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# OPTIMIZING INDIRECT COOLING OF A HIGH ACCURACY SURFACE PLANE MIRROR IN PLANE-GRATING MONOCHROMATOR

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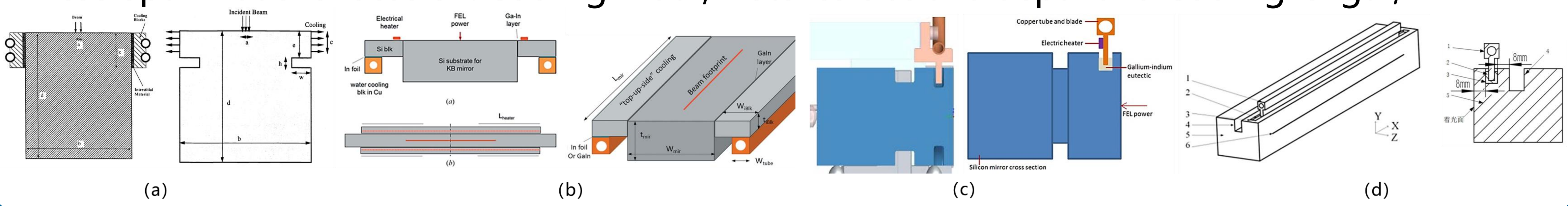
## INTRODUCTION

In recent years, numerous light sources are developing synchrotron facilities with **higher brightness**, **smaller divergence angle** and more stability. During the development, the researching of the optics cooling of the beamline has draw much attention for the crucial role to realize goals above. There are so many articles focus on the cooling art of the first mirror, because it bears the highest heat load among all the optics in a beamline. However, for some VIA-PGMs in the downstream of the first mirror, few report about the cooling of optics in the PGM was found. Moreover, **the cooling of the VIA-PGM has became an issue** in some synchrotron facility with high brightness and ultra small divergence angle, not only for its thermal working condition and high accuracy surface requirement, but also for its **different optimization of cooling, compared to the first mirror**. This article will briefly list the common optimizations for the cooling of first mirror as references; then, based on a beamline of Hefei Advanced Light Facility (HALF), the limitation of these optimization in PGM are introduced; the reason and resolution are provided at the end.

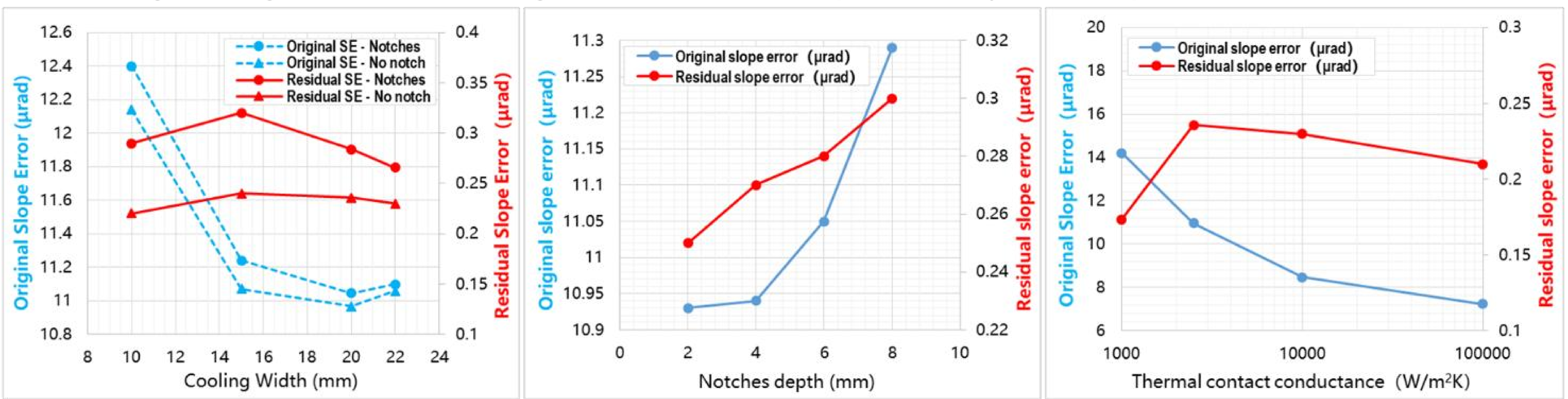
## OPTIMIZATIONS FOR INDIRECT COOLING OF THE FIRST MIRROR

These optimizations focus on: Cooling width, Notches bias and depth and Cooling length;




