Curriculum Vitae

Marco Malvestuto

Date and Place of birth: 09/05/1977, Sulmona (AQ), Italy,

Contact Information

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Present Position

Scientist at Elettra-Sincrotrone Trieste

- Scientist in charge of the MagneDyn project at FERMI
- collaborator of the laboratory for X-ray time resolved experiments (T-Rex)
- collaborator of the BACH beamline;

Lecturer (Docente a contratto) at the Physics department of University of Trieste "Modern Optics Laboratory" (a.a. 2010/2011) and "Modern Physics" (a.a. 2011/2012, 2012/2013).

Research Interests

I conduct experiments in solid-state physics.

My research interests are in the study of phases and phase transitions in low dimensional strongly interacting electron systems, there where the conventional picture for an electron does not hold anymore and the electrons are now dressed by the different degrees of freedom.

Emphasis is given to the study of phase transitions of the electronic, magnetic and structural properties in low dimensional systems and the interplay between these properties in these systems.

I utilize novel state of the art experimental tools to uncover the electronic properties of materials. My tools include: **conventional** and **time-resolved** soft x-ray absorption (XAS, x-ray magnetic circular dichroism (XMCD) and x-ray linear dicroism (XLD)), Resonant X-ray emission spectroscopy (RXES), X-ray photoemission (PES, pump-probe spin resolved PES, resonant PES). I have also a deep knowledge of XAS spectra modeling and analysis of a variety of solid state systems by means of state-of-the-art ab-initio theories and calculation codes.

I am in charge of the apparatus for **time resolved** XAS/XMCD measurements using synchronous **femtosecond laser pulses** and **x-ray synchrotron pulses** at the T-Rex laboratory and the BACH beamline at Elettra - Sincrotrone Trieste.

I am also an experienced user of synchrotron radiation sources and proposer or co-proposer of numerous experiments at major synchrotron radiation facilities, in particular (Elettra (Italy), ESRF (France), Soleil (France), ALS (USA)).

Education

- January **2003**-December **2005**: **PhD in Physics** at the **Department of Physics, University of Bologna**, (tutor Prof. Federico Boscherini); title of dissertation (12 June 2006)*"Atomic and electronic structure of rare-earth oxide thin films on silicon"*.
- July **2002**: undergraduate degree **("Laurea")** in Physics, **110/110 cum laude**, at the **University of L'Aquila** (tutor Prof. Adriano Filipponi); title (22 July 2002)*"Study of the phenomenon of recalescence in undercooled liquid germanium"*
- July 1996: **Diploma Liceo Scientifico** "Enrico Fermi" di Sulmona. Votazione 58/60.

Work history

- September 2010 - September 2012: **Researcher** (non-permanent position 11/09/2010-10/09/2011)
- September 2007- 2010: **Researcher** (non-permanent position 11/09/2007-10/09/2010) at Sincrotrone Elettra, **Beamline for advanced dichroism** (BACH) and **time resolved experiments laboratory**, **Fermi project.**
- April 2006-September 2007: **postdoc** at Elettra, **BACH Beamline** (group of Prof. F. Parmigiani), Sincrotrone Trieste
- July 2006-December 2006 –February 2007-August 2007: **Visiting postdoc associate** (*Development and setup of a new cryostat manipulator and an high-speed detector for ARPES measurements*): **Advanced Light Source (Lawrence Berkeley National Laboratory – USA)** (group of Prof. C.S. Fadley (University of California, Davis))
- **January 2003-2006**: PhD student at the Physics Department of University of Bologna, Italy (Borsa di studio, Luce di Sincrotrone)

Initiatives and Funded Projects

1) **MagneDyn Initiative (role: coordinator)**: ultra-fast magnetization dynamics in the light of Free Electron Laser (Fermi@Elettra). "*Magneto dynamical studies at Fermi@Elettra. A White paper*." Editors : F. Parmigiani and **M. Malvestuto** (see bibliography)
2) **Time resolved-XAS@synchrotrons (role: coordinator)**: a setup for time resolved soft x-ray absorption experiments in multi bunch mode (**ref. doi: 10.1063/1.3669787**)
3) **Streak Camera-trXAS (role: proposer and coordinator):** a streak camera apparatus for carrying out picosecond time resolved X-ray absorption (XAS) experiments at synchrotrons and FEL facilities.
4) **PASTRY, call** FP7-ICT-2011-8 **(role: local coordinator):** The project aims at exploiting the potential of Chalcogenide SuperLattices (CSL)-Phase change memory (PCM) cells, starting from an atomistic understanding of switching in CSL materials through experiments and physical model development, leading to new insights for CSL engineering **(total budget: 3,067,901.00 euros)**
5) **Ex-**Pro-Rel: 18 keuros

