

Personal information

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Training

Master of science (physical chemistry), University of Jyväskylä (1993).
Master of science (computer science), University of Jyväskylä (1993).
Master of science (mathematics), University of Jyväskylä (1994).
Licentiate of philosophy (physical chemistry), University of Jyväskylä (1995).
Doctor of philosophy (physical chemistry), University of Jyväskylä (1997).
Post-doctoral researcher in Prof. H. Kunttu's group, University of Jyväskylä (1997 - 2000).
Post-doctoral researcher in Prof. V. A. Apkarian's group, University of California,
Irvine, CA (2000 - 2002).

Academic work experience

Computer programmer, Department of Chemistry, University of Jyväskylä (1983 - 1985).
Computer programmer, Computer center, Brandeis University, Waltham, MA (1986 - 1987).
System administrator, Computer center, University of Jyväskylä (1988 - 1993, 1996 - 1997).
Researcher, Finnish Academy of Sciences (1998 - 2002).
Professor of chemistry (tenured), Department of Chemistry, University of Jyväskylä
(2002 - 2006).
Assistant professor of chemistry, Department of Chemistry and Biochemistry,
California State University at Northridge (2006 - 2010).
Associate professor of chemistry, Department of Chemistry and Biochemistry,
California State University at Northridge (2010 - 2015).
Professor of chemistry, Department of Chemistry and Biochemistry,
California State University at Northridge (2015 -).

Refereed scientific publications (student authors underlined>

1. Benzophenone-4-sulphonate: triplet absorption and decay in trifluoroacetic acid and acetonitrile, and energies of ground state, triplet and radical species, J. M. Eloranta, J. A. Eloranta, and J. A. Eloranta. *Acta Chemica Scandinavica* 50, 1092 (1996).
2. Comparison of spin density calculation methods for various alkyl-substituted 9,10-anthraquinone anion radicals in the solution phase, J. Eloranta, V. Vatanen, A. Grönroos, M. Vuolle, R. Mäkelä, and H. Heikkilä. *Magnetic Resonance in Chemistry* 34, 898 (1996).
3. EPR, ENDOR and TRIPLE resonance of amino-substituted 9,10-anthraquinone radicals and the rotation of the amino groups in the solution phase, J. Eloranta, V. Vatanen, A. Grönroos, M. Vuolle, R. Mäkelä, and H. Heikkilä. *Magnetic Resonance in Chemistry* 34, 903 (1996).
4. Molecular orbital study of the isotropic hyperfine coupling constants of hydroquinone and tetramethylhydroquinone cation radicals, J. Eloranta, R. Suontamo, and M. Vuolle. *Journal of the Chemical Society, Faraday Transactions* 93, 3313 (1997).
5. Molecular orbital study of conformational isomers and rotational barriers of methyl substituted hydroquinone cation radicals, J. Eloranta, V. Vatanen, K. Vaskonen, R. Suontamo, and M. Vuolle. *Journal of Molecular Structure (THEOCHEM)* 424, 249 (1998).
6. Temperature dependence of the isotropic hyperfine coupling constants in 1,4-hydroquinone and 1,4-dihydroxy-naphthalene cation radicals, J. Eloranta and M. Vuolle. *Magnetic Resonance in Chemistry* 36, 98 (1998).
7. 193 nm photodynamics of NO in rare gas matrices: fluorescence, thermoluminescence and photodissociation, J. Eloranta, K. Vaskonen, H. Häkkinen, T. Kiljunen, and H. Kunttu. *Journal of Chemical Physics* 109, 7784 (1998).
8. EPR and ENDOR spectroscopy studies on α -aminoanthraquinone cation radicals in solution, V. Vatanen, J. Eloranta, and M. Vuolle. *Journal of Chemical Society, Perkin Transactions 2* 11, 2483 (1998).
9. Thermal mobility of atomic hydrogen in solid argon and krypton matrices, K. Vaskonen, J. Eloranta, T. Kiljunen, and H. Kunttu. *Journal of Chemical Physics* 110, 2122 (1999).
10. Photogeneration of atomic hydrogen in rare gas matrices, J. Eloranta, K. Vaskonen, and H. Kunttu. *Journal of Chemical Physics* 110, 7917 (1999).
11. Trapping of laser vaporized alkali metal atoms in rare gas matrices, K. Vaskonen, J. Eloranta, and H. Kunttu. *Chemical Physics Letters* 310, 245 (1999).
12. *Ab initio* and molecular dynamics studies on rare gas hydrides: potential energy curves, isotropic hyperfine properties, and matrix cage trapping of atomic hydrogen, T. Kiljunen, J. Eloranta, and H. Kunttu. *Journal of Chemical Physics* 110, 11814 (1999).
13. EPR and MO calculation studies on α -aminoanthraquinone anion radicals in aprotic solvents, V. Vatanen, J. Eloranta, and M. Vuolle, *Magnetic Resonance in Chemistry* 37, 774 (1999).

