Simulating SMA dust polarization maps of magnetized protostellar cores

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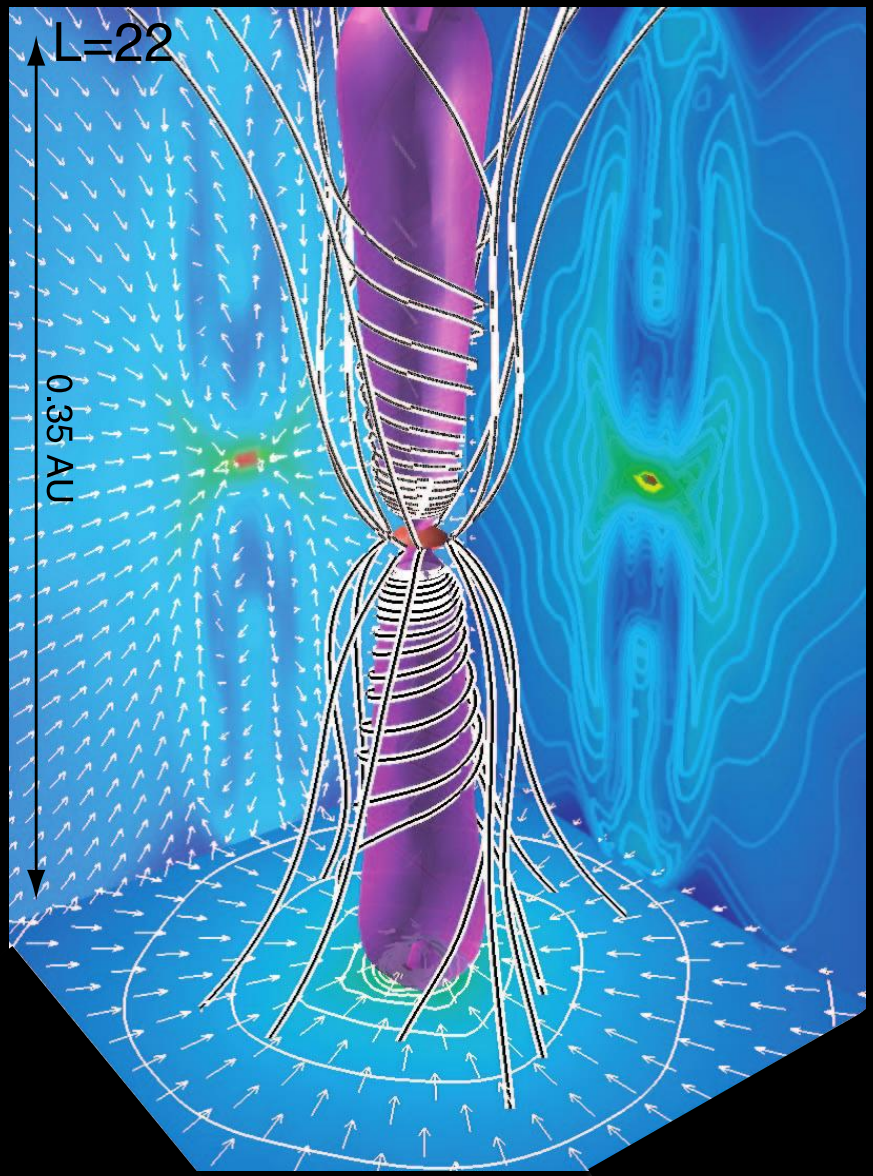
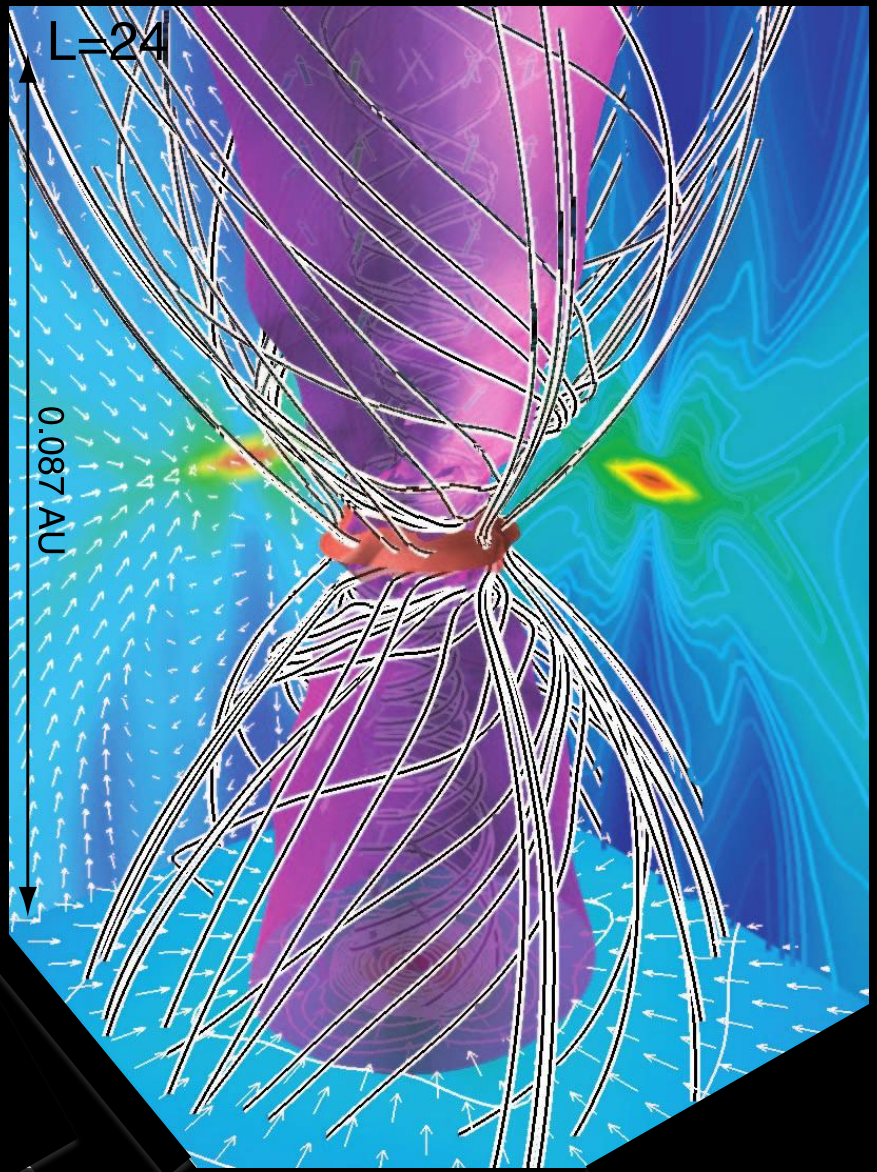
National Tseng-Hua University





