

Double-stops on the flute

Knowing the basic acoustic laws of the flute makes possible for us to understand and describe the phenomenon of multiphonics. Several attempts have been made for this but a general treatise about it is still missing. Some flautists have also made experiments for organizing multisounds available on the flute in a certain order to hand them over to composers and flautists. I had the same goal when planning my table. I tried to find the form which is the easiest to use, includes the most useful and the least useless information and which is logical and easy to survey. Therefore I did not choose a principle connected to a technical feature of the flute like blowing-in or fingering but I grouped sounds according their most traditional and musical feature, the pitch. Since the spectrum of possible chords is infinitely rich I had to narrow down the choices: *this chart includes double sounds resulting from pairing tones of the twelve-tone system at a range of two octaves and a half and which can be played on the flute*. So I avoided micro-intervals and multiphonics with more than two notes.

I have found the proper fingerings from practical experience based on the theory of acoustics. I generally used C-foot flute, I have chosen fingerings with B-foot only if there was no other possibility. I left empty space for combinations for which I have not found a fingering yet or which are obviously impossible to produce. I hope to fill some of these empty squares later. I have often found several fingerings for a particular sound. In these cases I tried to keep the best one. If I could not decide between them or different variations had different dynamic features, I fitted more information into the right rubric. I have chosen between fingerings according to the following aspects (in order of importance): 1. Correct intonation of the interval, 2. Beauty of the sound, 3. Easiness of producing the right sound, 4. Simplicity of fingering. - I obviously found the sound more important than to save the flautist certain difficulties.

My work has two aims: I would like to open the ears of flautists for double-sounds the practising of which develops sound technique and hearing, enriches the set of technical devices, deepens the contact with the instrument and offers experiences about the physical being of our means of expression which we cannot attain in another way. On the other hand I want to pass on these innumeral possibilities offered by multiphonic technique into the hand of composers. I would like to make it possible for them to use double-stops knowing the sounds to be expected and the technical difficulties, and to call their attention to the fact that multiphonics are not only an effect but real musical sounds which can function to function as important parts of a musical material both in structure and in dramaturgy if used in the right way. However, I do not want to burden composers with theoretical and acoustic knowledge, therefore I am confined to the most necessary information.

My chart (the 'periodic system' by its nickname) includes information in a system of coordinates where one axis stands for the upper voice, the other one for the lower voice. I found this form the most practical. Besides I give dynamic limits, degrees of difficulty and, in the most extreme cases, the position of the flute, too. For notating fingerings I have chosen the system developed by István Matuz because, although this is still unknown to flautists, it is understandable from the enclosed explanation and using traditional signs would take three or four times more space. In addition, these letters have acoustic information for experts and are more logical and musical than numbers or circles.

With my work I hope to enrich general knowledge about the flute, the methodological set of devices and, by pieces composed on the basis of the 'periodic system', even the literature for the flute. I am sure that despite all my efforts there will be errors and inconsequences left in the notation. I would like to take the opportunity to ask composers and flautists who have questions or remarks concerning the chart not to hesitate to contact me at the given address.

What is multiphonics? – Sound of multiphonics.

Probably it had always been known that wind instruments are able to produce several pitches at the same time but until the beginning of the 20th century the tradition of European music could handle these phenomenon only as false notes since its aesthetic norms did not accept indistinct, hardly analyzable sounds. It is undeniable that if two or more frequencies resonate within the same tube the sound is not as clearly perceivable as the same sounds coming from independent acoustic systems. It is easy to distinguish sounds with different timbres, it is a bit more difficult to perceive sounds with the same timbre (that means the same combination of overtones and the same waveform) which originate from different bodies. On the piano, the resonating space is already the same and strings react to each other so parts influence each other a little. It is even more true in the case of the violin and its relatives because the role of the (common) resonating body is even more important. Only one more step and we get to the winds where the same air column is generated on several different frequencies so the interaction of voices is the most significant here.

Since timbre is determined by mixing proportions of partials, it is unambiguous that several tones sound together even when we can recognize only one pitch. If we pay closer attention, we can hear one or two overtones even within a normal musical note. The easiest is to recognize is the 12th and two octaves plus a major third note over the fundamental (major triad in open position!) and on the flute it is possible to emphasize and strengthen overtones to make them sound fundamental-like. There is an overlap between air speeds needed for producing different partials, therefore it is possible to favour several overtones at the same time and to make them sound together with the same volume. To find and keep the right strength of blowing for two neighbouring partials is more difficult than for single notes since the overlap is not very great.