## LIMITATIONS OF THESE OPTIMIZATIONS FOR PLANE MIRROR

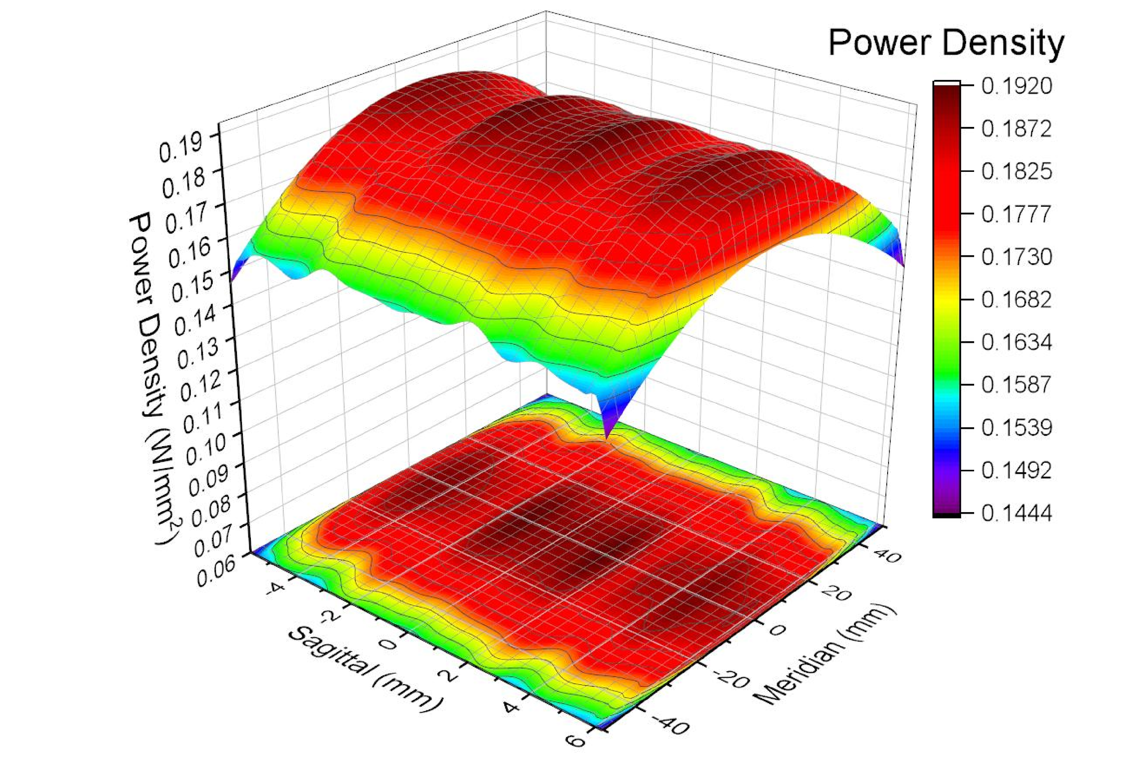
No enough margin or diminishing of the residual slope error by these optimizations for PM.

