CONFERENCE SUMMARY

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Abstract. The present paper reviews the talks and poster papers presented at the IAU 182 symposium. The papers are divided into different subjects, highlighting their contributions to the field of outflows from young stars. The observational contributions were notable because of the results recently obtained with new instruments (e. g., with radio interferometers and space based observatories). The theoretical contributions were noted by the increased understanding of the production of collimated winds from young stars, and by numerical and analytic work on the propagation of the outflows.

1. Introduction

The IAU 182 symposium is the first conference dedicated to Herbig-Haro objects since the symposium on HH objects in Mexico in 1983. This unusually long time-span between conferences (at least, for astronomical subjects) has resulted in an extremely exciting meeting. In particular, very interesting new observational results have been presented, driven by new instrumental developments : mm interferometers (Plateau de Bure, Nobeyama, Owens Valley, BIMA, and now even the VLA !), ISO, infrared cameras and spectrographs on many optical telescopes and HST. Notably, the UV wavelength range has been mostly absent from the meeting.

From the theoretical point of view, this meeting has been the ground for discussions on detailed models of HH jets and molecular outflows, as well as models for the production and collimation of MHD winds from young, low mass stars. The interaction between the observers and the theoreticians that occurred during this meeting was very positive, and hopefully will result in important progress in the near future.

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The present paper is organized as follows. Section 2 describes a more or less complete tabulation of the poster papers and talks presented at the meeting. Section 3 discusses some of the important observational work presented at the meeting, and section 4 discusses part of the theoretical work. Finally, section 5 is dedicated to conjectures about the (near) future evolution of the field of outflows from young stars.

2. Papers presented at the meeting

One of the most interesting novelties in the organization of the meeting was the production of a "Poster Proceedings" book, edited by Malbet and Castets (1997), which was distributed to the participants upon arrival. This book is most useful and, together with these Proceedings should provide a more or less complete coverage of the work presented at the meeting.

Tables 1-5 list all of the poster papers and talks given at the meeting, divided into a number of different categories. These categories have been chosen so as to highlight the contributions of the papers to the field of outflows from young stars, which was the main topic of the conference.

I would like to apologize to all second authors for the fact that in order to save space both the talks and the poster papers are listed exclusively under the name of the first author (in the "first author" column of the tables). The talks are labeled with a "t" in the "reference" column, and the poster papers are labeled with the page number of the corresponding paper in the poster proceedings book (Malbet and Castets 1997). Some authors presented both talks and posters on similar subjects, and the two contributions are then listed together in the same line (with both a "t" and a page number in the "reference" column). Most of the papers corresponding to the talks can of course be found in these Proceedings.

Finally, there were a number of "late poster papers" presented at the meeting. Some of these are included in tables 1-5, with an "lp" entry in the "reference" column. However, a probably high percentege of the late poster papers has not been included in the tables.

I have risked to introduce a column of "comments", in which I have tried to describe the different papers in 2-5 words. It is of course impossible to do a fair description of any of the papers in such a way. These comments only represent the things that came to my mind as particularly interesting from looking at the papers in the poster proceedings book and at my notes. I feel that they might be useful as a guide to the subjects covered in the meeting.

The observational papers have been divided into :

Outflows : subdivided into categories depending mostly on wavelength range, instrumental technique, or particular instruments,

T Tauri, FU Ori stars : subdivided into variability, spectra and disks/ envelopes around T Tauri stars,

Cores and globules (no subdivision)

Star formation : mostly includes papers which do not fit in the other categories,

Orion M 42 objects : papers on OMC 1 HH objects, proplyds, etc. .

The theoretical papers are listed together under the **Theory** heading, which is subdivided into : wind production/collimation; jet/outflow models; disks, envelopes; collapse; chemistry of outflows; and other topics.

The division into these categories is of course quite arbitrary, since many papers include many different observational results, and many are also both observational and theoretical. This is particularly true of the longer talks, which in many cases covered a broad range of subjects.

If we take the classification of the papers in tables 1-5 seriously, we would conclude that out of a total of 166 papers, 127 were observational, and 39 were theoretical. Of the 166 theoretical and observational papers, 87 were directly concerned with HH objects and/or molecular outflows (keeping the 3:1 observational to theoretical paper ratio of the total sample). The majority of the remaining papers are concerned with observations and theory of the near environment of the outflow sources (35 papers) and cloud cores (18 papers).

