

**Schweizerische Musikforschende Gesellschaft Basel**  
**03.11.2020**

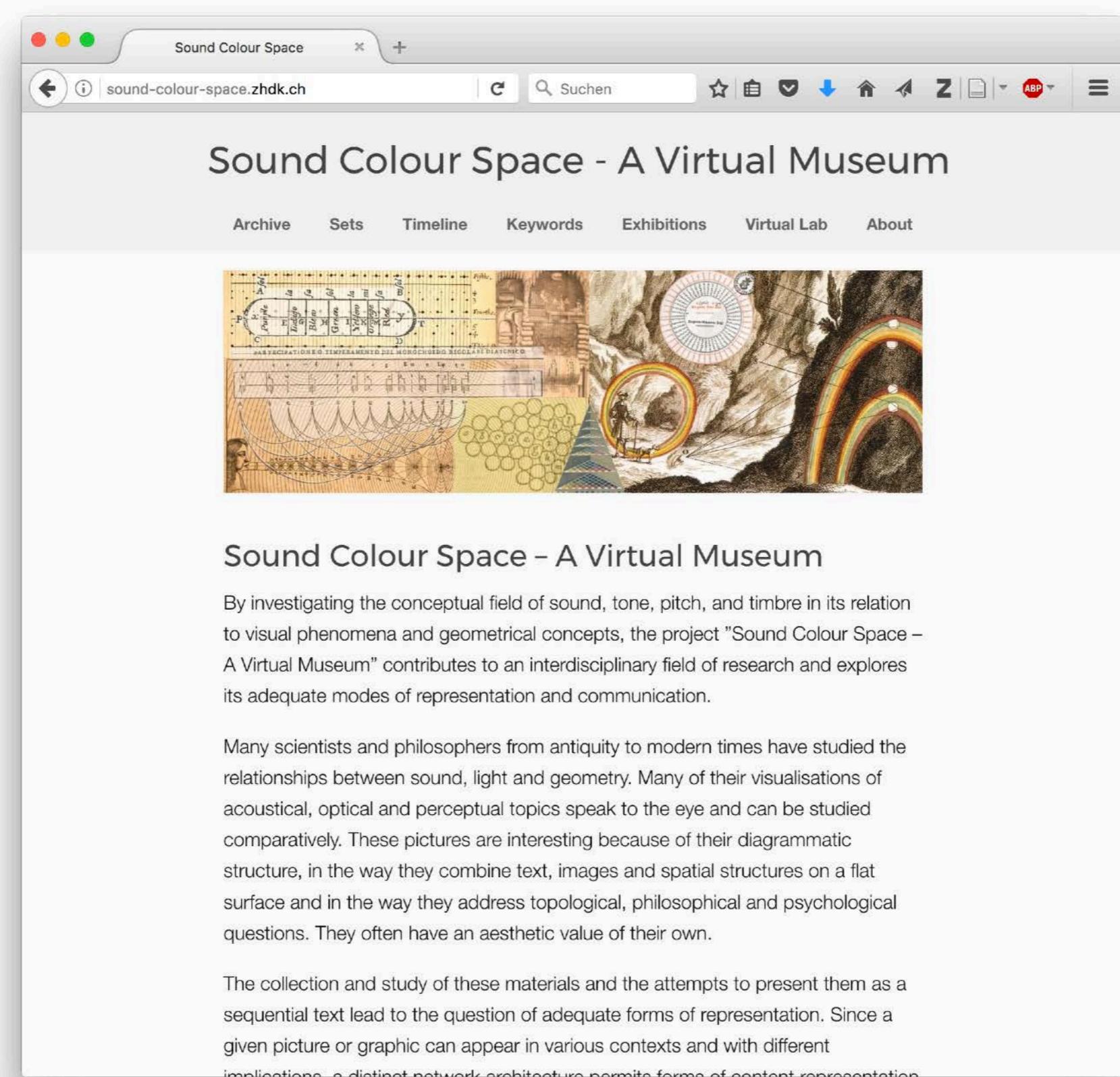
# **Sound Colour Space**

## Diagrammatische Strukturen des Museums und diagrammatische Arbeitsweisen beim Aufbau des Museums

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**Vorsitzende des Digitalrads, ZHdK**

# Das virtuelle Museum: sound-colour-space.zhdk.ch

Online-Publikation der Sammlung und der Analyse der historischen Diagramme



The screenshot shows a web browser window titled "Sound Colour Space". The address bar displays "sound-colour-space.zhdk.ch". The main content area features a large, detailed historical diagram titled "PASTORALISATIONE O TIMPERAMENTO DEL MONDO CH' E' IN RIGOLARE DIATONICO". This diagram includes various musical scales, a circular color wheel, and a landscape illustration with figures. Below the diagram, the title "Sound Colour Space - A Virtual Museum" is repeated. A descriptive text follows, explaining the project's focus on the relationships between sound, light, and geometry. Another paragraph discusses the historical context, mentioning scientists and philosophers from antiquity to modern times who studied these relationships. The bottom section contains a partially visible text about the collection and study of materials.

Sound Colour Space - A Virtual Museum

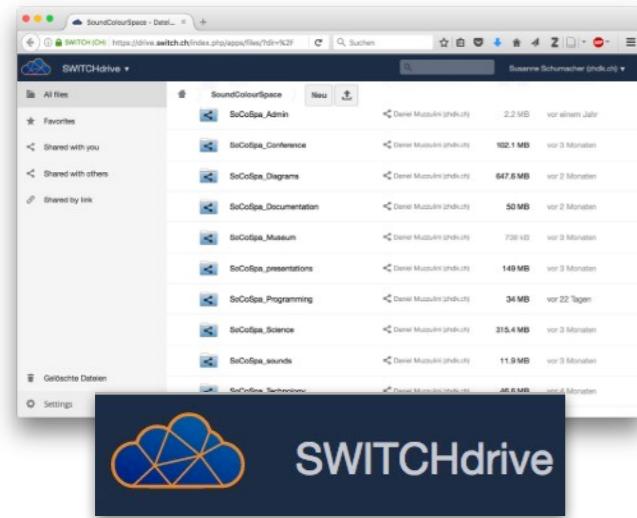
By investigating the conceptual field of sound, tone, pitch, and timbre in its relation to visual phenomena and geometrical concepts, the project "Sound Colour Space – A Virtual Museum" contributes to an interdisciplinary field of research and explores its adequate modes of representation and communication.

Many scientists and philosophers from antiquity to modern times have studied the relationships between sound, light and geometry. Many of their visualisations of acoustical, optical and perceptual topics speak to the eye and can be studied comparatively. These pictures are interesting because of their diagrammatic structure, in the way they combine text, images and spatial structures on a flat surface and in the way they address topological, philosophical and psychological questions. They often have an aesthetic value of their own.

The collection and study of these materials and the attempts to present them as a sequential text lead to the question of adequate forms of representation. Since a given picture or graphic can appear in various contexts and with different implications, a distinct network architecture permits forms of content representation.

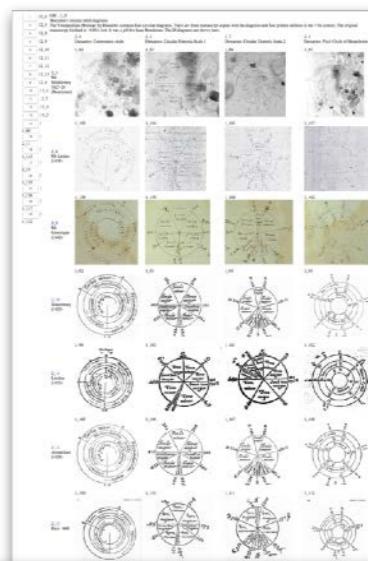
# Zusammenspiel der beteiligten Systeme

Ablagen, Datenbanken, Code-Repositorien, Internetseiten

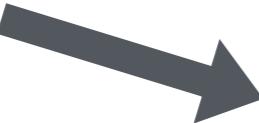
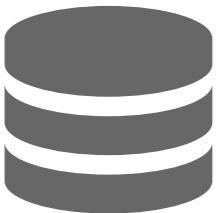


The screenshot shows a project page on the "hdk Medienarchiv der Künste" website. The title is "Tone Systems". It includes a thumbnail of a manuscript page, a list of metadata, and several circular diagrams arranged in a grid. Below the main content is a navigation bar with links like "Set", "Werk", "Projekt", "Projektschaufenster Website ZHdK", "Archiv ZHdK", "Zusammenfänge", and "Nutzung".

**hdk** Medienarchiv der Künste

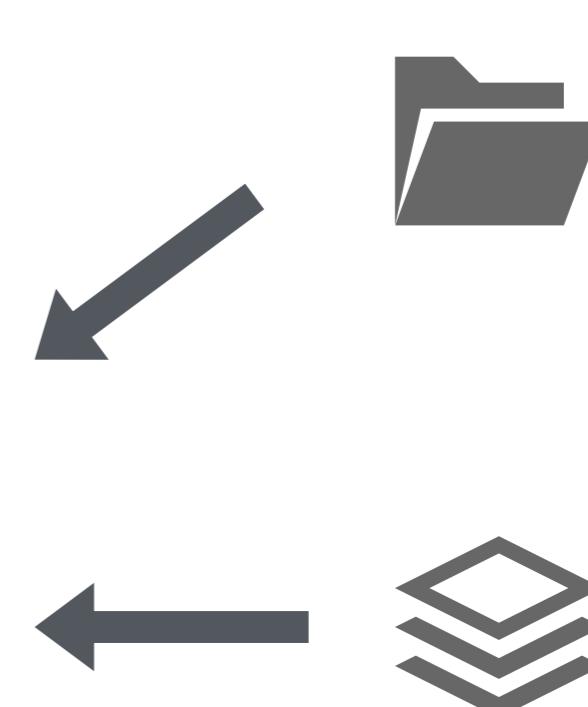


**Prototyp des Museums**



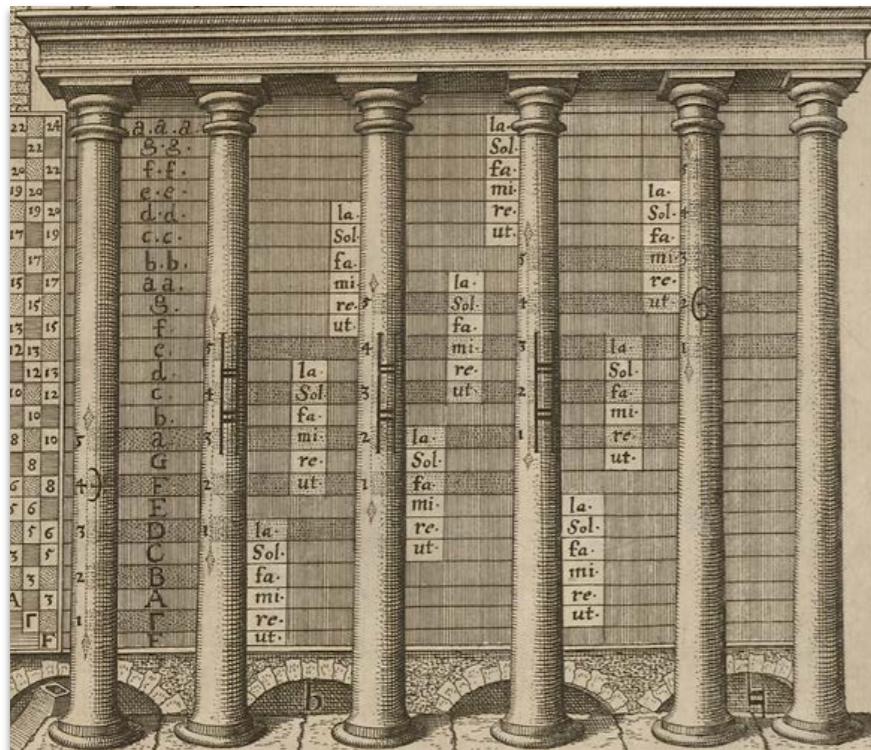
The screenshot shows a virtual museum interface titled "Sound Colour Space - A Virtual Museum". It features sections for "Archive", "Sets", "Timeline", "Keywords", "Exhibitions", "Virtual Lab", and "About". The main content area displays several historical musical diagrams and tables, including a "Tetrakty square", "Hexachords", "Greek Tetrachords", and "Circles". There are also dropdown menus for "10th", "13th", "14th", "15th", "16th", "17th", "18th", "19th", and "20th" centuries.

