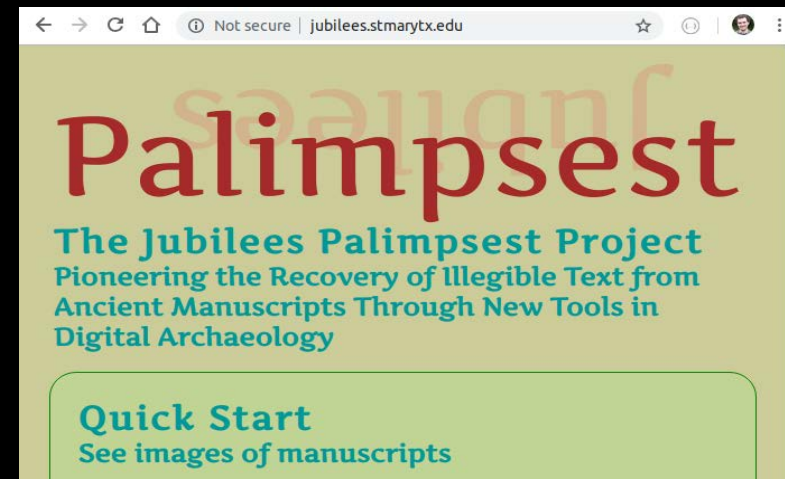


Rochester Institute of Technology, Weekly Seminar Series, November 28, 2018

What Humanities Scholars Really Want from Digital Imaging

A report from the experience of
the Jubilees Palimpsest Project
<http://jubilees.stmarytx.edu>

Todd R. Hanneken
St. Mary's University, San Antonio
thanneken@stmarytx.edu
[@thanneken](#)



Four priorities for humanities imaging science

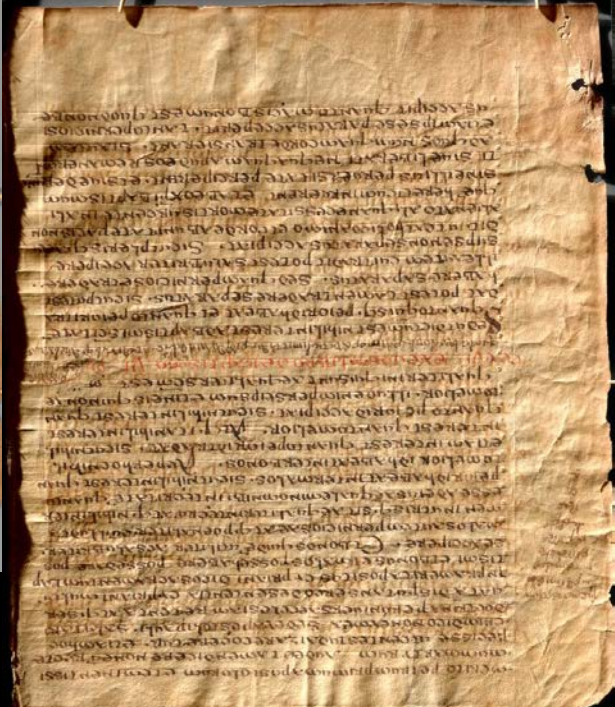
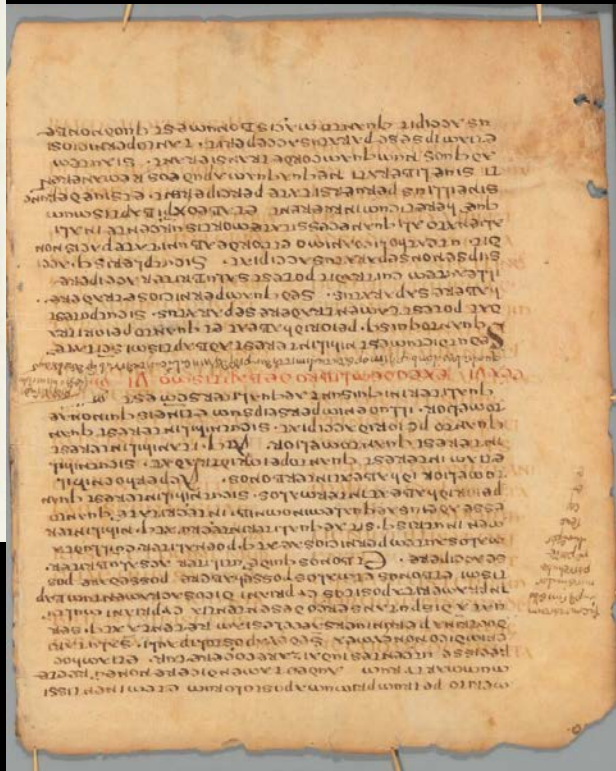
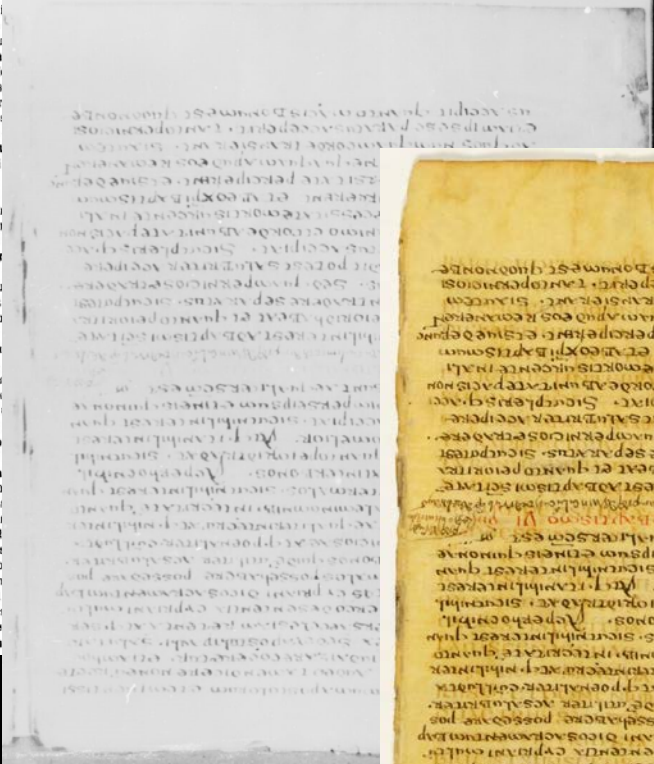
1. Access
2. Interactive experience
3. Surpass the human eye
4. Someone to pay for it

1. Access from where we are

- Data collection
 - Systematic
 - At the appropriate level
- Preservation
 - Archive and R-CHIVE
- Licenses
- Viewers beyond viewing
 - Comparison
 - Annotation
 - Collaboration
- Standards for interoperability

110. a. rum dimittis illis
secus quod place-
bit domino eorum in iu-
dicio et iustitia
autem postquam
intrabunt in terram
suam annos
et postea dominabi-
tur a principibus et
tyrannis per annos
xliii et xliii annos
abrumpeas lib x
nam descendenti tri-
bus dote et transfe-
rant scenae testi-
monium tunc datus
caelosis fecit pa-
lam scenae suae
et ferrum sanctua-
ri sui et ponentur
duae tribus sanctita-
tis nam x tribus sta-
billent sibi secus
ordinationes suas
regna et adherent
uictimas per annos
xx et uir circumuol-
labunt muros et
circumibo uir et
adcedent ad testa-
mentum domini et dnum
pollent quem fecit
colubus cum eis et im-
molabunt natos
suos diis alienis et
ponent idola scenae
seruientes illis
et in domo domini faci-
ent scelerate et s-
culpent omnem ani-
malium idola mollia
illis temporibus
ueniet illis ab ori-
ente rex et teget
equitatis terram
eorum et incendet
colonia eorum igne
cum addo sancta

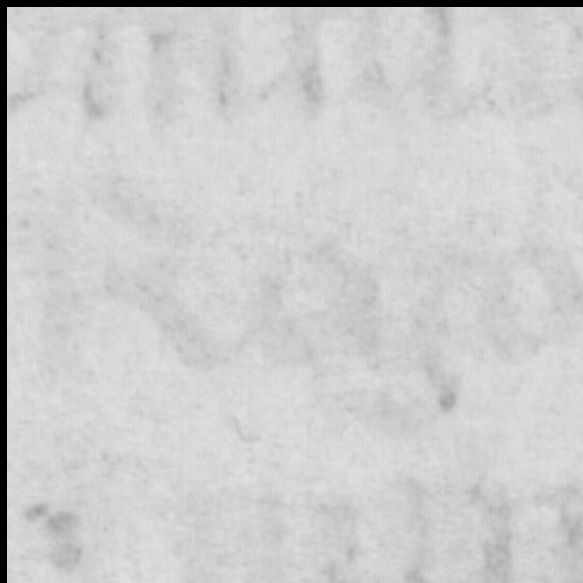
109. a. domini et sancta uen-
na tollit et omnem
plebem eiciet et du-
cet illos in terram
patriae suae et duas
tribus
Tunc
duo
et du
in ca
esari
enles
nost
iusto
quia
tis et
dacti
cum
bunt
tes i
boru
rum
facit
trou
dome
uenit
et oo
bunt
caelo
deus
ac e
niace
tum
tasti
iuran
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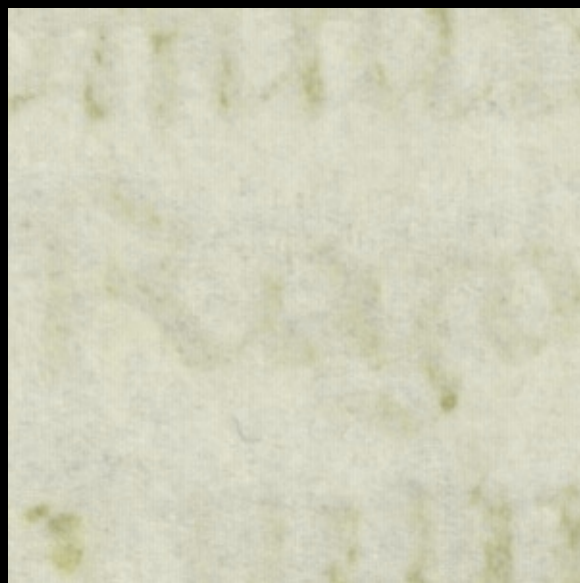
Binary color resolution



