Oort 134



Cher Monsieur

Monsieur

trouver un mom

Je voudra

de cette nouve

à Nice. Avec l

d'autant plus

Je vous p

mes respectueus

UNIVERSITY OF MANCHESTER

Leiden, February 17, 1981.

STERREWACHT LEIDEN

7 Dec.

Dear Prof. Oort,

Recently I made some notes about some of the aspects of the galactic center HI and CO phenomenology which seem to me relevant to interpretation of the anomalous velocity features in the center. I put the notes on your desk, hoping that we might soon have a chance to discuss the data in more detail. The notes scarcely contain anything new, but rather points which in my opinion are worth emphasing in discussing the pro's and con's of ejection and field models. (The only point which might be new is #3, about the apparent +,− velocity pairing of the anomalous features).

Butler Burton

COCKLEY MOOR · DOCKRAY · PENRITH · CUMBRIA

26 June 1981

Dear Jan,

Earlier this week we were talking about you, reminiscing about old times long remembered, and wondering how you are keeping. Then just by chance today we saw a review of your birthday book.

We felt we couldn't miss the opportunity to send our warmest good wishes and congratulations on your 80th, and our most affectionate greetings to you both.

Fred & Barbara

gemeente Franeker

8800 AB franeker
postbus 58, tel. 0
bankrelatie: rabo
rek. no. 32.04.15.
giro bank 83 94 3

no.

onderwerp: 200

de heer Prof. dr. J.H. Oort
Pr. Kennedylaan 169
2324 EV Oegstgeest

Ho

Wi el
se
2C
ee
Of
Hi
U
a

b

c

c

W

I

ent

De Heer Mr J.J.H. Pop 20 sept.
Burgemeester in Franeker
Hoogachtb. Burgemeester

Het doet ons plezijn op U, mede namens mijn collega's, nog kenn
dank uit te spreken voor Uw bijdrage aan het Symposium
georganiseerd in Franeker op donderdag - vrijdag. Dit kon dank
zulk een bijzonder leerzame wijze plaatsvinden
geweest is mèdes uit het prachtig verzorgde verslag
te blijk. Een stad die zich zien in de volksbreed
in dezen geest werk,
en de verantwoordelijkheid in
gewaardeerd worden mag.
We hebben gemerkt in de
en het Symposium, waar
het uitzicht bestaan in de toekomst.
2 à 3 dagen
Graag willen wij nu Uw vragen om
20
bijdrage in officiële vorm
wij ons donderdag geheid krijgt. Hoe waardevol Uw
we met ons kinderen mogen.
Met groeten
ent

De gedachtenwisseling tijdens onze bijeenkomst in
Franeker Uw 2e bijdrage aan het
Leidraad hoge. Het heeft ons de Kinder-Vluchtelingen
in onze gedachten.

bijl.:
conc.
coll.

RAS

TELEPHONE:

gemeente franeker

8800 AB franeker
postbus 58, tel. 05170-2741
bankrelatie: rabobank franeker
rek. no. 32.04.15.600
giro bank 83 94 34

de heer Prof. dr. J.H. Oort
Pr. Kennedylaan 169
2324 EV Oegstgeest

no. uw brief d.d. no. franeker, 31 mei 1981

onderwerp: 200 jaar Planetarium

Hooggeachte heer Oort,

Wij stellen het zeer op prijs dat U bereid bent op 17 en 18 september a.s. onze gast te zijn, tijdens de viering van het 200-jarig jubileum van ons Planetarium. Wij zouden het eveneens op prijs stellen wanneer Uw echtgenote U zal vergezellen. Of wij daarop mogen rekenen vernemen wij nog gaarne van U. Hierbij willen wij U enige nadere informatie doen toekomen. U treft hierbij aan:

a. een officiële uitnodigingskaart voor 17 september, waarop U tevens het programma voor die middag vindt;
b. een circulaire en het programma voor 18 september, de dag van het symposium;
c. een overzicht van de andere festiviteiten rondom het Planetarium;
d. een programma van de gehele feestweek Agrarische Dagen.

Wij hebben voor U voor de nacht van 17 op 18 september een hotelkamer gereserveerd in Hotel-Restaurant De Doelen op de Breede plaats 6 (05170-2261). Na afloop van de plechtigheden op donderdagmiddag 17 september hebben wij een diner met gemeentebestuur en jubileumcommissie, waarop U uiteraard ook onze gast bent, 's Avonds kunnen wij de speciaal geschreven revue "Heisa om Eise" in de Koornbeurs bijwonen.

Gaarne zullen wij begin september nader contact met U opnemen over reis- en aankomsttijd enz. Eventuele vragen Uwerzijds vernemen wij gaarne.

Met de meeste hoogachting,

Namens de jubileum-commissie
200 jaar Planetarium,

(mr. J.J.H. Pop)

bijl.:
conc.
coll.

