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Datasheet for the decision of 5 March 2024

Case Number: T 2620/19 - 3.4.03

Application Number: 14185601.3

Publication Number: 2851933

IPC: H01J49/06, H01J37/05, G01N23/227

Language of the proceedings: EN

Title of invention:
Analyser arrangement for particle spectrometer

Patent Proprietor:
Scienta Omicron AB

Opponent:
MB Scientific AB

Headword:
ARPES

Relevant legal provisions:
EPC Art. 54, 56, 101(2), 101(3)(b)

Keyword:
Novelty - (yes)
Inventive step - main request (no) - obvious solution - common general knowledge - auxiliary request (no)

Decisions cited:
T 1021/21, G 0007/95, T 1081/01

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Case Number: T 2620/19 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 5 March 2024

Appellant: (Patent Proprietor)	Scienta Omicron AB Box 15120 750 15 Uppsala (SE)
Representative:	Zacco Sweden AB P.O. Box 5581 Löjtnantsgatan 21 114 85 Stockholm (SE)
Appellant: (Opponent 2)	MB Scientific AB Seminariegatan 29B 752 28 Uppsala (SE)
Representative:	Brann AB P.O. Box 3690 Sveavägen 63 103 59 Stockholm (SE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 19 July 2019 concerning maintenance of the European Patent No. 2851933 in amended form.**

Composition of the Board:

Chairman	T. Bokor
Members:	M. Stenger
	J. Thomas

Summary of Facts and Submissions

I. The appeals of the patent proprietor and of opponent 2 concern the interlocutory decision of the opposition division to maintain European patent No. EP 2 851 933 published on 19 October 2016 in amended form according to the then second auxiliary request. The corresponding European application No. 14 185 601 is a divisional application of parent application No. 12 870 629 filed on 6 March 2012.

II. Documents

Reference is made to the following documents:

O2D1: User manual for the Scienta Electron Spectrometer SES 200, dated 96-04-15
O2D2: WO 2011/019457
O2D4: US 4358680
O2D7: compilation of Email exchanges, labeled individually X1 to X5
O2D11: User manual for the Scienta Electron SES-2002 spectrometer
O2D12: User manual for the Scienta Electron R4000 analyser

III. During the proceedings before the opposition division, objections with respect to Articles 100(a) and 100(c) EPC were discussed.

IV. In the impugned decision, the opposition division found that the then main request (patent as granted) fulfilled the requirements of Article 123(2) EPC so that the ground for opposition according to Article 100(c) EPC was unfounded.

Independent claim 7 of the then main request was found to lack novelty over O2D1/O2D11.
Independent claims 1 and 7 of the then first auxiliary request were found to lack inventive step in view of a combination of O2D1/O2D11 with O2D7 and the common general knowledge. The division also found that no other combination of the available prior art on file, in particular O2D1/O2D11 in combination with O2D4 or O2D2, rendered any of the independent claims of the then first auxiliary request obvious.

V. Requests of the patent proprietor

At the end of the oral proceedings before the Board, the patent proprietor requested that the impugned decision be set aside and that the patent be maintained on the basis of the patent as granted (main request) or on the basis of one of the first to eleventh auxiliary requests.

The first to fifth auxiliary requests were filed with the proprietor's grounds of appeal. The sixth to eleventh auxiliary requests were filed with its reply to the grounds of appeal of the opponent.

All claim sets comprise independent method and apparatus claims.

The patent proprietor further requested, during the written procedure before the Board, that the decision to admit documents O2D7 to O2D11 be overturned, but withdrew this request for O2D7 during the first day of the oral proceedings before the Board (23 January 2024). It had already accepted, with letter of 21 December 2023, that the contested emails were

actually sent and that they included the documents attached to them.

In addition, the patent proprietor requested that the novelty objections made by opponent 2 for the first time on appeal not be admitted into the appeal proceedings (see also the patent proprietor's reply to the grounds of appeal of opponent 2, section 4.3). In that respect, the proprietor explicitly mentioned *inter alia* documents O2D1 and O2D11.

VI. Requests of opponent 2

At the end of the oral proceedings before the Board, opponent 2 requested that the decision under appeal be set aside and that the patent be revoked in full.

Opponent 2 further requested that auxiliary requests 2 and 4 not be admitted into the proceedings.

VII. Claim 1 of the main request, i.e. as granted has the following wording (labeling 1., 1.1., 1.2. ... taken from the impugned decision):

1. *A method for determining at least one parameter related to charged particles emitted from a particle emitting sample (11), comprising the steps of:*
1.1. *forming a particle beam of said charged particles and*
1.2. *transporting the particles between said particle emitting sample (11) and an entrance (8) of a measurement region (3)*
1.2.1. *by means of a lens system (13)*
1.2.1.1 *having a substantially straight optical axis (15);*

