



Mode-Driven Snapshot Management and Rapid Parameter Restoration for Accelerators

Presenter: Miaomiao Liao
Supervisor: Wenjuan Cui
Division: Instrumentation and Control
Technology



OUTLINE

1. Background and Objectives

2. System Architecture and Implementation

3. Restoration Workflow and Key Functions

4. Experimental Results and Discussion

5. Achievements and Future Work

01 Background and Objectives

From fragmented parameter operations to unified, verifiable restoration

■ Engineering Challenge

Over 30 control screens; distributed settings and device dependencies

■ Research Objective

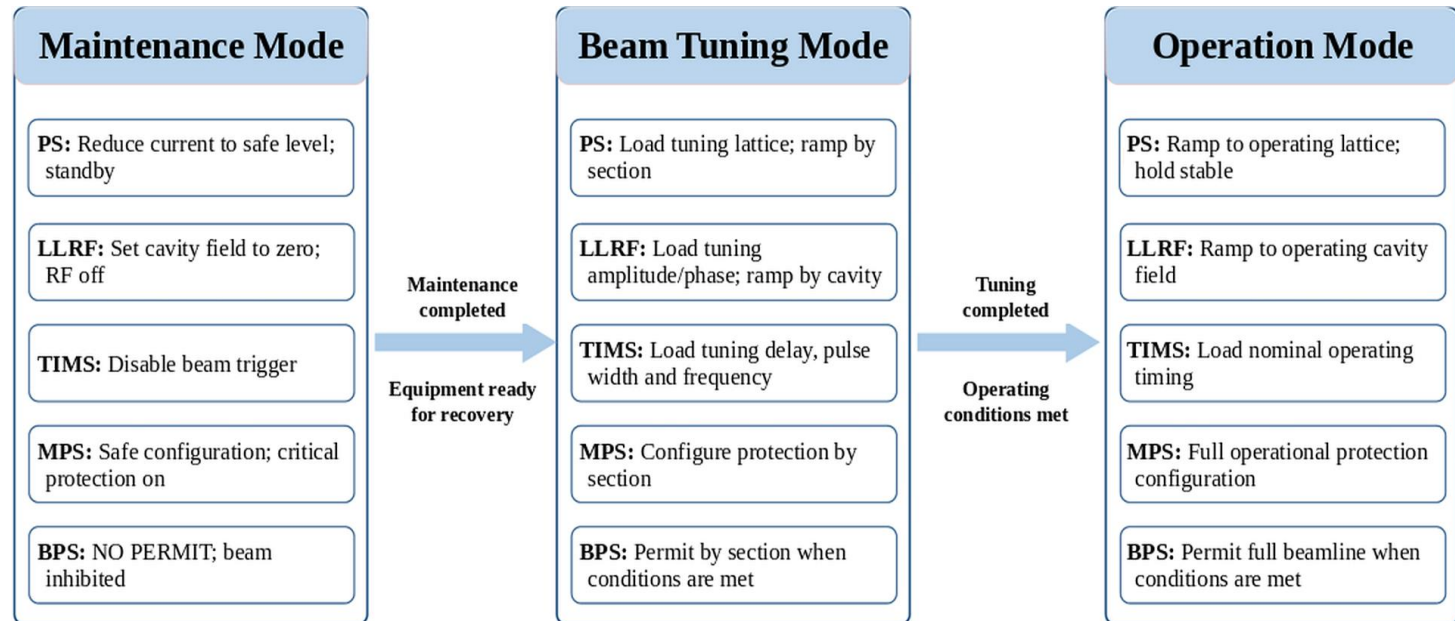
Map operating modes to snapshots, parameter groups and execution rules