CARNEGIE INSTITUTION OF WASHINGTON

DEPARTMENT OF TERRESTRIAL MAGNETISM

July 9, 1981

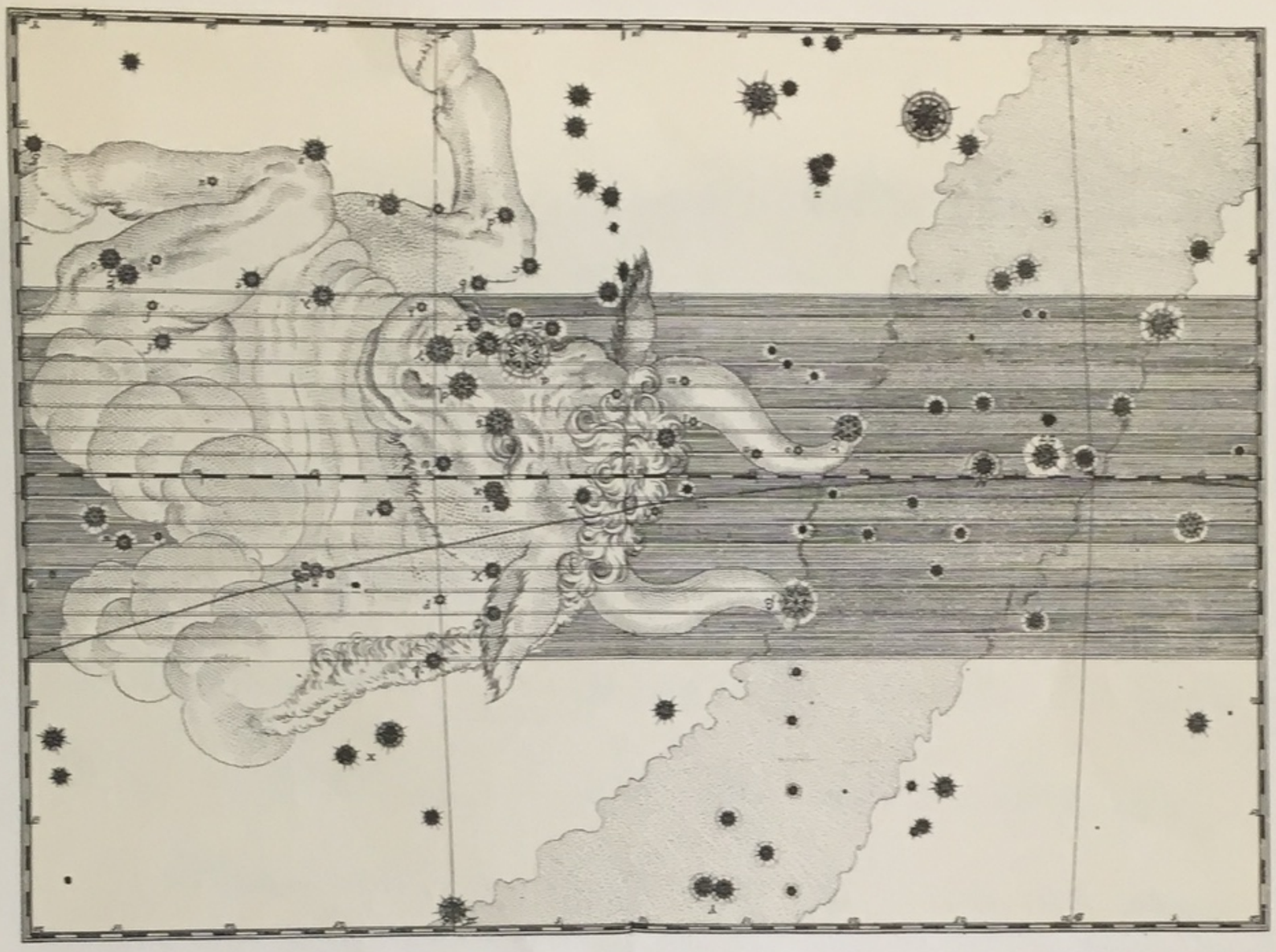
Dear Mieke, dear Jan,

Bob and I want to thank you both for the very warm welcome you gave us in your home and at the Sternwacht. Our visit was an especially lovely one, and I think it was due to the hospitality you showed us, and our children. It was so nice to get to know you better, in the surroundings of your home and garden. For several days after leaving we kept talking of our nice visit, and we really missed you. Perhaps some day there can be another visit, and we can get to see your island home.

Our stay in Groningen was very exciting scientifically and the weather cooperated too. Only in Paris was it cold (~ 9°C mid afternoon) and rainy,

Beautiful. Glad
you enjoyed it with human
beings.

CARNEGIE INSTITUTION OF WASHINGTON



TAURUS
COPPER ENGRAVING BY ALEXANDER MAIR
Johann Bayer's *Uranometria* (1603) was the first true star-atlas.
Gift of Earnest C. Watson, Millikan Library
Copyright © 1975, California Institute of Technology Archives
MUSEUM REPRODUCTIONS 6P-56

but we dressed for it and walked and walked.

We hope we will see you both in Washington again. You will have a warm welcome with us any time you can come.

Love from us both,

Vera & Bob

Bob & I are both [illegible]

← without the Crab Nebular.

Rubin

Rubin

CABLE ADDRESS
"MAGNETISM"

il June4
real
ng

on for
it
galactic
ıg the
ı der
iden.
chance

Mieke.
here.
a visit.

ıuct
ach
I'm not
ly work
NGC 3067,
axis.

ie from V=150 km/s
4X isophotal radius.
trapolating the observed.
so, then >95% of
om radii past the
ing for more such cases.

e you in June.
to the trip.

Sincerely.
Vera

Rubin

Rubin

Beautiful. 16 mei
Gevraagd of ze with Vera
kwam.

CARNEGIE INSTITUTION OF WASHINGTON

DEPARTMENT OF TERRESTRIAL MAGNETISM

5241 BROAD BRANCH ROAD, N. W.

WASHINGTON, D. C. 20015

TELEPHONE: 966-0863
AREA CODE 202

CABLE ADDRESS
"MAGNETISM"

May 21, 1981

Dear Jan,

I leave for Chile tomorrow, and will not be back in DTM until June4 or 5 (following Karl's Ph. D. graduation from Harvard). My real reason for writing is to tell you that Bob and I are planning a visit to Holland for about 2 weeks, leaving Washington on June 12. Bob will be attending the 60th birthday celebration for Niko van Kampen in Utrecht on June 18 and 19, and I decided it would be a fine time for me to visit with the nearby extragalactic people. I have made arrangements to spend a few days during the week of June 22 at Groningen, and have written to Harry van der Laan about speding a few days of the week of June 15 at Leiden. I have offered to give a colloquium, and would welcome the chance to discuss our work.

I hope that during this time we will be able to see you an Mieke. If you come in to the Observatory, then I should see you there. If not, perhaps you can leave a message and we can arrange a visit. It would be disappointing to be so close and not see you.

The work continues to go well. I have been able to construct "template"rotation curves for each absolute magnitude, each Hubble type, with which to compare any rotation curve. I'm not certain that it is the best way yet, but it will certainly work to get an absolute magnitude. We also have a result for NGC 3067, the Sb galaxy with a QSO a few radii away, near the minor axis. If the absorption seen in the QSO spectrum arrises in the

Now May 22 en route Miami

disk of the Sb, then the rotation curve continues to rise from V=150 km/s (at the isophotal radius) to V = 335 (+125, -100) at 4X isophotal radius. This rise is just that which would come from extrapolating the observed. slight rise, 3–7 kpc, out to 40 kpc. If this is so, then >95% of the mass, but <15% of the luminosity comes from radii past the isophotal [25 mag/(arc sec)^2] radius. We are searching for more such cases.

Best wishes to you & Mieke, and we hope to see you in June.
Bob & I are both looking forward very much to the trip.

Sincerely.

Vera

Rubin

CARNEGIE INSTITUTION OF WASHINGTON

DEPARTMENT OF TERRESTRIAL MAGNETISM

5241 BROAD BRANCH ROAD, N. W.

WASHINGTON, D. C. 20015

TELEPHONE: 966-0963

AREA CODE 202

CABLE ADDRESS

"WASHINGTON"

June 5, 1981

Dear Jan and Mieke,

Thank you very much for your recent letter, and the invitation to Bob and me to stay with you while in Leiden. It would be a great pleasure to do so. If convenient, we would like to spend Sunday, Monday, and Tuesday nights, June 14, 15, and 16. Starting June 17 we have reservations in Utrecht, with Bob's meeting. I will plan to spend Monday -Thursday at Leiden, perhaps even Friday depending upon the meeting plans. But on Thursday I will travel to Leiden from Utrecht.

