UK Nuclear Activity

September 2017 Issue 51

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Newsletter archive: http://npg.dl.ac.uk/OutreachNewsletter/index.html

Nuclear Physics Public Engagement Website: www.stfc.ac.uk/NuclearPhysicsForYou

Nuclear Physics Outreach Poster – order hardcopies from STFC free of charge here

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*1. Nuclear Physics Publications for September**

If you are publishing a paper that you think would be of media value please contact Wendy Ellison, STFC Press Officer. She can help with press releases and publicity. If you get in touch with her before publication she can also get material ready in advance for the day of publication.

Eur. Phys. J. C (2017) 77:550 https://link.springer.com/article/10.1140/epjc/s10052-017-5129-6
Insight into particle production mechanisms via angular correlations of identified particles in pp collisions at √s = 7 TeV
ALICE Collaboration, UK Authors: D. Alexandre, H. A. Andrews, L. S. Barnby, M. Borri, M. Chartier, D. Evans, K. L. Graham, P. G. Jones, A. Jusko, M. Krivda, R. C. Lemmon, R. Lietava, J. Norman, O. Villalobos Baillie, N. Zardoshti
*Published 24 August 2017

JPS Conf. Proc. 14, 021001 (2017) http://journals.jps.jp/doi/10.7566/JPSCP.14.021001
Fusion Cross Sections of Astrophysics Interest Within the STELLA Project
Sandrine Courtin[1,2,3,*], Guillaume Fruet[1,2], David G. Jenkins[4], Marcel Heine[1,2], Daniele Montanari[1,2,3], Luke G. Morris[4], Gavin Lotay[5], Patrick H. Regan[5], Oliver S. Kirsebom[6], Serge Della Negra[7], Faïrouz Hammache[7], Nicolas de Sereville[7], Beyhan Bastin[8], François de Oliveira[8], Giacomo Randisi[8], Christelle Stodel[8], Christian Beck[1,2], and Florent Haas[1,2]
Published September 2017

Phys. Rev. C 96, 034302 (2017) https://journals.aps.org/prc/abstract/10.1103/PhysRevC.96.034302
Statistical approaches to lifetime measurements with restricted observation times
X. C. Chen[1,*], Q. Zeng[1,2], Yu. A. Litvinov[1,3,4], X. L. Tu[1,4], P. M. Walker[5], M. Wang[1], Q. Wang[1,6], K. Yue[1], and Y. H. Zhang[1]
Published 1 September 2017

*Also including missed publications from previous months.

Phys. Rev. C 96, 034301 (2017) https://journals.aps.org/prc/abstract/10.1103/PhysRevC.96.034301
Ground-state configuration of neutron-rich ^{35}Al via Coulomb breakup
S. Chakraborty[1], Ushasi Datta[1,2,*], T. Aumann[2,3], S. Beceiro-Novo[4], K. Boretzky[2], C. Caesar[2], B. V. Carlson[5], W. N. Catford[6], M. Chartier[7], D. Cortina-Gil[4], G. De Angelis[8], P. Diaz Fernandez[4,9], H. Emling[2], O. Ershova[2], L. M. Fraile[10], H. Geissel[2,11], D. Gonzalez-Diaz[2], H. Johansson[9], B. Jonson[9], N. Kalantar-Nayestanaki[12], T. Kröll[3], R. Krücken[13], C. Langer[2], T. Le Bleis[13], Y. Leifels[2], J. Marganiec[2,3], G. Münzenberg[2], M. A. Najafi[12], T. Nilsson[9], C. Nociforo[2], V. Panin[2], R. Plag[2], A. Rahaman[1], R. Reifarth[2], M. V. Ricciardi[2], C. Rigollet[12], D. Rossi[2], C. Scheidenberger[2,11], H. Scheit[3], H. Simon[2], J. T. Taylor[7], Y. Togano[2], S. Typel[2], Y. Utsuno[14], A. Wagner[15], F. Wamers[2], H. Weick[2], and J. S. Winfield[2]
Published 1 September 2017

