

# **12th IIR International Conference on Cryogenics 2012**

**(CRYOGENICS 2012)**

**Dresden, Germany  
11-14 September 2012**

**ISBN: 978-1-62276-604-8  
ISSN: 0151-1637**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2012) by the International Institute of Refrigeration  
All rights reserved.

Printed by Curran Associates, Inc. (2013)

For permission requests, please contact the International Institute of Refrigeration  
at the address below.

International Institute of Refrigeration  
177 Boulevard Malesherbes  
F 75017 Paris France

Phone: 33 1 422 73 235

Fax: 33 1 422 31 798

[iifiir@iifiir.org](mailto:iifiir@iifiir.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

**Content**

<b>Content</b>	<b>3</b>
<b>Committees</b>	<b>8</b>
<b>Conference partners</b>	<b>9</b>
<b>CRYOGENICS IN PARTICLE PHYSICS</b>	<b>11</b>
<b>001</b> -----	<b>12</b>
<b>Cryogenics for the Future Accelerator Complex NICA at JINR</b>	<b>12</b>
<i>Agapov N.* , Batin V.* , Emelianov N.* , Hisameev I.** , Krakovsky B.*** , Mitrofanova Y.* , Nikiforov D.* , Popov O.*** , Trubnikov G.* , Udut V.*** , Ziskin G.**</i>	12
<b>010</b> -----	<b>18</b>
<b>Thermal Design of Cryogenic Permanent Magnet Undulator for SLS</b>	<b>18</b>
<i>Anghel A.* , Jakob B.* , Bruegger M.* , Schmidt T.* , Tanaka T.** , Kohda T.***</i>	18
<b>036</b> -----	<b>24</b>
<b>Analysis of the SIS100 Superconducting Magnet Cooling</b>	<b>24</b>
<i>Bleile A.* , Fischer E.* , Khodzhbagiyan H.** , Mierau A.*</i>	24
<b>CRYOGENICS IN PARTICLE PHYSICS &amp; FUSION</b>	<b>27</b>
<b>030</b> -----	<b>28</b>
<b>Design, Manufacturing and Assembly of the Cryogenic Transfer Line for XFEL/AMTF</b>	<b>28</b>
<i>Fydrych J.* , Chorowski M.* , Duda P.* , Grzegory P.** , Iluk A.*** , Malcher K.*** , Michalski G.** , Rusinski E.*** , Strychalski G.**</i>	28
<b>020</b> -----	<b>34</b>
<b>Design Proposal For MITICA Cryogenic Plant</b>	<b>34</b>
<i>Valente M.* , Fellin F.* , Haas H.** , Hanke S.** , Scannapiego M.** , Zaccaria P.*</i>	34
<b>018</b> -----	<b>40</b>
<b>The MITICA Facility: A Possible Optimization of the Cryogenic Plant Cooling Capacity</b>	<b>40</b>