Until we stay with the natural overtone system, i.e. we use the flute as an open-open tube (one opening is the blowing-in hole, the other is the first open hole whose name is the same as absolute name of the pitch we get as the fundamental), the circle of our multisounds will have the limitation of intervals included by the original overtone system and the notes do not get very clearly separated just because of their close relation and harmonicity. These chords are called pseudo-multiphonics. Their sign in the chart is a small circle above the letter mark (like a flageolet). However, the original overtone-system can be changed by leaving at least three open holes on the tube. In these cases we may get completely new (but calculable) overtone-structures which include different intervals from the original ones. Constituents of multiphonics produced by these special fingerings do not merge into each other as much as pseudo-multiphonics but the sound is less harmonic, too. Although the pitches given are the most dominant, one may expect to realize other additional frequencies.

Some of these belong to the deformed overtone-structure and the flautist can avoid making them become a real resonance. Others are combination sounds originating from the very fact that the two desired pitches are present so they cannot be ceased. Still, they will always stay essentially softer than main tones. Naturally these difference tones and virtual fundamentals will appear anyway when any two of the possible musical sounds resonate at the same time but are especially favored in our case where the sounds are closed in one acoustic system. This is not a disadvantage of the flute but only a feature of the instrument.

The special, hard-to-determine sound of multiphonics is an aesthetic feature which can become a virtue in a musical work. For instance, in soft sounding intervals we may expect interferences which make the effect quasi 'ethereal' while louder multiphonics full of secondary frequencies and hard to detect by ear make a more energetic sound than the same chord would make on two flutes, for example. At the fingerings where I marked extreme turning out of the flute (C) the sound is usually colorless, airy. The sound of the most difficult *p*, *pp* chords (signed with number 4 or 7, see below) can hardly be made absolutely secure. However, this uncertain hovering gains a special beauty, too. The composer has to know that the timbre of double-stops is fixed and that there are a lot of small differences within the basic categories mentioned here. To describe these little nuances would be too complicated here.

Question of intonation

The tuning of flutes today is based on the equally tempered twelve-tone scale. Still, it is not easy how to determine correctly tuned double-stops. At first while experimenting I could only compare the pitches of multisounds to the pitch I normally play on the flute, although it may be individually different how high one plays the same flute. Therefore it is possible that one finds well-tuned multiphonics a little too high or too flat compared to his habitual sound since most multiphonics are a lot less feasible to intone than individual tones, because they can be sounded only in a certain position of the flute and on a certain pitch. Chords can also be intoned to some extent partly on the traditional way, turning the flute in or out and making slight motions with the jaw, or with the fingers if the fingering includes some holes on the keys (b, a, fs, f, or e). A fraction of these small holes may be covered even where I have not signed it by crossing the letter, although it is very rarely necessary. If a small letter is crossed it always indicates halving the small opening. This is not precisely measurable so the creative experimenting of the player is essential. With these *tunable multiphonics* we have to count on differences up to a half tone if we move the finger one or two millimeters. That is why sometimes I have given the same fingering for neighbouring double-sounds.

The other question of intonation concerns what we hear or call a perfect interval. I myself found acoustic clarity more authoritative than equal temperament. Also because the unavoidable combination tones will be in tune that way. I marked imperfect intonation with arrows. These misintonations never reach a quarter-tone but are already noticeable without much importance in case of a solo flute. Multiphonics often sound out of tune at first but after a little searching it is possible to play them in tune. In these cases I have not used intonation marks. However, where the right intonation requires a significant turning of the flute, I used the 'U' mark. The differences of individual flutes very rarely result in any difference in intonation.

Intonation marks:

- both tones are too high or too low: ↓ ↑
- the lower tone is in tune, the upper one is too high or too low: ≡ ↗ ↘
- the upper tone is in tune, the lower one is too high or too low: ≡ ↗ ↘
- the lower tone is too low, the upper tone is too high: ↔
- the sound is to be intoned strongly down or up by blowing-in: ∪ ∩

Dynamics of multiphonics

A large number of multiphonics cannot be played on every dynamic level. The dynamic range of particular sounds can generally be widened by long practice but not beyond certain limits. In my 'periodic system' I have given dynamics with which it is the easiest to produce the particular chords. Of course, I could utilize only my own experiences here. Allowances have to be made for differences in physiology or style. We also have to take into consideration the differences of certain flutes. Still, we can take the given dynamic marks as a basis.

Chords marked with *pp* sound only very soft while others signed with *p* can often be developed to *mf* or – with a special overpressed blowing-in – even to a noisy *f*orte sound. I either did not write any dynamic marks to dynamically malleable double-sounds, or signed the most natural dynamics in brackets. Generally, intervals smaller than an octave cannot be played louder than *f*orte, we can only expect a real powerful *fortissimo* sound at larger intervals.

