Adaptive Optics PSF Reconstruction

SKY results at Keck & Gemini/Altair

Laurent Jolissaint - aquilAOptics, Switzerland
Chris Neyman, Peter Wizinowich - W. M. Keck Observatory
Julian Christou - Gemini Observatory

special thanks to
Laurent Mugnier, ONERA
Francois Rigaut, Gemini
Benoit Neichel, Gemini

AO4ELT conference, Victoria, BC, Canada, 26-30th September 2011

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model input #2
mean r_0 during AO run
from a seeing monitor

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fitting error structure function for D/r0=1
computed analytically using a Fourier approach
PSD_{FE} -> SF_{FE}

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  - to capture everything in a single shot

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- project started January 2010...

PSF-R campaign 2010

lessons learned at Gemini/Altair

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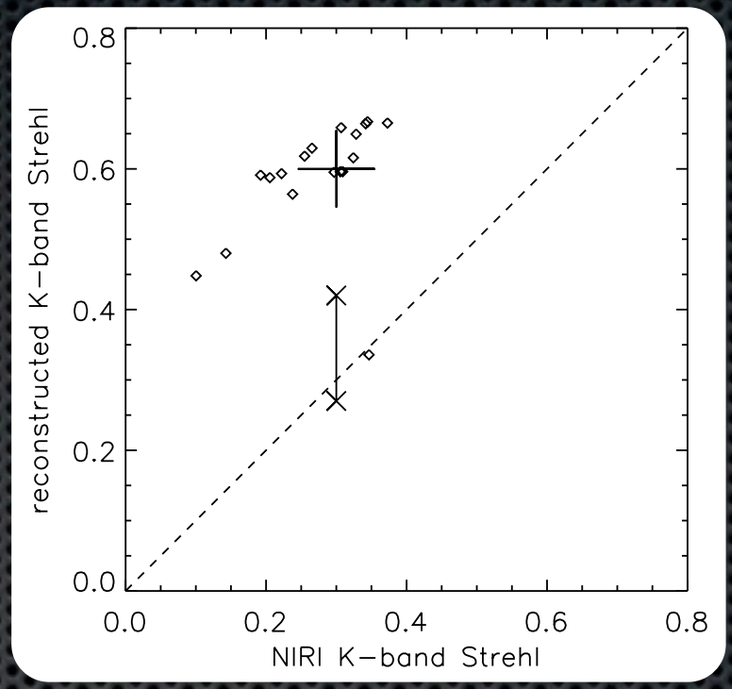

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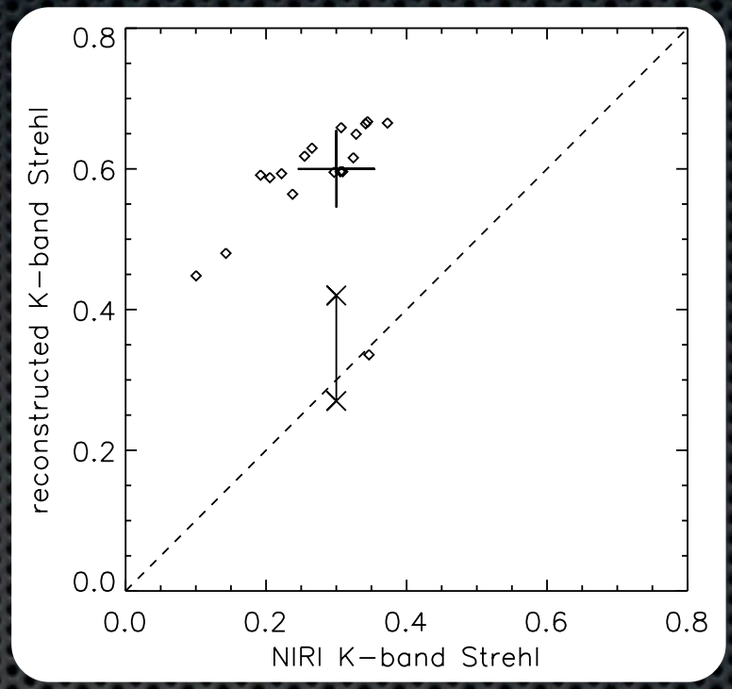

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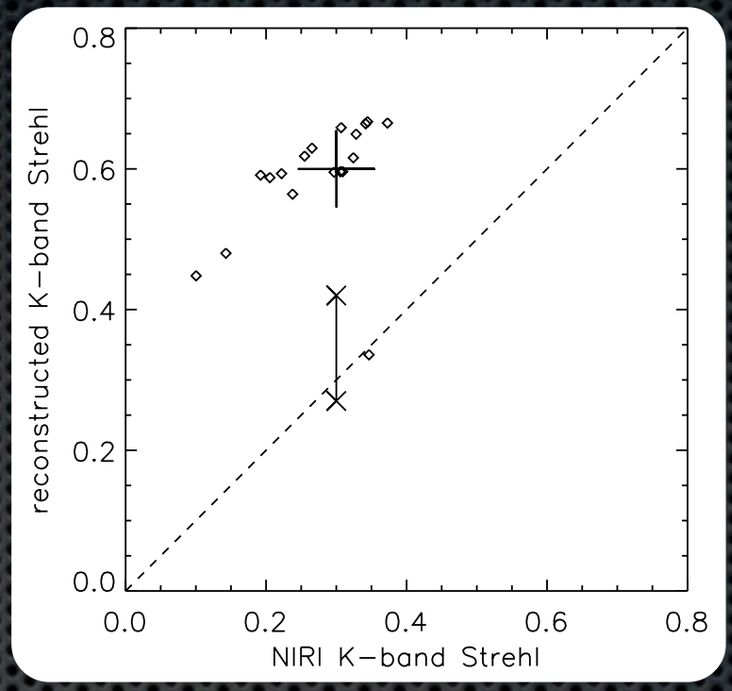

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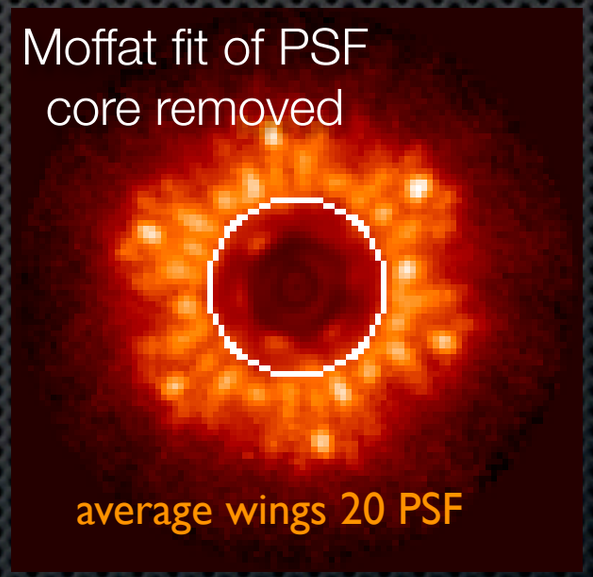


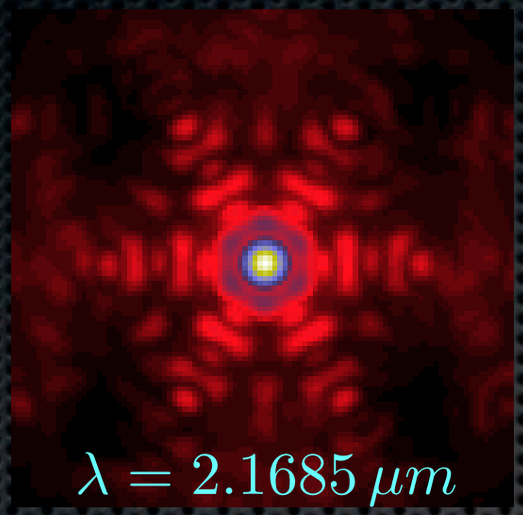
this is an image of the average of the wings of 20 PSF with different WFS / M2 angles

PSF-R campaign 2010

lessons learned at Keck II AO

Keck-AO PSF-R results (1st campaign)

PSF-R
AO-only
perfect
telescope



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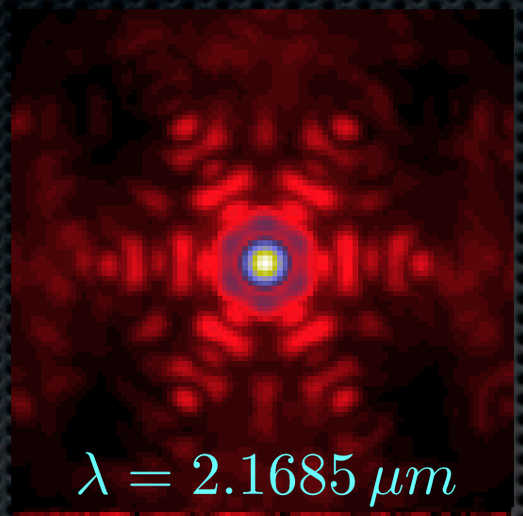