**Virtuelles Museum**

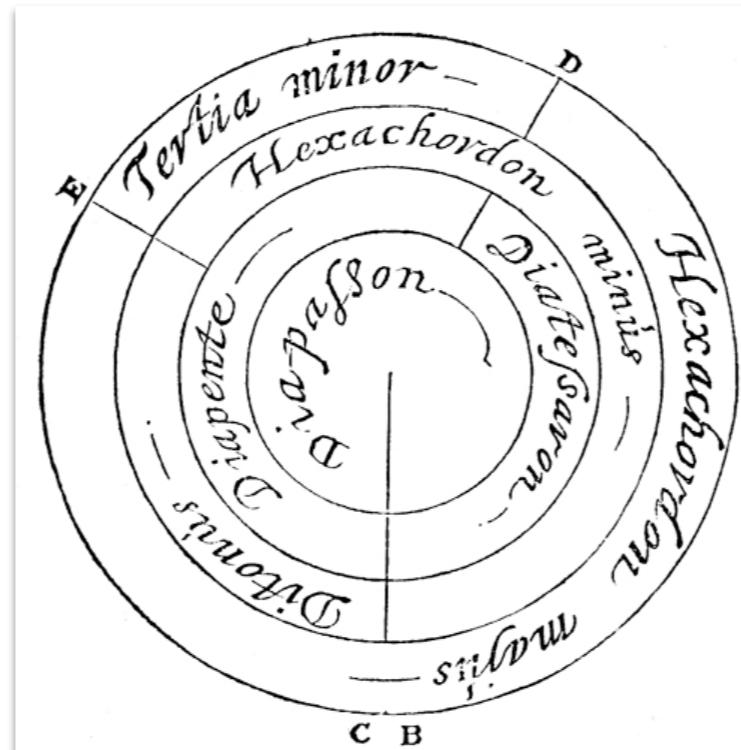


# Gegenstände der Untersuchung

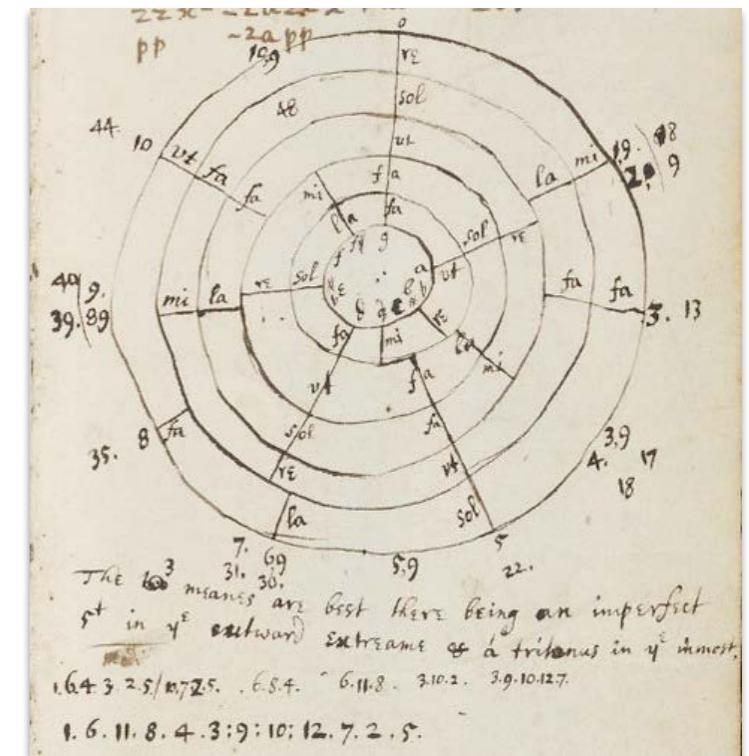
Historische Diagramme zu Ton- und Farbsystemen von Robert Fludd, René Descartes, Isaac Newton und anderen



Fludd: Hexachord, Detail aus dem *Templum Musicae*, 1624



Descartes: Consonance Circle, *Compendium Musicae*, 1656

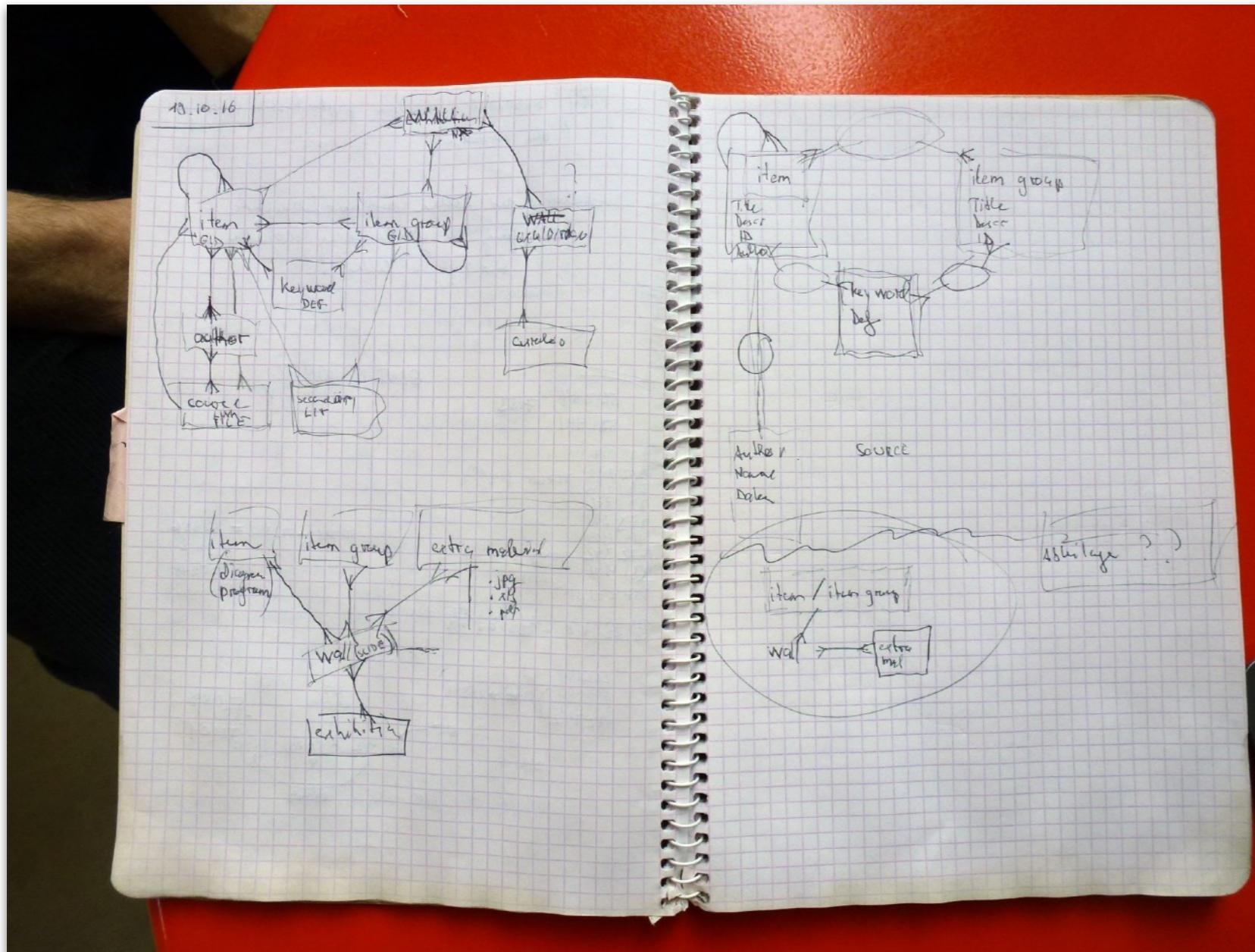


Newton: Diatonic Circles (1), *Musical Notes*, 1665

Ziel des Projekts: Analyse der historischen Diagramme und Vermittlung ihrer Bedeutung in einem Virtuellen Museum

# Mit dem Datenmodell das Virtuelle Museum konzipieren

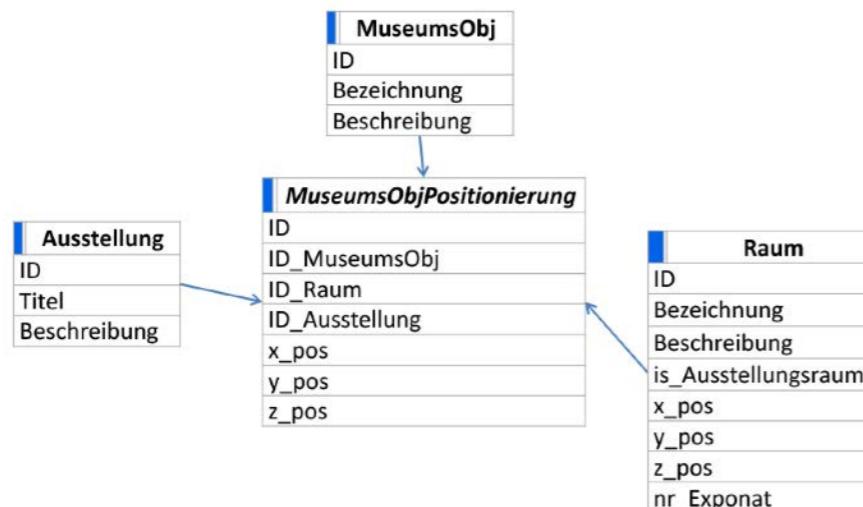
Zugeschnitten auf das Thema des Forschungsprojekts



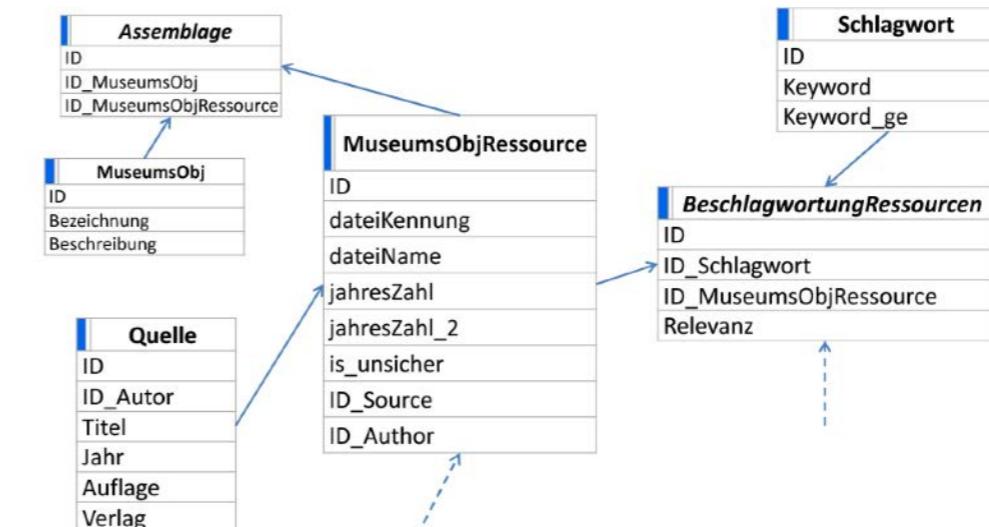
Daniel Muzzolini: Arbeiten am Datenmodell des Virtuellen Museums

# Elemente des Museums und ihre Beziehung zueinander

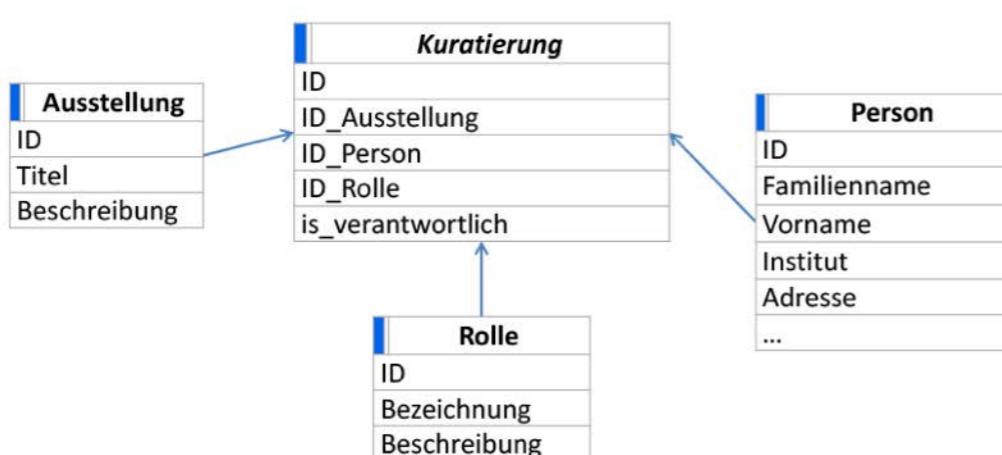
Ausstellung: Museumsobjekt-Positionierung



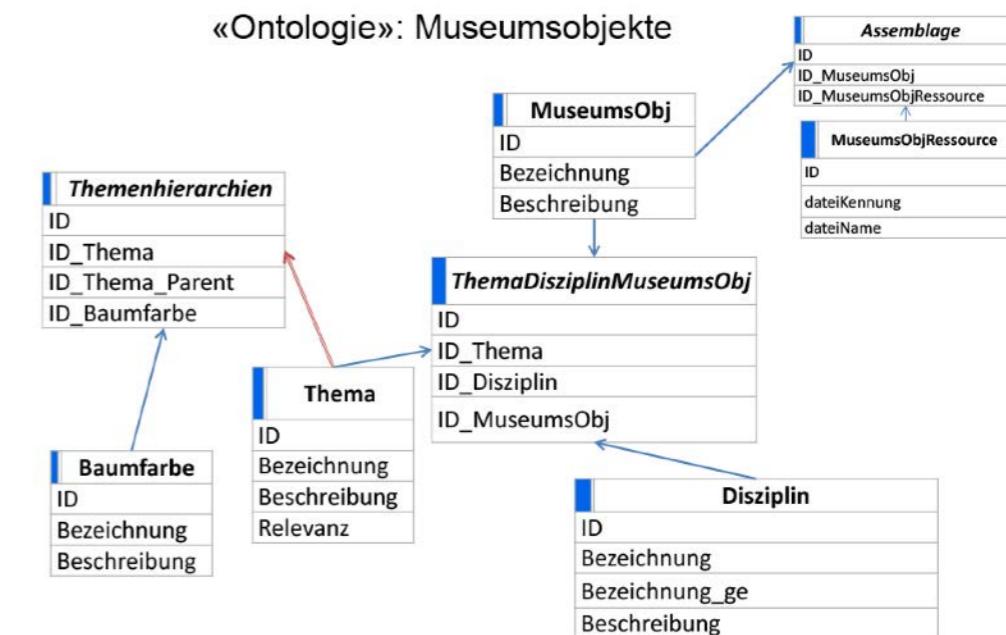
Beschlagwortung: Museumsobjekt-Ressourcen