<i>Fellin F.* , Passardi G.** , Valente M.* , Zaccaria P.*</i>	40
<b>095</b> -----	<b>46</b>
<b>Cryogenics for the European Spallation Source</b>	<b>46</b>
<i>Wang X.L. , Koettig T. , Gallimore S. , Hees W.</i>	46
<b>SUPERCONDUCTIVITY AND ITS APPLICATIONS</b>	<b>52</b>
<b>002</b> -----	<b>53</b>
<b>Experimental Study of Superconducting Magnets for the NICA Accelerator Complex</b>	<b>53</b>
<i>Khodzhbagiyan H. , Bazanov A. , Donyagin A. , Galimov A. , Karpinsky V. , Kuznetsov G. , Nikitaev P. , Smirnov A. , Trubnikov G.</i>	53
<b>037</b> -----	<b>59</b>
<b>Measurement of Dynamic Heat Losses in the Fast Ramped Superconducting Magnets for the SIS100 Synchrotron</b>	<b>59</b>
<i>Bleile A.* , Fischer E.* , Khodzhbagiyan H.** , Mierau A.* , Schnizer P.*</i>	59
<b>026</b> -----	<b>65</b>
<b>The Cryogenic System of the 43 T Hybrid Magnet of LNCMI Grenoble, France</b>	<b>65</b>
<i>Ronayette L.* , Barbier R.* , Bredy Ph.** , Fazilleau Ph.** , Grandclément C.* , Hervieu B.** , Juster FP.** , Pfister R.* , Pugnât P.*</i>	65
<b>054</b> -----	<b>73</b>
<b>Cooling systems for superconducting power applications – Experiences gained from HTS cable and fault-current limiter projects</b>	<b>73</b>
<i>Hobl A.* , Bock J.* , Allweins K.**</i>	73
<b>051</b> -----	<b>79</b>
<b>Components and Systems for HTS Applications</b>	<b>79</b>
<i>Kade A. , Kaiser G. , Klupsch M. , Schneider M. , Herzog R. , Klier J.</i>	79
<b>SUPERCONDUCTIVITY &amp; VERY LOW TEMPERATURES</b>	<b>85</b>
<b>015</b> -----	<b>86</b>
<b>Superconducting Current Feeders System for SST-1</b>	<b>86</b>
<i>Gupta N.C. , Garg A. , Sonara D. , Panchal R. , Shah P. , Nimavat H. , Sharma A.N. , Prasad U. , Tanna V.L. , Pradhan S.</i>	86
<b>042</b> -----	<b>91</b>
<b>Study of Refrigeration Characteristics of Slush Nitrogen in Flow System</b>	<b>91</b>
<i>Nakamura N. , Komagome T. , Lee Y. , Boone J.</i>	91
<b>053</b> -----	<b>97</b>
<b>Compact Dilution Refrigerator for Sensor Cooling</b>	<b>97</b>
<i>Schneider M. , Arndt J. , Giesel J. , Zerweck-Trogisch U. , Klier J. , Herzog R.</i>	97