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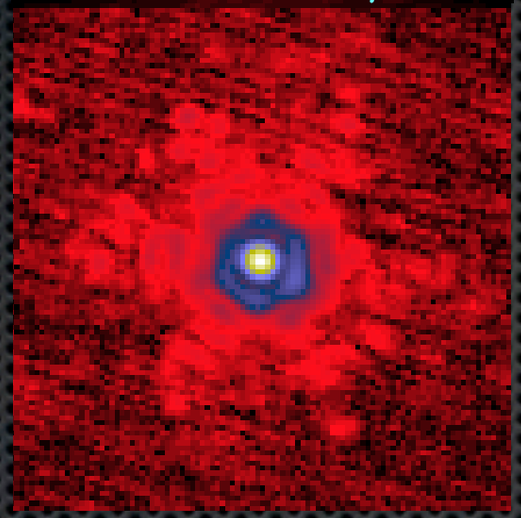

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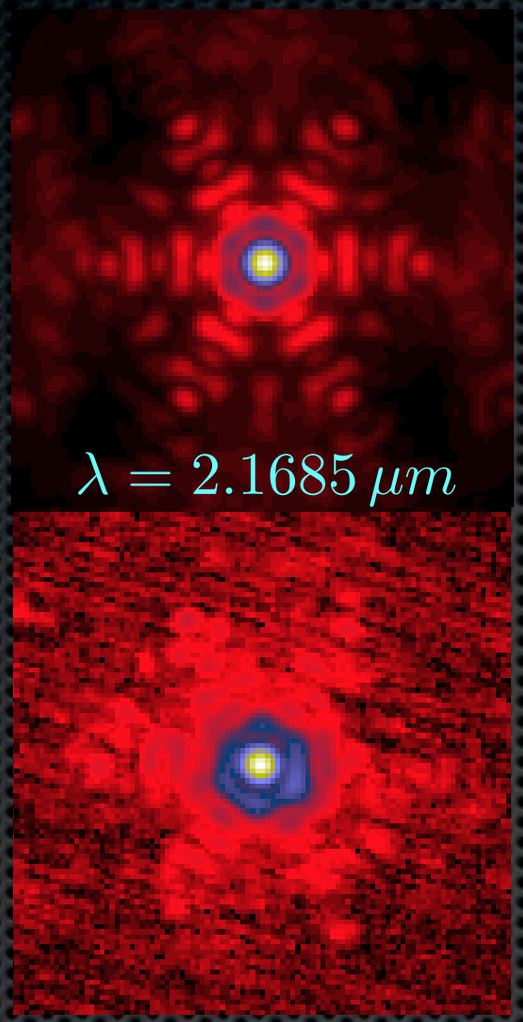

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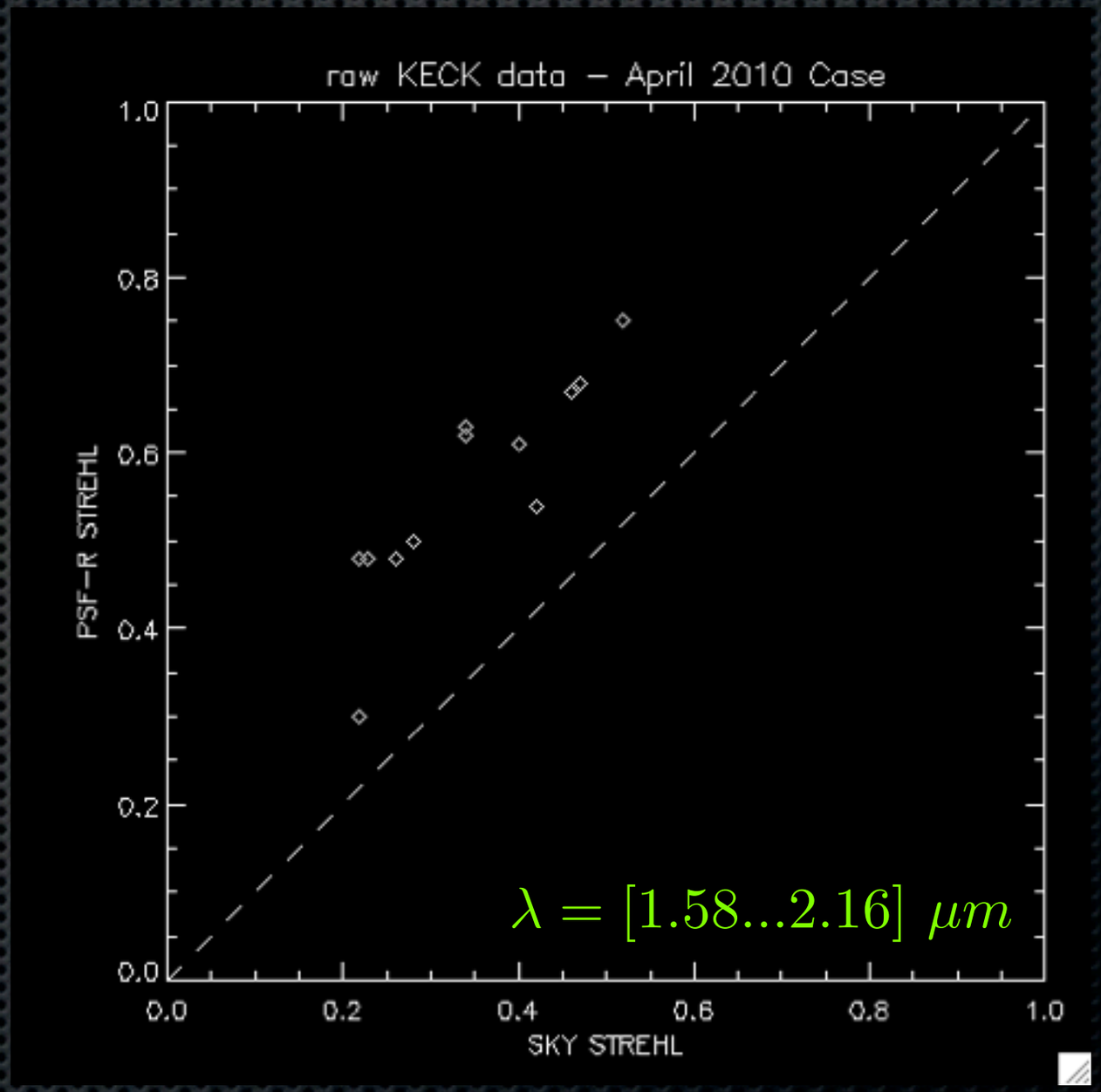

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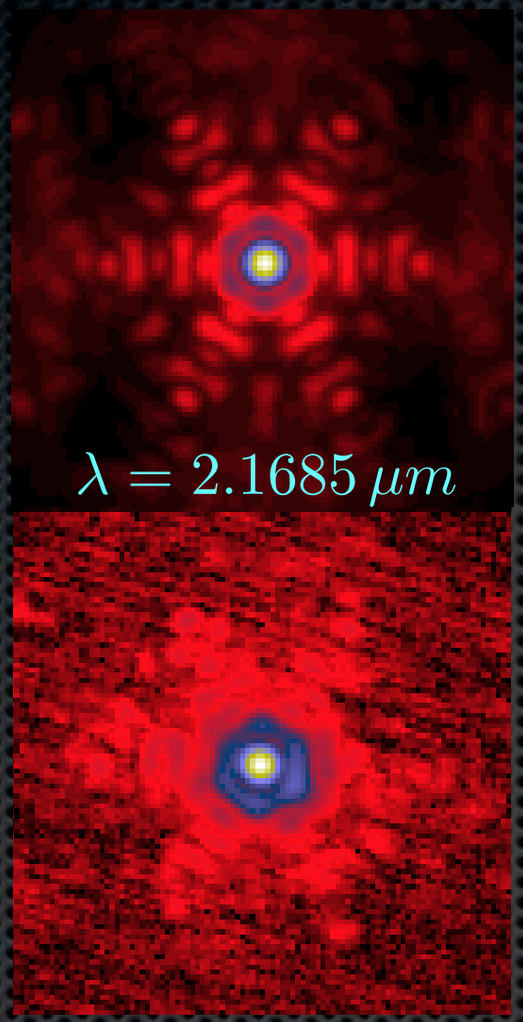