14. Theoretical analysis of alkali metal trapping sites in rare gas matrices, J. Ahokas, T. Kiljunen, J. Eloranta, and H. Kunttu. *Journal of Chemical Physics* 112, 2420 (2000).
15. An *ab initio* study of halogenated diphenyl ethers. NMR Chemical Shift Prediction, J. Eloranta, J. Hu, R. Suontamo, E. Kolehmainen, and J. Knuutinen. *Magnetic Resonance in Chemistry* 38, 987 (2000).
16. Electronic-structure and short-range recombination dynamics of S₂ in solid argon, T. Kiljunen, J. Eloranta, H. Kunttu, M. Pettersson, L. Khriachtchev, and M. Räsänen. *Journal of Chemical Physics* 112, 7475 (2000).
17. Effect of allopurinol treatment on myocardial oxygen free radical production during reperfusion in coronary artery bypass surgery, M. Tarkka, M. Vuolle, S. Kaukinen, P. Holm, J. Eloranta, U. Kaukinen, T. Sisto, and J. Kataja. *Scandinavian Cardiovascular Journal* 34, 593 (2000).
18. Effect of ischemic preconditioning (IP) in myocardial protection in CABG-patients: Can the free radicals act as a trigger of IP ?, Z. Wu, M. Tarkka, E. Pehkonen, J. Eloranta, M. Vuolle, L. Kaukinen, E. Honkonen, and S. Kaukinen. *Chest* 119, 1061 (2000).
19. Exciplex absorptions and emissions in solid rare gases involving atomic hydrogen, J. Eloranta and H. Kunttu. *Journal of Chemical Physics* 113, 7446 (2000).
20. Electronic absorption spectra of HXeCl, HXeBr, HXeI, and HXeCN in Xe matrix, J. Ahokas, K. Vaskonen, J. Eloranta, and H. Kunttu. *Journal of Physical Chemistry A* 104, 9506 (2000).
21. Effect of ischemic preconditioning, cardiopulmonary bypass and myocardial ischemic/reperfusion on free radicals generation in CABG patients, Z. Wu, M. R. Tarkka, J. Eloranta, E. Pehkonen, J. Laurikka, L. Kaukinen, E. L. Honkonen, M. Vuolle, and S. Kaukinen. *Cardiovascular Surgery* 9, 362 (2001).
22. Magnetic properties of atomic boron in rare gas matrices. An electron paramagnetic resonance study with *ab initio* and diatomics-in-molecules molecular dynamics analysis, T. Kiljunen, J. Eloranta, J. Ahokas, and H. Kunttu. *Journal of Chemical Physics* 114, 7144 (2001).
23. Optical properties of atomic boron in rare gas matrices: an UV-absorption/LIF study with *ab initio* and diatomics-in-molecules molecular dynamics analysis, T. Kiljunen, J. Eloranta, J. Ahokas, and H. Kunttu. *Journal of Chemical Physics* 114, 7157 (2001).
24. The triplet He₂^{*} Rydberg states and their interaction potentials with ground state He atoms, J. Eloranta and V. A. Apkarian, *Journal of Chemical Physics* 115, 752 (2001).
25. Structure and energetics of He₂^{*} bubble-states in superfluid ⁴He, J. Eloranta, N. Schwentner, and V. A. Apkarian. *Journal of Chemical Physics* 116, 4039 (2002).
26. Strong-field excitation of liquid and solid Xe using intense femtosecond pulses, M. Pettersson, R. Zadayan, J. Eloranta, N. Schwentner, and V. A. Apkarian. *Journal of Physical Chemistry A* 106, 8308 (2002).
27. A direct interrogation of superfluidity on molecular scales, A. V. Benderskii, J. Eloranta, R.

