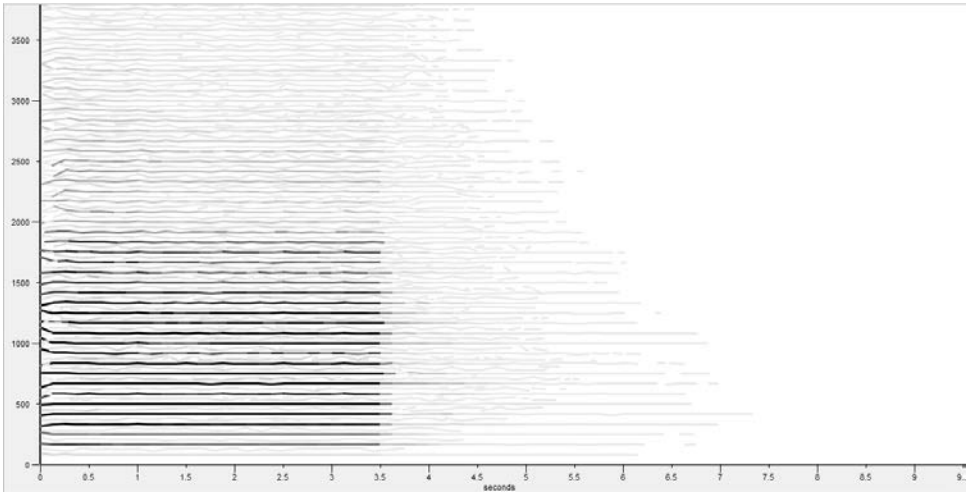
Spectralism

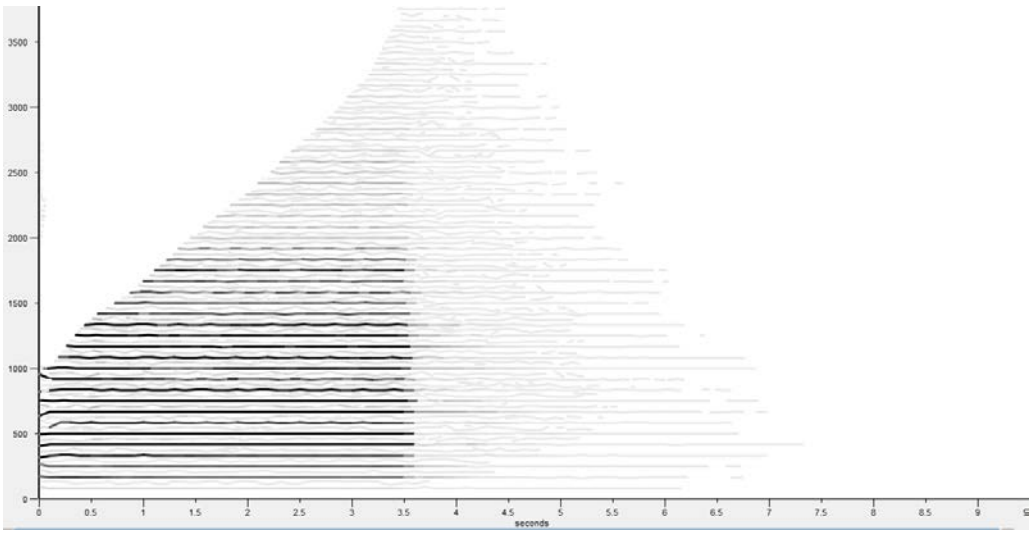
- Coined by Hugues Dufourt in an article published in the 1979.
- ***[Octave sensitive microtonal music]***
- When creating a harmonic language, taking sound and its **physical (scientific)** attributes as the most important parameter in music.
- What defines a particular sound?
- **The spectrum:** many vibrating frequencies that participate in the making of a particular sound.
- When they are initiated in **time**.
- The **amplitude** and **phase** (volume) of their initiation and following existence.
- Founded as *Group L'Itinéraire* in 1973, as a reaction against serialism which had been dominating the music scene for about two decades.
- Gérard Grisey , Tristan Murail, Hugues Dufourt, Roger Tessier, Michaël Levinas.
- Main Objectives:
    - Development of a new musical language based on **scientific knowledge** about **acoustics** and the **psychology of perception** (technological approach)
    - **Skepticism** about **extrinsic** construction models (critique of serialism)
    - Emphasis on the central importance of **sound/timbre** as a shifting (living) **organism** (naturalistic approach)
    - Establishment of **pitch hierarchies** in which properties from the **overtone series** serve as the main point of reference.
- Murail has often cited the music of figures like Ligeti and Xenakis as more important in the development of his own thought thanthe music of Boulez or Barraque. Cage or Stockhausen (even though the latter's Stimmung (1968) may be considered essentially a spectral work).
- Sometimes an interplay between harmonicity and inharmonicity; on the one hand we have harmonic material that is congruent, more or less in accord with the natural overtone series, and on the other hand harmonic material that is less in accord with the natural series.
- 'Harmonic' spectra has no priority over 'inharmonic' spectra, which by all means also has **musical potential.**