1.3. *deflecting the particle beam in at least a first coordinate direction (x, y)*
1.3.1. *perpendicular to the optical axis of the lens system*
1.3.2. *before entrance of the particle beam into the measurement region,*
1.4. *detecting the positions of said charged particles in said measurement region,*
1.4.1. *the positions being indicative of said at least one parameter,*
1.4.2. *wherein detecting the positions of the charged particles involves detection of the positions in two dimensions,*
1.4.2.1. *one of which is indicative of the energies of the particles and*
1.4.2.2. *one of which is indicative of the start directions of the particles,*

characterised in that

the method further comprises the step of
1.5. *deflecting the particle beam in the same at least first coordinate direction (x, y)*
1.5.1. *at least a second time*
1.5.1.1. *before entrance of the particle beam into the measurement region and*
1.6. *controlling the deflections of the particle beam*
1.6.1. *such that a predetermined part (A, B) of the angular distribution (39) of the particles forming the particle beam passes the entrance of the measurement region,*
1.6.2. *wherein a series of different predetermined parts are successively recorded.*

VIII. Claim 7 of the main request, i.e. as granted has the following wording (labeling 7., 7.1., 7.1.1. ... taken from the impugned decision):

7. *A photo-electron spectrometer (30) of hemispherical deflector type*
7.1. *for analysing a particle emitting sample (11)*
7.1.1 *by determining at least one parameter*
7.1.1.1. *related to charged particles*
7.1.1.2. *emitted from the particle emitting sample, the spectrometer comprising:*
7.2. *a measurement region (3)*
7.2.1. *having an entrance (8)*
7.2.1.1. *allowing said particles to enter the measurement region;*
7.3. *a lens system (13)*
7.3.1. *for forming a particle beam of said charged particles and*
7.3.2. *transporting the particles*
7.3.2.1. *between said particle emitting sample and said entrance of the measurement region,*
7.3.3. *said lens system having a substantially straight optical axis (15);*
7.4. *a deflector arrangement (31) comprising*
7.4.1. *a first deflector (33A/33C, 33B/33D)*
7.4.1.1. *for deflecting the particle beam in at least a first coordinate direction (x, y) perpendicular to the optical axis of the lens system*
7.4.1.1.1. *before entrance of the particle beam into the measurement region,*
7.5. *a detector arrangement (9)*
7.5.1. *for detecting the positions of the charged particles in the measurement region,*
7.5.1.1. *said positions being indicative of said at least one parameter,*

7.5.2. *wherein the detector arrangement is configured to determine the positions of the charged particles*
7.5.2.1. *in two dimensions,*
7.5.2.1.1. *one of which is indicative of the energies of the particles and*
7.5.2.1.2. *one of which is indicative of the start directions of the particles,*

characterised in that

7.6. *said deflector arrangement further comprises at least a second deflector (33A'/33C', 33B'/33D')*
7.6.1. *for deflecting the particle beam in the same at least first coordinate direction (x, y)*
7.6.1.1. *at least a second time before entrance of the particle beam into the measurement region (3) and* ***in that***
7.7. *said spectrometer further comprises a control unit (35)*
7.7.1. *operable to cause the deflector arrangement to deflect the particle beam*
7.7.1.1. *such that a predetermined part (A, B) of the angular distribution (39) of the particles forming the particle beam passes the entrance of the measurement region,*
7.7.1.2. *wherein a series of different predetermined parts are successively recorded.*

IX. Claim sets of the other requests

(a) first to fifth auxiliary requests

The **first** auxiliary request differs from the main request in that the expression "*operable to*" in feature 7.7.1 is replaced by the expression "*configured*

to". It corresponds to the first auxiliary request underlying the impugned decision.

The independent claims of the **second** auxiliary request comprise, with respect to the claims as granted, the additional features

1.6.1.1 *in a direction being substantially parallel to the optical axis (15) of the lens system (13),* (method)

and

7.7.1.1.1 *in a direction being substantially parallel to the optical axis (15) of the lens system (13)* (apparatus),

These additional features correspond to the features of claims 6 (method) and 15 (apparatus) as granted.

The independent claims of the **third** auxiliary request comprise, in addition to the independent claims of the second auxiliary request, the additional features (labeling by the Board)

1.6.1.2 *wherein all deflections of the particle beam takes* [sic] *place within the lens system, meaning that*

1.6.1.2.1 *at least one lens (Ll) acts on the particles before the first deflection of the particle beam and*

1.6.1.2.2 *at least one lens (L3) acts on the particles after the last deflection of the particle beam* (method),

and

7.7.1.1.2 *wherein the deflector arrangement (31) and the lens system (13) are arranged such that at least one lens element (Ll) of the lens system is positioned upstream of all deflectors (33A/33C, 33B/33D, 33A' / 33C', 33B' /33D') of the deflector arrangement*

7.7.1.1.3 *and at least one other lens element (L3) of the lens system is positioned downstream of all deflectors of the deflector arrangement,* (apparatus). These additional features correspond to the features of granted claims 4 (method) and 12 (apparatus).

The Board notes that the third auxiliary request essentially corresponds to the second auxiliary request as maintained by the opposition division (and therefore to the present fifth auxiliary request), the only difference being that the expression "*configured to*" in claim 5 is replaced by the expression "*operable to*".