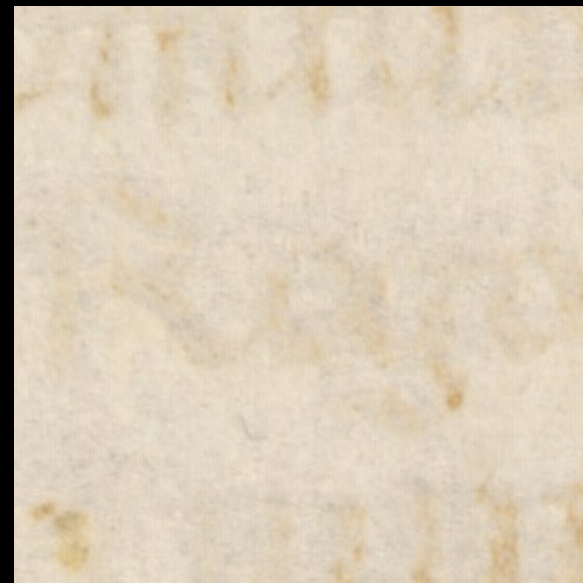
1 channel color resolution



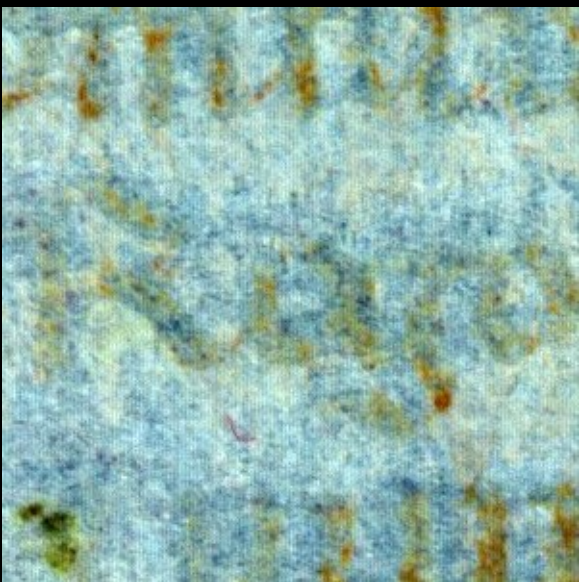
2 channel color resolution



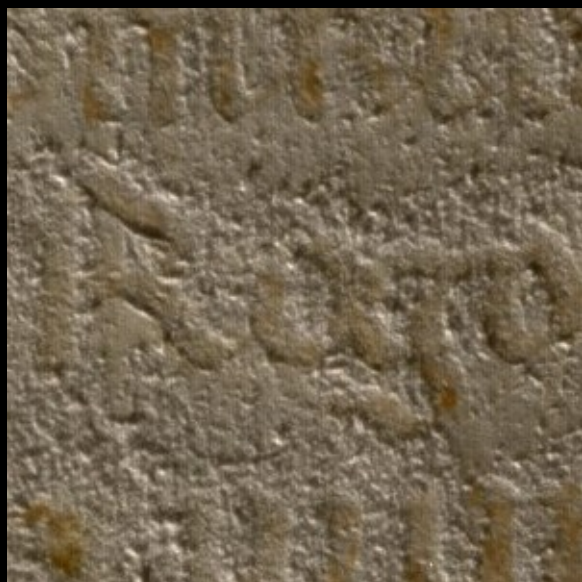
3 channel color resolution



Extended Spectrum



Accurate Color Raking



Extended Spectrum Raking



Pseudocolor Raking



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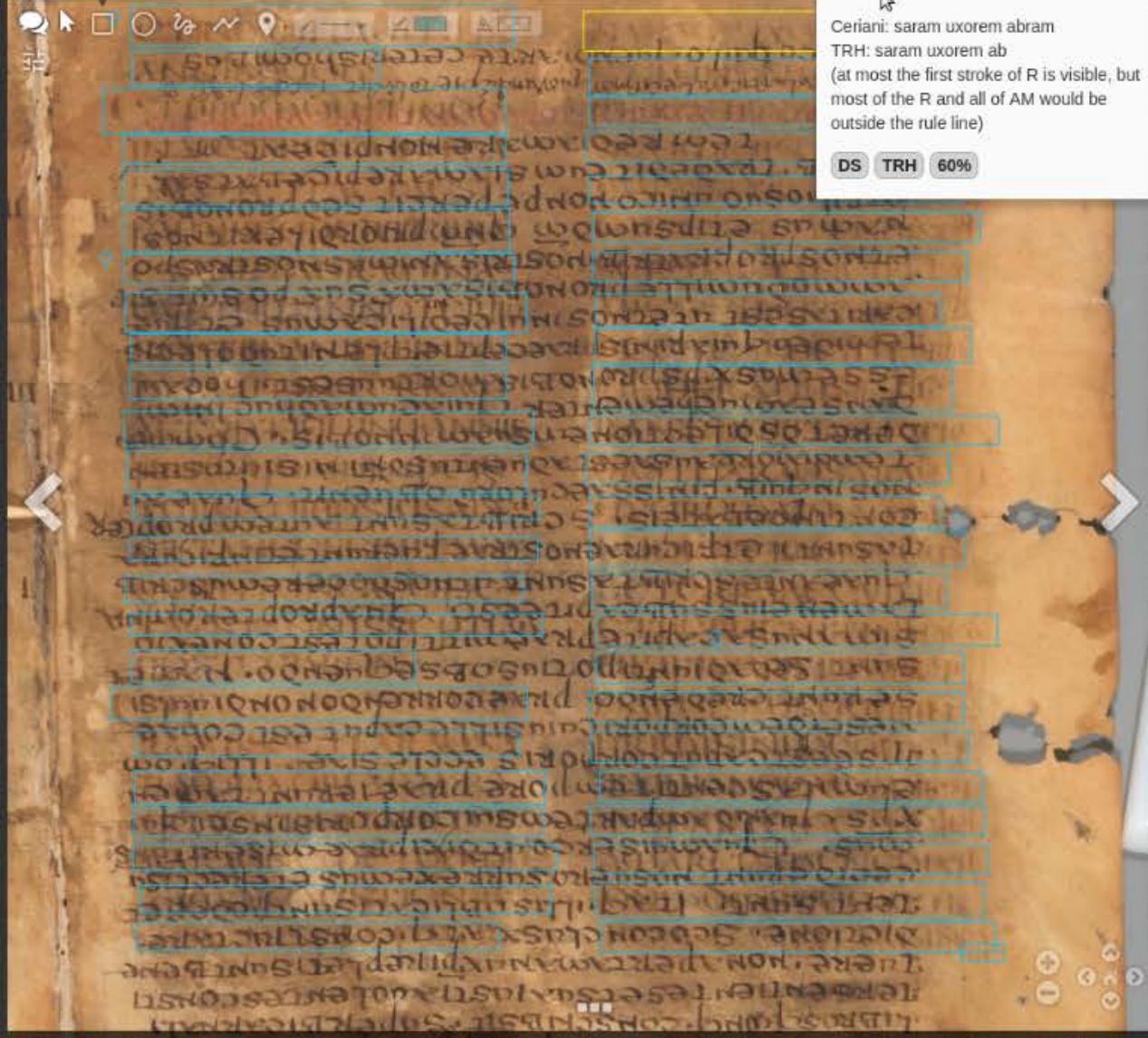


1. Access from where we are

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psiana_C73inf (Latin Moses)