073	-----	102
	<b>The AEGIS Low Temperature System</b>	<b>102</b>
	<i>Eisel T., Bremer J., Burghart G., Doser M., Dudarev A.</i>	102
	<b>CRYOCOOLERS, LIQUID HELIUM</b>	<b>106</b>
039	-----	107
	<b>A 3-Dimensional Numerical Study a Co-Axial type Acoustic Stirling Cryocooler</b>	<b>107</b>
	<i>Farouk B. *, Spoor P. **, Corey J. **, Antao D.S. *</i>	107
038	-----	114
	<b>Effects of the Inertance Tube Length and Diameter on Pulse Tube Refrigerator Performance</b>	<b>114</b>
	<i>Farouk B., Antao D.S.</i>	114
052	-----	120
	<b>3-Cycle Pulse Tube Cooler for Cryogenic High-Power Applications</b>	<b>120</b>
	<i>Kuhn M., Kaiser G., Schildbach T., Schroeder G., Klier J., Herzog R.</i>	120
008	-----	126
	<b>Low Temperature Phase Equilibria of Refrigerant Mixtures</b>	<b>126</b>
	<i>Winkelmann D., Oellrich L.R.</i>	126
088	-----	133
	<b>Studies of Adsorption Characteristics of Activated Carbons down to 4.5K for the Development of Cryosorption Pumps</b>	<b>133</b>
	<i>Kasthurirengan S. *, Behera U. *, Gangradey R. **, Krishnamoorthy V. ***, Udgata S.S. ***, Tripathi V.S. ****</i>	133
	<b>CRYOTHERAPY, CRYOBIOLOGY</b>	<b>140</b>
006	-----	141
	<b>Cryotherapy State-of-art and Challenges in Poland</b>	<b>141</b>
	<i>Chorowski M. *, Piotrowska A. *, Adamowicz B. **, Haladyn E. **</i>	141
077	-----	146
	<b>Study of Contact Methods to Cool Biological Tissue in Local Surgery</b>	<b>146</b>
	<i>Kondratenko R. *, Butorina A. **, Nesterov S. *</i>	146
004	-----	150
	<b>Application of the Very Low Temperatures for the Preservation of Rare Plants' Seeds of Ukraine</b>	<b>150</b>
	<i>Arapetyan E. *, Usatenko Yu. **</i>	150
094	-----	154
	<b>A Preliminary Method for Ultra-Rapid Freezing of the Nicotiana Tabacum BY-2 Cell Line by Encapsulation / Vitrification</b>	<b>154</b>
	<i>Schumacher H.M., Bitter E., Heine-Dobbernack E.</i>	154
074	-----	159
	<b>Standardization of the Cryopreservation Process for Parathyroid Glands</b>	<b>159</b>
	<i>von Walcke-Wulffjen V. *, Mohrbacher J. *, Gepp M. **, Schmidt T. **</i>	159
	<b>AIR SEPARATION AND PRODUCT STORAGE, CO<sub>2</sub> SEQUESTRATION</b>	<b>163</b>
058	-----	164
	<b>Air Separation Unit Installation and Qualification at the French Guiana Space Centre</b>	<b>164</b>
	<i>Burdaszewski P.</i>	164
032	-----	172
	<b>Advanced Cryogenic Processes for low Purity Oxygen Production</b>	<b>172</b>
	<i>Kirchner L., Lochner S., Dowy S.</i>	172
085	-----	178
	<b>Oxygen Supply for CO<sub>2</sub> Capture by Oxyfuel Coal Combustion</b>	<b>178</b>
	<i>Higginbotham P., Kalbassi M., Gibson S.</i>	178
078	-----	183
	<b>Feasibility Study of "CO<sub>2</sub>-Free Hydrogen Energy Supply Chain" Utilizing Australian Brown Coal Linked with CCS</b>	<b>183</b>
	<i>Inoue K., Yoshino Y., Kamiya S., Harada E.</i>	183
	<b>MISCELLANEOUS</b>	<b>188</b>
076	-----	189
	<b>Thermosiphon Tanks for Reliable Pump Operation</b>	<b>189</b>
	<i>Hnizdil T., Chrz V., Kotek M., Lánský M.</i>	189
045	-----	199
	<b>Numerical Simulation of Mixed Convection Heat Transfer to Forced Flow Supercritical Helium</b>	<b>199</b>
	<i>Rebelo N., Ghosh P.</i>	199
055	-----	206
	<b>Presentation of the German Working Committee NA 016-00-07 AA: Safety Devices for Helium Cryostats</b>	<b>206</b>
	<i>Blum L. *, Grohmann S. **, Haberstroh Ch. ***, Lau M. ****, Otte W. *****, Reinhardt M. *****, Schröder C.H. *****, Süßner M. *****</i>	206

<b>LIQUEFIED NATURAL GAS (LNG)</b>	<b>214</b>
031 -----	215
<b>Conceptual Design of an Efficient Small LNG Production Facility</b>	<b>215</b>
<i>Quack H.</i>	215
041 -----	221
<b>A Techno-Economic Optimization for Micro-Scale Liquefaction Plants</b>	<b>221</b>
<i>Arteconi A.* , Pacetti M.** , Polonara F.**</i>	221
040 -----	226
<b>LNG as Vehicle Fuel in Italy</b>	<b>226</b>
<i>Arteconi A.* , Polonara F.**</i>	226
047 -----	233
<b>Exergy Analysis to Determine Appropriate Design and Operating Parameters for Collins Refrigerator-Liquefier under Mixed Mode Operation</b>	<b>233</b>
<i>Kundu A.* , Thomas R.J.** , Ghosh P.* , Chowdhury K.*</i>	233
<b>CRYOBIOLOGY AND -TECHNOLOGY</b>	<b>240</b>
046 -----	241
<b>Analysis on Protein Stability in Tris Buffered Purified Bulk Solutions during the Freezing Process</b>	<b>241</b>
<i>Heidingsfelder J., Reinsch H., Klier J., Herzog R.</i>	241
003 -----	246
<b>Coupled Transport of Water and Cryoprotectant across Cell Membranes and Applications to Cryopreservation</b>	<b>246</b>
<i>Weng L., Li W.</i>	246
064 -----	252
<b>Biological and Technological Challenges Establishing a Future-Proof Cryogenic Biomaterialbank</b>	<b>252</b>
<i>Ciba P.* , Böhmert B.* , Lermen D.** , Fuhr G.R.** , Kruse C.*</i>	252
087 -----	254
<b>Cryopreservation of Mesenchymal Stromal Cells by Vitrification in Multicomponent Solutions</b>	<b>254</b>
<i>Petrenko A.Yu., Trufanova N.A., Petrenko Yu.A.</i>	254
070 -----	260
<b>Safety and Quality Assurance in Donation, Harvest and Preservation of Cells and Tissues of Human Origin - A Review of Own Experience</b>	<b>260</b>
<i>Měřička P., Straková H., Štěrba L.</i>	260
<b>LIQUID HYDROGEN</b>	<b>266</b>
067 -----	267
<b>Thermophysical Properties of Hydrogen and Deuterium at all Ortho-Para Compositions</b>	<b>267</b>
<i>Leachman J., Richardson I.</i>	267
080 -----	273
<b>Principles for the Liquefaction of Hydrogen with Emphasis on Precooling Processes</b>	<b>273</b>
<i>Walnum H.T.* , Berstad D.* , Drescher M.* , Neksa P.* , Quack H.** , Haberstroh Ch.** , Essler J.**</i>	273
081 -----	281
<b>Search for the Best Processes to Liquefy Hydrogen in Very Large Plants</b>	<b>281</b>
<i>Quack H.* , Essler J.* , Haberstroh Ch.* , Walnum H.T.** , Berstad D.** , Drescher M.** , Neksa P.**</i>	281
061 -----	287
<b>The Development of Methods and Means for Long-Term Storage of Liquid Hydrogen of High Purity (Extended Abstract)</b>	<b>287</b>
<i>Cheremnykh O.Ya.</i>	287
050 -----	289
<b>A New Cryogenic High-Pressure H<sub>2</sub> Test Area: First Results</b>	<b>289</b>
<i>Klier J.* , Rattay M.** , Kaiser G.* , Klupsch M.* , Kade A.* , Schneider M.* , Herzog R.*</i>	289
<b>RARE GASES</b>	<b>295</b>
059 -----	296
<b>Assessment of the Storage of Crude Helium in Reserves in Europe or Elsewhere</b>	<b>296</b>
<i>Clarke R.H.* , Scurlock R.**</i>	296
024 -----	302
<b>Cascade Units for Neon Isotopes Production by Rectification Method</b>	<b>302</b>
<i>Bondarenko V.L.* , Simonenko Yu.M.** , Lyschik A.A.*** , Yemelyanov A.M.** , Dalakov P.I.***</i>	302
022 -----	309
<b>Enrichment of Rare Gases Concentrates with Application of Diaphragm Technologies</b>	<b>309</b>
<i>Bondarenko V.L.* , Losyakov N.P.** , Simonenko Yu.M.*** , Chuklin A.P.***</i>	309
060 -----	316
<b>The Future of Helium? A Global Agency to Oversee Production, Storage, Supply and Use of Helium Gas and Liquid</b>	<b>316</b>
<i>Scurlock R.* , Clarke R.H.** , Glowacki B.A.*** , Nuttall W.J.****</i>	316