Ausstellung: Kuratierung

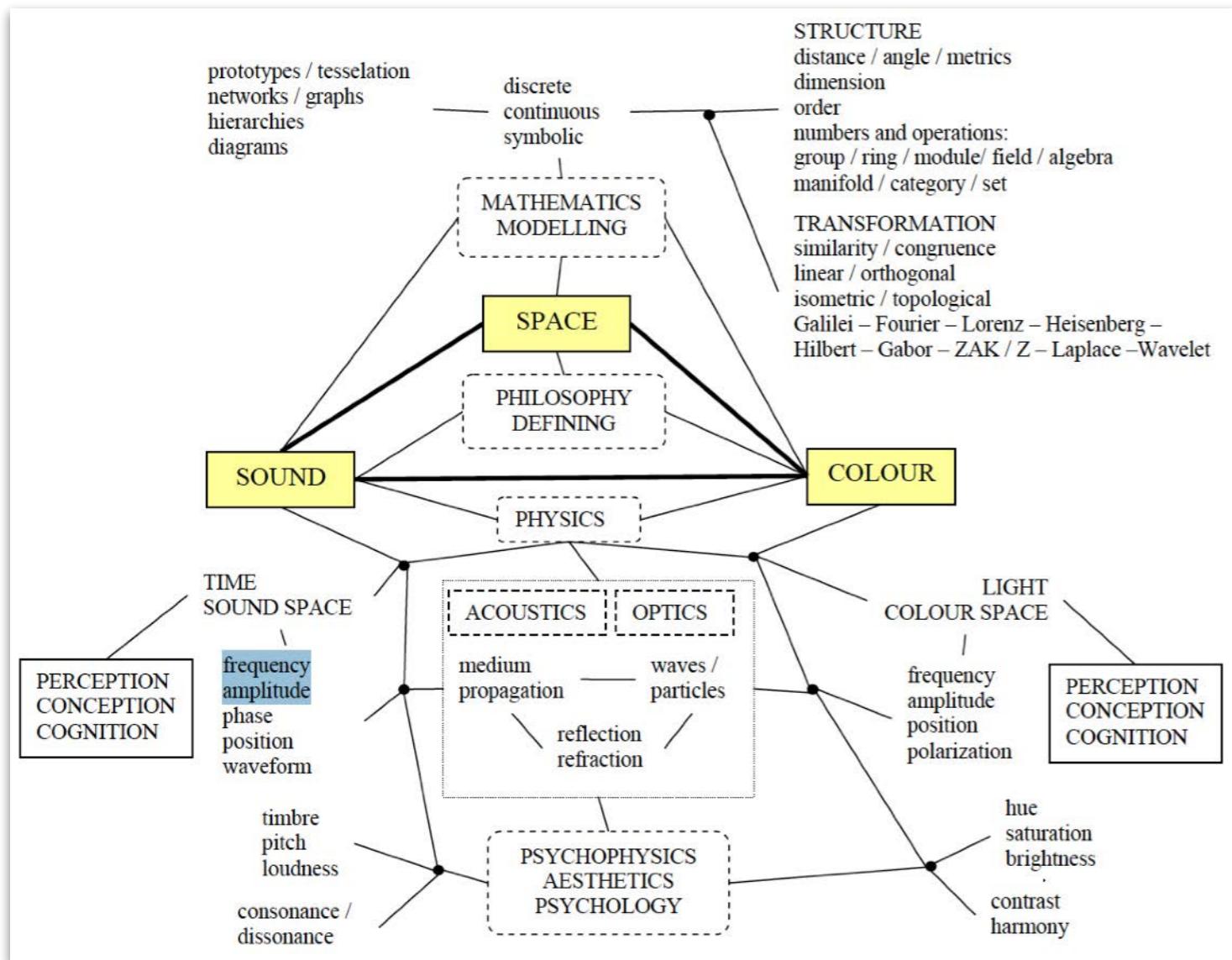


«Ontologie»: Museumsobjekte



# Begriffsnetzwerk und Schlagworte

Thematische Gruppierung der Inhalte

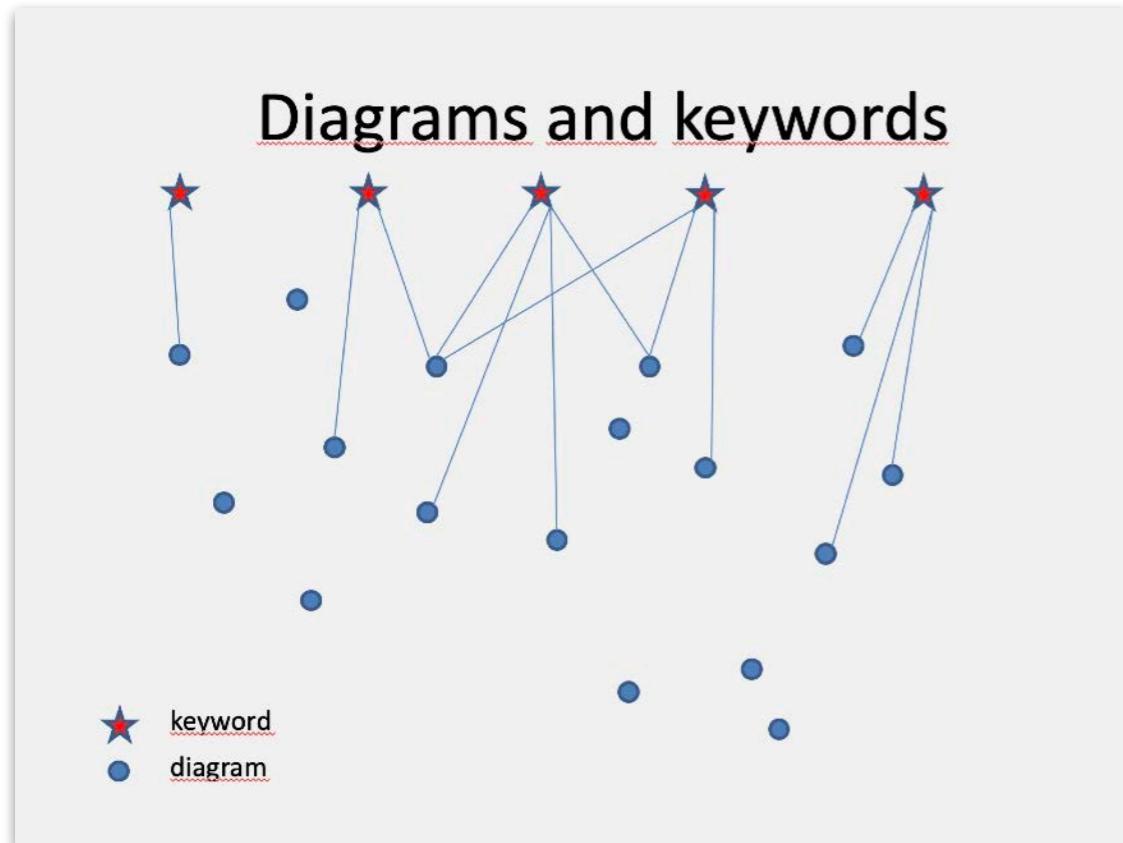


Daniel Muzzolini: Begriffliche Strukturierung des Themenfeldes. Netzdiagramm der Beziehung der Begriffe untereinander und kurze Erläuterung der Schlagworte

Greek tetrachords	tuned in the ratio 6:5) and an octave (in the ratio 2:1), equal to 648:625
harmony of the spheres	
Hertz	unit to measure frequency, number of periods per second
hexachord	part of a diatonic scale with six notes covering a major sixth
<u>Hexachordon duris</u>	the hexachord G-A-B-C-D-E
<u>Hexachordon mollis</u>	the hexachord F-G-A-Bb-C-D
<u>Hexachordon naturalis</u>	the hexachord C-D-E-F-G-A
interval	
<u>ionian</u>	
irrational number	number that cannot be expressed as fraction, number with infinite aperiodic decimal representation
just intonation	
kappa-n	a graph with n-nodes where all pairs of nodes are connected by an edge
lesser diesis	difference between an octave (in the ratio 2:1) and three justly tuned major thirds (tuned in the ratio 5:4), equal to 128:125 or about 41.06 cents
<u>limma</u>	the diatonic Pythagorean semitone (256:243)
logarithmic scale	
logos	Greek word for ratio, rational number
lute	
<u>lydian</u>	
mean tone temperament	tuning where the major third 5:4 is divided into two equal tones
Mese	
<u>mixolydian</u>	
monochord	instrument with a single string used for performing acoustical experiments
multiple proportion	ratio of the form n:1
n-edo	division of the octave into n equal intervals
<u>Nete hyperbolaion</u>	
n-tet	division of the octave into n equal intervals
<u>Numeri Sonori</u>	
octave	interval with the ratio 2:1
<u>ottonario</u>	the set of the first eighth numbers 1, 2, 3, 4, 5, 6, 7, 8
perfect major triad	triad with the proportion 4:5:6
perfect minor triad	triad with the proportion 10:12:15
<u>phrygian</u>	
pitch	
proportion	
Pythagorean chromatic semitone	interval of the ratio 2187:2048
Pythagorean comma	interval with the ratio 531,441:524,288, six tones (9:8) minus an octave (2:1)
Pythagorean diatonic semitone	interval of the ratio 256:243
Pythagorean fifth	
Pythagorean hammers	
<u>Pythaoreean major third</u>	interval with the ratio 81:64 consisting of two equal tones (9:8)
<u>quinario</u>	the set of the first five numbers 1, 2, 3, 4, 5
ratio	pair of two numbers
relatively prime	integer numbers without a common divisor <u>gerater</u> than 1

# Funktionen von Schlagworten aus Sicht der BesucherInnen

Zugang zu den Inhalten via Schlagwörter



## Keywords

Sound Colour Space - A Virtual Museum

Archive Sets Timeline Keywords Exhibitions Virtual Lab About

filter ×

12-tet 53-tet 58-tet 59-tet analogia Apotome Aristoxenus arithmetic mean arithmetic progression ars nova ars subtilis artes liberales artificial comma augmented triad beats binomial coefficients Bis Diatessaron bisection of musical intervals Boethius brightness chords chroma chromatic genus chromatic scale chromatic tetrachord church modes circle of fifths circular pitch diagram classification clevein ocellae colour colour circle colour mixing colour scale colour solid colour spectrum colour sphere colour top colour topology colour triangle colour vision colour wheel combinations combination tones combinatorics complementary colours concentric circles consonance Consonance circle consonant chords consonants continuous proportion coordinate system counterpoint cube diapente Diatessaron diatonic scale Diatonic Scale 1 Diatonic Scale 2 disisis dissonance dissonant chords ditonus double cone double tetrakys duration enneagram equilateral triangle Euclid's altitude theorem figurate number figurate numbers four elements frequency geometric mean geometric progression Glareanus golden ratio Greek tetrachords Greek tone harmonic mean harmonics harmony of the spheres helix hexachord hexachordon minus hexachords hierarchy of ratios hue imperfect consonance infinity infrared inversion irrational ratio just intonation kappa-12 kappa-14 kappa-15 kappa-3 kappa-4 kappa-5 kappa-6 kappa-7 kappa-n keyboard lambdoma Limma logarithmic pitch logarithms lute magic square major third major tone major triad matrix meantone temperament mesolabio microintervals microtones minor sixth minor tone minor triad modal scales monochord multidimensional scaling multiple proportion multiple ratio multiple reflection musica ficta music theory Newton's rings n-tet number triangle octave octave reply octave similarity overtone perfect consonance pitch circle Pitch Circle of Hexachord pitch classes pitch grid Porphyrian tree primary colours prism pulse patterns Pythagoras Pythagorean comma Pythagorean diatonic scale Pythagorean diatonic tone system Pythagorean fifth Pythagorean fourth Pythagorean hammers Pythagorean number system Pythagorean semitone Pythagorean triangle quarter tone quinary Quinte toni contraria rainbow recitum reflector telescope reflexion refraction residual pitch saturation Schisma score semicircle semitone scenario sesquialtera Sesquidecimassima set diagram similar triangles sinusoidal vibration solmization spectral colours sphere spiral square staff string superparticular ratio superposition synthesizer syntonic chromatic scale syntonic comma syntonic diatonic scale syntonic enharmonic tetrachord syntonic intervals syntonic sixths syntonic third syntonic tone system temperament tetrachord tetrahedron timbre timbre space transposition tree diagram triangular number triangular vibration trinity trinity shield tripla Tritonus trumpet marine tuning tuning fork ultraviolet vectors vibration vibration pattern vowels vowel triangle wavelength wave propagation whole tone zodiac

## «counterpoint»

Sound Colour Space - A Virtual Museum

Archive Sets Timeline Keywords Exhibitions Virtual Lab About

back ≡ ■ □

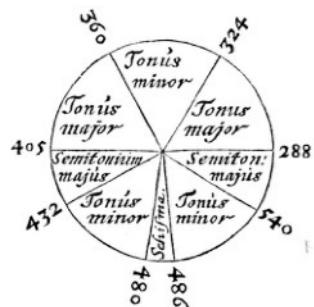
Title / Author	Date	Diagram	Annotation
Counterpoint in two parts Guido of Arezzo	c. 1200		The vowels a, e, i, o, u are assigned to the pitches C, D, E, F, G, cf. [2018]. A short musical example is given, in which the vowels of the text are sung on the related pitch. In order to ...
Counterpoint in two voices (?) Johannes Cotto	c. 1200		
Typus Sceptrologia Musurgica Gaspar Schott	1657		

