

# Impact Factor

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1.

*Inside the control booth of BTA-6,<sup>1</sup> which is suffused with the red glow of instrument lighting; HỒNG is going through the pre-observation checklist for the telescope, adjusting things on the (rather large) control panel, while ALEKSANDR waits. The hulking mass of the telescope's main mirror looms large overhead through the window of the control booth, slowly pivoting and swivelling as HỒNG performs minute adjustments.*

Hồng ...technically wasn't lying.

Aleksandr You promised!

Hồng (*making excuses*) I promised to take you stargazing. We're in the observatory. That counts, right?

*A screen on the console shows a live feed of the telescope's field of view and a heads-up display. A nebula dominates the viewing.*

Aleksandr Yes, but I see you only twice a year —

Hồng (*without looking up from instrument panel*) Look — it's the coldest, clearest night we've had all winter — like I said, it's perfect for stargazing.

Aleksandr I assumed you meant there would be things for *me* to see —

Hồng (*sighs*) Okay, okay.

Aleksandr — *other* than giant dinner plate up there.

Hồng Sasha,<sup>2</sup> look, I'm giving you a guided tour of this little corner of the universe. Just give me some time to get the scope ready, alright?

Aleksandr (*Points up*) This corner, or (*gestures around*) *this* corner?

Hồng Don't be silly. (*finishes up*) Alright, look.

*HỒNG turns to the work desk and presses a few buttons; a very large screen flickers to life, and the nebula appears there, in luscious detail*

Hồng (*pleased*) This is IC-405, the Flaming Star nebula — nebulae are clouds of gas and dust in space.

Aleksandr (*with grudging admiration*) Is pretty. (*looks at small screen, then at big one*) You did not just pull that off the Internet, yes?

Hồng (*offended*) Of course not! And this isn't false-colour, either. You're seeing what BTA is looking at, right now, on visual wavelengths, plus spectroscopic data. Look —

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<sup>1</sup>BTA-6: (Russian) Большой Телескоп Альт-азимутальный, Bolshoi Teleskop Alt-azimutalnyi, pronounced "beh teh ah"; Large Altazimuth Telescope. Formerly the largest Earth-based telescope from 1975 to 1990, in the Caucasus mountains.

<sup>2</sup>Sasha: (Slavic) diminutive form of "Alexander"

*She pokes a lesser star; a reticule appears above the targeted area, and an inset plot of spectral density appears in a corner, together with a rainbow visualisation. The first spectrum is a rainbow with some dark bands.*

Aleksandr Ooh. What is that?

Hồng It's a spectrum — light at different wavelengths from that part of the picture — sort of like how you characterise your protein structures with crystallography? Except instead of using different proteins at one standard wavelength, we use a standard grating to distinguish many wavelengths.

Aleksandr Huh?

Hồng Like making rainbows, but with SCIENCE!

Aleksandr (*mock-affrontedly*) Oy!

Hồng (*chuckles*) Back to the tour: IC-405 is both an emission and reflection nebula. This is because its central star, AE Aurigae, is very young — class O — and very hot.

Aleksandr Hot?

Hồng Well, different stars have different spectra (*pokes different stars to make her point; the bright part of the rainbows jumps around, remaining mostly reddish, but the dark bands stay where they are, varying only in darkness*) — the bluer they are, the hotter they are. This tells us that the surrounding stars aren't nearly as hot. (*plot shifts drastically into a blue-dominated rainbow with some dark bands*): it's not related to them, just passing through the region.

Aleksandr I see. (*he doesn't, but indulges her*)

Hồng (*taking this as a sign to continue*) AE Aurigae's passing through the nebula at quite high speed — over 90 km/h! — so in the visible band, it illuminates the dust in its immediate vicinity: reflection.

Aleksandr (*nodding*) Mmmm.

Hồng But it's also hot enough that the light coming out of it ionises — blasts electrons away from — the surrounding gas. When these electrons recombine, they give off light too: emission.

Aleksandr Ahhh.