- Zadoyan, and V. A. Apkarian. *Journal of Chemical Physics* 117, 1201 (2002).
28. Toward a universal molecule injector in liquid helium: Pulsed cryogenic doped helium droplet source, V. Ghazarian, J. Eloranta, and V. A. Apkarian. *Review of Scientific Instruments* 73, 3606 (2002).
 29. Host-guest charge transfer states: CN doped Kr and Xe, S. Fiedler, K. Vaskonen, J. Ahokas, H. Kunttu, J. Eloranta, and V. A. Apkarian. *Journal of Chemical Physics* 117, 8867 (2002).
 30. A time dependent density functional treatment of superfluid dynamics: Equilibration of the electron bubble in superfluid ^4He , J. Eloranta and V. A. Apkarian. *Journal of Chemical Physics* 117, 10139 (2002).
 31. On the formation mechanism of impurity-helium solids: evidence for extensive clustering, E. A. Popov, J. Eloranta, J. Ahokas, and H. Kunttu. *Low Temperature Physics* 29, 510 (2003).
 32. EPR studies of atomic impurities in rare gas matrices, H. Kunttu and J. Eloranta. *Progress in Theoretical Chemistry and Physics 10 (EPR of Free Radicals in Solids)*, Eds. A. Lund and M. Shiotani (2003, Kluwer Academic Publishing). 2nd Ed. 2012.
 33. Efficient numerical method for simulating static and dynamic properties of superfluid helium, L. Lehtovaara, T. Kiljunen, and J. Eloranta. *Journal of Computational Physics* 194, 78 (2004).
 34. Solvation of triplet Rydberg states of molecular hydrogen in superfluid helium, T. Kiljunen, L. Lehtovaara, H. Kunttu, and J. Eloranta. *Physical Review A* 69, 012506 (2004).
 35. Time-domain analysis of electronic spectra in superfluid ^4He , J. Eloranta, H. Ye. Seferyan, and V. A. Apkarian. *Chemical Physics Letters* 396, 155 (2004).
 36. Charge transfer states of C_2 in Kr clusters, S. Fiedler, H. Kunttu, and J. Eloranta. *Chemical Physics* 307, 91 (2004).
 37. From a fixed bed Ag-alumina catalyst to a modified reactor design: how to enhance the crucial heterogeneous-homogeneous reactions in HC-SCR?, K. Arve, E. A. Popov, M. Rönnholm, F. Klingstedt, J. Eloranta, K. Eränen, D. Yu. Murzin. *Chemical Engineering Science* 59, 5277 (2004).
 38. Mechanism of decomposition of peracetic acid by manganese ions and diethylenetriamine pentaacetic acid (DTPA), E. A. Popov, J. Eloranta, V. Hietapelto, V.-M. Vuorenpallo, R. Aksela, and J. Jäkärä. *Holzforschung* 59, 507 (2005).
 39. HC-SCR of NO_x over Ag/alumina: a combination of heterogeneous and homogeneous radical reactions?, K. Arve, E. A. Popov, K. Eränen, F. Klingstedt, L.-E. Lindfors, J. Eloranta, D. Yu. Murzin. *Catalysis Today* 100, 229 (2005).
 40. Generation of intrinsic excitations in superfluid ^4He by using gas jet approach, E. A. Popov, J. Ahokas, J. Eloranta, and H. Kunttu. *Journal of Low Temperature Physics* 138, 85 (2005).
 41. A 2-level anisotropic electronic system in superfluid ^4He , L. Lehtovaara and J. Eloranta. *Journal of Low Temperature Physics* 138, 91 (2005).