Tables 1-5 do not include a very interesting late poster paper by Reipurth, which predicted the appearance of a new version of his HH object catalogue (Reipurth 1994). This new version will include approximately twice as many objects as the previous 1994 edition, and I personally look forward to having a copy soon !

The following two sections describe a few of the more notable aspects of the observational and theoretical results (respectively) presented at the meeting. The discussion is centred on the work directly related to the formation and propagation of outflows from young stars.

3. Observational results

The probably most exctiting reported observations of outflows were the ones resulting from the new, space based instruments ISO and HST. The ISO observations (see table 1) have opened up a previously little observed region of the spectrum of outflows, showing lines of [O I] and [C II], and in some objects also lines of different molecules.

The HST images presented in this meeting (see table 2) give a surprising new view of HH jets, with the well known chains of knots resolved into small bow-shaped structures, shocks in sharp bends, and less well defined structures in other cases. Proper motion determinations have been carried out, and new knots have been seen to appear close to the outflow sources.

Some of the HST images of HH objects (e. g., of large heads of jets) appear to finally have spatially resolved the cooling regions behind HH shock waves in an unambiguous way. This has been shown in a quite dramatic way, e. g., in the H$\alpha-$[S II] subtracted images of Reipurth and Heathcote (1997). Very interesting structures are also observed in some bow shocks, where a complex fragmentation appears to be occurring.

The mm interferometrical observations of molecular outflows presented at the meeting (see table 1, and Guilloteau *et al* 1997) are possibly even more interesting than the ISO and HST observations. We now see that at least some molecular outflows are highly collimated, and have structures that look like shells at the walls of elongated cavities, or like well collimated jets. In some objects, both structures coexist, with higher velocities in the jet-like, central component. Also, different molecules are seen in each component. These observations represent a dramatic improvement in spatial resolution over previous observations of molecular outflows, and should provide a very strong impulse for further modelling.

Also, single dish mm observations of outflows appear to be giving most interesting results (see table 1, and Bachiller and Pérez Gutiérrez 1997). Information is now available of the spatial distribution of the emission of several different molecules along some outflows. These observations appear to finally provide similar constraints on molecular outflow models to the ones that have been available for many years for HH objects.

New radio continuum interferometric observations of the jet-like structures associated with the sources of HH objects were reported in 6 papers. Rodríguez (1997) pointed out that now there are ~ 80 HH sources detected in radio continuum, ~ 30 of which have been resolved spatially (mostly into jet-like structures). Maps with the new 7 mm detectors at the VLA provide an unprecedented (for HH flows) resolution of $\sim 0.04''$. Ray *et al* (1997) reported the detection of polarization offset from the position of an outflow source (from which the magnetic field can be estimated). Such observations clearly provide important constraints for wind collimation mechanisms.

It is interesting to note that the same number of papers has been presented on ground based IR imaging/spectroscopy as on optical imaging and spectroscopy. This is a measure of the extremely lively progress of IR observations of HH objects (see table 2, and Eislöffel 1997). Most of the IR observations have been restricted to imaging, but we also see that some spectroscopic work is being done (giving both line ratios and radial velocities, see, e. g., Noriega-Crespo 1997). These observations of course focus on studying the very rich IR spectrum of the H_2 molecules.

These IR observations show H_2 structures associated with optically detected HH objects or with optically invisible "H_2 jets". A clearly important issue is to see to what extent these two kinds of objects correspond to similar phenomena. Also, it appears to be most interesting to compare the spatial distribution of the H_2 emission with the emission of other molecules. This has been done, e. g., by Chandler & Richer (1997) for the case of HH 211 (see also Zinnecker *et al.*, 1997; Guilloteau *et al* 1997).

The optical imaging papers focused on searches for new HH objects, and on the study of the so-called "superjets" (Bally and Devine 1997). On the first subject, the work presented in the conference shows that searches of HH objects based on optical imaging still yield a number of interesting new outflows. On the latter subject, the 3 papers presented at this meeting (see table 2) show exciting identifications of jets extending over many parsecs. Even out to these unprecedently large distances from the source, a very striking jet/counterjet symmetry appears to be preserved.