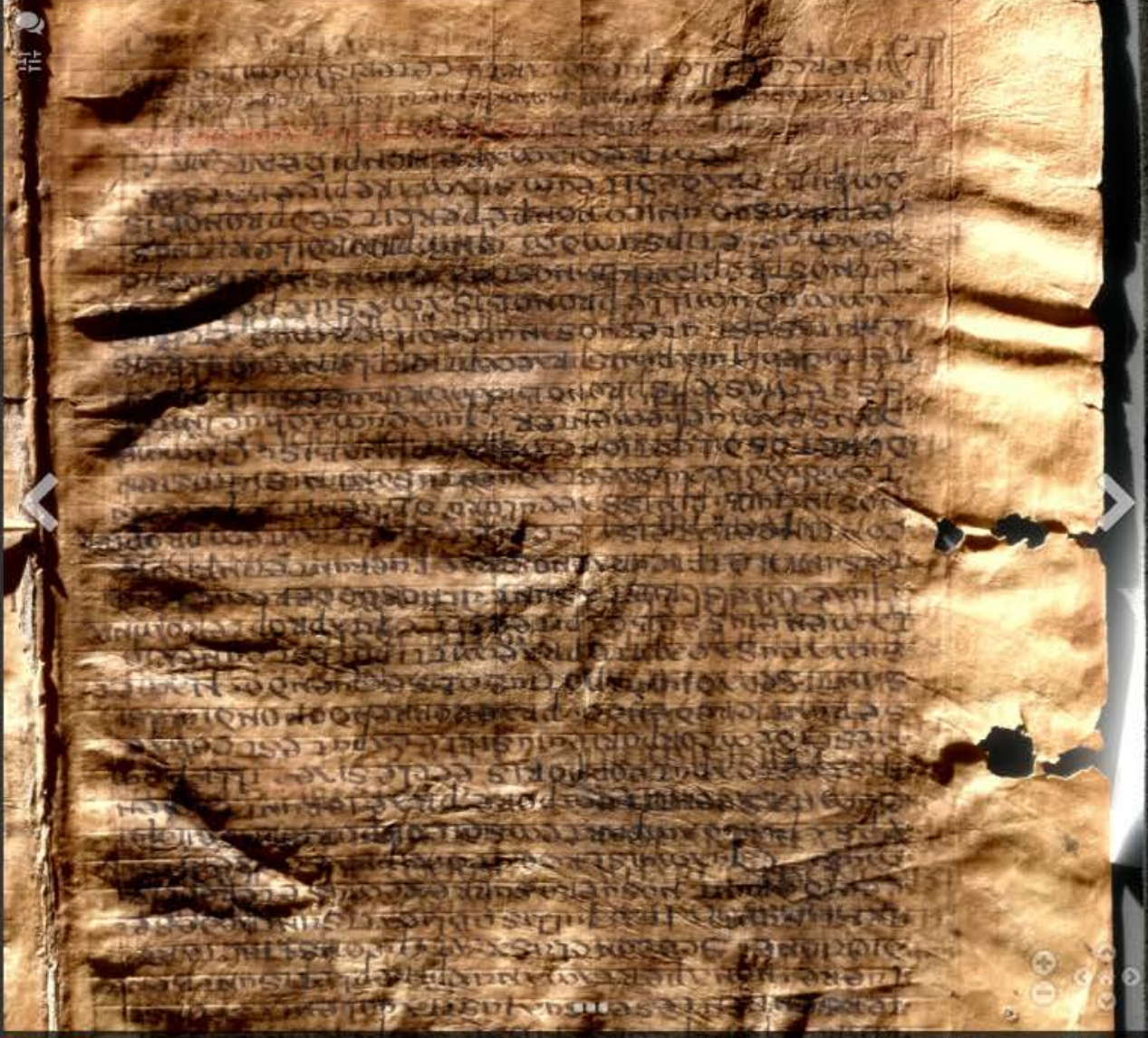


[Edit](#) [Delete](#)

☞ Ceriani: saram uxorem abram
TRH: saram uxorem ab
(at most the first stroke of R is visible, but most of the R and all of AM would be outside the rule line)

DS **TRH** **60%**

Ambrosiana_C73inf (Latin Moses)



Page 083 (19c062) Page 084 (19c061)




Image Cube

1. Accurate Color Diffuse
2. Accurate Color Raking NE
3. Accurate Color Raking SE
4. Accurate Color Raking SW
5. Accurate Color Raking NW
6. Accurate Color Transmissive
7. Extended Spectrum Diffuse
8. Extended Spectrum Raking NE
9. Extended Spectrum Raking SE
10. Extended Spectrum Raking SW
11. Extended Spectrum Raking NW
12. Extended Spectrum Transmissive
13. KTK Ruby Diffuse
14. KTK Ruby Raking NE
15. KTK Ruby Raking SE
16. KTK Ruby Raking SW
17. KTK Ruby Raking NW
18. KTK Ruby Transmissive
19. Microfilm
20. Ceriani1861

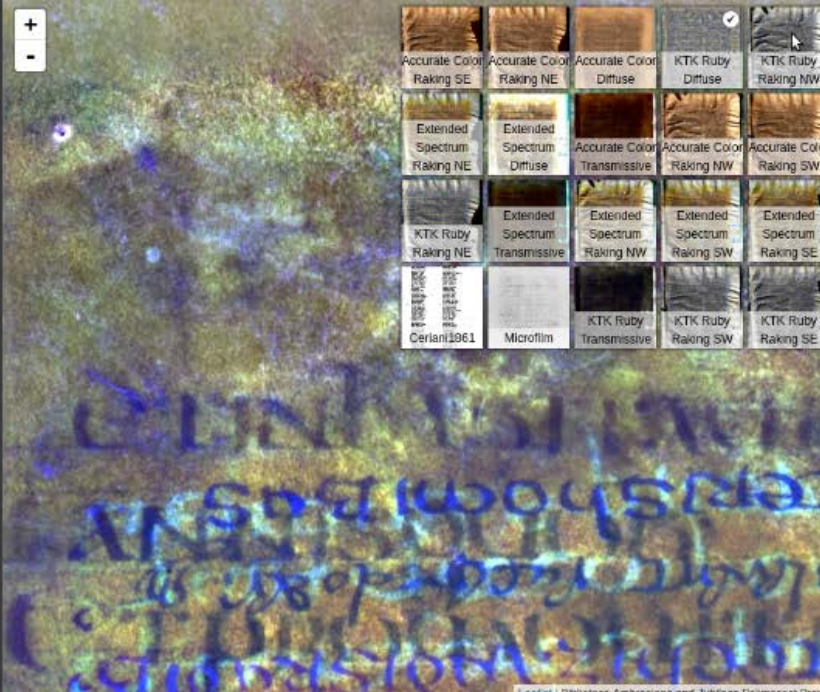
WebRTI Images Available:

1. Accurate Color
2. Extended Spectrum
3. KTK Ruby

Transcriptions and Translations:

1. Transcription Latest
2. Transcription Ceriani 1861
3. Translation Latest
4. Translation VanderKam 1989 (Latin)
5. Translation VanderKam 1989 (Edingpic)

Leaflet with Image Cube from Manifest Coordinates - Chromium



Leaflet | Biblioteca Ambrosiana and Jubilees Palimpsest Project

Latin Moses (Jubilees and Testament of Moses), The Jubilees Palimpsest Project

Latin Moses (Jubilees and Testament of Moses), The Jubilees Palimpsest Project

Ancient page 083 (=modern page number 062)

col. a	col. b
Et inhabitauit illic	saram uxorem abram.
annis duobus.	Et tunc abram glorificauit
Et promouit inde	diuitiis ualde
in austrum usque ba-	omnibus ouibus et
halot et facta est	bubus et asinis et
famis super terram.	camelis et equis et
Et abiit abram in aegyptum	seruis et ancillis
anno tertio	argento et aro ualde.
septimani et inhabitauit	Etenim et loth
in terram	filio fratris sui erant
aegypti quinque annis	diuitiae. Et reddidit
priusquam raperetur	farao saram
uxor ipsius ab eo.	uxorem abram uiro
Et tunc quibus uentum	non et cisit cum

Translation of Latin Moses - Chromium

Translation of Latin Moses - Chromium

13:10 ... 5c083 he stayed there for two years. Then he went to the southern territory as far as Bahalot. There was a famine in the land. 13:11 So Abram went to Egypt in the third year of the week. He lived in the land of Egypt for five years before his wife was taken from him by force. 13:12 Tanais, the Egyptian city, was built at that time — seven years after Hebron. 13:13 When the pharaoh took Abram's wife Sarah by force, the Lord punished the pharaoh and his household very severely because of Abram's wife Sarah. 13:14 At that time he made Abram extremely wealthy with all (kinds of) sheep, cattle, donkeys, camels, horses, male and female servants, silver and very (much) gold. Lot — his brother's son — was also wealthy. 13:15 The pharaoh returned Abram's wife Sarah to her husband and expelled him from the land of Egypt. He went to the place where he had first pitched his tent — at the location of the altar, with Ai on the east side and Bethel on the west. He blessed the Lord his God who had brought him back safely. 13:16 5c084 During the forty-first jubilee, in the third year of the first week, he returned to this place. He offered sacrifices and called on the Lord's name: 'You, most high God, are my God forever and ever'.

13:17 In the fourth year of this week Lot separated from him. He settled in Sodom. Now the Sodomite people were very sinful. 13:18 They were evil in their hearts that Lot, his brother's son, had separated from him for he had no children. 13:19 Lot was taken captive from him. But in the fourth year of this week — of the same jubilee — God said to Abram: 'Look up from where you are staying toward the west, the south, the east, and the north; 13:20 because all the land which you see I will give to you and your descendants forever. I will make your descendants like the sands of the sea, for your descendants will not be counted. 13:21 Now you — get up and walk its width. Look at everything because I will give it to your descendants'. Then Abram went to Hebron and lived ...

15:20 5c083 '... him, make him numerous, and increase him very much. For he will father 12 princes, and I will make him into a larger nation. 15:21 But my covenant I will establish with Isaac whom Sarah will bear for you at this time next year'. 15:22 When he had finished speaking with him, God ascended from Abraham.

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Filter objects: Add new object from URL: Load

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	Catholic Church. Homiliarium. Homiliary including works of Bede, Augustine, and Gregory: manuscript, [11--]. MS Typ 441. Harvard University 40 items	
	Poems by Guillaume de Machaut, [15 cent.] National Library of Wales 178 items	
	The clans of the Scottish Highlands Stanford University 360 items	
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	A group of Irish Free State Army soldiers firing artillery on the Four Courts University College Dublin 1 item	
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	大正新脩大藏經圖像部第12b02卷 University of Tokyo 1 item	

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2. Interactive experience

- Is there a substitute for first-hand experience?
- Spatial resolution
- Color resolution and accuracy
- Depth
- Surface texture
- Interactivity

meto peritiam a pistolo am ceteri herissi
mum a r r r r m ad e o l a m e n d i c e r e n o n e l i p e r e
i l e s s e u r e n t e s i n d a i z a r e c o c e r t u r e t a a m h o c
c r i o d i c o n o t e r e x s e d e p o s t u p u l i s a l t a m
d o c t r i n a p e r t i n e r s e r e l e s i a m r e t e r t a a t q u e s e r
a r a d i s p a r s e r e o d e s e r e n t u r a c r i p t a m e a l t i
t p r a m e r t a p o s i t a t e p r i a m d i c o s a c r a m e n t u m r a p
t s o m e t b o n a t e m a l o s p o s s e a r e p o s s e d a r e p o s
s e a c c i p e r e . E t b o n o s q u i d e u i l t e r a c s a l u b r e r
m a l o s u r t e m p e r m i c i o s e a r q u o e n a l i t e r c o l l a t a
m e n i n u r s q u e t a e q u a l i t e r m e c a t r q u e n i l i n e r
e s s e a d e u s e q u a l e m o m i b i n t e c t a r e q u a n t u
p e r i o r i a b e a r m e r m a l o s . s i c u t n i l i n e r e s t q u a n t
t o m e l i o r i a b e a r m e r b o n o s . A p e r p h o e r i b i l
e a m i r e c e s t q u a n t o p e i o r i a t i a t e . s i c u t n i l i
m e r e s t q u a n t o m e l i o r . A t q u e t a n i l i n e r e s t
q u a n t o p i o r i a a c c i p i a t . s i c u t n i l i n e r e s t q u a n
t o m e l i o r . i l l a d e m p e r s i p s u m e n i e s q u a n o n a e
q u a l i t e r m i q u a n t a e q u a l i t e r s c o m e s t m
c e r v i e x o d e o m l i b r o d e b a p t i s m o . V i g e n t i s e t
m e t a s i s t o r i a p e r o m e t a m l i c o m m u n i t e m l i b r o d e b a p t i s m o

CXXVI ex o d o m l i b r o d e b a p t i s m o . V i g e n t i s e t m e t a s i s t o r i a p e r o m e t a m l i c o m m u n i t e m l i b r o d e b a p t i s m o

qualiter miqua...
com...
qua...
tome...
qualiter miqua...

meto peritiam...
mum a r r r r m...
i l e s s e...
c r i o d i c o...
d o c t r i n a...
t p r a m e r t a...
t s o m e t b o n a...
s e a c c i p e r e...
m a l o s u r t e m...
m e n i n u r s q u e...
e s s e a d e u s e...
p e r i o r i a b e...
t o m e l i o r i a...
e a m i r e c e s t...
m e r e s t q u a n t...
q u a n t o p i o r i...
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q u a l i t e r m i...
c e r v i e x o d e...
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m e t a s i s t o r i...
c r i o d i c o n o t...
d o c t r i n a p e r...
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m e n i n u r s q...
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m e r e s t q u...
q u a n t o p i...
t o m e l i o r .

us accipit quantum magis dicitur est quod non de
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nisi sine libet ut nequam apud eos remaneret
spem illius peruersitate percipere. et sine de quibus
que heretiam in frangeret et in eo xpi baptisium
alitero aliquid peressit in mortis uircente mali
dit ut etiam in christo et corde ab uiritate pacis non
supset non separatus accipiat. Sicut plerisque acci
illam eam curritur potest saluiter accipere
habere separatus. sed quam per nichilios e tradere
dat potest tamen tradere separatus. si cupias
quod quisque penitus habeat et quantum perior
separatum est nihil pertinet ad baptismum scilicet

meto peritiam a pistolo am ceteri herissi
mum a r r r r m ad e o l a m e n d i c e r e n o n e l i p e r e
i l e s s e u r e n t e s i n d a i z a r e c o c e r t u r e t a a m h o c
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d o c t r i n a p e r t i n e r s e r e l e s i a m r e t e r t a a t q u e s e r
a r a d i s p a r s e r e o d e s e r e n t u r a c r i p t a m e a l t i
t p r a m e r t a p o s i t a t e p r i a m d i c o s a c r a m e n t u m r a p
t s o m e t b o n a t e m a l o s p o s s e a r e p o s s e d a r e p o s
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m a l o s u r t e m p e r m i c i o s e a r q u o e n a l i t e r c o l l a t a
m e n i n u r s q u e t a e q u a l i t e r m e c a t r q u e n i l i n e r
e s s e a d e u s e q u a l e m o m i b i n t e c t a r e q u a n t u
p e r i o r i a b e a r m e r m a l o s . s i c u t n i l i n e r e s t q u a n t
t o m e l i o r i a b e a r m e r b o n o s . A p e r p h o e r i b i l
e a m i r e c e s t q u a n t o p e i o r i a t i a t e . s i c u t n i l i
m e r e s t q u a n t o m e l i o r . A t q u e t a n i l i n e r e s t
q u a n t o p i o r i a a c c i p i a t . s i c u t n i l i n e r e s t q u a n
t o m e l i o r . i l l a d e m p e r s i p s u m e n i e s q u a n o n a e
q u a l i t e r m i q u a n t a e q u a l i t e r s c o m e s t m
c e r v i e x o d o m l i b r o d e b a p t i s m o . V i g e n t i s e t
m e t a s i s t o r i a p e r o m e t a m l i c o m m u n i t e m l i b r o d e b a p t i s m o

CXXVI ex o d o m l i b r o d e b a p t i s m o . V i g e n t i s e t m e t a s i s t o r i a p e r o m e t a m l i c o m m u n i t e m l i b r o d e b a p t i s m o

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etiam ipse se parat ut accepit. tam operum in
ad quos nunquam corde transierat. si autem
nisi sine libet ut nequam apud eos remaneret
spem illius peruersitate percipere. et sine de quibus
que heretiam in frangeret et in eo xpi baptisium
alitero aliquid peressit in mortis uircente mali
dit ut etiam in christo et corde ab uiritate pacis non
supset non separatus accipiat. Sicut plerisque acci
illam eam curritur potest saluiter accipere
habere separatus. sed quam per nichilios e tradere
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quod quisque penitus habeat et quantum perior
separatum est nihil pertinet ad baptismum scilicet

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etiam ipse se parat ut accepit. tam operum in
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que heretiam in frangeret et in eo xpi baptisium
alitero aliquid peressit in mortis uircente mali
dit ut etiam in christo et corde ab uiritate pacis non
supset non separatus accipiat. Sicut plerisque acci
illam eam curritur potest saluiter accipere
habere separatus. sed quam per nichilios e tradere
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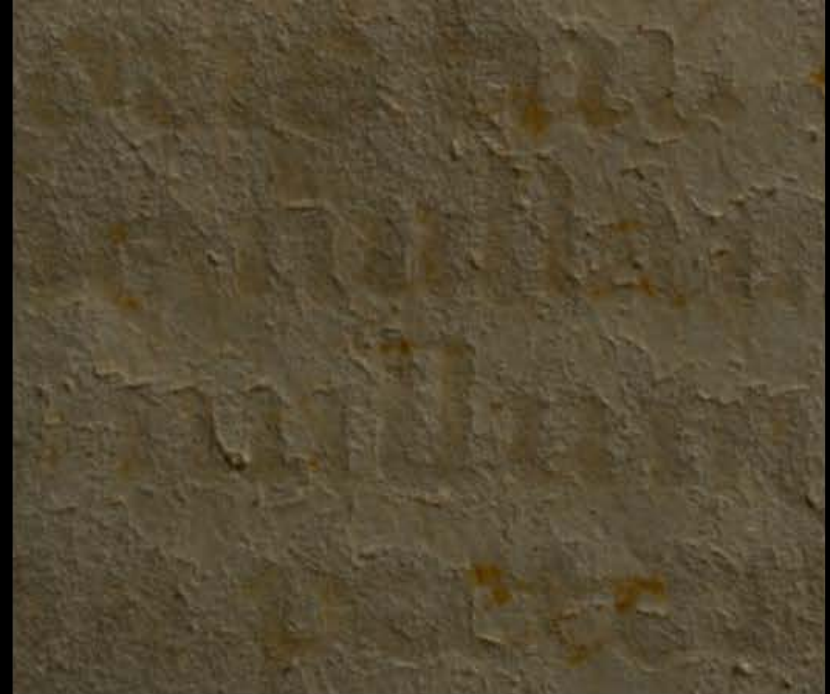
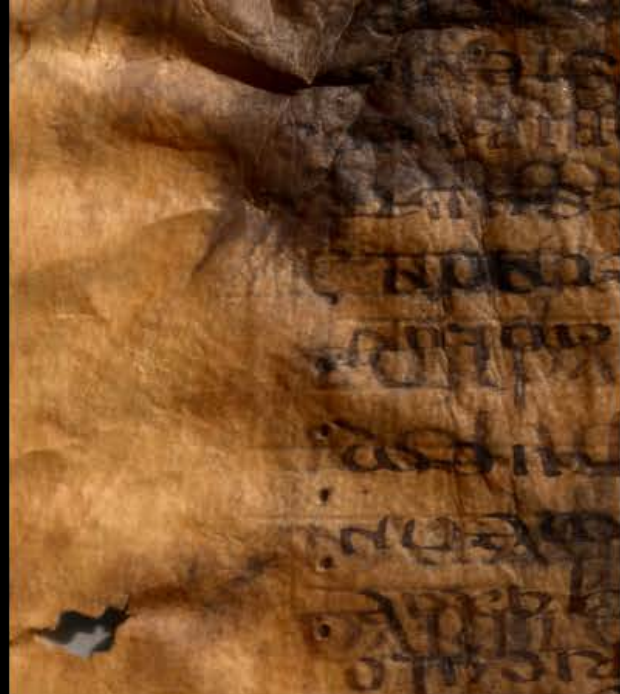
qualiter miqua...
com...
qua...
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qualiter miqua...

meto peritiam...
mum a r r r r m...
i l e s s e...
c r i o d i c o...
d o c t r i n a...
t p r a m e r t a...
t s o m e t b o n a...
s e a c c i p e r e...
m a l o s u r t e m...
m e n i n u r s q u e...
e s s e a d e u s e...
p e r i o r i a b e...
t o m e l i o r i a...
e a m i r e c e s t...
m e r e s t q u a n t...
q u a n t o p i o r i...
t o m e l i o r . i l l...
q u a l i t e r m i...
c e r v i e x o d e...
m e t a s i s t o r...
m e t a s i s t o r i...
c r i o d i c o n o t...
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t p r a m e r t a...
t s o m e t b o n...
s e a c c i p e r e...
m a l o s u r t e...
m e n i n u r s q...
e s s e a d e u s...
p e r i o r i a b...
t o m e l i o r i...
e a m i r e c e...
m e r e s t q u...
q u a n t o p i...
t o m e l i o r .

2. Interactive experience

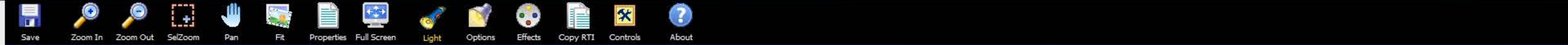
- Is there a substitute for first-hand experience?
- Spatial resolution
- Color resolution and accuracy
- Depth
- Surface texture
- Interactivity





...um...
...on...
...in...
...et...
...que...
...sunt...
...et...
...et...
...et...
...et...
...et...





RTI Zoom is: 45 %

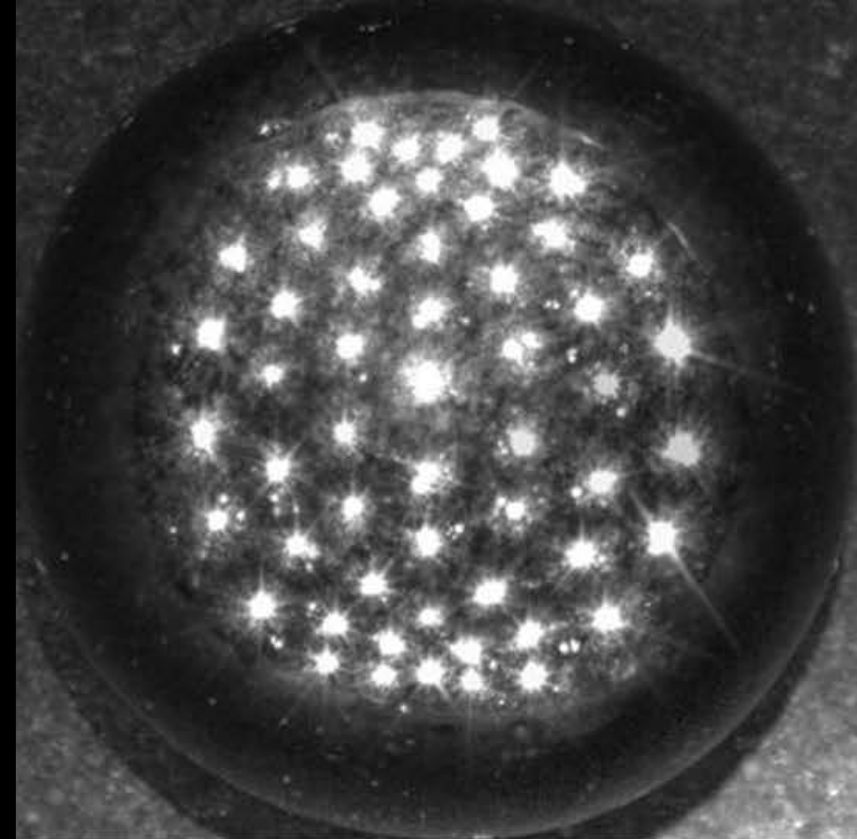
Texture and Interactivity: Reflectance Transformation Imaging (RTI)

- Capture
- Processing
- Visualization



Texture and Interactivity: Reflectance Transformation Imaging (RTI)

- Capture
- Processing
- Visualization



$$C = a_0 L_u^2 + a_1 L_v^2 + a_2 L_u L_v + a_3 L_u + a_4 L_v + a_5$$

```

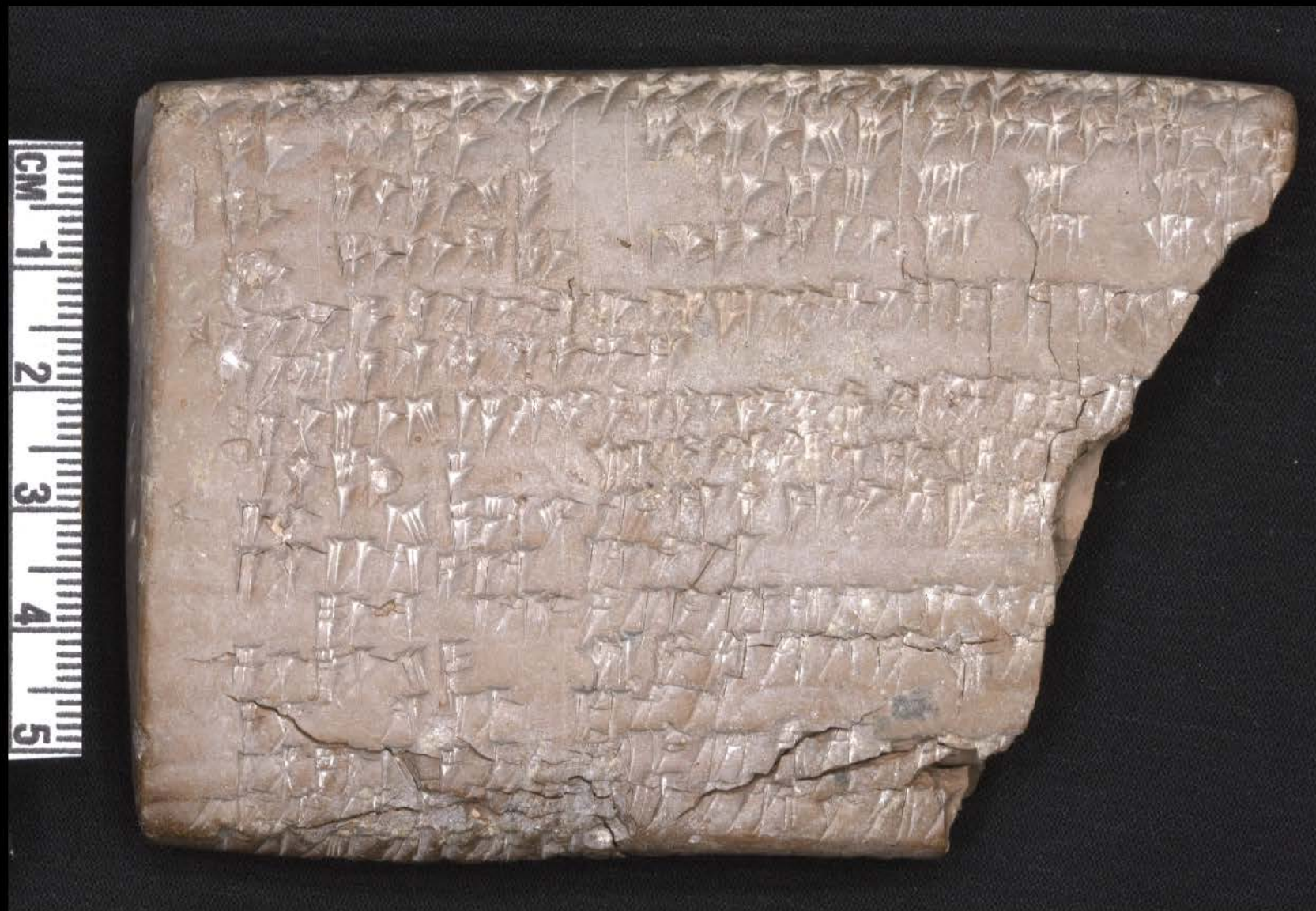
hsh_matrix[9*in->num_used+i] = 2*sqrt(35/M_PI) * cos(3*phi)*pow((cos(theta) - pow(cos(theta),2)),(3/2));
hsh_matrix[10*in->num_used+i] = (sqrt(210/M_PI) * cos(2*phi)*(-1 + 2*cos(theta))*(-cos(theta) + pow(cos(theta),2)));
hsh_matrix[11*in->num_used+i] = 2*sqrt(21/M_PI) * cos(phi)*sqrt(cos(theta) - pow(cos(theta),2))*(1 - 5*cos(theta) + 5*pow(cos(theta),2));
hsh_matrix[12*in->num_used+i] = sqrt(7/(2*M_PI)) * (-1 + 12*cos(theta) - 30*pow(cos(theta),2) + 20*pow(cos(theta),3));
hsh_matrix[13*in->num_used+i] = 2*sqrt(21/M_PI) * sqrt(cos(theta) - pow(cos(theta),2))*(1 - 5*cos(theta) + 5*pow(cos(theta),2))*sin(phi);
hsh_matrix[14*in->num_used+i] = (sqrt(210/M_PI) * (-1 + 2*cos(theta))*(-cos(theta) + pow(cos(theta),2))*sin(2*phi));
hsh_matrix[15*in->num_used+i] = 2*sqrt(35/M_PI) * pow((cos(theta) - pow(cos(theta),2)),(3/2))*sin(3*phi);

```



Texture and Interactivity: Reflectance Transformation Imaging (RTI)

- Capture
- Processing
- Visualization



RTI Zoom is: 45 %

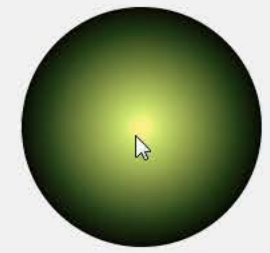
General

luminance (x0.1) 0 10 20 30 40

0 25 50 75 100

Thumbnail

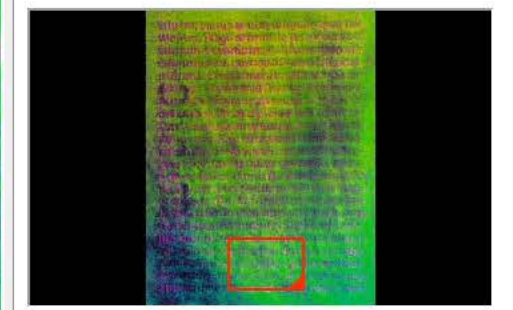
Move cursor in the selected image or in the thumbnail above to move the light around in the image.



Light
x 0.00
y 0.00
Zoom
200%
Pan
x 863
y 2359

Rendering mode
Default

Navigator | Bookmarks
File DataArchive\Pal1\Pepl\20140415-Pal1-99-Pepl-04-50m-yccf01.ptm
Size 2376 x 3040 Format LRGB PTM





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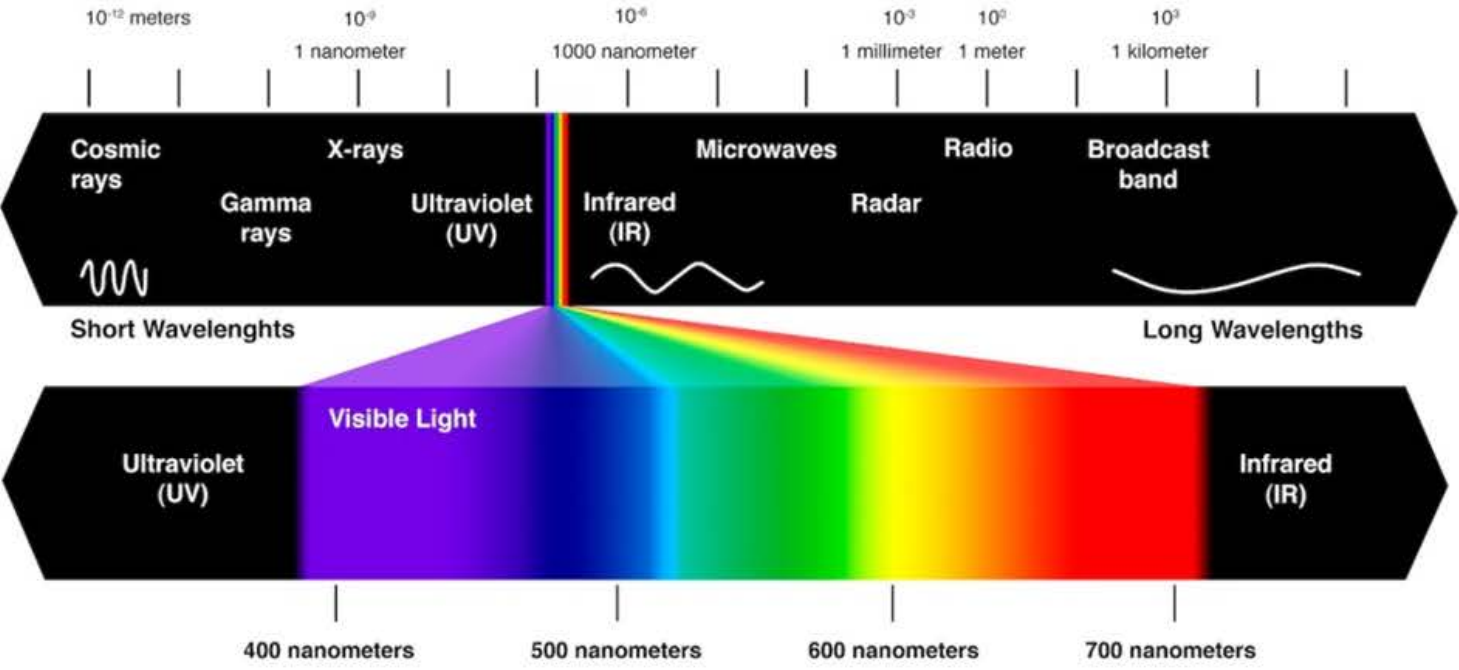
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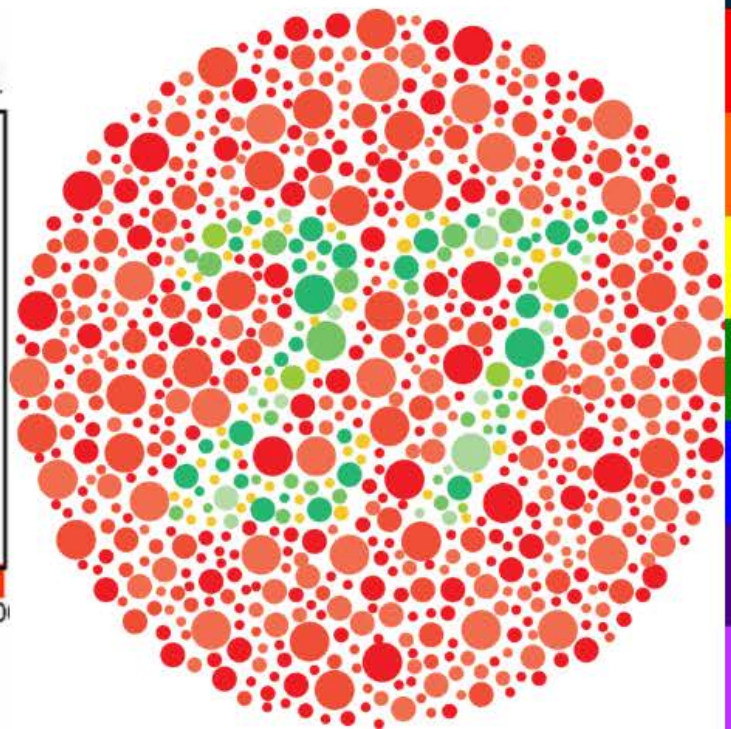
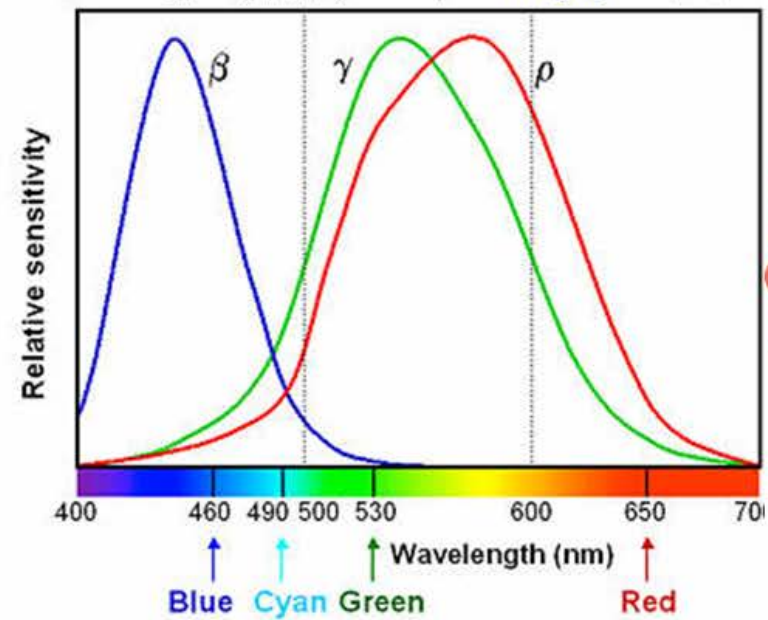
3. Surpass the human eye

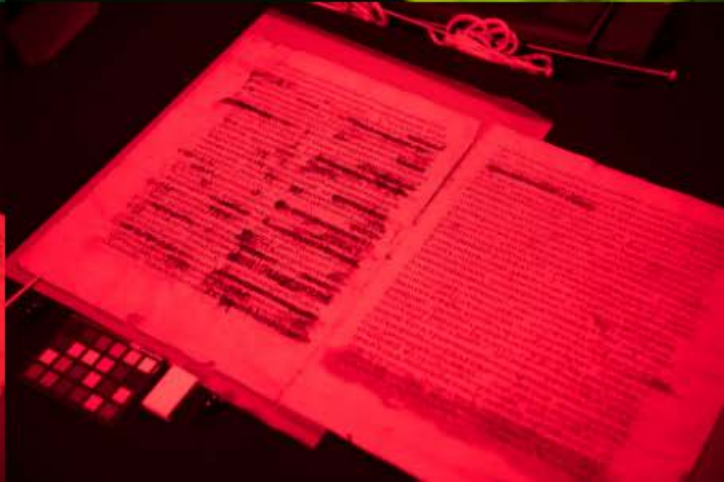
- Capture
 - Three bands (human eye)
 - Sixteen bands (multispectral)
 - Hundreds of bands (hyperspectral)
- Processing
 - Many tools in the toolkit
 - Trial and error, informed intuition
 - Evaluation pitfalls
 - Scientific analysis of chemical composition
 - Machine learning in transformations
 - Machine learning for evaluation
- Visualization
 - Pseudocolor
 - Motion



Human spectral sensitivity to color

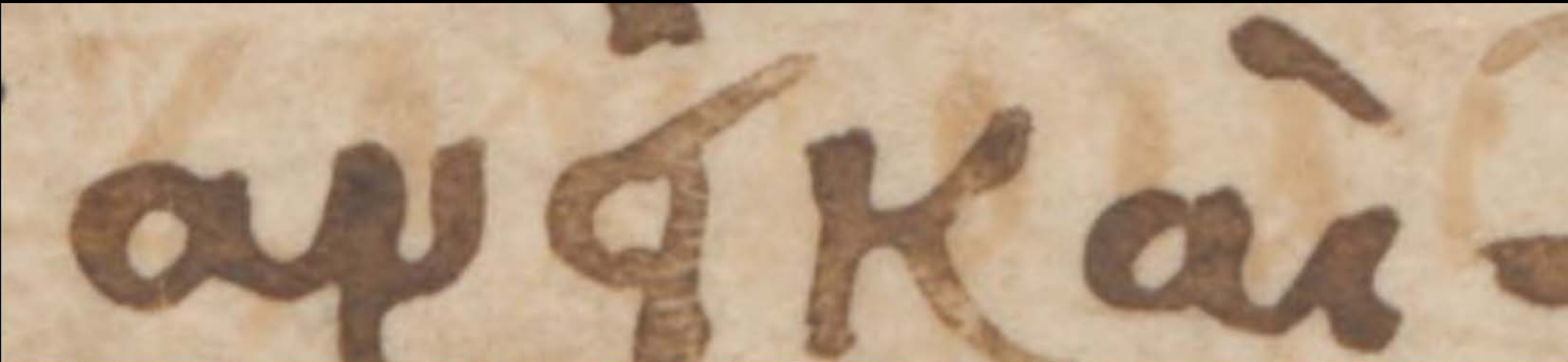
Three cone types (ρ , γ , β) correspond *roughly* to R, G, B.



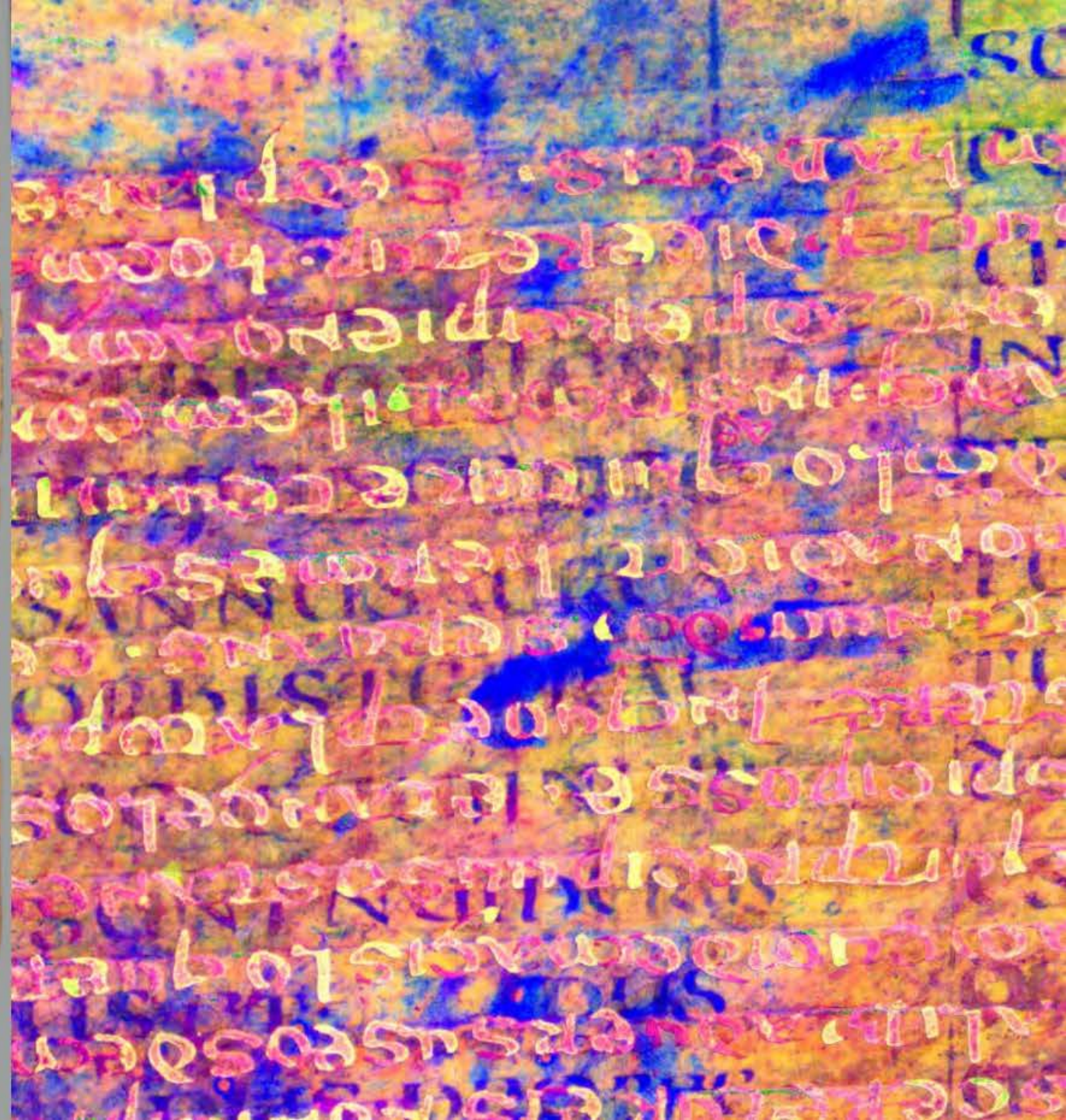


3. Surpass the human eye

- Capture
 - Three bands (human eye)
 - Sixteen bands (multispectral)
 - Hundreds of bands (hyperspectral)
- Processing
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[The text on this page is written upside down and is largely illegible due to significant fading and bleed-through from the reverse side. It appears to be a dense block of Latin text.]



Accurate Color



Extended Spectrum



3. Surpass the human eye

- Capture
 - Three bands (human eye)
 - Sixteen bands (multispectral)
 - Hundreds of bands (hyperspectral)
- Processing
 - Many tools in the toolkit
 - Trial and error, informed intuition
 - Evaluation pitfalls
 - Scientific analysis of chemical composition
 - Machine learning in transformations
 - Machine learning for evaluation
- Visualization
 - Pseudocolor
 - Motion

4. Someone to pay for it

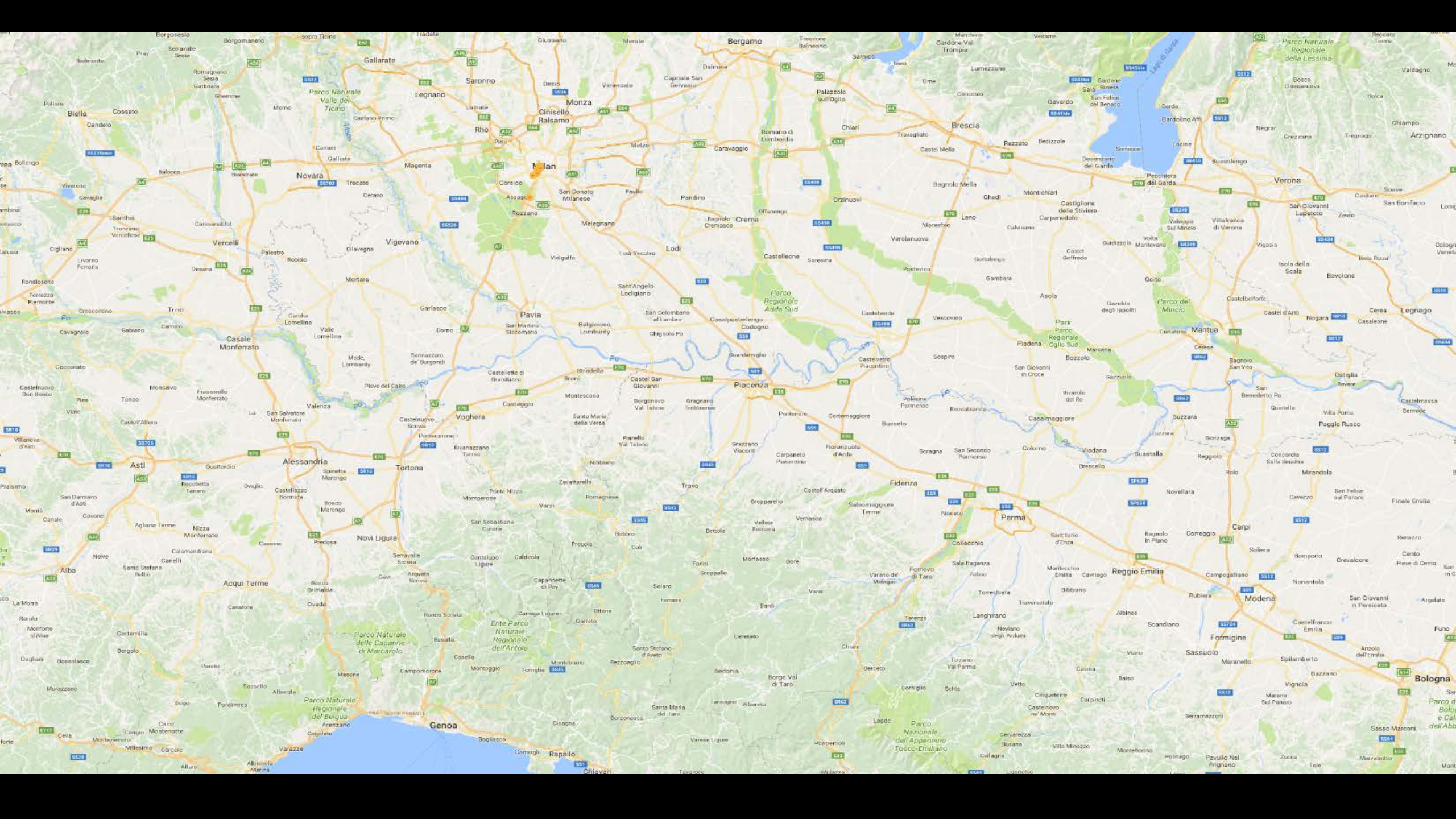
1. Lower costs

- Travel
- Stability
- Economy of scale
- Equipment options
- Software options

2. Stable funding models

3. Build on related industries

- Medical imaging
- Gaming
- Movies and television
- Cell phone cameras
- Geographic information systems
- Cultural heritage private industry



4. Someone to pay for it

1. Lower costs

- Travel
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3. Build on related industries

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- Gaming
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- Cultural heritage private industry

← → ↻ 🏠 https://github.com/thanneken/SpectralRTI_Toolkit ☆

🐙 This repository Search Pull requests Issues Marketplace Explore 🔔 + 👤

📄 thanneken / [SpectralRTI_Toolkit](#) 🙄 Unwatch 2 ★ Star 1 🍴 Fork 1

↔ Code ⓘ Issues 0 🏷️ Pull requests 0 📁 Projects 0 📖 Wiki 📊 Insights ⚙️ Settings

Process Spectral RTI Images in ImageJ Edit

[Add topics](#)

🕒 38 commits 🌿 1 branch 📦 0 releases 👤 1 contributor 📄 GPL-3.0

Branch: master ▾ New pull request Create new file Upload files Find file Clone or download ▾

👤 thanneken Add files via upload Latest commit e328c23 on Jul 31

📁 Guide	Add files via upload	3 months ago
📄 LICENSE	Initial commit	a year ago
📄 PCA_class	Principal Component Analysis Plugin	a year ago
📄 README.md	January 24, 2017 update	10 months ago
📄 SpectralRTI_Dataset.bash	Capture folders now specify Gamma or NoGamma	8 months ago
📄 SpectralRTI_Toolkit.ijm	Update SpectralRTI_Toolkit.ijm	4 months ago
📄 Stack_Manipulation-2.0.1.zip	Required "Slice Keeper" function, included in Fiji	4 months ago
📄 bij_plugin.zip	Biomedical Imaging in Java	4 months ago
📄 ijp-toolkit_bin_2.1.0.zip	http://ijp-plugins.sourceforge.net/plugins/color/	8 months ago

📖 README.md

SpectralRTI_Toolkit

Process Spectral RTI Images in ImageJ

The toolkit processes the data from a Spectral RTI capture session. This data includes diffuse narrowband spectral images, monochrome RTI captures from 35 or more light positions, and an accurate color image. The toolkit guides processing of the light position (lp) file, and outputs to HSH RTI, PTM, and WebRTI formats. The base color processing options are Accurate Color, Extended Spectrum, and PCA Pseudocolor. The Toolkit is intended to be usable by general users without requiring any editing of text files, command line arguments, or regular expressions. For more information about Spectral RTI see

Guide to Creating Spectral RTI Images

Contents

1. What is Spectral RTI and do I need it? ([LINK](#))
 - a. Cost/benefit of adding RTI ([LINK](#))
 - b. Cost/benefit of adding spectral ([LINK](#))
 - c. How does the integration work? ([LINK](#))
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 - j. Options for custom processes ([LINK](#))
 - k. Light position data ([LINK](#))
 - l. Additional prompts ([LINK](#))
 - m. Tips for frequent use ([LINK](#))
5. Make the images accessible to users ([LINK](#))
 - a. RTI files ([LINK](#))
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 - c. Tiled and layered Jpeg2000 files for IIIF ([LINK](#))
6. Help make Spectral RTI better ([LINK](#))
7. Glossary ([LINK](#))

4. Someone to pay for it

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MegaVision

The **First** Name in
DIGITAL IMAGING

Professional



- Digital camera backs, camera systems accessories and software for professional photographers.

>> Camera Backs

OEM Scientific



- Image capture solutions, subsystems, and enabling software for OEM integrators and technical imaging applications.

>> OEM Scientific

Cultural Heritage



- Multi-spectral camera systems for the imaging of cultural heritage treasures, opening new possibilities for conservation, preservation and reproduction.

>> Cultural Heritage

Ophthalmology



- Digital camera backs, and enabling software for fundus cameras.

We set the standard for retinal image quality.

>> Ophthalmology Imaging

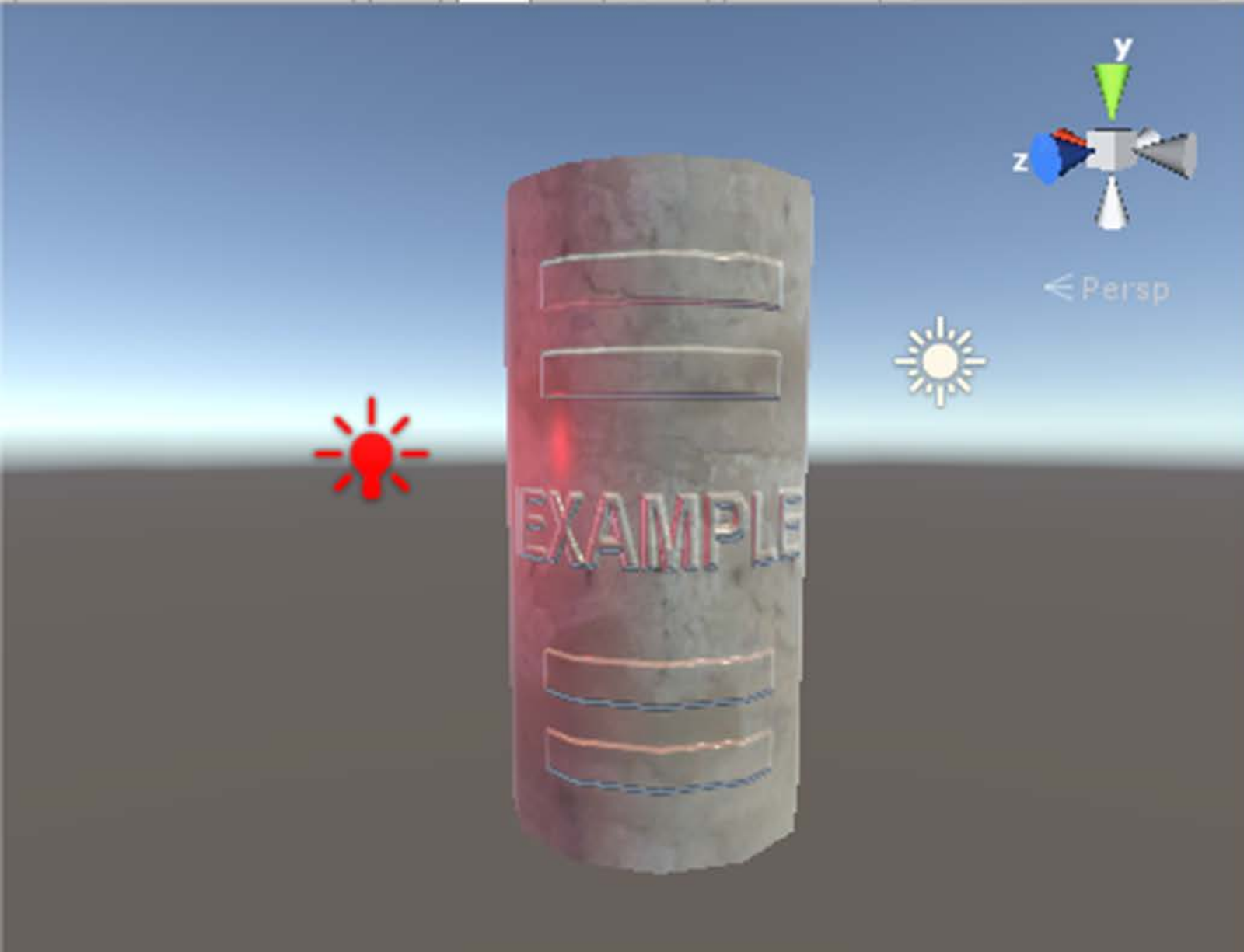
Retinopathy



- Imaging solutions for the evaluation and assessment of diabetic retinopathy and retinal disorders.

>> Retinopathy Imaging





Inspector

Simple Bumpmap Example
Shader: Standard

Rendering Mode: Opaque

Main Maps

- Albedo
- Metallic: 0
- Smoothness: 0.5
- Source: Metallic Alpha
- Highlights:
- Reflections:
- Normal Map: 1
- Height Map
- Occlusion
- Emission: 0
- Detail Mask

Tiling: X 2 Y 1
Offset: X 0 Y 0

Production Budget Costs



4. Someone to pay for it

1. Lower costs

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Rochester Institute of Technology, Weekly Seminar Series, November 28, 2018

What Humanities Scholars Really Want from Digital Imaging

A report from the experience of
the Jubilees Palimpsest Project
<http://jubilees.stmarytx.edu>

Todd R. Hanneken
St. Mary's University, San Antonio
thanneken@stmarytx.edu
@thanneken

1. Access
2. Interactive experience
3. Surpass the human eye
4. Someone to pay for it