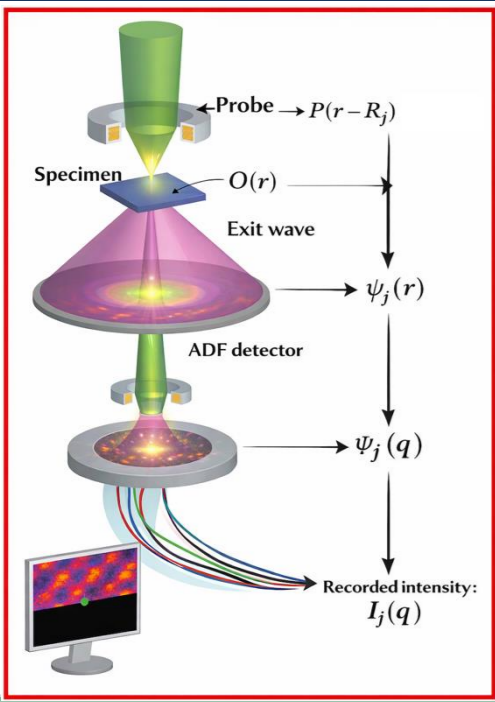


Towards Understanding and Optimising Ptychography for High-Performance Electron Microscopy

LU Shan | Supervisor: Prof. ZHU Ye | Co-supervisor: Dr. CHEN Changsheng

1.1 Why this project?



Phase loss → Phase retrieval:
overlap supplies redundant constraints

ePIE → PtyRAD: from hand-derived updates to AD-based multi-parameter fitting

1.2 Objective and Project Progression