Imitating/simulating the spectral envelope of a basic sound (harmonic)

- The spectral envelope of a low E.
- The partials appear as sin waves, a result of **Fourier analysis**.
- Individual instruments behave as sin waves and thus they simulate a harmonic sound.



- The spectral envelope of a low E, where low frequencies dominate at first, and then higher and higher partials get incorporated ***[a less realistic rendition, Haas]***



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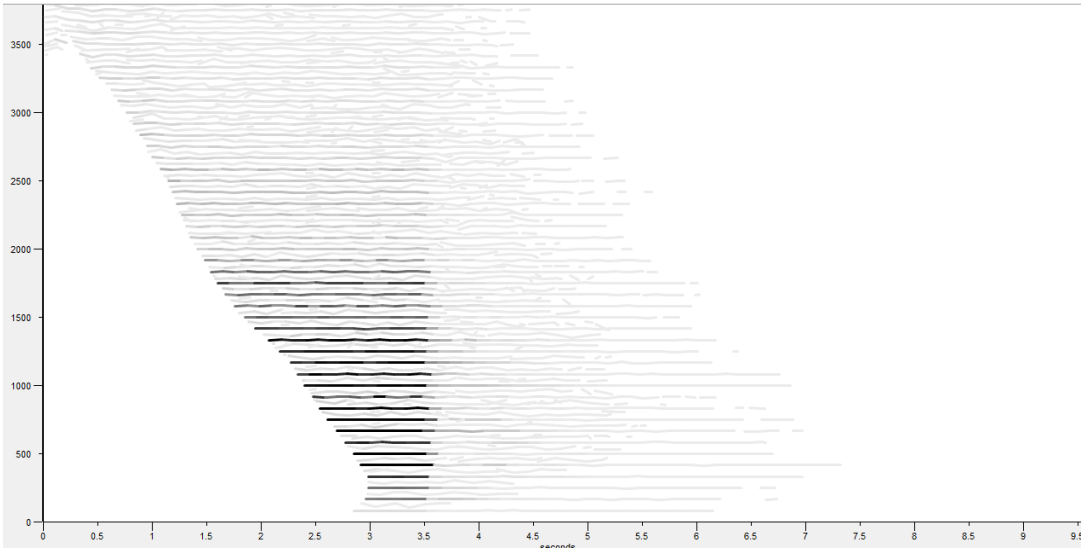
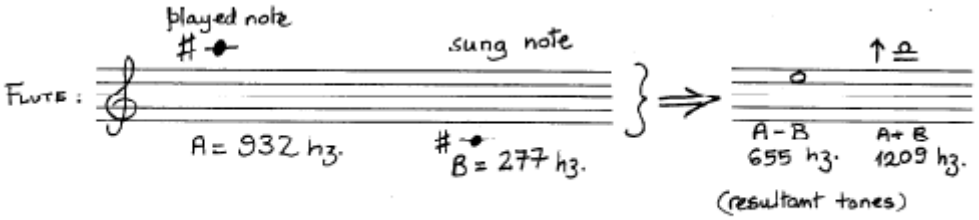


Overtone Series

- Per Norgard, *Voyage into the Golden Screen*
- First so called spectral piece.
- Makes use of the overtone series based on two fundamentals: G and Ab

Amplitude Modulation (inharmonic)

