

2024 粒子物理实验径迹重建研讨会

2024 Workshop of Tracking in
Particle Physics Experiments

Summary and Prospects

Xiaocong Ai (ZZU)

May 19, 2024, Zhengzhou

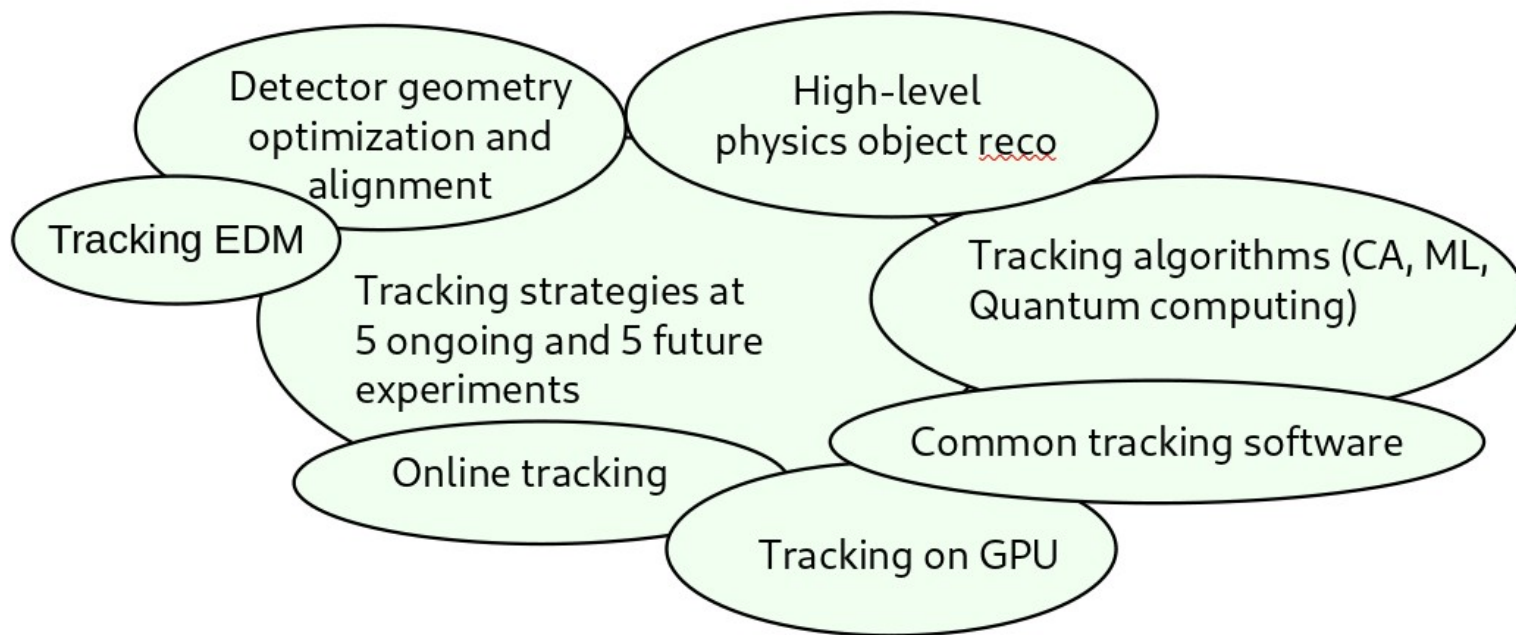
Participants

- 59 on-site participants + >10 remote participants (from 18 institutes)
 - 2x what we expected...
 - With expertise on both software and computing, and detectors and physics