UNDERSTANDING

Forward Model
Objective Structure

OPTIMISING

Controlled Studies
Solver Choices

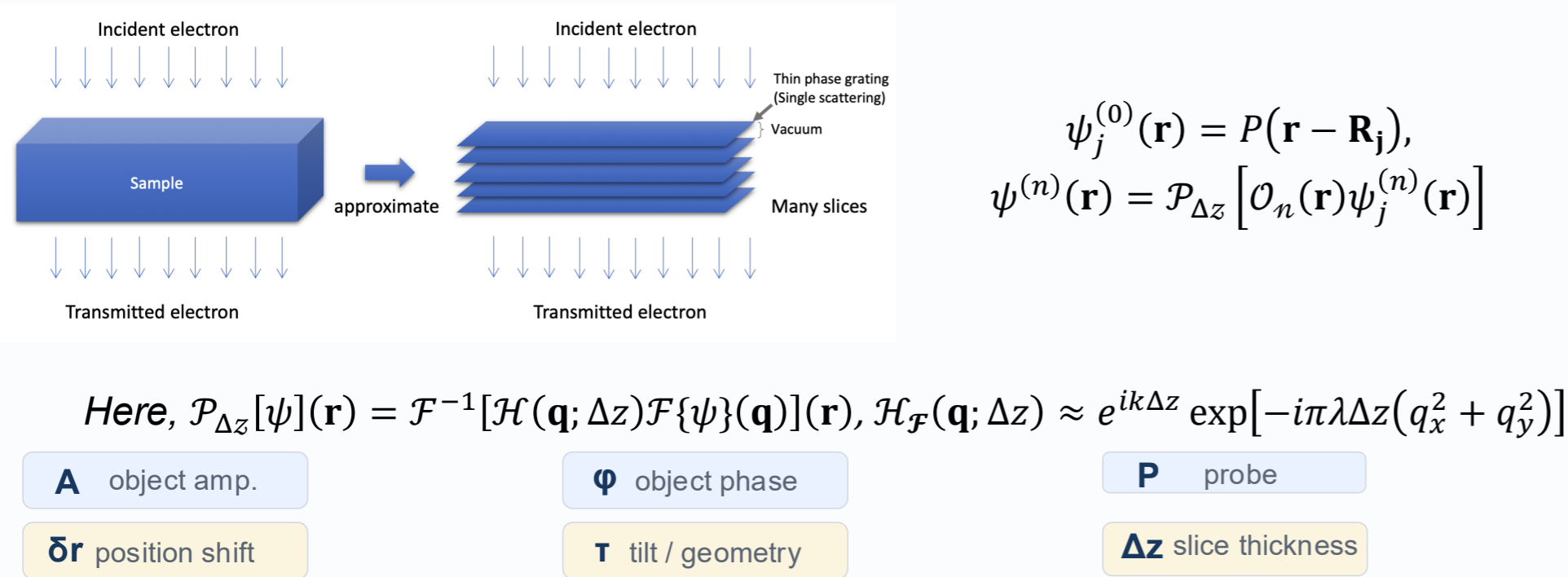


1.3 Shared study setup

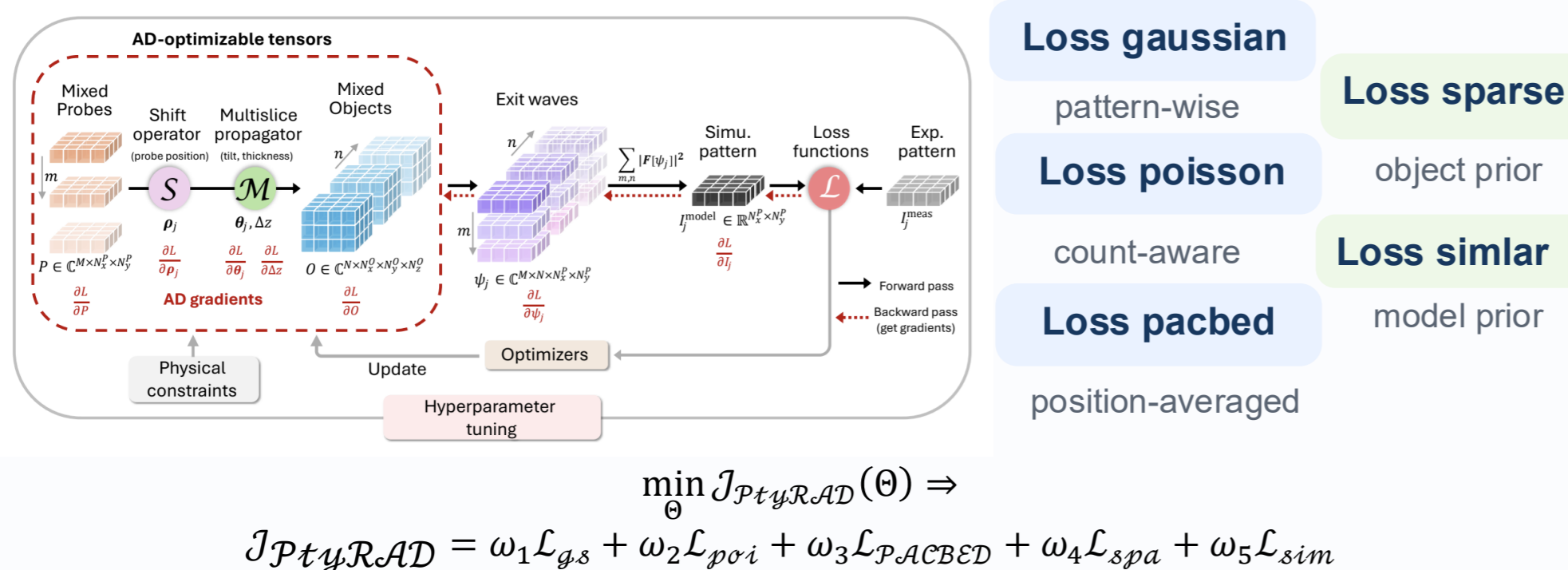
SrTiO ₃ 4D-STEM	Raw 200×200 scan	central 100×100
32-slice multislice	4 probe modes	1 object modes
0.5 on the fly	Random Grouping	Adam, 200 iter
probe@5, tilt/pos@10	1.0 single + 0.5 PACBED + 0.1 sparse	