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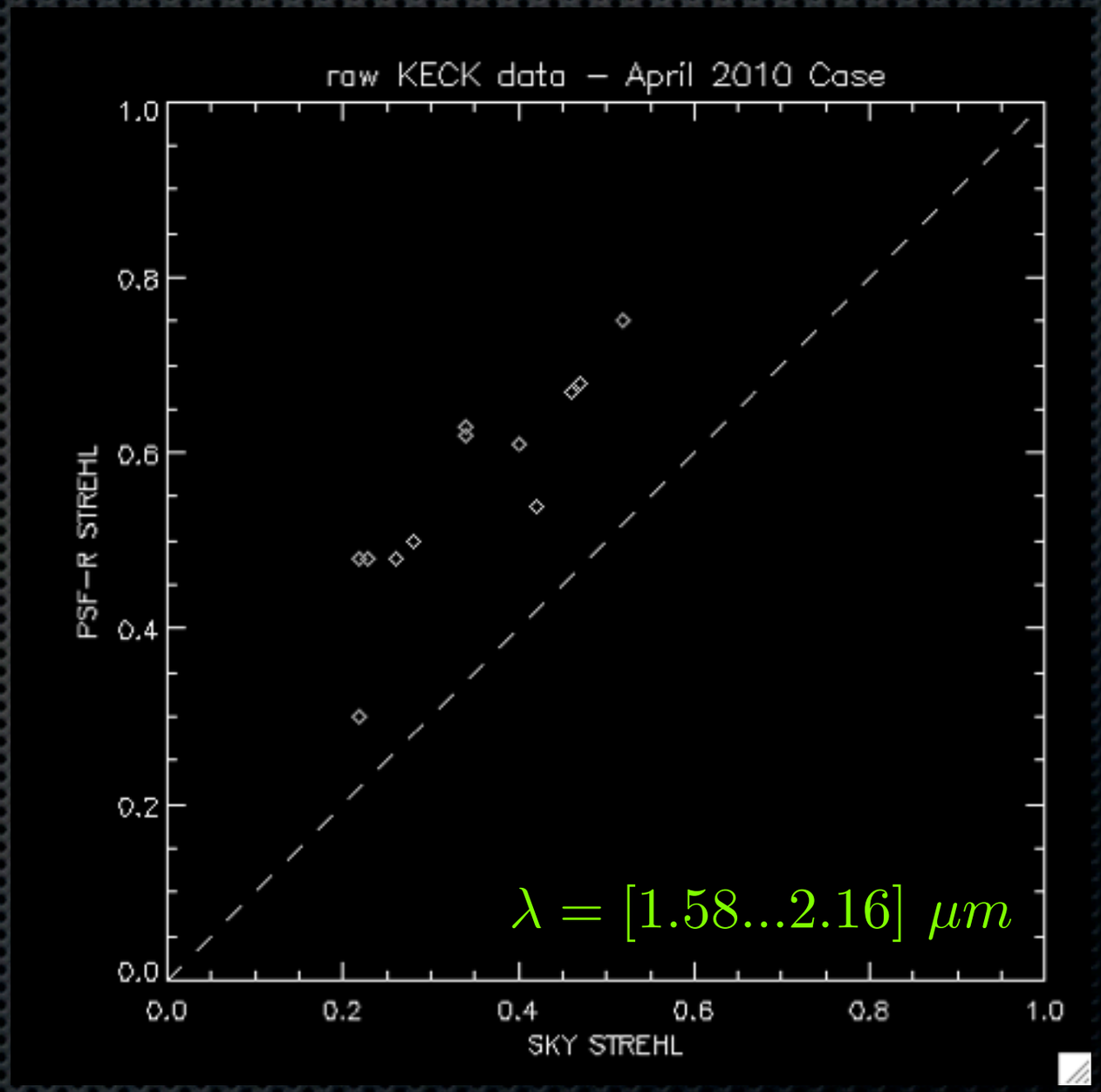


missing aberration is and ~ 200 nm and order n=2-4

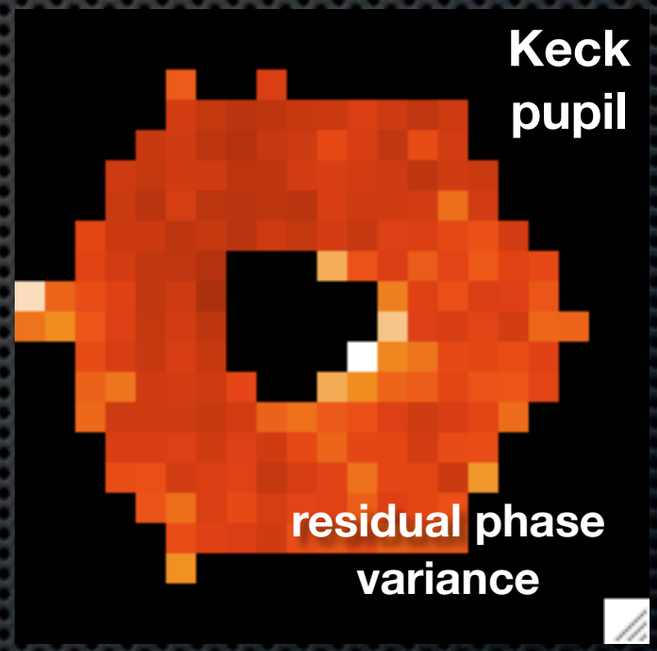
testing the fundamentals

question 1

is the residual phase really stationary across the pupil ?

residual phase stationarity

- **YES** this is basically true where actuators receive enough light



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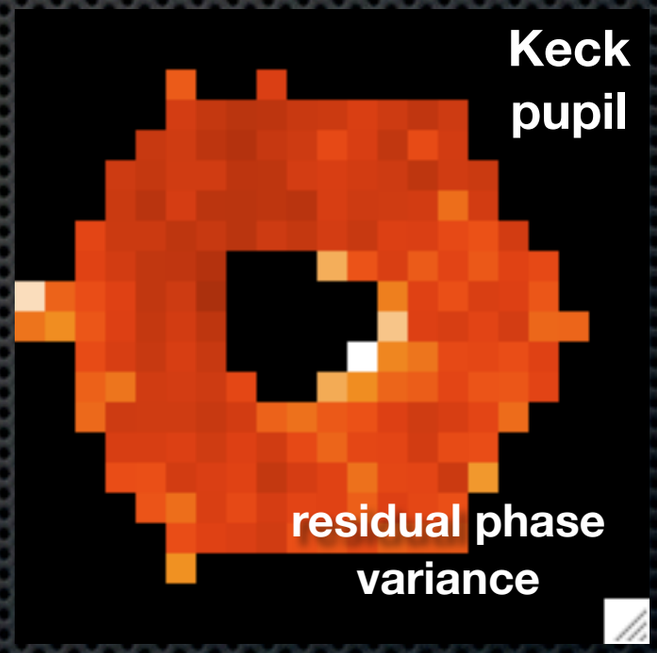
- **no need** yet to give up on the OTF product paradigm



question 2

How accurate is the seeing estimation ?

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- we did this at Keck II this summer...

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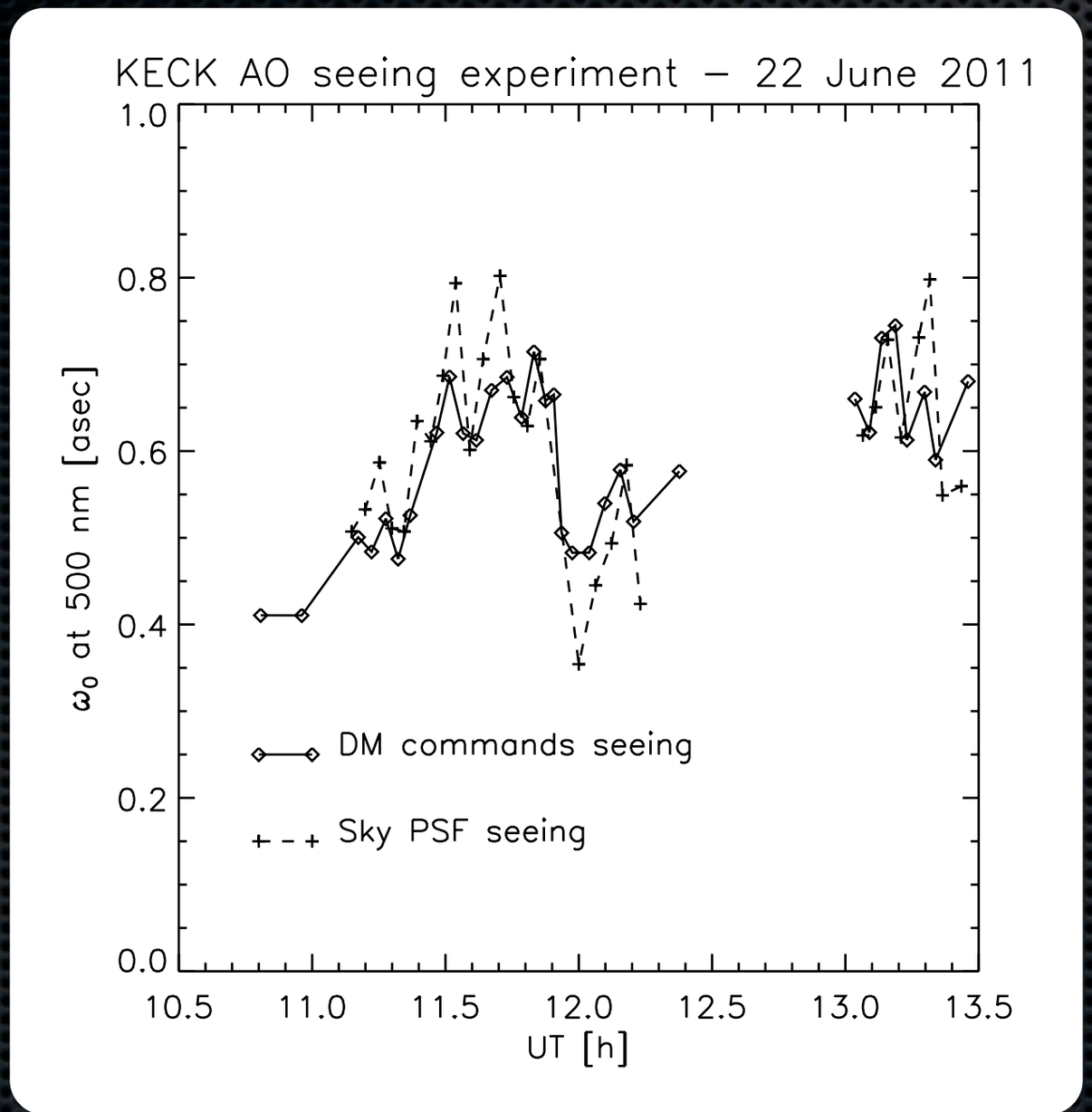