The **fourth** auxiliary request corresponds essentially to the second auxiliary request, the only difference being that independent apparatus claim 6 comprises the expression "*configured to*" instead of "*operable to*".

The **fifth** auxiliary request corresponds essentially to the third auxiliary request, the only difference being that independent apparatus claim 5 comprises the expression "*configured to*" instead of "*operable to*". It thus corresponds to the second auxiliary request as maintained in the decision under appeal.

That is, the independent apparatus claims of the main request and of the second and third auxiliary requests comprise, in feature 7.7.1, the expression "*operable to*", while the independent apparatus claims of the first, the fourth and the fifth auxiliary requests comprise the expression "*configured to*".

Further, the independent claims of the second and fourth auxiliary requests comprise, in addition to the features of the independent claims as granted, the

features of claims 6 (method) and 15 (apparatus) as granted.

Finally, the independent claims of the third and the fifth auxiliary requests comprise, in addition to the features of the independent claims of the second and the fourth auxiliary requests, respectively, the additional features of granted claims 4 (method) and 12 (apparatus).

(b) sixth to eleventh auxiliary requests

The **sixth to eleventh** auxiliary requests essentially correspond to the main request and the first to fifth auxiliary requests, respectively, the only difference being that features 1.6.2 and 7.7.1.2 are replaced, respectively, by features 1.6.2' and 7.7.1.2' as follows (additions w.r.t. features 1.6.2 and 7.7.1.2 underlined by the Board):

1.6.2' *wherein a series of different predetermined parts having different start angles in the y-direction are successively recorded* (method)
and
7.7.1.2' *wherein a series of different predetermined parts having different start angles in the y-direction are successively recorded* (apparatus).

As a basis for this amendment, the proprietor indicated page 11, lines 32 to 33 of the application as filed.

X. Relevant arguments of opponent 2

Opponent 2 submitted that features 1.6.2/7.7.1.2 extended beyond the content of the application as filed under Articles 100(c) and 123(2) EPC.

In its reply to the grounds of appeal of the patent proprietor, opponent 2 had further contended that the independent claims of the second and the fourth auxiliary requests were not clear (due to the expression "substantially parallel") and could not be carried out by the skilled person, contrary to Articles 84, 83 and 100(b) EPC.
With respect to Articles 100(a), 54 and 56 EPC, opponent 2 essentially argued that the subject-matter of the independent claims of all requests was not novel over O2D1 or at least not inventive over O2D1 combined with O2D7 and the common general knowledge.

XI. Relevant arguments of the patent proprietor

The patent proprietor essentially submitted that the independent claims of the requests fulfilled the requirements of Articles 100(c) and 123(2) EPC. It did not give its approval to considering the ground of opposition under Article 100(b) EPC.
It furthermore submitted that none of the available prior art documents disclosed two deflectors deflecting particles twice in the same coordinate direction. The subject-matter of the independent claims of the requests was thus inventive.

Reasons for the Decision

1. The appeals are admissible.

2. **Procedural issues**

2.1 Admission of O2D8 to O2D11

The Board does not see any legal basis in the EPC for excluding in appeal proceedings documents admitted into

the opposition proceedings - effectively "un-admitting" such documents -, particularly if the impugned decision is based on them (see e.g. decision T 1021/21, Reasons, point 3.). Following the case law of the Boards of Appeal on this issue (*Case Law of the Boards of Appeal*, 10th edition 2022, V.A.3.4.4), the admission of documents O2D8 to O2D11 into the proceedings cannot be challenged, contrary to the request of the patent proprietor.

2.2 Admission of new novelty attacks

The impugned decision discusses the objection of opponent 2 that the subject-matter of claim 7 as granted is not new over O2D1. However, the Board is not aware of any detailed discussion during the proceedings before the opposition division that the subject-matter of claim 1 lacks novelty in view of either O2D1 or O2D11, as submitted by the patent proprietor.

Nevertheless, lack of inventive step starting from O2D1 and O2D11 (both documents were considered by the opposition division to be equivalent, see point 14.1 of the impugned decision) is discussed in detail in the impugned decision for the then first and second auxiliary requests (sections 16.1, 16.2 and 17) and thus had to be discussed anyway in the present appeal proceedings.

This could not have been done without establishing the distinguishing features over O2D1/O2D11, and in this manner at least implicitly considering (lack of) novelty of these claims w.r.t. these documents (see also G 7/95, Headnote, last sentence and Reasons 7.2).

The above view of the Board was already indicated in the Board's preliminary opinion, and the patent proprietor did not bring further arguments on this issue at the oral proceedings. Accordingly, the Board has decided to admit the novelty objections over O2D1 or O2D11.
Irrespective thereof, the Board found that the subject-matter of the independent method claims of the requests was novel over O2D1 (see point 4.3 below).

2.3 Admission of the second and fourth auxiliary requests

As set out below (see point 9), the subject-matter of the independent method claims of the second and fourth auxiliary requests was found to lack inventive step. It was therefore not necessary to discuss admission of these requests.

2.4 The clarity objections formally raised under Article 84 EPC and the issue of sufficiency under Article 83 EPC, as independent formal arguments against the claimed subject-matter, became moot in view of the Board's finding on inventive step. The Board nevertheless comments on these issues, as they have a bearing on claim interpretation.

