



Fig. 1 (color online) The left figure (color histogram) is compares the distance between the 100 experimental results of the three algorithms and the global optimal solution (0 scale in the figure horizontal line). And the middle figure (color line) Compare the iterative curves of the three algorithms when the global optimal solution is obtained in each experiment. The right figure (color line) is the Step Response Image of Accelerator Power Components. The green line represents the original step response of the power component, and the blue line represents the step response of the component adjusted by PI adjustment after using the algorithm in the text to optimize.

References

[1] Kenneth V. Price, Rainer M. Storn, Jouni A. Lampinen, Differential Evolution: A Practical Approach to Global Optimization[M], (2005).
 [2] F. Yang, W. M. Qiao, W. Zhang, Astronomy and Astrophysics, 3110(2011)1094.

8 - 30 Radiation Safety Report of IMP in 2022

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The radiation safety license of IMP includes the using of the class I, II and III radiation facilities, and the class III, IV and V radiation sources, which were reissued on June 23rd 2022.

The main radiation devices at IMP include the class I radiation facility Lanzhou Heavy Ion Research Facility HIRFL, China accelerator facility for super heavy element CAFE, and several class III radiation facilities.

There are 38 radioactive sources in category V and above category V, including 7 category III sources, 4 category IV sources and 27 category V sources, all of which have fulfilled the environmental protection supervision procedures.

In 2022 HIRFL runs for 7 944 h in total. There are 19 kinds of beams provided for various scientific experiments completed that covers the total operation beam time of 6 095 h, and the highest energy of the ion beam provided was ⁷⁸Kr²⁶⁺ with the energy of 460 MeV at CSR throughout the year.

Environment radiation level was measured with TLDs which were placed on the campus of the institute around HIRFL, 15 sites of radiation level show no difference with environment background level of Gansu province^[1]. Furthermore, environmental neutron and gamma dose was monitored by 3 environment radiation monitoring stations continuously, and no abnormal data had been found in 2022. Environmental radiation dose of neutron and gamma ray had been measured with portable dose meter twice per year, and the measured results show no difference to the background, which can be seen in Table 1.

The external dose received by workers mainly due to the residual radiation after the accelerator was shut down. Maximum surface dose rate had been measured in 2022 is 4 mSv/h at the end of the target at 130 SFC hall. To reduce the external dose of workers, adequate cooling time, and reducing the operating time is essential.

662 persons accepted individual dose monitoring in 2022, and the results are shown in Table 2. The annual collective effective dose was 105.92 mSv. 662 persons are less than 1 mSv. The highest individual dose was about 0.57 mSv, which did not exceed the dose limit (20 mSv) of national standard. Table 2 shows the measured results in 2022 of IMP.

Total α , β radioactivity in soil, water, plant samples from environment around HIRFL and soil, plant samples from Radioactive Waste Storeroom (RWS) are measured with BH1216 low background α , β Measuring Instrument and the results are shown in Table 3, in comparison with the background level of China^[2].

Table 1 Environment dose surrounding HIRFL.

Measuring time: Jun 30th, 2022; beam: 75 MeV/u ¹² C ⁶⁺ at SSC Instruments: FHT762 neutron dosimeter, BH-3013B γ dosimeter				
Location	Direction	Distance/m	Neutron dose rate/(nSv/h)	γ dose rate/(nSv/h)
Experimental hall door	South	1	8.15	84
		10	10.8	98
		20	8.23	92
		30	3.62	88
The north gate of IMP	North	50	1.02	102
2# building	East	5	6.76	96
		20	1.1	88
		30	1.06	86
6# building	Northwest	5	4.86	94
	West	5	8.27	111
	SSC north	5	3.91	102
	Northeast	5	16.1	100

Table 2 Individual dose monitoring results in 2022.

Time	Number of monitored individuals	Annual collective effective dose/mSv	Average annual effective dose/mSv	Number of individuals with different annual effective dose/mSv				
				<1	1 5	5 10	10 20	≥ 20
2022	662	105.92	0.18	662 (0.57 mSv)	0	0	0	0

Table 3 Total α , β radioactivity of the environmental samples in 2022.

Site	Water/(Bq/L)		Site	Soil/(Bq/kg)		Plant/(Bq/kg)	
	α	β		α	β	α	β
Exhibition Center	30.64	259.31	North of CSRe	531.65	1 854.31	36.89	175.11
Sangyuanzi bridge	39.25	301.25	South of the institute	456.22	1 954.32	60.25	254.31
Tap water	36.44	269.87	North of 6# building	562.38	1 456.88	73.15	168.36
Waste water	32.15	263.98	West of 6#building	684.32	681.24	36.89	175.11
			North of RWS	639.12	1 698.11	35.14	218.67
			West of RWS	621.35	841.23	42.69	228.69
			East of RWS	649.31	784.52	48.15	225.16
			South of RWS	705.32	785.69	31.67	269.34

References

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