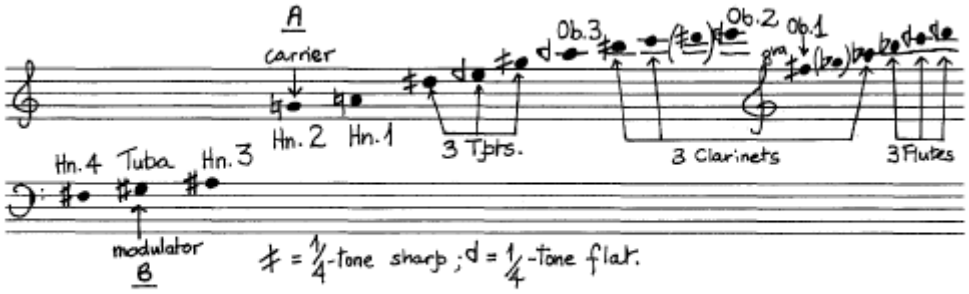
- ***[Tristan Murail, almost Debussian in sound]***
- ***[A representative of a more inharmonic sound world]***
- A process whereby a modulator oscillator is allowed to **transform the amplitude of a carrier oscillator.**
- The interaction of two pitches (oscillators) creates sidebands **at the sum and difference of frequencies (**C+M and C-M).
- Below is an excerpt taken from Tristan Murail's *Ethers* (1978). ***[Early]***
- The flautist plays a note, at 932 Hz (A#) (treated as the carrier), and sings another one at 277 Hz (C#) (treated as a modulator) **simultaneously.**
- The following pitches are created as a result C+M = 1209 Hz and C-M = 655Hz.
- These four pitches make up for the pitch organization of the first 30 or so bars.



EX 1: HARMONIC MATERIAL FOR BARS 1-33 OF *ETHERS*

Frequency Modulation (inharmonic)

- A process whereby a modulator oscillator is allowed to **transform the frequency of a carrier oscillator.**
- The interaction of two pitches (oscillators) creates sidebands **at the sum and difference of frequencies (**A+B and A-B) as well as those at integer multiples of the modulating oscillator's frequency (A+2B, A-2B, A+3B, A-3B…etc).
- The following is an excerpt is taken from Tristan Murail's *Gondwana* (1980).



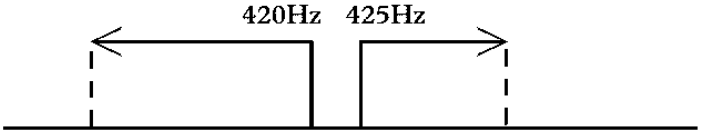
EX.3: OPENING SPECTRUM OF MURAIL'S *GONDWANA* (B.3) – notes in brackets are

- The interactions between two pitches a minor 9th apart, emulating a carrier oscillator at a steady frequency (G4, Horn 2) and a modulator oscillator (G#3, Tuba). Many alien sidebands are produced at the sum and difference frequencies, including sums and differences of the carrier oscillator and the integer multiples of the modulator oscillator). (Fc+Fm, Fc-Fm, Fc+2Fm, Fc-2Fm…)
- All of these sidebands are played/synthesized by the other instruments. The resulting sound is very inharmonic (removed from the natural series), because **the ratio of frequencies between the carrier and the modulator is not a whole number**. As music progresses, harmonicity is achieved.

Bandwidth Manipulation

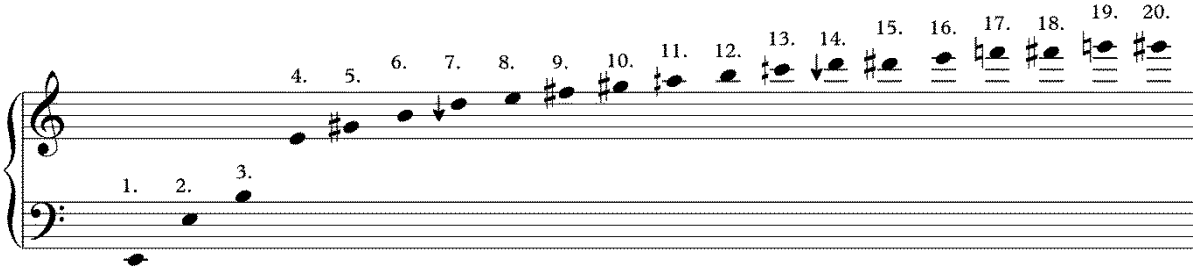
- James Tenney's Critical Band (1988)
- A process whereby a very small range of close frequencies are allowed to sound/pass through the bandwidth.
- At this stage, inharmonicity dominates with lots of beating patterns between close frequencies

- Gradually, the bandwidth opens up to extend the range of possible frequencies; more and more frequencies are allowed to sound.
- An addition to this, pitch/frequency material strives to become more and more harmonic.