2.5 Clarity of the expression "*substantially parallel*"

Even though not formally objectionable as being unclear within the meaning of Article 84 EPC, the feature requires interpretation also for the purposes of novelty and inventive step. However, the Board finds no difficulty in interpreting the feature, and holds that the skilled person would construe that expression in view of the patent specification and its common general knowledge. In the Board's reading, the corresponding

feature of granted claims 6 and 15 corresponds to a parallelism that is actually required by the detector to avoid artefacts (see also the second paragraph of point 6.3 below).

2.6 Articles 100(b) and 83 EPC

The opponent submitted that is was not evident from the claims alone or from the description how two deflections in the same direction could change the initial direction of the particles such that they entered the measurement region "*in a direction being substantially parallel to the optical axis of the lens system*".
It was thus also not evident how the invention according to auxiliary requests 2 and 4 could be carried out by the skilled person as required by Articles 100(b) and 83 EPC (reply to the grounds of opposition of the patent proprietor, point 4.1).

The Board considers that this objection is also, to a certain extent, a question of clarity, i.e. the interpretation of the feature objected to. In this respect, the Board sees no particular problem and can interpret the feature without any difficulty. The Board observes that the claims in question do not define that the particles are deflected twice "*in the same direction*", but in the "*same at least first coordinate direction*". Further, the skilled person would understand from Figure 8B and the corresponding part of the description of the granted patent (paragraph [0058]), that the two deflections bend the particle beam in the same coordinate direction (e.g. the y-coordinate direction), but in an opposite direction (e.g. plus y and minus y). That is, the two deflections are performed in antiparallel directions.

3. Preliminary remarks concerning O2D7

The patent proprietor accepted that the e-mail communications X1 to X5 actually had taken place place and that they had comprised the documents attached to them. The formal admission of these e-mail communications as documents in the proceedings was not contested anymore, but only their public prior art character.

The following observations of the Board are made for the purposes of determining the prior art character of X1 to X5, i.e. if and how they are to be treated as publicly available prior art.

3.1 Sending dates of X1 to X5

X5 bears a date (24 May 2016) after the filing date of the contested patent (6 March 2012) and therefore does not form part of the prior art.

With respect to X1 to X4, the Board notes that they have been sent in the following order on the following dates:
X3 (12 November 2010) - X2 (14 December 2010) - X1 (4 January 2011) - X4 (12 January 2011). That is, all of these documents were sent before the filing date of the impugned patent.

3.2 Individual pieces of prior art

It was a point of dispute during the written proceedings before the Board whether X1 to X5 could be considered as representing one piece of prior art or

would have to be considered as individual pieces of prior art.

The **patent proprietor** submitted that X1 to X5 had differing subject lines and were not generated by and distributed to the same group of people. They could thus not be regarded as a single document (see the patent proprietor's grounds of appeal, point 3.1).

Opponent 2 submitted that X1 to X4 could be regarded as a single piece of prior art because
- they all discussed the development of the same type of instrument (electron spectrometers for ARPES applications),
- X1, X2 and X4 even explicitly mentioned that the instrument is from Scienta, i.e. the patent proprietor,
- and one of the recipients was involved in all of the e-mails X1 to X4, whereby a single person of the public had access to the combined contents of Xl to X4.

Alternatively, X1 to X4 could also be considered as a documentation of an open discussion on the development of a new instrument and should therefore be regarded as one source of prior art (see opponent 2's reply to the grounds of appeal, points 6.2.3.2 and 6.2.3.3).

The **Board** notes that generally, different documents representing an open discussion on the development of the same type of instrument are not regarded as one single document, and as such a single piece of prior art. Rather, this could be considered as an indication that the teachings of these documents could possibly be combined. Further, the fact that a single person of the public has immediate and direct access to the contents of a number of documents, e.g. various pieces of correspondence as in the present case, does normally

not mean that these documents can be taken as representing one piece of prior art, because of this "personal connection" between them.

In the present case, the e-mails summarised under X4 all refer to the same subject (PO K0000030433) and thus can be considered to represent one single e-mail thread.

X1 and X2 contain, in the subject line, only "Re:" and "RE:". In X3, the subject line reads "Angular 3D mode of Scienta". Therefore, X1 to X4 together do not belong to one single E-mail thread; however, they all relate to the idea, first formulated apparently by the author of X1 and X3, to put a deflector in an existing Scienta analyser to deflect electrons perpendicular to the slit in order to avoid sample rotation.

Thus, X1 to X4 have to be regarded as separate pieces of prior art.

3.3 X1 to X5, public availability

During the written phase, it was disputed whether X1 to X5 were publicly available or subject to an implicit or explicit confidentiality clause.

