



AI-Driven Multistream Pipeline for Physics Lectures

Aleksei Mikhasenko¹, Mikhail Mikhasenko², Ilya Segal², Soraya Thiess²
¹Bonn University, ²Ruhr-University Bochum

Contact: s63amikh@uni-bonn.de

LECTURE NOTES

Goal: high-quality learning materials for students
Problem: combine several sources of information (recorded voice, student notes, and drawings)
Solution: use LLMs in several processing steps

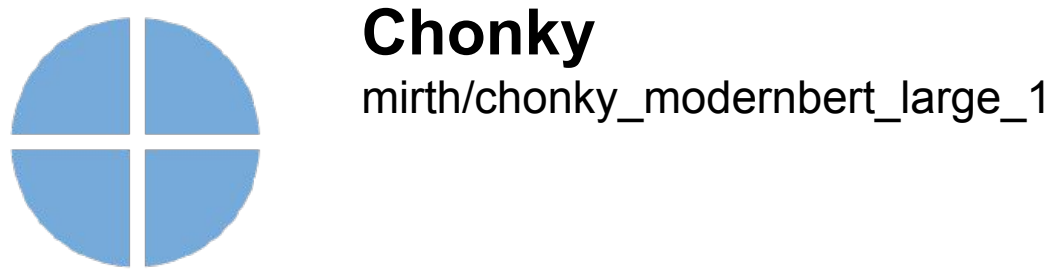
Part 1: Initial Transcription and Raw Data Preparation



