



Research on 2D-3D Collaborative Layout for Particle Accelerators

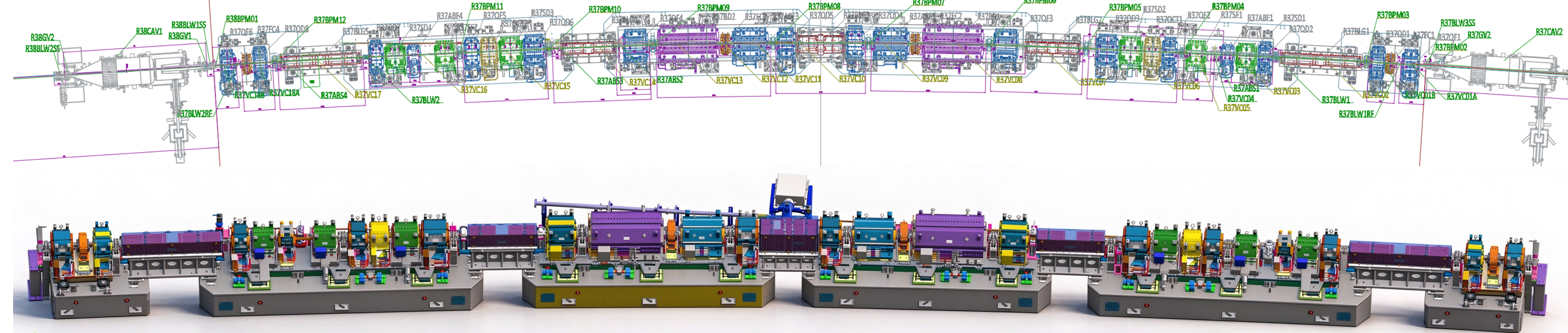
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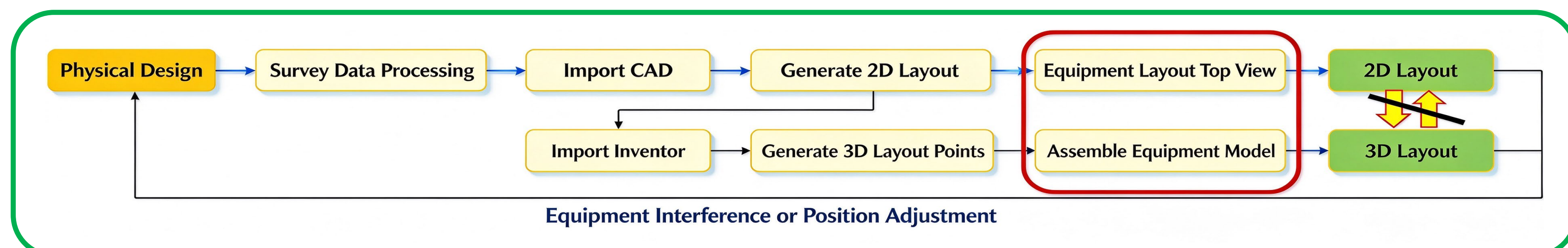
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2D and 3D layout drawings serve as core tools for the design and construction of accelerator facilities throughout their full lifecycle. With the advancement of particle and nuclear physics research, future accelerators are developing toward large-scale and ultra-precise configurations, with circumferences extending to tens or even hundreds of kilometers. Such a leap in scale leads to exponential growth in the number of equipment, which can be tens of hundreds of times that of existing accelerators, posing great challenges to preliminary layout design. For equipment layouts spanning several kilometers, manual point-by-point planning requires massive manpower for repetitive drawing and presents obvious drawbacks during model iteration. Against this backdrop, this paper proposes a 2D-3D collaborative layout mechanism, offering an innovative approach for efficient layout design and intelligent upgrading of accelerator facilities. The design and progress of this work are described herein.



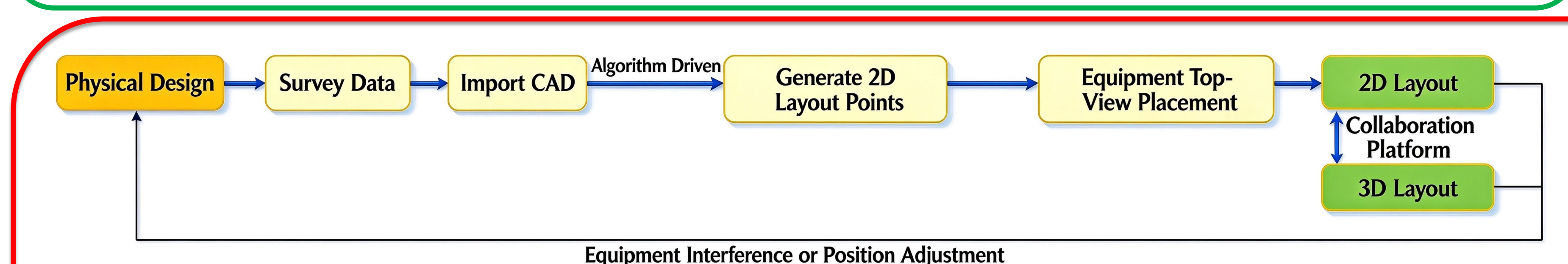
2D and 3D Layout of HEPS Storage Ring Standard Cell



At the early design stage of accelerator facilities, a phased iterative design workflow is adopted.

