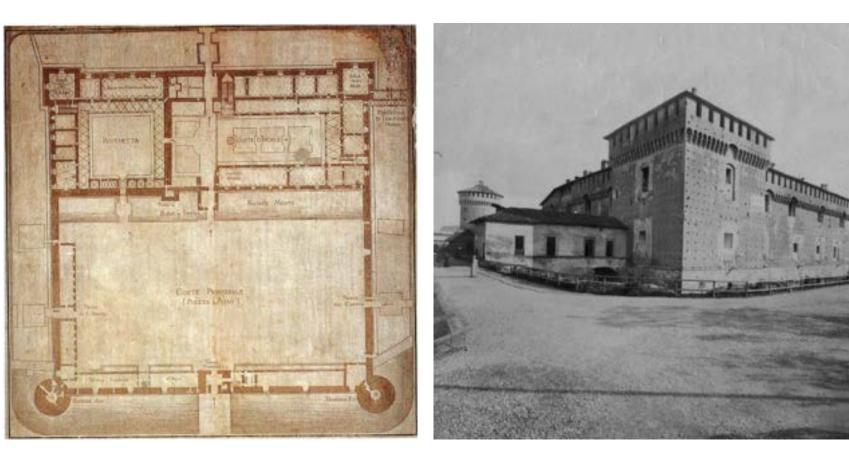
LA TECNOLOGIA ALLA SCOPERTA DEI DISEGNI E DELLE PITTURE DI LEONARDO

Francesca Tasso – Alessandro Zanini/Laura Bartoli

> Photonics 4 Cultural Heritage Castello Sforzesco Milano, Italy 1st December 2023





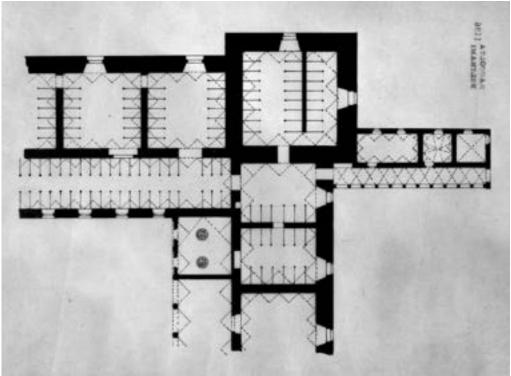


la saleta negro no fi pride sompo / Lundi fi defarm la Camera grande de le apre: (ou de la sort. mis bronarde promete: finisla p hup september n de pa quille l' potro en golder: p'de li por

"A la saletta negra non si perde tempo. Lunedì si desarmarà la Camera granda da le asse, cioè da la tore. Magistro Leonardo promete finirla per tuto Septembre, et che per questo si potrà etiam goldere: perché li ponti ch' el farà lasarano vacuo de soto per tuto"