Hồng Nobody's ever seen a star forming, but nebulae are our best bet for where they're born. By studying the composition of the nebulae, we can —

Aleksandr How?

Hồng Huh?

Aleksandr You mean we can see what they are made of?

Hồng (*with increasing enthusiasm*) Ah! We use their spectra again. Look: the light from this part of the nebula (*pokes reddish part of nebula; resulting spectrum is mostly black, with a few bright coloured bands; the plot is flat, sparsely populated with spikes.*) mostly arrives in several narrow wavelength bands — “spectral lines” — which correspond to electronic transitions specific to the gas and dust, from which we infer their composition. In this case, they're emitted from hydrogen, nitrogen and oxygen recombination.

Aleksandr (*still lying*) Mm. Yes. Also knew that.

**Hồng** (*really getting into it now*) On the other hand, light from here (*pokes bluer part of the nebula; similar spectrum to AE Aurigae with deeper absorption lines*) matches up quite closely with the black body spectrum (*pokes AE Aurigae, spectrum doesn't change much*) from AE Aurigae itself: it's just being reflected, so its spectrum matches the illuminating stars, with some absorption lines, instead, owing to the material and intervening gas.

**Aleksandr** (*hesitating*) But if blue means hot, doesn't that mean the dust —

**Hồng** No, it isn't actually as hot as the star, it's just reflecting — when we see sunlight from the moon, it doesn't mean that the moon is 6500 Kelvin.

**Aleksandr** Hmpf.

**Hồng** Here, you try!

*ALEKSANDR tentatively prods a relatively dark region to the north of the nebula, where nothing is seen. A black-body spectrum appears, with a faint rainbow visualisation.*

**Hồng** Hmmmm. (*pokes around, obtaining dark spectra, then pokes the original point. The spectrum reappears*) Odd. (*she makes a note*)

**Aleksandr** Yes?

**Hồng** That patch you — that light seems to be of a star — except there isn't one there. Possibly...nahhh.

**Aleksandr** Something up?

**Hồng** I don't know. (*ponders, then brightens up*) Want to see something cool?

**Aleksandr** You have no idea.

## 2.

*NATALIA is having an interview with LEV at her office in the Institute of Astronomy. HÔNG has a smaller desk in a corner in the same office, which stands empty. NATALIA is seated at her own desk, and LEV, in military uniform, has taken HÔNG's chair.*

**Natalia** — manufacturing, computers — all have their roots in space technology. Going back further, almost all of modern mathematics was motivated by astronomical problems.

**Lev** And physics.

**Natalia** And physics. But one must admit that our technological civilisation owes a great technical debt to astronomical research!

**Lev** *American* research, though.

**Natalia** What's that supposed to mean?

**Lev** Isn't that the exact same story that the American agency trots out every time their civilians threaten them with budget cuts?

**Natalia** That doesn't mean that they get to take all the credit. Ever since they retired Shuttle, *Soyuz*<sup>3</sup> has been the sole launch vehicle for manned spaceflight. We are now single-handedly responsible for humanity's continued advancement into the cosmos!

<sup>3</sup>*Soyuz*: (Russian) сою́з, *sayooz*, Union; also the name of the Russian launch vehicle.

**Lev** (*sharply*) Dispense with the flattery. We're not.

**Natalia** *Our* scientists are working on it, even if they're technically financed by the Americans. Maybe if we could pay well enough to prevent our best researchers from leaving for America —

**Lev** No, I mean, you're not even right on that. Look at that name! *Soyuz* is as derelict as the Union it stood for.

**Natalia** They're not quite the same ships that sent you —

**Lev** — but no longer the pinnacle of technology either! (*brooding silence*) Manned spaceflight is a lost cause. What's the use of looking out if you can't get there?

**Natalia** But *we* can! The Americans don't even have a launch vehicle!

**Lev** Oh, yes? Let's see what the latest *Soyuz* has to offer. Solar panels: latest models first developed for private homeowners — American homeowners. Computers: small only in comparison to older models — we used to make them, instead of importing, from America! And not to mention the cost, compared to the American commercial rockets. *Soyuz* today is ancient —

**Natalia** Pardon me, but we were discussing *my* department. The space programme is well beyond my purview — as *you* should know.