<b>POSTER SESSION - SUPERCONDUCTIVE MATERIALS AND MAGNETS</b>	<b>321</b>
013 -----	322
<b>Design of a Superconducting Inductor for Axial Concentration Flux Motor</b>	<b>322</b>
<i>Ailam E., Hachama M., Benallal M.N., Hocine A.</i>	322
016 -----	328
<b>Stability of YBCO Coated Conductor according to Cu Stabilizer Thickness for Cryogenic Applications</b>	<b>328</b>
<i>Joonhan B., Beomyong E., Haejong K., Kichul S.</i>	328
033 -----	333
<b>Properties of Impregnated Superconducting Coils Made from YBCO Coated Conductor Using Different Technology of Impregnation</b>	<b>333</b>
<i>Frolek L., Seiler E., Šouc J., Pardo E.</i>	333
049 -----	338
<b>Study of Heat Electrodynamic Processes in High Temperature Superconductors (HTSC) Taking into Account Defects of Their Internal Structure</b>	<b>338</b>
<i>Arkharov A., Romanovskiy V., Dontsova E.</i>	338
086 -----	341
<b>Critical Current Degradation Analysis in Irradiated Superconducting Materials</b>	<b>341</b>
<i>Sosnowski J.</i>	341
093 -----	346
<b>Opportunities for Improving the Electrochemical Characteristics of Ni-Zn Batteries using High Temperature Superconducting Ceramic</b>	<b>346</b>
<i>Ivanova G.<sup>*</sup>, Stoyanova-Ivanova A.<sup>**</sup>, Terzieva S.<sup>**</sup>, Kovacheva D.<sup>***</sup>, Mladenov M.<sup>*</sup>, Blagoev B.<sup>****</sup>, Dimitrov D.<sup>**</sup></i>	346
056 -----	351
<b>Superconducting Unclosed Shields for Improving Homogeneity of the Magnetic Field in Magnetic Systems</b>	<b>351</b>
<i>Kulikov E.<sup>*</sup>, Agapov N.<sup>*</sup>, Dorofeev G.<sup>**</sup>, Drobin V.<sup>*</sup>, Malinovski H.<sup>*</sup>, Prokofichev Yu.<sup>*</sup>, Smimov A.<sup>*</sup>, Trubnikov G.<sup>*</sup></i>	351
<b>POSTER SESSION - CRYOCOOLERS AND COOLING OF SUPERCONDUCTIVE SYSTEMS</b>	<b>356</b>
019 -----	357
<b>Cool-Down Processes of the NICA Accelerator Complex</b>	<b>357</b>
<i>Mitrofanova Y., Emelianov N., Nikiforov D.</i>	357
021 -----	363
<b>Liquid Cryogen Targets for Experiments in Nuclear Relativistic and Particle Physics</b>	<b>363</b>
<i>Konstantinov A.<sup>*</sup>, Borzunov U.<sup>*</sup>, Shimanskiy S.<sup>*</sup>, Varava A.<sup>**</sup></i>	363
062 -----	372
<b>Studies of Performance Characteristics of Twin Thermoacoustic Prime Mover with Gas Mixtures as Working Fluids</b>	<b>372</b>
<i>Behera U.<sup>*</sup>, Kasthurirengan S.<sup>*</sup>, Kamble B.<sup>**</sup>, Kuzhiveli B.<sup>**</sup>, Krishnamoorthy V.<sup>***</sup></i>	372
065 -----	378
<b>Cryogenic System of Superconducting Separator for Kaon Channel of IHEP Accelerator</b>	<b>378</b>
<i>Kozub S., Ageyev A., Bakay A., Orlov A., Stolyarov M., Zinchenko S.</i>	378
068 -----	384
<b>High-Power Stirling-Type Pulse Tube Cryocooler for Operation Near 80 K</b>	<b>384</b>
<i>Sun J.<sup>****</sup>, Dietrich M.<sup>***</sup>, Thummes G.<sup>**</sup></i>	384
090 -----	390
<b>Status of the Cryogenic System for the ARIEL E-Linac at TRIUMF</b>	<b>390</b>
<i>Sitnikov A., Bylinski I., Koscielniak S., Koveshnikov A., Laxdal R., Yosifov D.</i>	390
<b>POSTER SESSION - HEAT TRANSFER</b>	<b>396</b>
017 -----	397
<b>The Cryogenic Insulation Characteristics of GFRP in Liquid Nitrogen</b>	<b>397</b>
<i>Kim H.J.<sup>*</sup>, Seong K.C.<sup>*</sup>, Choi J.H.<sup>**</sup>, Kim W.J.<sup>**</sup>, Kim S.H.<sup>**</sup></i>	397
071 -----	402
<b>Cryogenic He experiment on Natural Turbulent Convection</b>	<b>402</b>
<i>Kralik T., Urban P., Musilova V., Hanzelka P., Srnka A., Repisky A.</i>	402
072 -----	408
<b>Radiative Heat Transfer at Low Temperatures over Microscopic Distances in Vacuum</b>	<b>408</b>
<i>Kralik T., Musilova V., Hanzelka P., Horak M., Srnka A.</i>	408
027 -----	413
<b>Design of a Cryogenic Helium Plate-Fin Heat Exchanger</b>	<b>413</b>
<i>Hu Z.J.<sup>*</sup>, Qiu Y.N.<sup>*</sup>, Zhang N.<sup>**</sup>, Li Q.<sup>*</sup></i>	413
<b>POSTER SESSION - LIQUID HYDROGEN</b>	<b>417</b>
025 -----	418
<b>Cryogenic hydrogen storage in highly porous materials – A modelling approach – (Extended Abstract)</b>	<b>418</b>
<i>Schlemminger Ch., Naess E., Büniger U.</i>	418