Part 2: Processing of data

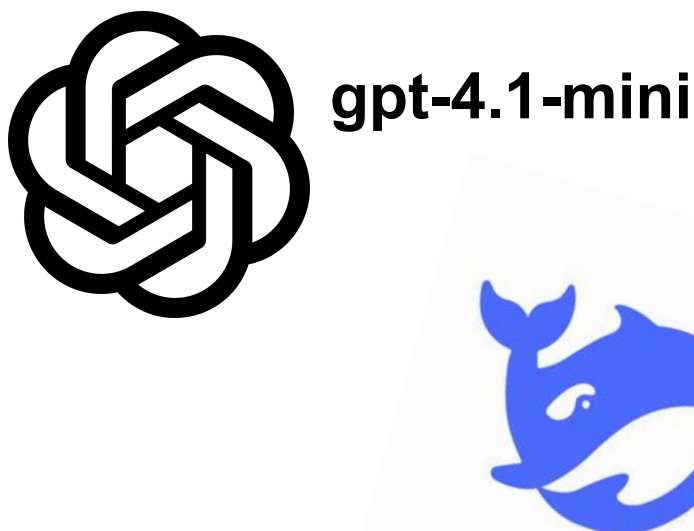


1. Step: create chunks using pre-trained model



2. Step: remove unrelated content

3. Step: create blocks using weighted similarity



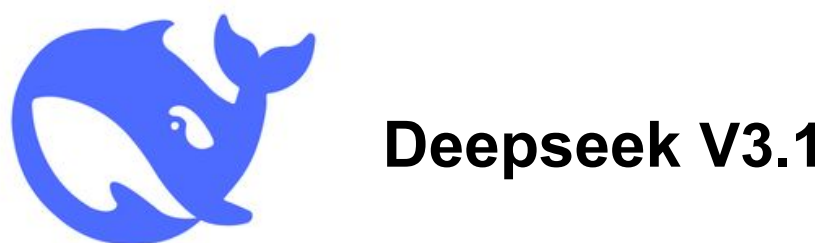
4. Step: Create formulas from blocks

5. Step: Refine blocks with formulas

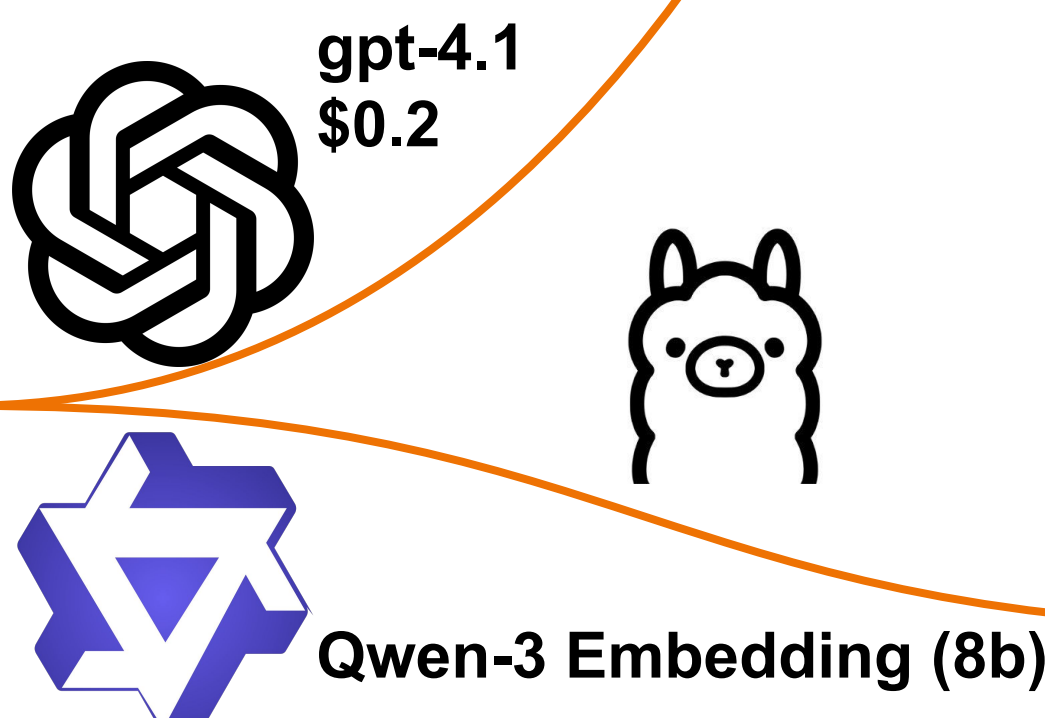


6. Step: Create formulas from blocks

7. Step: Create titles for blocks



8. Step: Add markdown elements



9. Step: Add images based on embedding similarity

10. Step: Save results to markdown

Part 3: Render to html and publish results

Blocks are created by maximizing this sum:

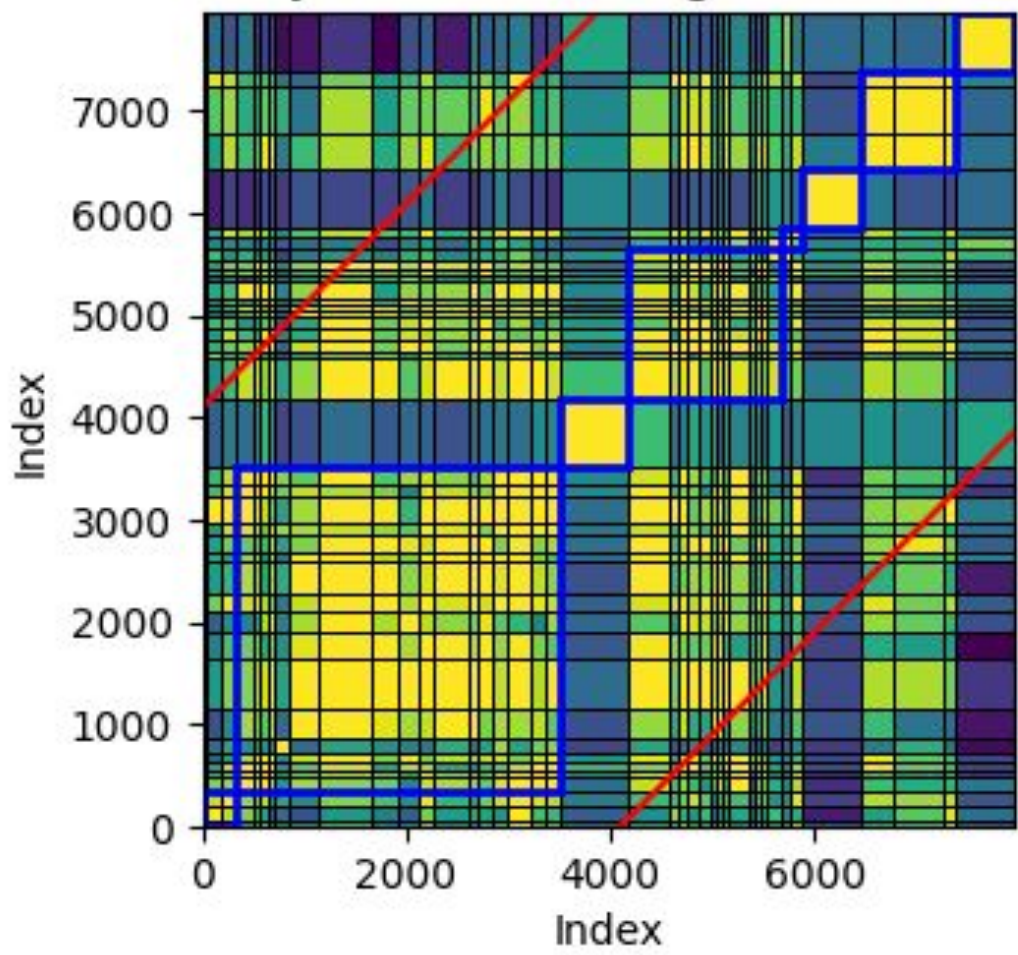
$$\left[\max_{\tau} \sum_{(i,j) \in \text{same block}} (M_{ij} - \tau), v_i v_j \quad \text{s.t.} \quad \sum_{i \in \text{block}} v_i \leq L_{\max} \right]$$

- v_i : length (or weight) of chunk i
- M_{ij} : cosine similarity between chunks i, j , divided by a configurable threshold and clipped at 1

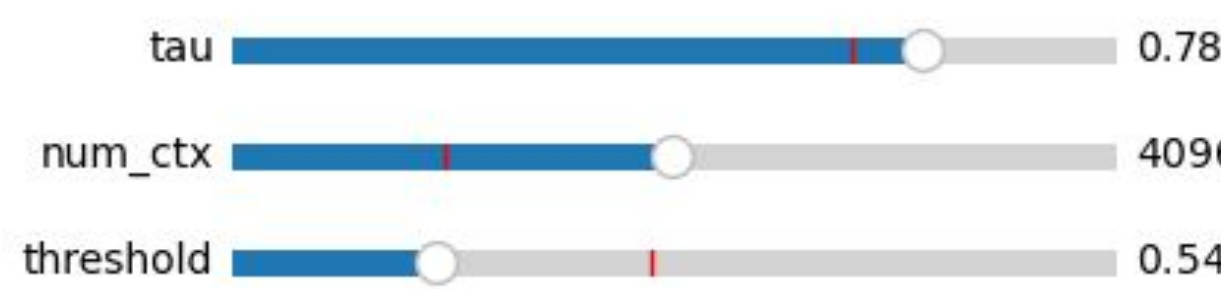
$$M_{ij} := \min \left(\frac{\cos(i, j)}{\text{threshold}}, 1 \right)$$

- τ : similarity offset (configurable constant)
- L_{\max} : maximum total length allowed per block