Phys. Rev. C 96, 034305 (2017) https://journals.aps.org/prc/abstract/10.1103/PhysRevC.96.034305
Isomer-delayed γ-ray spectroscopy of A=159–164 midshell nuclei and the variation of K-forbidden E1 transition hindrance factors
Z. Patel[1,2], P. M. Walker[1], Zs. Podolyák[1], P. H. Regan[1,3], T. A. Berry[1], P.-A. Söderström[2], H. Watanabe[2,4,5], E. Ideguchi[6,7], G. S. Simpson[8], S. Nishimura[2], Q. Wu[9], F. R. Xu[9], F. Browne[2,10], P. Doornenbal[2], G. Lorusso[2,3], S. Rice[1,2], L. Sinclair[2,11], T. Sumikama[12], J. Wu[2,9], Z. Y. Xu[13], N. Aoi[6,7], H. Baba[2], F. L. Bello Garrote[14], G. Benzoni[15], R. Daido[7], Zs. Dombrádi[16], Y. Fang[7], N. Fukuda[2], G. Gey[17], S. Go[18], A. Gottardo[19], N. Inabe[2], T. Isobe[2], D. Kameda[2], K. Kobayashi[20], M. Kobayashi[18], T. Komatsubara[2], I. Kojouharov[21], T. Kubo[2], N. Kurz[21], I. Kuti[16], Z. Li[22], M. Matsushita[18], S. Michimasa[18], C.-B. Moon[23], H. Nishibata[7], I. Nishizuka[12], A. Odahara[7], E. Şahin[14], H. Sakurai[2,13], H. Schaffner[21], H. Suzuki[2], H. Takeda[2], M. Tanaka[7], J. Taprogge[24,25], Zs. Vajta[16], A. Yagi[7], and R. Yokoyama[18]
Published 6 September 2017

Phys. Rev. Lett. 119, 102301 (2017) https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.119.102301
Anomalous Evolution of the Near-Side Jet Peak Shape in Pb-Pb Collisions at $\sqrt{s_{NN}}$ = 2.76 TeV
ALICE Collaboration, UK Authors: D. Alexandre, H. A. Andrews, L. S. Barnby, M. Borri, M. Chartier, D. Evans, K. L. Graham, P. G. Jones, A. Jusko, M. Krivda, R. C. Lemmon, R. Lietava, J. Norman, O. Villalobos Baillie, N. Zardoshti
Published 8 September 2017

Phys. Rev. C 96, 034904 (2017) https://journals.aps.org/prc/abstract/10.1103/PhysRevC.96.034904
Evolution of the longitudinal and azimuthal structure of the near-side jet peak in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV
ALICE Collaboration, UK Authors: D. Alexandre, H. A. Andrews, L. S. Barnby, M. Borri, M. Chartier, D. Evans, K. L. Graham, P. G. Jones, A. Jusko, M. Krivda, R. C. Lemmon, R. Lietava, J. Norman, O. Villalobos Baillie, N. Zardoshti
Published 8 September 2017

J. High Energy Phys. (2017) 2017:32 https://link.springer.com/article/10.1007/JHEP09%282017%29032
Searches for transverse momentum dependent flow vector fluctuations in Pb-Pb and p-Pb collisions at the LHC
ALICE Collaboration, UK Authors: H. A. Andrews, L. S. Barnby, M. Borri, M. Chartier, D. Evans, K. L. Graham, C. Hills, P. G. Jones, A. Jusko, M. Krivda, R. C. Lemmon, R. Lietava, S. W. Lindsay, J. Norman, O. Villalobos Baillie, E. Willsher, N. Zardoshti
Published 8 September 2017

Physics Letters B 772, 567 (2017) http://www.sciencedirect.com/science/article/pii/S0370269317305646
Centrality dependence of the pseudorapidity density distribution for charged particles in Pb–Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV
ALICE Collaboration, UK Authors: D. Alexandre, H. A. Andrews, L. S. Barnby, M. Borri, M. Chartier, D. Evans, K. L. Graham, P. G. Jones, A. Jusko, M. Krivda, R. C. Lemmon, R. Lietava, J. Norman, O. Villalobos Baillie, N. Zardoshti
Published 10 September 2017

EPJ Web of Conferences 146, 10001 (2017)
https://www.epj-conferences.org/articles/epjconf/abs/2017/15/epjconf-nd2016_10001/epjconf-nd2016_10001.html
Total absorption studies of high priority decays for reactor applications: ^{86}Br and ^{91}Rb
A. Algora[1,2a], S. Rice[1,3], V. Guadilla[1], J.L. Tain[1], E. Valencia[1], A.-A. Zakari-Issoufou[4], J. Agramunt[1], J. Äystö[5], L. Batist[6], J.A. Briz[4], M. Bowry[3], V.M. Bui[4], R. Caballero-Folch[7], D. Cano-Ott[8], A. Cucoanes[4], T. Eronen[3], V.V. Elomaa[3], E. Estevez[1], M. Estienne[4], M. Fallot[4], G.F. Farrelly[3], L.M. Fraile[9], M. Fleming[10], E. Ganioglu[11], A.R. Garcia[8], W. Gelletly[1,3], B. Gómez-Hornillos[7], D. Gorelov[5], V. Gorlychev[7], J. Hakala[5], A. Jokinen[5], D. Jordan[1], A.