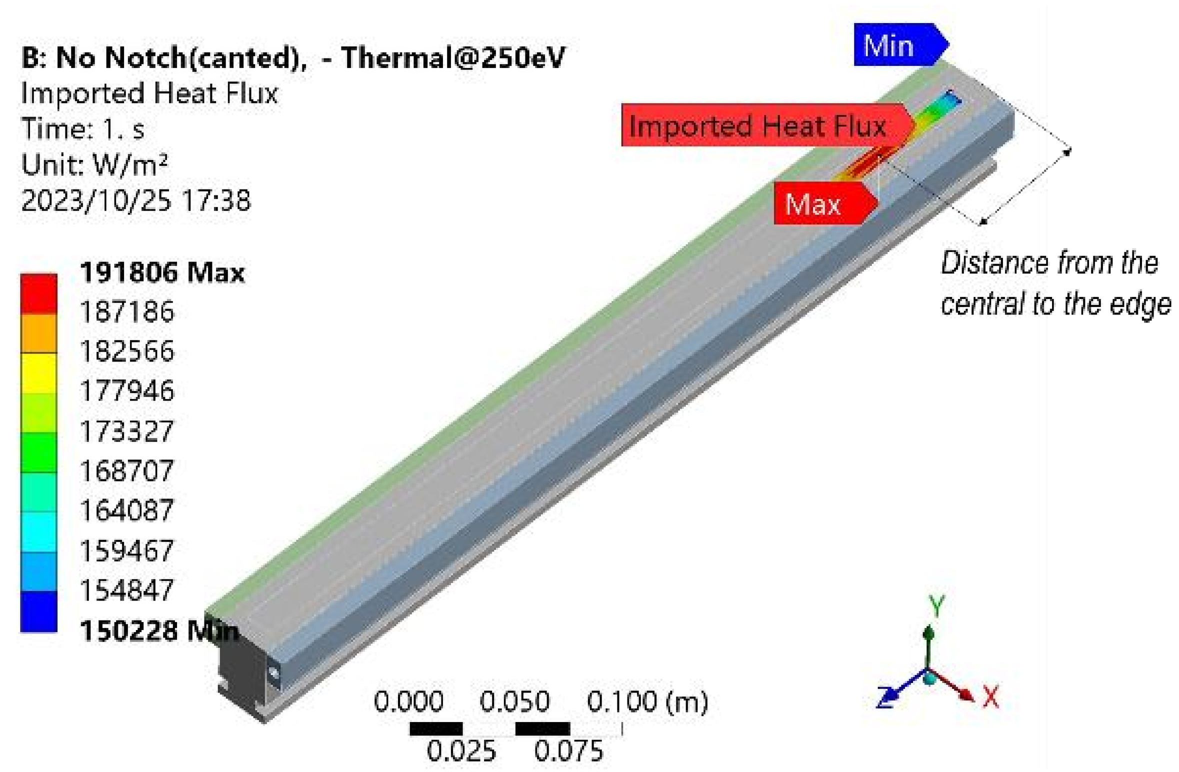



a) Influence of the cooling width and notches bias. ( TCC = 2500W/m²K)

b) Influence of the notches' depth. ( TCC = 2500W/m²K)

c) Influence of the contact thermal conductance. (No notch, Cooling width: 20mm)