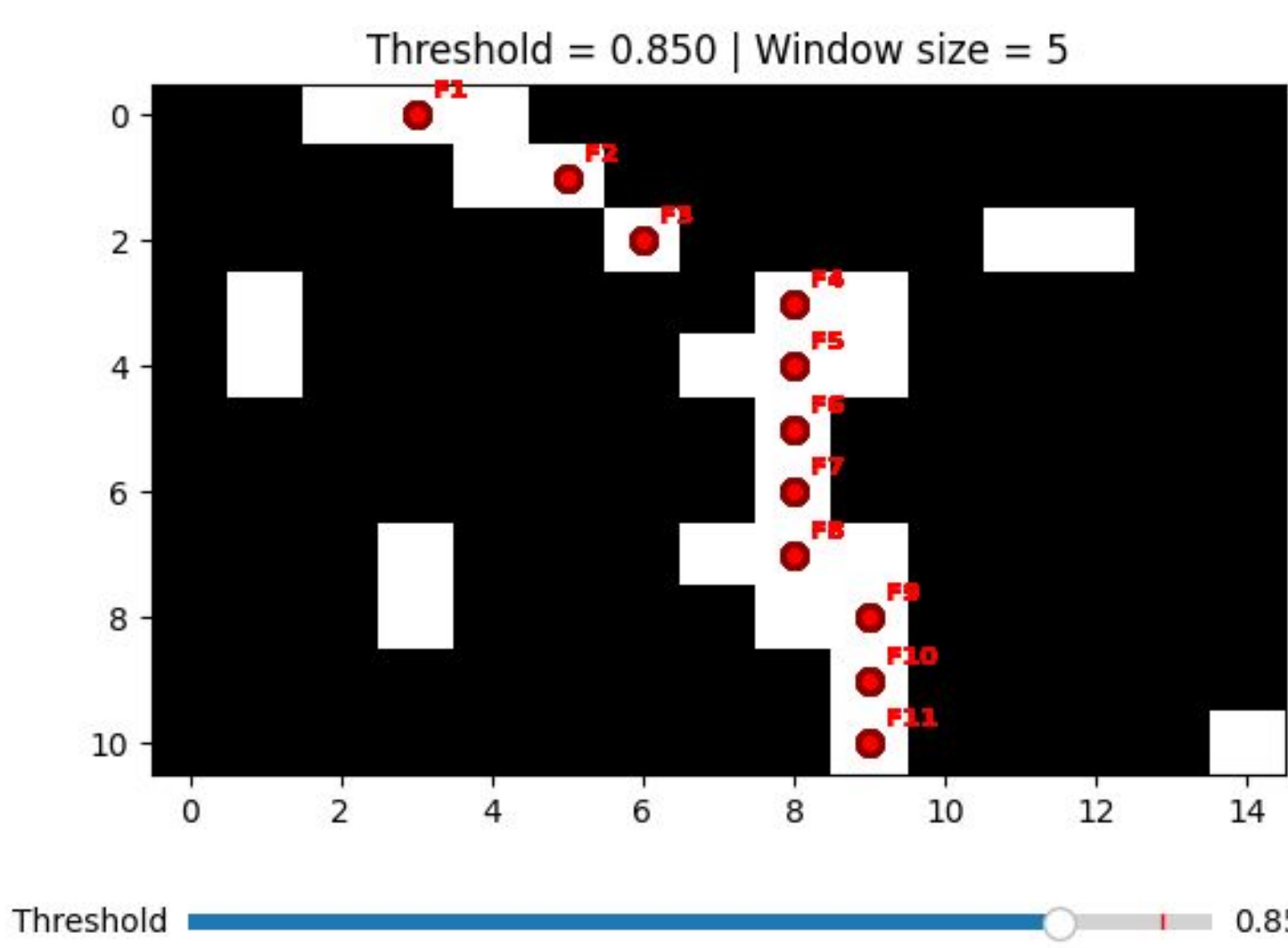
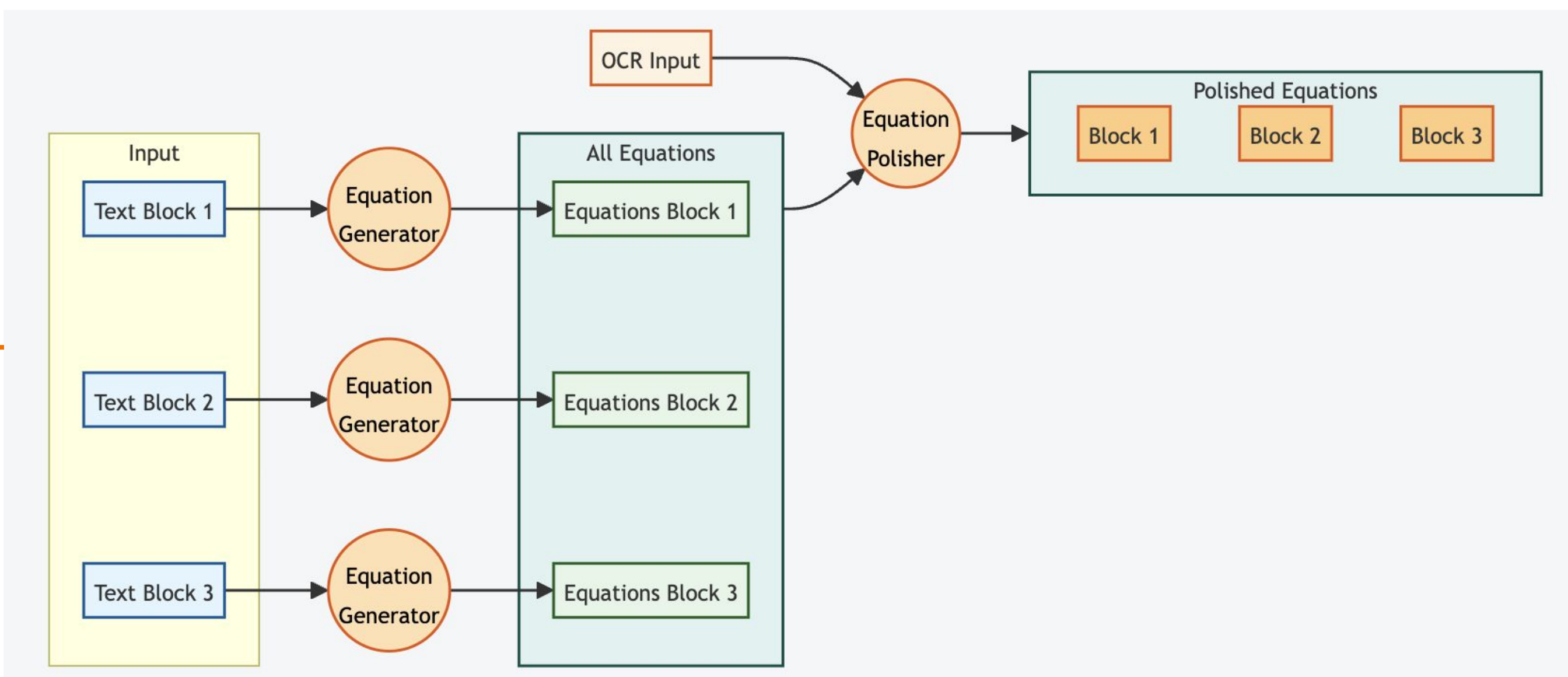
Similarity Matrix with Segment Boundaries



Visual segment separation



Configurable parameters



Images inserted starting from chunk with red dot in all white chunks

Threshold can be regulated

① The Dalitz plot density for three-body decays is:
$$\frac{d^2\Gamma}{dm_{12}^2 dm_{13}^2} = \text{constant} \times |\mathcal{M}|^2$$

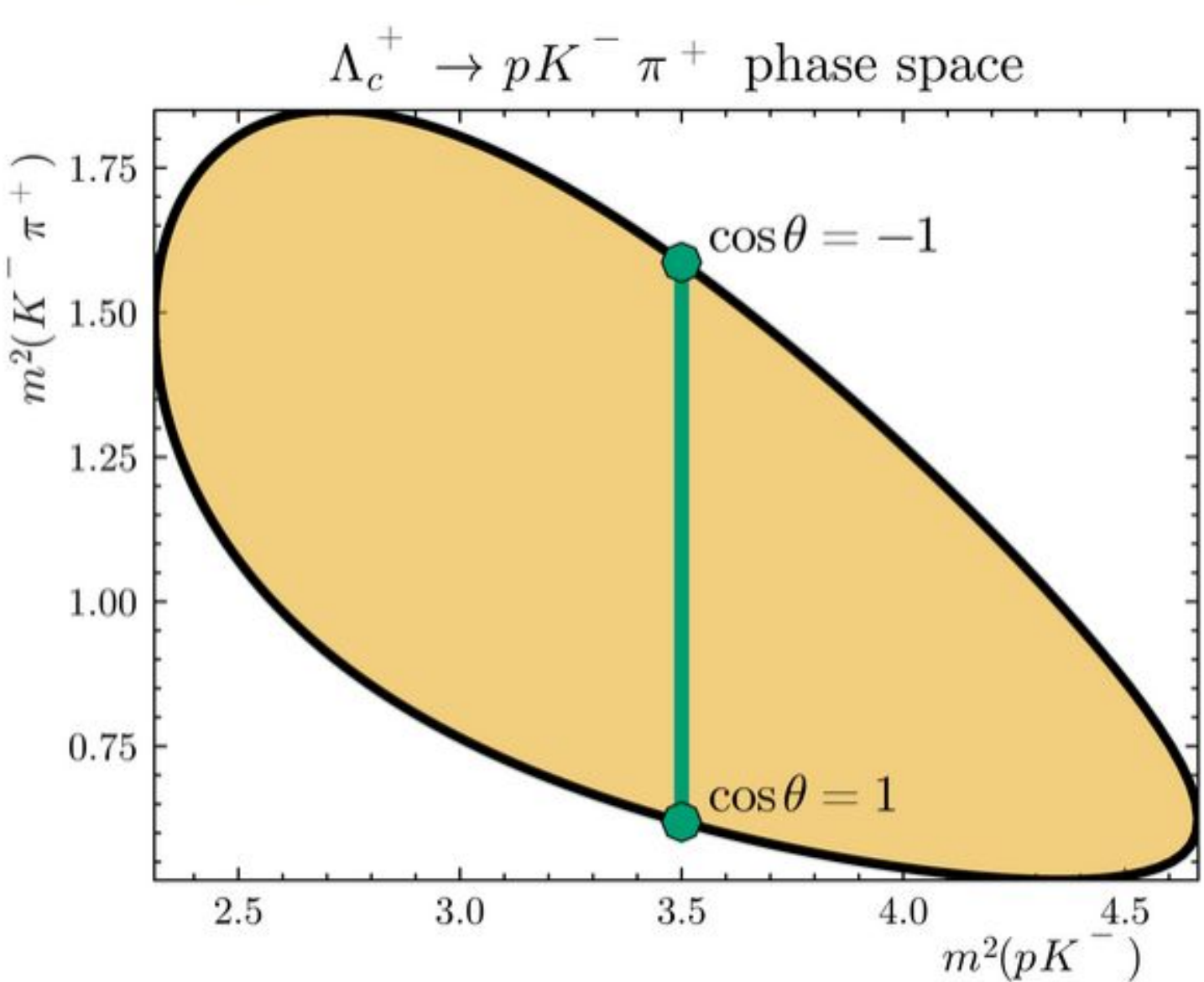
where m_{ij} are invariant masses and \mathcal{M} is the decay amplitude. (see Figure-1)

Markdown notes

The lines appear parallel to the sides of the Dalitz triangle:

- K^* resonances parallel to one side
- Δ resonances parallel to another side
- Δ resonances parallel to the third side

Markdown lists



Images in correct places

Labels for each image



Check it out yourself !

Figure 3: The Dalitz plot, a representation of the phase-space for the three-body decay. (see Figure-6) It appears as an ellipse-shaped area where the internal region corresponds to allowed kinematics and the outside region is forbidden. On the x-axis lies the squared mass of two final-state particles, while the y-axis corresponds to the other subsystem. A horizontal line represents a slice of the phase-space with one mass fixed. The borders of the area correspond to configurations where all three momenta are aligned in the rest frame of the decaying particle, or equivalently, where the scattering angle in the relevant rest frame is either 0 or π .