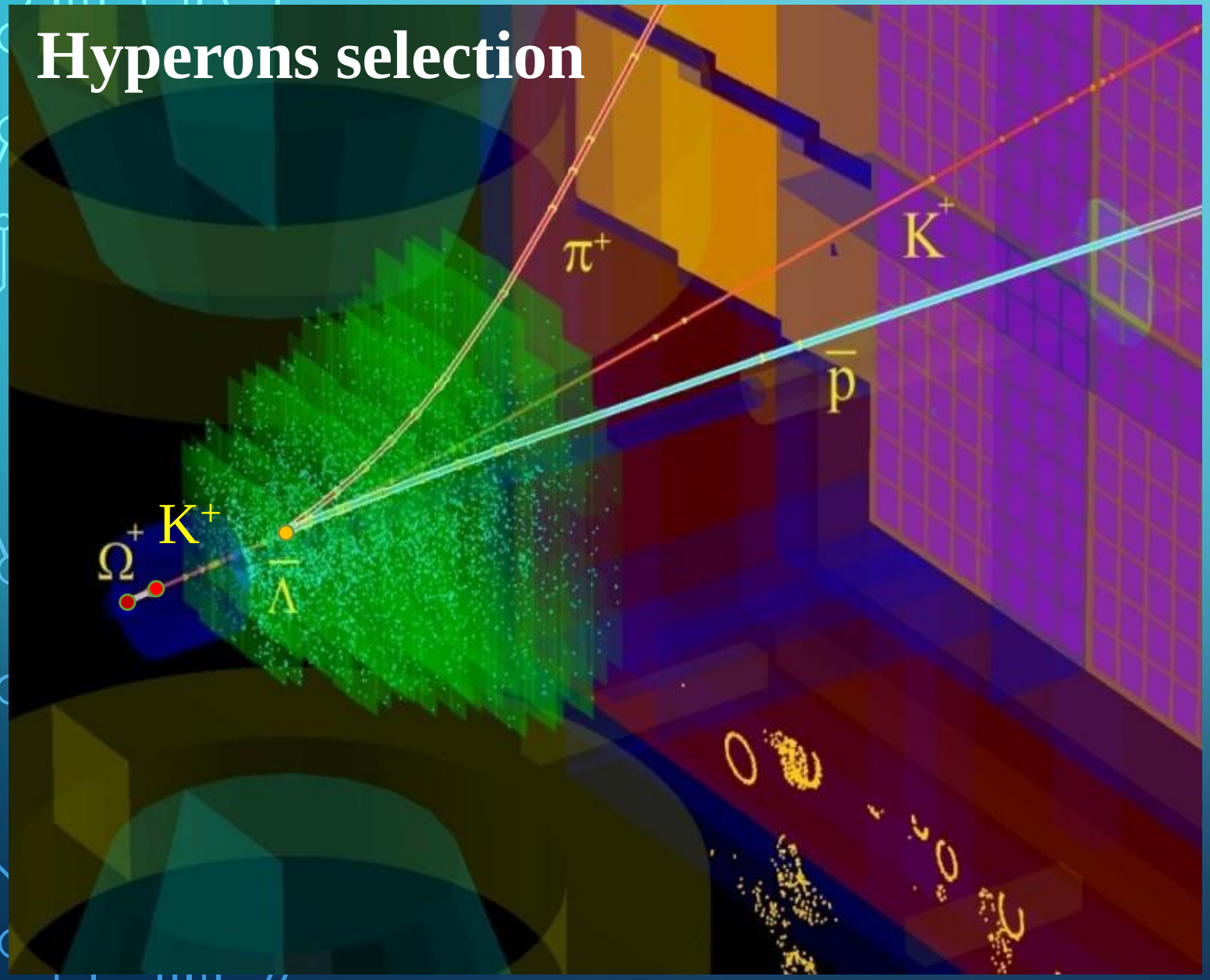
KF PARTICLE FINDER PACKAGE IN CBM



- KFParticle class describes particles by:

$$\mathbf{r} = \{ x, y, z, p_x, p_y, p_z, E \}$$

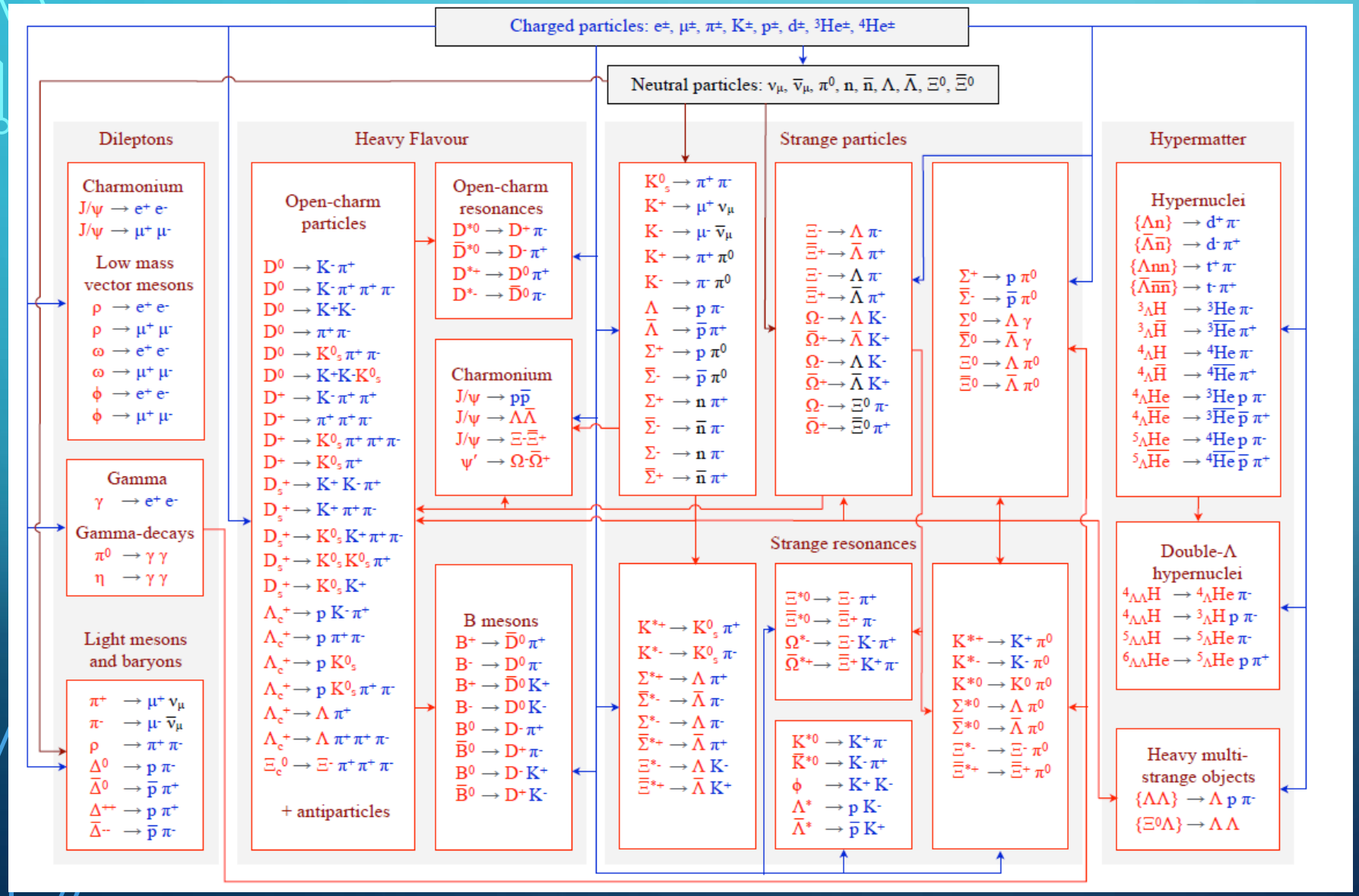
State vector

$$C = \langle \mathbf{r}\mathbf{r}^T \rangle = \begin{bmatrix} \sigma_x^2 & C_{xy} & C_{xz} & C_{xp_x} & C_{xp_y} & C_{xp_z} & C_{xE} \\ C_{xy} & \sigma_y^2 & C_{yz} & C_{yp_x} & C_{yp_y} & C_{yp_z} & C_{yE} \\ C_{xz} & C_{yz} & \sigma_z^2 & C_{zp_x} & C_{zp_y} & C_{zp_z} & C_{zE} \\ C_{xp_x} & C_{yp_x} & C_{zp_x} & \sigma_{p_x}^2 & C_{p_xp_y} & C_{p_xp_z} & C_{p_xE} \\ C_{xp_y} & C_{yp_y} & C_{zp_y} & C_{p_xp_y} & \sigma_{p_y}^2 & C_{p_yp_z} & C_{p_yE} \\ C_{xp_z} & C_{yp_z} & C_{zp_z} & C_{p_xp_z} & C_{p_yp_z} & \sigma_{p_z}^2 & C_{p_yE} \\ C_{xE} & C_{yE} & C_{zE} & C_{p_xE} & C_{p_yE} & C_{p_zE} & \sigma_E^2 \end{bmatrix}$$