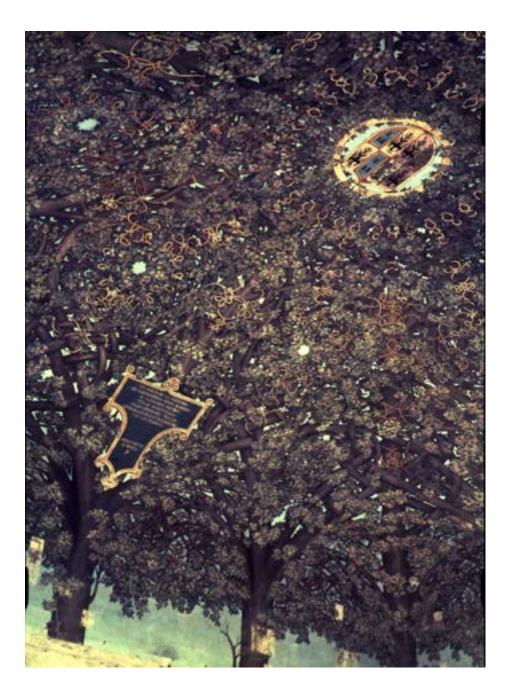
Vicende conservative





Intervento di fine '800: Luca Beltrami ed Ernesto Rusca





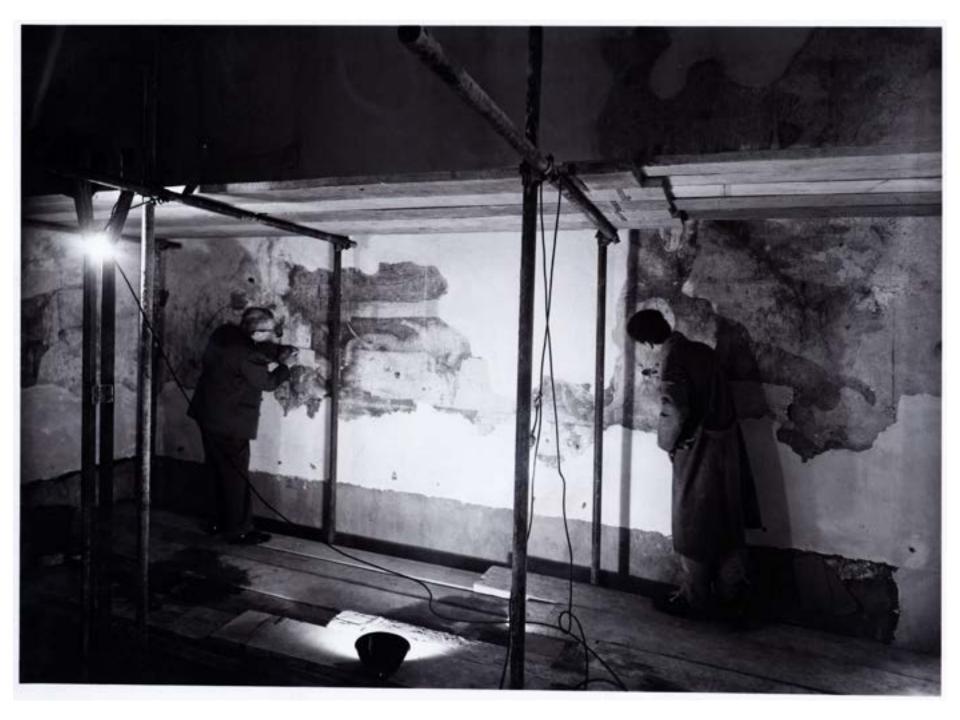


Particolari della volta dopo l'intervento di ridipintura di Ernesto Rusca, Civico Archivio Fotografico, Milano, 1902-1908 ca.