Daniel Muzzolini: Funktion der Schlagwörter als eine Form des Zugangs zur Sammlung der historischen Diagramme.  
oben: schematische Darstellung  
rechts: Screenshots aus dem Virtuellen Museum

# (Re)präsentationsformen der historischen Diagramme



## Quellen



digitalisierte  
Diagramme  
aus  
historischen  
Traktaten

## Metadaten



Autoren, Titel,  
Datierungen,  
Erscheinungs-  
orte

## Texte



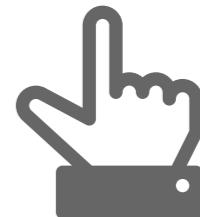
Annotationen,  
Schlagworte,  
Definitionen

## Anordnungen



Bild-Text- und  
Bild-Bild-  
Tableaus,  
lineare  
Rezeption

## Interaktionen



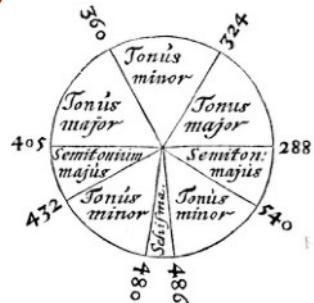
programmierte  
Diagramme,  
interaktive  
Tonsysteme

# An jeweilige Vermittlungsform angepasste Datenorganisation

Zugriff auf verschiedene Repositorien und Ablagen

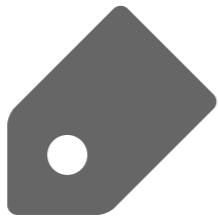


Quellen



digitalisierte  
Diagramme  
aus  
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Metadaten



Autoren, Titel,  
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orte

Texte



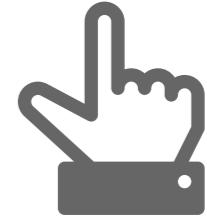
Annotationen,  
Schlagworte,  
Definitionen

Anordnungen



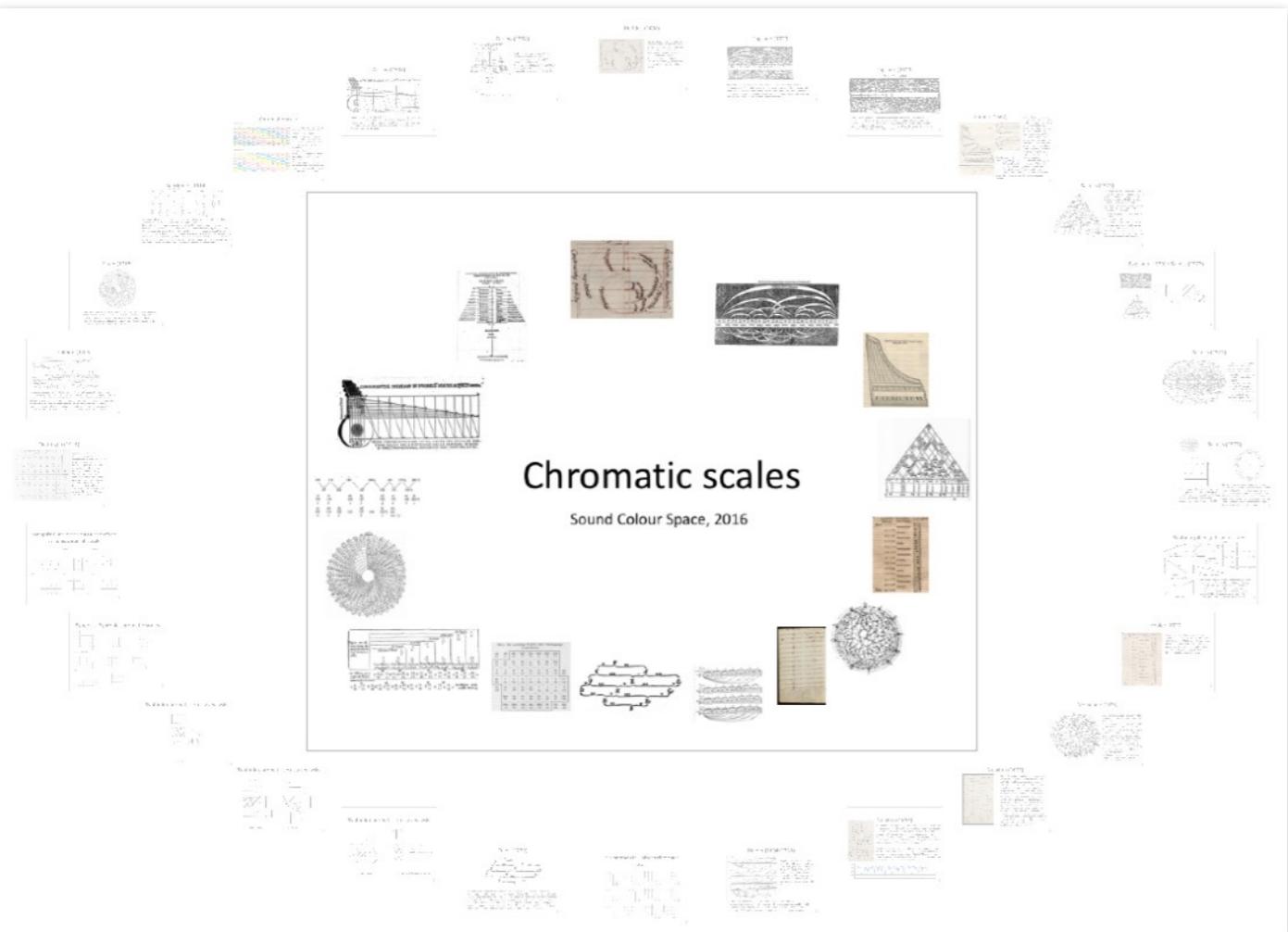
Bild-Text- und  
Bild-Bild-  
Tableaus,  
lineare  
Rezeption

Interaktionen



programmierte  
Diagramme,  
interaktive  
Tonsysteme

# Format der virtuellen Ausstellungen



**Raimund Vogtenhuber:**  
**Bewegbare Anordnungen von**  
**Tableaus und Diagrammen im**  
**Internet-Browser. «Eingespielt»**  
**sind Inhalte von Dirmoser und**  
**Muzzolini.**

Francisco Salinas (1577)

overview  
title  
back  
forward

Chromatic scale of 14 pitch classes per octave. There are two ambiguous pitches D and b. #E should be read as Eb: it is a chromatic semitone (25:24) lower than E. There are five regular chromatic semitones 25:24 and six regular diatonic semitones 16:15, the ratio of f#-g however is 27:25 instead. The scale is a subset of Salina's scale of 24 pitch classes [46]. The larger intervals of the scale are analysed in a triangle, which substitutes Boethius's system of arcs and uses fewer lines to label the same number of relationships. The names of the intervals can be found directly below the point of intersection of the related oblique lines.

Fogliano (1529) / Salinas (1577)

overview  
title  
back  
forward

Manuale de piu varie scienze musicale (1529)  
primo libro de musica

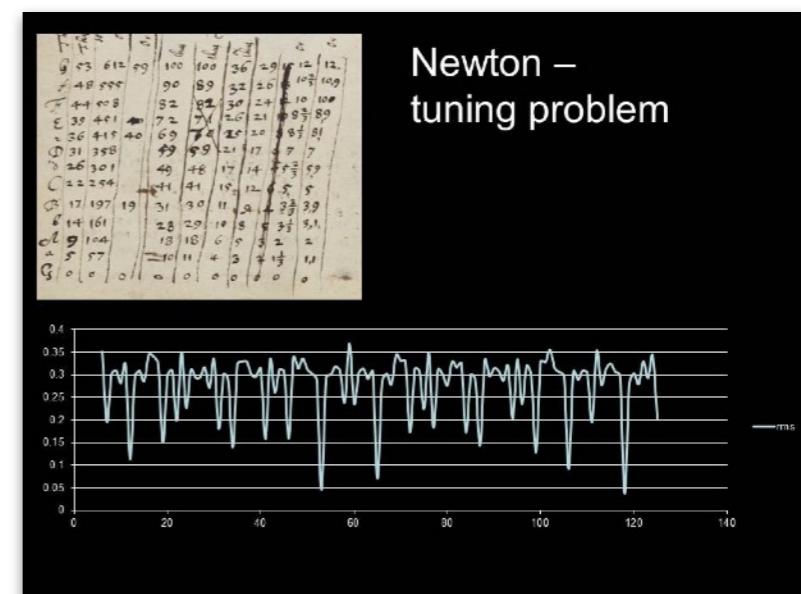
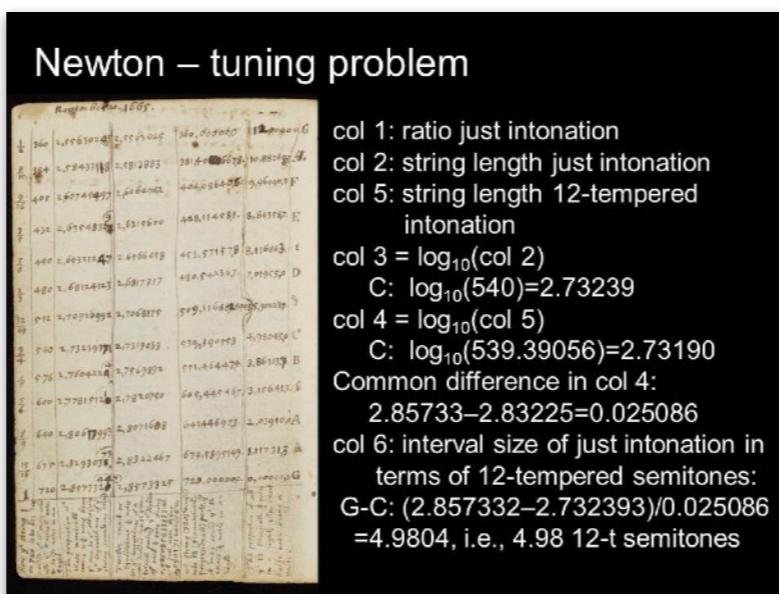
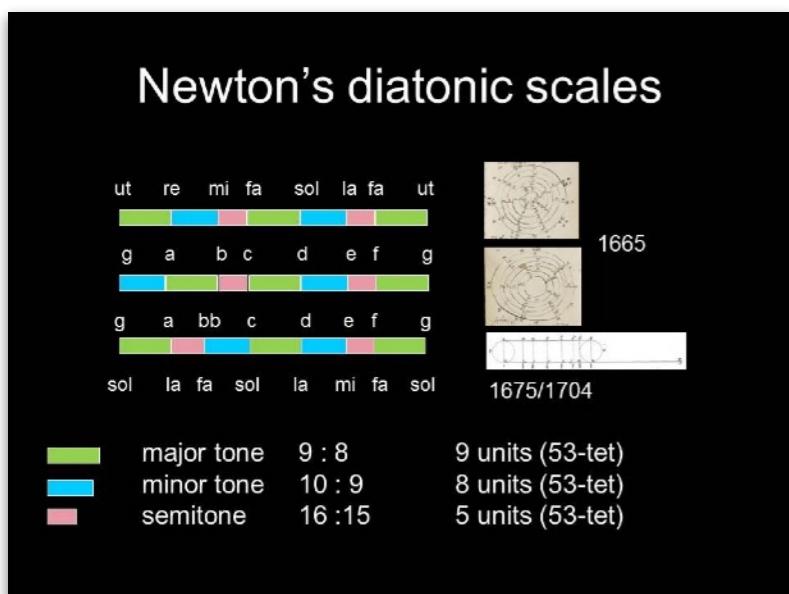
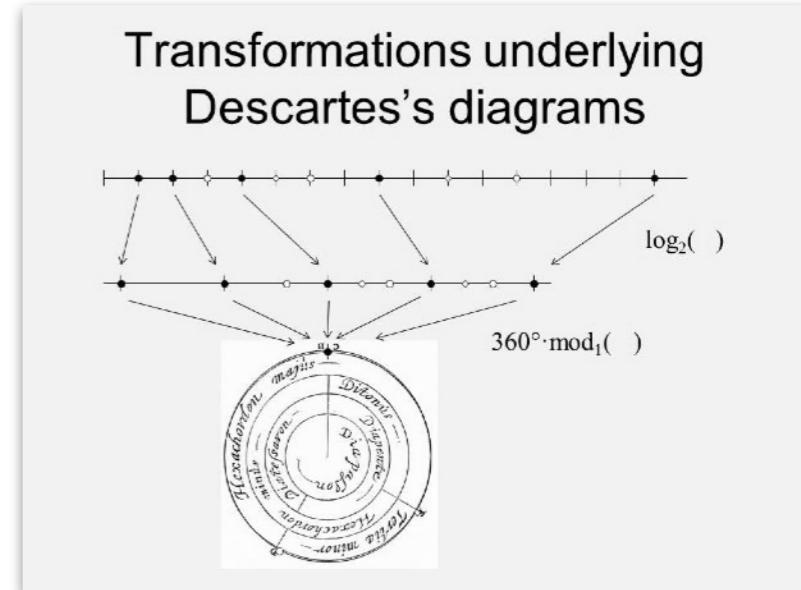
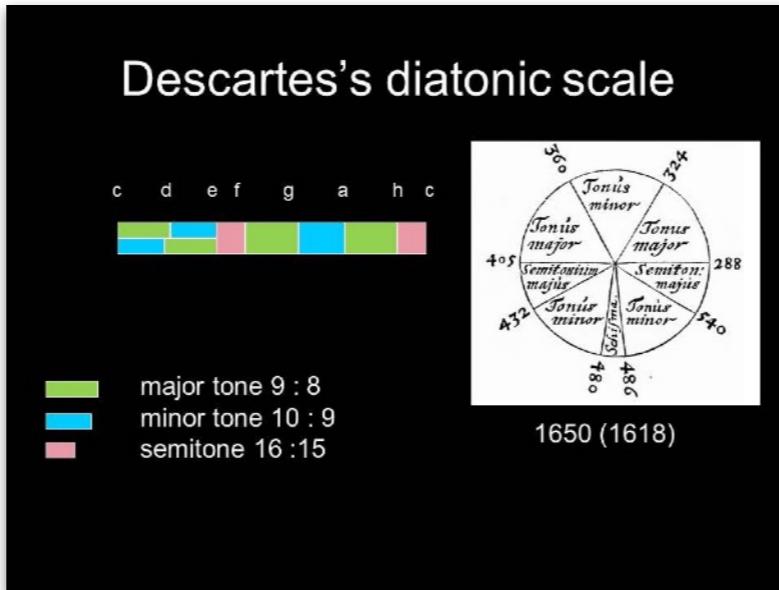
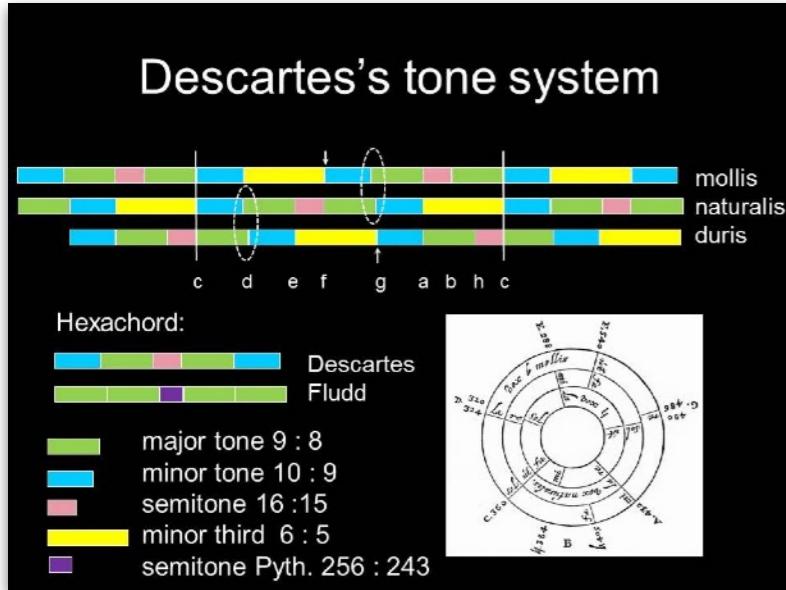
Chromatic scale of 24 pitch classes per octave. The indicated string lengths admit its interpretation in terms of Pythagorean fifths (3:2) and syntonic major thirds (5:4). There are four different pitches for F#/Gb and four different pitches for A#/Bb. In the realisation in the 53-tet tuning the distance between neighboured pitches varies from 1 to 3 units.