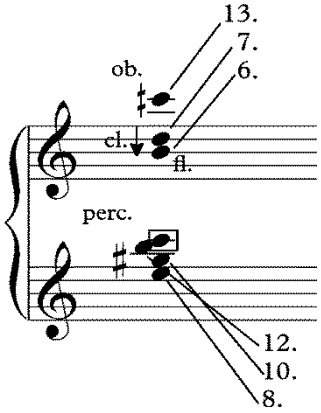


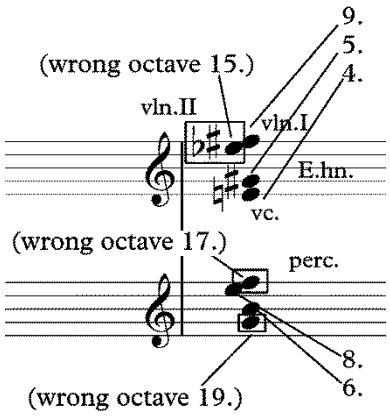
Grisey' *Partiels* (1975)

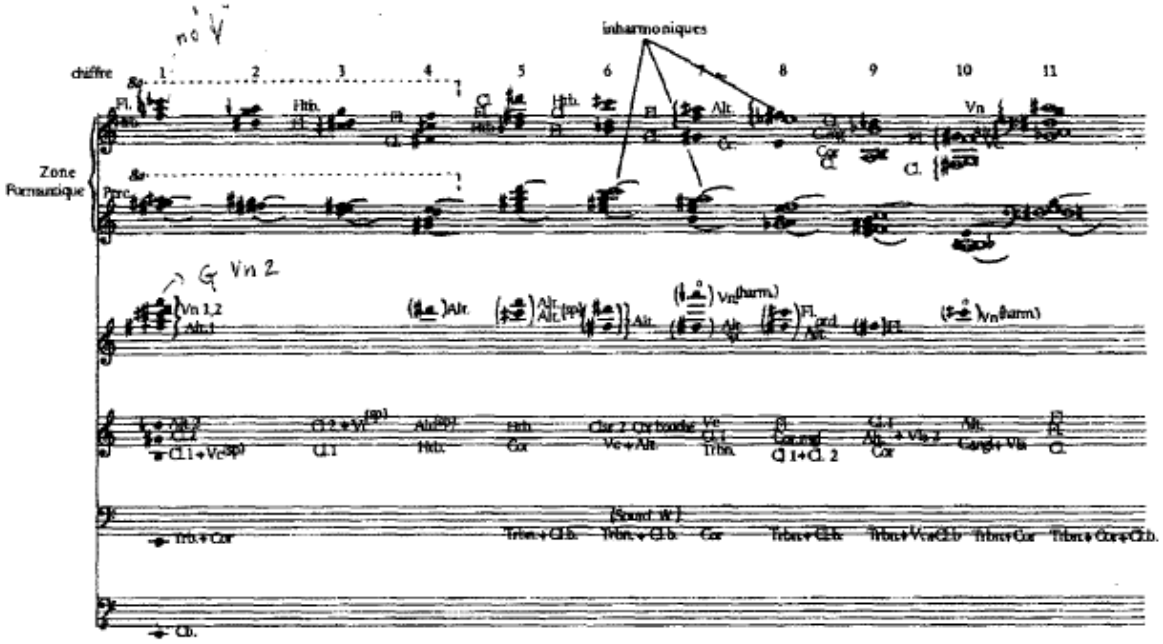
- 'We are musicians and our model is sound, not literature; sound, not mathematics; sound, not theatre, or the plastic arts, or quantum physics, or geology, astrology or acupuncture!'
- Begins with the instrumental synthesis of a low trombone E2.
- The instruments act **almost like sine waves, and they simulate this spectrum.**
- Is the low trombone E the tonic?
- Seems more like the harmonious E spectrum, taken as a sound unit, is the tonic.
- Relatively harmonic sonority and ends with noise of a paper crumpling.
- A rather organic approach to form, where the transformation can be defined as a smooth process.