On-going collaborations:

- Prof. Dr. Ir. P.H.M. van Loosdrecht, Zernike Institute for Advanced Materials, The Netherlands: orbital physics and phase transitions in layered manganites
- Dr. Mario Cuoco and Dr. A. Vecchione, University of Salerno, Italy: Orbital physics in layered ruthenates
- Dr. A. Radaelli, Micron Technology, Milano, Italy: Chalcogenide SLM
- Prof. J. Robertson, University of Cambridge, UK: Switching mechanism in Chalcogenide SLM
- Prof. R. Calarco, Paul Drude Institute, Berlin, Germany: Chalcogenide SLM

Current research

I am currently working on the:

1. Orbital physics and magnetic order phase transitions in strongly electron correlated layered compounds ($Pr_{0.5}Ca_{1.5}MnO_4$ and $Sr_{n+1}Ru_nO_{3n+1}$)
2. Laser-induced charge, orbital and magnetic ordered-non ordered phase transitions in layered PCMO manganites
3. XLD and XMCD study of the metamagnetic state of the $Sr_4Ru_3O_{10}$ system across the Fermi Non-Fermi liquid electronic states
4. XLD study of electron doped NCCO superconductors

Research experience

- **Time resolved XAS** experiment on the photoinduced melting of crystalline germanium with intense femtosecond laser pulses.
- **Time resolved XAS** on charge ordered $Pr_{0.5}Ca_{1.5}MnO_4$ manganite
- **XAS data analysis** for local structure determination combined with structural ab-initio calculations (FEFF and Wien2k)
- **X-ray Absorption Spectroscopy** (XAS) and **resonant x-ray emission (RXES)** experiments in a variety of experimental conditions, in the hard and soft energy ranges.
    - Selected investigated systems:
        - Layered $Sr_{n+1}Ru_nO_{3n+1}$ (Strontium ruthenate oxides); superconducting and metamagnetic phase
        - FeAs oxypctinitide
        - Layered multiferroic $CuFeO_2$
        - Orbital anistropy and polarization in $KCuFe_3$
        - Layered Bismuth Barium Cobaltates, Calcium cobaltates.
        - Potassium Niobium Silicate glasses (KNS)
        - Rare earth oxide (Lu_2O_3, Lu silicate, Yb_2O_3, Y_2O_3, HfO_2) ultra thin films on Si; this is part of my PhD work performed on the GILDA beamline (ESRF) and BEAR and ALOISA beamlines (ELETTRA).
        - Silver-Germanium (AgGe) Solid state solution (undergraduate work)
        - (InGa)(AsN)
        - Boron in Silver Borate Glasses

    - As implanted in Si (grazing incidence XAS)
    - Supercooled liquid Ge (undergraduate work)
- **Photoemission (resonant and non-resonant):** core level and valence band measurement on rare earth and transition metal oxides, strongly correlated systems.
- **Spin Resolved Photoemission:** time resolved and pump-and-probe photoemission experiment on Au (111) surface states employing fourth harmonic generation from a Ti:sapphire Laser
- **Angle resolved photoemission** on cobaltates.
- **Hard X-ray Photoemission:** study of the gamma_alpha-phase transition of metallic Cerium.
- **Molecular beam epitaxy** of rare-earth oxides on Si. In particular, set up of an MBE apparatus for the growth of rare-earth oxides (Lu_2O_3 and Yb_2O_3) on silicon using an e-beam evaporator; the system includes standard surface science tools such as XRD, LEED, Auger spectroscopy, AFM, inverse photoemission, EELS. This is part of PhD work was performed during a 1 year stay at the TASC laboratories in Trieste, in collaboration with Prof. Stefano Nannarone and Dr. Maddalena Pedio.
- **Energy Scanning X-Ray Diffraction** (ESXD) on solid solutions (e.g. AgGe (Silver-Germanium) solid state solution) using L'Aquila-Camerino high temperature oven, on the BM29 beamline of ESRF (this is part of undergraduate work).
- Development of an experimental set-up for the **nucleation rate** determination in supported **undercooled liquid metal** droplets and novel approach to determine the nucleation rate of an undercooled liquid from a wide statistical ensemble of measured recalescence temperatures. Undergraduate work performed at the University of L'Aquila.