■ System Coverage

Five subsystems: PS / LLRF / TIMS / MPS / BPS

■ Configuration Scale

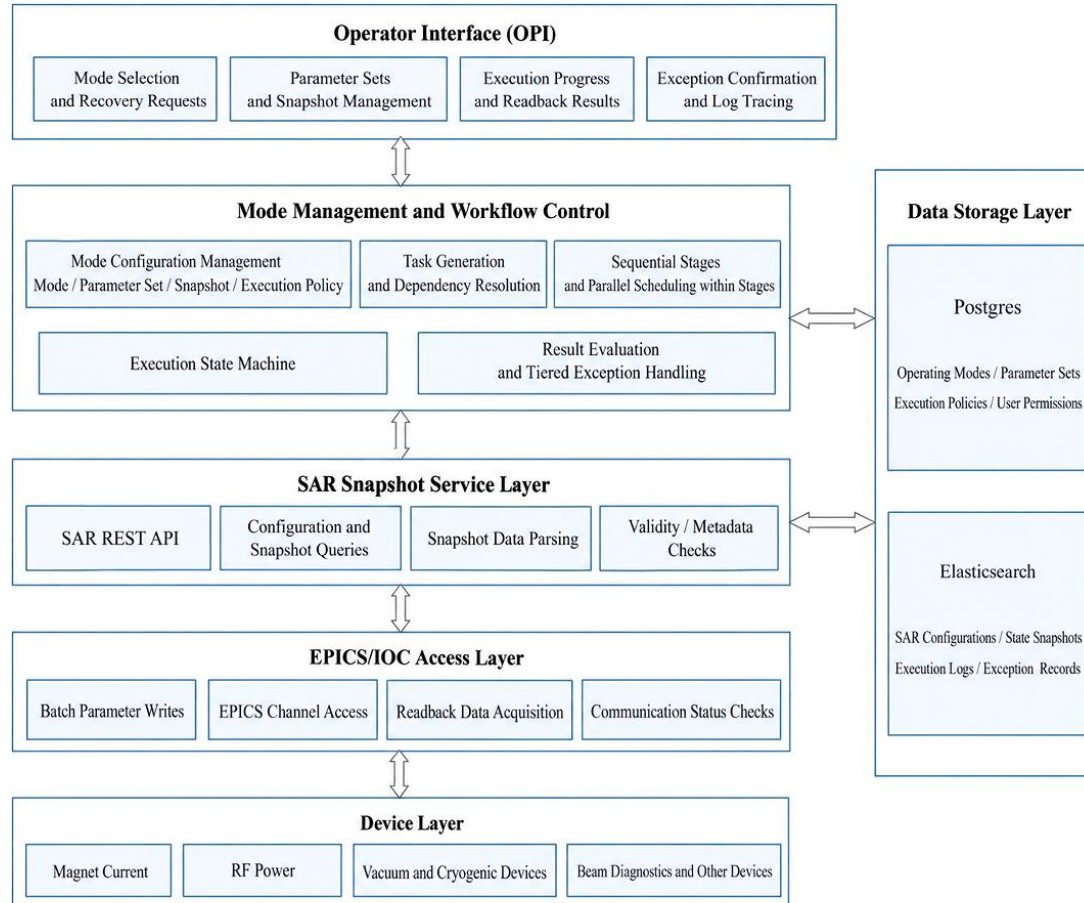
1,514 PV entries: 1,215 writable and 299 read-only



Conceptual target states and transitions for maintenance, tuning and operation

02 System Architecture and Implementation

SAR supplies snapshots; operating modes define scope and execution constraints



Architecture of the multi-subsystem restoration system

Layered Architecture

Operator UI / Orchestration / SAR / EPICS /
Devices / Data

Configuration-Driven Design

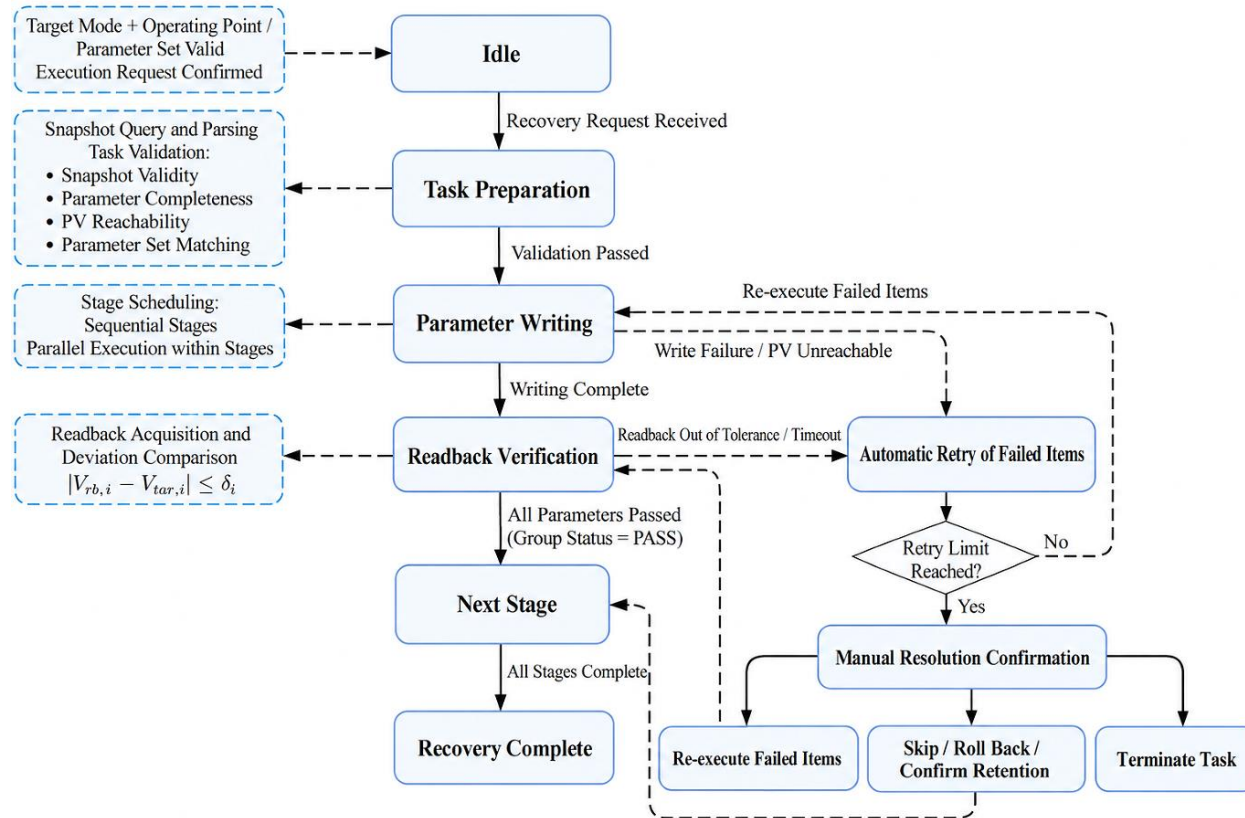
Restoration tasks are defined by ModeCode, parameter groups, SnapshotID, SetPV/ReadPV, tolerances and criticality.