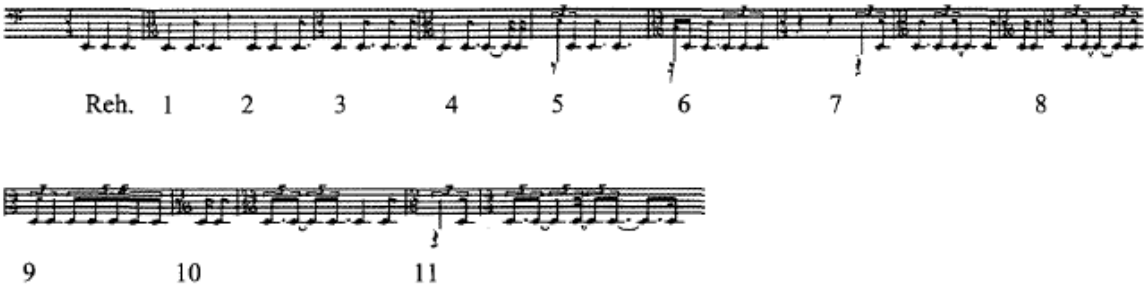
- Initially we have a '**harmonic' simulation of the spectrum,** where all instruments are assigned to some frequency encountered in the overtone series of E2 trombone sound.
- However, by rehearsal 6, more and more **inharmonic frequencies** make their ways into the texture, such as C natural, which is nowhere even to be found within the natural overtone series of E2.
- The both Eb and the F natural can actually be found within the spectrum, but they are in the wrong octave:



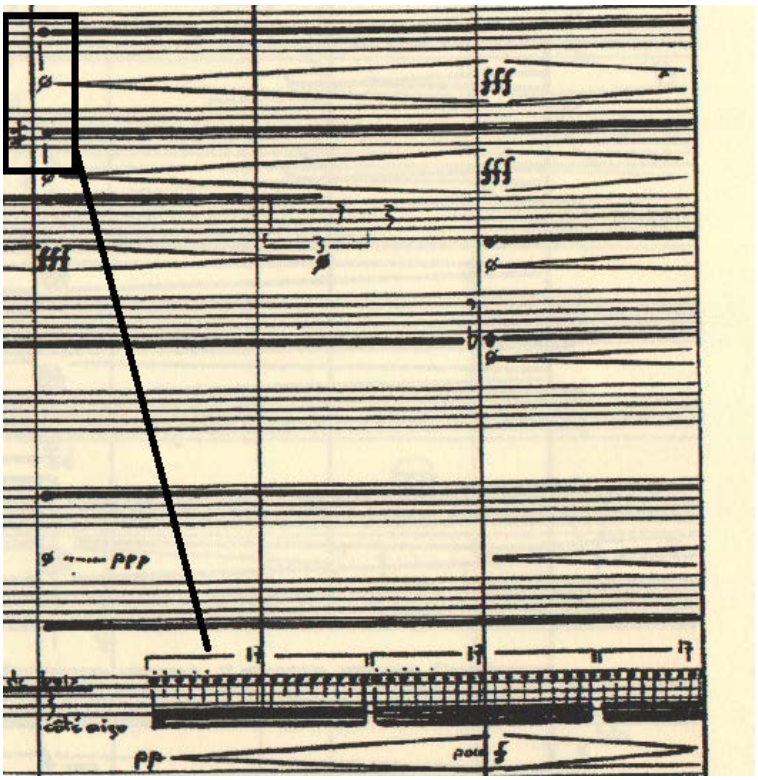




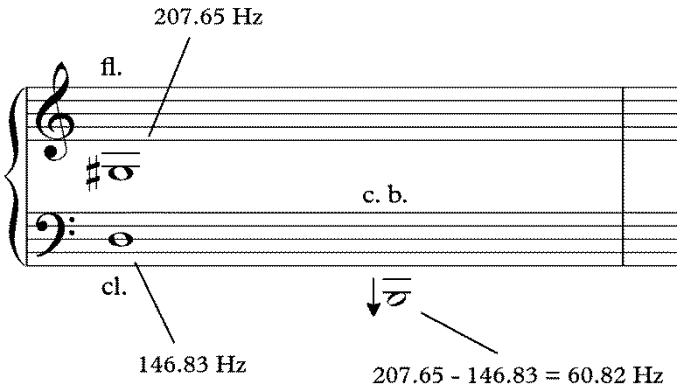
- In terms of the rhythmical initiation of the low E, the piece begins with a rather periodic configuration, where initiations are equally distributed metrically.
- However, as the piece progresses, these initiations become more and more irregular metrically:



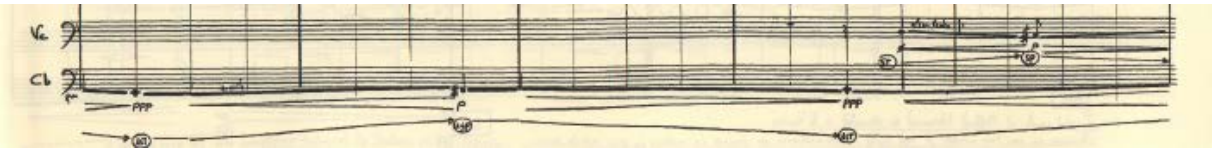
- Ring modulation, difference frequencies.
- At first we have frequency differences that are very tiny. These result in beating patters that are simulated by other instruments.
- 147 Hz – 135 Hz = 12 Hz; 12 beats per second.
- Right now the quarter note is at 88 beat per minute, which is 1.46 beats per second.
- 12 beats per second is 8.5 times faster than 1.46 beats per second within quarter note equals to 88.
- A new tuplet needs to amount to 8.5 x 88 = 748 beats per minute.
- It turns out 17th tuplet does the job.



- Gradually the frequency differences expand more and more to actually produce difference tones:
- At rehearsal 16, the below interaction of tones produces a note slightly lower than B1 at 61.74 Hz, this note is simulated by the contrabass.

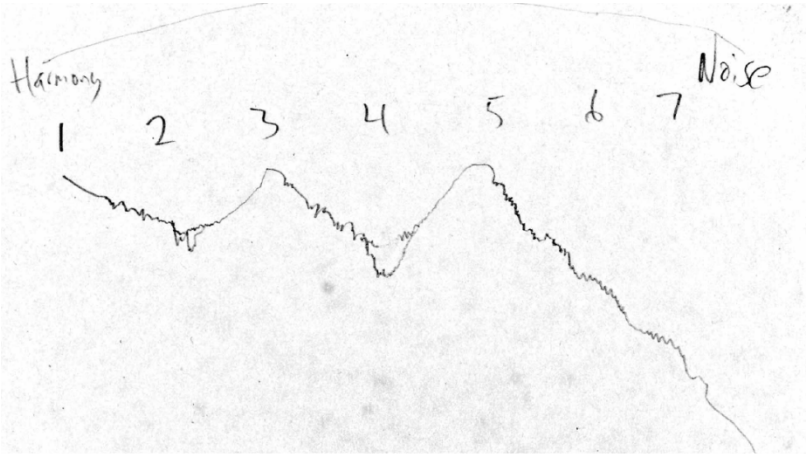


- Later at rehearsal 47, one encounters an extremely distorted low E fundamental:



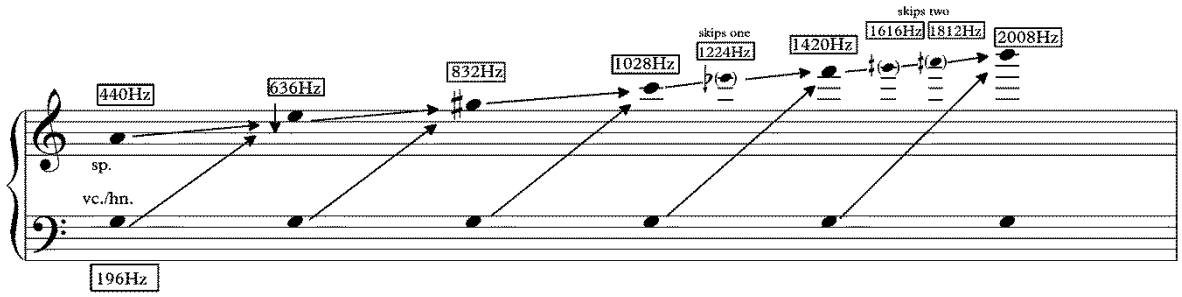
Formal Conclusions

- R. 1-11: spectral harmonic (partials of a low E trombone sound) → inharmonic, rhythmic periodicity→aperiodicity.
- R. 12-22: distortion→ spectral harmonic, ring modulation.
- R.23-27: linear, harmonic → inharmonic
- R. 28-32: distortion→ harmonic
- R. 33-41: inharmonicity begins: harmonic → distortion, ascending→ descending, periodicity→ aperiodicity
- R. 41-46: distortion, rhythmic phrasing interpolation, slow beating pattern-glissando
- R. 47-48: distortion around fundamental, simulation of extremely slow beating pattern around E tonic.