**Lev** (*long pause, then makes a scribble in his notebook*) Very well. Next question, then: aside from spaceflight, and ancient history, how does astronomy continue —

*They are interrupted by HỒNG banging the door, unlocking the door, barging into the room, out of breath and panting a little.*

**Hồng** Professor!

**Natalia** (*darkly*) Ah.

**Lev** Who is this, Natalia Iossifova?

**Hồng** Professor, there's something —

**Lev** (*to NATALIA, but looking at HỒNG*) I believe I made it clear that we were *not* to be interrupted.

**Natalia** Yes yes yes, she isn't even supposed to be in Moscow right now. (*to HỒNG*) Something urgent, I hope?

**Hồng** (*advancing to NATALIA's desk*) Professor, do you remember the anomalous dwarf star?

**Natalia** Which?

**Hồng** A year or so ago? Too dim to be a white dwarf, too hot to be a brown?

**Natalia** Oh, yes. The one that couldn't get published.

**Hồng** If you put it that way...anyway, it's been a year, and I've been making observations like you told me. I tried estimating its parallax<sup>4</sup> today, and —

**Natalia** And no doubt found something interesting. I'll grant you that. Do you know what you're interrupting?

*HỒNG notices LEV for the first time and squeaks. LEV glares daggers at her.*

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<sup>4</sup>Parallax: apparent angular motion resulting from horizontal displacement of observational vantage point

**Natalia** (*gesturing*) Colonel Lev<sup>5</sup> Ivanovich Landau, former cosmonaut and military official to the Academy representing the General Manpower Office, visiting the Institute today for an audit and fiscal review. Colonel, my student, Năm Hồng.

**Lev** (*growling menacingly*) Pleased to make your acquaintance.

**Hồng** (*cringes*)

**Natalia** (*to HỒNG*) Colonel Landau is in the process of reassessing our department's budget for the next five years.

**Hồng** But the parallax —

**Natalia** I doubt distance determination will be of immediate —

**Hồng** (*timidly*) 1.1 arcminutes.

*Beat, while NATALIA and LEV process this morsel of information differently.*

**Natalia** I beg your pardon?

**Lev** 1.1 what?

**Hồng** The parallax of the object. 1.1 arcminutes.

**Natalia** Not arcseconds?

**Hồng** No, I checked, it was positively huge. You should see the exposures. And not only that, but — what?

**Natalia** (*long, stunned pause as it sinks in, then —*) Not arcseconds?

**Lev** What's going on?

**Hồng** (*starts, then, a little flustered:*) Well, imagine you stay put but look at an object through first your left eye, then your right —

**Lev** (*looming threateningly, advances on HỒNG*) Don't be stupid, I was a cosmonaut once. This had better be good. Tell me. Now. What. Object?

*HỒNG has backed up to a wall, and looks at NATALIA pleadingly; NATALIA gives a dazed nod*

**Hồng** A year ago, we — I — no, not me, but, well —

**Lev** Take your time.

**Hồng** (*gulp, deep breath*) We discovered, using BTA-6, an unusual object: its spectral profile was of a black body around 6500 Kelvin — the same temperature as our sun — but with considerably stronger hydrogen lines, all blueshifted.

**Lev** So, a thicker photosphere than average? And moving towards us?

**Natalia** (*stares*)

**Lev** (*to NATALIA*) What? Cosmonaut.

**Natalia** (*rolls eyes*) Then those questions...?

**Hồng** (*ignoring this exchange, and talking over NATALIA*) No, that wasn't the unusual part. Its brightness was unusually low — 26<sup>th</sup> magnitude,<sup>6</sup> when we first observed it. That

<sup>5</sup>Lev: (Russian) pronounced "Lyev"

<sup>6</sup>apparent magnitudes: A logarithmic measurement of the intensity of stars. The lower the magnitude, the brighter the star is. A reduction of 5 magnitudes corresponds to an increase in brightness by a factor of 100.

didn't make sense! A star of comparable size and temperature to our sun would have to be about 50 kiloparsecs away to achieve that kind of brightness — far outside our galaxy, based on its coordinates. But that object appeared in the foreground of a nebula only 1500 light-years away.