Subsystem Integration

Integrated TIMS, PS, LLRF, MPS and BPS; supports individual and coordinated ALL restoration.

03 Restoration Workflow and Key Functions

Beyond parameter writes: readback validation, exception handling and traceability



Staged parameter restoration and exception-handling
workflow

Execution Sequence

Mode check → Snapshot retrieval → Validation →
PV precheck → Write → Readback → Decision

Type-Specific Verification

Analog: tolerance; enum: exact match; RF phase:
wrapped phase difference; status: state check.

Exception Handling

Automatic retries, graded manual decisions,
controlled skips, rollback or termination.



Current Mode: Maintenance ModeCode: 7950 SAR Connection: Normal **READY**

Target Mode Selection

Maintenance

Commissioning

Operation

Subsystem Selection

Full Restore (ALL)

TIMS

PS

MPS

LLRF

BPS

Start Restore

Stop Task

Overall Task

PS

Target Snapshot: fe53e2d6

Writable PVs: 183

Progress: 100

Subsystem Execution Status

TIMS
Snapshot: e56c62a Writable: 458
0
● IDLE
Time: 0.000 Config: 458

PS
Snapshot: fe53e2d6 Writable: 183
100
● SUCCESS
Time: 4.296 Config: 183

MPS
Snapshot: a1bce29 Writable: 66
0
● IDLE
Time: 0.000 Config: 66

LLRF
Snapshot: 376f376 Writable: 191
0
● IDLE
Time: 0.000 Config: 191

BPS
Snapshot: 74e8d22f Writable: 317
0
● IDLE
Time: 0.000 Config: 616

Restore Results Target Snapshot: PS / fe53e2d6 Successful PVs: 183 / 183 Verification Rate: 100.0 Exceptions: 0 Total Time: 5.390

Execution Stages

Mode Confirmation → Snapshot Retrieval → Snapshot Validation → PV Precheck → Parameter Write → Readback Check → Result Evaluation

Recent Logs

17:34:45 SAR multi-subsystem restore service
17:34:52 PS restore request received
17:34:53 Maintenance mode confirmed
17:34:53 Snapshot retrieval completed
17:34:53 Snapshot validation completed
17:34:53 PV connection precheck completed
17:34:53 Starting PS restore
17:34:58 PS restore successful
17:34:58 All parameters restored successfully

WARNING: Partial restore failure in current parameter group; subsequent stages paused

Exception ID: E204-0812-161849 Current Stage: Readback Check Parameter Group: MPS Results: 18 succeeded / 57 failed

Subsystem Execution Status

Group	Progress	Status	Exceptions	Time/s
TIMS	0	IDLE	0	0.000
PS	0	IDLE	0	0.000
MPS	100	PARTIAL	57	190.90
LLRF	0	IDLE	0	0.000
BPS	0	IDLE	0	0.000

Exception Details and Manual Handling

Exception Type: Partial parameter restore failure
Severity: **Critical** Rollback: Yes
Exception PV: iLinac-LBHL09-TIMS:WRN02 BP:Bypass
Target Value: 0
Readback Value: 0
Error / Tolerance: 0.000 / 0.000
Auto Retry: 3 / 3
Target Snapshot: MPS / b248526e
Policy: Retain partial results, pause subsequent stages, and await manual handling
Suggestion: Check failed items; retry, confirm and continue, or roll back this group