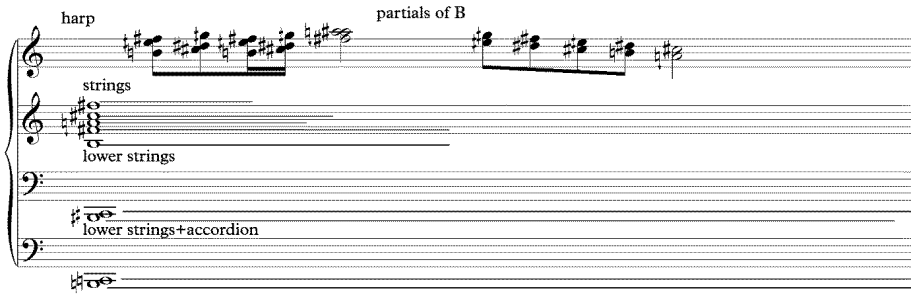
Vivier the lonely child (1980) *[same year as Gondwana]*

- We do not know the exact time and circumstances of his birth, and we do not know the exact time and circumstances of his death.
- Became obsessed with the identity of his mother.
- 'His is a world where human beings express themselves in invented languages.
- Autobiographical works.
- Lonely child: 'first time a work in which, by widespread consensus, he found a musical language unique to him.'
- Underlining a 'main' technical innovation.
- Visited Europe in the November of 1979.
- Studied with Karlheinz Stockhausen and Gilles Tremblay.
- Absorbed many of the ideas of Messiaen from Tremblay, including the chord of resonance, which is an equal tempered rendition of partials 4-15.
- 'Added resonance' dissonant pitches in the upper and triadic configurations at the bottom register.
- 'Inferior resonance' the opposite, imitating the sounds of gongs, bells…
- Not really a spectral composer, although his works were heavily influenced by the spectral works of the spectral school in the 1980s.
- **Combination tones**, or more poetically described by the composer, '*les couleurs'*.
- In addition to notes being played by the performers, the interactions of those notes generate other tones.
- If two sine wave frequencies interact, one at 200Hz and the other at 150Hz. We will hear in addition to those original ones, their sums and differences: 350 Hz (200 Hz+150Hz) and a 50 Hz (200Hz-150Hz).
- Brings about a more inharmonic spectrum.
- Shortly before his death Vivier remarked to Grisey: 'I'm also composing with spectra now. You've influenced me...only I twist mine a little!'
- Occasional chiming of the *rin*, a Japanese percussion instrument whose coloristic contribution becomes indispensible to the overall color palate of the piece.

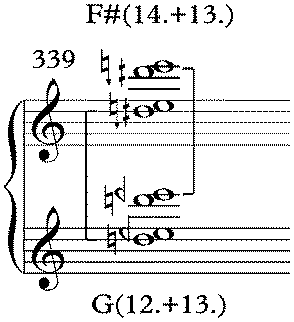


Haas and the virtual spectra

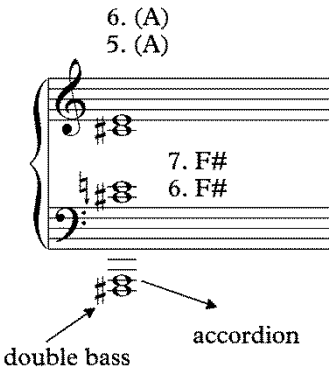
- Haas does rely on a harmonic language extracted from the natural overtone series, but does not employ rigorous computer analysis to derive his harmonies.
- His 'virtual spectra' are created more intuitively.
- A fuzzy spectrum of a low B:



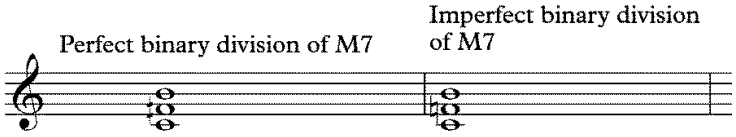
- Combined spectra of F# and G where only the high partials are played, filled with enharmonic notes:



- Combined spectra of A and F# again filled with enharmonic notes:



- A link between equal temperament and overtones series:



- Transformation of two harmonic worlds by the slightest pitch deviations: