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Dr. Christian Day

Senior Vice President, Head of Fuel Cycle designate

Dr. Christian Day joined Kyoto Fusioneering on May 1, 2024 as Senior Vice President and Head of Fuel Cycle. With around 170 publications in peer-reviewed journals and numerous conference contributions and invited talks, he brings extensive scientific expertise.

Dr. Day is driven by a passion to make fusion energy a reality through innovative thinking and deep integration of physics and technology. He believes fusion can be achieved through allowing teams to think outside of the box. This motivates his work at Kyoto Fusioneering to help make fusion happen as soon as possible.

Fusion Development Contributions

Dr. Day's core expertise lies in the area of fuel cycle technologies- vacuum pumping, tritium processing, fuel injection and particle exhaust. He led the systematic development of cryosorption pumps for fusion through all technology readiness levels. He then expanded into fueling technology and integrated fueling/pumping system studies. He was involved in the physics and technology programs of JET, JT-60SA, AUG and W7-X, and, most recently, DTT. In 2014 he was awarded the first SOFT Innovation Prize for the concept of Direct Internal Recycling, a transformative new approach to reduce tritium inventories in the fuel cycle of a fusion power plant.

In the years following that, with his European Team, he laser-focused on the challenges of fusion devices- integrating fuel cycle architectures and systematically downselecting tritium technologies for reactor-scale devices. Dr. Day has mentored the next generation in parallel through lectures at KIT and global workshops on tritium and fuel cycle topics.

1989	University of Karlsruhe, Graduation Diploma in Chemical Engineering and Process Technology: Dipl.-Ing.,
1995	University of Karlsruhe, PhD in Technical Thermodynamics: Dr.-Ing.
1995-2024	Joined FZK (Forschungszentrum Karlsruhe / Research Centre Karlsruhe) to work in Fusion (in 2009, FZK merged with the University Karlsruhe to become the Karlsruhe Institute of Technology (KIT))
1995-2009	Systematic technology development of cryopumps for ITER
2000-2006	Developing tritium-compatible roughing pump systems
2002-2007	Leader of the Vacuum Group of the KATRIN neutrino mass experiment
2002-2003	Building and the testing the Prototype Cryosorption Pump in the Trace Tritium Experiment in JET
2004-2010	Involved in the development of vacuum pumping systems for ITER neutral beam injectors
2006	Section Leader Vacuum Pumping at FZK
2008-present	Executive Board Member of the German Vacuum Society
2009-2012	Chair of the Coordinated Committee on Fuelling and Pumping of the European Fusion Development Agreement
2009-2024	Teaching position ´Vacuum Science and Technology´ at Institute of Technical Thermodynamics and Refrigeration Technology, KIT
2011-2020	Member of the EU-JT-60SA Research Unit
2014-2017	Excellence Research Grant of the European Metrology Programme
2014	First SOFT Prize for innovation in fusion research for the game-changing fuel cycle concept of ´Direct Internal Recycling´
2014-2024	Project Leader of Work Package Tritium-Fuelling-Vacuum in the EUROfusion DEMO Programme
2016-2021	Member of Technical Advisory Panel of Fusion for Energy
2019-2021	Member of JT-60SA Satellite Tokamak Programme Project Committee

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Scientific Expertise

Vacuum pumping technology including:

- Divertor and neutral beam cryopumping system of ITER
- Divertor cryopumping system of JT-60SA
- Divertor cryopumping system of DTT
- Cryo- and getter pump concepts for high throughput gas neutralizer neutral beam injectors
- Sealing concepts for tritium-compatible mechanical pumps

Tritium processing technology including:

- Isotope separation by molecular sieving with different pore size distributions and at variable temperatures
- Ultrapure separation of hydrogen isotopes by superpermeation at high temperature metal foils
- Technology optioneering and technical readiness assessments of fuel cycle processing technologies

Matter injection including:

- Gas injection under a wide range of rarefaction with expansion into vacuum
- Centrifugal pellet injection

Particle exhaust including:

- Modelling of neutral gas dynamics in the subdivertor to extract requirements on pumping efficiencies
- Integrated development of divertor structures with optimised particle exhaust capabilities

Dr. Day has decades of experience tailoring fusion fuel cycle architectures to the needs of various fusion power plant concepts.