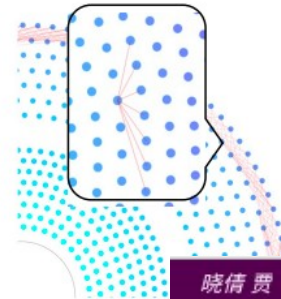
Talks

- 23 talks (mostly invited)
- 8 topics

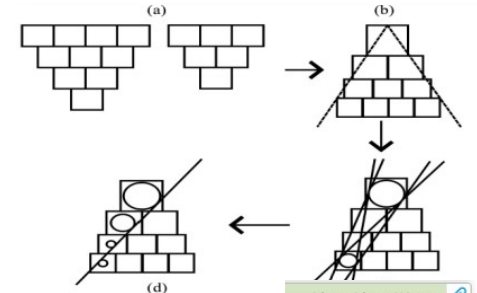


About track finding

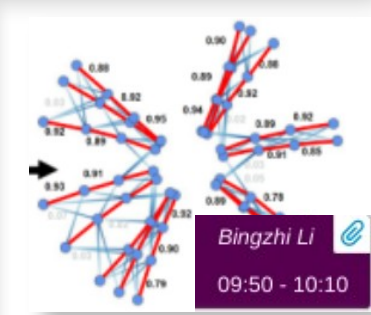
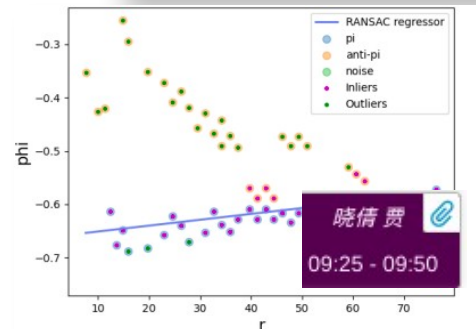
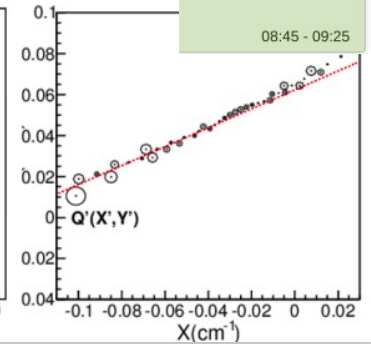
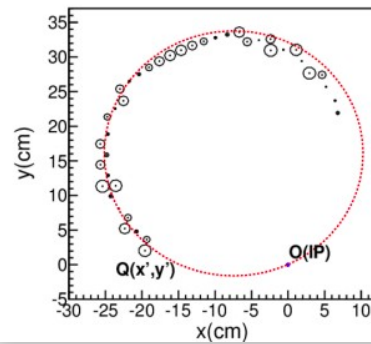
- Template/pattern matching (BESIII, STCF)
 - Template matching, pattern map for edge classification
- Track segment finder
- RANSAC (COMET)
- Hough Transform (BESIII, STCF, ATLAS)
- Cellular Automaton (Belle-II, CEE)
- Combinatorial Kalman Filter (ATLAS, CEPC, STCF, darkSHINE)
- GNN (BESIII, STCF, g-2)



A wire on layer neighbors on
09:25 - 09:50



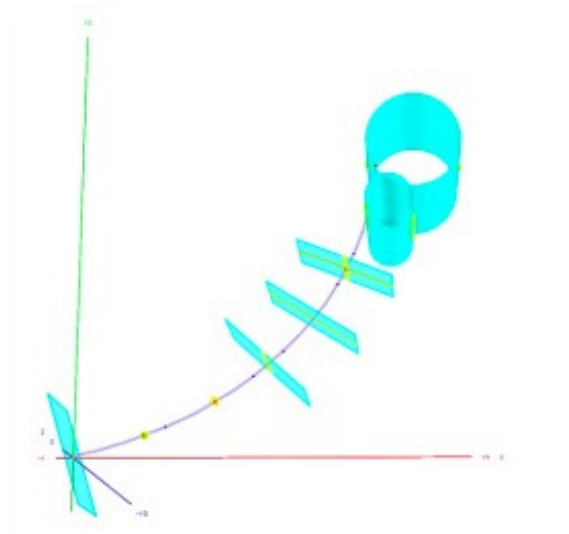
Liang-Liang Wang
08:45 - 09:25



Bingzhi Li
09:50 - 10:10

About track fitting

- 2D Circle fitting
- 3D fitting:
 - Kalman filter: BESIII, CEPC (GenFit), STCF (GenFit), COMET (GenFit), BelleII (GenFit)
 - Global chisq fitter: BESIII, ATLAS



$$\mathbf{p}_{k|k} = \mathbf{p}_{k|k-1} + \mathbf{K}_k (\mathbf{m}_k - \mathbf{H}_k \mathbf{p}_{k|k-1})$$

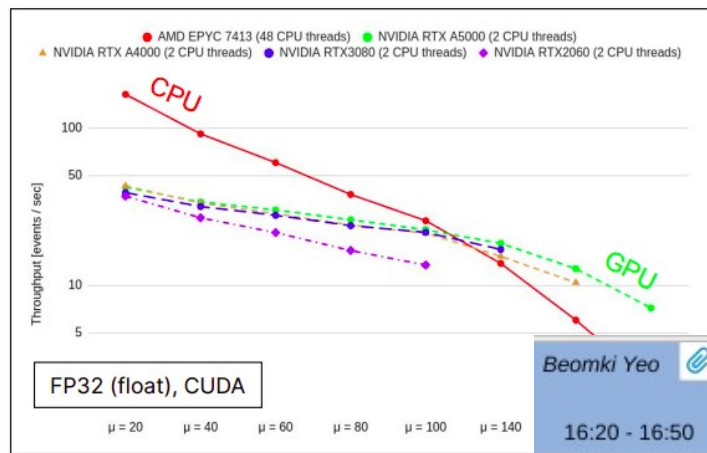
Filtered track parameters at measurement k Predicted track parameters from k-1 measurements Gain matrix the k-th measurement Derivative