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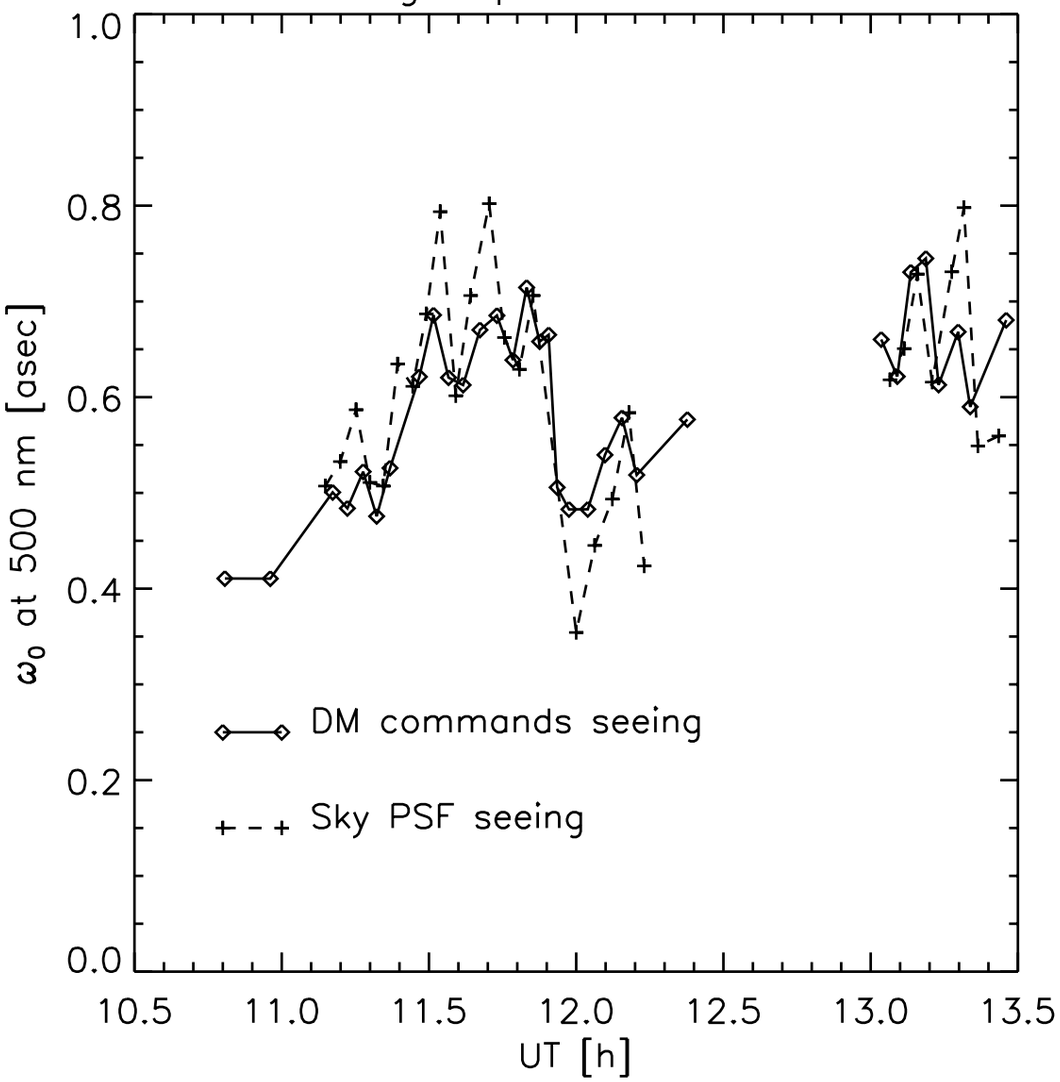

DM-based seeing is reliable

question 3

can we retrieve the static phase

from sky-based phase diversity ?

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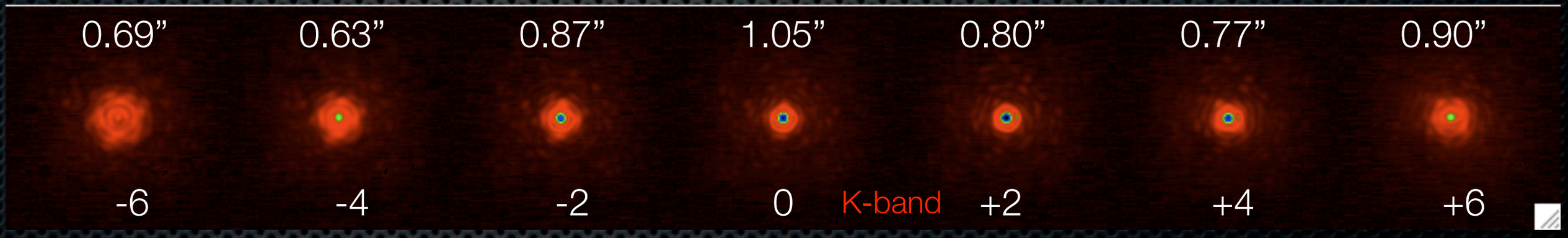

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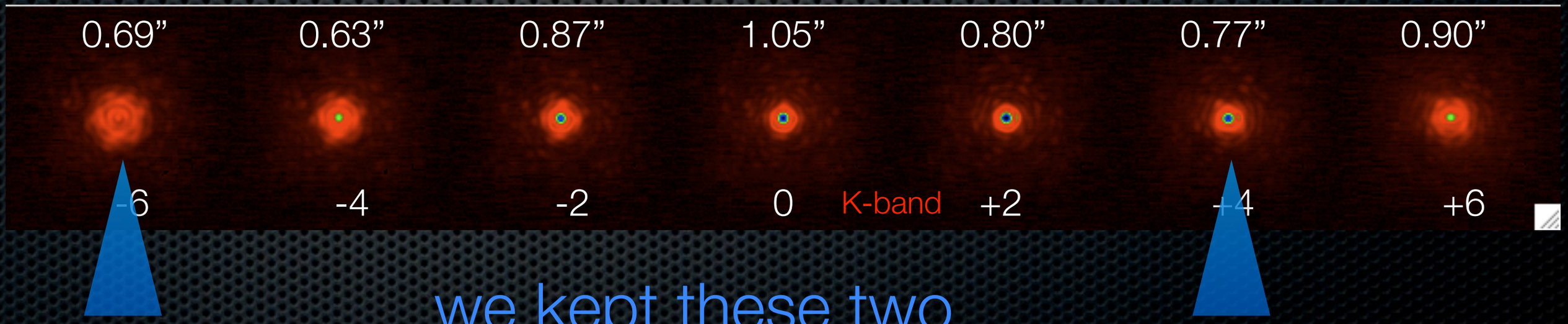

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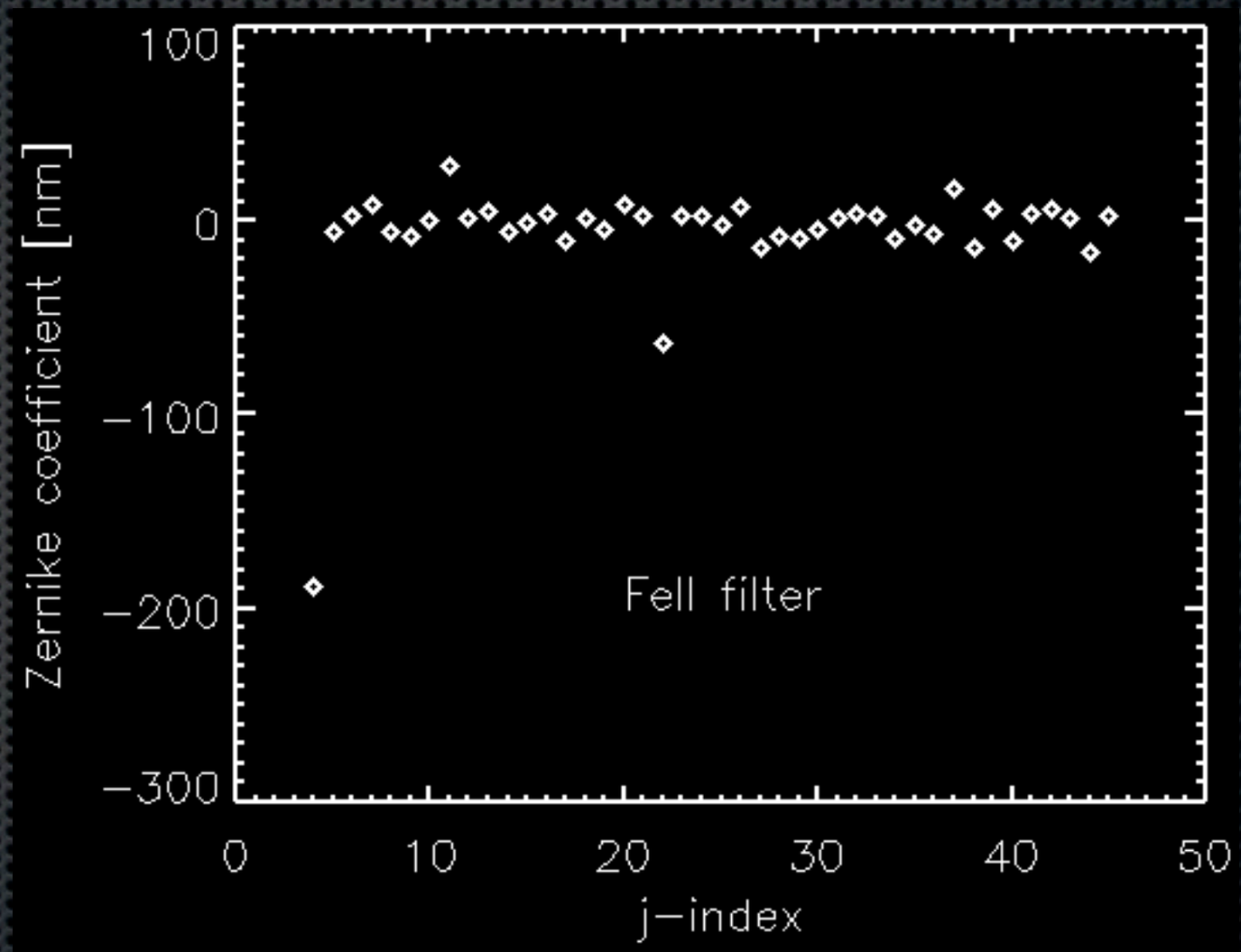
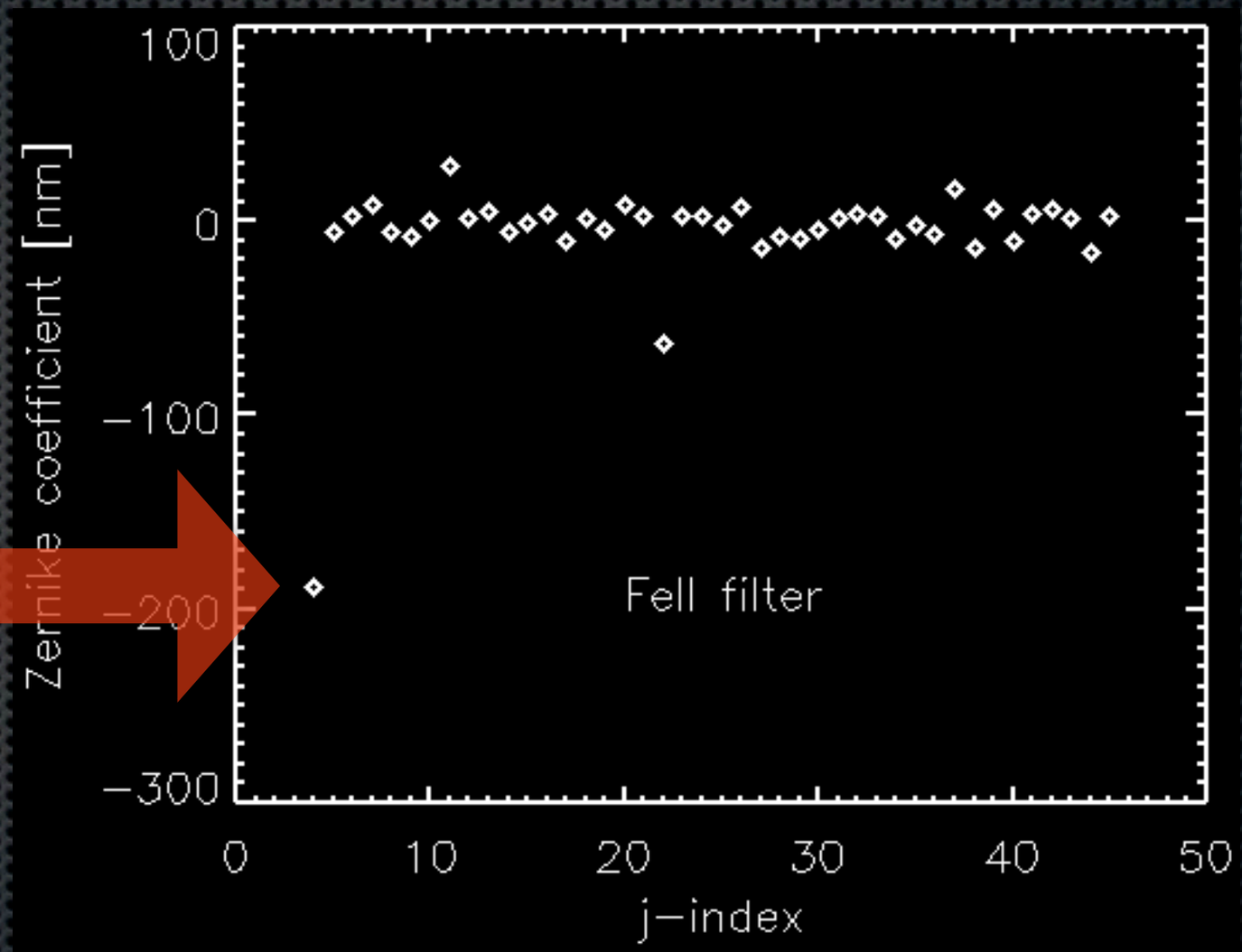


sky phase diversity at KECK II

-190 nm of defocus !!



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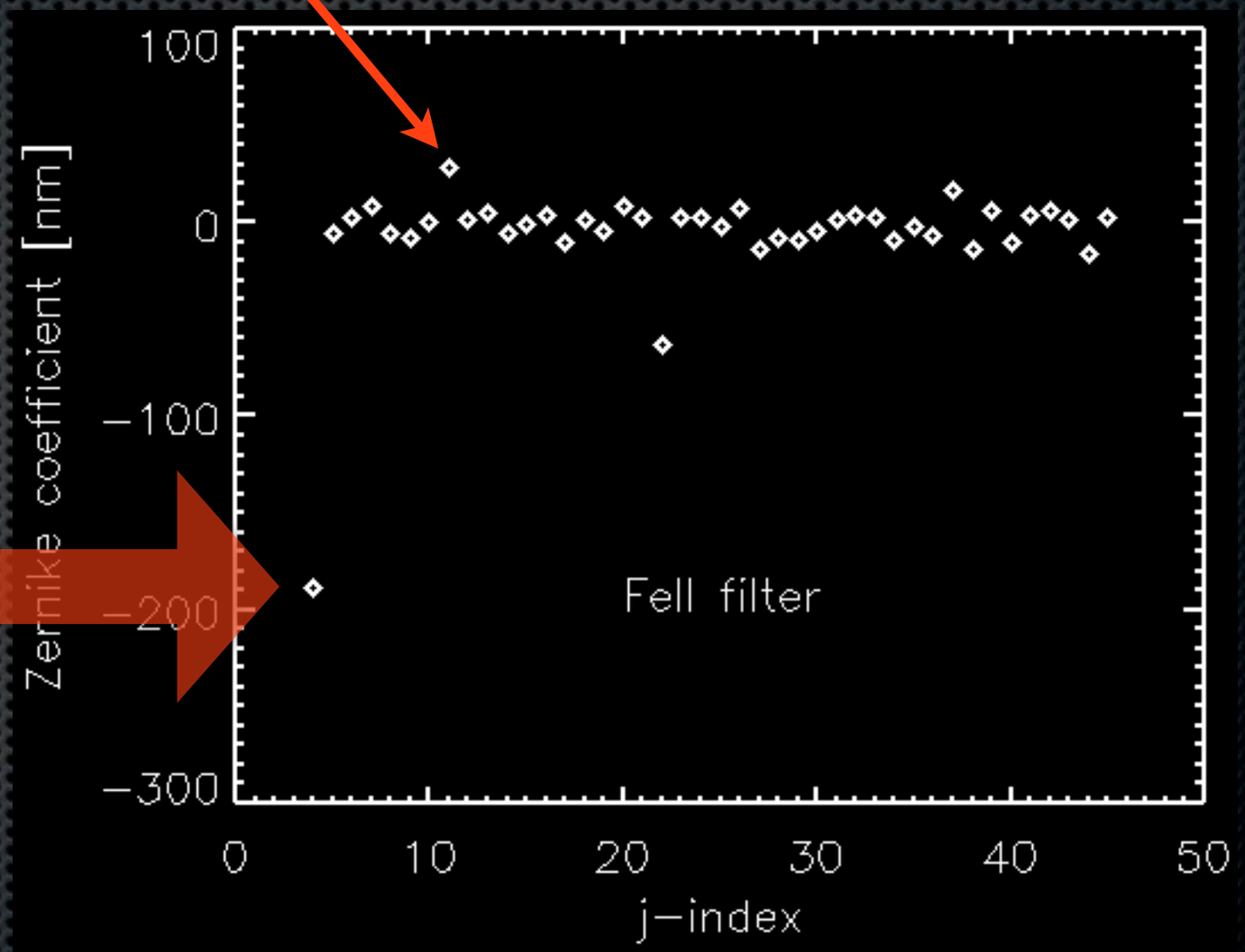

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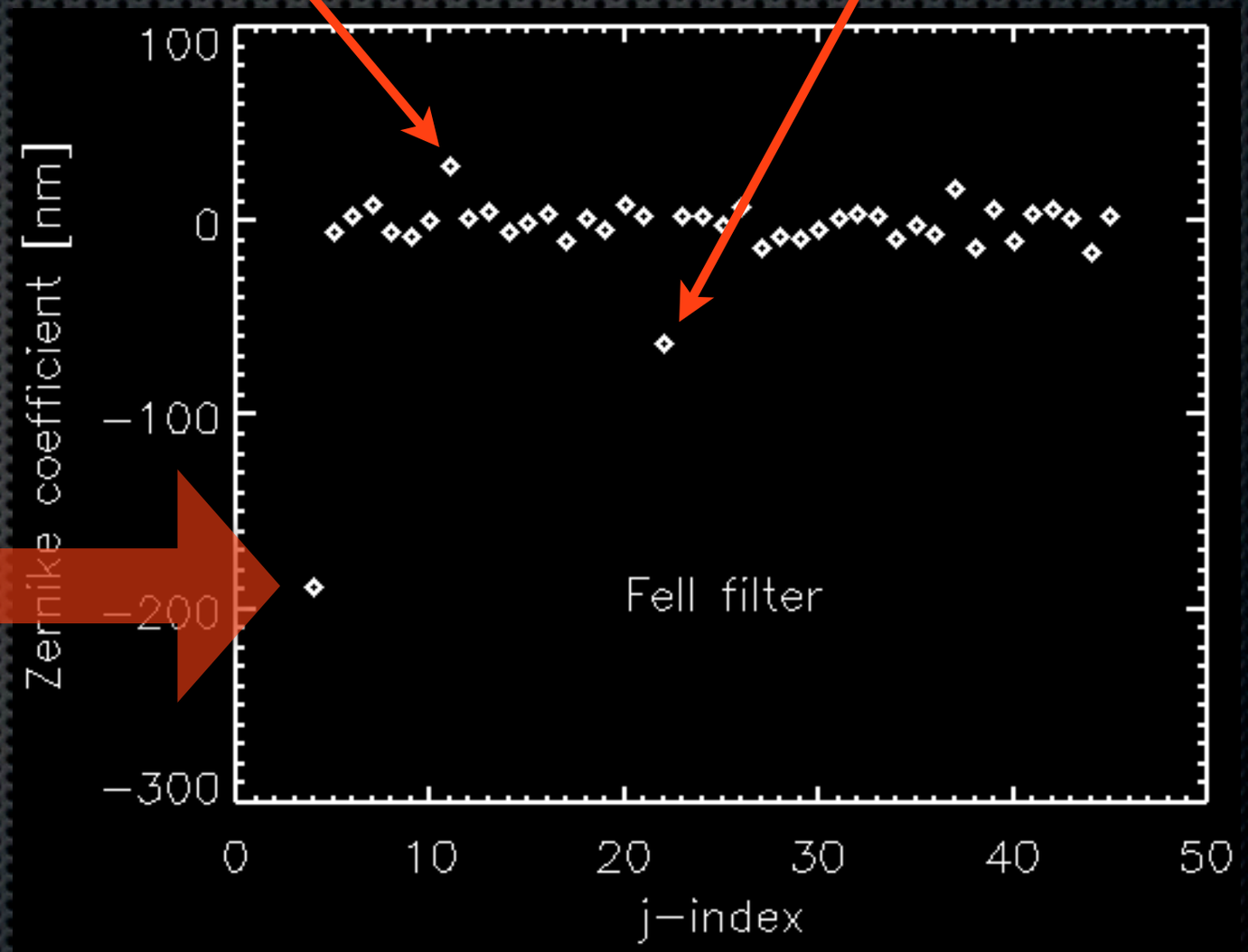

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200 nm WFE

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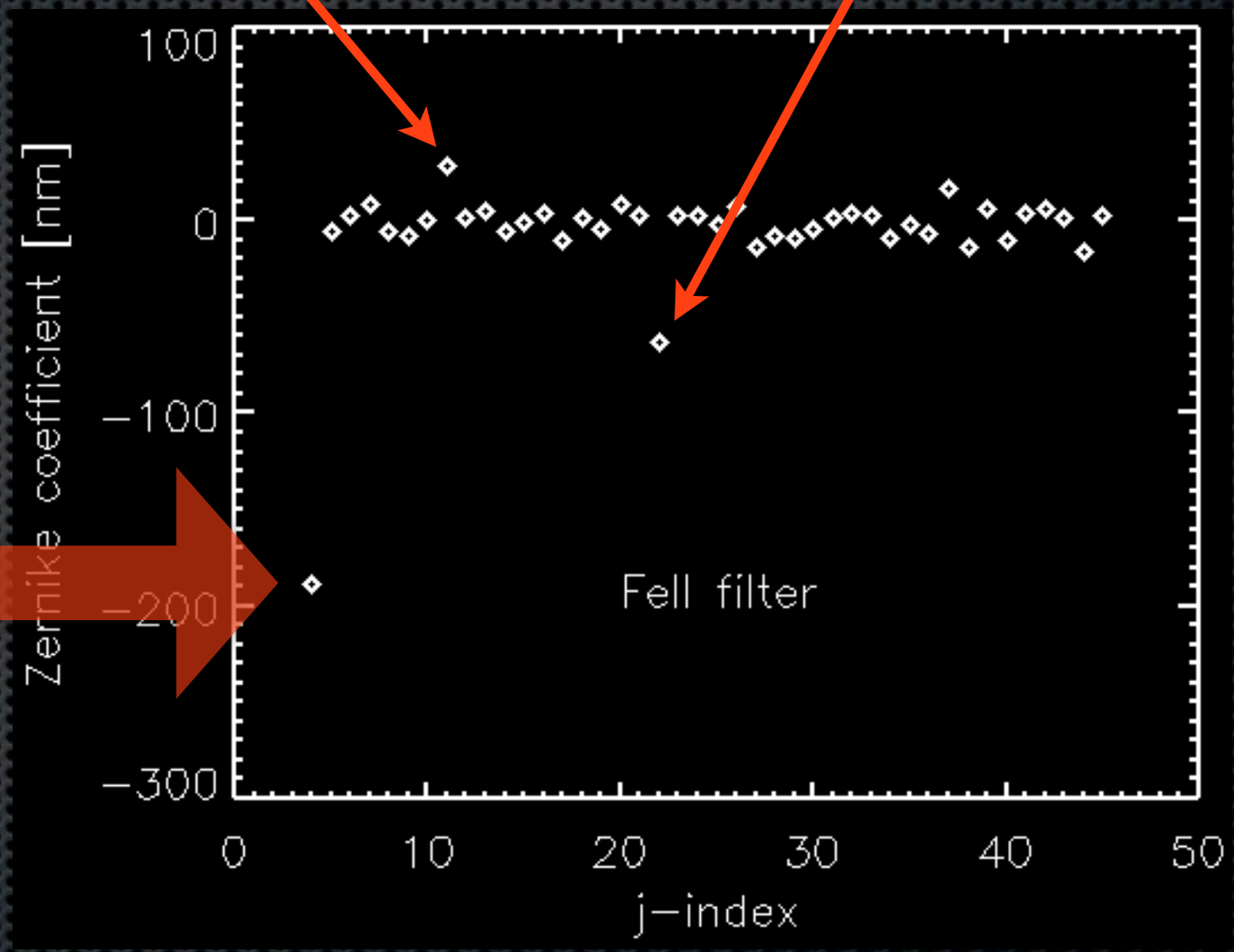
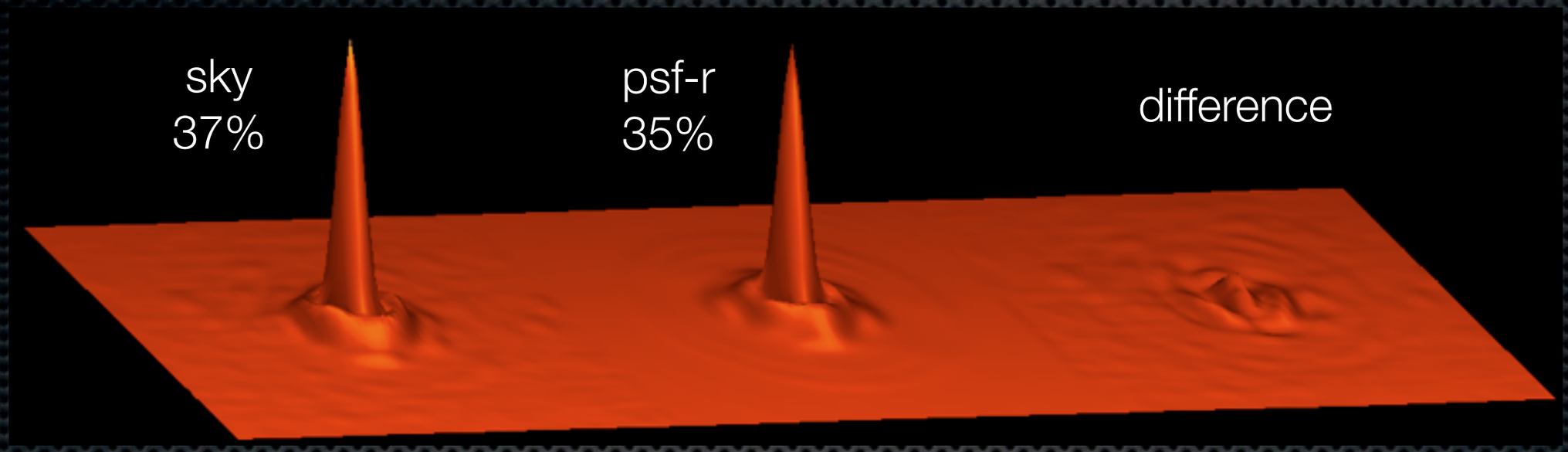