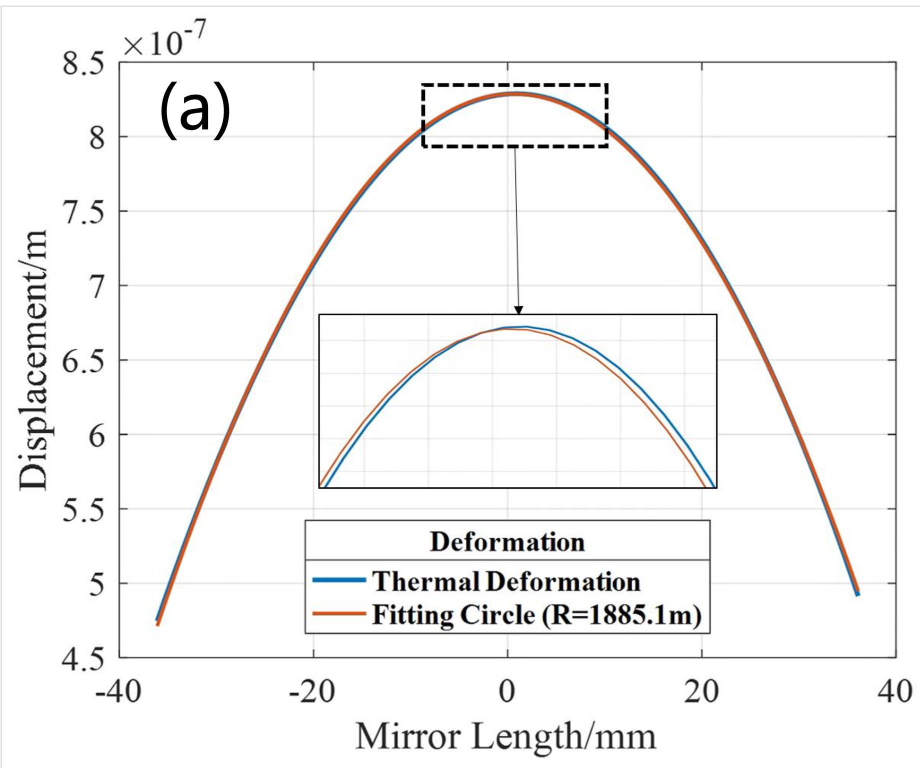


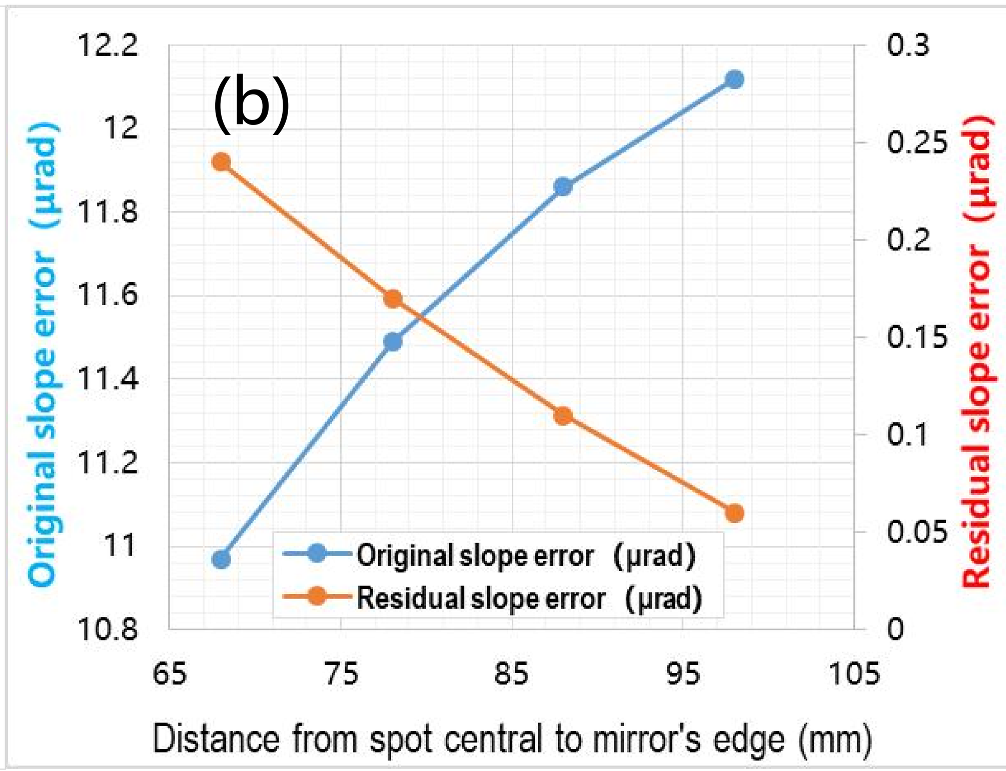




Power density under the maximum working condition ($q''_{max}$=0.192W/mm²K, P = 188.5W) and the cooling structure utilized.

## RESOLUTIONS FOR COOLING OF PALNE MIRROR

A core reason, that can be put after comparing the curve of deformation and fitted one ,is the **asymmetry of thermal deformation** in the meridian direction, shown in (a), which dues to the **asymmetry cooling structure**. This problem will become even worse under the maximum heat load working condition. The effective way to handle it is make the high heat load spot far from the edge of the plane mirror. Via parametric simulation, the balanced parameter can be easy found in (b).




## CONCLUSIONS

- ✓ The **cooling of the plane mirror's** optimizations in VIA-PGM are different from the first deflection mirror.
- ✓ Combined with the **optimizations** for first mirror and **symmetry of the PM's cooling structure**, the plane mirror can provide large margin (**~60nrad**) at the max heat load condition, heat load of up to **0.192 W/mm², 188.5 W** on the plane mirror.
- ✓ It is suitable for these **VIA-PGM** who has **a relative large space** to do the implement.