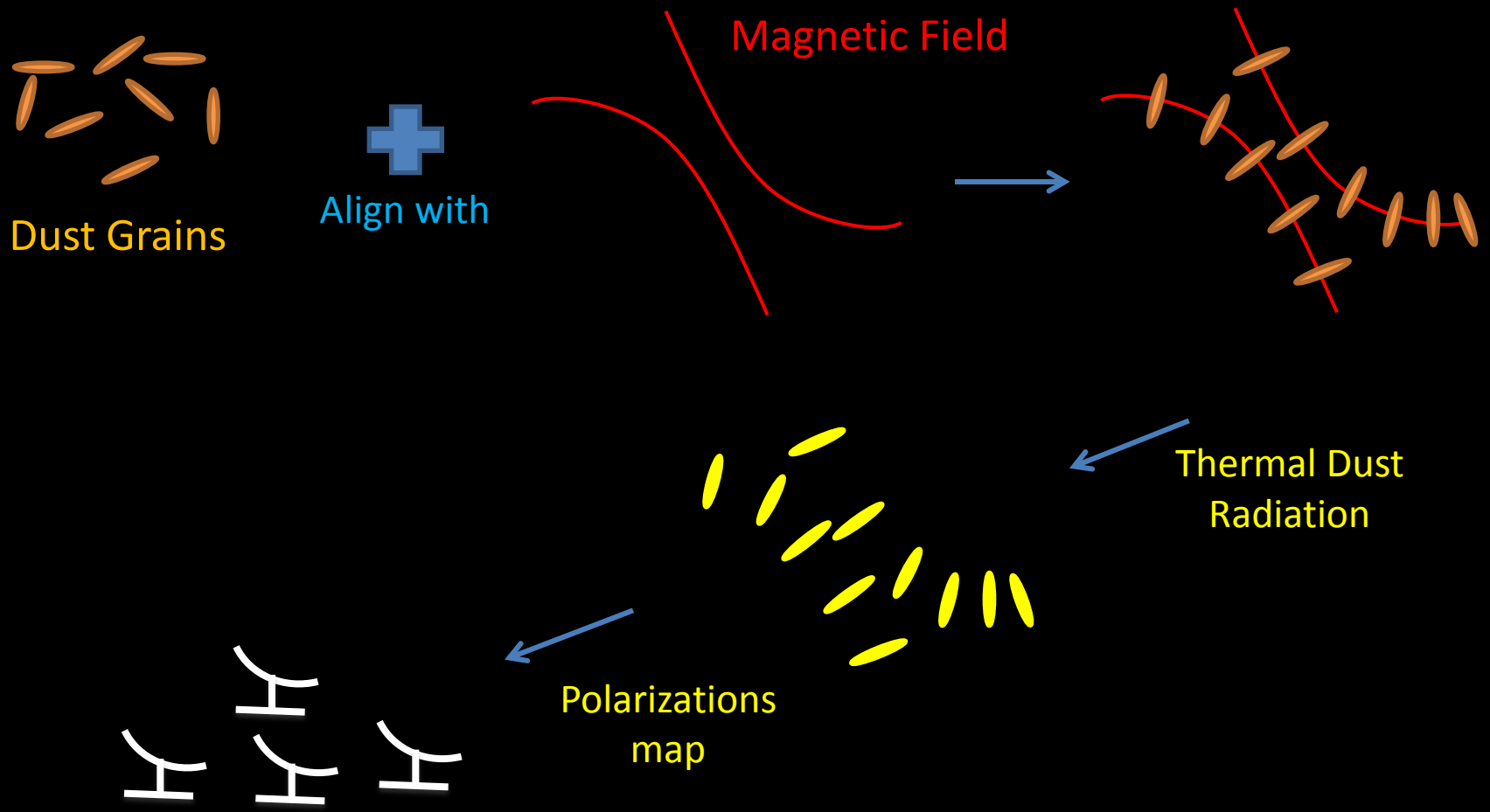
Machida *et al.* (2008)

As an observer, what can we see if those models are real?

Introductions

How to observe the magnetic field?

The distribution of the polarizations of thermal dust radiation gives information of the configuration of the magnetic field.

