

RISK ASSESSMENT: LIGHT



PRESERVATION OF BUDDHIST TREASURES RESOURCE is the free online resource for monasteries and communities, with practical information on digital documentation, risk assessment and disaster recovery, safer storage, and preservation of thangka and other treasures. The resource comes from over 50 years of preservation work in monasteries.



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RISK ASSESSMENT: LIGHT

RISK ASSESSMENT: LIGHT 風險評估：光

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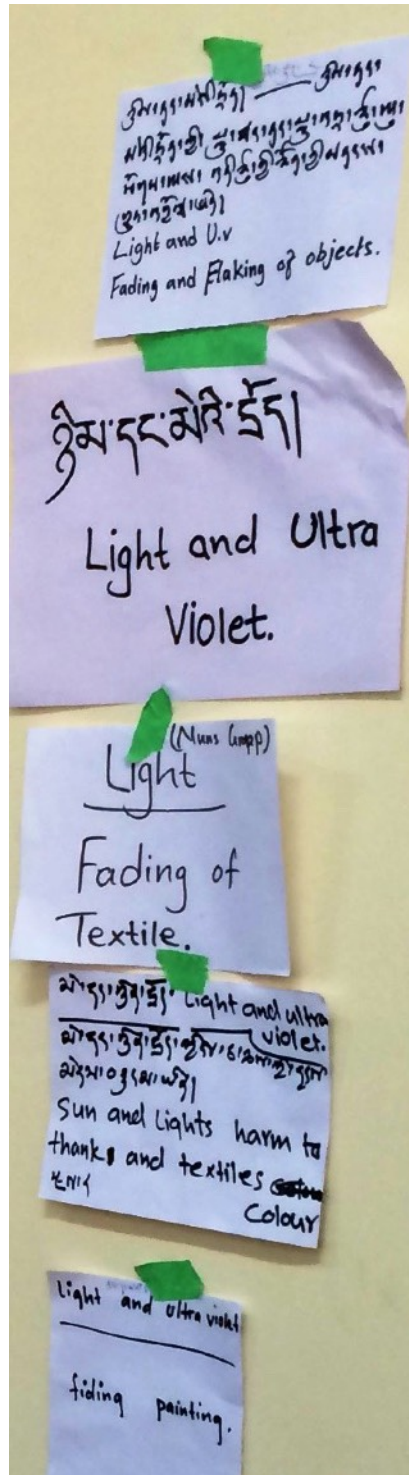
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Introduction 介紹



Monk and nun participants in Preservation of Monastery Treasures workshop talk about their own experiences with light damage in their home monasteries and communities 參與「保存寺院法寶工作坊」的僧尼們，就各自所在寺院和社群的光害經驗進行交談

- "Light and UV cause fading and flaking of objects" 光線和紫外線造成物品褪色和剝落
- "Fading of textile" 紡織品褪色
- "Sun and lights harm thangka and textile color" 太陽和光線傷害唐卡和紡織品的色澤
- "Fading of paintings" 繪畫褪色

A monk was discussing how his monastery used to have "old-fashioned" incandescent lightbulbs, and then the government came to the monastery and gave them the fluorescent bulbs and tubes, and said, "Now you have to use these to be energy efficient." Now we know that fluorescent tube lights are damaging to treasures.

一位僧眾談到他的寺院曾經用的是那種「老式」白熾燈泡，後來政府的人來到寺院，給了他們日光燈泡和燈管，並且說：「現在你們必須用這樣的燈來節省能源。」現在我們才知道日光燈管的光線對法寶是有損害的。

Light is an energy source, that has three parts: first is invisible but we can feel it, that is the heat aspect of light; second is the visible part of light that we can see, and helps us to see; and third is the very high energy invisible part of light that we cannot see. We can measure these on what is called a light spectrum wavelength. All three parts of light will damage objects.

光是一種能源，它含有有三個部分：1. 首先是看不見、但我們能感受到的部分，這是光所具備的熱這個面向。2. 第二是光可見的部分，也就是我們能看到並幫助我們看得見的面向。3. 第三點是光極高能、不可見的部分。我們可以由測量所謂的「光譜波長」而得知。這三個部分都會對物品有傷害性。

Light damage is cumulative and irreversible. Exposure to light can cause fading and color change and cause irreversible deterioration of your monastery treasures. There are two problems with light: the brightness and the wavelength, or its energy. High-frequency energy causes the most damage. It is the worst kind of energy for preservation. The atoms and molecules within your monastery treasures exceed their activation energy thresholds. It is the fast-moving energy in sunlight that ruins your skin and destroys your treasures. This is the same energy in fluorescent lights.

光害是長時間累積而來，且無法逆轉的。暴露在光下可能造成你寺院寶物的顏色褪變，帶來不可挽回的退化。

光有兩個問題：亮度和波長或說它的能量。高頻率能量帶來的傷害最大。對於收藏保護而言，是最糟的一種能量。寺院寶物的原子和分子超出它們的活能極限。太陽光中快速運作的能量是損害你的皮膚和摧毀寶物的罪魁禍首。這與日光燈的能量具有相同的傷害力。