Kankainen[5], V.S. Kolhinen[5], F.G. Kondev[12], J. Koponen[5], M. Lebois[13], T. Martinez[8], P. Mason[3], E. Mendoza[8], M. Monserrate[1], A. Montaner-Pizá[1], I. Moore[5], E. Nácher[14], S.E.A. Orrigo[1], H. Penttilä[5], Z. Podolyák[3], I. Pohjalainen[5], A. Porta[4], P.H. Regan[3], J. Reinikainen[5], M. Reponen[5], S. Rinta-Antila[5], J. Rissanen[5], B. Rubio[1], K. Rytkönen[5], T. Shiba[4], V. Sonnenschein[5], A.A. Sonzogni[15], J.-Ch. Sublet[10], V. Vedia[9], A. Voss[5] and J.N. Wilson[13]
Published 13 September 2017

EPJ Web of Conferences 146, 10002 (2017)
https://www.epj-conferences.org/articles/epjconf/abs/2017/15/epjconf-nd2016_10002/epjconf-nd2016_10002.html
Total absorption spectroscopy of fission fragments relevant for reactor antineutrino spectra
M. Fallot[1a], A. Porta[1], L. Le Meur[1], J.A. Briz[1], A.-A. Zakari-Issoufou[1], V. Guadilla[2], A. Algora[2,13], J.-L. Taìn[2], E. Valencia[2], S. Rice[3], V.M. Bui[1], S. Cormon[1], M. Estienne[1], J. Agramunt[2], J. Äystö[4], L. Batist[14], M. Bowry[3], R. Caballero-Folch[5], D. Cano-Ott[6], A. Cucoanes[1], V.-V. Elomaa[7], T. Eronen[7], E. Estévez[2], G.F. Farrelly[3], L.M. Fraile[15], M. Fleming[16], E. Ganogliu[17], A.R. Garcia[6], W. Gelletly[2,3], M.B. Gomez-Hornillos[5], D. Gorelov[7], V. Gorlychev[5], J. Hakala[7], A. Jokinen[7], M.D. Jordan[2], A. Kankainen[7], P. Karvonen[7], V.S. Kolhinen[7], F.G. Kondev[8], J. Koponen[7], M. Lebois[18], T. Martinez[6], P. Mason[3], E. Mendoza[6], F. Molina[2], M. Monserrate[2], A. Montaner-Pizá[2], I. Moore[7], E. Nácher[19], S.E.A. Orrigo[2], H. Penttilä[7], A. Perez[2], Zs. Podolyák[3], I. Pohjalainen[7], P.H. Regan[3,9], J. Reinikainen[7], M. Reponen[7,10], S. Rinta-Antila[7], J. Rissanen[7], B. Rubio[2], T. Shiba[1], V. Sonnenschein[7], A.A. Sonzogni[11], J.-C. Sublet[16], V. Vedia[15], A. Voss[7], C. Weber[7,12] and J.N. Wilson[18]
Published 13 September 2017

EPJ Web of Conferences 146, 10009 (2017)
https://www.epj-conferences.org/articles/epjconf/abs/2017/15/epjconf-nd2016_10009/epjconf-nd2016_10009.html
Isomer-delayed gamma-ray spectroscopy of neutron-rich ^{166}Tb
L.A. Gurgi[1a], P.H. Regan[1,2], P.-A. Söderström[3], H. Watanabe[4,5], P.M. Walker[1], Zs. Podolyák[1], S. Nishimura[3], T.A. Berry[1], P. Doornenbal[3], G. Lorusso[1,2,3], T. Isobe[3], H. Baba[3], Z.Y. Xu[6,7], H. Sakurai[3,8], T. Sumikama[3,9], W.N. Catford[1], A.M. Bruce[10], F. Browne[10], G.J. Lane, F.G. Kondev[12], A. Odahara[13], J. Wu[3,14], H.L. Liu[15], F.R. Xu[14], Z. Korkulu[3,16], P. Lee[17], J.J. Liu[16], V.H. Phong[3,18], A. Yagi[13], G.X. Zhang[15], T. Alharbi[19], R.J. Carroll[1], K.Y. Chae[20], Zs. Dombradi[16], A. Estrade[7,21], N. Fukuda[3], C. Griffin[21], E. Ideguchi[13,23], N. Inabe[3], H. Kanaoka[13], I. Kojouharov[24], T. Kubo[3], S. Kubono[3], N. Kurz[24], I. Kuti[16], S. Lalkovski[1], E.J. Lee[20], C.S. Lee[17], G. Lotay[1], C.B. Moon[25], I. Nishizuka[9], C.R. Nita[10,26], Z. Patel[1], O.J. Roberts[27], H. Schaffner[24], C.M. Shand[1], H. Suzuki[3], H. Takeda[3], S. Terashima[5], Zs. Vajta[16], S. Kanaya[13] and J.J. Valiente-Dobòn[28]
Published 13 September 2017

Phys. Rev. C 96, 034317 (2017) https://journals.aps.org/prc/abstract/10.1103/PhysRevC.96.034317
Quadrupole moment of ^{203}Fr
S. G. Wilkins[1,*], K. M. Lynch[2], J. Billowes[1], C. L. Binnersley[1], M. L. Bissell[1], T. E. Cocolios[3], T. Day Goodacre[1,4,†], R. P. de Groote[3], G. J. Farooq-Smith[3], K. T. Flanagan[1], S. Franchoo[5], R. F. Garcia Ruiz[1,3], W. Gins[3], H. Heylen[3], Á. Koszorús[3], G. Neyens[3], H. H. Stroke[6], A. R. Vernon[1], K. D. A. Wendt[7], and X. F. Yang[3]
Published 19 September 2017

Phys. Rev. Lett. 119, 132502 (2017) https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.119.132502
New Measurement of the Direct 3α Decay from the ^{12}C Hoyle State
R. Smith[*], Tz. Kokalova[†], C. Wheldon, J. E. Bishop, M. Freer, N. Curtis, and D. J. Parker
Published 25 September 2017

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2. News to Report

a. PINE 2017

The nuclear physics department at the University of Manchester hosted the first Post-Docs In Nuclear event, PINE 2017, on September 6th and 7th 2017. Just over 50 post-doctoral research associates and fellows from physics, chemistry, materials, engineering, earth and environmental sciences attended with representatives from universities and research institutions across the UK.

Participants were treated to a keynote presentation from Juan Matthews, a visiting professor in nuclear energy technology at the Dalton Nuclear Institute. He spoke on the main technical challenges for developing the next generation of reactors, a fascinating insight into the UK's current stance and position with regards to nuclear energy. This was followed by a presentation from Amy Gandy, a lecturer in the department of materials science at the University of Sheffield where she gave an overview of her career including tips on how to obtain a lectureship, her research and the impact on it of moving from a PDRA to a lecturer. The rest of the afternoon was filled with invited presentations from researchers in physics, chemistry, engineering, materials and environmental sciences. Topics covered were broad, including all aspects of the nuclear fuel cycle. The excellent quality and diversity of the post-doctoral presentations was a great flagship for the UK's current research activities related to nuclear energy, despite the government's reluctance to commit to a clear and definite structure to the UK's nuclear energy policy.

Discussions continued in a more informal matter over refreshments and pizza as the evening poster session got underway. A total of around 30 posters were on display and the library was a hub of discussion well into the evening as researchers met one another, learnt what was going on in different research fields and discovered common interests.

The presentations on the second day had a different feel to them; speakers from industry and research laboratories such as Rolls Royce and NNL gave thorough overviews of the importance of research and university involvement in their companies. Although the focus was on universities and companies working together to develop technologies, it was clear that PDRAs and fellows have great career opportunities within the nuclear industry. The event closed with some very informative talks on aspects of research that perhaps are not usually covered. Information on how to get involved with outreach activities was presented followed finally by information on how to work with industry as a university researcher without being worried about giving away all your best ideas to a commercial company.

PINE 2017 was free to attend thanks to funding from the EPSRC nuclear champion grant and the STFC network+ UK Nuclear Data Network (www.ukndn.ac.uk).

Contribution by Tobias Wright
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b. Annual Meeting of the BRIDGCE Network

The Annual Meeting of the BRIDGCE Network "Stars, Supernovae and Nucleosynthesis IV" was held from 4-5 September at the Higgs Centre of the University of Edinburgh (https://higgs.ph.ed.ac.uk/workshops/stars-supernovae-and-nucleosynthesis-iv). The BRIDGCE UK network (http://bridgce.ac.uk/) aims to bring together scientists from different fields to BRIDge the Disciplines related to Galactic Chemical Evolution. It facilitates and encourages collaborations between scientists of different areas to address important outstanding questions in galactic chemical evolution.