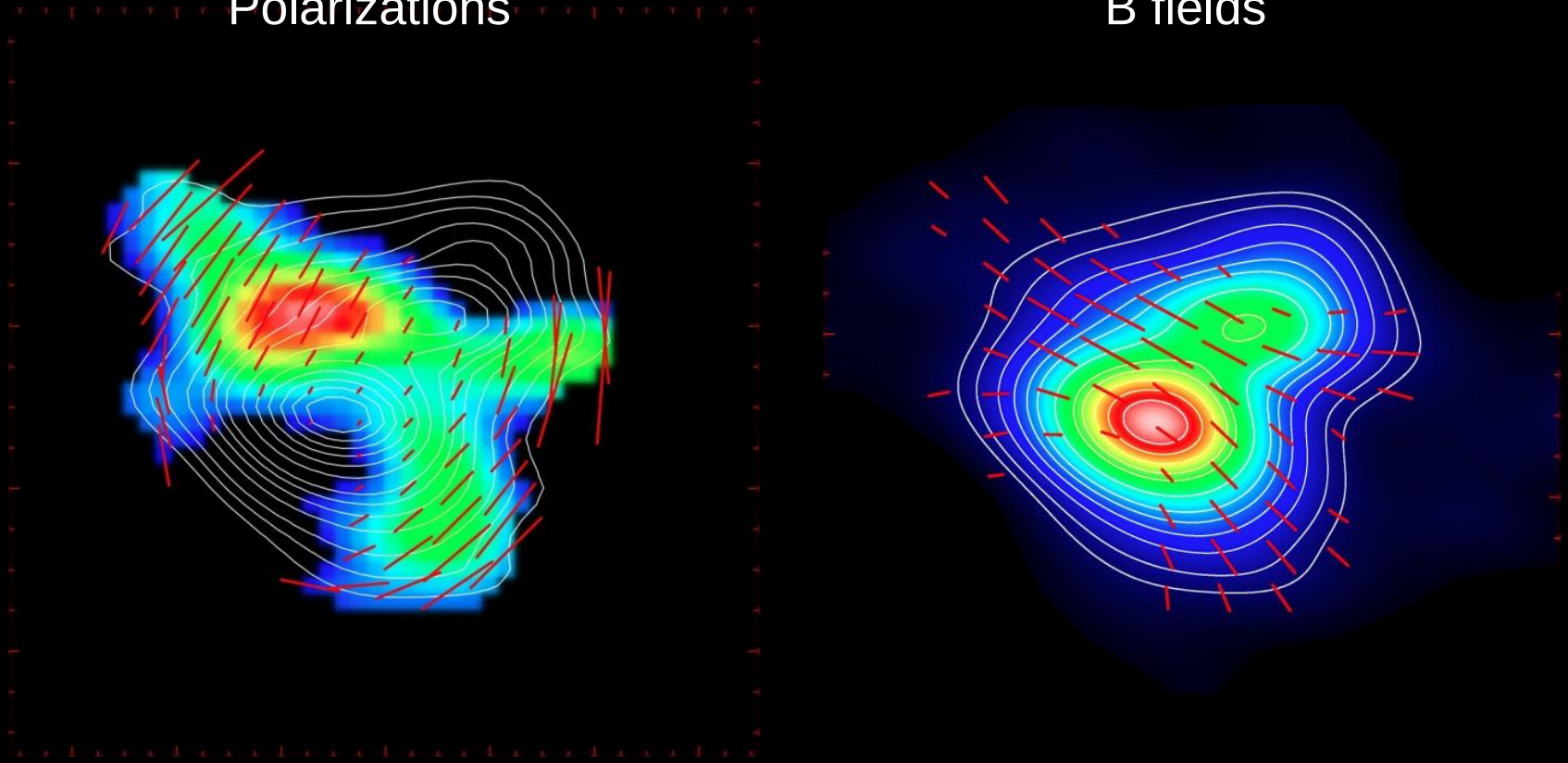


Polarizations map

Polarization of Dust Emission: $P \perp B_p$

Polarizations

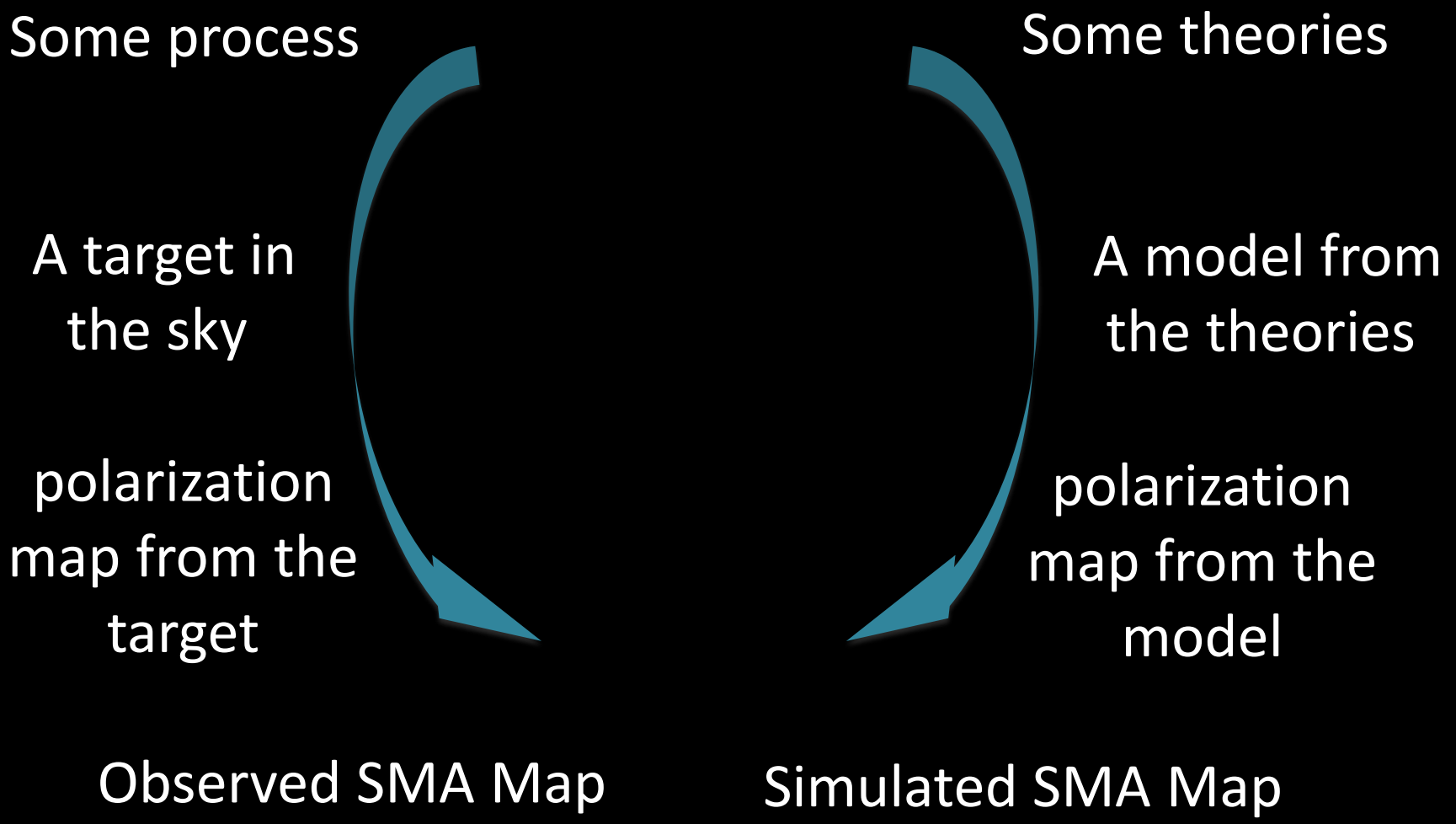
B fields

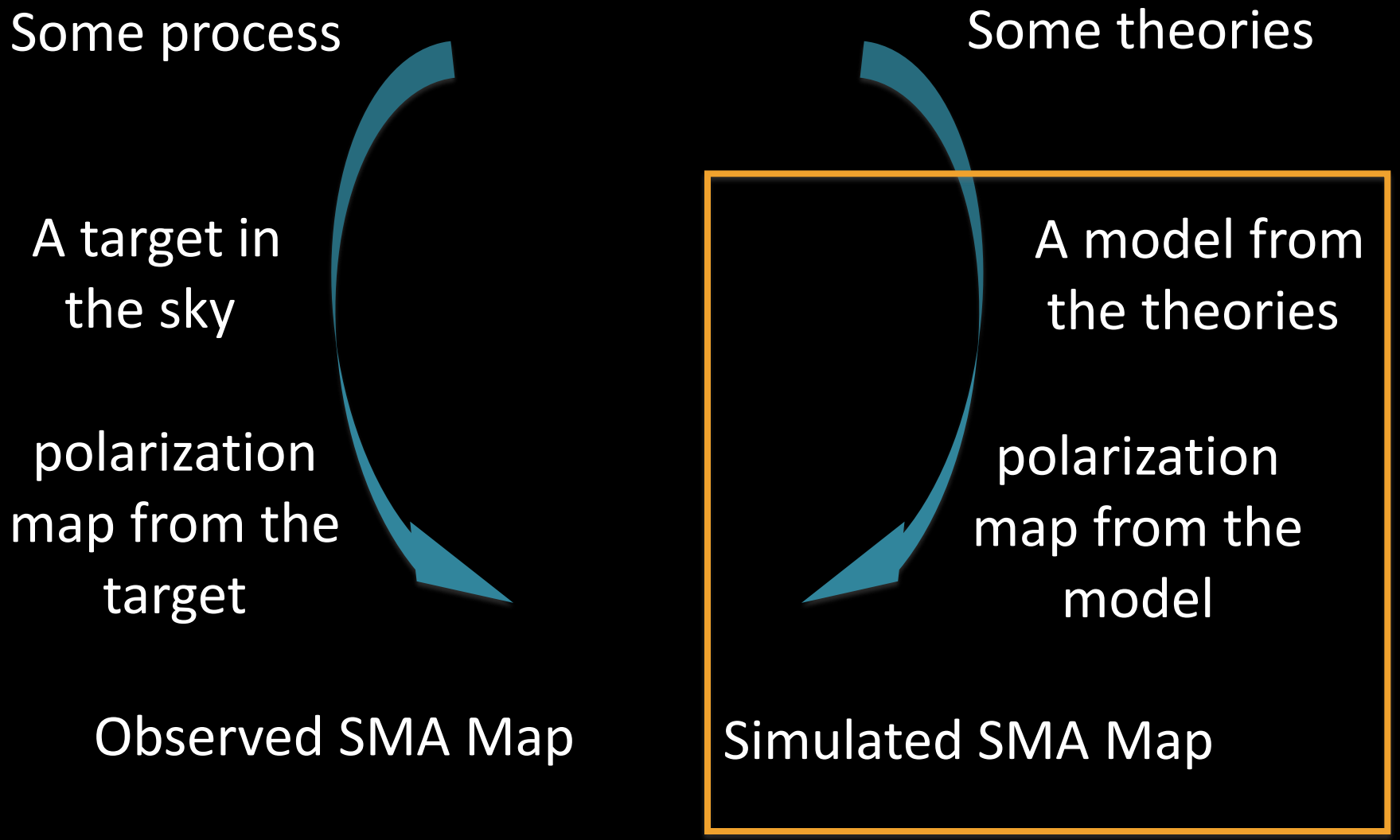


Polarization map (left) and magnetic field map (right) from Girart, Rao, & Marrone (2006), Science, 313, 812

As an observer, what can we see if those models are real?

Our work


Some process
A target in the sky
polarization map from the target
Observed SMA Map
Some theories
A model from the theories
polarization map from the model
Simulated SMA Map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Prof. Machida's group

Providing a model which was generated from some theories

A array that contains the profiles of the density and the magnetic field.

Our program

Integrating the 3D magnetic field profile into a 2D I, Q, U map

Stoke I,Q,U map

UVGEN in Miriad

Transferring the I,Q,U map into a SMA map

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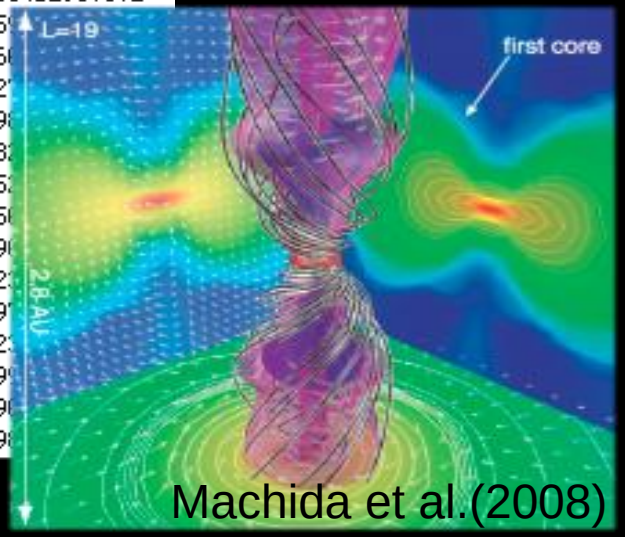
Providing a model which was generated from some theories

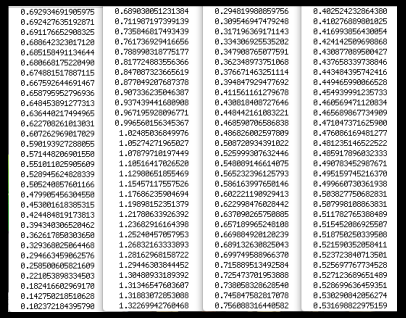
Bx(x,y,z)	By(x,y,z)	Bz(x,y,z)	Density(x,y,z)
0.692934691905975	0.689030051231384	0.294819980859756	0.402524232864380
0.692427635192871	0.711987197399139	0.309546947479248	0.410276889801025
0.691176652908325	0.735846817493439	0.317196369171143	0.416993856430054
0.688642323017120	0.761736929416656	0.334306925535202	0.424142509698868
0.685158491134644	0.788990318775177	0.347908765077591	0.430877089500427
0.680668175220490	0.817724883556366	0.362348973751068	0.437658339738846
0.674881517887115	0.847087323665619	0.376671463251114	0.443484395742416