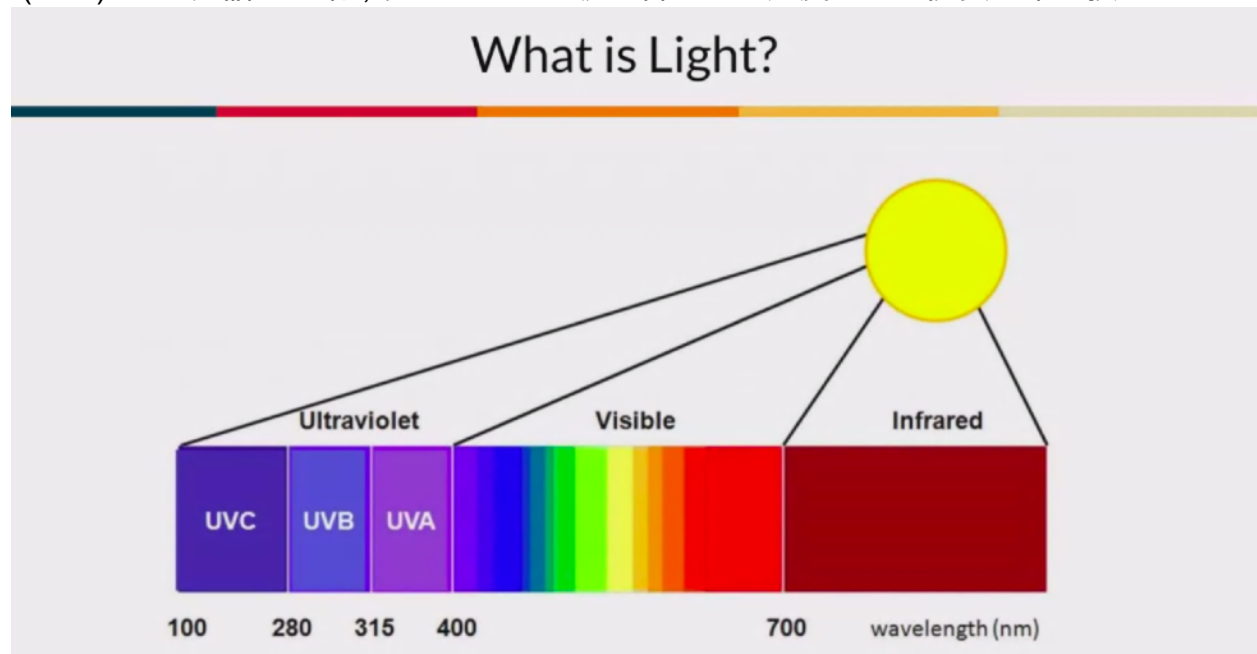
Causes of Light Damage in Monasteries: Science of Light 寺院內光害的成因：
光的科學

Which monastery treasures are sensitive to light damage? Silk, nylon, wood-pulp paper, color photographs, and certain dyes and pigments. This includes many treasures that would be found in a lhakhang, shedra, storage room, monastics' rooms, and in the community.

哪些寺院裡寶物對光害敏感呢？絲綢、尼龍、木漿紙、彩色照片，以及一些特種的染色和顏料。這些涉及到佛殿、佛學院、儲藏室、寺院房間和社群可以看到的很多法寶。

The potential damage from light is twofold. One is the wavelength of the light. In essence, the only light you need to see is that which occupies the wavelength band from 380 nm to 760 nm. The harmful wavelength is in the short, blue wavelength spectrum, ultraviolet (UV). The longer energy waves at the other end of the spectrum can also damage your monastery treasures by causing localized heating.

可能因光線帶來的傷害有兩個方面。第一，燈的波長。大體上，你需要看的唯一一種是波段在380nm至760nm之間波長的燈。有害波長，屬於短的藍色波長的光譜，紫外線（UV）。而光譜另一端，長一些的能量波也會因局部熱度而對寺院寶物帶來損害。

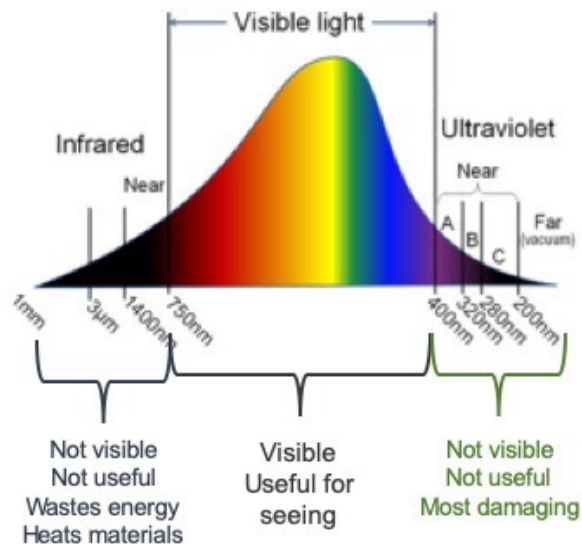


What Is Light? Image credit to ArtRatio.co.uk

光是什麼？圖片出處：ArtRatio.co.uk

Light and UV

- Eliminate UV



What we call light is a form of visible energy of varied wavelengths

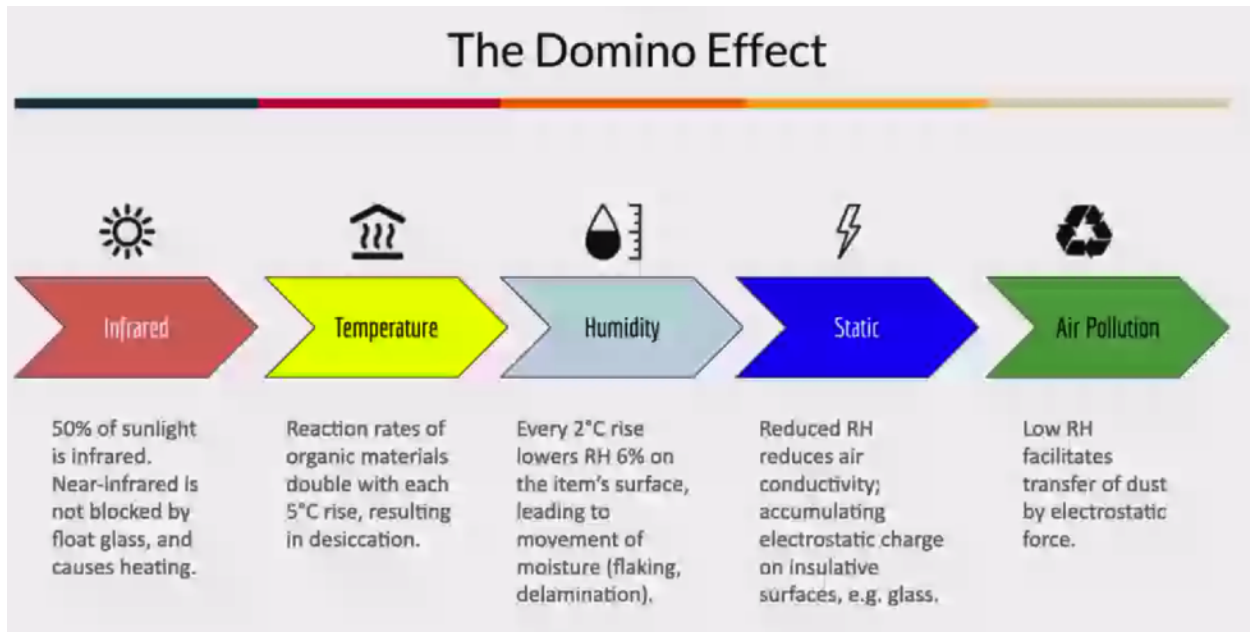
被我們稱為光的，是一種不同波長帶來的可見能量

With light, it's not only how bright it is but what kind of light it is, what wavelength. These are all the wavelengths of light. Where it says "infrared," we are referring to the kind of light emitted from incandescent lightbulbs. Where it says "ultraviolet," on the right, that's the short blue wavelength that gives you skin cancer, and is what these fluorescent tubes have.