The **Board** notes that the persons involved in X1 to X4, except for one person who was an employee of the patent proprietor, have worked for a number of different research institutes (Brookhaven National Laboratory, University of Missouri - Kansas City, Forschungszentrum Jülich) when these e-mails were sent.
Further, X1 to X4, in accordance with O2D8, do not comprise any indication that their content was to be

treated in a confidential manner, as accepted by the proprietor in its letter of 21 December 2023.
This may not have been the result of an active removal of the confidentiality requirement, as submitted by the patent proprietor in the same letter. Nevertheless, the information contained in X1 to X4 was available to a number of people working for different organisations, and without any explicit indication that it should be kept secret.

The Board notes that there is also no indication that any special relationship existed between them other than that they were all working in the same research area, which could be interpreted as a kind of implicit confidentiality obligation as set out for a different case in decision T 1081/01 (points 6 and 7 of the Reasons; see also *Case Law of the Board of Appeal*, 10th Edition 2022, I.C.3.3.3).
The Board therefore holds that the information contained in X1 to X4 was publicly available before the filing date of the contested patent.

4. Article 123(2) EPC

The objection of the opponent relating to an intermediate generalisation due to the absence of the narrow entrance slit in claim 1 raised under Article 123(2) EPC became moot in view of the Board's finding on inventive step. The Board nevertheless finds it useful to comment on these issues, as they concern features that relate to the (mode of) operation of the system (see point 5.3 below).

Features 1.4.2, 1.4.2.1 and 1.4.2.2 require that one ofthe dimensions of the detected position of charged particles is indicative of the energies of the

particles and one of which is indicative of the start directions (emission angle) of the particles. As submitted by opponent 2, however, without a slit, the measured energies would smear out. Thus, the positions detected in two dimensions would not be meaningful. For these reasons, the Board holds that features 1.4.2, 1.4.2.1 and 1.4.2.2 implicitly require the presence of an entrance slit. The dimensions of this slit will be chosen by the skilled person according to the circumstances of the desired application, as submitted by the patent proprietor. In particular, its width will be selected according to the desired energy resolution.

Therefore, the Board holds that the formal absence of the narrow entrance slit in claim 1 does not constitute an intermediate generalisation, contrary to the submissions of opponent 2.

5. Article 54 EPC, main request, claim 1

5.1 The **patent proprietor** submitted that O2D1 did at least not disclose a second deflection of the particle beam in the same at least first coordinate direction and that a series of different predetermined parts successively were recorded by controlling the deflectors accordingly (features 1.5, 1.5.1 and 1.6.2). It emphasised that in ARPES systems, octagonal deflectors like the one present in the lens of O2D1 were sometimes used during measurements in imaging mode, but never during measurements in angular mode, as explicitly stated in O2D12 (page 1-4, section "Lens deflection").

5.2 **Opponent 2** submitted that the use of the term "at least" in feature 1.5 "*deflecting the particle beam in the same at least first coordinate direction*" had the

effect that any (second) deflection in a direction having a (non-zero) component in the first coordinate direction was comprised in the wording of feature 1.5, corresponding to (second) deflections in any direction except directions perpendicular to the first coordinate direction. O2D1 disclosed, e.g. on sheet 56H1-2A, an octagonal deflector (see also section 1.1.2) and a deflector A9 (see also section 1.2.3 and Figure 1.2-1). O2D1 thus disclosed features 1.5 and 1.5.1.

In addition, the two deflectors shown on sheet 56H1-2A had the purpose of correcting for misalignment of the excitation spot and the electron optical lens axis (octagonal deflector, section 1.1.2), and correcting the direction of the electrons passing the analyser aperture (deflector A9). Therefore, the deflections in the two deflectors of O2D1 even had to be exactly antiparallel so that the electrons could enter the detector in a direction perpendicular to the detector entrance plane.
Opponent 2 emphasised that the only difference in the lens between imaging mode and angular mode in ARPES systems was that its focal length was set to infinity (in angular mode). Thus, there was no reason why the octagonal deflector of O2D1 could not be used during measurements in angular mode.

Opponent 2 submitted that the first term "wherein" of feature 1.6.2 did not necessarily refer to feature 1.6. Instead, it could refer to the claim as a whole. Changing the angle of the particle beam, i.e. recording different predetermined parts successively as defined in feature 1.6.2 was thus, according to the wording of the claim, not necessarily done by controlling the deflectors accordingly. Instead, it was within the scope of the claim that this could be done by means of

rotating the sample while keeping the settings of the deflectors constant.

5.3 The **Board** notes that, in view of features 1.4.2, 1.4.2.1 and 1.4.2.2 according to which one of the detected positions is indicative of the start directions of the particles, the claim cannot be read as defining the operation of an ARPES system in transmission/image mode. It could however be read as defining the operation of an ARPES system as disclosed in O2D1 in angular mode.

In view of the submissions of the parties during oral proceedings, the Board concludes that voltages are applied to the octagonal deflector of O2D1 (as well as to the similar deflectors disclosed in O2D11 and O2D12) during a measurement under certain circumstances in transmission/image mode (as submitted by the patent proprietor). The Board is further convinced that this could be done in principle also in angular mode (as submitted by opponent 2, since the only difference between the two modes with respect to the lens is its focal length).