0.667592644691467	0.877049207687378	0.394847929477692	0.449465990066528
0.658795952796936	0.907336235046387	0.411561161279678	0.454939991235733
0.648453891277313	0.937439441680908	0.430818408727646	0.460569471120834
0.636440217494965	0.967195928096771	0.448442161083221	0.465689867734909
0.622708261013031	0.996560156345367	0.468590706586838	0.471047371625900
0.607262969017029	1.02485036849976	0.486826002597809	0.476086169481277
0.590193927288055	1.05274271965027	0.508720934391022	0.481235146522522
0.571448206901550	1.07879710197449	0.525999307632446	0.485917896032333
0.551011025905609	1.10516417026520	0.548089146614075	0.490783452987671
0.528945624828339	1.12980651855469	0.565232396125793	0.49515
0.505240857601166	1.15457117557526	0.586163997650146	0.49966
0.479905456304550	1.17686235904694	0.602221190929413	0.50382
0.453001618385315	1.19898152351379	0.622998476028442	0.50799
0.424484819173813	1.21780633926392	0.637090265750885	0.51178
0.394340306520462	1.23682916164398	0.657189965248108	0.51545
0.362617850303650	1.25240457057953	0.669884920120239	0.51875
0.329368025064468	1.26832163333893	0.689132630825043	0.52159
0.294663459062576	1.28162968158722	0.699749588966370	0.52372
0.258500605821609	1.29446303844452	0.715889513492584	0.52569
0.221053898334503	1.30480933189392	0.725473701953888	0.52712
0.182416602969170	1.31346547603607	0.738058328628540	0.52869
0.142750218510628	1.31883072853088	0.745847582817078	0.53029
0.102372184395790	1.32269942760468	0.756088316440582	0.53169



Machida et al.(2008)

Prof. Machida's group

Providing a model which was generated from some theories



A array that contains the profiles of the density and the magnetic field.