Intervento di metà '900: Ottemi della Rotta e BBPR

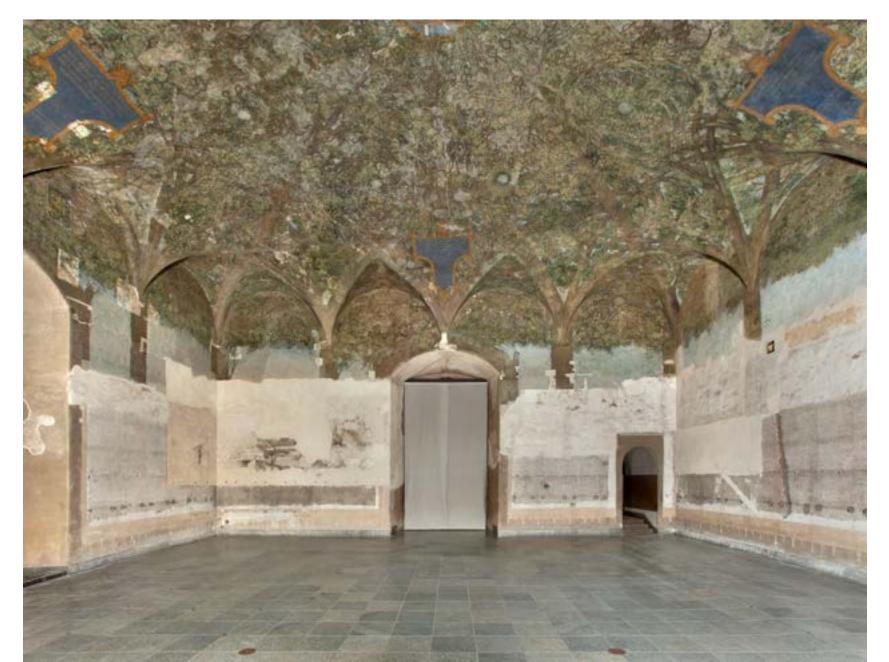


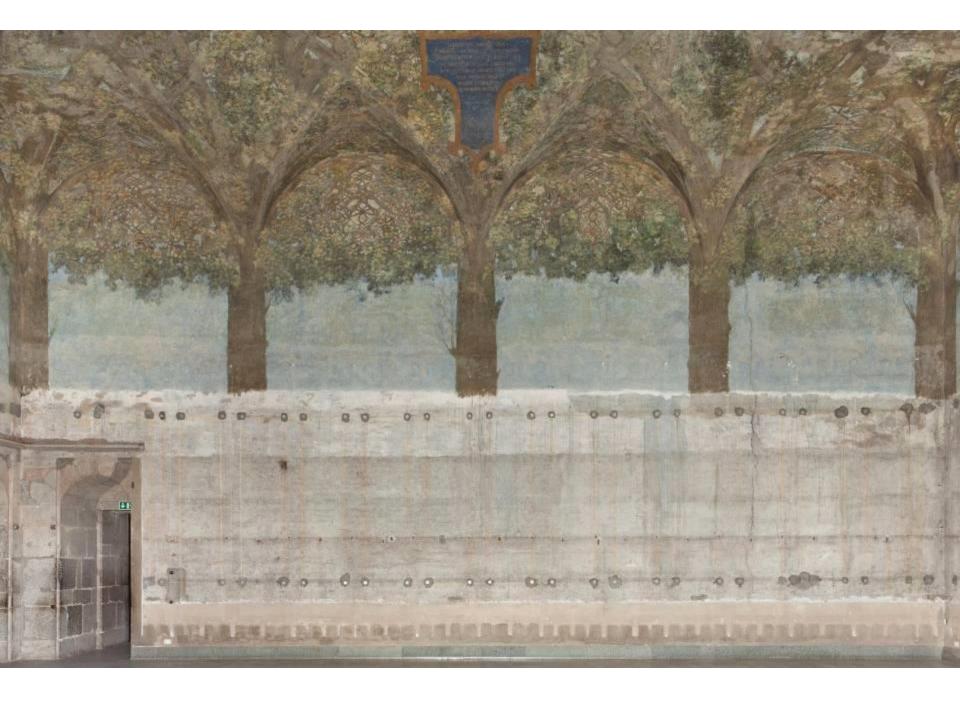






Il restauro in corso





Fase 1: il Monocromo







Fase 2: le tracce di disegno preparatorio