069	-----	421
	<b>The Development of Methods and Means of Gasification of Liquid Hydrogen under Supercritical Parameters (Extended Abstract)</b>	<b>421</b>
	<i>Cheremnykh O.Ya.</i>	421
082	-----	424
	<b>The development of methods and means of evacuation of hydrogen from tanks of a space flying apparatus under supercritical parameters (Extended Abstract)</b>	<b>424</b>
	<i>Cheremnykh O.Ya.</i>	424
	<b>POSTER SESSION - LNG</b>	<b>426</b>
091	-----	427
	<b>Computer Program for Simulating the Rollover Phenomenon during the Storage of the Stratified Layers of Liquefied Natural Gas</b>	<b>427</b>
	<i>Belgacem A.* , Rebiai R.* , Belmedani M.*</i>	427
	<b>POSTER SESSION - AIR SEPARATION</b>	<b>435</b>
023	-----	436
	<b>Mixtures on Basis of Rare Gases. Application and Methods of Production</b>	<b>436</b>
	<i>Bondarenko V.L.* , Diachenko O.V.** , Simonenko Yu.M.***</i>	436
028	-----	442
	<b>Development of an Equation of State for the Representation of Solid-Liquid, Solid-Vapour, and Liquid-Vapour Equilibria of Substances of Interest for the Air Distillation Process</b>	<b>442</b>
	<i>Stringari P.* , Campestrini M.* , Coquelet C.* , Arpentinier P.**</i>	442
029	-----	448
	<b>Study Concerning the Possibility for Increasing Argon Recovery from a Cryogenic Air Separation Process</b>	<b>448</b>
	<i>Cuzic M.* , Serban Al.** , Popa V.***</i>	448
034	-----	452
	<b>Test Procedures for Cryogenic Components and Considerations for Leakage Measurement</b>	<b>452</b>
	<i>Boersch M., Holdener F., Iten E., Oertig D.</i>	452
083	-----	457
	<b>Study on the Miniature Turbo-Expander Reverse Brayton Cryocooler Designed for Operation at 100 K</b>	<b>457</b>
	<i>Hou Y.** , Lai T.* , Zhao H.* , Chen R.*</i>	457
084	-----	462
	<b>Experimental Investigation on the Thermodynamic Performance of Turbo-Expander in Two Phases</b>	<b>462</b>
	<i>Lai T.* , Hou Y.** , Niu L.* , Liu J.*</i>	462
	<b>POSTER SESSION - CRYOSURGERY</b>	<b>466</b>
048	-----	467
	<b>Dreams and Reality of Cryogenic Technology in Surgery</b>	<b>467</b>
	<i>Butorina A.* , Arkharov A.** , Matveev V.**</i>	467
	<b>Author Index</b>	<b>475</b>