However, not even opponent 2 submitted that this is done in a routine or even inevitable manner in angular mode, while the patent proprietor, referring to O2D12, submitted that this is not done at all. The Board further notes that none of the available ARPES system manuals O2D1, O2D11 and O2D12 mentions applying any voltage to the octagonal (or corresponding) deflector during a measurement, as acknowledged by both parties. O2D1 does therefore not directly and unambiguously disclose that the *octagonal deflector* deflects the particle beam in at least a first coordinate direction perpendicular to the optical axis of the lens system

before entrance of the particle beam into the measurement region as defined in features 1.3, 1.3.1 and 1.3.2.

However, the deflection electrode A9 positioned between the aperture slit and the entrance slit of the detector is used to compensate small imperfections of the lens by correcting the direction of the electrons passing the analyser aperture (section 1.2.3 of O2D1). The Board understands this section of O2D1 such that a voltage is applied to A9 during all measurements, including measurements in angular mode. Therefore, O2D1 discloses that deflector A9 deflects the particle beam as defined in features 1.3, 1.3.1 and 1.3.2.
For the sake of completeness, the Board notes that the deflections performed by deflector A9 are controlled such that a predetermined part of the angular distribution of the particles forming the particle beam passes the entrance of the measurement region as defined in features 1.6 and 1.6.1, which are therefore also disclosed in O2D1.

As noted above, O2D1 does not directly and unambiguously disclose that the octagonal deflector deflects the particle beam during the measurements. No other deflector than the octagonal deflector and deflector A9 is disclosed in O2D1. Thus, O2D1 does not disclose the features of claim 1 relating to the second deflection, namely, features 1.5, 1.5.1 and 1.5.2, as submitted by the patent proprietor.

Concerning feature 1.6.2, the Board notes that claims should be interpreted in a technically meaningful manner taking into account the whole disclosure of the patent (*Case Law of the Boards of Appeal*, 10th edition 2022, Chapter II.A.6.1).

In the present case, the whole point of the patent is to avoid mechanical manipulation of the sample (in particular tilting and rotation, see e.g. paragraphs [0023] to [0026]). Thus, the term "wherein" in feature 1.6.2 has to be interpreted as referring to feature 1.6 and not to the claim in general, contrary to the submission of the opponent. That is, feature 1.6.2 has to be read as meaning that the series of different predetermined parts are successively recorded by controlling the deflections of the particle beam as defined in feature 1.6.
Therefore, O2D1 does not disclose feature 1.6.2, either, as submitted by the patent proprietor.

The subject-matter of claim 1 of the main request is thus new under Article 54 EPC in view of O2D1.

6. Article 56 EPC, main request, claim 1

O2D1 discloses a prior art ARPES system and therefore the features 1, 1.1, 1.2, 1.2.1, 1.2.1.1, 1.4, 1.4.1, 1.4.2, 1.4.2.1, 1.4.2.2. Furthermore, as set out above, O2D1 discloses features 1.3, 1.3.1, 1.3.2, 1.6 and 1.6.1. In addition, a series of different predetermined parts are recorded by means of a computer-controlled manipulator (see section 1.6.6 of O2D1).

6.1 Difference

The subject-matter of claim 1 of the main request thus differs from O2D1 by the features relating to the second deflection of the particle beam, namely features 1.5, 1.5.1, 1.5.1.1, and in that feature 1.6.2 is performed by controlling the deflections of the particle beam according to feature 1.6.

6.2 Technical effect, objective technical problem

The effect of these distinguishing features is that an angle sweep can be performed without mechanically moving (i.e. tilting or rotating) the sample. The objective technical problem to be solved may thus be defined as how to perform an x-y mapping of the angular space/distribution of the electrons emitted from the sample while avoiding moving the sample.

6.3 Inventive step

This problem is mentioned in both X2 and X3. Both documents propose to use a deflector before the entrance slit of a Scienta ARPES analyser to solve that problem (X2: second paragraph; X3: idea 1 in the attached figure). The skilled person would therefore be prompted by any of these documents to use a deflector instead of moving the sample.

When trying to do so, the skilled person would then be aware that using only one deflector for that purpose would result in the particle beam arriving at the entrance slit of the detector at an angle to the optical axis of the lens, contrary to what is required by the detector to avoid artefacts. The skilled person would therefore know that it had to correct the direction of the particle beam before the entrance to the detector such that it becomes aligned with the optical axis of the lens.

The most straightforward solution for this follow-up problem resulting from the use of a deflector instead of a mechanical manipulator of the sample would be to use an additional, second deflector. The Board notes that the deflector A9 in O2D1 is used exactly for that

purpose of correcting the direction of the electrons (see O2D1, section 1.2.3).
When such a second deflector is used, it is inevitable that it will deflect the electrons in the same coordinate direction, but in the opposite direction as the (first) deflector used to replace the mechanical manipulator. These two anti-parallel deflections will result in a generally S-shaped path of the beam of electrons.
The Board notes that both O2D2 and O2D4 give examples of arrangements using two deflectors in combination with a lens (O2D2: deflectors 1015 in lens 1010 in Figure 1; O2D4: deflectors p1, p1', p2, p2' in lens CL, ZL in Figure 1). O2D4 expressly points out the resulting "dog-leg" shaped path of the beam as the result of the double deflection, apparently corresponding to the claimed two anti-parallel deflections.