The paper of Böhm and Goodson (1997) presented a new analysis of spectrophotometric data of HH objects, concluding that the presently available shock wave models appear to have quite surprising problems. The remaining papers on optical spectroscopy focussed on 20 to 300 km/s resolution spectroscopy with long-slit or spectro-imaging spectrographs (the lower resolutions corresponding to the latter technique). Four papers (Solf 1997; Mundt 1997; Corcoran and Ray 1997; Lavalley *et al.* 1997) were dedicated to the analysis of the so-called "microjets", extending for distances of only 2-4″ from the source. These results appear to be highly interesting in that they provide some of the most important constraints available for wind production/collimation models.

Such constraints are also provided by the observations of the properties of T Tauri stars, which show evidence for the co-existence of inflow and outflow in many objects (Hartmann 1997; Calvet 1997; Edwards 1997). The observation of variabilities in timescales ranging from hours to decades (see table 3), as well as the determination of magnetic fields (Guenther 1997), also provide important constraints on wind collimation mechanisms as well as on models of jet structures resulting from variabilities of the source.

Finally, a number of observational papers on dense cores were presented. These studies ranged from radio wavelenghts (e. g., Terebey and Padgett 1997) to the IR (Gredel 1997), and included in many cases detailed comparisons with kinematic+radiative transfer models. From such comparisons, a quite clear picture of the collapse and rotation of the clouds can be obtained. In very intriguing papers, André (1997) and Fuller and Ladd (1997) set out the basis of how to obtain an evolutionary sequence for cores and very young stars.

4. Theoretical results

The theoretical papers were to some extent dominated by the wednesday session on MHD wind models. Camenzind, Heyvaerts, Kwan, Pudritz and Shu participated in a round-table discussion chaired by Hartmann, and there were also a number of talks during the day. Let me give a short description of the main issues that arose in the talks of the participants :

- Camenzind (1997) presented a model of a wind from a strongly magnetized star, and discussed the possible (though non-intuitive !) importance of the light cylinder in such flows. He also showed predictions of line-profiles from the wind model (based on the introduction of a somewhat arbitrary heating term),
- Heyvaerts (1997) gave a very technical talk which described the general properties of asymptotic wind solutions (for large distances from the source). He also talked about the possibility of having a "polar boundary layer" to prevent on-axis crushing. This of course is an intriguing idea in the context of observations of HH flows,
- Kwan (1997) talked about coronae around disks, and presented kinematic models of these regions,
- Pudritz and Ouyed (1997) presented numerical simulations of a jet ejected from a magnetized disk. These models assumed an arbitrary mass loading from the disk into the wind. Interesting predictions were made of the conditions under which the jets are stable or unstable, the latter jets having chains of knots,
- Shu and Shang (1997) presented the X-wind model, which appears to be the more complete model to date. A complete solution of the dynamical structure of the wind has been computed by Shu and collaborators, as well as an analytic solution for the asymptotic regime of large distances from the source. Shu also presented X-wind driven thin shell solutions into a stratified environment.

There were also a number of other talks on MHD wind production and collimation (see table 4), describing important aspects of these flows. One of the important remaining problems of wind models appears to be the determination of the temperature structure of the base of the wind, which is most interesting as it would enable a comparison with the T Tauri microjets. This issue was addressed in two papers (Martin 1997; Paatz and Appl 1997). A different issue was raised by Frank and Mellema (1997), who discussed the collimation of a gasdynamic wind through the interaction with a stratified environment. Finally, the paper of Ultchin *et al.* (1997) was very interesting, studying the possibility of producing a "blobby" outflow through the interaction between a star with "starspots" and an accretion disk.

There were a number of interesting papers on the dynamics of HH jets and molecular outflows. Many issues were described in the review of Cabrit *et al* (1997). The talks of Stone (1997) and Massaglia *et al* (1997) as well as several poster papers (see table 4) addressed the effects of Kelvin-Helmholtz instabilities in radiative jets. Smith *et al* (1997) presented numerical simulations of jets from variable sources, which included a simplified treatment of the chemistry.

More detailed discussions of the chemistry (but of course for dynamically more simple situations !) were presented by Hollenbach (1997) and Pineau des Forêts *et al* (1997). It would be most interesting to see if it is possible to implement a comparable chemical sophistication in 2 or 3D calculations. Also intriguing was the talk of Taylor (1997) who stressed the importance of the radiative field of HH objects in evaporating grain mantles and modifying the chemistry of the surrounding environment.

There were a number of papers on modelling disks (e. g., Bell and Chick 1997), envelopes (e. g., Berger and Ménard 1997) and collapse of cores (e. g., Hanawa *et al.* 1997, see also table 5). Particularly interesting was the paper of Toropin *et al.* (1997) which presented a full MHD calculation of an infalling envelope leading to the production of an outflow.

Finally, I would like to commend the papers of Hartquist and Dyson, Henney and Arthur, Wilkin *et al* and Gvaramadze (1997) for having described very clear analytic work. Interestingly, these papers are all on the "other topics" section of table 5. I hope that this does not show that we will not see any future purely analytic papers directly concerned with outflows from young stars !

5. Final speculations

As a final section of this paper, let me give a series of speculations about what will possibly be interesting ways forward in the field of outflows from young stars. These possibilities are mostly not my original ideas, as they attempt to reflect some of the most fruitful discussions between observers and theoreticians that occurred during the meeting.

1. Do the outflows directly reflect the time-history of the ejected wind ?

From a purely naive point of view, one would think that the amazingly symmetric structures observed in the two lobes of many outflows directly imply an origin for the structures that is associated with time-dependent phenomena of the ejection. Furthermore, the strong symmetry appears to imply that the interaction with the environment (which is observed to be highly inhomogeneous) cannot have a strong effect on the propagation of the outflow. These arguments would lead us to believe that, at least in some of the "superjets", the outflows behave in an approximately ballistic way until many parsecs away from the source !

Of course a possibility would be that the first "outflow event" clears out the inhomogeneous environment, leaving behind a less dense, more homogeneous medium. Successive ejection events could then travel into and interact with this homogeneous medium and still preserve symmetries between the two lobes even if the flow is not ballistic. Appropriate numerical simulations should be able to tell us whether or not this alternative scenario is a working possibility.

A clearly also important point is to attempt to directly relate the observed structures in HH jets with the variability of the source. To this effect, both the HST images of regions close to HH sources and the studies of variabilities of T Tauri stars appear to be most important.

2. What do the outflows with high lobe-to-lobe asymmetries tell us ?

There are certainly objects which show very strong lobe-to-lobe asymmetries. It is then of course quite straightforward to interpret these asymmetries as evidence for interaction with the (highly inhomogeneous) environment. However, as we have seen in this meeting, even radio continuum jets with lengths of a few arcseconds sometimes show important asymmetries. If these asymmetries are indeed due to strong interactions with the environment, it appears to be difficult to reconcile this with the striking symmetries observed on much larger scales. Are we then actually seeing asymmetric ejections from the sources ? Could the same source produce both asymmetric (for small knots) and symmetric (for large working surfaces) ejection events ?

3. Does the cross section of an outflow reflect the cross section of the ejected wind ?

From direct radial velocity, proper motion and line flux measurements it is possible to obtain an idea of the cross section of a collimated flow. It would be most interesting to see more work in this direction being carried out in the future. The important question then is whether or not this cross section directly reflects the angular dependence of the wind ejected from the source. The work presented in this meeting of the interaction of initially isotropic winds with a stratified circumstellar environment appears to indicate that the answer might be negative.

4. The microjets

Of course, the situation is more hopeful for the microjets (described in this meeting) or the thermal radio jets observed to extend for a few arcseconds away from the source. Do these "short" jets preserve more faithfully the structure of the wind ejected from the source ? At what distances from the source does the lateral interaction with the environment produce shocks that modify the jet cross section ?

5. HST

The new observations of HH objects with the HST provide a set of data which is ideal for comparisons with numerical simulations. It is now both important and straightforward to produce numerical models with more sophisticated treatment of the ionization structure in order to obtain predictions that can be directly compared to the high resolution HST data. In the near future, we will undoubtedly be seeing "second epoch" HST images, which will give a most intriguing picture of the time-evolution of HH flows.

6. Molecular outflows, chemistry

In this conference, we have seen an explosion in the available information about molecular outflows. A large increase in the spatial resolution, together with an increase in the number of different lines and chemical species that are studied provide suitable data for very detailed comparisons with models. Clearly, more sophisticated chemical/dynamical models will have to be produced to interpret this data. Possibly, in this way the real nature of the relation between HH jets and molecular outflows (two winds, lateral, or head entrainment) will finally be established.

7. Instabilities, turbulence

We have seen several papers about K-H instabilities in radiative jets (a field in which little effort had been done in the past). Do these instabilities lead to fully turbulent jets ? How does the turbulence affect the propagation of the jet ? Can we empirically determine whether or not HH jets and/or molecular outflows are turbulent ?

To conclude, I would like to point out that these seven points are limited to the topics that interest me more closely (as evidenced by the fact that I was able to follow the discussions) and clearly do not reflect the wide variety of discussions which occurred during this most fruitful meeting.

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TABLE 1. Poster papers and talks

Topic	First author	Reference	comments
Outflows			
General			
	Padman	t	cavities, jets, changes in coll., precession
	André	t	evolution of inflow/outflow
Radio (single dish)			
	Cernicharo	t	IRAM, HH 111, CO tube, bullets, momentum estimates
	Bachiller	t	IRAM, spatial progression of chemistry
	Bence	57	JCMT, wind-driven shells
	Dent	88	JCMT, molecules in HH 2
	Gibb	120	JCMT, CO in HH 25, 26
	Hogerheijde	138	JCMT, CO, evolutionary sequence ?
	Ogura	166	SEST, CO in HH 135, 136
Radio (interferometry)			
	Guilloteau	t	PdBI obs. of outflows, cavities, jets, precession
	Rodríguez	t	VLA thermal jets ($\sim$ 80), geometries, sources
	Ray	t	Merlin, polariz., determination of B off the source
	Bloemhof	60	VLA continuum of known HH objects, also IR
	Bontemps	63	VLA continuum, new jet (asymm.)
	Cesaroni	73	PdBI, new flow, also single dish+IR
	Chandler	76	VLA, inner SiO jet in HH 211, also JCMT
	Dutrey	101	PdBI, SiO bow shocks
	Girart	123	BIMA, high vel. HCO^+
	Gueth	126	PdBI, superimposed cavities
	Hughes	141	VLA continuum, Cepheus A
	Ladd	144	BIMA, strong changes in position angle
	Martí	160	VLA continuum, proper motions of HH 80-81 jet
	Nagar	163	BIMA, CO sheath of HH 111
	Shepherd	175	OVRO, CO in flow from B star, also IR images
	Wilner	193	VLA continuum, non-thermal emission in jet
	Zhang	195	BIMA, jet-like flow, SiO, CO, also IR (H_2)
	Estalella	266	VLA, NH_3 in quadrupolar outflow
	Wiseman	lp	NH_3 in flows in the Orion Ridge region
ISO			
	Liseau	t	typical HH spectrum : [O I] 63μ, [C II] 158μ
	Ceccarelli	66	LWS spectra of outflow, [O I], CO, H_2O
	Mazzini	lp	spectra of 17 HH objects

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TABLE 2. Poster papers and talks, continued

Topic	First author	Reference	comments
IR observations			
	Eislöffel	t	H_2 in embedded flows, line profiles, entrainment
	Noriega-Crespo	t	Excitation of H_2, mixing layers, fluorescence
	Ayala	5	H_2, new flow, also spectra
	Massi	21	H_2, new flow, known HH objects
	Palacios	30	H_2, known HH objects
	Schultz	39	", shocked cloudlet
	Eiroa	103	H_2 close to Serpens radio jet
	Herbst	135	H_2, new flow, also spectra
	Fernandes	109	spectra, contribution of H_2 fluorescence
	Richer	172	images and spectra of RNO 43 precessing jet
	Smith	178	Fabry-Perot, ortho/para H_2 ratios
	Tabone	184	H_2 in HH 24, 135, 136
	Zinnecker	198	point-symmetric H_2 bow shocks in HH 212
	Herbst	215	H_2 Fabry-Perot image of T Tau environment
	Miralles	227	H_2, new flow
	Nisini	lp	FIR spectroscopy of outflow
	Zinnecker	lp	unbiased H_2 jet survey of Orion A
	Quirrenbach	lp	H_2 in T Tauri, adaptive optics
Optical imaging			
	Bally	t	superjets, timescales, symmetries
	Cernicharo	8	new flow, also mm continuum map
	Alten	51	new flows
	Corporon	85	", flow in a cavity
	Devine	91	new flows
	Devine	95	HH 34 superjet, also radial vel.+proper motions
	Hojaev	218	environment of pre-FU Ori star
	Eislöffel	lp	superjets, evidence for precession
Optical spectroscopy			
	Böhm	t	high/low excitation, problems with shock modelling
	Solf	t	micro-jet long-slit spectra, two components, accel.
	Mundt	t	micro-jets in many stars
	Corcoran	82	long-slit, micro-jet, Herbig Ae star
	Fridlund	117	long-slit, 2D coverage, HH 29
	Lavalley	147	2D spectro-imaging of DG Tau micro-jet
	Magakian	158	long slit+ 2D spectro-imaging of R Mon jet
	Movsessian	lp	2D spectro-imaging of Haro 6-5B
HST			
	Reipurth	t	HH 46/47, 111, 34, 80/81, 1/2, $H\alpha-$[S II]
	Fridlund	t	L 1551 IRS 5 jet, reflection neb., new knots
	Stapelfeldt	t	HL, XZ, DG, DG B, and T Tauri, HH 30, reflection neb.

TABLE 3. Poster papers and talks, continued

Topic	First author	Reference	comments
T Tauri, FU Ori stars			
Variability			
	Semkov	42	optical spectrophot., possible FU Ori star
	Beskrovnaya	204	polarization, Hα profile
	Pogodin	244	line profiles, outflow/inflow
	Chelli	263	Br γ variability in DF Tau
	Fernández	269	line profiles, Hα, He I, Na I D
	Folha	272	Pa β line profile, infalling material
	Gameiro	275	line profiles, Hα, He I, Na I D
	Castro	278	UV (IUE) continuum variability
	Grankin	281	photometry of WTTS
	Bertout	288	photometry, spot model, acc. luminosity
	Heines	294	linear polarization, wavelenght dependence
	Ibrahimov	297	1981-1995 photometry of FUors
	Reipurth	309	FUor BBW 76, photometry, line profiles
	Smith	315	DR Tau, photometric var. with $\tau \sim 1$ hr
Spectra			
	Hartmann	t	magnetospheres, smaller (1/10) values for $\dot{M}$
	Calvet	t	T_e from blue absorpotion comp. of permitted lines
	Edwards	t	accretion columns, cTTS with short rotation periods
	Guenther	t	Ca II K lines, determination of B, 2-3 kG
	Mennessier	300	Doppler imaging, spots
	Pedrosa	306	classification of Hα profiles
Disks, envelopes			
	Kitamura	t	NMA maps of disks, L 1551 IRS 5, DG and TM Tauri
	Meyer	224	6-12 μ spectra of disk
	Monin	230	1-5 μ adaptive optics, disks in binaries
	Harvey	291	SSV 13, 47-95 μ scans, photometric variab.
	Dutrey	lp	2.7 mm cont. survey of T Tauri disks
	Dutrey	lp	DM Tau and GC Tau disks, mm interf., many molecules
Cores and globules			
	Fuller	t	evol. sequence for cores, time indicators
	Terebey	t	mm interf., infall+rotation, modelling of line prof.
	Choi	11	radio interf., HH 1 source
	Mangum	18	radio, single dish
	Morato	24	"
	Motte	27	"
	Panis	33	"
	Sugitani	45	radio interf.
	Wang	48	IR imaging
	Anglada	54	radio, single dish, sources of outflows
	Olberg	169	CS, DCO^+ in environment of HH 110, 111
	Ward-Thompson	257	ISO maps of pre-stellar core
	Wiesemeyer	260	mm interf. of infalling envelopes, also models
	Gredel	284	HH 100 IRS, observations and models of IR cont.