Covariance matrix

1. Covariance matrix contains essential information about tracking and detector performance.
2. The method for mathematically correct usage of covariance matrices is provided by the KF Particle package based on the Kalman filter (KF) developed by FIAS group[1,2] primarily for CBM and ALICE.
3. Heavy mathematics requires fast and vectorised algorithms.
4. Mother and daughter particles are KFParticle and are treated in the same way.
5. The natural and simple interface allows to reconstruct easily rather complicated decay chains.

KF PARTICLE FINDER PACKAGE IN CBM (2019) & STAR (2023)



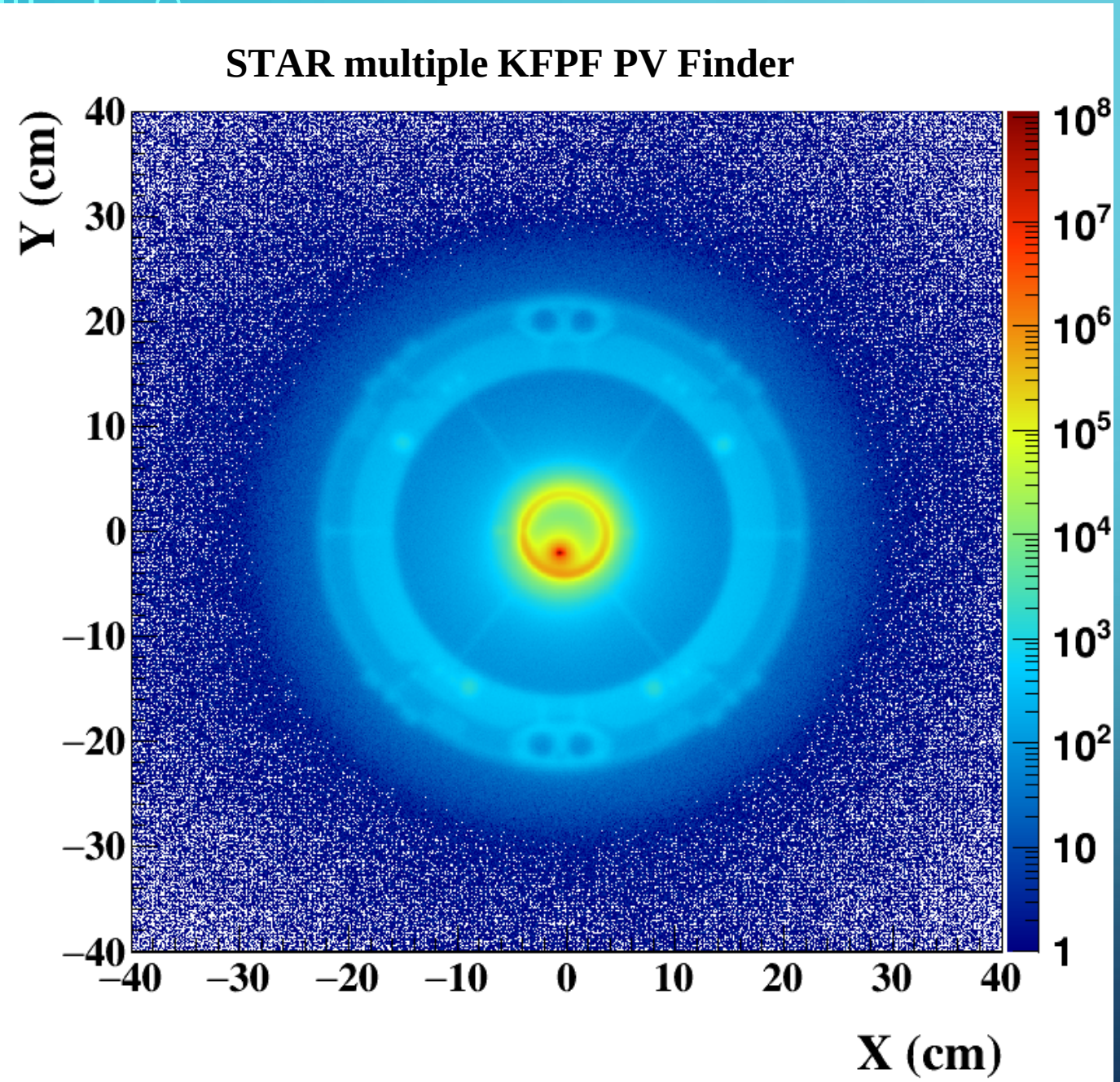
CBM: 193, STAR: **261** decays
All decays are reconstructed in one go.