Salinas (1577)

overview  
title  
back  
forward

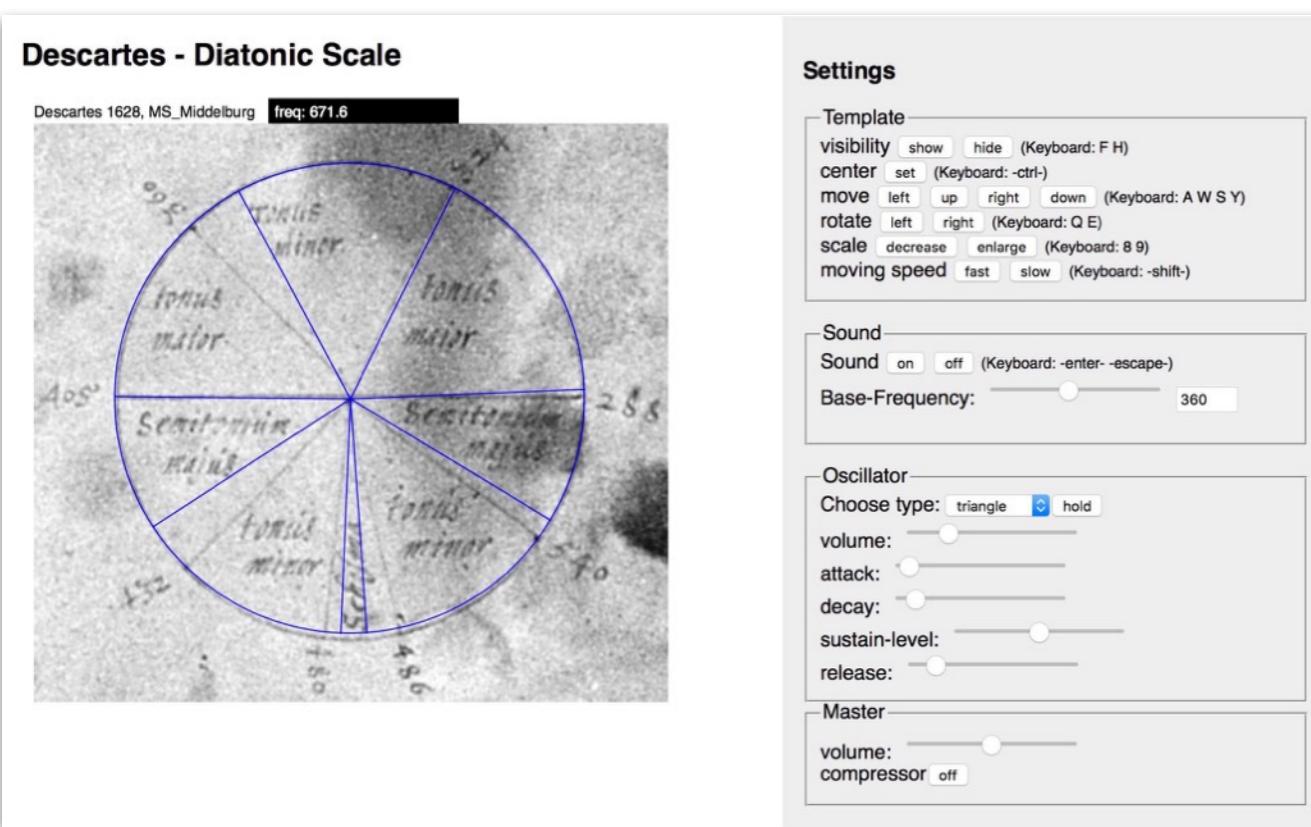
Chromatic scale of 24 pitch classes per octave. The indicated string lengths admit its interpretation in terms of Pythagorean fifths (3:2) and syntonic major thirds (5:4). There are four different pitches for F#/Gb and four different pitches for A#/Bb. In the realisation in the 53-tet tuning the distance between neighboured pitches varies from 1 to 3 units.

# Exponate in virtuellen Ausstellungen

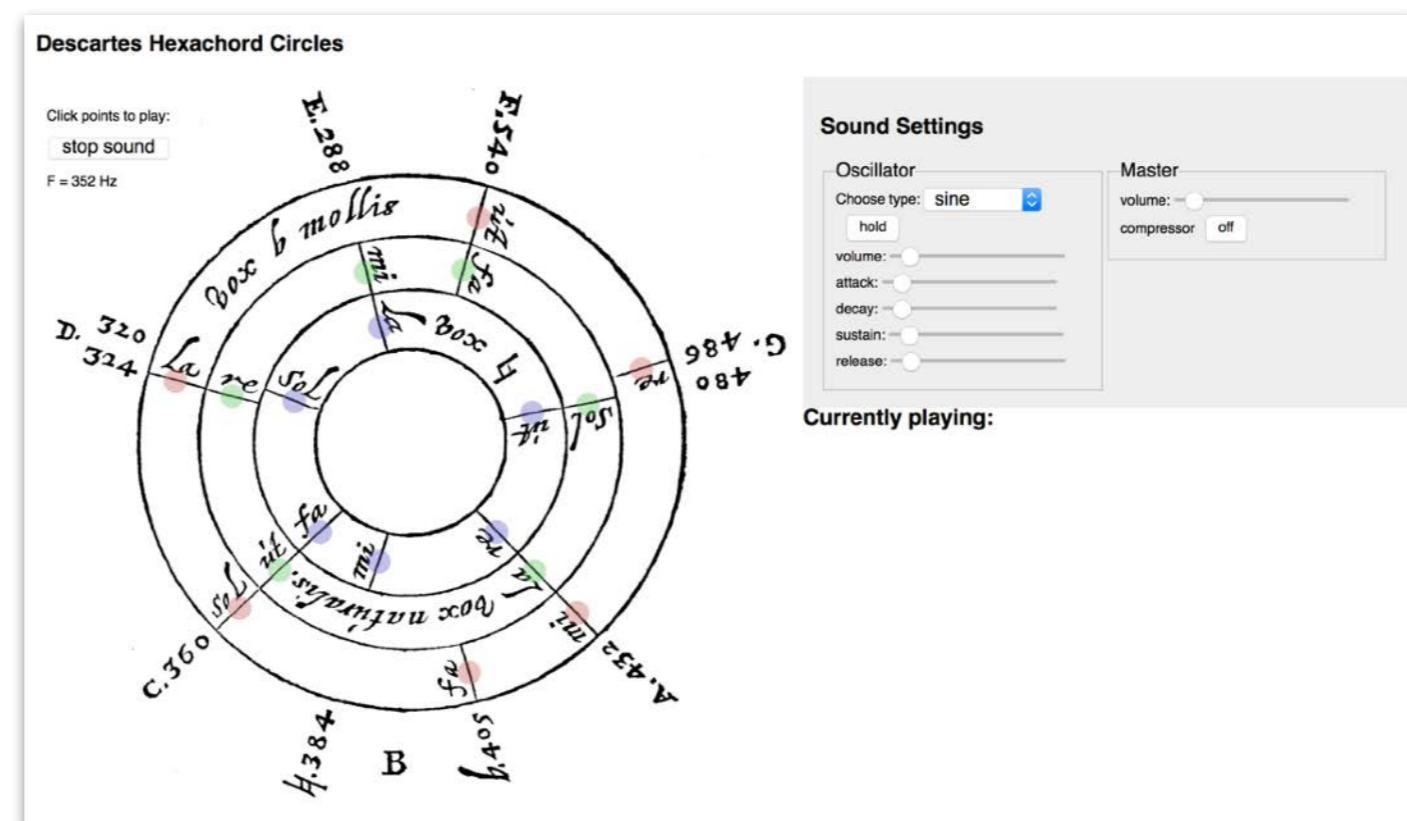


Daniel Muzzolini: Erläuterung der Themen der einzelnen Diagrammen mit Hilfe von eigenen Diagrammen oder Notationen

# Sonifikation der historischen Diagramme

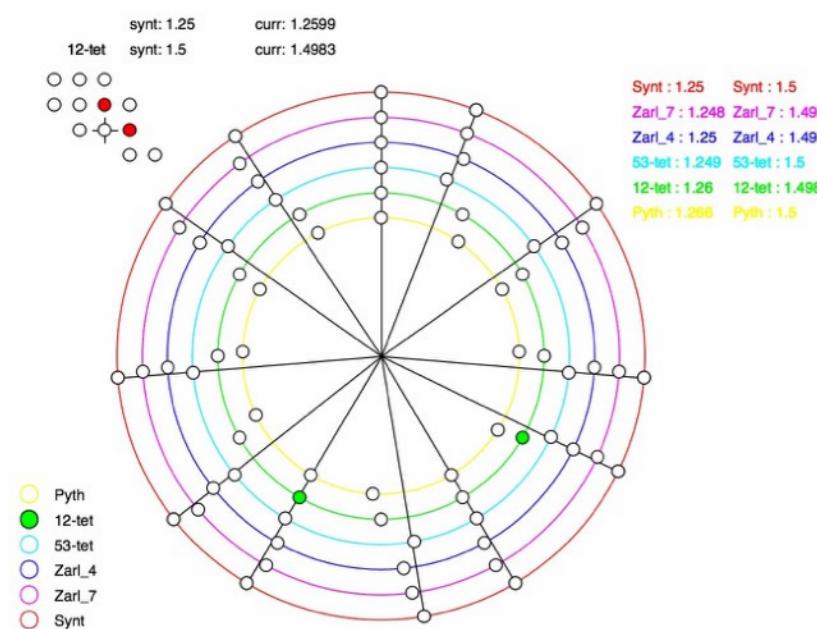


# Daniel Muzzolini: Mathematische Rekonstruktion der diatonischen Skala bei Descartes. Interaktives Vergleichen mit den historischen Diagrammen und hörbar Machen der Theorie.