Difficulties of producing multiphonics

I found it very important to refer to the various difficulties of playing each double-stop although it was not an easy task. For different people various types of blowing-in prove to be the most difficult. I could only more or less register my experiences by dividing the multiphonics into seven groups to mark at least tendencies. I ignored the difficulties of fingerings, this is generally obvious from the number of letters that sign the fingering. The more small letters, meaning open hole keys, are used (especially with their crossed through version) the more complicated the fingering is. The difficulty of soft multi-sounds is not only to get them but to keep them. We have to count on one or two seconds for getting the soft sounds marked with numbers 3, 4, 6, or 7, so it is risky to use them in fast alternation. *Forte* and *mf* multiphonics with numbers 1, 2, 3, 5 and 6 or soft ones numbered 1, 2 and 5 are usually easy to keep repeating in fast tempo and they are even sometimes easier to play *staccato* than as long notes. To play chords after each other tied in perfect *legato* is very often impossible.

Levels of difficulty:

1. Double-stops which can be easily produced with blowing-in used in classical technique.

2. Double-stops which can be produced with bit more difficulty with the usual blowing-in and ones which need a little different way of blowing-in but are sounded easily.

3. Chords which are difficult to produce but still need the usual way of blowing-in and ones which are of medium difficulty produced in a little different way of blowing-in.

4. Difficult multiphonics which can be produced in a slightly unusual way.

5. Chords which can be sounded easily but with a very unusual way of blowing-in.

6. Multiphonics of medium difficulty which need a very unusual way of blowing-in.

7. Sounds which are very hard to produce even with very unusual blowing-in.

How should flautists use the chart?

This chart can be used by everyone according to his purposes in choosing fingerings randomly or thematically. In any case, I suggest that you pay great attention to the sound production, whether you take the table in your hand as a way of developing your sound technique, or if you are just curious. At first play the two chosen tones on normal sounds for yourself, then try to imagine them together intensively. Start to produce them only after that, considering, of course, the dynamic marks. At the beginning it is important to experiment with various ways of blowing-in but the most basic task is to imagine the sound strongly and to listen absorbedly to the actual sound. I suggest that you practice with closed eyes.

At the beginning, multiphonic flute playing proves to be difficult, but with the right persistence it can be improved quickly. The flautist has to take into account that he will need to do brave experiments concerning the ways of blowing-in. It is worthy to try out extreme possibilities in the positions of the flute as well as concerning the form of the embouchure and the air-pressure. The sensations of chord-playing are so refined that it is impossible to describe them. I can only try to give some instructions: 1. When trying to get soft sounds the flute generally has to be more turned in than usual. I marked it only in the most extreme cases, although the 'U' sign marking the position of the flute is sometimes used only due to the intonation. 2. *Lip-support*: I use this expression for the feeling when we do not create resistance while letting the air out through a relatively big mouth-hole in relation to the given air-pressure. In this case, besides having a very secure diaphragm-support, we are not supposed to enervate the lip-muscles yet we must keep them stable without pressing them together. This technique is indispensable for controlling the air-stream. It is necessary for most soft sounds. 3. Connected to the last point one should be aware of a sensation called 'oboist-embouchure' by Auréle Nicolet or 'rabbit embouchure' by István Matuz: in this position the lower lip (actually the jaw) is pulled back while we let the air in under the upper lip which is pushed forward in an arched form. When speaking about unusual ways of blowing-in, I usually do not mean some weird position of the flute, but these two sensations mentioned here which also come in useful in classical sound technique. 4. When we have to turn the flute strongly out we should press it hard to the lower row of teeth to have the lip-hole as close to the edge as possible while not covering much of the blowing-in opening. We often need lip-support and rabbit embouchure in this kind of position, too. 5. One should try to gradually reduce special movements until the point where the motion between

multiphonics is hardly visible, the changes should rather happen inside.

It is a special art to learn the complicated fingerings. We must be very precise in this question, we have to refine a special sensitivity in the fingerings. The most problematic fingerings are the ones where trill-keys (d,ds) have to be pressed while also covering the small holes which are under the right hand. Try to touch the keys with the broadest part of your right hand fingers and to turn or pull the middle and/or the ring-finger to the appropriate trill-key to press it down. We should be very careful to continue covering the small holes. This may be uncomfortable but it can be done.

And the composer?

Hopefully the composer has already got all the necessary information for using the chart on the right way, the only thing left to do is to hang the periodic system above his desk and to start working on his new flute piece. If this piece is not composed for flute alone I have to tell you that to play multiphonics is even more difficult when other instruments are also sounding at the same time because it is very important for the flautist to hear himself to the finest details. It is also possible that he hears his own part through headphones.

When you finished the piece and you want to publish it you can follow two methods. One is to write the given fingerings under the multiphonics and the mark for turning out or in if necessary. In this case you have to enclose the explanation of the fingering-notation. The other way is to ask a flautist who has studied this notation thoroughly to encode the fingerings into a more common system of fingering-notation. Of course, I will also be happy to help in this. I would like to use the opportunity to ask you that if you used my work in your piece, please, send it to me so that I can look through it and perform it.

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