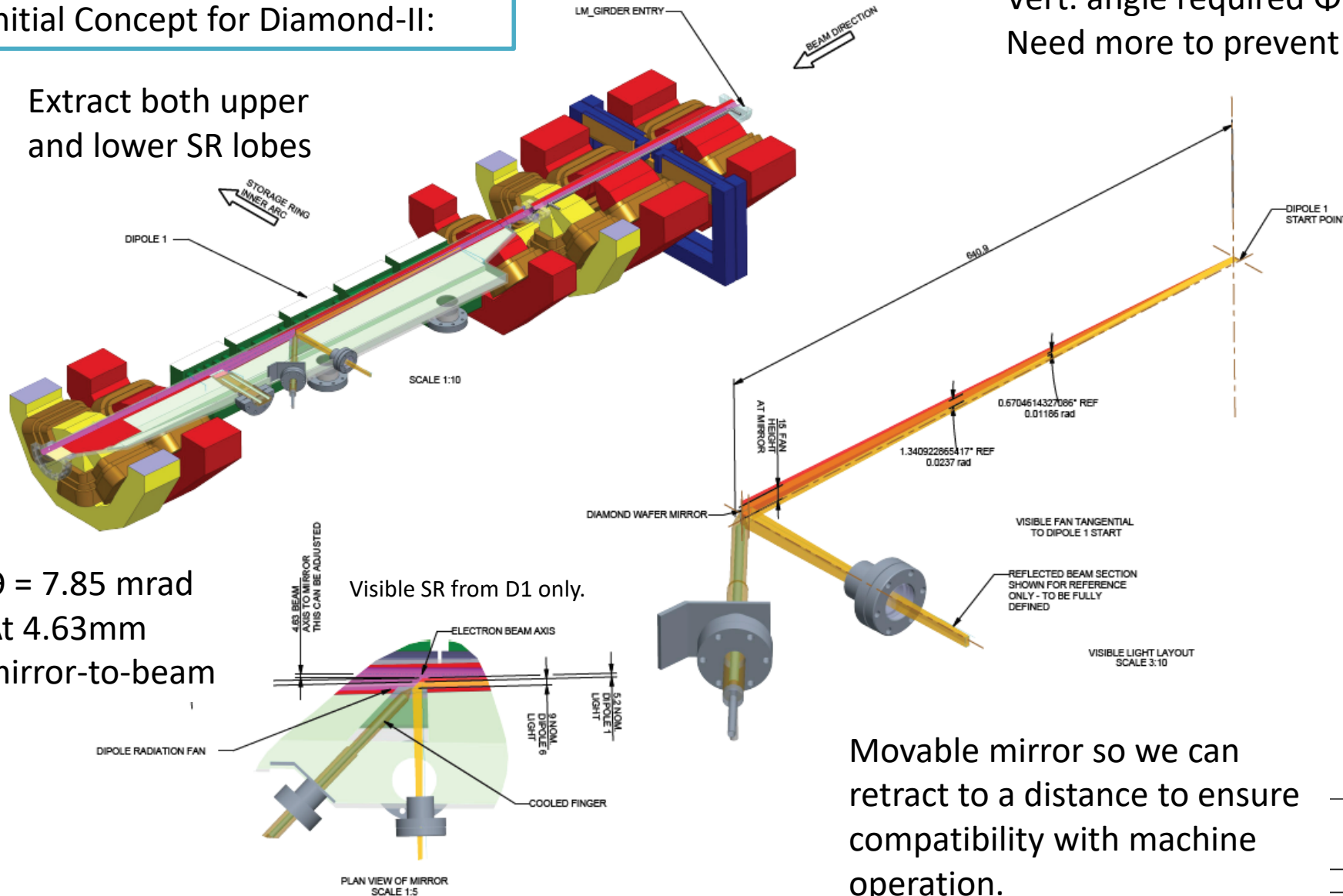
Investigated an extraction mirror within the dipole vessel:

- Diamond mirror (without absorber)
 - Based on J.W. Flanagan et al., “Thermal Performance of Diamond SR Extraction Mirrors for SuperKEKB”, in Proc. IBIC'19, Malmö, Sweden, Sep. 2019, pp. 327-330.
 - FEA shows we are unable to ensure required flatness (approx. $\lambda/10$) due to heating from X-ray fan
- Traditional mirror with copper finger absorber

Extraction Mirror Concept

Initial Concept for Diamond-II:

Extract both upper and lower SR lobes



$\theta = 7.85$ mrad
At 4.63mm
mirror-to-beam

Visible SR from D1 only.