We actually arrive in Schiphol airport midday on Saturday, but plan to spend Saturday and Sunday in Amsterdam at the museums. (We do not have a hotel reservation, but were planning to go to the visitors desk at the airport). We will plan to call you on Saturday (or Sunday morning if you are out on Saturday), and can then tell you which train we will take to Leiden. We will plan to arrive in Leiden about 6 or 7 on Sunday, so you will not have to plan for dinner on Sunday night. If for any reason these plans are inconvenient, we will just look for accomodations in Leiden for those nights.

Bob and I are very much looking forward to the visit, and the opportunity to see so many old friends. Best wishes to you both,

Sincerely,
Vera

We leave D.C. June 12: PA #106 to London (7:20 AM June 13 arrival)
Then KLM #120 9AM-11AM or KLM 124 11-13 depending on connections.

Leiden, November 4, 1980.

5843.

Dr. A.R. Sandage,
Mt Wilson Observatory,
813 Santa Barbara Street,
PASADENA, CA 91101.
U.S.A.

Dear Dr. Sandage,

I am trying to write an review on superclusters. In this connection I would much appreciate to receive a preprint of an article by Yahil, yourself and Tammann (1980) which was cited in a preprint of Tonry's thesis on the subject of our acceleration towards the Virgo cluster.

How are you? We have seen far too little of each other in the past years. With my best greetings,

yours,

Leiden, August 17, 1981.

5843.

Dr. R.H. Sanders,
Kapteyn Laboratorium,
Postbus 800,
9700 AV GRONINGEN.

Dear Dr. Sanders,

Enclosed I am sending you the questions I wanted to ask. In connection with these questions I would ask you to read p. 173 and p. 181 (2nd column) of our article and to look once more at the pictures. I am suggesting to Heeschen to publish a picture of my introductory report.

As I promised youwwhen we discussed this matter at the VLA I am sending you separately 2 pictures; one is an Hα picture at wavelength chosen so as to bring out the S-E forked arm. This shows the striking difference in the general Hα intensity preceding and following the arm. The other picture is one that was published in our article and shows in my opinion rather convincingly the weakening of the S-W arm in the region of the western plateau, while normally the arm would increase in strength while it moves inward. A similar weakening is shown by the strong N-E arm.

Because these photographic prints are unique (I have others butth they are of inferior quality) I must ask you to return these pictures to me as soon as you have inspected them. In fact, I intend to send the large print to Heeschen for reproduction. Please let me know your ppinion after you have investigated the pictures.

I am also looking forward to seeing a preprint of your note.

Sincerely yours,

NGC 4258: A Bent Jet in a Spiral Galaxy.

R.H. Sanders
Kapteyn Astronomical Institute

The remarkable continuum arms in the spiral galaxy NGC 4258 are suggestive of some form of ejection from the nucleus of this galaxy (Van der Kruit, Oort and Mathewson, 1972). To summarize the observations (see Oort, Figure 2, this volume), the "anomalous spiral arms" are clearly distinct from the normal spiral arms, although wound in the same sense; there is a sharp gradient of the continuum emission on the leading edge of the arms, and an indication that the arms split on the western side; the arms go directly into the nucleus and coincide with Hα emitting filaments (Courtes, Viton and Veron, 1965).

The only model which has been suggested for the anamalous arms involves highly directional ejection of 10^7 to 10^8 $M_\odot$ of gas at velocities from 800 km/s to 1600 km/s. Interaction of the clouds with the differentially rotating gaseous disk of the galaxy accounts for the observed shape of the arms. We may obtain an alternative model by assuming that the anomalous arms are more or less steady state jets which are bent both by a pressure gradient in the interstellar medium and by the ram pressure of rotating extended atmosphere. From the balance of centrifugal force within the bent jet against ram pressure and pressure gradient forces, one may derive a differential equation for the shape of the jet (Begelman, Rees and Blandford, 1979). I have assumed a rotating isothermal atmosphere (or gaseous halo) in a Hubble low potential with constant angular velocity on cylindrical shells. In this model there are five free physical parameters:

1) $f = V_{mx}^2/(\sigma^2 + V_{mx}^2)$.
   Here V_{mx} and σ are respectively the maximum rotational velocity and the velocity dispersion of the gas in the halo.
2) θ_e = the initial angle of the jet with respect to the rotation axis of the galaxy.
3) $\lambda = \rho_a V_a^2/\rho_j V_j^2$.
   This is the initial ram pressure in terms of the momentum flux in the jet.

4) S_o = the distance of the sonic point in the jet from the galactic nucleus.

5) R_o = the nozzle radius.

In addition there are two projection angles θ_1 and θ_2, but one of these is the known inclination of the galaxy.

There is one very necessary constraint on such a model. Ram pressure bends a jet into a spiral, but it is a leading spiral. However, the anomalous spiral arms have the same sense of winding as the normal spiral arms, and, presumably, the normal spiral arms are trailing. This means that, in the context of this model, the anomalous arms cannot lie in the plane of the galaxy. If our line of sight is between the plane of the galaxy and the plane of the anomalous arms then both the trailing normal arms and the leading anomalous arms will project into spirals with the same sense of winding.

Figure 1 shows the optimum bent jet model compared to recent VLA 20 cm observations of NGC 4258.