The meeting featured talks by national and international speakers on the topics of astronomy, galactic chemical evolution, nuclear astrophysics and stellar evolution modelling. In particular, priority lists of nuclear reactions of key importance in astrophysics, which have been established by the BRIDGCE UK network, were presented and ways to (re-) measure these reactions were discussed.

The meeting was kindly supported by the Higgs Centre for Theoretical Physics, STFC, IoP (Nuclear and Astroparticle Groups), and the Nuclear Physics Group of the University of Edinburgh. If you are interested in participation in or updates from BRIDGCE, you can register to our mailing list via the main webpage and/or contact a member of the steering committee.

Raphael Hirschi, Claudia Lederer-Woods claudia.lederer-woods@ed.ac.uk and Alex Murphy (Edinburgh)

c. Viewpoint: Watching the Hoyle State Fall Apart - two experiments provide the most precise picture to date of how an excited state of carbon decays into three helium nuclei.

Contribution by ***Oliver Kirsebom****, taken from https://physics.aps.org/articles/v10/103*

We are used to picturing atomic nuclei as smooth and spherical distributions of neutrons and protons. But the reality is often very different, and the carbon-12 nucleus provides the perfect case in point. In its ground state and some of its excited states, carbon's six neutrons and six protons are thought to segregate into three clusters of two neutrons and two protons, otherwise known as helium nuclei or alpha particles. Two experimental teams have now performed measurements that will help explore key details of this alpha-cluster model. Robin Smith and colleagues at the University of Birmingham, UK [1], and Daniele Dell'Aquila of the University of Naples Federico II, Italy, and colleagues [2] analyzed the breakup of an excited state of carbon-12, known as the Hoyle state, into three alpha particles. The teams' measurements are sufficiently sensitive that they might be used to confirm recent model predictions about the Hoyle state, which is relevant to the nucleosynthesis of carbon in stars. Their results could also be used to probe certain parameters of the alpha-cluster model.

In the 1920s, before the discovery of the neutron, physicists speculated that alpha particles were the fundamental constituents of atomic nuclei—a reasonable guess for the time, given that many radioactively decaying nuclei emit alpha particles. Researchers eventually realized that the building blocks of nuclei are, in fact, neutrons and protons. But the alpha-cluster model has survived as a useful effective theory, capable of describing numerous nuclei and their excited states.

Appreciation for the importance of alpha clustering came in the 1950s, when physicists were struggling to explain the nucleosynthesis of carbon-12 in the Universe. The leading idea was that carbon-12 is produced via the so-called triple-alpha reaction in stars, in which two alpha particles fuse into beryllium-8 and then capture a third alpha particle to form carbon-12. However, the predicted reaction rate was more than 7 orders of magnitude too low to produce the abundance of carbon in the solar system.

The astrophysicist Fred Hoyle solved this problem in 1953, when he showed that this reaction would run forward much more quickly if the beryllium-8's capture of the third alpha particle resulted in a short-lived excited state of carbon-12, which subsequently relaxes to the carbon-12 ground state. The Hoyle state was soon observed in experiments at the excitation energy Hoyle had predicted.

Although the standard shell model of nuclear physics failed to predict the Hoyle state, a 1956 model put forth by Haruhiko Morinaga successfully described it in terms of three weakly interacting alpha particles [3].

Morinaga's crude model has since been greatly refined, but its essential feature—an alpha-clustered structure—has largely been verified in experiments [4].

However, researchers continue to debate and test the specifics of the alpha-cluster model, such as the degree of clustering and whether the alpha particles are configured in a linear chain, a bent arm, or a triangle [5]. The experiments by Smith et al. and Dell'Aquila et al. concern the specific manner in which the Hoyle state decays into its three constituent alpha particles—a possible decay path that is different from the relaxation to the carbon ground state mentioned previously. In 2014, theorists [6] predicted that 99.9% of such decays occur through an indirect two-step process in which the Hoyle state first emits one alpha particle, and then the beryllium-8 nucleus left behind breaks up into two more alpha particles. Only in 0.1% of cases would the breakup proceed more directly and form three alpha particles at once.