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43. Thermal decomposition mechanism of N₂ impurity helium solids, E. A. Popov, J. Ahokas, J. Eloranta, and H. Kunttu. *Journal of Low Temperature Physics* 139, 557 (2005).
44. Electronic spectroscopy of C₂ in solid rare gas matrices, S. Fiedler, J. Eloranta, K. Vaskonen, and H. Kunttu. *Journal of Physical Chemistry A* 109, 4512 (2005).
45. Applicability of density functional theory to model molecular solvation in superfluid ⁴He, T. Isojärvi, L. Lehtovaara, and J. Eloranta. *AIP Conference Proceedings in Low Temperature Physics A*, 386 (2006).
46. On the formation mechanism of impurity helium solids, E. Popov, J. Ahokas, J. Eloranta, and H. Kunttu. *AIP Conference Proceedings in Low Temperature Physics A*, 384 (2006).
47. Small multielectron bubbles in bulk superfluid ⁴He, L. Lehtovaara and J. Eloranta. *AIP Conference Proceedings in Low Temperature Physics A*, 167 (2006).
48. Solution of time-independent Schrödinger equation by the imaginary time propagation method, L. Lehtovaara, J. Toivanen, and J. Eloranta. *Journal of Computational Physics* 221, 148 (2007).
49. Dynamics of He₂^{*} triplet state excimer bubbles in superfluid ⁴He, J. Eloranta, *Chemical Physics* 332, 304 (2007).
50. Rotation of methyl radicals in a solid argon matrix, E. Popov, T. Kiljunen, H. Kunttu, and J. Eloranta. *Journal of Chemical Physics* 126, 134504 (2007).
51. One- and two-electron bubbles in superfluid ⁴He, L. Lehtovaara and J. Eloranta. *Journal of Low Temperature Physics* 148, 43 (2007).
52. Stabilization of peracetic acid with aspartic acid diethoxy succinate (AES), E. Popov, J. Väliisaari, V.-M. Vuorenalo, V. Hietapelto, R. Aksela, and J. Eloranta. *Holzforchung* 61, 539 (2007).
53. Stabilization of H₂O₂ in presence of Fe(II) and Mn(II) impurities under alkaline conditions, E. Popov, J. Väliisaari, V.-M. Vuorenalo, R. Aksela, and J. Eloranta. *Holzforchung* 61, 543 (2007).
54. Application of mean-field and surface hopping approaches for interrogation of the Xe₃⁺ molecular ion photoexcitation dynamics, S. Fiedler, H. Kunttu, and J. Eloranta. *Journal of Chemical Physics* 128, 164309 (2008).
55. Self-assembly of neon quantum gel in superfluid ⁴He: Prediction from density functional theory, J. Eloranta. *Physical Review B* 77, 134301 (2008).
56. Rotation of methyl radicals in a solid krypton matrix, T. Kiljunen, E. Popov, H. Kunttu, and J. Eloranta. *Journal of Chemical Physics* 130, 164504 (2009).

57. Rotation of methyl radicals in molecular solids, T. Kiljunen, E. Popov, H. Kunttu, and J. Eloranta. *Journal of Physical Chemistry A* 114, 4770 (2010).
58. Nonadiabatic dynamics by the mean-field and surface-hopping approaches: energy conservation considerations, S. L. Fiedler, and J. Eloranta. *Molecular Physics* 108, 1471 (2010).
59. Kinetics of UV-H₂O₂ advanced oxidation in the presence of alcohols: The role of carbon centered radicals, E. Popov, M. Mametkuliyeu, D. Santoro, L. Liberti, and J. Eloranta. *Environmental Science and Technology* 44, 7827 (2010).
60. Solvation of atomic fluorine in bulk superfluid ⁴He, J. Eloranta. *Low Temperature Physics* 37, 384 (2011).
61. Theoretical study of quantum gel formation in superfluid ⁴He, J. Eloranta. *Journal of Low Temperature Physics* 162, 718 (2011).
62. Injection of atoms and molecules in a superfluid helium fountain: Cu and Cu₂He_n ($n = 1...∞$), E. Vehmanen, V. Ghazarian, C. Sams, I. Khatchatryan, J. Eloranta, and V. A. Apkarian. *Journal of Physical Chemistry A* 115, 7077 (2011).
63. Experimental and theoretical characterization of the long-range interaction between He*(3s) and He(1s), N. Bonifaci, F. Aitken, V. M. Atrazhev, S. L. Fiedler, and J. Eloranta. *Physical Review A* 85, 042706 (2012).
64. Theoretical modeling of ion mobility in superfluid ⁴He, S. L. Fiedler, D. Mateo, T. Aleksanyan, and J. Eloranta. *Physical Review B* 86, 144522 (2012).
65. Excited atoms in cavities of liquid He I: Long-range inter-atomic repulsion and broadening of atomic lines, V. M. Atrazhev, J. Eloranta, N. Bonifaci, H. van Nguen, F. Aitken, K. van Haeften, and G. Vermeulen. *European Physical Journal - Applied Physics* 61, 24302 (2013).
66. Dynamics of vortex assisted metal condensation in superfluid helium, E. Popov, M. Mametkuliyeu, and J. Eloranta. *Journal of Chemical Physics* 138, 204307 (2013).
67. Interaction of helium Rydberg state atoms with superfluid helium, S. L. Fiedler and J. Eloranta. *Journal of Low Temperature Physics* 174, 269 (2014).
68. Study of helium cryoplasma by electro-physical and spectroscopic methods, H. G. Tarchouna, N. Bonifaci, F. Aitken, V. A. Shakhmatov, V. M. Atrazhev, J. Eloranta, and F. Jomni. *Combustion and Plasma-chemistry* 12, 222 (2014).
69. Solvation of intrinsic positive charge in superfluid helium, D. Mateo and J. Eloranta. *Journal of Physical Chemistry A* 118, 6407 (2014).
70. Rotational superfluidity in small helium droplets, D. Mateo, F. Gonzalez, and J. Eloranta. *Journal of Physical Chemistry A* 119, 2262 (2015).
71. Interaction of ions, atoms and small molecules with quantized vortex lines in superfluid ⁴He, D. Mateo, J. Eloranta, and G. A. Williams. *Journal of Chemical Physics* 142, 064510 (2015).
72. Copper dimer interactions on a thermomechanical superfluid ⁴He fountain, E. Popov and J.

- Eloranta. *Journal of Chemical Physics* 142, 204704 (2015).
73. Laser assisted detection of metal nanoparticles in liquid He-II, V. Fernandez, A. Garcia, K. Vossoughian, E. Popov, S. Garrett, and J. Eloranta. *Journal of Physical Chemistry A* 119, 10882 (2015).
 74. Ejection of metal particles into superfluid ^4He by laser ablation, X. Buelna, A. Freund, D. Gonzalez, E. Popov, and J. Eloranta. *Journal of Physical Chemistry B* 120, 11010 (2016).
 75. Theoretical modeling of electron mobility in superfluid ^4He , F. Aitken, N. Bonifaci, K. von Haeften, and J. Eloranta. *Journal of Chemical Physics* 145, 044105 (2016).
 76. Time-resolved study of laser initiated shock wave propagation in superfluid ^4He , A. Garcia, X. Buelna, E. Popov, and J. Eloranta. *Journal of Chemical Physics* 145, 124504 (2016).
 77. Interaction of helium Rydberg state molecules with dense helium, N. Bonifaci, Z. Li, J. Eloranta, and S. L. Fiedler. *Journal of Physical Chemistry A* 120, 9019 (2016).
 78. Dynamics of laser ablation in superfluid ^4He , X. Buelna, E. Popov, and J. Eloranta. *Journal of Low Temperature Physics* 186, 197 (2017).
 79. A thermodynamic model to predict mobility of electrons in superfluid helium, F. Aitken, F. Volino, L. G. Mendoza-Luna, K. von Haeften, and J. Eloranta. *Physical Chemistry Chemical Physics* 19, 15821 (2017).
 80. Density functional theory of doped superfluid liquid helium and nanodroplets, F. Ancilotto, M. Barranco, F. Coppens, J. Eloranta, N. Halberstadt, A. Hernando, D. Mateo, and M. Pi. *International Reviews in Physical Chemistry* 36, 621 (2017).
 81. The onset of nanoscale dissipation in superfluid ^4He at zero temperature: The role of vortex shedding and cavitation, F. Ancilotto, M. Barranco, J. Eloranta, and M. Pi. *Physical Review B* 96, 064503 (2017).
 82. Spectra, line intensities of the $C\ ^1\Sigma_g^+ \rightarrow A\ ^1\Sigma_u^+$ and the $c\ ^3\Sigma_g^+ \rightarrow a\ ^3\Sigma_u^+$ transitions in liquid normal He, and rotational level populations of the $C\ ^1\Sigma_u^+$ and the $c\ ^3\Sigma_u^+$ terms, V. M. Atrazhev, V. A. Shakhatov, R. E. Boltnev, N. Bonifaci, F. Aitken, and J. Eloranta. *High Temperature* 55, 165 (2017).
 83. Nonmonotonic distribution of population of the $a\ ^3\Sigma_u^+$ triplet state rotational levels in corona discharge in cryogenic helium gas, N. Bonifaci, V. M. Atrazhev, V. A. Shakhatov, R. E. Boltnev, K. von Haeften, and J. Eloranta. *High Temperature* 55, 326 (2017).
 84. Application of time-resolved shadowgraph imaging and computer analysis to study micrometer-scale response of superfluid helium, S. Sajjadi, X. Buelna, and J. Eloranta. *Review of Scientific Instruments* 89, 013102 (2018).
 85. First observation of solitons in bulk superfluid ^4He , F. Ancilotto, D. Levy, J. Pimentel, and J. Eloranta. *Physical Review Letters* 120, 035302 (2018).
 86. Density functional theory modeling of vortex shedding in superfluid ^4He , A. Freund, D. Gon-