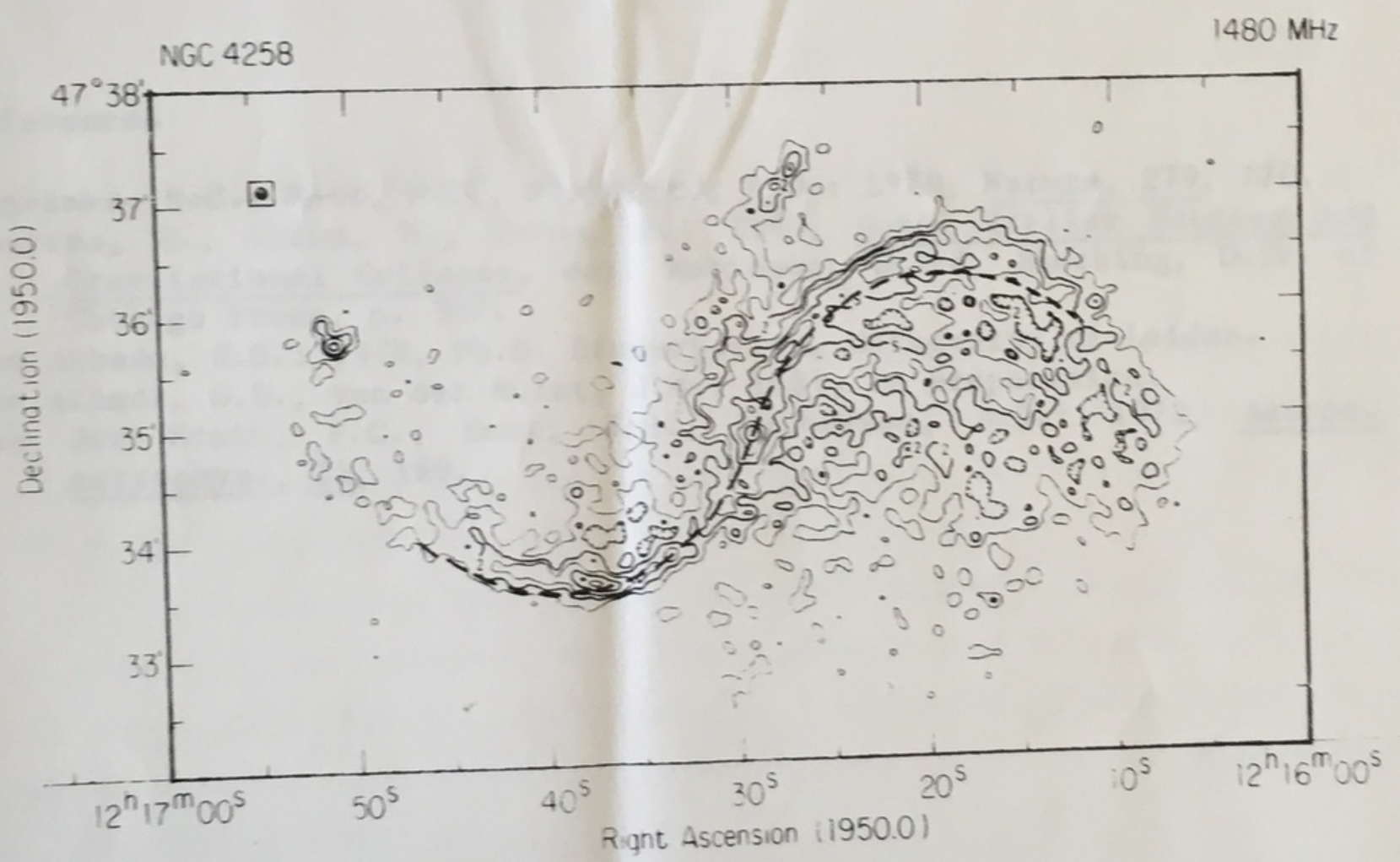


Figure 1. The bent jet projected on to the plane of the sky (dashed line) compared with the VLA 20 cm continuum map of Van Albada and Van der Hulst.

The parameters of this model are f = 0.8, θ_e = 80°, λ = 1.0, S_o = 250 pc, R_o = 100 pc with projection angels of 198° and 72°

(inclination). We see that the fit to the shape of the anomalous arms is reasonable. Moreover assuming a jet velocity of 1000 km s^{-1}, the mass loss rate is fairly mild (10^{-3} $M_\odot$/year).

This model has a very explicit observational consequence. To get the proper projection of the anomalous arms, the north western arm must lie behind the galactic plane. Therefore, we should see 21 cm absorption against this continuum arm.

NGC 4258 is an example of a normal spiral galaxy which may contain a jet. If jets do exist in normal spirals, perhaps the nuclei of most normal galaxies contain the same engines that are found in the powerful radio galaxies.

I am very grateful to G.D. van Albada and J.M. van der Hulst for kindly allowing me to use their 20 cm VLA map of NGC 4258 in advance of publication.

References

Begelman, M.C., Rees, M.J., Blandford, R.D.: 1979, Nature, 279, 770.
Courtes, G., Viton, M., Veron, P.: 1965, Quasi Stellar Sources and Gravitational Collapse, eds. Robinson, Shild, Shucking, Univ. of Chicago Press, p. 307.
Van Albada, G.D.: 1978, Ph.D. Dissertation, University of Leiden.
Van Albada, G.D., van der Hulst, J.M.: 1981, in preparation.
Van der Kruit, P.C., Oort, J.H., Mathewson, D.S.: 1972, Astron. Astrophys., 21, 169.

IAU Symposium No. 97

QUESTIONS AND COMMENTS

Speaker: R. Sanders Date: August 4

Name of Questioner: J.H. Oort

Question or Comment:

I see several objections to your model.
The first is that the normal arms of NGC 4258 show a pronounced weakening where according to the model of Van der Kruit, Oort & Mathewson the ejected gas would have swept them away.
The second is that the inner parts of the anomalous arms, where they are seen in Hα emission, show that the general, presumably disk-emission in the region preceding the arms is much stronger than in the region behind, indicating that these parts of the arms, which reach out to at least 6 kpc from the centre, are likewise situated in the disk. This is further corroborated by the fact that they participate in the disk's rotation.

Speaker's Response:

The outer spiral arms, at least the southern arms, do become less intense closer to the center of ~~thos~~ this galaxy. From visual inspection of photographs of this galaxy, the weakening seem to me to be entirely consistent whith what is seen in other normal Sb systems (M 81 for example).
As you point out, the general Hα emission is certainly weaker in front at the southern anomalous arm; however, the region of this low intensity does coincide with a large dust patch. My impression from van der Kruit's work ~~in~~ on the Hα filaments associated with the anomalous arms is that the kinematics of these features differ rather conspicuously from that of the general disk.

The bent jet model does account for two observational characteristics of the anomalous arms which are difficult to explain by a model involving ejection of massive clouds in the plane. First of all, there is the fact that the gradient of the contiuum is strongest on the leading edge of the arms where the jet would be interacting with the rotating ambient medium. Secondly, the anomalous arms do seem to be split, at least on the northern side. It is possible that a supersonic jet could break if it is bent too much.
I will discuss this in a later paper.

sterrewacht leiden

HUYGENS LABORATORIUM - WASSENAARSEWEG 78

Postbus 9513
2300 RA Leiden
Telex 39058 astro nl
Tel. 071-148333 (ext) s043

Leiden, November 8, 1979.

Dr. W.L.W. Sargent,
Astronomy Dept. 105-24,
California Institute of Technology,
1201 E. California Blvd.,
Pasadena, Cal. 91125.
U.S.A.

Dear Dr. Sargent,

Thank you very much for sending me a preprint of the article on the Ly α lines.

I have studied it with intense interest, and have reported on it at a session of our "literature club". It was the most interesting reading I have done for years. It opens up a field of research that might prove to be of great importance for our knowledge of the universe.

On one point I disagree with your interpretation, viz. where you use the "Hubble flow" to deduce an upper limit for the diameters of your "clouds" from their line widths. I believe that this is not possible. The very fact that the "clouds" are discrete features implies that they cannot be expanding in the same way as the universe: their expansion must necessarily have slowed down, and could, for instance, well be zero. The line width would then have to be ascribed to internal motions, and does not tell us much about the thickness.

In my opinion there is, therefore, no reason to think that the absorption lines would be due to relatively small clouds. They might well be caused by very large structures. With this in mind I have considered what sort of structures a line towards a quasar may traverse. There are four known categories to be looked at: individual galaxies, groups of galaxies, galaxy clusters and superclusters. In addition there might be a hitherto undiscovered class of objects, such as you suggest.

Let us first consider the others.

As regards the individual galaxies you have given two rather convincing arguments for discarding this possibility, viz. 1^o the excessive sizes of the galaxies that would be required (radii of $\sim$ 175 h_{100}^{-1} kpc for sample 1, and larger still if the smaller line widths are included; beside the argument that no matter has been observed at such large radii you stress convincingly that the galaxies would then begin to overlap, which appears impossible; the more so because of their extremely uneven distribution: most galaxies are situated in regions where the density is an order of magnitude higher than the <u>average</u> density in the universe, and 2^o the fact that the Ly α absorption lines show no correlation such as they should do if they were connected with individual galaxies. - I was impressed by your discussion of these correlations, in particular by Figure 5 and the striking difference it shows between the metal-line absorptions on one hand and the Ly α absorptions on the other. You have made a good case in this Figure for ascribing the former to galaxy halo's.

Next consider groups of galaxies. In Ap.J. Suppl. 32, 409, Turner & Gott give data for 103 groups in the region with $b > +40^{o}$, $\delta > 0^{o}$, comprising 6000 square degrees and extending to a distance of about 30 Mpc (if $H_o = 50$). Their median diameter being roughly 2^{o} the groups would cover about 1/17 of the sky. A line of sight would therefore on the average traverse one group per 17 x 30 = 510 Mpc, which is of the same order as the separation between your Ly α absorptions (340 Mpc if $H_o = 50$). However, the average velocity dispersion in a group is about 180 km/s (cf. Rood & Dickel, Ap.J. 224, 724), much larger than that indicated by the widths of your lines. It may be, of course, that any intergalactic gas in the groups would have a smaller velocity dispersion than the galaxies, but in that case this gas must have a smaller diameter than that found from the galaxies, too small in fact to provide the number of absorption lines required. Moreover this gas would be expected to be metal rich. Therefore we must probably discard groups as a possible cause of your absorption lines.

As to galaxy clusters their frequency is estimated to be about 10^5 times less than that of the groups. Although their diameters may average between 5 and 10 times larger this would by no means counterbalance their scarcity. Also, the gas would again have to have a very much smaller diameter if it is to produce an absorption line as narrow as the Ly α lines.

Now consider the superclusters. Our knowledge of these is still fragmentary. But I feel tempted to consider them as serious candidates. Next to the rich clusters they are the most striking features in the distribution of galaxies. This is evident, for instance, in the distribution of the Shapley-Ames galaxies over the sky, a major fraction of these being concentrated in the Virgo cluster and its extensions (De Vaucouleurs' "Local Supercluster"); similarly, at greater distance, by the Coma super-cluster, for instance, which appears to extend over about 200 x 100 Mpc. The prominence of superclusters is also evident along the line of sight, cf. the enclosed picture of the radial-velocity distribution of the galaxies seen in the area covering the denser part of the Hercules super-cluster (copied from ESO Scientific Preprint No. 65 by Tarenghi, Tifft, Chincarini, Rood & Thompson).

Very roughly three giant superclusters with dimensions ranging from 200 x 100 to 100 x 50 Mpc, and within ∿ 200 Mpc distance, have been discussed in the literature, as well as two minor superclusters with dimensions of the order 30 x 15 Mpc, and lying within ∿ 60 Mpc distance (I am taking $H_o = 50$). In general these seem to have flat or elongated shapes.Assuming that about half the sky has been studied, the above data would lead to a value of about 300 Mpc for ℓ_o. The fact that they have the same order of separations as you find from your Ly α absorptions has led me to give serious thought to superclusters as a possible origin of these absorptions. It would be fantastic if the Ly α absorption could teach us new things about this aspect of the large-scale structure of the universe! However, at the present stage this is no more than a speculation. The behaviour of the intercluster gas in superclusters is largely unknown. If we accept the notion that the forefathers of the superclusters are the "pancakes" into which the primordeal gas in the Universe must have collected as pointed out by Zeldovich and his co-workers, we would have to suppose that the fairly large random motions

unreasonable. The observed widths of the Ly α lines would then be principally due to thermal motions.

Each supercluster should then produce a single Ly α line.

In the case of the superclusters all of the difficulties with which your 30-kpc gas clouds are faced would at first sight seem to disappear. They will not suffer evaporation, the gas can be held together by its own gravitation. It does not need a not surrounding medium. The dangerous "balancing" which you describe for your clouds appears to be avoided in this model. In addition, the superclusters will not be correlated with each other, so that the lack of correlation in the Ly α systems is explained in a natural way.

I want to write to Zeldovich to ask his views on the probable condition in the supercluster/pancake remnants.

The most crucial question which might ultimately be answered by observations is that of the lateral dimensions of the Ly α absorption features. If they are related to superclusters of, say, 100 Mpc, their diameters should be about $3\overset{\circ}{.}5$ at $z = 2.5$ (for $H_o = 50$, $q_o = 0.1$), while if they are objects of 30 kpc diameter their angular diameter would be of the order of 8". If one could find two sufficiently bright quasars with a separation of one or two degrees the Ly α absorptions could probably show whether or not they are due to objects with sizes of the order of those superclusters.

One exceedingly interesting question is whether or not any metals are contained in the absorption features. You write that you have been able to find <u>some</u> information on Ly β. Would it similarly be possible to get a significant upper limit to the C IV intensity by averaging all your absorption systems?

I want to thank you once more for sending me your article and to express again my admiration for the beautiful work you have accomplished.

I am sending this letter to the two authors, Sargent and Boksenberg, whom I have the pleasure of knowing personally.

With best wishes,

sincerely,

J. H. Oort

Ap J 234, 793. (Tarenghi et al.)

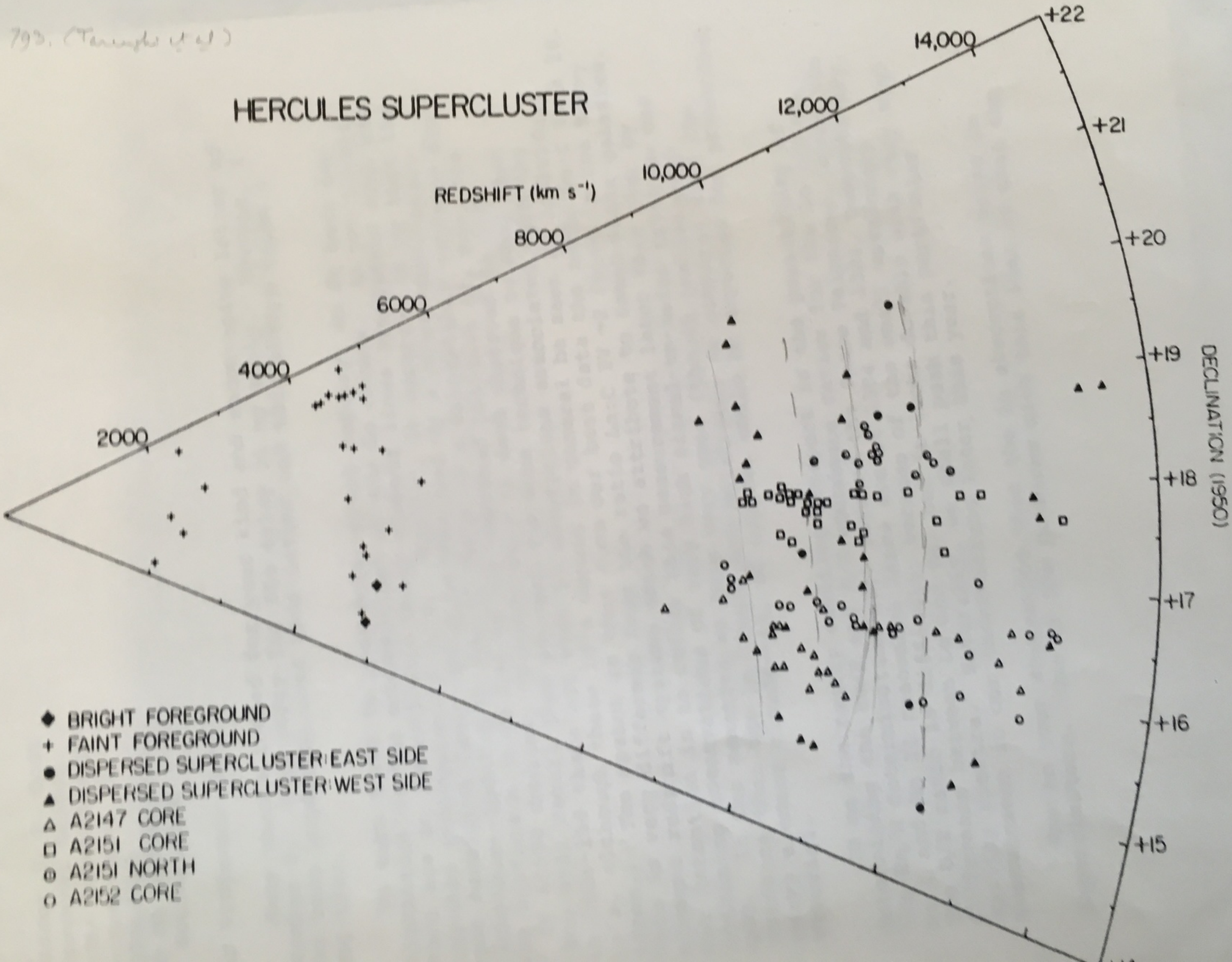


Fig. 3

Br.

CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA 91125

February 11, 1980

Professor J. H. Oort
Sterrewacht Leiden
Huygens Laboratorium
Wassenaarseweg 78
Postbus 9513
2300 RA Leiden,
The Netherlands

Dear Professor Oort:

Many thanks indeed for your kind and encouraging letter of November 8. I am sorry for the delay in my reply. However, I have been pondering over your letter and this always takes a long time.

To turn first to your more recent enquiry, we do have new information on the compositions of the Lα clouds. As you recall there are no identifiable heavy element lines associated with the supposed intergalactic Lα's. However, it occurred to me that the most sensitive limit would be obtained by a cross-correlation technique--looking to see if there is a statistical tendency for the continuum to be low at the expected position of, say, the C IV λ1550 doublet, corresponding to each observed Lα line. (You will recall that we used the same technique to show that in 2126-158 there are weak Lβ absorptions associated with the Lα's, although these Lβ's cannot in general be seen as individual lines.) The upshot is that from our best data the ratio Lα:C IV ≥ 10. This is very different from the ratio Lα:C IV ~2 found in the heavy element redshift systems which we attribute to intervening galaxies. Our intention is to refine this measurement later this year by obtaining observations of very high signal-to-noise ratio on one QSO. In the meantime we have very good (though preliminary) evidence that the Lα clouds are metal-poor as compared with the heavy element clouds--as, of course, would be expected for primordial material.

To me the really exciting prospect is the possibility of determining the He/H and D/H abundance ratios for the Lα clouds. The He/H determination will require the Space Telescope, since the He I and He II resonance lines are at λ584 and λ304, respectively. The D/H ratio is difficult, because of the small wavelength difference between Lα and Dα, but it looks do-able with very high quality spectra. Naturally, we shall push this particular measurement in our observations later this year.

Now to your suggestion that the Lα absorptions arise in superclusters. One of the problems with this idea is that the

Bre...

velocity dispersion within a supercluster must be large. If the superclusters are bound and have dimensions of 100 Mpc, then the differential Hubble velocity across such a cluster is 10^4 km/sec so the velocity dispersion must be at least this. I do not see how such a large structure would have the small velocity dispersion that is observed. On the other hand, the clouds may well be smaller entities within the superclusters. Presumably the tendency for superclusters to occur is contained already within Peeble's correlation function. As you saw, the observed correlation function for the Lα clouds is in disagreement with the galaxian correlation function extrapolated back to z ~ 2.5. However, I doubt that our present Lα correlation function contains enough information on scales of 100 Mpc (~10^4 km/sec) to say whether or not the Lα clouds are in superclusters. We propose to obtain much between data on the correlation function later this year. This can be done by observing more QSO's and by measuring weaker lines on better spectra.

In any case, I am still convinced that the Lα clouds are fairly small objects supported by external pressure. You rightly are somewhat suspicious of the balancing between self-gravitation and evaporation which is required on our interpretation. However, in our view the clouds only constitute a small fraction of the mass of the Universe: it may be that only the small fraction of clouds that satisfy our conditions remain.

Once more I thank you for your interest in our work. It is one of the few pieces of work that I am really pleased with.

With best wishes,

Sincerely,

Wallace Sargent

Wallace Sargent

WLWS/mr

P.S. Regretfully Paper II is still being written: I'll send a copy later.

CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA 91125

Aug. 17 1981

Dear Professor Oort,

About two months ago we made observations of two QSO's with $z \sim 2.5$ which are separated by only 3 arcminutes on the plane of the sky. As you will see from the enclosed paper, an analysis of the absorption lines in the two objects shows no tendancy for the Lα lines to correlate — thus providing a clear contradiction with your hypothesis that the lines arise in gas generally distributed in super-clusters.

More recently, Boksenberg, Young and I have made further observations of one of the two QSO's, 1623+268 No. 77, in order to try and set a really good limit on the composition of the Lα clouds. These observations are excellent and we expect to have the results (which I shall send to you) within a few weeks.

The lack of clustering shown by the Lα clouds continues to baffle me; however, the considerations concerning the correlation function in the enclosed paper ~~that~~ have led to new insights (at least for us) on what observations one should make.

Yours sincerely

Wallace Sargent

CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA 91125

Leiden, September 11, 1981+

Professor J. H. Oort
Sterrewacht Leiden
Postbus 9513
2300 RA Leiden
The Netherlands

5843.

Dr. W.L.W. Sargent,
Astronomy Dept. 105-24,
Caltech,
1201 East California Blvd.,
PASADENA, CA 91125.
U.S.A.

Dear Professor Oort:

Dear Dr. Sargent,

I have received your letter of August 17 and the two very interesting SYS ~~and YSB~~ts SYS and YSB (of which I would appreciate to get reprints as well after the artéles have appeared). The article on the Lα absorption lines in the two neighbouring quasars I have read with special care. It appears that you have made a decisive test, and that the édea of abosrption in extended sheets of gas has to be dropped. In a way this is a pity because a positive result would have given interesting information on the universe; but I am not surprised by your result. There were more difficulties involved in my hypothesis than I had thought at first.

The separate clouds that yourhypothesized also encounter difficulties. Most serious may be the lack of clustering which your new results appear to establish rather definitely. It is hard to conceive how the small clouds could have escaped the clustering process. But, may be, they must cannot exist in a cluster or a group because they would amalgamate with spirals, or with each other.

An alternative, but quite extreme supposition would be that the absorption lines are due to galaxies with extremely extended HI disks or which are surrounded by huge complexes of HI. We know of spirals that extend to 100 kpc with rotation velocities that shownno sign of any decrease even at that distance. Your Lα lines correspond to HI column densities of $\gtrsim 10^{14} cm^{-2}$, while the measurable limit for 21-cm emission is $\sim 10^{18} cm^{-2}$, so there might be a very long way to go before reaching $10^{14} cm^{-2}$. May be such objects cannot cluster because they are too large.

I was much interested in youurstatements on pp. 10 and 11 concerning the redshift dependence of N(z). It seems to me that this may open an important new possibility for the determination og q_o as soon as the Space Telescope becomes available for measuring Lαabsorptions atssmall z. The evolution of the objects causing the Lα absorptions may form an obstacle, but no more serious than the obstacles in all other methods for determining q_o. I wonder whether you could let me have a prerping of the paper by Young, Sargent & Boksenberg 1982, which you mentioned in this connection.

The second preprint, on the CIV absorptions, was no less interesting to me. The large halo radii you suggest look somewhat excessive, in particular when confronted with the absence of HI emission that the Cornell group has stated. A possible splution might be to consider dwarf galaxies having very large halos, instead of L galaxies. The former may be much more numerous.

With ~~many~~thanks for your interesting information,

your sincerely,

CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA 91125

September 17, 1981

Professor J. H. Oort
Sterrewacht Leiden
Postbus 9513
2300 RA Leiden,
The Netherlands

Dear Professor Oort:

Thank you for your very interesting comments on the two papers SYS and YSB -- I shall certainly send you reprints when they appear next Spring.

I enclose two more preprints, including the one on the N(z) relationship that you requested. I had thought that I sent you a copy of this work earlier this year when the papers were completed, but evidently I was mistaken.

In the YSB paper on the C IV absorptions we took into account the whole galaxian luminosity function in estimating the required cross section. The details are given on p. 62 of Sargent et al., Ap. J., 230, 49 (1979), a reprint of which I enclose. Of course, it is entirely possible that the standard luminosity function which is assumed in that paper seriously underestimates the number of extreme dwarf galaxies. In fact, one of the main reasons underlying my work with K. Y. Lo to search for dwarf galaxies in nearby groups has been to test this very possibility.

I entirely agree that the study of the redshift dependence of N(z) holds great promise for the determination of q_o. As we showed in SYBT (p. 54), the dependence on q_o is greatest for $z = 0$! Also, at $z = 0$ we have at least some chance of studying the evolution of the clouds directly so, like you, I am eagerly awaiting the launch of the Space Telescope. Of course, it may turn out that there are no Lα clouds left at the present epoch. Also, as shown in Appendix B of SYBT, the amount of data required is daunting.

I have to apologize that this letter is neither as complete nor as coherent as I would have wished. However, as you have probably heard by now, Peter Young, my close collaborator in these investigations for the last five years, died in tragic circumstances on September 6, 1981. Peter had been my Ph.D. student (although I had little to teach him) and joined my work with Boksenberg almost as soon as he arrived at Caltech. He was a person of extraordinary brilliance and I feel his loss very deeply. During this year we had completed six papers, although often under

difficult circumstances, and we were still eagerly discussing the next phases of the work only a few days before he died. I shall continue to work on the Lα clouds, particularly on their composition and I have some ideas on how to attack the mystery of their distribution. However, it is clear that without Peter the rate of progress will be much slower.

Turning to a more cheerful topic, I have heard that you intend to come to a meeting on the Galactic Center here in Pasadena in the New Year. I do hope that you can be persuaded to stay longer in Pasadena so that, among other things, we might talk about the absorption lines.

With many thanks for your comments,

Yours sincerely,

Wallace

Wallace Sargent

WLWS/mr
enc.

Copie

sterrewacht leiden

HUYGENS LABORATORIUM - WASSENAARSEWEG 78

Postbus 9513
2300 RA Leiden
Telex 39058 astro nl
Tel. 071-148333 (ext) 5843.

Leiden, September 11, 1981+

Leiden, December 11, 1981.

Dr. W.L.W. Sargent,
Astronomy Dept. 105-24,
Caltech,
1201 East California Blvd.,
PASADENA, CA 91125.
U.S.A.

Dr. W.L.W. Sargent,
California Institute of
Technology,
Pasadena, CA 91125.
U.S.A.

Dear Dr. Sargent,

I have received your letter of August 17 and the two very interesting preprints, SYS and YSB (of which I would appreciate to get reprints as well after the articles have appeared). The article on the Lα absorption lines in the two neighbouring quasars I have read with great interest. You have made a convincing case that these lines are due to clouds of gas has to be dropped in your picture of the universe; but I am not surprised by your given interesting information on the universe; but I am not surprised by your result. There were more difficulties involved in my hypothesis than I had thought at first. Most serious may be the lack of correlation. The observational results appear to establish rather definitely. It is hard to conceive how the small clouds could have escaped the cluster or a group because they would amagamate with spirals, or with each other.

An alternative, but quite extreme supposition would be that the absorption lines are due to galaxies with extremely extended HI disks of which are surrounded by huge complexes of HI. We know of spirals that extend to 100 kpc with rotation velocities that show no sign of any decrease even at that distance. Your Lα lines correspond to HI column densities of $\sim 10^{14} cm^{-2}$, while the measurable limit for 21-cm emission is $\sim 10^{18} cm^{-2}$, so there might be a very long way to go before reaching $10^{14} cm^{-2}$. May be such objects cannot cluster because they are too large.

I was much interested in your statements on pp. 10 and 11 concerning the redshift dependence of N(z). It seems to me that this may open an important new possibility for the determination of q_o as soon as the Space Telescope becomes available for measuring Lα absorptions at small z. The evolution of the objects causing the Lα absorptions may form an obstacle, but no more serious than the obstacles in all other methods for determining q_o. I wonder whether you could let me have a preprint of the paper by Young, Sargent & Boksenberg 1982, which you mentioned in this connection.

The second preprint, on the CIV absorptions, was no less interesting to me. The large halo radii you suggest look somewhat excessive, in particular when confronted with the absence of HI emission that the Cornell group has stated. A possible solution might be to consider dwarf galaxies having very large halos, instead of L_* galaxies. The former may be much more numerous.

With many thanks for your interesting information,

yours sincerely,

J.M.O.

Dear Dr. Sargent,

I have not yet reacted to your letter of September 17th, largely because I have been entirely absorbed by the writing of an article on superclusters for the Annual REview of Astronomy and Astrophysics, which I am finishing these days.

My wife and I shall beiin Pasadena from January 2-20. I am looking forward to having some discussions with you during that time on the problems in which both of us are so much interested. Maybe I can postpone my answer to your letter until that time.

With best regards and good wishes for the Christmas season,

yorus sincerely,

Copie

sterrewacht leiden

HUYGENS LABORATORIUM - WASSENAARSEWEG 78

Postbus 9513
2300 RA Leiden
Telex 39058 astro nl
Tel. 071-148333 (ext) 5843.

Leiden, September 11, 1981+

Dr. W.L.W. Sargent,
Astronomy Dept. 105-24,
Caltech,
1201 East California Blvd.,
PASADENA, CA 91125.
U.S.A.

Dear Dr. Sargent,

I have received your letter of August 17 and the two very interesting preprints SYS* and YSB** (of which I would appreciate to get reprints as well after the articles have appeared). The article on the Lα absorption lines in the two neighbouring quasars I have read with special care. It appears that you have made a decisive test, and that the idea of abosrption in extended sheets of gas has to be dropped. In a way this is a pity because a positive result would have given interesting information on the universe; but I am not surprised by your result. There were more difficulties involved in my hypothesis than I had thought at first.

The separate clouds that you hypothesized also encounter difficulties. Most serious may be the lack of clustering which your new results appear to establish rather definitely. It is hard to conceive how the small clouds could have escaped the clustering process. But, may be, they just cannot exist in a cluster or a group because they would amagamate with spirals, or with each other.

An alternative, but quite extreme supposition would be that the absorption lines are due to galaxies with extremely extended HI disks or which are surrounded by huge complexes of HI. We know of spirals that extend to 100 kpc with rotation velocities that show no sign of any decrease even at that distance. Your Lα lines correspond to HI column densities of $\sim 10^{14} cm^{-2}$, while the measurable limit for 21-cm emission is $\sim 10^{18} cm^{-2}$, so there might be a very long way to go before reaching $10^{14} cm^{-2}$. May be such objects cannot cluster because they are too large.

I was much interested in your statements on pp. 10 and 11 concerning the redshift dependence of N(z). It seems to me that this may open an important new possibility for the determination of q_o as soon as the Space Telescope becomes available for measuring Lα absorptions at small z. The evolution of the objects causing the Lα absorptions may form an obstacle, but no more serious than the obstacles in all other methods for determining q_o. I wonder whether you could let me have a preprint of the paper by Young, Sargent & Boksenberg 1982***, which you mentioned in this connection.

The second preprint, on the CIV absorptions, was no less interesting to me. The large halo radii you suggest look somewhat excessive, in particular when confronted with the absence of HI emission that the Cornell group has stated. A possible solution might be to consider dwarf galaxies having very large halos, instead of L_* galaxies. The former may be much more numerous.

With many thanks for your interesting information,

yours sincerely,

J.K.O.

(Sargent, Young & Schneider
* Lα absorptions in two quasars at z = 2.52 and 2.60, with sep. of 187" (1-2 Mpc).
** "CIV absorption in an Unbiased Sample of 33 QSO's: Evidence for the Intervening Galaxy Hypothesis"
*** "... Evidence for Cosmological Evolution in the Lα Lines"

SCIENTIFIC DIRECTOR
UNITED STATES NAVAL OBSERVATORY
34TH AND MASSACHUSETTS AVE., NW
WASHINGTON, D.C. 20390

5 June 1981

Dear Jan,

I have been asked by the organizer, Dr. W. T. Sullivan, to present a paper on the early history of radio astronomy in the Netherlands at the XXth General Assembly of URSI in the session on history. I was very reluctant to accept as I feel a current Dutchman should present such a paper. Apparently, however, none of those involved in the early days in Holland will be at URSI. After discussions with Professors Oort and van der Laan I finally accepted the assignment.

However, I now need help, as I have only a limited file. I plan to talk about the 1944 Colloquium, the early discussions between Oort and de Voogt, the Würzburg antennas, the start by Ir Ho, the fire, the rapid build-up by Muller, the experiences with operations in Kootwijk and reductions in Leiden, improvements in equipment, work towards the Dwingeloo dish, Seeger's 400 MHz work, the 1955 Crab Nebula occultations, the start-up of Dwingeloo, the "absolute flux" of Cas A, the first discussions about the Beneluxcross, and the development of solar radio astronomy in Nederhorst den Berg and later in Dwingeloo. That was a long one-sentence outline. I need help with pictures and stories on the receiver and antenna developments, short paragraphs on items I should not overlook, etc. I need help especially with the Solar work. I will address a specific request to you ~~on a separate sheet~~ Below. This part of the letter is more general. I do have the 25th anniversary booklet "Een zilveren spiegel", which is a great help.

I will be in Holland from Monday, July 13 through Wednesday, July 15 and hope to visit Leiden and Dwingeloo. Please write to me so that your letter reaches me before July 4, which is the date I leave Washington. You can contact me after that c/o Prof. H. van der Laan in Leiden. Replies may certainly be in Dutch. Your help will be greatly appreciated. I hope to be able to do justice to the tremendously important role Dutch Radio Astronomy has played in the development of the field.

Sincerely,

CART WESTERHOUT

cc:
Prof. J. H. Oort
Prof. H. van der Laan
Prof. C. A. Muller
Ir. H. C. Kahlmann
Dr. A. D. Fokker
Ir. B. G. Hooghoudt
Mr. A. C. Hin
Mr. A. H. Schöller
Dr. C. L. Seeger

De verhalen in "Een Zilveren Spiegel" geven een heleboel hulp. Als je mij mogelijkerwijze zoudt kunnen helpen aan een paar punten betreffende de jaren 1945-1950 (Wanneer begon Ir Ho eigenlijk?). Zijn er misschien populaire artikeltjes? Ik zal uiteraard in het archief in Dwingeloo snuffelen en zal daar nog wel het nodige vinden. Bedankt alvast. Jan