Our program

Integrating the 3D magnetic field profile into a 2D I, Q, U map

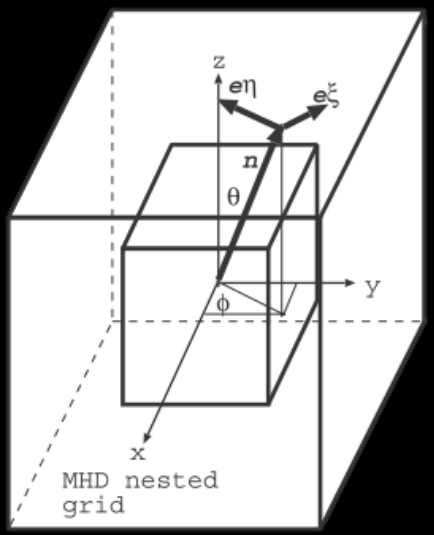
Stoke I,Q,U map

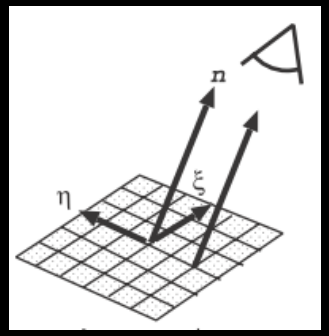
UVGEN in Miriad

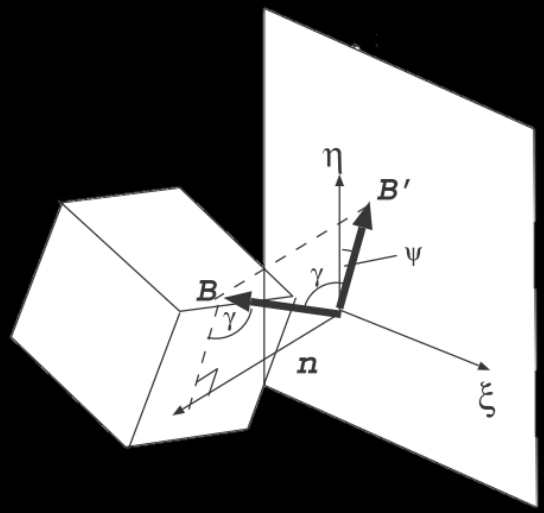
Transferring the I,Q,U map into a SMA map

Our program

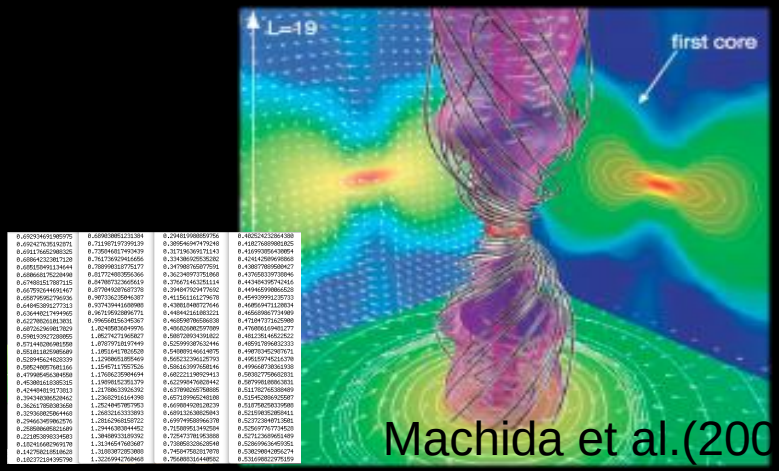
Our program calculated the polarization distribution of thermal dust radiation using molecular outflow data obtained from two-dimensional axisymmetric MHD simulations.







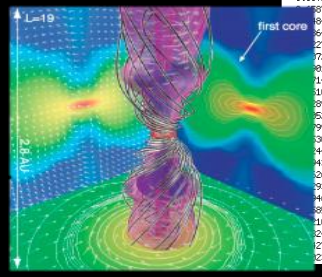
Kohji TOMISAKA *et al.*

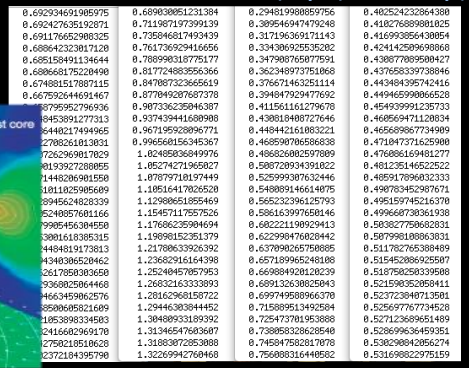


Our program

Integrating the 3D magnetic field profile into a 2D I, Q, U map

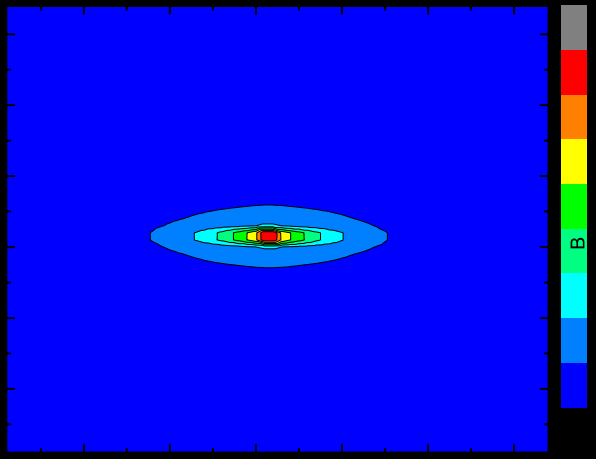
Bx(x,y,z) By(x,y,z) Bz(x,y,z) Density(x,y,z)