Liang-Liang Wang

08:45 - 09:25

About Quantum and accelerated tracking

The higher the better



FPGA implementation

$$\varphi = \varphi_4 + \Delta\varphi$$

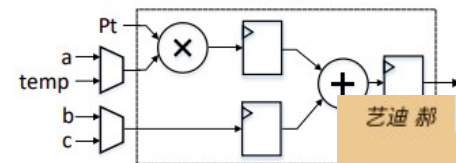
Resource friendly

$$\Delta\varphi = a \times p_t^2 + b \times p_t + c$$

系数查找表

二次项	一次项	常数项
a	b	c

二次多项式计算

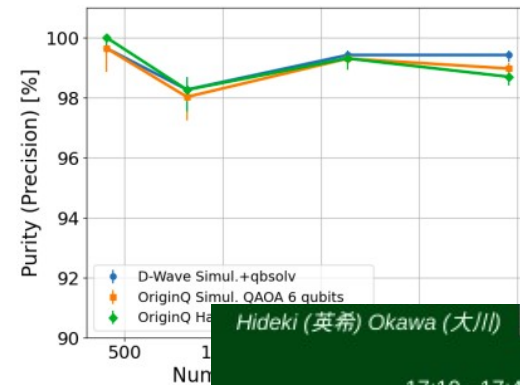
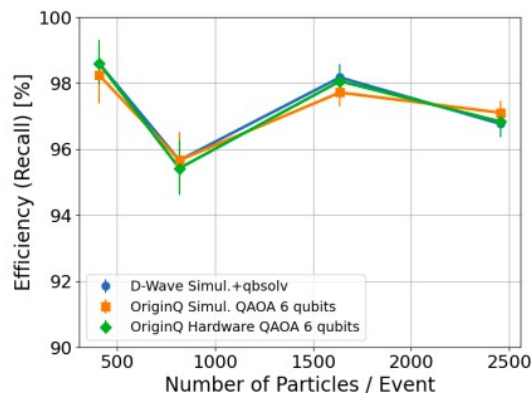
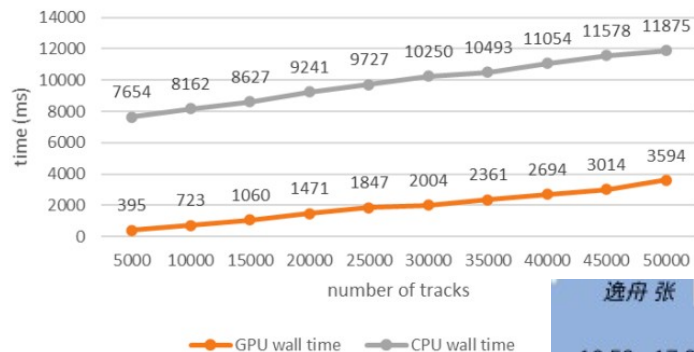