PhD thesis (2003-2006)

The aim of my PhD project was to study electronic and structural properties of a class of High Dielectric constant (high-k) ultra thin film oxides deposited on Silicon by either atomic later deposition (ALD) (in collaboration with MDM, Milano, Italy) or molecular beam epitaxy (MBE). The study of such materials is of great importance since they are among the materials systems currently considered as a replacement of thermally grown silicon dioxide as a dielectric in future CMOS devices. My PhD work involved a multi-technique approach using Synchrotron Radiation (ESRF, Grenoble, France and ELETTRA, Trieste, Italy):

- XAS (x-ray absorption spectroscopy) (both experimental and computational approach) at both the cations (Lutetium, Ytterbium, Yttrium, Hafnium) and oxygen absorption edges to study interface properties in the following experimental conditions:
    - Total reflection (reflEXAFS) in grazing incidence geometry
    - Partial fluorescence yield with solid state detectors
    - Total electron yield detection
    - Auger Yield
- PES (photoemission spectroscopy).

These techniques were used to investigate the initial growth stages of Lu_2O_3, HfO_2, Yb_2O_3, Y_2O_3 films deposited on clean Si(100) surface

Teaching experience

March 2012-May 2012: Lecturer (Docente a contratto), Course "Modern Physics", Physics department, University of Trieste.

March 2011-July 2011: Lecturer (Docente a contratto), Course "Modern Optics Laboratory", Physics department, University of Trieste.

2010-2011: tutor: Master Thesis of Lorenzo Galli "Toward a comprehensive picture of the orbital polarization and the magnetic properties of ruthenates"
by Lorenzo Galli, Physics department, University of Trieste

2010-2011: tutor: Master Thesis of Giulio Vampa "Toward the observation of ultrafast demagnetization by high harmonic generated ultraviolet coherent pulses" Physics department, University of Trieste

2010-2013: tutor: PhD work of Valentina Capogrosso Physics department, University of Trieste

Language Skills

Italian mother tongue, English fluent, French basic

Computing Skills

Ab-initio codes for electronic structure calculations and XAS spectra simulation: FEFF, FEFFIT, Wien2K