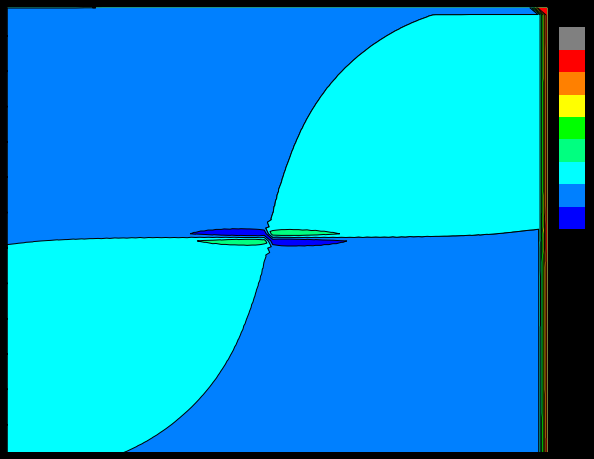


$$q = \int \rho \cos 2\psi \cos^2 \gamma \, ds \,,$$

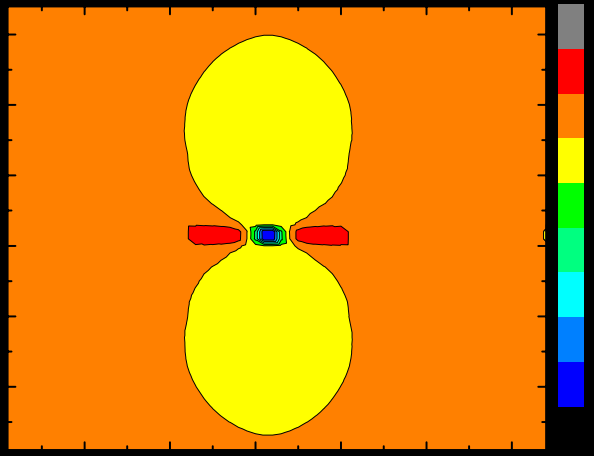
$$u = \int \rho \sin 2\psi \cos^2 \gamma \, ds \,.$$



Stokes I map



Stokes U map



Stokes Q map

Prof. Machida's group

Providing a model which was generated from some theories

0.6929346919005975	0.6090308512313384	0.2948119908859756	0.4825242328643880
0.6924276359192871	0.7119071973991390	0.3095469474792480	0.4102768098810254
0.6911766529083252	0.7358406174934387	0.3171963691711426	0.4169930564300537
0.6886423230171204	0.7617369294166565	0.3343069255352020	0.4241425896907806
0.6851589491134644	0.7889983187758179	0.3479087868077591	0.4308778095989227
0.6806681752204918	0.8177248835563660	0.3623489737510681	0.4376583397388458
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0.6675224465914678	0.8778492876873779	0.3948479229477692	0.4494659086656189
0.6587959527969360	0.9073362359963870	0.4115611612796783	0.4549399912357330
0.6484538912773132	0.9374394416089844	0.4308184087276764	0.4605649711208343
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0.6227882610813904	0.9965681563453674	0.4685987065886688	0.4710473716259766
0.6072629690170288	1.0248503684997559	0.4868268025970459	0.4760861694812775
0.5901939272880554	1.0527472196650314	0.5087289934539795	0.4812354654502869
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0.5518812537193298	1.1051641702651978	0.5488891466140747	0.4907834529876709
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0.5052408576011658	1.1545711755752563	0.5861639976501465	0.4996607303619385
0.4799854564666748	1.1768623590469360	0.6022211909294128	0.5038277864456177
0.4538016188144684	1.1989815235137939	0.6229984760284424	0.5079981088638306
0.4244848191738129	1.2178863382339478	0.6378982657384872	0.5117827653884888
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0.3293680250644684	1.2683216333389282	0.6891326308250427	0.5215903520584106
0.2946634769439697	1.2816296815872192	0.6997495889663696	0.5237238407135010
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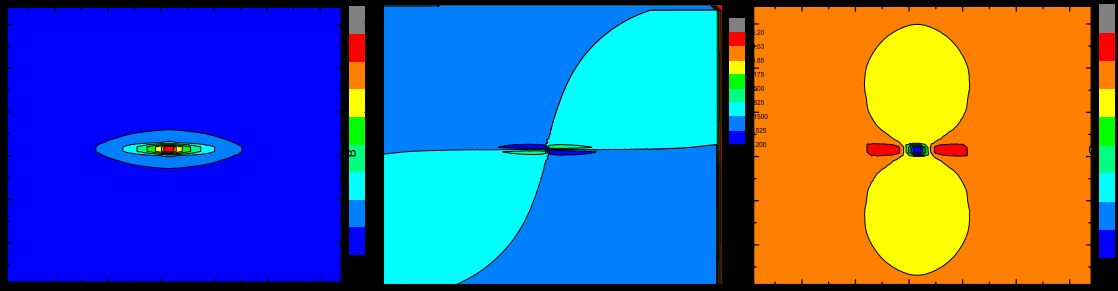
0.1023721694946289	1.3226994276428223	0.7568803310394287	0.5316908359527588

A array that contains the profiles of the density and the magnetic field.

Our program

Integrating the 3D magnetic field profile into a 2D I, Q, U map

Stoke I,Q,U map



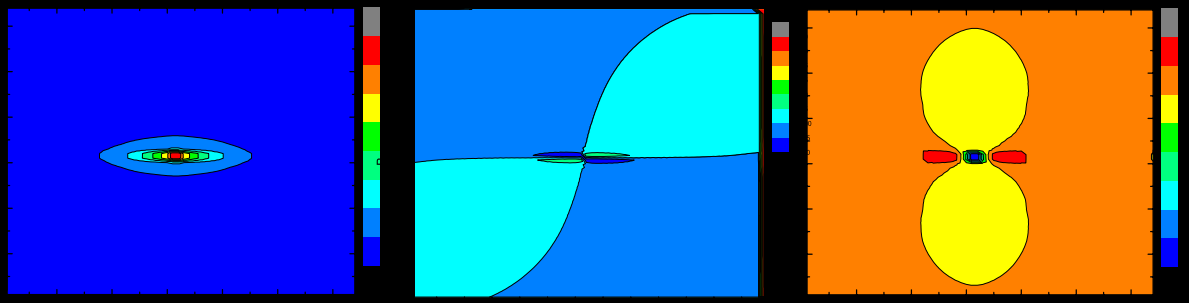
UVGEN in Miriad

Transferring the I,Q,U map into a SMA map

UVGEN in Miriad

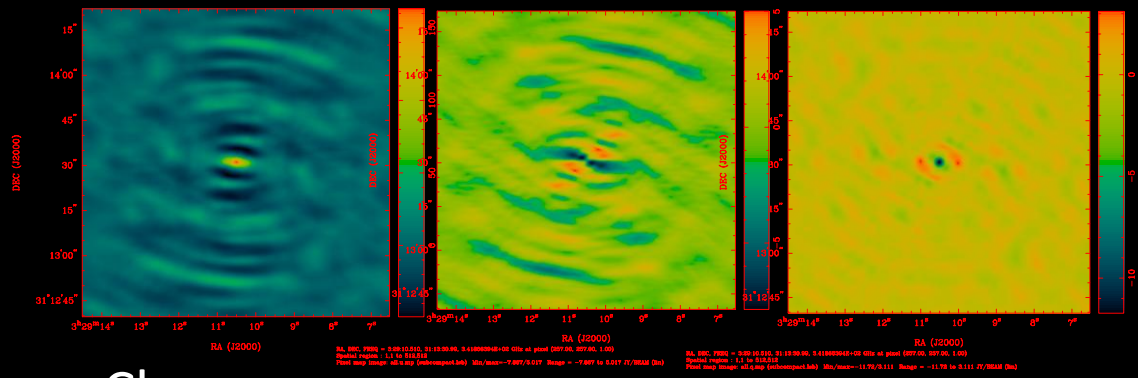
Transferring the I,Q,U map into a SMA map