# Rendering von interaktiven Diagrammen

Pitch-Diagram



Sound Settings

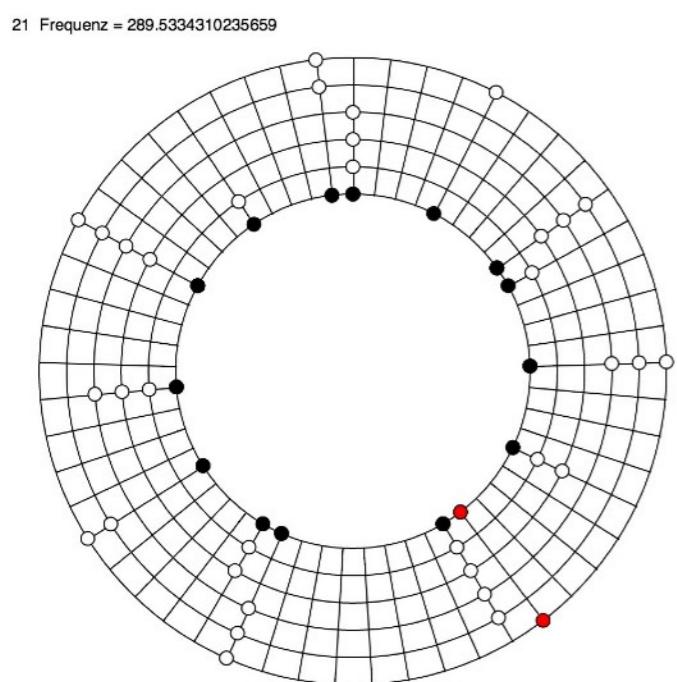
Please enter the Base-Frequency:

220 set

Oscillator  
Choose type: triangle hold  
volume:  
attack:  
decay:  
sustain-level:  
release:  
Master  
volume:  
compressor off

Daniel Muzzolini: Interaktive Pitch Diagramme berechnen verschiedene historische Tonhöhensysteme und machen deren Tonschritte hör- und sogar vergleichbar.

Pitch-Diagram



Sound Settings

Please enter the Base-Frequency:

220 set

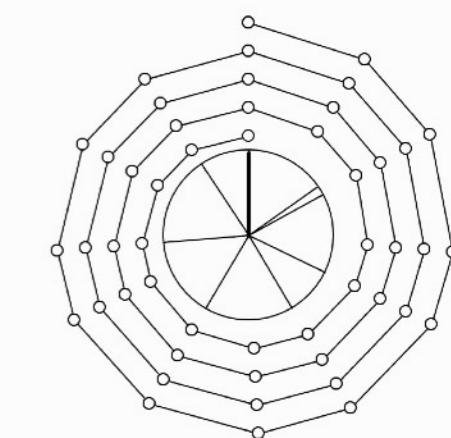
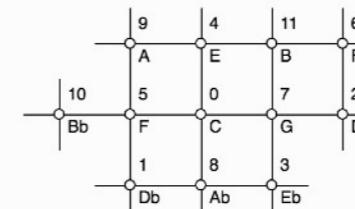
Oscillator  
Choose type: triangle hold  
volume:  
attack:  
decay:  
sustain-level:  
release:  
Master  
volume:  
compressor off

Pitch-Diagram

Mersenne 1

single tone

JSB: 0 +



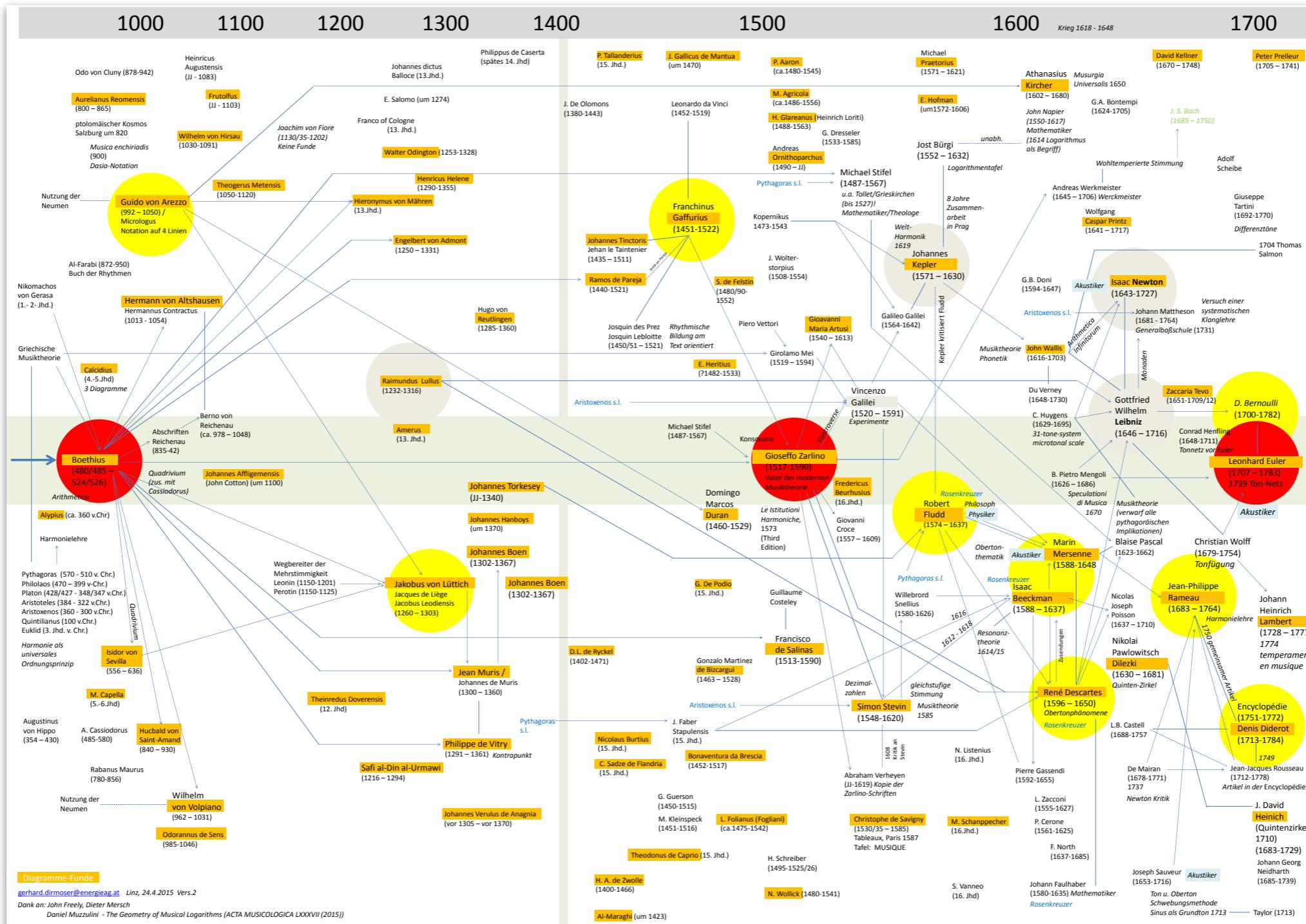
Sound Settings

Please enter the Base-Frequency:

220 set

# Entwicklungslienien und Bezüge verstehen

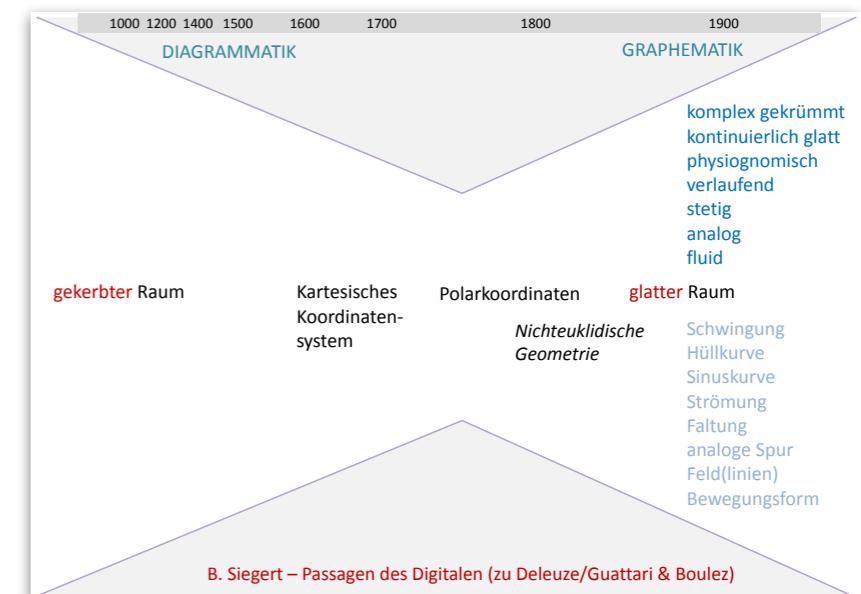
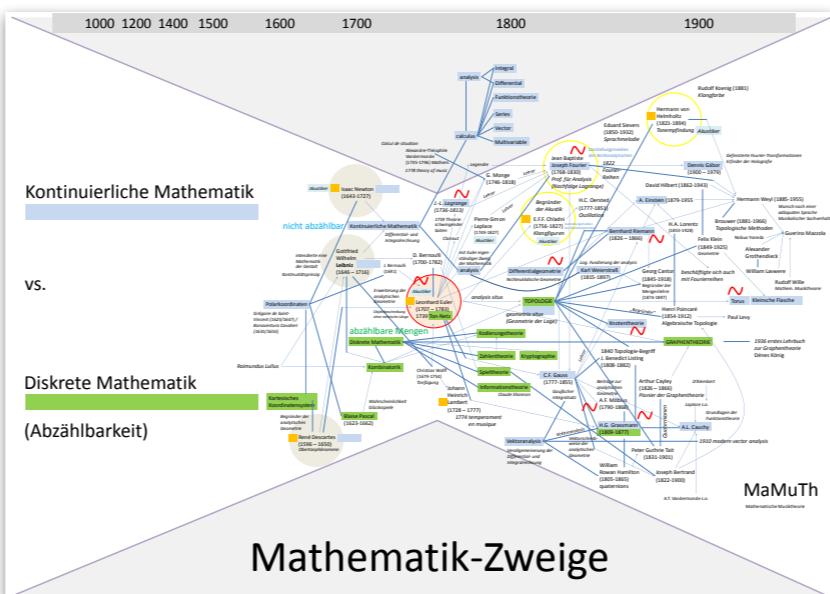
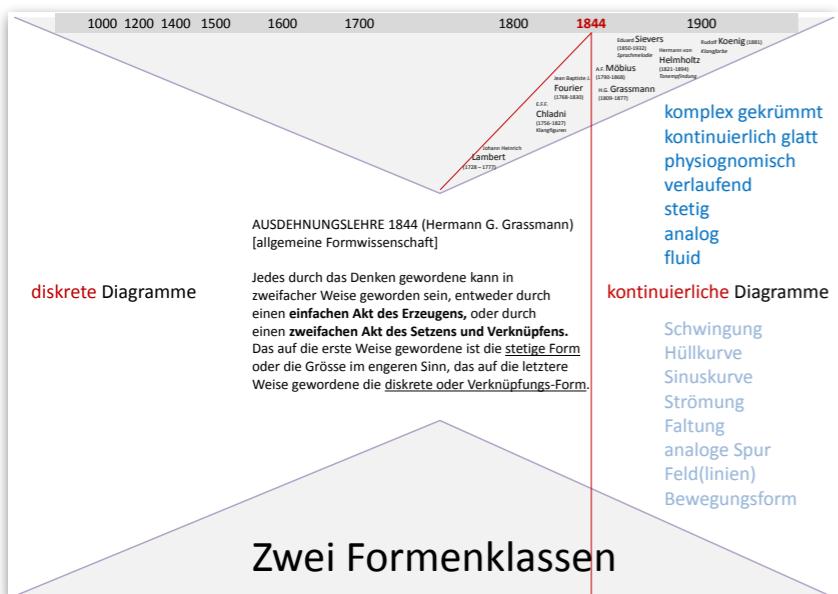
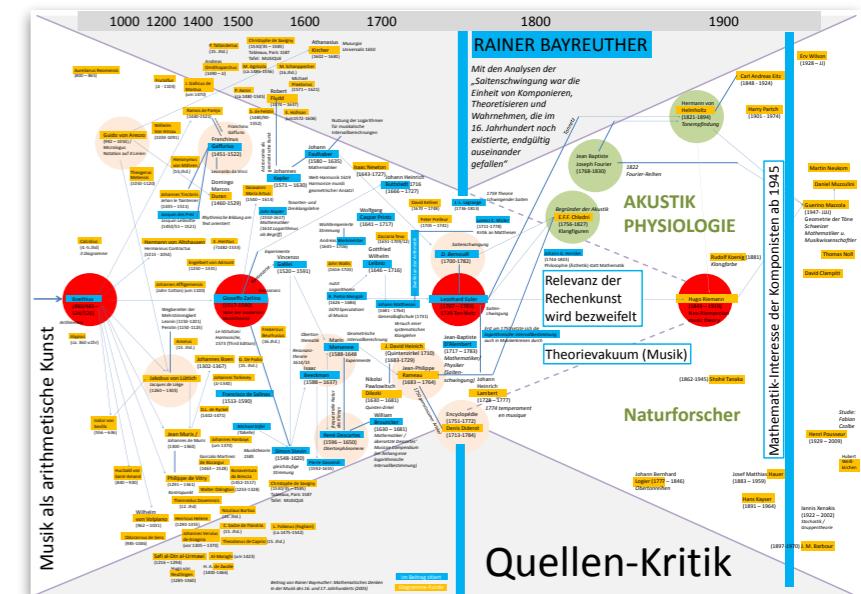
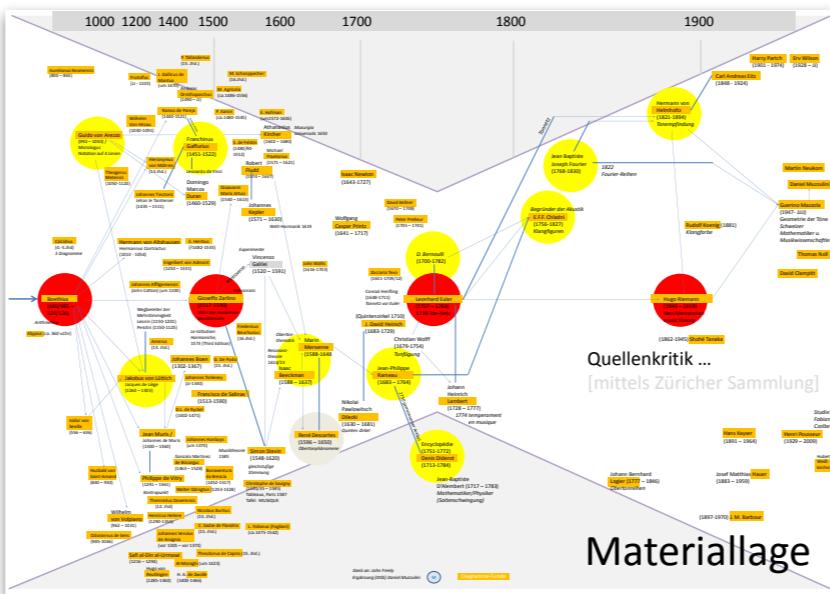
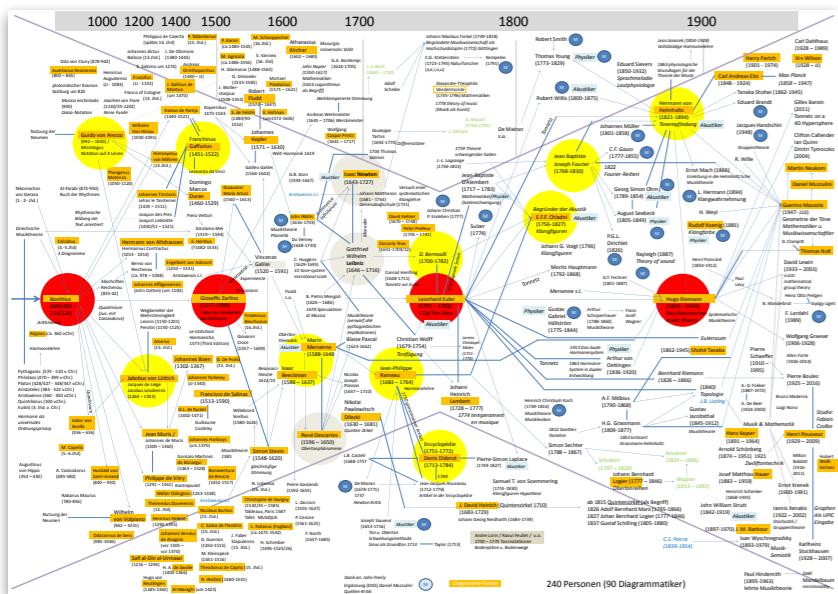
Zeitstrahl mit Einordnung der wichtigen Autoren



Gerhard Dirmoser: Graphischer Überblick zu Personen aus der Geschichte der Musikdiagrammatologie und ihre Beziehungen untereinander

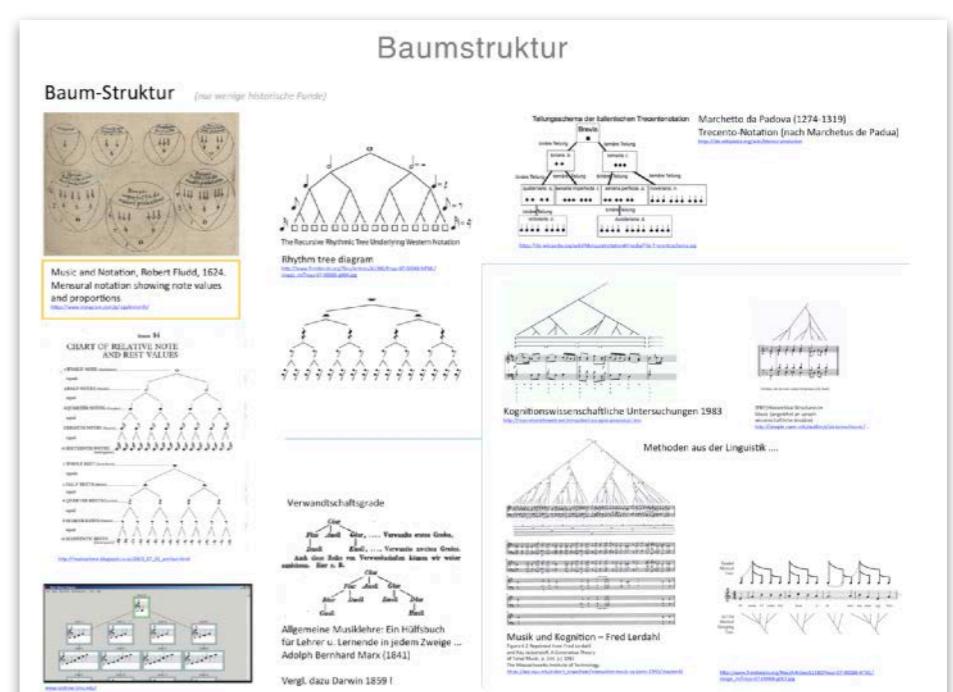
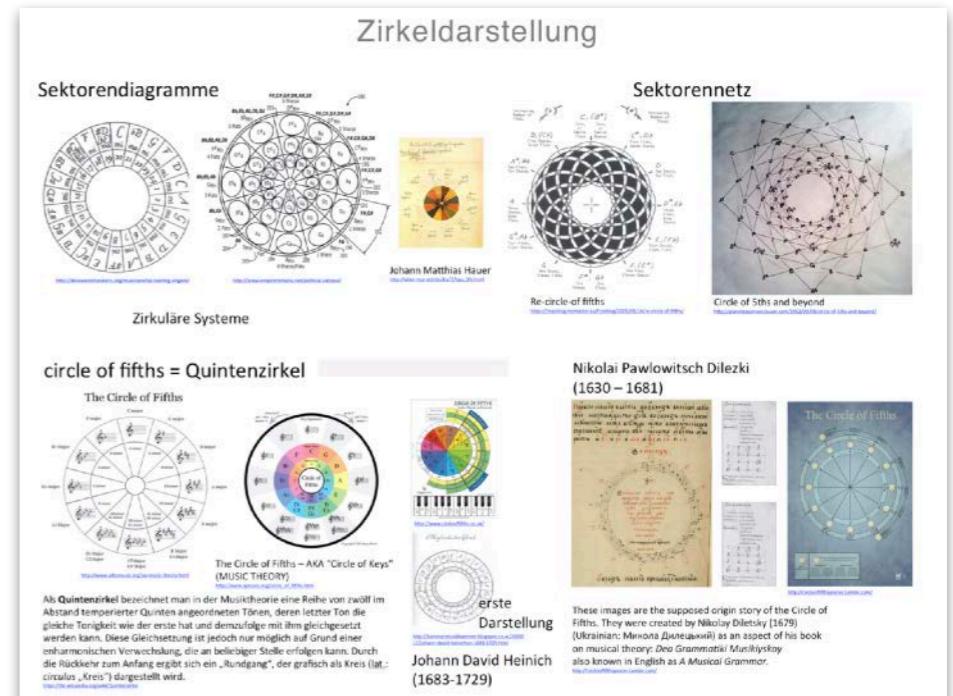
# Daten nach verschiedenen Gesichtspunkten analysieren

Zeitstrahl mit Einordnung der wichtigen Autoren



**Gerhard Dirmoser: Sichtbar Machen von Aspekten der Geschichte der Musikdiagrammatologie**

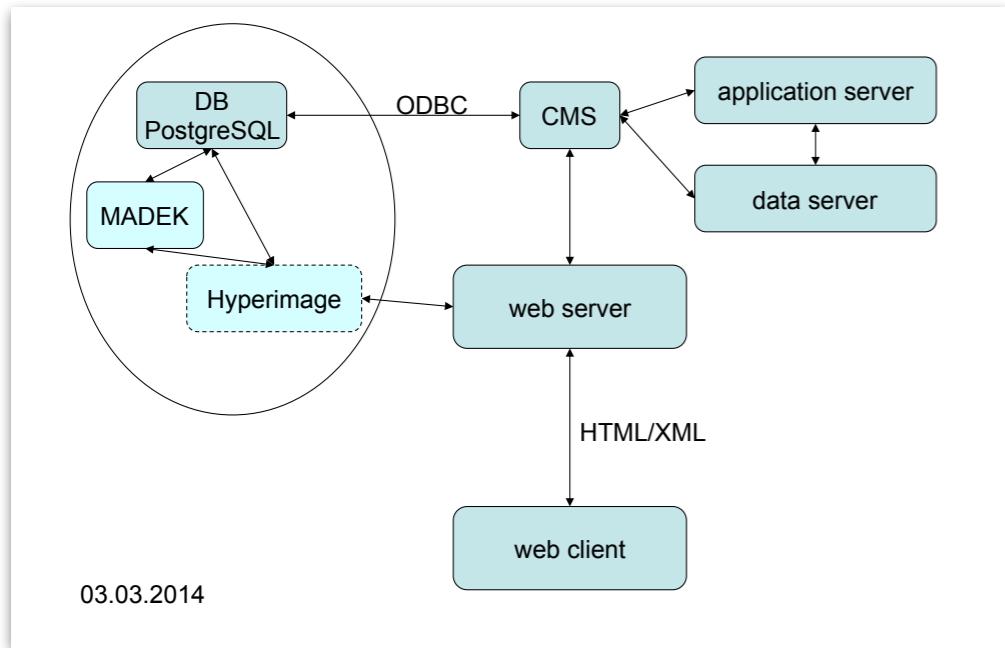
# Anordnungen der Quellen zu grossen Tabeleaus



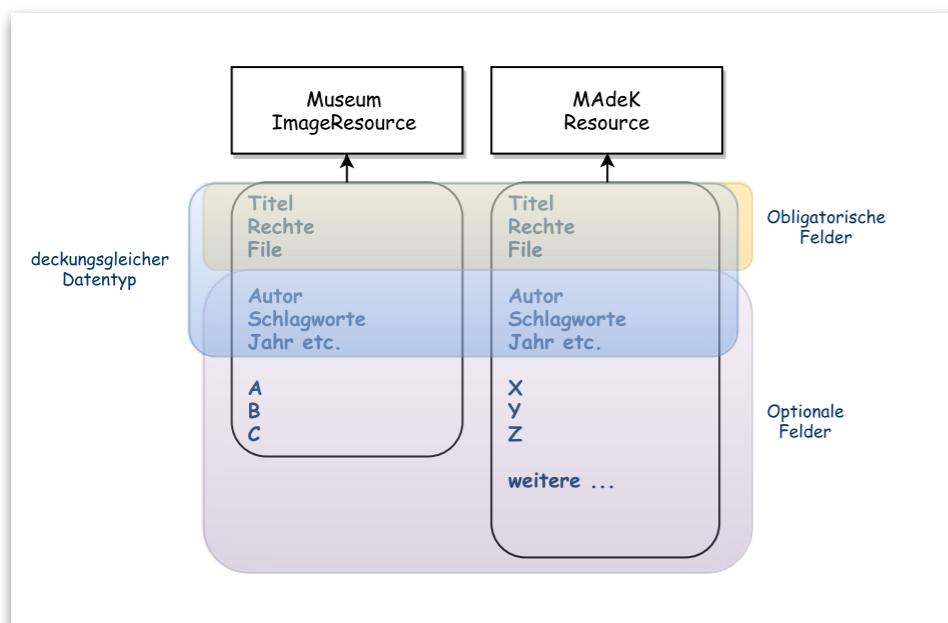
**Gerhard Dirmoser: Darstellungsformen vergleichen und Themen identifizieren**

# Zusammenspiel der Systeme

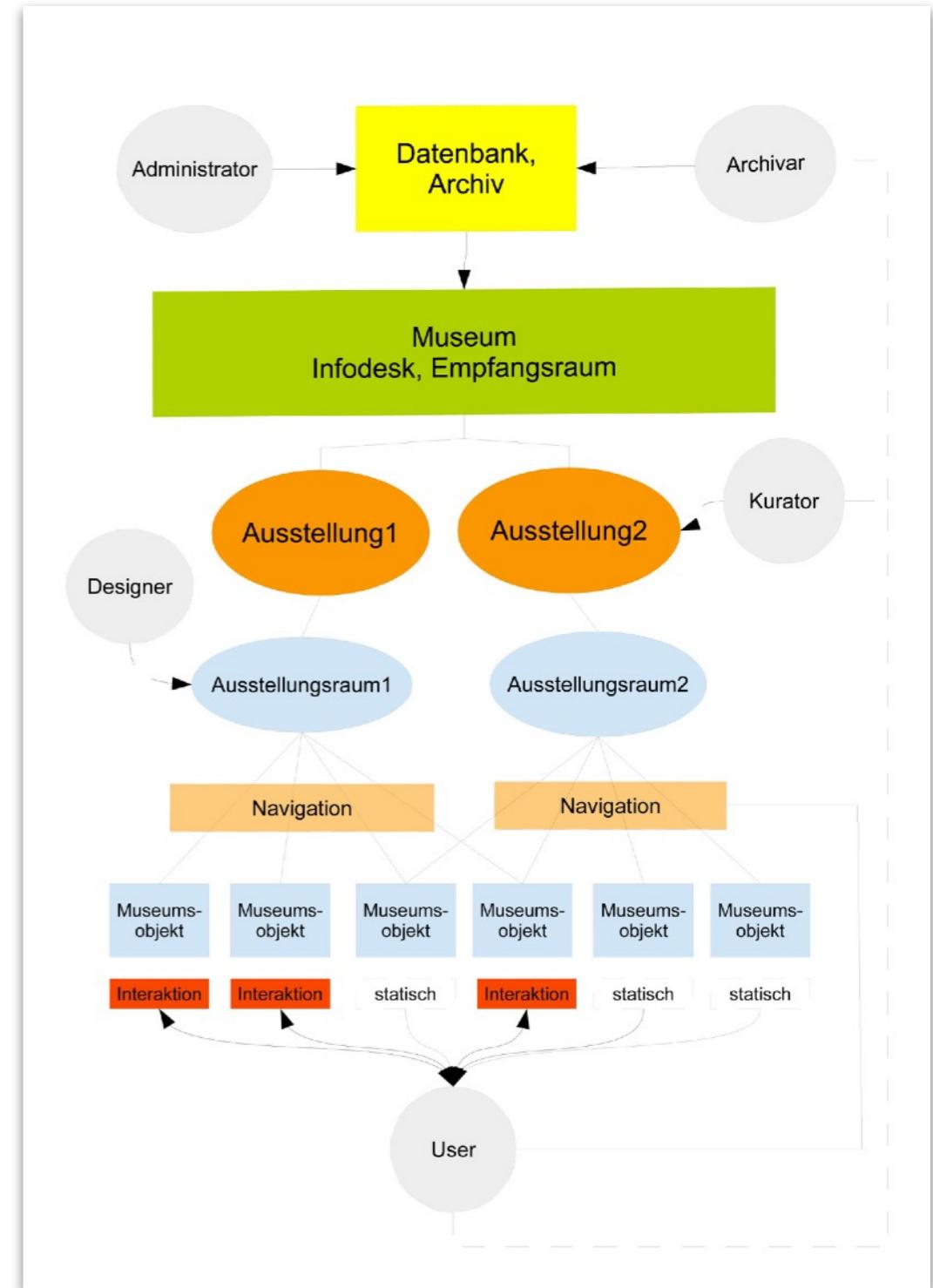
Auf der Seite der Datenorganisation und auf der Seite der Nutzer



Daniel Muzzolini: Überlegungen zur Software-Architektur



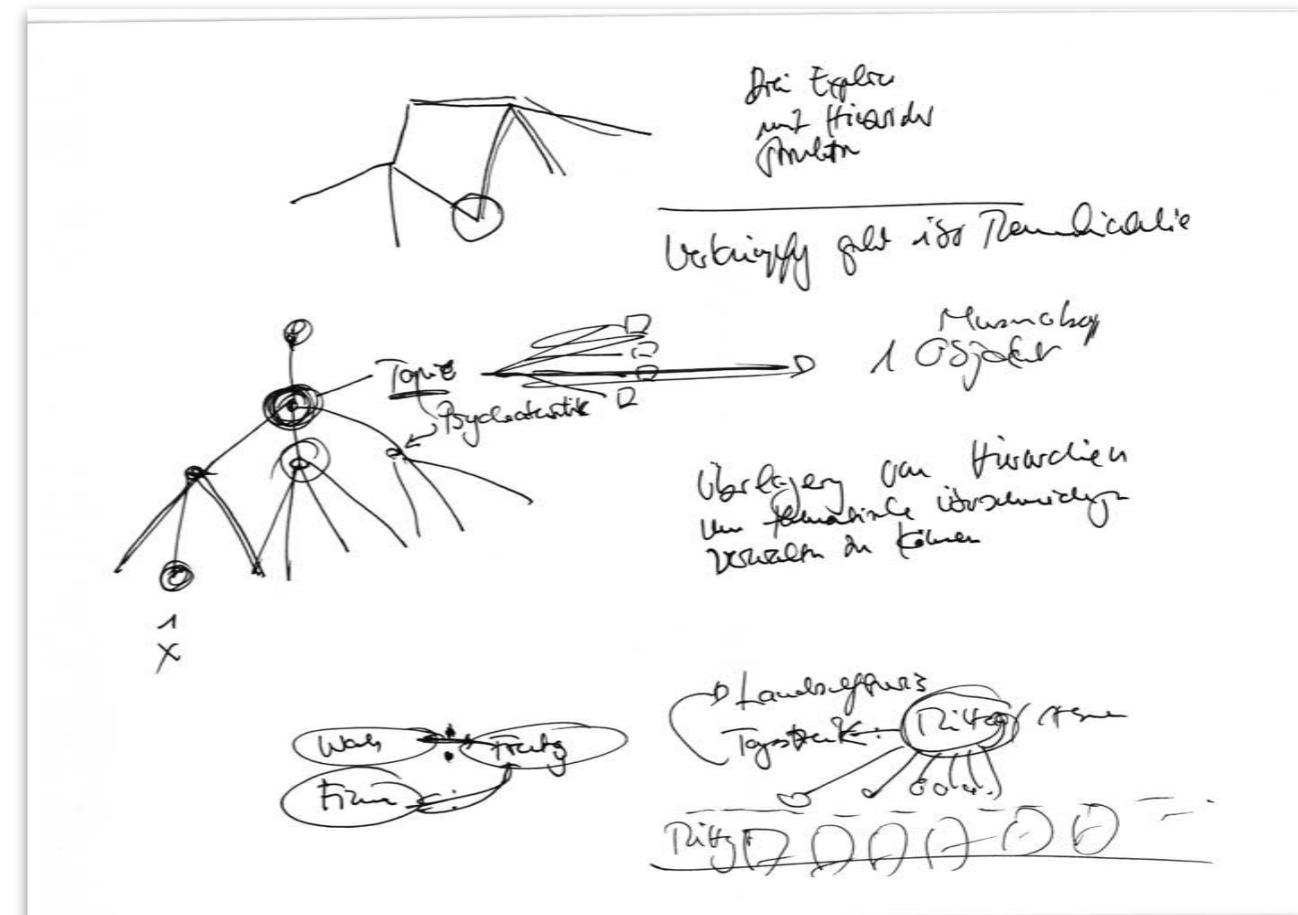
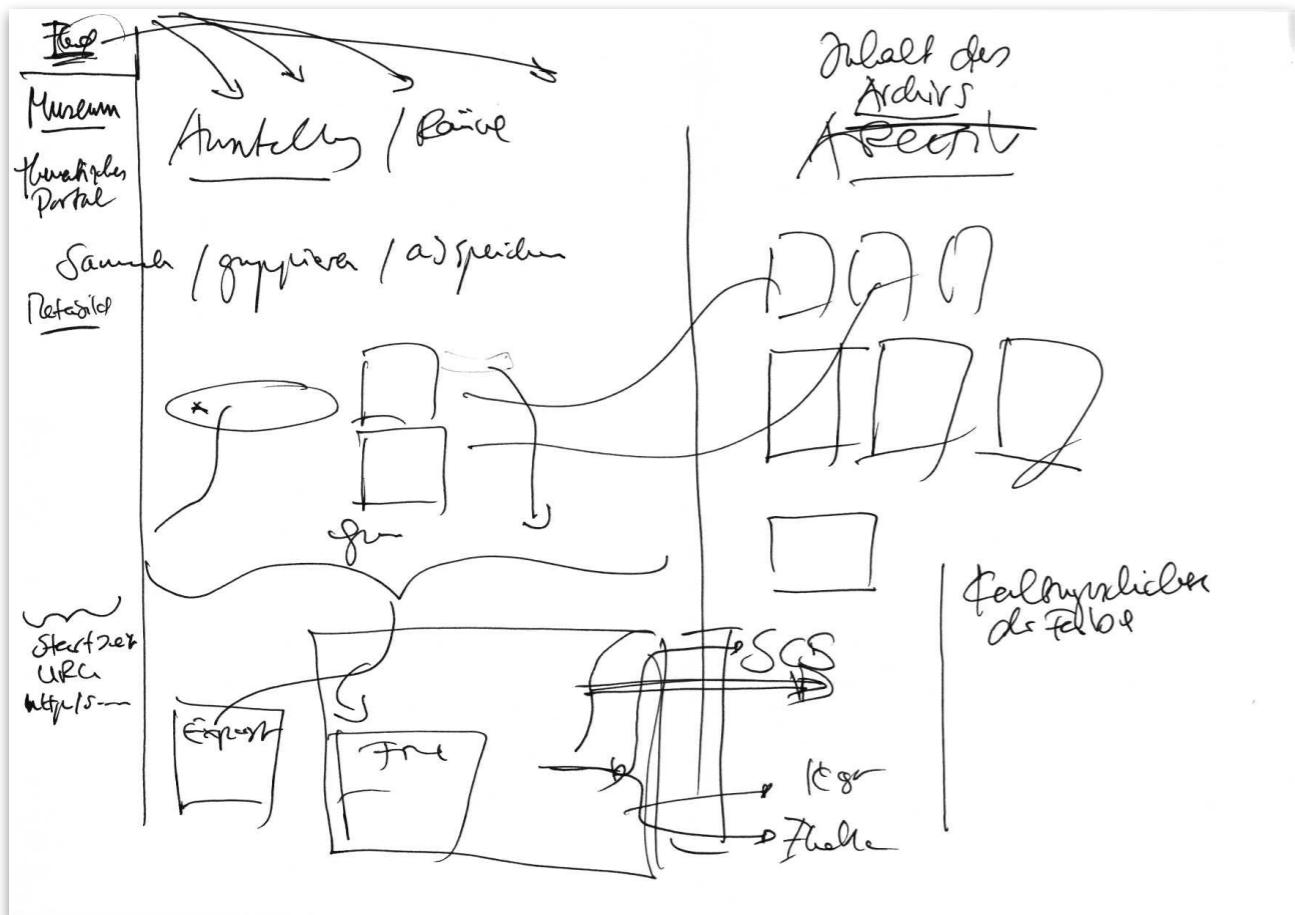
Christoph Stähli: Zusammenspiel der Datenquellen



Raimund Vogtenhuber: Funktionsdiagramm des Virtuellen Museums

# Beziehungen zwischen Datenmodell und Vermittlungsformen

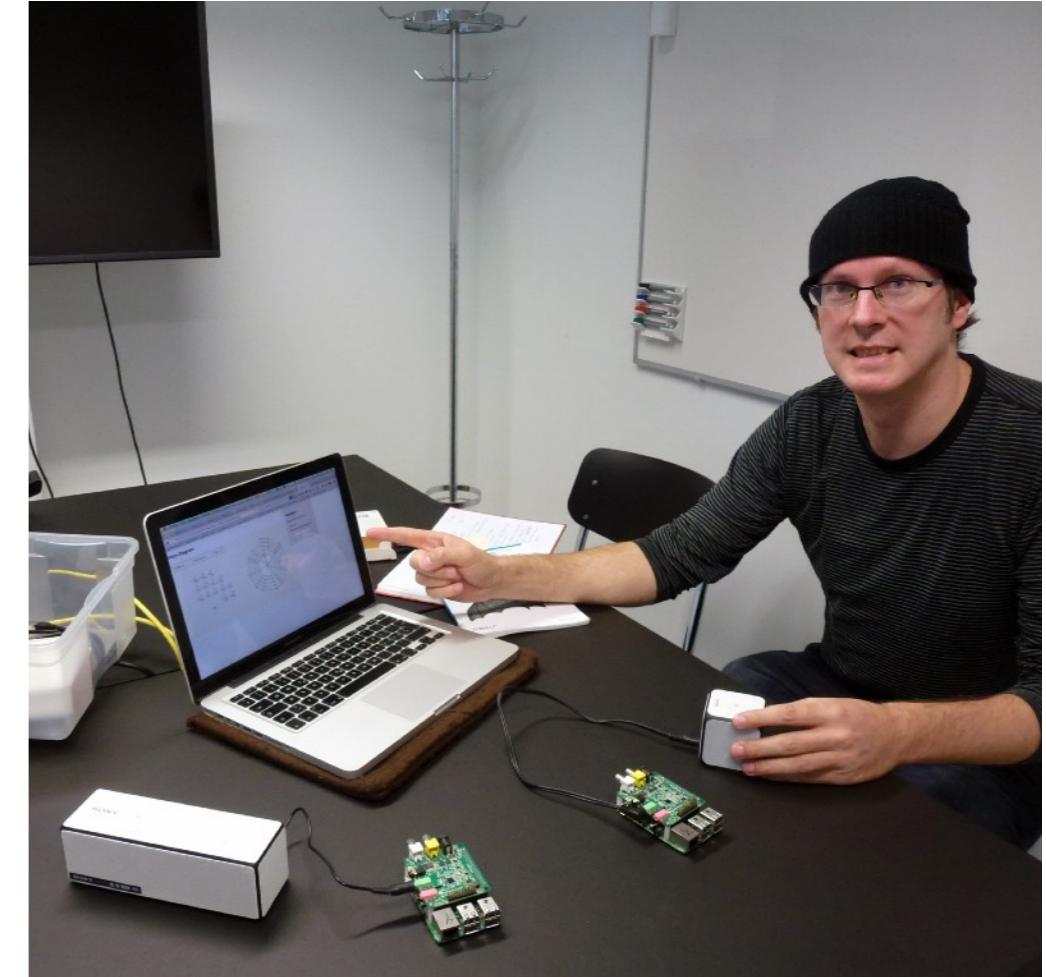
Wechselseitige Abhängigkeit – schrittweise Annäherung



Susanne Schumacher: «Mitzeichnungen» bei Gesprächen zu Konzept und Modell des Virtuellen Museums

# Denken und Verstehen beim «Diagraphieren»

Diagramme zeichnen, basteln, erklären, programmieren, künstlerisch interpretieren



Jeroen Visser und Raimund Vogtenhuber