Cycle 1-2: temp = a×Pt+b 3-4: ar = a×Pt+b + b×Pt + c

艺迪 郝

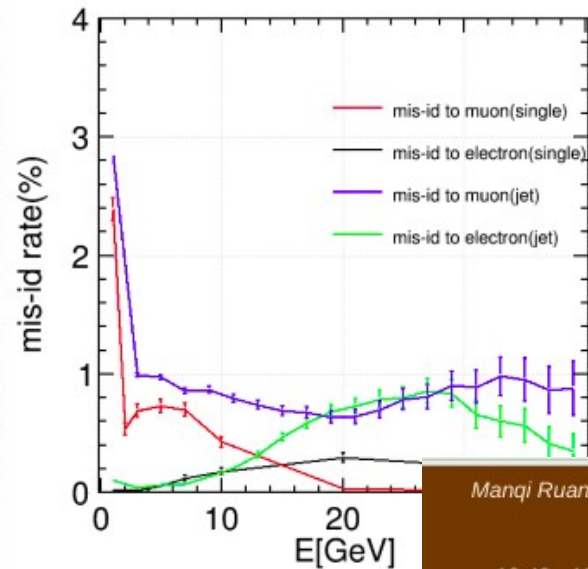
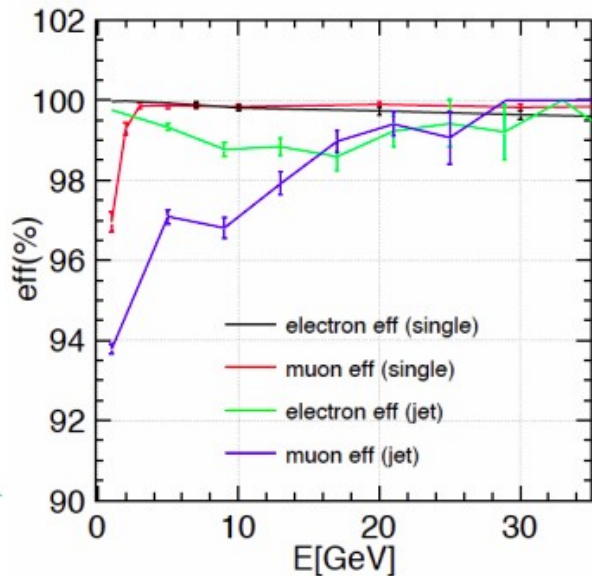
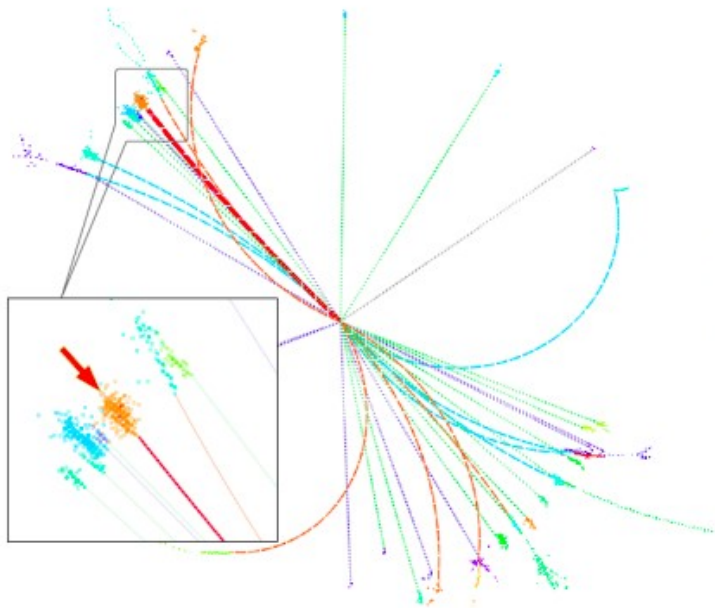
14:50 - 15:20

time cost of GPU & CPU



About tracking for high-level physics object reco

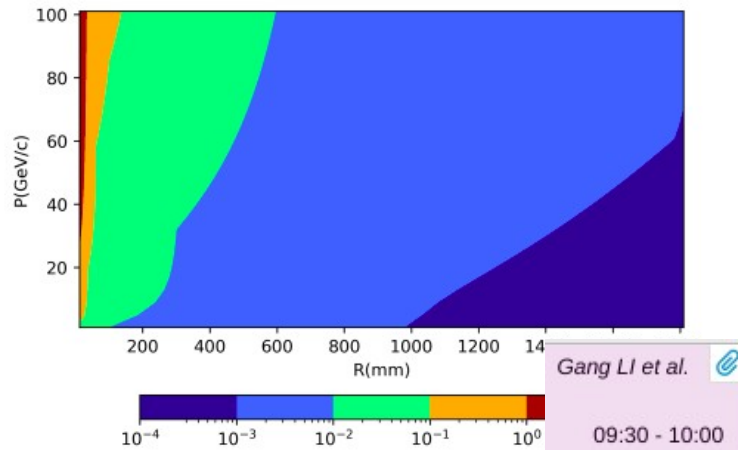
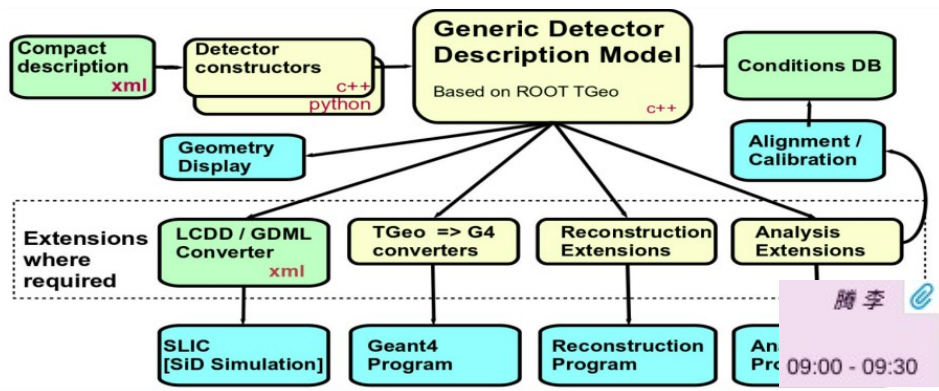
12