Based on the Kalman filter method - mathematically correct parameters and their errors.

KF Particle Finder is successfully tested in STAR and allows to reconstruct up to 2 times more signal.

STAR developments are fully merged with the KF Particle Finder repository.

THE CBM & STAR KFPF PRIMARY VERTEX FINDER



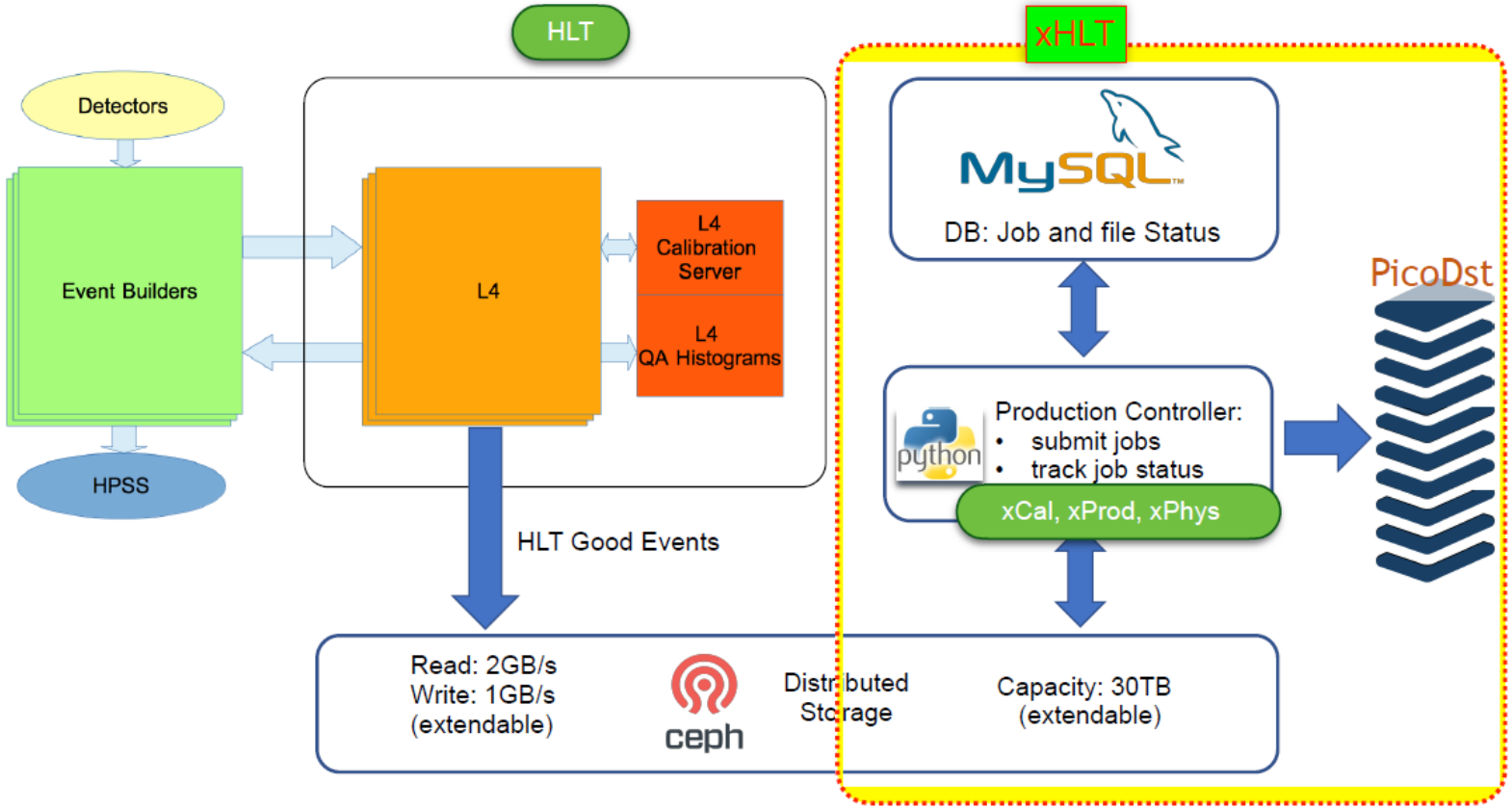
KFPF options:

1. Single (best) PV
2. Multiple PV
3. MC PV
4. External PV

STAR iTPC 2019

High IR → Multiple PV

HYPERNUCLEI IN STAR WITH EXPRESS ANALYSIS

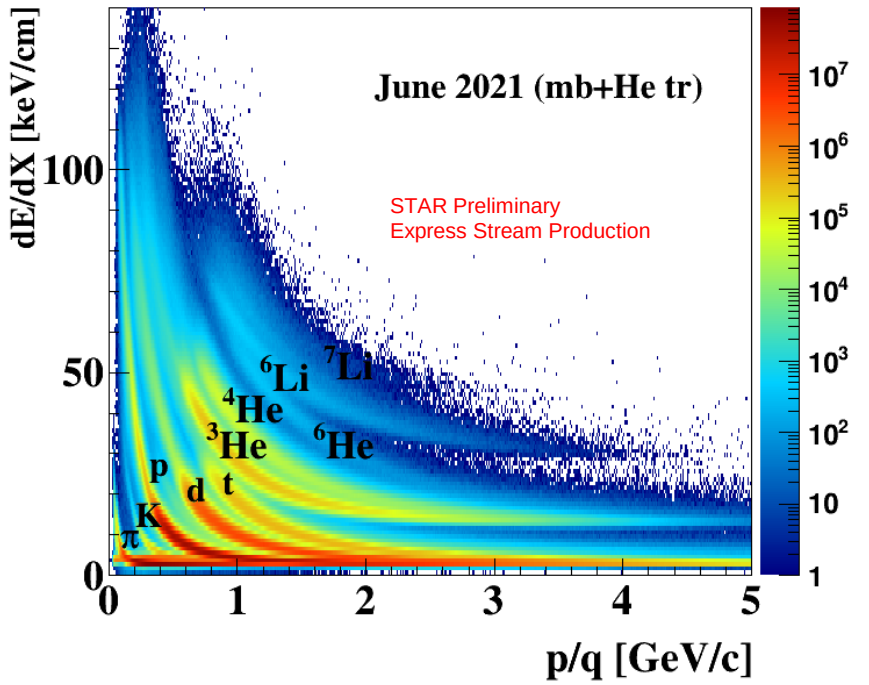


Full chain of express production and analysis has been running since 2019

Express Production (selection) jobs on HLT farm (300-500 job slots)