02 Understanding PtyRAD

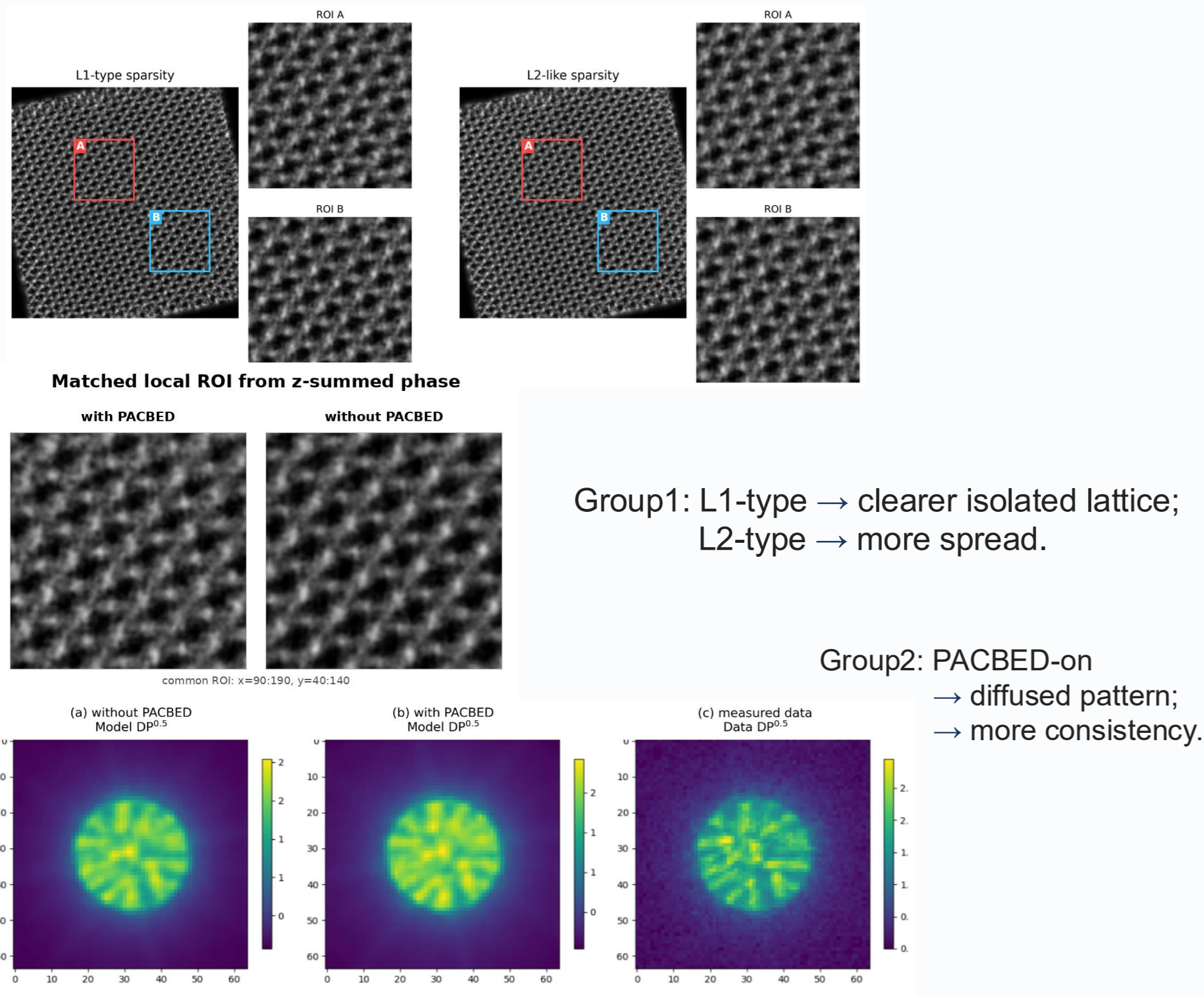
2.1 Physical Multislice Model



2.2 Optimisation Model

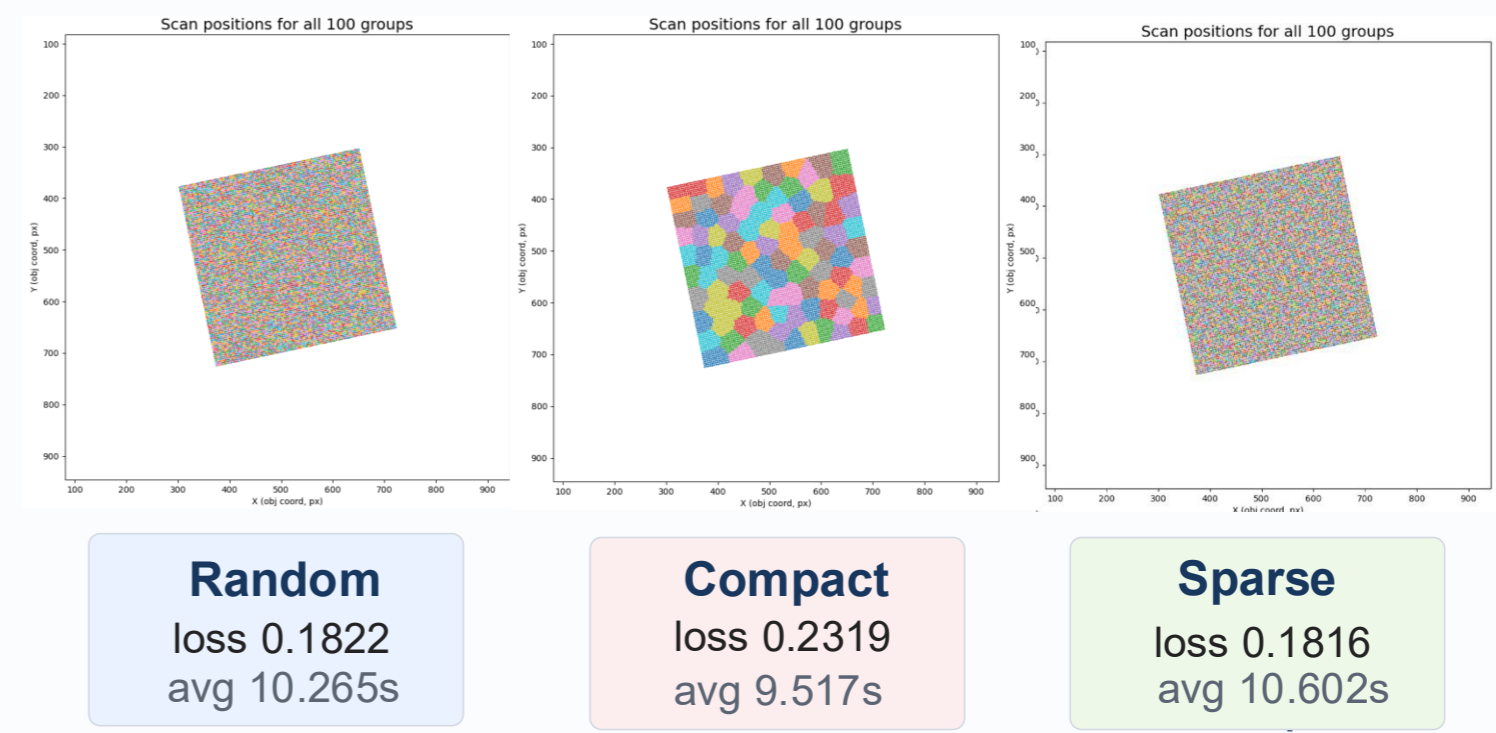


2.3 Understanding through loss design



03 Optimising PtyRAD