- zalez, X. Buelna, F. Ancilotto, and J. Eloranta. *Physical Review B* 98, 094520 (2018).
87. Study of shock waves and solitons in bulk superfluid ^4He , X. Buelna, D. Gonzalez, A. Freund, and J. Eloranta. *Physical Review B* 99, 144518 (2019).
 88. Ultrafast relaxation of photoexcited superfluid He nanodroplets, M. Mudrich, A. C. LaForge, A. Ciavardini, P. Keeffe, C. Callegari, M. Coreno, A. Demidovich, M. Devetta, M. Di Fraia, M. Drabbels, P. Finetti, O. Gessner, C. Grazioli, A. Hernando, D. M. Neumark, Y. Ovcharenko, P. Piseri, O. Plekan, K. C. Prince, R. Richter, M. P. Ziemkiewicz, T. Möller, J. Eloranta, M. Pi, M. Barranco and F. Stienkemeier. *Nature Communications* 11, 112 (2020).
 89. Time-resolved shadowgraph photography of laser-heated plasmonic gold nanoparticles in water, D. Stavich, B. Nestoiter, D. Gonzalez, A. Freund, X. Buelna, K. Wang, J. Teprovich, and J. Eloranta. *Journal of Physical Chemistry C* 124, 14022 (2020).
 90. Peracetic acid-based advanced oxidation processes for decontamination and disinfection of water: A review, X. Ao, J. Eloranta, C.-H. Huang, D. Santoro, W. Sun, Z. Lu, and C. Li. *Water Research* 188, 116479 (2020).
 91. Time-resolved study of resonant interatomic Coulombic decay in helium nanodroplets, A. C. LaForge, R. Michiels, Y. Ovcharenko, A. Ngai, J. M. Escartin, N. Berrah, C. Callegari, A. Clark, M. Coreno, R. Cucini, M. Di Fraia, M. Drabbels, E. Fasshauer, P. Finetti, L. Giannessii, C. Grazioli, D. Iablonskyi, B. Langbehn, T. Nishiyama, V. Oliver, P. Piseri, O. Plekan, K. C. Prince, D. Rupp, S. Stranges, K. Ueda, N. Sisourat, J. Eloranta, M. Pi, M. Barranco, F. Stienkemeier, T. Möller, and M. Mudrich. *Physical Review X* 11, 021011 (2021).
 92. Unravelling the Full Relaxation Dynamics of Superexcited Helium Nanodroplets, J. D. Asmussen, R. Michiels, K. Dulitz, A. Ngai, U. Bangert, M. Barranco, M. Binz, L. Bruder, M. Danailov, J. Eloranta, R. Feifel, L. Giannessi, M. Pi, K. C. Prince, R. J. Squibb, D. Uhl, A. Wituschek, M. Zangrando, C. Callegari, F. Stienkemeier, and M. Mudrich. *Physical Chemistry Chemical Physics* 23, 15138 (2021).
 93. Density functional theory of superfluid helium at finite temperatures, A. Long and J. Eloranta. *Journal of Chemical Physics* 155, 074102 (2021).

Other scientific publications

1. Xemr - A general purpose Electron Magnetic Resonance software, J. Eloranta. *EPR Newsletter (International EPR society)* 10, 3 (1999); <http://www.csun.edu/~jeloranta/xemr/>
2. libmeas - Development library for controlling scientific instruments under Linux; <http://www.csun.edu/~jeloranta/libmeas/index.html>
3. libgrid - Parallel development library for manipulating Cartesian grids; <http://www.csun.edu/~jeloranta/libgrid/index.html>