Platform: Linux/UNIX, MacOS X, MS Windows

Programming languages: FORTRAN and C/C++

Computer used: PC, Macintosh

Programs: IGOR, OpenOffice, Gnuplot, Topdrawer, LaTex, Gimp, Matlab

Schools and Conferences attended

- VII National School on Synchrotron Light-Santa Margherita di Pula (Cagliari) 15-26 September 2003
- "*INFMeeting-National Conference on Physics of Matter*", Bari (Italy) 24-28 June 2002, (**poster**: '$Ag_{(1-q)}Ge_q$ terminal solid solution', 'undercooled liquids')
- "*INFMeeting-National Conference on Physics of Matter*", Genova (Italy) 23-25 June 2003, (**oral presentation**: 'High dielectric costant materials: Y_2O_3 thin films deposited on silicon substrate: an EXAFS structural study').
- SRMS-4 Conference: Synchrotron radiation in material science (August 2004), Grenoble, France (**poster**: High dielectric constant Y_2O_3 ultra thin films on Si(001): a structural study)
- AIC2004: Associazione Nazionale Cristallografia, XXXIV congresso nazionale 26-29 settembre 2004, Department of Physics, University "La Sapienza", Rome, Italy (**poster**: XAS structural study of High dielectric constants rare earth oxide ultra thin films on Si(001)).
- SCM: III Scuola Nazionale in Simulazioni Computazionali Multiscala 14-18 febbraio 2005, Department of Physics Chemistry, Modena, Italy
- XII convegno SILS (Società Italiana di Luce di Sincrotrone), Modena, Italy. (**Poster**: Local atomic and electronic structure of High Dielectric constant ultra thin film on Si(100)).
- E-MRS 2005 Spring Meeting 31 May - 3 June 2005, Strasbourg (France). (**Poster**: Local atomic and electronic structure of Yb_2O_3 and Lu_2O_3 High Dielectric constant ultra thin film on Si(100)).
- E-MRS 2006 Spring Meeting Nice, France, May 29 - June 2, 2006 (**Oral:** Study of the initial growth stages of Lu_2O_3 on Si(100)
- First International workshop on the physical properties of lamellar cobaltates , July 16th – July 20th 2006, Orsay, France. Laboratory of Solid State Physics of Université Paris Sud XI.
- 1st International Summer School of the Mainz-MATCOR Graduate School of Excellence, 25-30 September, 2006, University of Mainz, Mainz, Germany.
- 14th International Conference on X-ray Absorption Fine Structure (XAFS14), Camerino, Italy, July 26-3, 2009, **poster**
- Joint Conferences on Advanced Materials FNMA 09, September 27-20, 2009, Sulmona-L'Aquila Italy, **poster**
- Excitement in magnetism: Spin-dependent scattering and coupling of excitations in ferromagnets International Workshop at Ringberg Castle (Tegernsee, Germany) November 22-25, 2009, **oral presentation**
- 10th International Workshop on X-Ray Spectroscopy of Magnetic Solids (XRMS10) 2010, **poster.**
- 7th International Conference on Synchrotron Radiation in Materials Science-Oxford (SRMS-7) 2010, **oral presentation**
- Science at FELs 2012 **15-18 July, 2012 at DESY in Hamburg, Germany**

Publications list

1. "*Lattice expansion and Ge solubility in the $Ag_{(1-q)}Ge_q$ terminal solid solution*" A Filipponi, V. M. Giordano, and M. Malvestuto, **Physica Status Solidi** (b) 234, No. 2, 496-505 (2002);
2. "*An experimental set-up for the nucleation rate determination in supported undercooled liquid metal droplets*" A Filipponi and M. Malvestuto, **Meas. Sci. Technol.** 14(2003) 875-882 (Thesis work)
3. "*Structural characterization of epitaxial Y_2O_3 on Si (001) and of the Y_2O_3/Si interface*" S. Spiga, C. Wiemer, G. Tallarida, M. Fanciulli, M. Malvestuto, F. Boscherini, F. D'Acapito, A. Dimoulas, G. Vellianitis, and G. Mavrou, **Materials Science and Engineering: B**, 109 (2004) pp. 47-51.
4. "*X-ray absorption study of the growth of Y_2O_3 on Si*" M. Malvestuto, F. Boscherini et al., **Phys. Rev. B 71**, 075318 (2005)
5. *"The atomic site of As implanted in Si at ultra-low energies"* F. D'Acapito, C. Maurizio, M. Malvestuto, **Materials Science and Engineering B** 114–115 (2004) 386–389
6. *"X-ray absorption spectroscopy study of Yb_2O_3 and Lu_2O_3 thin films deposited on Si(100) by Atomic Layer Deposition*." M. Malvestuto, G. Scarel, C. Wiemer, M. Fanciulli, F. D'Acapito and F. Boscherini, **Nuclear Instr. and Methods B**. 246 (1), pp. 90-95 **(2006).**
7. *"Local atomic environment of high-k oxides on silicon probed by x-ray absorption spectroscopy"* M. Malvestuto and F. Boscherini, ***Topics in Applied Physics*** 106, pp. 143-152, (Springer), Editors M. Fanciulli and G. Scarel.
8. *"In-situ photoemission study of Lu_2O_3 ultra thin films deposited on Si(100)"* M. Malvestuto and F. Boscherini, M. Pedio, S. Nannarone ***Journal of Applied Physics*** 101 (7), art. no. 074104 ***(2007)***
9. *"Temperature-independent ytterbium valence in YbGaGe"* B.P. Doyle, E. Carleschi, E. Magnano, M. Malvestuto, A. Dee, A.S. Wills, Y. Janssen and P.C. Canfield **Physical Review B** 75, 235109 **(2007)**
10. *"Anions relative location in the group-V sublattice of GaAsSbN/GaAs epilayers"* G. Ciatto, J. C. Harmand, F. Glas, L. Largeau,M. Le Du, F.Boscherini, M. Malvestuto, P. Glatzel, R. Alonso Mori, and L. Floreano ***Physical Review B - Condensed Matter and Materials Physics*** 75 (24) **2007**, art. no. 245212
11. *"X-ray absorption and diffraction study of II-VI dilute oxide semiconductor alloy epilayers"* F Boscherini, M Malvestuto, G Ciatto, F D'Acapito, G Bisognin, D. De Salvador, M Felici, A Polimeni, and Y Nabetani ***Journal of Physics Condensed Matter*** 19 (44) **2007**, art. no. 446201
12. "*Evidence for Strong Itinerant Spin Fluctuations in the Normal State of CeFeAsO(0.89)F(0.11) Iron-Oxypnictides*" F. Bondino, E. Magnano, M. Malvestuto, F. Parmigiani, M. A. McGuire, A. S. Sefat, B. C. Sales, R. Jin, D. Mandrus, E. W. Plummer, D. J. Singh, N. Mannella, **Physical Review Letters,** 101 (26) 267001 **(2008)**
13. *Overlap of Cu 3d and F 2p orbitals and low-energy excitations in KCuF3 studied by polarization-dependent x-ray absorption and emission spectroscopy,* Bondino, F., Malvestuto, M., Magnano, E., Zangrando, M., Zacchigna, M., Ghigna, P., Parmigiani, F. **Physical Review B - Condensed Matter and Materials Physics** 79 (11), art. no. 115120 **(2009)**

14. *Absolute spin calibration of an electron spin polarimeter by spin-resolved photoemission from the Au(111) surface states*, Céphise M. Cacho, Sergio Vlaic, Marco Malvestuto, Barbara Ressel, Elaine A. Seddon, and Fulvio Parmigiani, **Rev. Sci. Instrum.** 80, 043904 **(2009)**
15. *Electronic structure and charge transfer processesin Bi-Ca misfit cobaltate*, E Carleschi, M Malvestuto, V Brouet, M Zacchigna, S. H´ebert, W Kobayashi, H Muguerra, D Grebille, and F.Parmigiani**, Physical Review B** 80, 035114 (**2009**)
16. *Orbital symmetry of Ba(Fe1-xCox)2As 2 superconductors probed with x-ray absorption spectroscopy*. C Parks Cheney, F Bondino, T.A Callcott, P Vilmercati, D Ederer, E Magnano, M Malvestuto, F Parmigiani, A.S Sefat, M.A McGuire, R Jin, B.C Sales, D Mandrus, D.J Singh, J.W Freeland, N Mannella. **Physical Review B - Condensed Matter and Materials Physics** (2010) vol. 81 (10)
17. Electronic structure of $CeFeAsO_{1-x}F_x$ (x=0, 0.11, and 0.12) F. Bondino, E. Magnano, C. H. Booth, F. Offi, G. Panaccione, M. Malvestuto, G. Paolicelli, L. Simonelli, F. Parmigiani, M. A. McGuire, A. S. Sefat, B. C. Sales, R. Jin, P. Vilmercati, D. Mandrus, D. J. Singh, and N. Mannella **Phys. Rev. B 82, 014529 (2010) – Published July 23, 2010**
18. *Enhancement of room temperature ferromagnetism in N-doped TiO2x rutile: Correlation with the local electronic properties*. G. Drera1, M.C. Mozzati2, P. Galinetto 2, Y. Diaz-Fernandez3, L. Malavasi3, F. Bondino, M. Malvestuto 4, and L. Sangaletti1 **Appl. Phys. Lett. 97**, 012506 (2010)
19. *Dopamine Adsorption on Anatase TiO_2(101): A Photoemission and NEXAFS Spectroscopy Study* K. Syres†, A. Thomas*†, F. Bondino‡, M. Malvestuto§, and M. Gratzel, **Langmuir** 2010, 26(18), 14548–14555
20. *Indium growth on reconstructed Si(111)$\sqrt{3} \times \sqrt{3}$ and 4 × 1 in surfaces*. D Vlachos, M Kamaratos, S.D Foulias, F Bondino, E Magnano, M Malvestuto. **Journal of Physical Chemistry C** (2010) vol. 114 (41) pp. 17693-17702
21. *Electronic structure trends in the $Sr_{n+1}Ru_nO_{3n+1}$ family (n=1,2,3)* M. Malvestuto, E. Carleschi, R. Fittipaldi, E. Gorelov, E. Pavarini,6 M. Cuoco, Y. Maeno, F. Parmigiani and A. Vecchione **Phys. Rev. B 83**, 165121 (2011)
22. *Local order and non-linear optical properties in bulk nanostructured niobiosilicate glasses* P. Pernice et al. **Journal of Non-Crystalline Solids, 2011 vol. 357 (3) pp. 1218-1222**
23. *Orbital topology, interlayer spin coupling, and magnetic anisotropy of the $CuFeO_2$ compound*. M. Malvestuto, F. Bondino, E. Magnano, F. Parmigiani, T. Lummen, P. van Loosdrecht **Phys. Rev. B 83**, 134422 (2011)
24. *Electronic structure of $FeSe_{1-x}Te_x$ studied by Fe $L_{2,3}$-edge x-ray absorption spectroscopy* N. L. Saini, Y. Wakisaka, B. Joseph, A. Iadecola, S. Dalela, P. Srivastava, E. Magnano, M. Malvestuto, Y. Mizuguchi, Y. Takano, T. Mizokawa, and K. B. Garg **Phys. Rev. B 83**, 052502 (2011)
25. *"Magneto dynamical studies at Fermi@Elettra. A White paper."* **Editors : F. Parmigiani and M. Malvestuto** (http://www.elettra.trieste.it/PEOPLE/index.php?n=MarcoMalvestuto.HomePage)
26. "*Gold Nanoparticles Dyads Stabilized with Binuclear Pt(Ii) Dithiol Bridges*" Fratoddi, Ilaria; Venditti, Iole; Battocchio, Chiara; Polzonetti, Giovanni; Bondino, Federica; **Malvestuto, Marco**; Piscopiello, Emanuela; Tapfer, Leander; Russo, Maria Vittoria, ***Journal of Physical Chemistry C* 115**, 15198–15204 (2011).

27. **Time-resolved soft x-ray absorption setup using multi-bunch operation modes at synchrotrons**. L. Stebel, **M. Malvestuto**, V. Capogrosso, P. Sigalotti, B. Ressel, F. Bondino, E. Magnano, G. Cautero, and F. Parmigiani **Rev. Sci. Instrum. 82**, 123109 (2011); doi: 10.1063/1.3669787
28. *Resonant X-ray emission study of Sr_2RuO_4 , $Sr_3Ru_2O_7$ and $Sr_4Ru_3O_{10}$* M. Malvestuto, L. Galli, E. Carleschi, R. Fittipaldi, E. Gorelov, E.Pavarini, M. Cuoco, Y. Maeno, A. Vecchione, and F. Parmigiani in preparation (2010)
29. *Direct probe of the variability of Coulomb correlation in iron pnictide superconductors*. P Vilmercati, C P Cheney, F Bondino, E Magnano, **M Malvestuto,** M A McGuire, A S Sefat, B C Sales, D Mandrus, D J Singh, M D Johannes, and N Mannella. **Physical Review B - Condensed Matter and Materials Physics**, 2012 vol. 85 (23).
30. *Self assembling monolayers of dialkynyl bridged Pd(II) thiols obtained by thermally induced multilayer desorption: Thermal and chemical stability investigated by SR-XPS*. C. Battocchio, I. Fratoddi, F Bondino, **M Malvestuto**, M.V. Russo, and G. Polzonetti. **Chemical Physics Letters**, 2012 vol. 527 pp. 57-62.
31. *Effects of charge-orbital order-disorder phenomena on the unoccupied electronic states in the single-layered half-doped Pr0.5Ca 1.5MnO4*. V. Capogrosso, M Malvestuto, I P Handayani, P.H.M. Van Loosdrecht, A A Nugroho, E Magnano, and F Parmigiani. Phys Rev B, 2013 vol. 87 (15).
32. *Labeling interacting configurations through an analysis of excitation dynamics in a resonant photoemission experiment: The case of rutile TiO 2*. G. Drera, L Sangaletti, F Bondino, M Malvestuto, L Malavasi, Y. Diaz-Fernandez, S Dash, M.C. Mozzati, and P. Galinetto. J Phys: Condens Matter, 2013 vol. 25 (7).

References

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