說到光，並不只看它有多亮，還要看它是哪一種光，哪種波長。光的所有波長就是這些。在說到「紅外線」時，我們指的是從白熾燈所射出的那種燈光。說到「紫外線」時，是指右端的短藍波長、會造成皮膚癌、也是所有日光燈管所射出的燈光。

The lower range of light waves can also be damaging to monastery treasures. Up to 50% of sunlight is composed of infrared. For example, when infrared energy heats glass, with every 5 degrees rise in temperature, you get increased deterioration of organic materials, for example, through desiccation (BSI PAS 198:2012).

較低端的光波也可能對寺院法寶造成損害。50%的太陽光是由紅外線組成的。當紅外線能源使玻璃受熱，溫度每升高五度，就會增加有機原料的退化，例如由於乾燥所致。



Effects of infrared. Image credit to ArtRatio.co.uk
紅外線效應。圖片來源：ArtRatio.co.uk

The diagram depicts long infrared light--light you don't see, which creates a lot of heat. The old incandescent lightbulbs, which emitted infrared light, could become quite hot. But the old incandescent lightbulbs had a beautiful warm tone to them, more in the red spectrum than in the blue of the fluorescents. People looked healthy, everything looked warm.

以上圖表顯示出長的紅外線光---你肉眼不可見的光線，製造很多熱能。而老式的白熾燈泡也會發出紅外線燈光，因此它變得相當熱。但老式白熾燈泡有一種美妙溫暖的亮度，更多屬於紅色光譜，而非日光燈的藍色光譜。用白熾燈的人看起來很健康，燈光也讓一切都看起來很溫暖。

The UV light waves from fluorescent tubes are the most damaging. And also, they're into the blue range of the spectrum so if you go into somebody's home and they have only fluorescent tubes, people don't look healthy. The colors of the home don't look warm and welcoming. Everything looks cold. That's because not only is the bulb damaging your textiles and your paintings, but it doesn't give a very healthy, positive psychological colour.

日光燈管所射出的紫外線光波是最有傷害性的。同時，它們屬於光譜上藍色的區域。因此，如果你去某人家裡，他們用的是日光燈管，人會看起來不健康。家裡的色調也看起來不溫暖，顯得冷冰冰的。一切看起來很慘淡。這是因為日光燈不僅對布藝製品和繪畫作品有傷害，它所帶來的心理色彩也不是很健康、很正向。

Many monasteries, even ones that were built recently, have fluorescent lights in the form of tubes or lightbulb-shaped compact fluorescents (CFL). Fluorescent lights produce similar wavelengths as the sun. Consider again that the sun can give you skin cancer, it can cause your textile treasures to fade and deteriorate.

很多寺院，甚至最近修建的寺院，都用日光燈管或是燈泡形狀的壓縮型日光燈。日光燈的光線製造出與太陽光類似的波長。鑒於太陽光會導致你患皮膚癌，你就知道它也能讓你的布藝寶物褪色或退化。

There are a lot of reasons why these fluorescent tubes should be removed. Not only for your mental and emotional health, not only because they're damaging textiles and paintings, but especially because they're poisonous when discarded. Fluorescent lights work because the mercury instigates a chemical reaction that makes light. These fluorescent lights cannot work without mercury. When they are put in the landfill, they can poison mother earth, and poison your water source. It is difficult to recycle them effectively.

取消使用日光燈管的原因非常多。這不僅關係到你的心理和情緒健康，也不只因為它們對布藝製品和繪畫作品有損害，而特別一個原因是當它們被棄置後，是有毒的。日光燈發光的原理是汞產生出一種化學反應。沒有汞，日光燈就不能發亮。當日光燈丟棄在垃圾填埋地，就會毒害土地，也會毒害到我們的水資源。有效地回收日光燈，是一件很困難的事。



This is a picture taken on the side of a package in Nepal. It is even available in the small street markets in Nepal. It's so important to change your lights. 這張圖拍到的是尼泊爾的一個包裝盒一側。這種燈在尼泊爾小街道的商店都能買到。改變你的燈，真的很重要！

Now people are switching to LED light, light emitting diodes. In several countries, you can get your fluorescent tubes taken away, and get free LED lights in to replace them. You can also request from a donor to contribute funds towards upgrading your monastery's lighting.

現在人們都換去使用LED燈---二極管發出的燈光。在一些國家裡，你可以讓人拿掉你的日光燈管，同時換上免費的LED燈。在寺院，你可以尋求功德主、贊助人的協助，請他們專門為改善、升級寺院的燈光明助善款。

So many monasteries put fluorescent lights in to save money. Many monasteries have them hanging directly over wall paintings, or near thangkas. Even last year people would say, "We can't get new LED lights in our local market." However, now you can buy these LED bulbs almost anywhere, even in small markets, at a range of prices. LED lights last as long as fluorescent tubes, but do not use as much electricity, and so are cheaper to use.

太多寺院為了省錢而使用日光燈。很多寺院將日光燈直接安裝在牆上的繪畫上方，或唐卡附近。甚至去年有人會說：「我們在本地商場裡買不到新的LED燈。」然而，現在你幾乎

隨處、甚至在很小的商店，都買得到價格範圍以內的LED燈泡。LED燈的使用壽命和日光燈一樣長，但不會那麼耗電，因此使用起來是更節省的。

Damage from Sunlight 陽光帶來的損害



Light damage on this large textile thangka is revealed by light from the door and windows raking over it every day, and by viewing the sunlight coming through the thangka 這幀巨幅布藝唐卡，每天被門和窗戶斜射進來的陽光照射，或被穿透它的陽光直射，已出現輕微損傷

This image shows a large textile thangka that was made fairly recently. This thangka is already suffering from serious light damage. The silk is shredding and tearing and the colors are fading. Every day, the light from windows above it, and the wide temple room door, sweeps across the thangka. The light shines through the silk from the front and then later the light comes through the back.

這幅圖片展示的大型布藝唐卡是相當近期製作的。而這幅唐卡已經受到嚴重的光害損傷。絲綢已經裂開、分解，顏色在消褪。每天，從它上面的窗戶和寺院敞開的門照進來的陽光橫掃過唐卡。除了前方的太陽光照射，絲綢也被它後面的燈光照射穿透。

You can see sun damage everywhere in most monasteries. 在大部分寺院的各個角落，
你都可以看到陽光照射帶來的損壞。



This damage is from the sun. These nuns are showing textiles that have been outside in the sun for only one year and they have faded. 這種損壞來自陽光。尼師們展示出暴露在室外陽光照射下僅一年的綢緞，它們已經褪色了。

Damage from Fluorescents 日光燈帶來的損壞





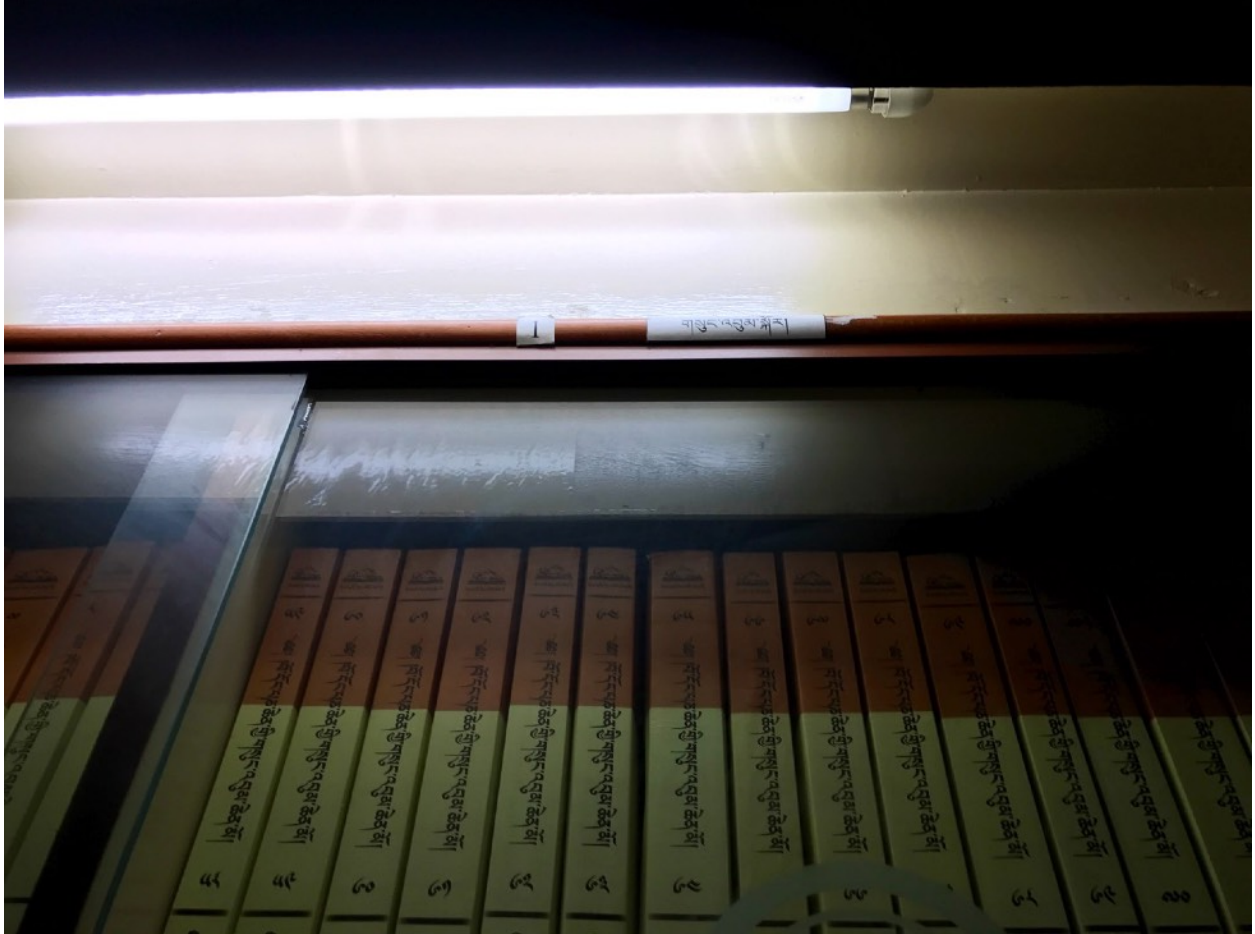
Compact fluorescent tubes have been installed in monasteries to replace older incandescent tubes. It is time to replace these compact fluorescents with LED lights. Please check your wiring and light sockets at the same time. 安裝在寺院裡的壓縮型日

光燈管代替更老式的白熾燈。是時候將壓縮日光燈換成LED燈了。同時請檢查你的線路和電燈插座。



Fluorescent tube lights are fading textiles and paintings in lhakhangs 日光燈使佛殿的紡

織品和繪畫褪色



Fluorescent tube lights are fading books and traditional texts in shedras and libraries 佛學院和圖書館的書也由於日光燈光的照射而褪色

In museums, archives and throughout the community, treasures are damaged by light that is bright, intense, and sometimes, using light sources of damaging wavelengths. 博物館、檔案室以及社區各個角落，明亮、強烈以及有時所用的具損壞性波長的光源，使寶藏受到損害。



This thangka was in a museum case, with a fluorescent tube light in the top of the case, for many years. The intensity of the light, and the ultraviolet content of the light coming from the fluorescent tube caused great damage to this thangka cover. The fine silk of the cover was so shredded by exposure to the fluorescent tube light in the exhibit case that if you just lightly touched it, it began to powder and fall apart. 這幅陳列在博物館展覽箱裡面的唐卡，箱子頂安裝了日光燈很多年。強烈的燈光，以及日光燈管發出的含有紫外線的燈光給整幅唐卡造成了巨大的損壞。唐卡表面精細的絲緞，由於暴露在日光燈下展示，而斷裂破碎，如果你稍微一碰它，它就開始粉碎、分崩離析。



*Monastery is exposing paintings and textiles to bright sunlight **and** fluorescent tube lights* 寺院裡的繪畫和布藝唐卡完全暴露在陽光以及日光燈下

Intensity of Light 光的亮度

Another source of light damage is the intensity, how bright it is. The problem with these lights, even if they are newer LED lights, is how bright the concentrated spot of light is. That is the brightness, high light level, that can also destroy textiles and other organic materials.

光害的另一個來源是亮度，光有多強。這些燈---甚至是更新的LED燈的問題，是燈照明的聚光點有多亮。這是亮度，高亮度也會造成紡織品和其他有機物質受到損害。

Intensity of light is measured by lux or lumens. Light damage increases over time, the damaged cannot be reversed, and the brighter the light the greater the damage. Bright sunlight can equal 30,000 lux, but fading in dyes and textiles starts at 50 lux.

燈光亮度是以勒克斯或流明來測量的。損壞會隨著時間增加，而受損處無法復原，而光線越強，損害就越大。明亮的陽光相當於3萬勒克斯，而50勒克斯就會使染色和紡織品開始褪色。

How Serious Is this Issue? 這個問題有多嚴重？

Lux Level	Typically found in:	Noticeable Fade in:	Almost Total Fade in:
100 Lux	Museums	From 7 months	From 15 years
500 Lux	Residential / Offices	From 7 weeks	From 5 years
1000 Lux	Retail	From 7 days	From 6 months
10,000+ Lux	Daylight	From 1 day	From 1 month

Light damage is irreversible and cumulative. Image credit to ArtRatio.co.uk
光害造成的損壞不可逆轉，且經日積月累而形成。圖表出處：ArtRatio.co.uk

For example, a skillfully painted set of new thangkas was on display in a temple for the first time. Very bright spotlights are used to illuminate the gold details. However, the glare from the light is so bright that you could hardly even see the details of the thangkas, your eyes are blinded by the brightness of the concentrated spotlight. If you tried to photograph, you would notice a bright spot in the middle of the picture. The intensity of the light is too high and will cause permanent damage to these paintings where fine gold details are applied in layers above layers of flat colors and shading. Furthermore, the expensive brocade will be quickly faded by the intensity of the light.

例如，一套精心繪製的新唐卡第一次在寺院裡展示。極明亮的聚光燈通常會照射出唐卡鑲金的細節處。然而，由於反光太刺眼，你幾乎無法看到唐卡的細節處。在聚光燈的強光下，你只會感覺眼花撩亂。如果你用相機拍照，會注意到在圖片中央有一個明亮的光點。這些鑲金圖案的細節是一層一層描繪在平面的顏色和陰影上面的，而光線亮度太高會給繪畫造成永久的損害。此外，昂貴的真絲緞面也會因為強光照射而很快褪色。







Monastery exhibit of beautiful new thangkas was lit with overly bright spotlights glaring at the center of the paintings 過度明亮的聚光燈，直接射在寺院展出的精美新唐卡繪畫的正中央



Intense points of light so close to paintings and textiles is not completely safe, not even if LED lighting is used 明亮的點綴燈太靠近繪畫和布藝，並不十分安全，即使用的是LED燈也如此。

Practical and Low-Cost Prevention of Light Damage to Monastery Treasures Monks and Nuns offered these suggestions for their own monasteries:

針對適用且低成本保護寺院法寶不受光害的防範措施，僧尼們為各自的寺院提出了這些建議：

- Replace compact fluorescent CFL bulbs with LED. The light spectrum of fluorescent lighting is very destructive to treasures made of organic materials including textiles and paintings. Fluorescent lighting has mercury in its structure that must be recycled and processed in a special way so as not to harm the environment. 以LED燈替代壓縮日光燈。日光燈的光譜對天然材質製成的法寶，包括紡織品和繪畫，都非常有破壞性。日光燈含有汞，所以必須回收，並以特定方式處理，否則將對自然環境有害。
- Do not hang thangkas inside windows. Sunlight, wind, and monsoon moisture can destroy colour and fabric. 不要將唐卡懸掛在窗戶裡面。日光、風和雨季的潮濕都會對其色澤和布料造成損壞。
- Use of inexpensive solar lights. 使用不昂貴的太陽能照明。
- Curtains or sunshades on windows help to limit light/UV damage. 窗戶上安裝窗簾和遮陽天棚會對減少紫外線光照有所幫助。

Do framing and glass enclosures prevent damage from light sources? 裝框和玻璃罩能阻擋光源的損壞嗎？

Most regular glass does not filter out damaging UV light frequencies, nor significantly limit damage from intensity. 大部分玻璃並不過濾有害的紫外線光頻，對限制強光傷害的作用也不大。



These large sections of glass are intended to protect the lhakhang treasures from damage from theft and dust. The glass may not prevent damage from light. 安裝大塊玻璃櫥窗為的是防止佛殿的珍寶遭盜竊或塵垢侵蝕。玻璃本身並不能阻止光害。



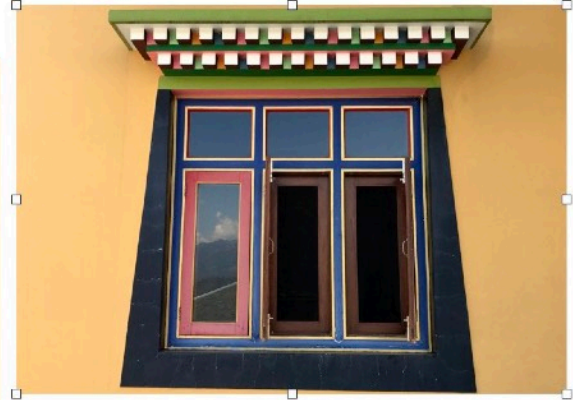
Does glass protect your monastery treasures from damage from various sources of light? Is this thangka protected by its framing technique, or harmed? 玻璃框有沒有保護寺院的寶物不被各種光源傷害嗎？這幅唐卡裝框之後，是被保護，還是被損壞呢？

The glass in this picture frame is intended to protect the thangka from damage from theft and dust. However, the glass will not prevent damage from the light shining on it, both from windows and from spotlights. There are types of glass/plastic that are designed especially for framing, to modulate damage from light, blocking most of the UV visible-energy frequency. 這幅相框的玻璃為的是保護唐卡被盜或受塵垢損傷。然而，

玻璃並不能阻擋由聚光燈和從窗外射在上面的光。有些特殊設計的玻璃和塑膠用來做相框，能阻擋大部分紫外線可見能源光頻，可以起到抑制光害的作用。

In addition, the glass is directly against the surface of the textile and painting, so changes in room temperature and relative humidity will cause condensation on the inside of the glass and thus damage the thangka. If monastery treasures are to be framed, there are simple ways that a frame can be constructed within the monastery to create a deeper space for the treasure, and the materials used in the frame can be selected and treated so that the wood acids are not transferred to the treasure, causing damage. Please contact treasurecaretaker.com for further information on safe framing techniques. 此外，直接貼在布藝製品和繪畫表面的玻璃，由於室內溫度和相對濕度的改變，會造成玻璃以內的壓縮，從而對唐卡造成損壞。如果寺院寶物要裝框，簡單的方式是相框可以在寺院內製作，從而給與寶物更深的空間；框架的材質也可經過選材和加工，使其木酸不會轉移到寶物上而帶來損害。請聯絡 treasurecaretaker.com 獲取安全裝框技術的更多信息。

Throughout your monastery or shedra, once you begin to look at light you can realize how it can beautifully illuminate, and yet destroy your monastery treasures. You could have control over what lightbulbs you use in your monastery, but how can you have control over the sun? Especially if you're in a monastery building that is traditionally built. Here is one example how the monastics created protection in a low-cost and practical way. This is a nunnery where the nuns were concerned about the sun coming in and fading their thangkas and wall paintings. They put a cloth on the outside of the windows—it looks very nice, it's very traditional. Plus, it helps keep the insects and birds out. 在整個寺院或佛學院，一旦你開始留意燈光，就可以認識到它可以給與美好的照明，但同時也損毀寺院的寶物。你可以控管寺院用什麼樣的燈泡，但你如何控制陽光？尤其是如果你身處一個以傳統方式修建的寺院。這裡有一個範例：僧眾如何創造低成本、實用性高的保護方式。這是一個尼眾寺院。尼師們很擔心太陽光照射進來而讓唐卡和壁畫褪色。於是她們在窗戶外面安裝了一層布帘——既美觀，也非常符合傳統。同時，它也可以防止昆蟲和小鳥飛進窗戶。



Nuns created simple and effective window covers with locally sourced cloth in a traditional design 尼師們以當地就能找到的、帶有傳統圖案的布料，製作了簡單卻很有作用的窗簾。





Window coverings, commercially available, are designed to reduce heat, intensity, and ultraviolet content of light coming through windows 市面上能買到的窗戶遮擋設計，能減少熱度、光線強度和窗外射進來的紫外線。

Hanging thangkas in the windows, however, exposes them to constant changes in temperature and relative humidity, vibrations from city life, etc. Even with these protective window covers, hanging thangkas in windows is not ideal. 然而，將唐卡懸掛在窗戶上，讓它們一直暴露在持續變化的溫度、相對濕度、城市脈動的震顫等等之中。即使帶有保護層的窗戶面，直接把唐卡掛在窗戶上也並不是理想的作法。

Measurement 測量

You can measure the light that is affecting your treasures, there are meters/instruments that measure the ultraviolet content of the light, the intensity of the light, the rising and falling of the light throughout hours, days, weeks, and months. 你可以測量一下對你的寶物造成影響的光。有儀器和設備可以對光所含的紫外線、燈光強度，以及每小時、每天、每週、每月的光線升降進行測量。



You can use instruments that measure the intensity and UV content of the light in your monastery. Some of these tools can upload information of light exposure to your mobile device. The instrument shown measures temperature, relative humidity, and light intensity and the information can be read as chart or graph. 你可以用儀器來測量寺院裡光線強度和所含的紫外線。有些工具可以將光照訊息上傳到你的手機。儀器所測量的溫度、相對濕度和光線強度，能以圖表或曲線圖的形式來顯示。



You can use instruments that measure the intensity and UV content of the light in your monastery. This simple instrument measures light intensity directly. 你可以用儀器來測量寺院裡光線的強度和所含的紫外線。這個簡單的儀器能直接測量光線強度。

Summary 總結

Bright sunlight can equal 30,000 lux, but dyes and textiles start to fade at 50 lux. In previous centuries in older monasteries, windows were smaller, and electric lighting was not available, or even invented, so the overall light exposure was significantly lower than it can be now. Rooms in which thangkas and other monastery treasures lived were darker! Museums work with the need for exhibit areas to keep light levels very low in order to protect museum treasures. Museums sometimes need to keep the light level as low as 50 lux, the point at which dyes and textiles begin to fade. Then how does a person from our times actually see anything in a dark room, as dark as in previous centuries, when we are so used to bright lights and large windows? This is how: your eyes adjust. It takes time for your eyes to adjust to a darker room. An area lit at 50 lux might seem dark when you first enter, but after a few minutes your eyes become adjusted, you become quite comfortable with the lower level of illumination, and you can see quite well. 明亮的陽光相當於3萬勒克斯，而50勒克斯就會使染色和紡織品開始褪色。過去幾個世紀，在更古老的寺院，窗戶都比較小，而那時買不到電燈，或電燈還未問世，因此，整體來說，暴露在光照下的情況，比現今要低很多。唐卡和其他寺院寶物擺放的房間甚至更暗！博物館在展區也保持光照度極低，為的就是保護博物館的收藏品。有時候博物館需要將光線保持在50勒克斯以下，以確保染色和紡織品不會開始褪色。那麼，當一個已經習慣於明亮燈光和大窗戶的現代人，到了像幾百年前的那種昏暗房間，如何可以看得見東西呢？事實是：你的眼睛會適應。到了一個較暗的房間，你的眼睛會需要一點時間適應。當你剛進入一個照明只有50勒克斯的區域，似乎感覺很暗，然而幾分鐘之後，你的眼睛就適應了，你會對比較低的明亮度感覺相當舒服，而你也能夠看得很清楚。

How do you prevent light damage to your treasures? Filter the sun from outside, control your lighting inside, choose your lightbulbs carefully, and turn off the lights when no one is there. Cover the windows. Replace your old tube lights with LED lights. It's very simple. With light, as with other risks, prevention is the best cure. 如何保護你的珍寶不受光害？過濾外面的陽光照射，調控室內的燈光，謹慎地挑選燈泡，房間裡沒人就關燈。將窗戶遮起來。將舊燈管換成LED燈。簡單易行。在光線這一方面，跟其他危機一樣，防範是最好的照料。

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Preservation of Buddhist Treasures

RISK ASSESSMENT ཉམ་ཁ་དུད་ཞིབ།

- ❖ **Pandemic** ཡོངས་ཁྱབ་རིམས་ནད།
- ❖ **Earthquake** ས་ཡོམ།
- ❖ **Fire** ཟེ།
- ❖ **Water** ཟླ།
- ❖ **Theft** ལྷན་ས།
- ❖ **Pests** གནོད་འབྲ།
- ❖ **Temperature and Relative Humidity** རྫོང་ཚད་དང་རྩོས་བཅས་ཀྱི་བཞུའ་ཚན།
- ❖ **Human Choices** མིའི་འདམ་ག།
- ❖ **Pollution** འབགས་བཅོག།
- ❖ **Light** ལྷག་མེ།

EMERGENCY PLANNING AND DISASTER MITIGATION རོ་དྲག་འཆར་གཞི་དང་རྒྱུན་དུ་ཞི་འཇམ།

SAFE STORAGE ཉམ་མེད་དོས་ཁང།

DOCUMENTATION ཡིག་ཆ་ཐོ་བསྟོད།

Preservation of Buddhist Treasures 佛教文物寶藏的保存

Risk Assessment 風險評估

- ◇ Pandemic 大流行病
- ◇ Earthquake 地震
- ◇ Fire 火災
- ◇ Water 水患
- ◇ Theft 盜竊
- ◇ Pests 害蟲



- ◇ Temperature and Relative Humidity 溫度和相對濕度
- ◇ Human Choices 人為選擇
- ◇ Pollution 污染
- ◇ Light 光線

Emergency Planning and Disaster Mitigation 應急計畫和災難減緩

Safe Storage 安全儲藏

Documentation 存檔和文獻記錄

Basic Elements of Emergency Plan for Monasteries and Communities 寺院和社群應急計畫的基本要素

1. People First 以人優先
2. Who Do You Call? 要呼叫誰?
 - Who is in charge? 誰是負責人?
 - Emergency phone numbers 緊急電話號碼
 - Full monastery residence list, to text, WeChat, WhatsApp, etc. 給寺院住眾名單上所有人發信息、微信、WhatsApp等傳訊。

3. Who Should Salvage Collections? 誰應該負責搶救集中?
Monastery Treasures Salvage Team (trained previously) 寺院寶藏搶救隊 (已訓練)
4. Where to Bring Damaged Treasures 受損寶物要送去哪裡?
Another monastery? 另一個寺院?
Your monastery dining room, classrooms, etc. 受災寺院的齋堂、教室等處。
5. What Do You Salvage First? 你首先要搶救什麼?
Decide your priorities, preferably before an emergency 最好在危急情況出現之前就決定好搶救的優先次序。
Mark the location of these priority treasures on floor plans 在寺院平面圖上標註這些優先搶救的寶物所在位置
6. Where Are the Emergency Supplies? 緊急救援物資在哪裡?
Stockpile supplies before an emergency occurs 危急出現前就儲備好物資
Mark the location of supplies on floor plans 在平面圖上標註好物資所在處
Contact local vendors for additional supplies 聯絡當地供應商增加物資
7. Who Provides Security During an Emergency? 在緊急情況時，是誰提供安全保障?
Monastics, community members, or government? 僧人，社群成員或是政府?
8. What Information Technology Will You Need to Replace? 什麼信息技術是你需要更新替換的?
Survey your hardware and software currently in use 審查目前適用的硬盤和軟體
Store monastery files in "cloud" or duplicated offsite 將寺院文件夾存在「雲端」或線下複製
9. Do You Have Insurance? 你們有保險嗎?
10. Who Has the Plan? 誰手裡存有這個計畫書
Make a list of who has copies of your Emergency Plan 寫出持有你應急計畫的人名單
Update Emergency Plan and Team 更新應急計畫和小組成員

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SCOTT'S "HOW TO CHANGE A LIGHTBULB" CHECKLIST

LEDs are likely the best energy-efficient source for most museum applications. Below is a list of lighting qualities to help museums maintain the quality they enjoyed using their incandescent track systems.

Intensity

- Are the new energy-efficient lights bright enough for each application in your museum?
- Are the lights still bright enough after you add lenses?
- Will the electronics from the new lights overheat inside a sealed can?
- Is dimming large quantities of fixtures as a group necessary? Are the new lights dimmable with your existing system or do you need to match a new dimming system to your new lights?

Distribution

- Spotlights: Do the new lights provide the same beam angles as your existing system? I typically use every beam spread available when I light exhibits - including 4, 8, 15 and 25 lamps.
- Wall wash: Can the lighting fixtures produce an asymmetric (rectangular or cigar-shaped) light so the illumination on the wall is flat (without scallops)?

