

## Cross Sections

Suzie Shrubb 2021

This suite of pieces examines cross section measurements undertaken by particle physicists and the liquid argon time projection chamber detectors they use to perform these measurements.

Each movement or piece focuses on a specific area that includes particle interactions inside the detector, the detector, the cross section and particle interactions that humans are interested in. In each work we are examining what happens when we translate these operations into a musical context, that is, the embodied experience of vibration taking place across a durational space.

Some of the pieces are direct translations of the particles and others examine how similar operations, such as a particle losing energy are found in a musical context, such as a note losing energy because air expelled by a human also has a shape that loses energy and then use this as a starting place for creation.

As we move through the suite the pieces become more complex and data related until the final movement, which is derived from a graph that plots the final presentation of the cross section measurement.

All the pieces contain elements of chance and are co-composed also by the performer in the moment. Chance is an essential part of any particle interaction since we can't know when the particle will interact we just know that at some point it will. The cross section is itself a measurement of the likelihood of a particular type of particle interaction occurring. Clearly the use of chance operations in this music is essential and particle physics is a form of Aleatoric music.

In a very real sense performers become detectors in this piece- picking up on subtle or not so subtle signals driven by their intuition, gut, sense, aestheticism and many other factors to guide them when to play or act or not play or not act.

Soloists and ensembles should take time to connect with themselves, their instrument/s and voices, one another and the vibrational space they are in as part of the rehearsal and learning process.

Prior to creating the soundscapes, performers should also make a study of these scores and the information available and spend time working out how and what the interpretations you make will mean or relate to the score, particles and detectors and their interactions.

Each score is rich in source material and the websites of Fermilab, BNL, Cern, Symmetry Magazine and [phys.org](http://phys.org) among others are all excellent sources for further reading, watching and listening.

In my work I always aim to be faithful to the ideas and data and present these accurately. Some of the pieces are more a presentation or expression of an idea in a vibrational space than a direct translation of specific data and some of the pieces are a more direct translation of data. This way of expressing the ideas is a conscious choice on the part of the composer in order that I can give a space and opportunity for people to engage in these ideas more directly and think about how to express them in a way that means something to them. In some of the pieces I invite people to become the detector and the particles and hopefully open up a possibility for people to express what this might mean to them. And, some of the pieces emerge from an

imaginal space of enquiry, such as the central question for Movement 1: “What happens when I imagine my piano is a detector being played by particles?” or “What music emerges from my piano when I imagine it is a detector being played by particles that are flying through it and interacting inside it?”

This collection of pieces is an exploration of ideas that are connected through the experimental set up and purpose. Each movement has a specific focus or narrower set of foci that changes through the sequence of movements. The rough narrative sketch through the piece is from initial measurement or particle interaction to final result.

The pieces can be performed as separate movements.  
Performers can also choose to perform selected movements.

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### Cross Sections- Movements

#### Movement 1

Particles and Interactions and Detector.

#### Movement 2 Energy States

Particles trajectory and energy loss as they move through the detector.

#### Movement 3 Particle Interactions

The harmonic and rhythmic languages that result from the particle interactions. How they translate over. ie: unchanged notes: ie QES- same note to same note- exchange particle between- not much changes over time- but something happens. Soundscape made from these. Possible templates: Feynman diagrams, scored suggestions. Performers can also to pass these interactions between them and know what interactions are being expressed.

#### Movement 4 Particle Interactions

These are now precisely scored out from data.

#### Movement 5 The Cross Section

Cross section graph. from data. Precisely scored out.