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Publications

- Day, C., Battes, K., Butler, B., Davies, S., Farina, L., Frattolillo, A., George, R., Giegerich, T., Hanke, S., Härtl, T., Igitkhanov, Y., Jackson, T., Jayasekera, N., Kathage, Y., Lang, P.T., Lawless, R., Luo, X., Neugebauer, C., Ploeckl, B., Santucci, A., Schwenzer, J., Teichmann, T., Tijssen, T., Tosti, S., Varoutis, S., Vazques Cortes, A. - The pre-concept design of the DEMO tritium, matter injection and vacuum systems - (2022) Fusion Engineering and Design, 179, art. no. 113139. DOI: 10.1016/j.fusengdes.2022.113139
- Schwenzer, J.C., Day, C., Giegerich, T., Santucci, A. - Operational Tritium Inventories in the EU-DEMO Fuel Cycle - (2022) Fusion Science and Technology, 78 (8), pp. 664-675. DOI: 10.1080/15361055.2022.2101834
- Abdou, M., Riva, M., Ying, A., Day, C., Loarte, A., Baylor, L.R., Humrickhouse, P., Fuerst, T.F., Cho, S. - Physics and technology considerations for the deuterium-tritium fuel cycle and conditions for tritium fuel self sufficiency - (2021) Nuclear Fusion, 61 (1), art. no. 013001. DOI: 10.1088/1741-4326/abbf35
- Giegerich, T., Battes, K., Schwenzer, J.C., Day, C. - Development of a viable route for lithium-6 supply of DEMO and future fusion power plants - (2019) Fusion Engineering and Design, 149, art. no. 111339. DOI: 10.1016/j.fusengdes.2019.111339
- Day, C., Butler, B., Giegerich, T., Ploeckl, B., Varoutis, S. - A smart three-loop fuel cycle architecture for DEMO - (2019) Fusion Engineering and Design, 146, pp. 2462-2468. DOI: 10.1016/j.fusengdes.2019.04.019
- Day, C., Butler, B., Giegerich, T., Lang, P.T., Lawless, R., Meszaros, B. - Consequences of the technology survey and gap analysis on the EU DEMO R&D programme in tritium, matter injection and vacuum - (2016) Fusion Engineering and Design, 109-111, pp. 299-308. DOI: 10.1016/j.fusengdes.2016.03.008
- Day, C., Varoutis, S., Igitkhanov, Y. - Effect of the Dome on the Collisional Neutral Gas Flow in the Demo Divertor - (2016) IEEE Transactions on Plasma Science, 44 (9), art. no. 7484308, pp. 1636-1641. DOI: 10.1109/TPS.2016.2565727
- Day, C., Giegerich, T. - Development of Advanced Exhaust Pumping Technology for a DT Fusion Power Plant - (2014) IEEE Transactions on Plasma Science, 42 (4), art. no. 6762984, pp. 1058-1071. DOI: 10.1109/TPS.2014.2307435
- Day, C., Giegerich, T. - The Direct Internal Recycling concept to simplify the fuel cycle of a fusion power plant - (2013) Fusion Engineering and Design, 88 (6-8), pp. 616-620. DOI: 10.1016/j.fusengdes.2013.05.026
- Day, C., Haas, H., Hanke, S., Hauer, V., Luo, X., Scannapiego, M., Simon, R., Strobel, H., Fellin, F., Lässer, R., Masiello, A., Papastergiou, S., Dremel, M., Mayaux, C., Pearce, R. - Design progress for the ITER torus and neutral beam cryopumps - (2011) Fusion Engineering and Design, 86 (9-11), pp. 2188-2191. DOI: 10.1016/j.fusengdes.2010.11.023
- Day, C., Antipenkov, A., Dremel, M., Haas, H., Hauer, V., Mack, A., Murdoch, D.K., Wykes, M. - R&D and design for the cryogenic and mechanical vacuum pumping systems of ITER - (2007) Vacuum, 81 (6), pp. 738-747. DOI: 10.1016/j.vacuum.2005.11.050
- Antipenkov, A., Day, C., Lässer, R., Mack, A., Wagner, R. - Tritium pumps for ITER roughing system - (2005) Fusion Science and Technology, 48 (1), pp. 47-50. DOI: 10.13182/FST48-47
- Day, C., Brennan, D., Camp, P., Jensen, H.S., Jones, G., Mack, A., Miller, A. - Performance of ITER-relevant cryopump panels for tritiated gases - (2005) Fusion Science and Technology, 48 (1), pp. 29-34. DOI: 10.13182/FST05-A873