Manqi Ruan

10:40 - 11:15

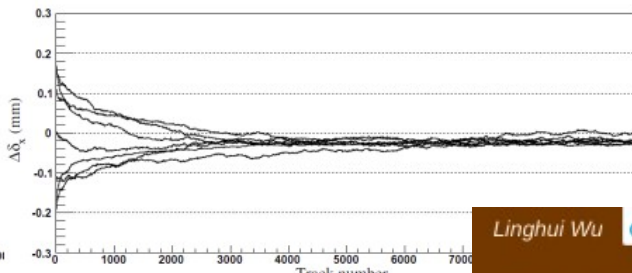
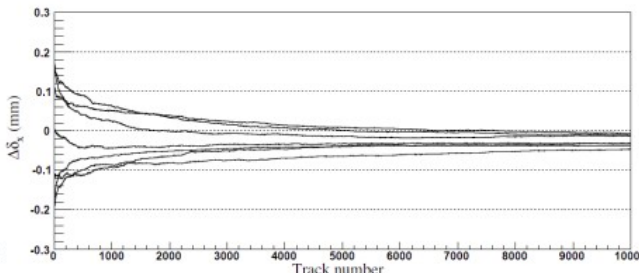
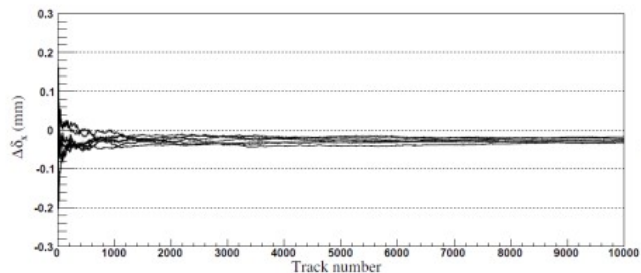
About detector geometry, optimization, alignment



A

B

C



Linghui Wu

11:15 - 11:45

Dedicated discussion

- The **tricky** parts that require special attention and prospects

11:00

Discussion: low momentum tracking

Jin Zhang

10:30 - 10:50

Discussion: tracking in high noise/dense environment

Xiaoshuai Qin

10:50 - 11:10

Discussion: Long-lived particle tracking

Xiaocong Ai

11:10 - 11:25

Discussion: prospects of common tracking software for future HEP experiments

Xiaocong Ai

11:25 - 11:40

Summary and Prospects

- Tracking plays a significant role in particle physics experiments
- First attempt of a tracking-dedicated tracking workshop in China
 - Involving 5 on-going experiments and 5 future ones
- Fruitful talks and discussion covering various tracking-related topics
- Hope this will inspire future related R&D projects for particle physics experiments
- And hope we can carry this workshop forward ...
- We highly encourage the participants to submit related abstracts to “中国物理学会高能物理分会第十四届全国粒子物理学术会议”（五）粒子物理实验技术
 - <https://indico.ihep.ac.cn/event/21331/>

Acknowledgments

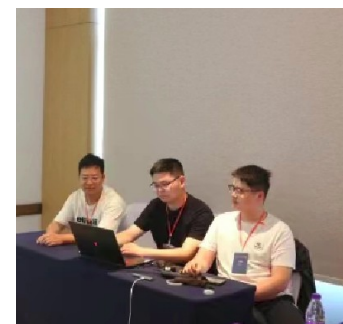
- Many thanks to our speakers, chairs and all participants for the contribution, comments, suggestions and support !
- Many thanks to our organizing committee for suggesting topics and inviting talks !
- And many thanks to our local organizing students for helping with the registration, preparation of the nice food and drinks, venue control and everything... !!

The Workshop Organizing Committee

- 郑州大学：艾小聪、刘义
- 中科院高能物理研究所：李卫东、孙胜森、伍灵慧、王亮亮
- 山东大学：黄性涛、秦小帅、李腾
- 中山大学：张晋
- 中科院近代物理研究所：郭爱强
- 清华大学：胡震

The Local Organizing Committee

- 艾小聪、刘义
- 博士生：吕云鹤
- 研究生：李豪，秦祖印，李昊霖，孙改革，王龙



Moments...



**We wish you a pleasant
and safe journey back !**