It follows from the above that the subject-matter of claim 1 of the main request is not inventive under Article 56 EPC in view of O2D1 combined with any of X2 or X3 and the common general knowledge of the skilled person.

The Board further notes that this finding does not necessarily imply that any of the already present deflectors in O2D1 (octagonal and A9) is used by the skilled person for the purpose of recording a series of different parts/start angles.

7. Article 56 EPC, fifth auxiliary request, claim 1

Claim 1 of the fifth auxiliary request differs from claim 1 of the main request in that it comprises the additional features 1.6.1.1, 1.6.1.2, 1.6.1.2.1 and

1.6.1.2.2 as follows (labeling 1.6.1.1, ... etc. added by the Board):

1.6.1.1 *in a direction being substantially parallel to the optical axis (15) of the lens system (13),*
1.6.1.2 *wherein all deflections of the particle beam takes* [sic] *place within the lens system, meaning that*
1.6.1.2.1 *at least one lens (L1) acts on the particles before the first deflection of the particle beam and*
1.6.1.2.2 *at least one lens (L3) acts on the particles after the last deflection of the particle beam,*

These additional features correspond to the features of granted claims 4 and 6.

7.1 With respect to Article 56 of claim 1 of the fifth auxiliary request, the **patent proprietor** essentially submitted that, although O2D1 or O2D11 could also be taken as closest prior art, O2D12 was the best closest prior art because it was the only manual mentioning the angular mode.
However, O2D12 explicitly mentioned on page 1-4 that the deflector in the lens should not be used in angular mode, because then deflections would create additional distortions. In contrast to that, the contested patent mentioned the advantages of positioning the deflectors in the lens in paragraphs [0063] and [0064].
In addition, X1 suggested to place a deflector in the final focal plane, X2 indicated that it would be a good idea to place a deflector close to the slit and in X3, a deflector was placed downstream of the lens. Thus, none of these documents suggested to position two deflectors in the lens. Instead of positioning the deflectors in the lens, the skilled person would try to

separate the problems of beam forming by the lens and of deflecting the beam by the deflectors and place the additional deflectors outside the lens.

Starting from O2D12, the skilled person would not consider O2D4, since it concerned only point-to-point imaging and furthermore involved meshes (1a, 1b in figure 1), which would destroy angular resolution, as would aperture 3a. Therefore, even if the skilled person combined O2D4 with O2D1 and X2/X3, it would not arrive at the claimed subject-matter.

O2D2 concerned, other than O2D12, time-of-flight measurement and would therefore not be considered by the skilled person. In addition, the deflectors 1015 shown in Figure 1 did not deflect particles twice in the same coordinate direction in the sense of the contested patent, but only served to correct small aberrations and to align the particles to the axis of the lens.

7.2 **Opponent 2** submitted that when putting into practice a combination of O2D1 and X2 or X3, the skilled person would have to solve the problem to put the two deflectors suggested by both X2 and X3 somewhere in the system disclosed in O2D1. When doing so, it would not limit itself to the initial positions proposed in X2 (in the lens probably close to the slit) and X3 (idea 1, in front of the slit). Instead, since it would be aware of the potential of the use of deflectors to replace mechanical manipulation suggested in X2 and X3, it would consider other positions as well, taking into consideration the corresponding advantages and disad vantages. These comprised, inter alia, considerations like saving space or in other words, achieving a

compact design and decoupling of the lens and the deflector actions.
When looking for possible positions of the two deflectors, the skilled person would also look at other documents than X2 and X3 and would be aware that in each of the four similar systems disclosed in O2D1 (Figure 1.1-1 and point 1.1.2), O2D11 (Figure 1.1-1 and points 1.1.1 to 1.1.3), O2D2 (paragraph [9]) and O2D4 (Figure 1), deflectors were placed inside the longest element of a lens. It would thus, with a reasonable expectation of success, choose the same position for the two deflectors to be arranged in O2D1. A particular combination of any of O2D1, O2D11 or O2D12 specifically with O2D4 was not necessary, even though such a combination would also be envisaged by the skilled person as a matter of course. Either way, the skilled person would have been prompted to position the two deflectors suggested by X2 and X3 inside the longest lens element, and thus would have arrived at the claimed subject-matter without any inventive step.

7.3 Finding of the Board

7.3.1 Closest prior art

In the assessment of inventive step of claim 1 of the main request as set out above, the Board started from O2D1 as representing the closest prior art, not O2D12, contrary to the submission of the proprietor.
Nevertheless, the features disclosed in O2D1 referred to during that assessment essentially correspond to features which are present in any generic ARPES system. The Board therefore considers that O2D12 would be a suitable closest prior art as well. This also applies to O2D11. In any case, the choice of either O2D1, O2D11

or O2D12 as closest prior art does not have any influence on the distinguishing features.