Color

- Do the lights produce the desired color? For most installations, the choice of a specific color temperature is less important than matching the color of the adjacent lighting sources.
- How important is color rendering to your application? Assessing color rendition is complicated and mockups on colored surfaces are useful, in addition to checking metrics like color rendering index (CRI) or IES's TM-30. Some LED's with CRI's in the low 80's produce light with excellent color rendering characteristics, although they may not render reds quite brightly as LEDs with a high CRI (<90). CRI values less than 10 points may not be noticeable and don't forget that the intensity light will have a significant impact on color rendition.
- Ultraviolet light needs to be eliminated or reduced to minimal levels (75 microwatts per lumen). Most LEDs don't create UV, but for the most light-sensitive materials (equivalent to ISO blue wool 1-4) it is best to avoid high CCT lamps (above 4000K).
- Are there, appropriate, opportunities to use colored light?

Movement

- Do the new energy-efficient lights flicker? Flicker is common when LEDs are improperly dimmed or when the electronics were poorly constructed. Check DOE and IEEE websites for more information. Flicker impacts people susceptible to migraines, photo-sensitive epilepsy and people on the autism spectrum.



Connecting to
Collections Care

How to Change a Lightbulb: LED Lighting for Museums

November 21, 2019

Presenter

Scott Rosenfeld, Lighting Designer
srosenfe@si.edu

Additional Resources

**Downloadable Materials and Links to Support Education About IES TM-30-15: IES
Method for Evaluating Light Source Color Rendition**

<http://www.personal.psu.edu/kwh101/TM30/main.htm>

Related Past Connecting to Collections Care Webinars

Introduction to LED Lighting (March 29, 2012) with Rick Kerschner *<http://bit.ly/331mzc4>*

**C2C Care Course: Preservation Methods and Materials for Exhibitions, Webinar One:
Museum Lighting: Balancing Display and Preservation** with Scott Rosenfeld LC, IES
(October 25, 2019) *<https://vimeo.com/297577018>*

LIGHT LEVELS

<https://www.youtube.com/watch?>

[v=j3lgz8F5OgY&list=PLKsvb3AsMnZSsmOROOXNHTVnGQuVOYeVG&index=7](https://www.youtube.com/watch?v=j3lgz8F5OgY&list=PLKsvb3AsMnZSsmOROOXNHTVnGQuVOYeVG&index=7)

Canadian Conservation Institute (CCI) Notes

- [N2/1 Ultraviolet Filters \(2015\)](#) (PDF Version, 300 KB)
- [N2/2 Measurement of Ultraviolet Radiation \(2015\)](#) (PDF Version, 466 KB)
- [N2/3 Track Lighting \(1992\)](#) (PDF Version, 630 KB)

Tools to Measure UV Light

<https://www.talasonline.com/UV-Light-Meter>



This handheld UV light meter measures both UVA & UVB light, in a compact and accurate unit.

This instrument is designed to measure ultraviolet light in the range from 280 to 400 nanometers (UV AB). The illumination range of the meter allows users to conduct the most precise quantitative measurements of ultraviolet radiation for radiometry and laboratory requirements, UV-curing in offset printing, lamp UV intensity & aging, industrial process monitoring, semiconductor fabrication, sunlight UV intensity to prevent skin damage, sterilization and environmental monitoring.

- Backlit LCD with 4 digit dual display
- High and Low measurements
- Range in a unit mW/cm^2 or uW/cm^2

- Socket for tripod mounting
- Automatic measuring
- Low battery indicator
- Magnetic mount
- 20 point memory
- Over Range Indication
- Zero Adjust
- Auto Record
- Includes Certificate of Traceable Calibration
- ROHS, CE, WEEE

Includes:

- 1 "9 V" battery, UV sensor probe, Instruction Manual, Hard carrying case

Unit Specifications:

- Spectrum Range: 280 ~ 400nm UV, AB Calibration Point: 365nm
- Illumination Range:
 Low: 1 $\mu\text{W}/\text{cm}^2$ ~ 1999 $\mu\text{W}/\text{cm}^2$
 High: 0.01 mW/cm^2 ~ 40.00 mW/cm^2
- Accuracy: 23 $\pm 5^\circ\text{C}$ (73.5 $\pm 9^\circ\text{F}$) $\pm 4\%$ ± 1 digit
- Sample Time: Approx. 0.3 sec.
- Memory: 20 points and 1 for interval time
- Operation Temperature: 32° to 122°F (0° to 50°C); 10~90% RH
- Weight: Approx. 3.2oz (90 g)
- Dimension: 5.51" x 1.93" x 1.14" (140 x 49 x 29 cm)
- Power Source: "9V" battery (included)

Tools to Measure Light Intensity

<https://www.talasonline.com/Digital-Light-Meter>

Digital Light Meter



A convenient and easy-to-use meter for measuring visible light. Unit switches between LUX and foot candle readings; LUX range: 0-200,2000,20000 with an accuracy of 3% of rdg. (5% at 20000), and FC range: 0-20,200,2000 with an accuracy of 3% of rdg. (5% at 2000). Carrying case has separate compartment for processor and sensor. Uses one 9v battery.



དགོན་པའི་གནའ་དངོས་གཅེས་སྤྱད་སྦྱོང་བཅར་ཚོགས་པ།

Digital inventory འཕུལ་ཆས་ཐོག་ནས་དངོས་ཐོར་འགོད་པ།

Risk assessment and disaster mitigation ཉེན་འཁུན་འགོག་དང་ཚད་གཤོང་ལེན།

Recording digital interviews with elders མི་རྒན་རབས་དང་འཕུལ་ཆས་ཐོག་ནས་བཅར་འདྲི་སྒྲིག་སྤྱད་བྱེད་པ།

Scientific research ཚན་རིག་ཉམས་ཞིབ།

Current project ད་ལྟོའི་ལས་འཆར།

Free online preservation resource for communities and monasteries

དགོན་པ་དང་སྤྱི་ཚོགས་ཀྱི་ཚེད་དུ་གནའ་དངོས་གཅེས་སྤྱད་ཐབས་ལམ། ཨིན་ཏར་ནེཌ་ཐོག་རིན་མེད་དུ་ལུལ་བ།



PRESERVATION OF BUDDHIST TREASURES RESOURCE is the free online resource for monasteries and communities, with practical information on digital documentation, risk assessment and disaster recovery, safer storage, and preservation of thangka and other treasures. The resource comes from over 50 years of preservation work in monasteries.



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