TABLE 4. Poster papers and talks, continued

Topic	First author	Reference	comments
Star formation			
	Churchwell	t	high mass star formation
	Claussen	t	water masers, kinematics with $10^{-3\prime\prime}$ resolution
	Giovanetti	14	optical and IR photometry of young stars
	Plazy	36	IR photometry of young stars
Orion M 42 objects			
	McCaughrean	t	proplyds, young low mass stars in trouble
	O'Dell	t	IR fingers, proper motions, large bow shocks
	Everett	106	H_2 fingers in OMC-1
	Persi	238	H_2, [S II] images of IRAS sources
	Tedds	lp	H_2 fingers in OMC-1
	Burton	lp	HH knots in Orion
Theory			
Wind production/coll.			
	Shu	t	X-wind, asymptotic flow, wind-driven shell, X-rays
	Camenzind	t	dynamos in disk, wind from star, emission lines
	Heyvaerts	t	asymptotic wind solutions, on-axis boundary condition
	Appl	t	K-H and current driven instabilities
	Ferreira	113, t	braking of star by outflow, saturation mechanism
	Lery	152, t	slow vs. fast rotators
	Frank	t	gasdynamic wind/environment interaction, radiative
	Martin	t	thermal structure of funnel flows, low temperatures
	Paatz	303	heating/cooling mechanisms in wind
	Shang	312	cosmic rays produced in MHD wind
Jet/outflow models			
	Cabrit	t	acceleration, bubbles, cavities, mix. layers, bow sh.
	Pudritz	t	knots in magnetized jet, currents loop back along bow
	Smith	t	simulations with chemistry, velocity cross section
	Massaglia	t	K-H in radiative, axisym. jets, comparisons with obs.
	Stone	t	K-H in slab and 3D radiative jets, twisting jets
	Rubini	t	crossing shocks in initially overpressured jet
	Bacciotti	t	plasma diagnostics, ion. state of jets, observations
	Chiuderi	79	linear+nonlinear MHD, shock-less
	Leeuwin	150	travelling knots, radiative, axisym.
	Suttner	181	internal working surfaces, H_2 and CO emission
	Thiele	187	adiabatic, 3D with B, nose cones
	Cerqueira	70	radiative, 3D, stability
	Downes	98	radiative K-H, slab jet
	Frank	115	adiabatic K-H with B, axisym.
	Hardee	132	K-H in radiative, 3D jet with B
	Toropin	254	production of MHD jet from collapse onto disk

TABLE 5. Poster papers and talks, continued

Topic	First author	Reference	comments
Chemistry of outflows			
	Hollenbach	t	chemistry in J and C shocks, instabilities, masers
	Taylor	t	"searchlight chemistry" in clumps near HH objects
	Pineau des Forêts	7, t	C shocks with chem., time-dep.: no critical points
Disks, envelopes			
	Bell	t	FU Ori disks, thermal instab., values of α
	Kwan	t	disk coronae, interpretation of line profiles
	Berger	201	polarisation modulations, circumbinary envelopes
	Chick	207	rad. transfer in envelopes, nested grid
	D'Alessio	210	irradiated accretion disks
	Men'shchikov	221	dusty, reprocessing disk around HL Tau
	Nakamura	235	thin disk simulation, formation of binaries
	Pickett	241	3D, ad./isoth. disks, formation of structure
	Ultchin	318	ejection of diamagnetic blobs from disks
Collapse			
	Hanawa	212	similarity sol. for collapse to form disk+star
	Nakamura	232	axisym. simulation of collapse with B
	Saigo	247	similarity, collapsing core+disk solution
	Tomisaka	250	accretion rate in collapsing core with B
Other topics			
	Hartquist	t	high mass stars, compact H II regions
	Henney	t	models for proplyds, two-wind interactions
	Wilkin	t	wind bow shocks, radiated energy, momentum transfer
	Gvaramadze	129	fingers in OMC-1
	Mac Low	155	stability of 3D C-shocks
	Wilkin	190	stellar wind b. s., non-uniform media, analytic