putting it all together:

the reconstructed Keck PSF

Fe II filter - 1.625 microns



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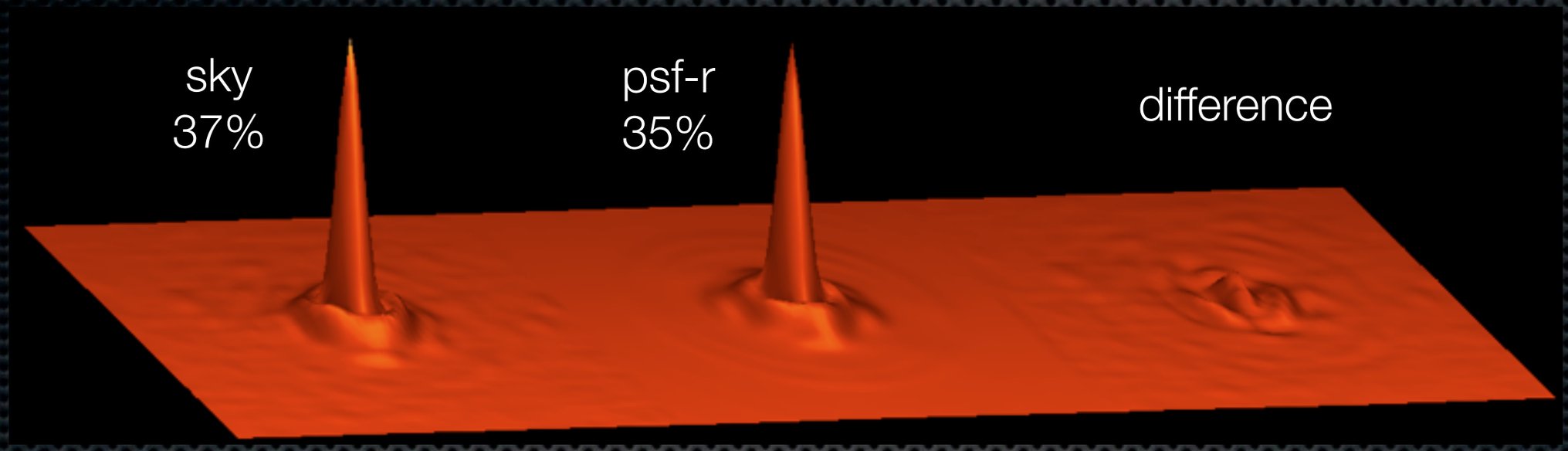
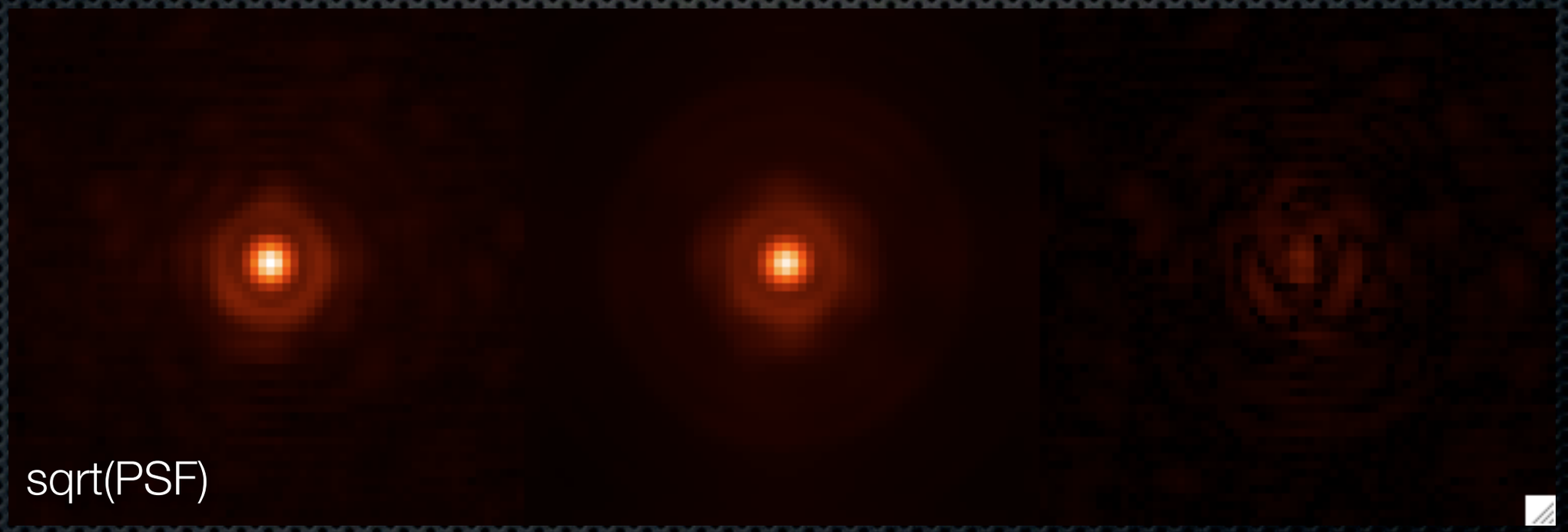
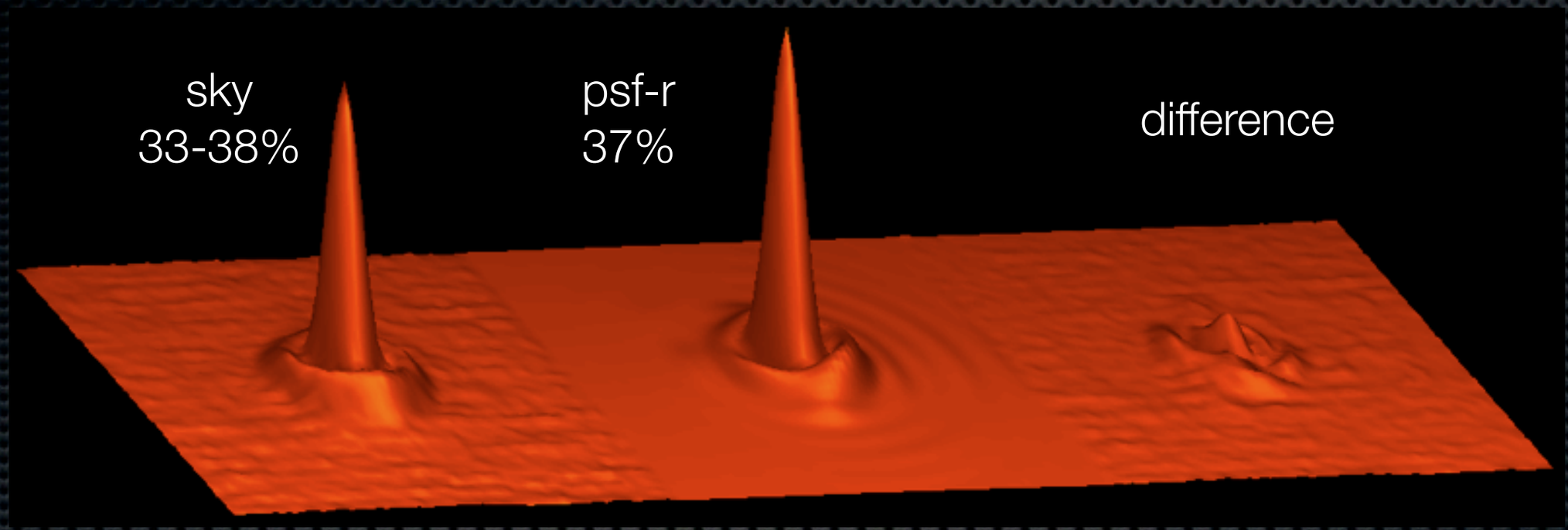




Br-gamma filter - 2.17 microns



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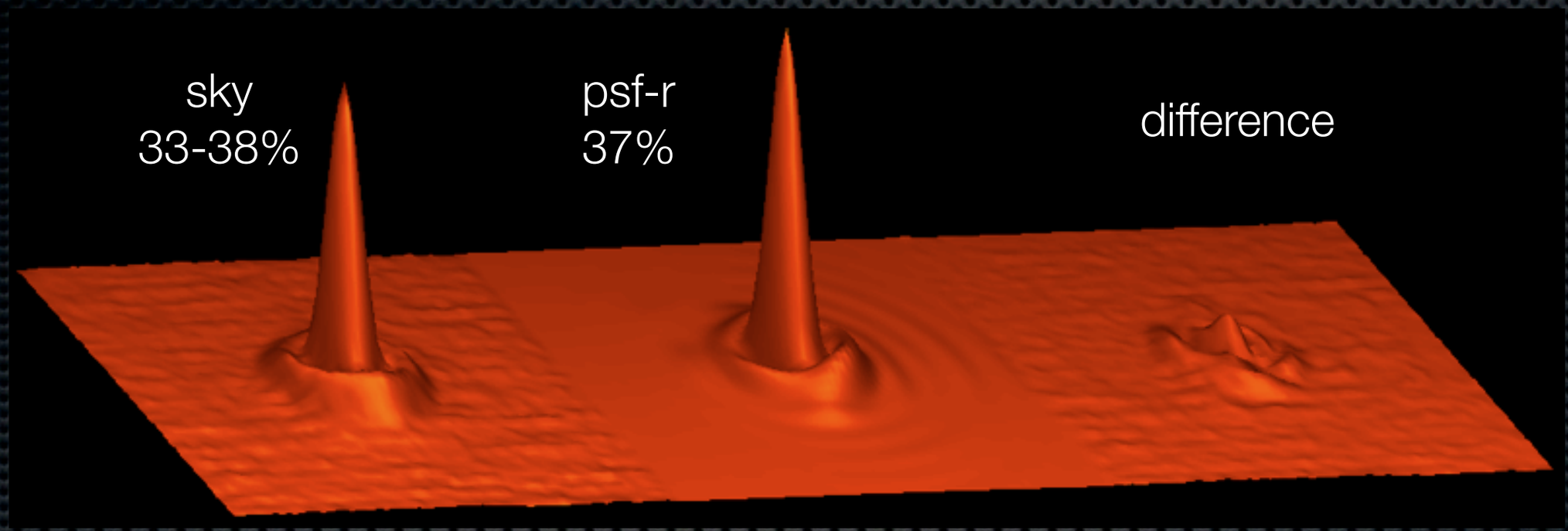