Lev So: problem.

Hồng Wasn't the only problem, but yes. Since it was so strange, no journal would publish it. It's a wonder that we could see it at all, 26<sup>th</sup> magnitude is on the limits —

Lev Not the only problem.

Hồng Well. Professor Gurevich (*points at NATALIA*) decided that if we knew how far away it —

Lev — you measured its parallax. I know. Judging by Natasha's<sup>7</sup> reaction, it's a great deal closer than you thought it would be. No?

Hồng (*pause*) Two more problems.

Lev I'm all ears.

Hồng It's gotten brighter over the past year — 25<sup>th</sup> magnitude now — and since it's blueshifted—

Lev Meaning?

Hồng It's not a star.

*Beat*

Lev Go on.

Hồng (*pulls out notebook with trembling hands, reads, despairingly*) Long story short: rogue planet — something about the size of Jupiter — heading our way at a thousand kilometers per second. It'll get here in, say, twelve years?

*Beat*

Lev You bastards.

Hồng Beg pardon?

Lev You sick bastards. (*to NATALIA*) Really, Natalia Iossifova, this, this melodrama, coming from you? How desperate you must be for cash! How many days of telescope time did this actor cost?

Natalia (*horrified silence*)

Hồng ...I — I'm not...

Lev (*looking back at her*) Not what? (*icily*) If you were really —

Natalia (*interjecting, surprising LEV*) Hồng, even if it were approaching —

Hồng It is!

Natalia — it needn't necessarily be heading right towards us.

Lev Exactly! Do you have any idea how unlikely that is? At least make up a better story!

Hồng It's not made up!

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<sup>7</sup>Natasha: (Slavic) Diminutive form of "Natalia"

Natalia But the blueshift alone —

Hồng That's the other problem.

Natalia — what other — (*realises*) oh. (*pauses*) Parallax. Of course.

Lev Of course what?

Natalia (*slowly, pointedly*) She waited a year.

Hồng So that I could subtract the —

Lev — proper motion.<sup>8</sup> (*pause*) I see.

Hồng Less than an arcsecond — negligible impact parameter<sup>9</sup> — as good as head-on.

*Silence*

Natalia Resolution?

Hồng On good nights, an arc—

Natalia Not you. (*to LEV*) If she's right, we have a world-ending calamity on our hands. Well?

Lev You're suggesting an evacuation.

Natalia I'm not suggesting anything. Not my place. But so much for manned —

Lev Stop that. This is crazy. Even I don't believe it. And if you think you are having a hard time convincing me — ha! Imagine what the Bear will say.

Natalia Oh dear.

Lev Exactly. Tell the Bear this, to his face — behold, we saw a flock of geese go by, and among them was a stray robin. Lo! Ten years hence, it shall come to pass that there will be in all of Russia, all at once, a mighty earthquake, the like of which no man has seen, or shall see hence. Woe, woe! All must fly to parts unknown, or they will surely die, for the earth will open and swallow all, the good and the wicked alike. Woe — wait, hang on, no, rejoice! See, we will reveal the way to your salvation — for a nominal fee, of course — just all your money — in fact, *all the money* —

Hồng Um ...

Lev Do you have *any* idea just how outlandish this sounds?

Hồng ...we could publish...

Lev (*wheels around to glare at her*) Excuse me, but I'm —

Hồng (*trying very hard to be brave*) maybe it'd be a good thing to let others know? Some Americans, perhaps?

Lev (*glares, sarcastically*) So that they can help do something about it? Sure, why not? Such a wonderful thing, international cooperation.

Natalia (*quietly*) She has a point, Lev Ivanovich.

Lev What?