7.3.2 Feature 1.6.1.1

In the Board's view, feature 1.6.1.1 only spells out explicitly the common general knowledge of the skilled person that, in order to avoid artefacts, the particle beam should not arrive at the detector entrance at an angle to the optical axis of the lens, as mentioned by the Board when assessing inventive step of claim 1 of the main request (see the second paragraph of point 6.3 above). Therefore, this feature cannot contribute to the acknowledgement of an inventive step.

7.3.3 Features 1.6.1.2, 1.6.1.2.1 and 1.6.1.2.2, objective technical problem to be solved

Features 1.6.1.2, 1.6.1.2.1 and 1.6.1.2.2 essentially define that the deflectors are to be placed inside the lens.
As set out above for the main request, the skilled person, when trying to solve the objective technical problem formulated above in section 6.2, would follow the suggestions of X2 and X3 to use a deflector instead of a mechanical manipulator. It would further apply its common general knowledge to use a second deflector to align the beam with the optical axis of the lens.

However, once the skilled would do so, it is inevitable that it has to solve the additional problem of where to place these two deflectors as submitted by opponent 2.

7.3.4 Features 1.6.1.2, 1.6.1.2.1 and 1.6.1.2.2, inventive step

The Board notes that both X2 and X3 are not very specific concerning the position of the deflector they suggest. The Board therefore holds that the skilled person, when trying to solve the problem mentioned above, would also consider other positions than the ones suggested in X2 and X3, as set out by the opponent.

When doing so, it would know from its common general knowledge that deflectors for deflecting a particle beam perpendicular to the axis of an electron lens can be positioned inside elements of the lens. This common general knowledge is exemplified, for instance, by documents O2D1, O2D11, O2D12, O2D2 and O2D4, in each of which deflectors for deflecting electrons perpendicular to the axis of an electron lens are positioned inside the elements of the lens.

Moreover, the skilled person would be aware of the advantages and disadvantages of the potential positions of the deflectors. It would be aware, for instance, that positions inside the electron lens would save space and provide a compact design, but might require a more elaborate control of the voltages applied to the lens elements and the deflectors. It would also be aware that positions of the deflectors outside the electron lens would decouple the deflection and the lens actions, but would have negative results on the angular acceptance and dispersion due to the increased distances between the sample and the lens (deflectors upstream of the lens) or the lens and the detector entrance (deflectors downstream of the lens), as set out in paragraph [0063] of the opposed patent.

The skilled person would then, depending on the circumstances, choose the position of the deflectors

outside or inside the lens (i.e. as defined in features 1.6.1.2, 1.6.1.2.1 and 1.6.1.2.2) according to the circumstances, without exercising an inventive activity.

For these reasons, the subject-matter of claim 1 of the fifth auxiliary request does not involve an inventive step within the meaning of Article 56 EPC.

The Board notes that this finding does not rely on some specific combinations of O2D1 with X2 or X3 and further O2D2 or O2D4 (which were contested by the proprietor). O2D2 and O2D4 merely illustrate, like O2D1, O2D11 and O2D12, the common general knowledge of the skilled person that deflectors can be positioned inside elements of an electron lens. In the words of the opponent, these documents only show that the skilled person, starting from O2D1, would have placed the deflectors inside the electron lens with a reasonable expectation of success.

8. First to fourth auxiliary requests

The independent method claims of the first to fourth auxiliary requests are identical to (third auxiliary request) or broader than (first, second and fourth auxiliary requests) independent claim 1 of the fifth auxiliary request. Thus, their subject-matter is not inventive under Article 56 EPC for the same reasons as set out above for claim 1 of the fifth auxiliary request.

9. Sixth to eleventh auxiliary requests

As set out above, the independent method claims of the sixth to eleventh auxiliary requests differ from the

independent method claims of the main request and the first to fifth auxiliary requests in that feature 1.6.2 is replaced by feature 1.6.2' as follows (the underlined part corresponds to the additional part with respect to feature 1.6.2):

1.6.2' *wherein a series of different predetermined parts <u>having different start angles in the y-direction</u> are successively recorded*

When assessing novelty and inventive step of claim 1 of the main request, the Board interpreted feature 1.6.2 such that the series of different predetermined parts of the angular distribution of the particles (see feature 1.6.1) related to different start angles (see, for example section 6.2 above, "angle sweep" and "x-y mapping") perpendicular to the electron lens axis. This corresponds to the part of feature 1.6.2' that was added with respect to feature 1.6.2.

That is, the reasoning set out above for the independent method claims of the main request and the first to fifth auxiliary requests also applies to the independent method claims of the sixth to eleventh auxiliary request. During the second oral proceedings on 5 March 2024 before the Board, the proprietor did not contest this finding of the Board.

The subject-matter of the independent method claims of the sixth to eleventh auxiliary requests is thus not inventive under Article 56 EPC.

10. Conclusion

It follows from the above that the subject-matter of the independent method claims of all requests lacks an

inventive step under Article 56 EPC. Consequently, the contested patent cannot be maintained, but has to be revoked under Articles 101(2) and (3)(b) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar: The Chairman:

S. Sánchez Chiquero T. Bokor

Decision electronically authenticated