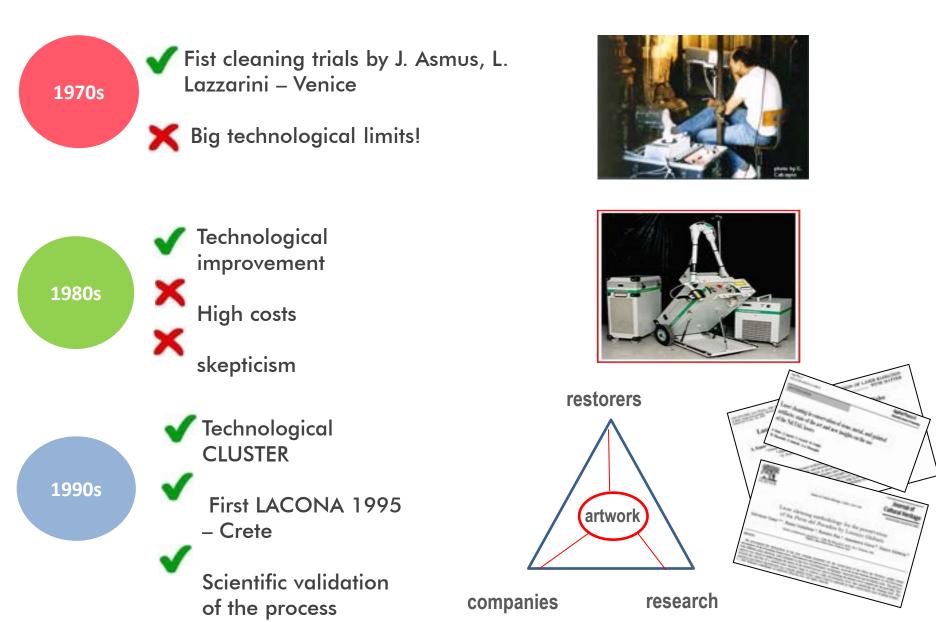
Fase 3: la policromia







LASER CLEANING TIMELINE



LASER CLEANING TIMELINE

 Optimisation of laser parameters

Application to **metals and wall** paintings

Overcoming of the yellowing x problem

Easel paintings?