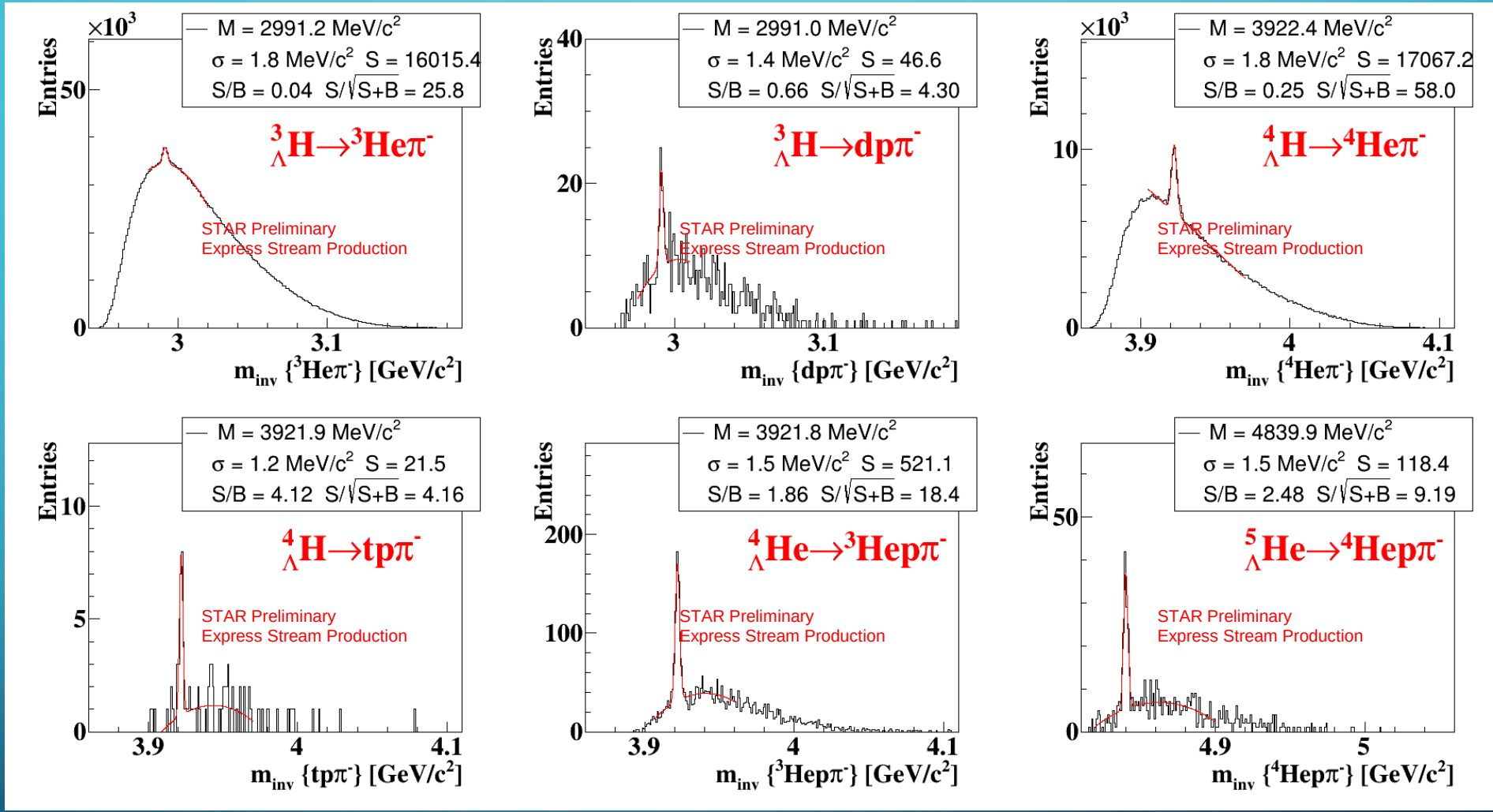
Trigger on He has been introduced to enhance **hypernuclei.**

437M AuAu HLT triggered events at 3 GeV



Save HLT good events to a local disk directly
PicoDst files produced in hours (collisions) or days (FXT) after data taking

437M HLT TRIGGERED EVENTS AT 3 GEV



- With increased beam collision intensity in the Fixed Target mode HLT farm had not enough capacities to process all collected data online.
- Therefore a trigger on He has been introduced to enhance hypernuclei.

The collected statistics is enough to measure yields, lifetimes and spectra of these hypernuclei