Vert. angle required $\Phi = \pm 4$ mrad
Need more to prevent diffraction from edges.

Rough Comparison to Diamond VLE:

- Extraction mirror positioned above X-ray SR fan and takes entire upper lobe of visible SR only.
- Distance from source ≈ 3.5 m
- Horiz fan width ≈ 25 mm
- Horiz acceptance $\theta \approx 7.14$ mrad

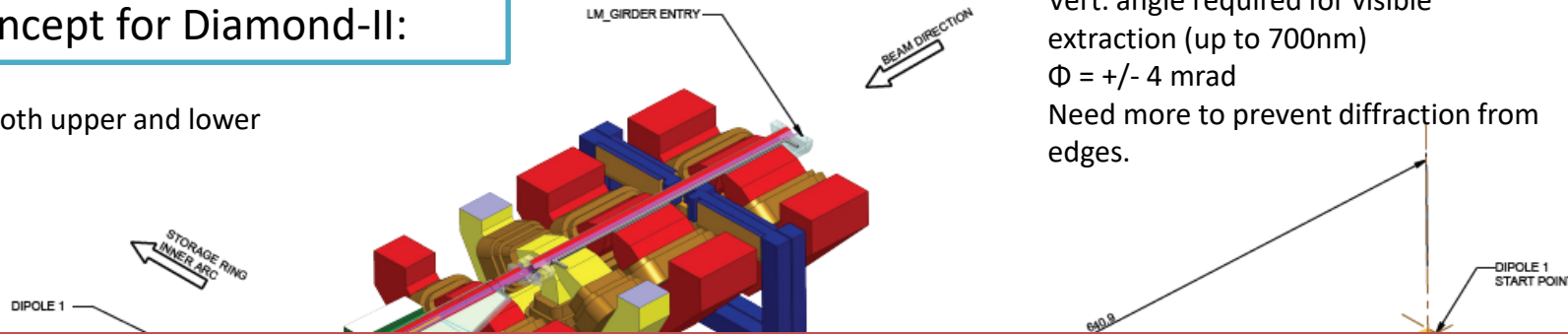
Movable mirror so we can retract to a distance to ensure compatibility with machine operation.

Technical drawings by A. Day.

Extraction Mirror Concept

Initial Concept for Diamond-II:

Extract both upper and lower SR lobes



Vert. angle required for visible extraction (up to 700nm)
 $\Phi = +/- 4 \text{ mrad}$
 Need more to prevent diffraction from edges.

Rough Comparison to Diamond LE:

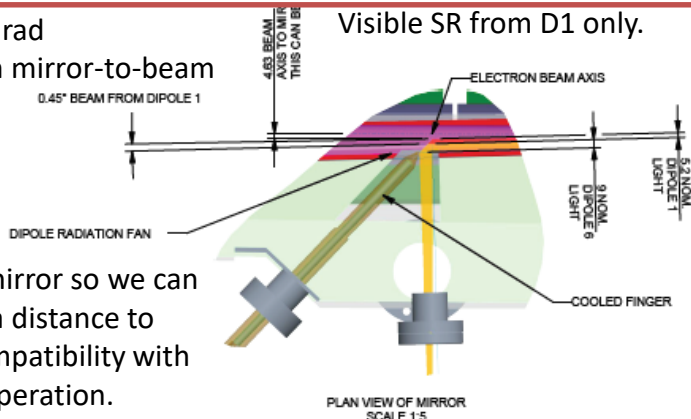
- Extraction mirror positioned above X-ray SR fan and takes entire upper lobe of visible SR only.