Recheck Exceptions Skip and Continue Keep Partial Results Roll Back Subsystem Stop Restore

Execution Workflow

Mode Confirmation: DONE 0
Snapshot Retrieval: DONE 0
Snapshot Validation: WARN 7
PV Precheck: WARN 0
Parameter Write: WARN 53
Readback Check: WARN 138
Result Evaluation: WAIT 0

Recent Event Log

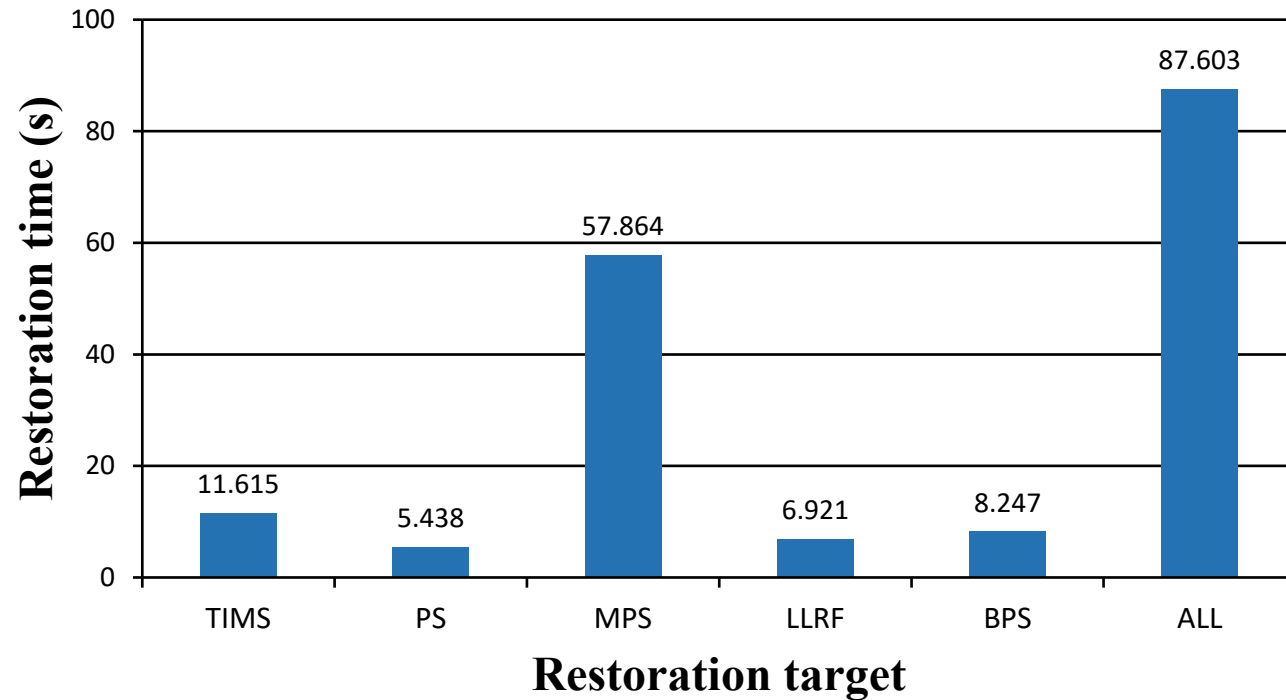
16:15:31 MPS snapshot value invalid
16:15:38 Critical snapshot exception skipped
16:16:34 MPS auto retry 1/3
16:17:19 MPS auto retry 2/3
16:18:04 MPS auto retry 3/3
16:18:49 MPS awaiting manual handling

Parameter restoration: operator interface (original system UI)

Exception handling and event log (original system UI)

04 Restoration Tests and Results

20 repeated trials: execution time is not determined by PV count alone



Mean restoration time over 20 trials

Test Coverage

1,514 configured PVs (1,215 writable; 299 read-only). Individual subsystems and ALL were tested.

Repeatability

20 restoration trials per target; 100% final verification pass rate under tested conditions.

Key Observation

MPS has only 66 PVs but takes 57.86 s on average; readback and verification overhead also matter.



05 Achievements and Future Work

A configurable, verifiable and traceable multi-subsystem restoration workflow

01

Unified Configuration

Five subsystems integrated; 1,514 PV entries classified and configured.

02

Restoration Service

Mode mapping, snapshot retrieval, staged scheduling and batch writes.

03

Verification and Exceptions

Type-specific readback, LLRF stability windows, retries and operator decisions.

04

Experimental Validation

Performance, repeatability and representative exception scenarios.

Next Steps

Engineering Deployment

Improve admission checks, snapshot versioning, timing and cross-facility migration.



THANKS

纵有疾风起，人生不言弃。

Even in the teeth of strong winds, one should never give up on life.