2000s

- Study and validation of Er:YAG laser system
- Advent of fiber lasers

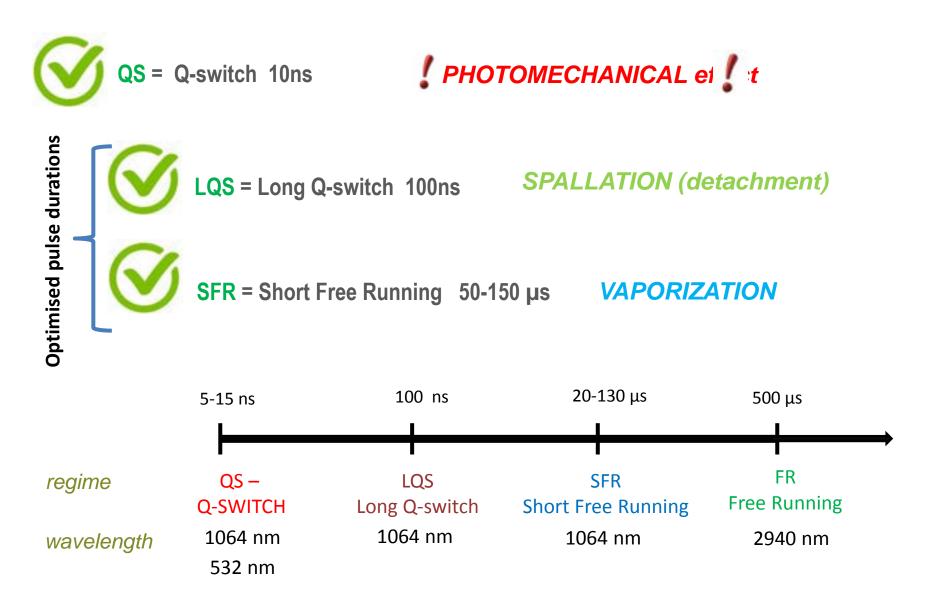


THE IMPORTANCE OF WAVELENGTH

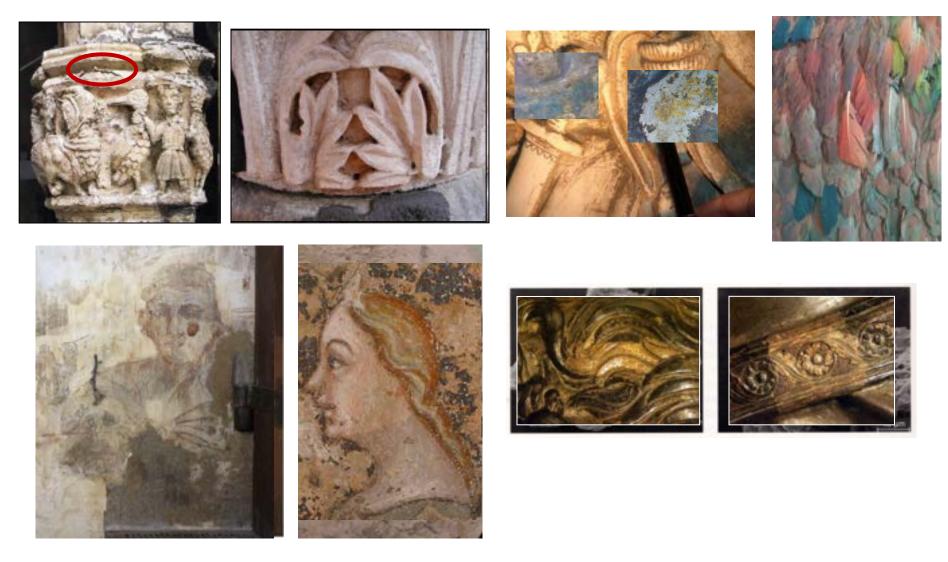
INCREASING WAVELENGTH

	-									1
Laser	UV			Vis		IR				
Excimer	193	248	308	351						
Nd:YAG	213	266		355		532		1064		
Er:YAG									2940	
Ti:Sapphire		265			398		795			
Depth (µm)										VARNISH
										SUBSTRATE

THE IMPORTANCE OF PULSE DURATION



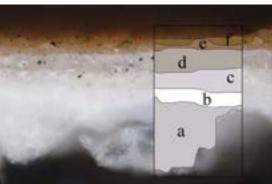
LASER CLEANING: WHY AND WHERE?







- Frescoes by Annibale Carracci and his school
- 1597 1607
- On the vault «The loves of the Gods», based on Ovidio's Metamorphosis
- Links in style with Renassaince masters
- Cartoni « a spolvero»
- Fresco with some a secco finishing touches



- A- Roman Stucco
- B white scialbo
- C white scialbo
- D white with black grains
- E Dark brown layer with red, yellow and brown grains
- F Brown layer with black, red and yellow grains



Different lasers for different problems

- **LQS laser** useful for scialbo layers removal and to preserve the original stucco surface. This laser preserves the sanguine drawings too. On graphite drawings only very low fluences can be applied (0,5 J/cmq).
- **QS laser** with green light (532nm) has been more suitable on graphite , allowing more treatments (3-4 ablations) for refinishing the drawing cleaning.
- Er:YAG laser has bene extremely useful for preserving chalk drawings and signs.







- P.C. K-G 37-38 engraving drawing Prob. Level 0 e 1
- Laser EOS COMBO
 - SFR ; E = 200-300-400 mJ ; f = 2-4 Hz; spot Ø = 3-3,5 mm
 - LQS 3 E = 450 mJ +/- filter 25%; f = 2-3-8 Hz; spot Ø = 2-3 mm
- Laser Er:YAG, Short: E = 300 mJ; f = 5 Hz; spot $\emptyset = 4 \text{ mm}$









ANNA BRUNETTO







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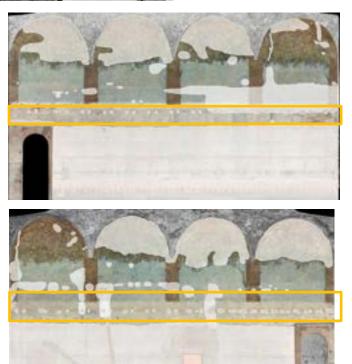
analisi critica e confronti