I, Q, U map



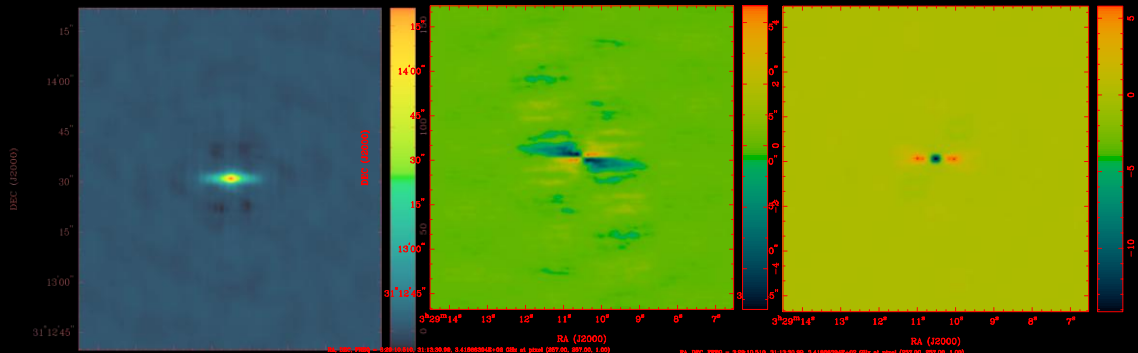
Simulating observations

Dirty map



Clean

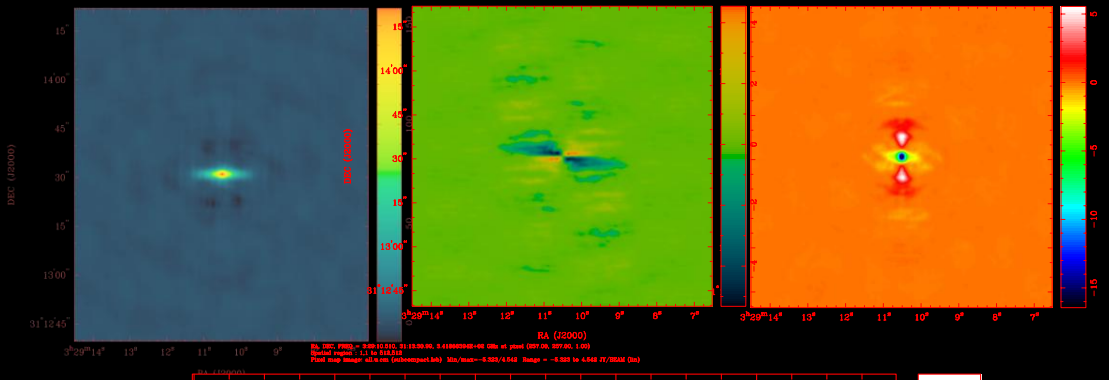
Clean map



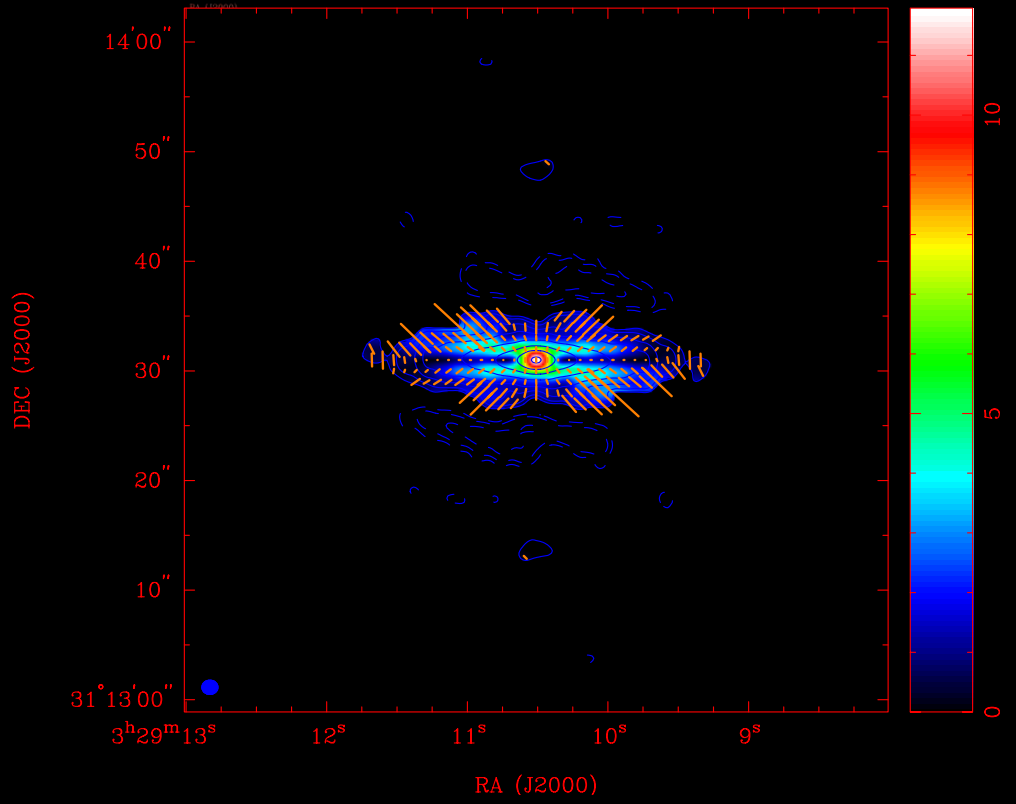
UVGEN in Miriad

Transferring the I,Q,U map into a SMA map

Clean map



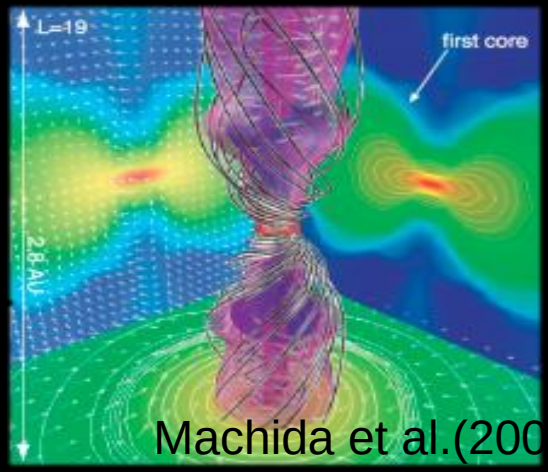
SMA observation map



Conclusions

Prof. Machida's group

Providing a model which was generated from some theories



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Our program

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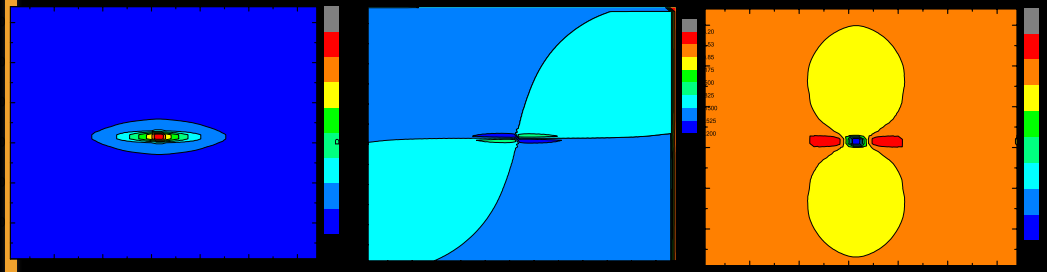