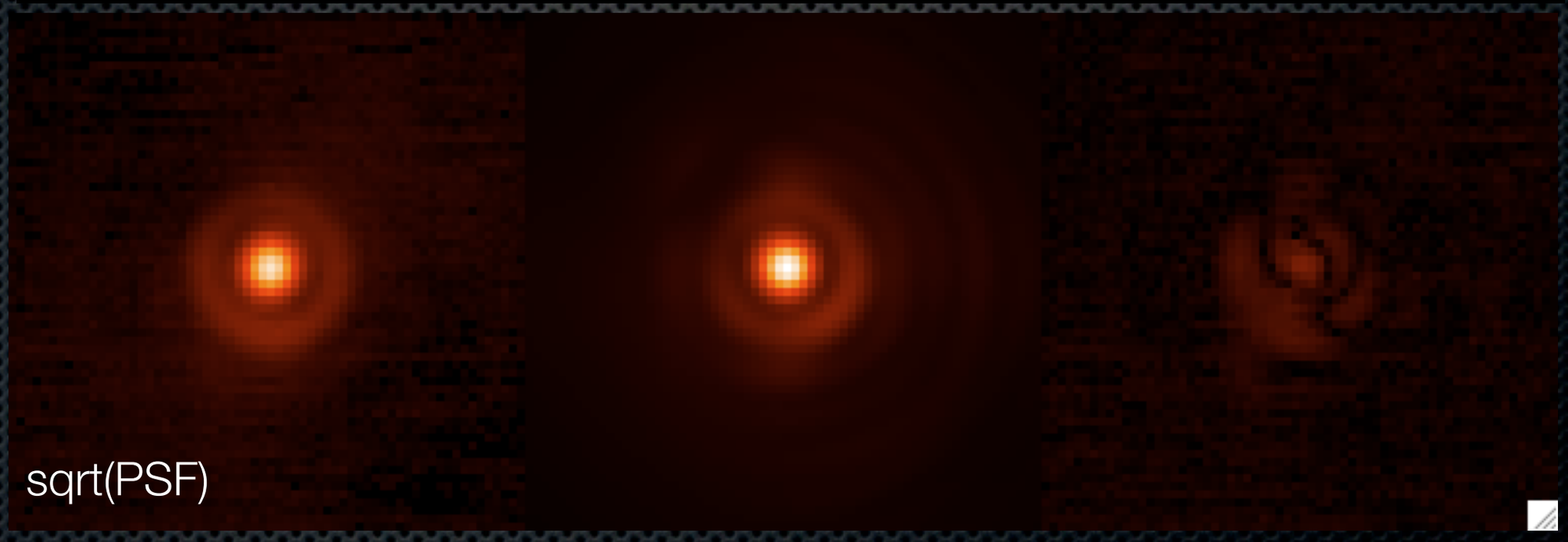

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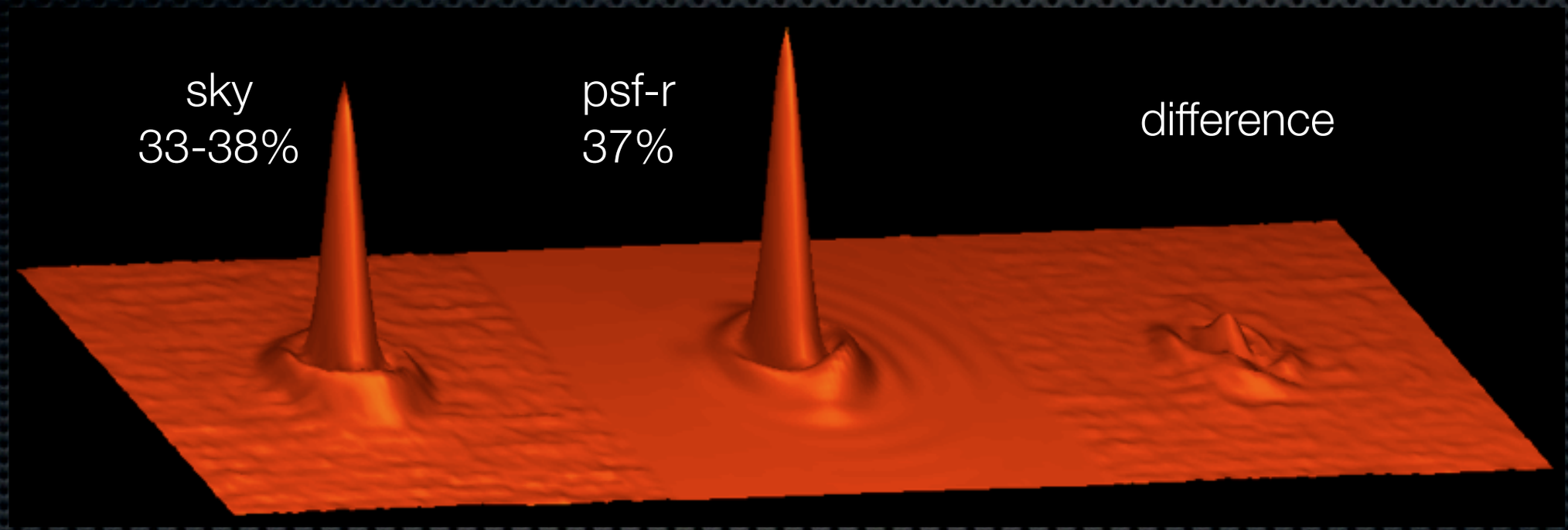

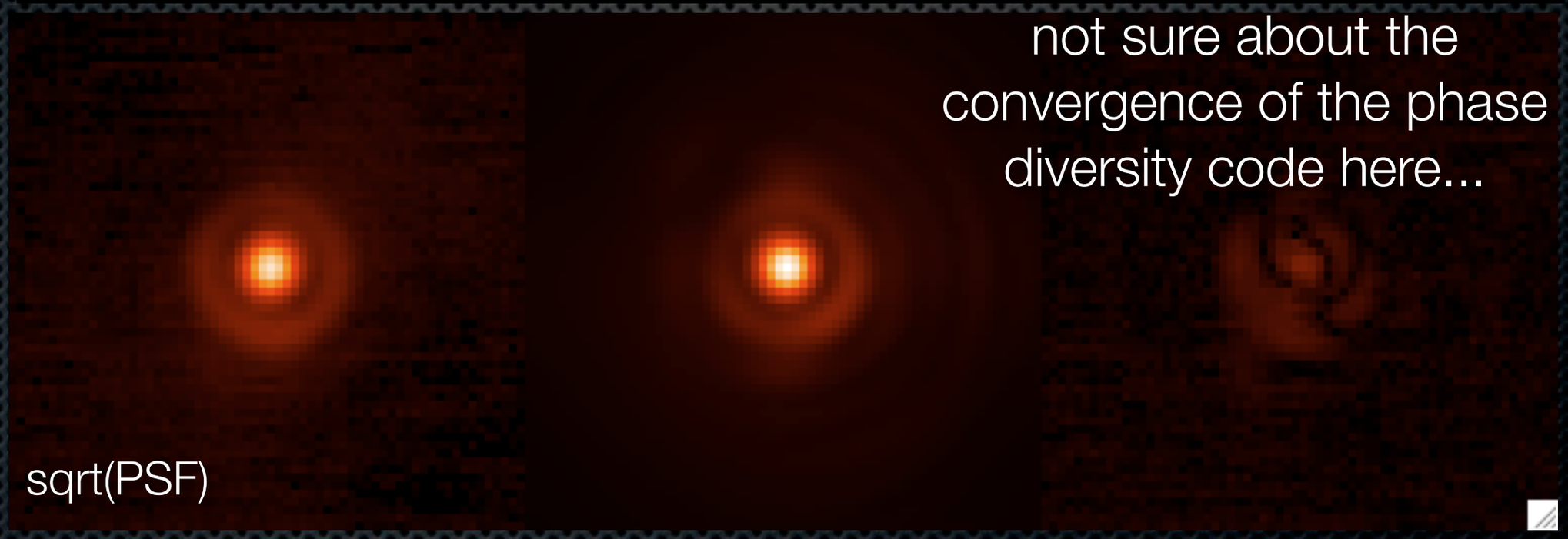

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Luc Simard

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PSF-R cannot be an afterthought in the AO design

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me