Natalia Think about it, Lev. (*tense silence*) Publication might not mean much these days —

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<sup>8</sup>Proper motion: apparent angular motion resulting from a distant object's own intrinsic velocity. Calculated by measurements spaced one year apart, such that the Earth is in the same position in both measurements.

<sup>9</sup>impact parameter: horizontal displacement of centre of mass of target from trajectory of projectile

**Hồng** (*strangled squeak*)

**Natalia** — but there remain reputable journals still. For them, at least, it means peer review and replication testing.

**Lev** (*silence*)

**Natalia** No, the Americans will be sceptical. They will want to make sure for themselves. After all, would they turn down a chance to show off their telescopes? Their technology? Their superior economy? All to prove us wrong?

**Lev** You don't actually believe that, do you?

**Natalia** Of course not. But do you?

*Beat*

**Lev** I see. (*slowly, as he puts this together*) If even the Americans think you're right...

**Natalia** Precisely. And — who else, do you think, would rather believe the Americans than their own scientists?

**Lev** (*considers implications*)

**Natalia** But to publish, we'll need to pay —

**Lev** (*waves it off*) Stop it. If you're right, it won't matter. And if you're wrong — I can always ...well. (*menacingly*) You know what can be done, not necessarily by me. Yes? (*piercing stare*)

*NATALIA looks pointedly at HỒNG, causing LEV to also look at her. HỒNG hesitates, then nods. She is petrified.*

**Lev** Very well. I will need time to think on this. (*packs up*) Consider the interview over.

*LEV leaves the office.*

**Hồng** (*pauses to recover her wits*) Professor!

**Natalia** (*calmly*) Don't do that again.

**Hồng** Professor, what was that about?

**Natalia** Colonel Landau takes his job as a public official very seriously — an anomaly, for someone in his position. We were discussing departmental funding before you entered. Does it begin to make sense now?

**Hồng** (*gets more agitated*) But what do we do now?

**Natalia** We publish, or die trying, as we always have. But first — are you *sure* this is correct?

### 3.

*Dim lights go on slowly, revealing a surrealist orrery, with different characters taking the place of various solar-system objects. In centre place is HỒNG, the Sun, around whom all others orbit. NATALIA, Venus, and LEV, Mars, pace slowly in circles around her, speeding up and slowing down as blocking demands. A thin, fierce circle of light delineates Earth's own orbit, left empty. Beyond Mars, REVIEWER A, REVIEWER B, REVIEWER C, and REVIEWER D take up the outer planets' orbits; the reviewers move ponderously. About the stage are strewn assorted bits of detritus. Harsh bright white light illuminating HỒNG as she speaks.*

**Hồng** Professor Gurevich spent her entire life savings in the first two years. She cast as wide a net as possible. The reviewers from the big names – those with a high “impact factor” – were as sceptical as she predicted –

*Cool lighting on the reviewers, one by one, when they talk over each other*

**Reviewer A** Hồng et al. seem to have a rather enlarged view of the significance of their work, especially given the alarmist undertones of their –

**Reviewer B** – I am generally very happy to provide extensive suggestions and comments on manuscripts, but this submission was an absolute waste of my time –

**Reviewer C** – It has been historically established that the instrumentation in question has been of decidedly questionable scientific use, especially compared –

**Reviewer D** – weak command of the English language –

**Hồng** – we got accepted by none of them. She – we – decided that the word had to get out somehow. We set a lower bar. But –

*Warm lighting on LEV and NATALIA when they speak*

**Lev** This is preposterous!

**Natalia** Lev Ivanovich, open access journals are peer reviewed too. They might be less prestigious, but that doesn’t make the process any less rigorous –

**Reviewer A** – congratulations! We are pleased to inform you that your paper –

**Reviewer D** – has been accepted for publication, pending amendments, in the –

**Lev** Look here! There are publishers, and there are publishers. Don’t you dare buy yourself publication in a low-impact-factor journal! How credible could that possibly be? And credibility is exactly what you need right now, which you can’t get from the –

**Reviewer B** – Journal of Observational Applied Metaphysics—

**Reviewer C** – pending receipt of a nominal publication fee –

**Hồng** – you’re right.

**Natalia** I’m sorry?

**Lev** I’m right?

**Hồng** We need credibility. We thought that peer review could give us that, but maybe there are other ways of getting the word out. Some way to be credible without already having a reputation, or lots of money. Newspapers? The Internet? Surely—

**Natalia** There are enough conspiracists as is –

**Lev** And you want spook the public *on purpose*?

**Natalia** There’d be pandemonium! Confusion!

**Lev** The Americans will think we’re crazy –

**Hồng** They already do!

**Lev** We need a better way of getting the word out.

**Natalia** (*pause*) ...“We”?

*All fall silent. Cosmic motion goes on.*

**Hông** We sent letters to our American counterparts; we heard nothing. In the seventh year, it got bright enough to interfere with the astrometry on spy satellites, and the military finally noticed. The Americans noticed too. But all the while we were watching it — watching it get brighter — watching it lose one magnitude every year, at first, then two, five years ago, then four last year —

*At this point ALEKSANDR enters from the side, walking briskly. As he does so, he passes by REVIEWER D on Neptune’s orbit, and locks arms with him; the two spin rapidly in a circle for maybe a quarter of a rotation before releasing each other. This causes REVIEWER D to pick up some of ALEKSANDR’s momentum and be launched off on a different trajectory. ALEKSANDR changes direction quite sharply as well. In this manner, ALEKSANDR and the other characters ricochet around the solar system in a gravitationally-induced frenzy, exchanging angular momentum and kinetic energy. Two of the characters are slingshotted out of the solar system. ALEKSANDR also smashes into LEV (who collapses, but by then quite far away from stage centre) in the process. This continues until ALEKSANDR reaches the circle representing Earth’s orbit. All the while, HÔNG keeps talking.*

**Hông** (*pausing dramatically as appropriate*) Do you have any idea how hard it is to create an orbital flight plan? We humans spend years figuring out how to get our probes to fly past as many planets as possible, like an impossibly difficult cosmic game of billiards. But if your cue ball is massive enough — and if God happens to be aiming for you — you don’t really need to aim very much —

*Right then, the ricocheting ends as ALEKSANDR crosses the 1 AU line; all freeze. All lights except the one on HÔNG go out. A heavy silence hangs over the air —*

**Hông** And that was it.

#### 4.

*Continuing immediately from where the last scene left off: naturalistic lighting returns. All vanish except HÔNG and ALEKSANDR, who are in a park riven with cracks, lying on a mat stargazing, awaiting the first perigee.*

**Aleksandr** You are sure?

**Hông** Yes. I’m sorry about —

**Aleksandr** Don’t be. You should have gone, though.

**Hông** Nah. I’ve never really seen myself as the underground type of person. And rocket fuel is still expensive, end of world or no. Well, was. Now. (*starts giggling*)

**Aleksandr** What?

**Hông** (*laughter takes some time to subside*) When I was little, I remember hearing someone — an American — he said, “An asteroid is Nature’s way of asking: ‘hey, how’s that space programme coming?’ ” And what do you know, he was right!

**Aleksandr** As were you.

**Hông** (*sigh*)

**Aleksandr** (*pause*) But they know that by now.

**Hồng** They tried. It is too late, but they still try. Are still trying. And —

**Aleksandr** — you could still help.

**Hồng** (*sighs*) There's twelve thousand humans left. Twelve thousand of them down there, right now, trying. I don't think one more or less makes much of any difference. Besides, Sasha—

**Aleksandr** Yes?

**Hồng** We'd never, ever, get a chance to go stargazing again.

*They cuddle on what remains of the grass. The dawn sky is clear. There are no birds left. There are no buildings left. Around them, the air is deathly still. One by one the stars wink out. The sun rises, more quickly than usual — except it is not the sun. A larger, magenta-tinged version of Jupiter heaves into view, growing by the second. Eventually it fills the sky. The air turns slightly red, then orange, and the ground begins to groan and shiver —*

*Lights out.*