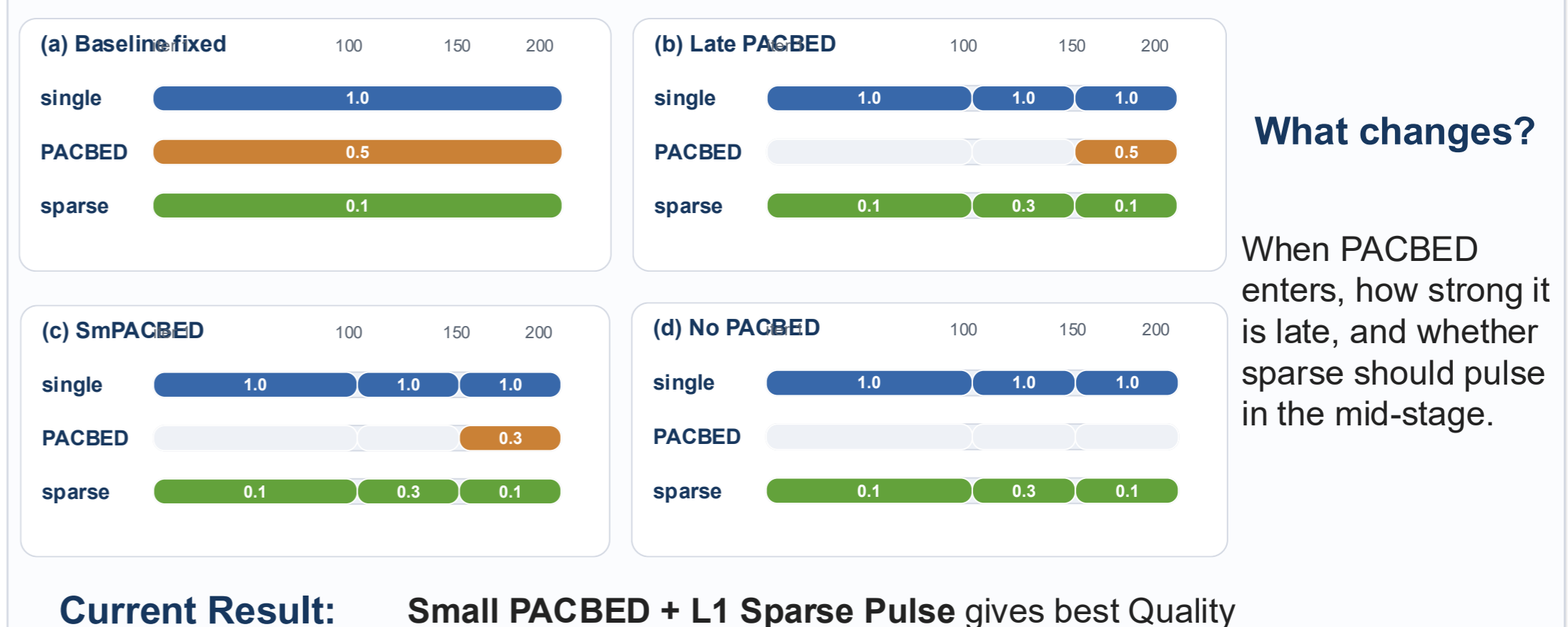
3.1 Batch geometry



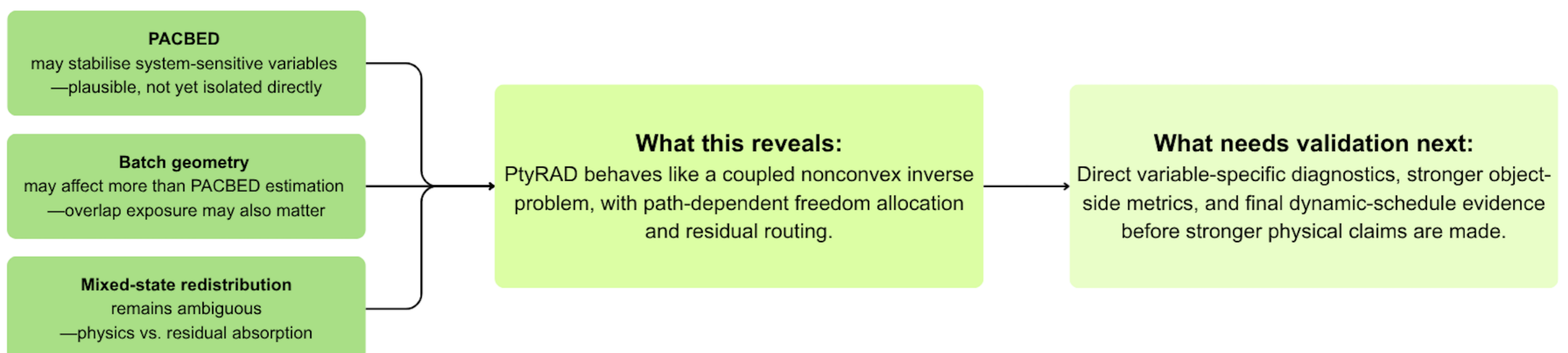
3.2 Limited late-stage refinement



3.3 Dynamic loss scheduling



04 Interpretation / discussion: plausible, but not yet fully validated



05 Future Work

- For Optimiser Refinement:
 - (i) Semismooth Newton–augmented-Lagrangian;
 - (ii) Matrix-free Levenberg–Marquardt.
- For Loss Design:
 - (i) More complex dynamical loss design;
 - (ii) Using Diffusion model to enhance/provide stronger prior.