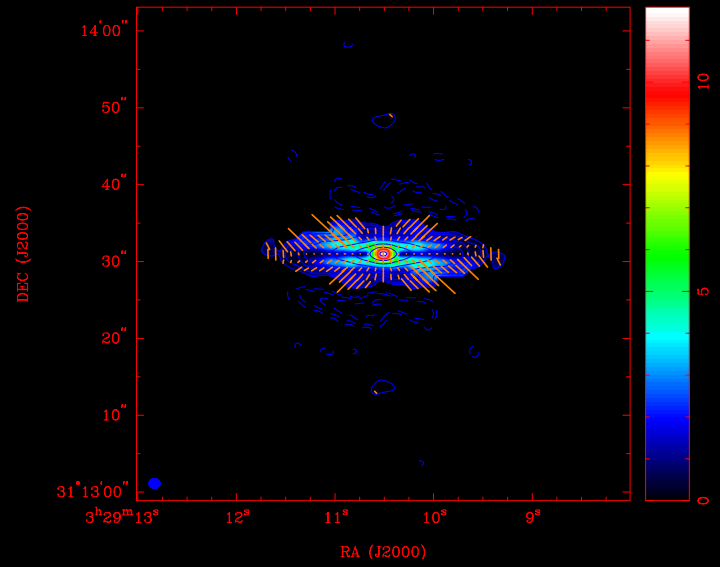


Stoke I,Q,U map

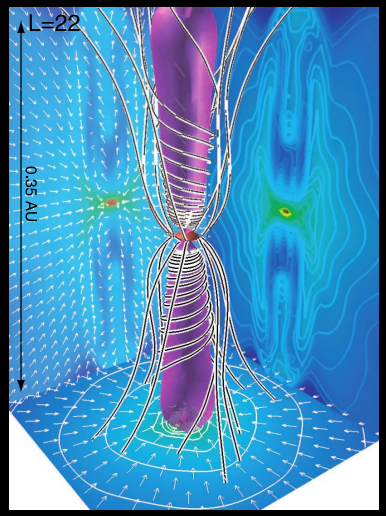
UVGEN in Miriad

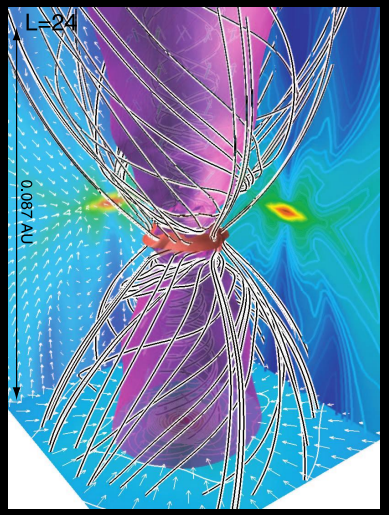
Transferring the I,Q,U map into a SMA map



SMA observation map

Any models with density and magnetic field





Our program

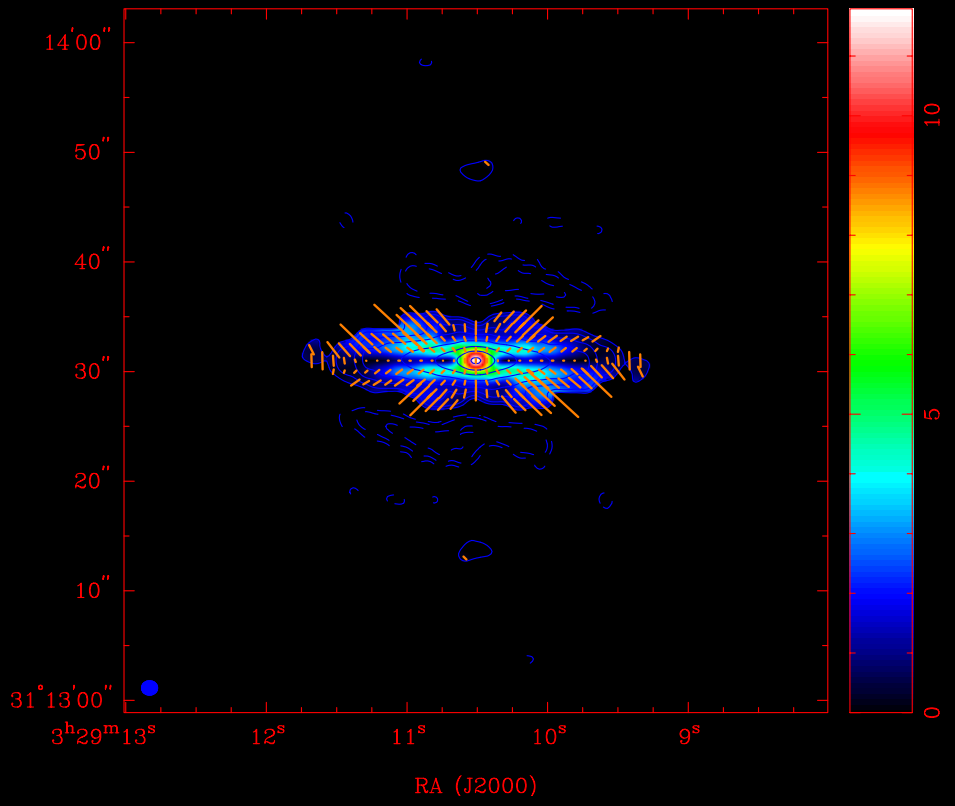
Integrating the 3D magnetic field profile into a 2D I, Q, U map

Stoke I,Q,U map

UVGEN in Miriad

Transferring the I,Q,U map into a SMA map

A SMA or ALMA observation map



Thank you