Napoli 13-15 dicembre 2023 Pelatro Down'Anna **Fondations** Exist in Febru

- Intervention on all four walls aimed at the identification of traces of Leonardesque decoration with laser technology
- The traces of drawings to be identified were concealed under «Scialbi» of different thicknesses with lime and tempera
- The drawings are made with charcoal, brush, drips, engravings, etc.
- Combined use of laser and scalpel
- Various lasers employed:
 - (1064nm) Nd:YAG QS
 - (1064nm) Nd:YAG LQS
 - (1064nm) Nd:YAG SFR
 - (2940nm) Er:YAG







Wall 3 Lunette 1-2: different levels of thinning of the scialbo layers



Wall 3 Lunette 2: details during the *descialbo* treatment







Wall 3 Lunette 2-3: during the descialbo operation



before

after

LASER APPLICATION FIRST PHASE 2017-2019: RESULTS



Very long and delicate intervention



Prevalent use of Nd:YAG, differentiating its use depending on the thickness to be removed (LQS for thin scialbo, SFR for thick scialbo (250-300 μ m).



Secondary spallation exploited (detachment and not ablation)



Cleaning almost always dry, integrated and alternated by the scalpel

LASER APPLICATION FIRST PHASE 2017-2019: RESULTS

TWO PHASES:



circumscription of the decoration traces with Nd:YAG system at LQS1 mode



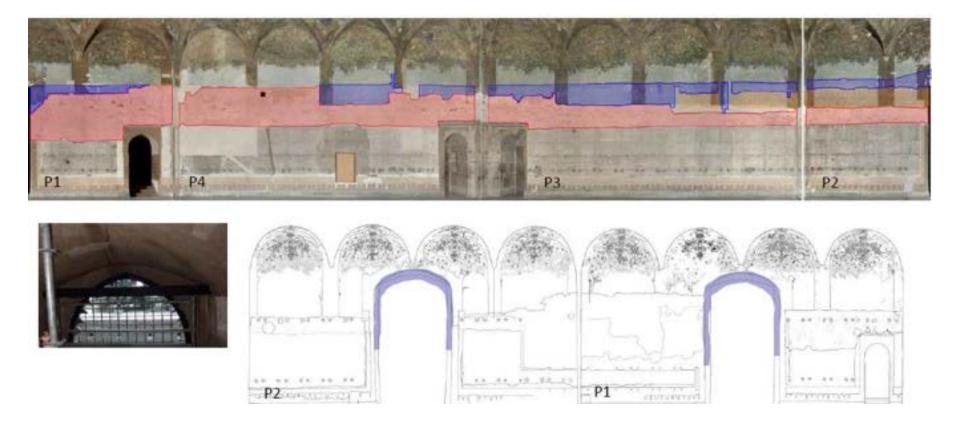
finishing with synergies of instruments between LQS+SFR or SFR+LQS at low fluences or with Erbium laser +SFR/LQS

Er:Yag laser used in particularly delicate points





LASER APPLICATION SECOND PHASE 2020-2021



In red, the areas with finishing of cleaning; in blue the new areas where scialbo is being removed in orange, the areas where twentieth-century repaintings were removed.

LASER APPLICATION SECOND PHASE 2020-2021

 The intervention was very long and complicated by the presence of different materials.

Every centimeter, the ablative phenomena of the chosen laser devices changed the dynamics of radiation absorption depending on the optical and chemical properties of the material encountered on the surface or on the underlying layers.



LASER AND POLYCHROMY



Laser also used for the removal of repaints.





removal of the brown band with laser technique.

LASER AND POLYCHROMY

THE BLUE SKY

_	
4	
1	

treatment with a swab with acetone to roughly remove the dust deposits and depolymerize the intervention of the Ottemi della Rotta



Treatment with different synergies of Nd:YAG and Er:YAG lasers to remove the overpaint layer



When one or more layers of *scialbo* were found in the interface of the original polychromy, it was necessary to operate only with Nd:YAG laser (LQS) and with some scalpel finishing.