Nevertheless, the current design approach presents the following critical bottlenecks:

Characterized by high manual dependence, the workflow produces both layouts manually with no built-in linkage. Any modification to the physical scheme (survey data) necessitates remodelling and redrawing of both layouts, lacking automatic update capability and incurring considerable redundant work and resource consumption. Furthermore, manual drafting may introduce hard-to-detect data acquisition errors, which impose substantial risks on layout quality and equipment installation.



The establishment of a 2D-3D collaborative layout update mechanism breaks the bottlenecks of conventional design and eliminates the isolation between 2D and 3D layouts. It enables:

- Automatic synchronization of one layout upon modification of the other.
- Substantial reduction of manual repetitive drafting and remarkable improvement in facility layout design efficiency.
- Elimination of information discrepancy caused by delayed updates, mitigation of design conflicts and error accumulation arising from version lag, prevention of schedule delays and rising rework costs, providing technical support for efficient iteration of complex scientific facilities.

Survey Data Processing and Import

1				Point Name	Leader Line Endpoint	Leader Line Endpoint	Leader Line Endpoint Z	Bulk Import of Points	Formula
33757	-14168.3716650079	-1907.106910052629	1200.000000	D1_001	-14168.37167	-1947.1200	36854.0	-14168.3716650079	-14168.3716650079
33758	-14168.3716650079	-1906.9691039919	1200.000000	D3_002	-14168.37167	-1946.8000	36855.0	-14168.3716650079	-14168.3716650079
33759	-14168.3716650079	-1906.9690772398	1200.000000	D3_003	-14168.37167	-1946.6000	36856.0	-14168.3716650079	-14168.3716650079
33760	-14168.3716650079	-1906.9690521487	1200.000000	D3_004	-14168.37167	-1946.3000	36857.0	-14168.3716650079	-14168.3716650079
33761	-14168.3716650079	-1906.9690251196	1200.000000	D3_005	-14168.37167	-1946.0000	36858.0	-14168.3716650079	-14168.3716650079
33762	-14168.3716650079	-1906.9690000970	1200.000000	D3_006	-14168.37167	-1945.6000	36859.0	-14168.3716650079	-14168.3716650079
33763	-14168.3716650079	-1906.9689752686	1200.000000	D3_007	-14168.37167	-1945.3000	36860.0	-14168.3716650079	-14168.3716650079
33764	-14168.3716650079	-1906.9689504302	1200.000000	D3_008	-14168.37167	-1945.0000	36861.0	-14168.3716650079	-14168.3716650079
33765	-14168.3716650079	-1906.9689256944	1200.000000	D3_009	-14168.37167	-1944.7000	36862.0	-14168.3716650079	-14168.3716650079
33766	-14168.3716650079	-1906.9689009323	1200.000000	D3_010	-14168.37167	-1944.4000	36863.0	-14168.3716650079	-14168.3716650079
33767	-14168.3716650079	-1906.9688762103	1200.000000	D3_011	-14168.37167	-1944.1000	36864.0	-14168.3716650079	-14168.3716650079
33768	-14168.3716650079	-1906.9688514882	1200.000000	D3_012	-14168.37167	-1943.8000	36865.0	-14168.3716650079	-14168.3716650079
33769	-14168.3716650079	-1906.9688267661	1200.000000	D3_013	-14168.37167	-1943.5000	36866.0	-14168.3716650079	-14168.3716650079
33770	-14168.3716650079	-1906.9688020440	1200.000000	D3_014	-14168.37167	-1943.2000	36867.0	-14168.3716650079	-14168.3716650079
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33772	-14168.3716650079	-1906.9687526000	1200.000000	D3_016	-14168.37167	-1942.6000	36869.0	-14168.3716650079	-14168.3716650079
33773	-14168.3716650079	-1906.9687278779	1200.000000	D3_017	-14168.37167	-1942.3000	36870.0	-14168.3716650079	-14168.3716650079
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33777	-14168.3716650079	-1906.9686289895	1200.000000	D3_021	-14168.37167	-1941.1000	36874.0	-14168.3716650079	-14168.3716650079
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33782	-14168.3716650079	-1906.9685063790	1200.000000	D3_026	-14168.37167	-1939.6000	36879.0	-14168.3716650079	-14168.3716650079
33783	-14168.3716650079	-1906.9684816569	1200.000000	D3_027	-14168.37167	-1939.3000	36880.0	-14168.3716650079	-14168.3716650079
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33785	-14168.3716650079	-1906.9684322127	1200.000000	D3_029	-14168.37167	-1938.7000	36882.0	-14168.3716650079	-14168.3716650079
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33818	-14168.3716650079	-1906.9676164834	1200.000000	D3_062	-14168.37167	-1928.8000	36915.0	-14168.3716650079	-14168.3716650079
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33829	-14168.3716650079	-1906.9673445403	1200.000000	D3_073	-14168.37167	-1925.5000	36926.0	-14168.3716650079	-14168.3716650079
33830	-14168.3716650079	-1906.9673198182	1200.000000	D3_074	-14168.37167	-1925.2000	36927.0	-14168.3716650079	-14168.3716650079
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