The experiments by Smith et al. and Dell'Aquila et al. [1, 2] have, for the first time, reached the level of sensitivity needed to test the 2014 prediction quantitatively, thereby providing a check on the alpha-cluster model's accuracy. To do so, both teams adopted established strategies for efficiently preparing a population of nuclei in the Hoyle state: Smith et al. produced them from a nuclear reaction between nitrogen and deuterium, while Dell'Aquila et al. utilized a reaction between carbon and helium. The decays through the two-step and one-step processes are difficult to distinguish: in the two-step process, the delay between the emission of the first alpha particle and the breakup of the beryllium-8 is only about 10^{-16}s—too short to measure. Luckily, the sequential and direct breakups can be distinguished by how the energy is shared between the alpha particles and the relative orientation of the alpha particles as they fly apart. Earlier experiments differentiated the two decay paths using special detectors that had high energy and spatial resolution and that could assign precise time stamps to each detected alpha particle. The new experiments go a step further by designing detection systems that can determine the directions of the alpha particles with increased confidence, especially in those cases where two alpha particles have very similar energies.

While previous experimenters managed to establish that at most 0.2% of decays are direct (with 95% confidence), the new experiments have, with the same confidence, succeeded in pushing this limit down to 0.04%. At first sight, the improved upper limit appears to conflict with the theoretical prediction of 0.1%. But this discrepancy mostly goes away if the predictions take into account the experimental resolution, leading to a revised predicted limit of 0.05%.

What will we do with this newly available comparison between theory and experiment? The agreement between experiment and theory is marginal, so even a two- to threefold improvement in the experimental sensitivity would be of significant interest. Reaching this seemingly modest improvement will, however, likely require new measurement techniques that go beyond the conventional spectroscopy used by Smith et al. and Dell'Aquila et al., such as taking advantage of the near-perfect detection efficiency of active-target detectors [7].

Nuclear theorists also need to figure out whether their calculations are as accurate as they appear. This pursuit should include a careful investigation of the sensitivity of the alpha-cluster model to various assumptions—in particular, to the model's description of the alpha-alpha interaction. Theorists should also attempt to calculate the breakup pathways using microscopic models that consider all 12 nucleons in the carbon nucleus [8], though such calculations are notoriously difficult.

We may ultimately discover that the breakup process isn't highly sensitive to the nuclei's initial structure and is instead mainly determined by the interactions between the alpha particles in the final state. Even in this case, improved measurements would still be an important check on calculations of the triple-alpha reaction in low-temperature stellar environments [9, 10].

This research is published in **Physical Review Letters**.

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3. Outreach Activity

Engaging Glasgow

Dr Bjoern Seitz from the University of Glasgow was recently invited by the Science Branch of the University of the Third Age to present on the Janus face of ionising radiation, highlighting the threats and fears in the wake of nuclear accidents, the use of instrumentation and education to mitigate the fears and how a detailed understanding of radiation and sensor systems leads to important advances in the diagnosis and treatment of cancer. The talk was very well attended and received by a very interested and motivated audience in excess of 50 attendants, followed by obligatory tea, biscuits and a lively Q & A session.

Mr Richard Gray and Dr Bjoern Seitz from the University of Glasgow led an online discussion on technological challenges in the characterisation of nuclear legacy waste. The detector scientists were approached by the Rodin group in Glasgow, who model themselves on the ancient cafe house tradition by having a learned discussion amongst interested and interesting people. The discussions took place online for about a month, finished by a face-to-face session at a Glasgow restaurant. Having been one of the most liveliest discussions Rodin had so far, it certainly generated a lot of exciting ideas (radioactivity smelling zombie cockroaches, anyone?) which will benefit all parties and will influence our research. A very different, but very exciting type of outreach.

Contributions by Bjorn Seitz
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(Glasgow)

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4. Media Interactions

Paddy Regan contributes to Punt PI show 'Lost Nukes' on BBC Radio 4,
http://www.bbc.co.uk/programmes/b092hscp
In this tenth anniversary edition, Steve's called in to investigate the unlikely disappearance of American and Russian nuclear weapons – with assistance from best-selling thriller writer Frederick Forsyth.
From an H-bomb lost over Savannah, Georgia to a cache of so-called 'suitcase nukes' which rumours suggest could still be stashed in modern day Moldova, Punt weighs up the evidence - with a little detour via Dorking...

Paddy Regan interviewed live on BBC Radio 2 for the Jeremy Vine Show on Monday 4th September to discuss the North Korean Nuclear Weapons test and related radiation monitoring and detection.
http://www.bbc.co.uk/programmes/b091j948

Contributions by Paddy Regan
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