Recent modifications to the dipole vessel for vacuum requirements means there is no space for an extraction mirror

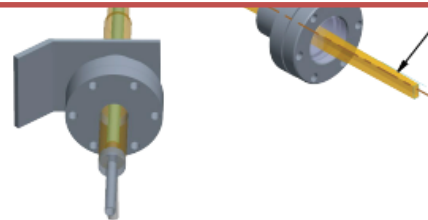
$\Theta = 7.85 \text{ mrad}$

At 4.63mm mirror-to-beam

Visible SR from D1 only.



Movable mirror so we can retract to a distance to ensure compatibility with machine operation.



SHOWN FOR REFERENCE ONLY - TO BE FULLY DEFINED

VISIBLE LIGHT LAYOUT SCALE 3:10

NOTE:

* THIS SKETCH SHOWS A PROPOSED LAYOUT FOR VISIBLE LIGHT EXTRACTION ON DIAMOND II.

* THIS IS FOR REFERENCE ONLY FURTHER DEVELOPMENT IS REQUIRED

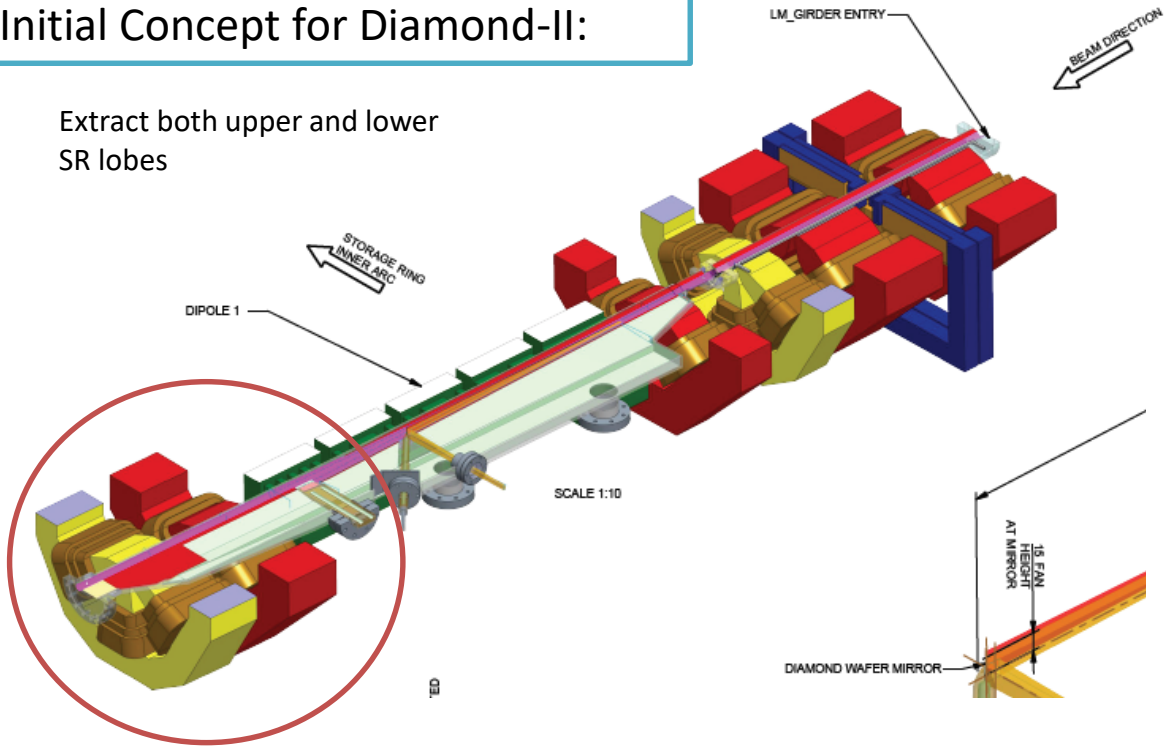
	THIS REVISION	TITLE			
	DRN DATE	AGD 07/04/20	DIAMOND II VISIBLE LIGHT EXTRACTION LM D1 STORAGE RING II		
	CHK DATE	-	ORIGINATOR/DATE	DRG STATUS	WIP
	APPD DATE	-	AGD 07/04/20	1 OF 1	REV. A
PDMLink	CHG No.	1151384			

Technical drawings by A. Day.

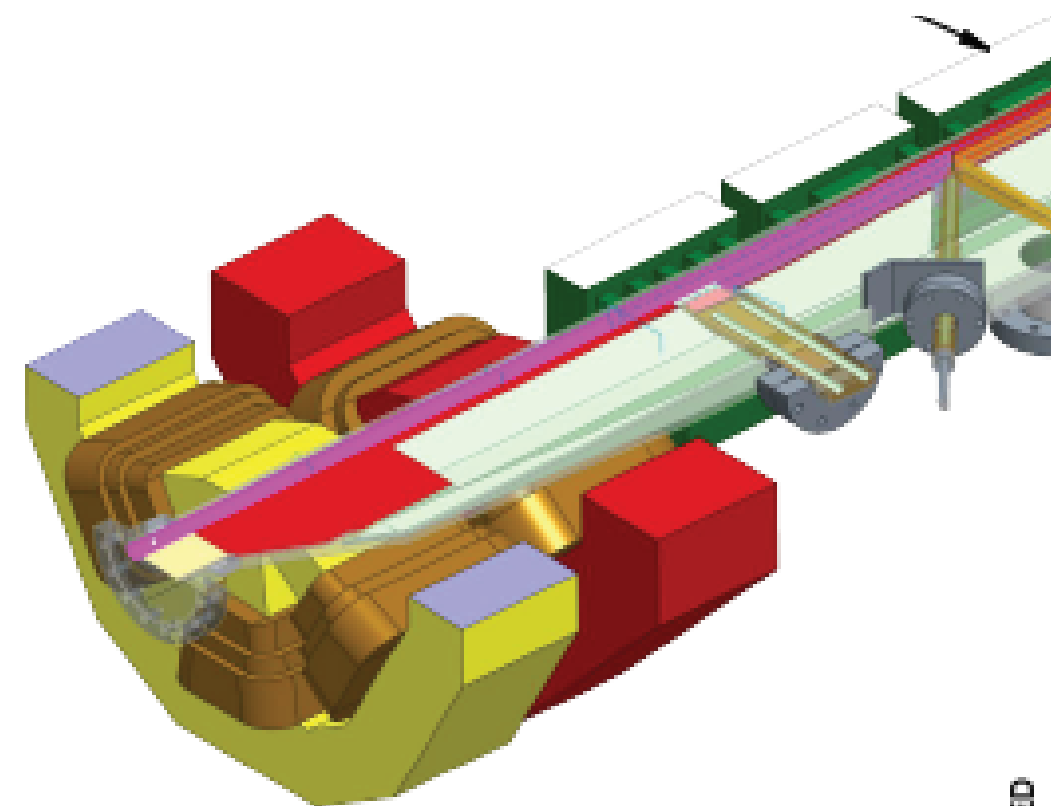
Modify Downstream Magnets

Initial Concept for Diamond-II:

Extract both upper and lower SR lobes



Investigating options to modify quadrupole and sextupole.



Aim is to find a common solution, as this challenge is faced by some of our beamlines.

Technical drawings by A. Day.

Summary

- Visible SR extraction is required for:
 - Streak camera
 - Fill pattern monitor
 - High resolution beam size monitor (pi-pol / interferometry)
- For these applications, both upper and lower lobes must be extracted with a high beam quality (i.e. minimum aberrations).
- Extraction is challenging in an MBA lattice due to spatial constraints.
- We are still considering other options:
 - Extraction mirror downstream of D3 dipole vessel?
 - Modification of sextupole and quadrupole downstream of D1 dipole.

Thanks to N. Hammond, A. Day, S. Hobdod, A. Morgan, I. Martin and R. Fielder for all contributions thus far!